SYNTACTIC AND SYMBOLIC ABILITIES IN ALZHEIMER'S DISEASE

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Syntactic and Symbolic Abilities in Alzheimer's Disease

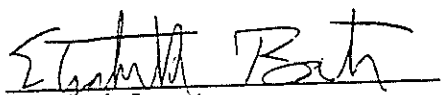
A dissertation submitted in partial satisfaction of the requirements for the degree Doctor of Philosophy in Linguistics

by

Daniel Kempler

1984

The dissertation of Daniel Kempler is approved.



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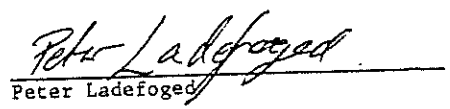

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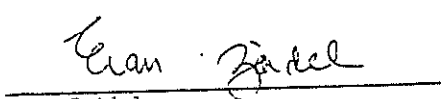

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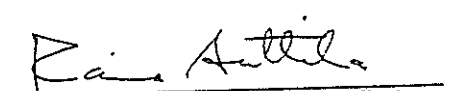

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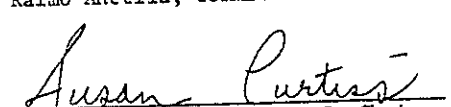

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DEDICATION

This dissertation is dedicated to the families of Alzheimer patients. It is they who most radically adjust their lives to accommodate the patients. It is they who must live with the disease's devastating effects day-in and day-out. I hope that this basic research will contribute in some way to successful early diagnosis of Alzheimer's disease, and eventually to development of an effective antidote which will relieve, prevent and counteract the effects of the disease.

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ABSTRACT OF THE DISSERTATION

Syntactic and Symbolic Abilities

in

Alzheimer's Disease

by

Daniel Kempler

Doctor of Philosophy in Linguistics

University of California, Los Angeles, 1984

Professors Raimo Anttila and Susan Curtiss, Co-Chairs

Two major theoretical positions on the relationship between component language abilities and between language and nonlinguistic cognitive abilities are discussed: functional vs. modular. Both make predictions about deficit conditions. Modular theories predict that independent mental faculties can be selectively preserved and/or impaired. Functional theories predict relatively less selective preservation and impairment. These predictions are tested with respect to syntactic, lexical semantic and gestural abilities in a population of eight Alzheimer patients.

The patients maintained productive morphosyntactic ability while lexical semantic and pantomime ability degenerated. Lexical semantic

and pantomime knowledge appeared to disintegrate in tandem. Deficits in the two areas were highly correlated, and errors in word production and pantomime production displayed certain similarities.

It is apparent that not all language abilities are equally modular. Expressive syntactic ability is extremely resiliant to the type of brain damage seen in Alzheimer's disease, and therefore can be characterized as "autonomous". Lexical semantic and pantomime ability are equally affected by the disease, and appear not to be indpendent from each other. The model of language proposed is one in which certain language abilities (i.e., syntax) are autonomous and relatively modular, while other abilities (e.g., lexical semantics) are relatively less modular.

These data are then integrated into a neurological model in an attempt to explain the patterns of dissolution and preservation of function. It is suggested that syntaccic abilities, because of their automatic nature, become focally represented in the vertical substrate of cortical pyramidal cells (i.e., the columns and bundles of apical dendrites), while lexical and pantomime abilities are more diffusely represented in the horizontal substrate of these same pyramidal cells. Evidence is presented that the pattern of dissolution seen in Alzheimer's disease may be at least partially attributed to the fact that the horizontal substrate degenerates earlier and to a greater degree than the vertical substrate.

Chapter I

INTRODUCTION

1.1 PROLOGUE

Sometimes when things fall apart, we can see more clearly how they were put together. The goal of this dissertation is to shed some light on the nature of human language by investigating how it falls apart. In Alzheimer's disease (AD hereafter) all higher intellectual functions, including language, dissolve over the course of years. As the synchrony of normal function degenerates, we can detect organization which is obscured in healthy populations. By studying the pattern and process of mental dissolution in AD, I will address two specific linguistic issues. First, I will attempt to discover the degree to which morphosyntactic ability can be separated from semantic ability. Second, I will investigate the extent to which morphosyntactic and semantic impairment parallel nonlinguistic symbolic impairments.

1.2 THEORETICAL BACKGROUND

Historically, two distinguishable positions on the relationship between mental abilities can be readily identified. One position has consistently maintained that mental functions are intrinsically interdependent (Lashley, 1929; Goldstein, 1948; Luria, 1966). Another position has held that the mind is componential, each component being structurally independent (Neisser, 1967; Geschwind, 1965; Fodor, 1983; Keil, 1981). Although both sides agree that normal functioning requires intimate interaction between abilities, they disagree on whether or not each mental function is learned and subserved by unique structural constraints and principles.

Theories of language and language acquisition are cast in similar opposing terms. Some theories assume that various language abilities (e.g., syntax and semantics) and nonlinguistic cognitive abilities are crucially interdependent. This position is best exemplified by functionalist models which attribute syntactic structure to a combination of semantic and pragmatic (i.e., communicative) functions (Bates and MacWhinney, 1982; Dik, 1978; Givon, 1979; Lakoff and Thompson, 1977). The common claim of these theories is that a grammar can be described in terms of cognitive categories and speech processes, without reference to additional abstract symbols (Bates and MacWhinney, 1982, p. 187). Importantly, morphosyntactic processes are viewed as epiphenomena of natural proceses. Morphosyntactic categories and processes are described as a direct mapping of semantic and pragmatic information onto surface forms. These descriptions of

language typically integrate language and nonlinguistic cognitive abilities in order to explain the acquisition of grammatical knowledge. Such theories propose that children construct a linguistic system from a combination of perceptual (acoustic), articulatory, mnemonic, conceptual (nonlinguistic), and communicative developments (Bates, 1979; Bruner, 1975; Corrigan, 1978; Sinclair, 1975).

In contrast, other theories assume a modular approach to language as a mental function. The most well developed of these theories have been associated with Transformational Grammar and its descendants (Chomsky, 1965; 1976; 1977; 1982). Contrasting with the functional approaches described above, modular approaches assume that (a) pragmatics should be separated and studied independently from grammar, and (b) within grammar, syntax, semantics and phonology should all be treated as autonomous of each other and studied independently[1] (Radford, 1981). Key to this approach is the assumption that syntax is fundamentally autonomous of other aspects of grammar, including semantics. Within this approach, the acquisition of a syntactic system depends on strong innate constraints on the form of adult grammar. The acquisition process is carried out by a process of "parameter setting" (Chomsky, 1982; Hyams, 1983). The innate givens consist of schemata for various types of rules, containing slots (or "free parameters") which will be fixed for a particular language upon

[1] Although it is obvious that these aspects of the grammar interact, the assumption is that each rule system (e.g., phonology) can be distinguished from the others (e.g., morphology, syntax) on the basis of certain principles which are unique to each system.

exposure to the relevant data (Pinker, 1982). This process is no- dependent on or derived from semantic, pragmatic or other nonlinguistic conceptual developments. The modular conception of language complements a modular approach to all mental functions, in which language is viewed as just one independent module among many. Within this approach, language and nonlanguage knowledge domains are assumed to be learned and function under different constraints (Keil, 1981).

Following from the assumptions made within each model of grammar, are predictions about language dissolution. The theories which stress the unity and interaction of mental systems predict that in cases of language dissolution we should see generalized linguistic, communicative and possibly intellectual impairment, but not distinct aphasic syndromes reflecting impairments in only parts of the system. We find arguments for such a position in the writings of Bay (1962), Goldstein (1948), and Schuell et al. (1964) who maintain that adult aphasics suffer from a general symbolic deficit, and differ from each other primarily in severity of aphasia, not type. Evidence for this position comes from nonlinguistic impairments which parallel linguistic impairments in type and extent (Duffy, Duffy and Pearson, 1975; Grossman, 1978; Varney, 1982).

On the other hand, modular theories predict that selective impairments of any aspect of mental functioning or language are possible. This approach is typified by the work of Goodglass and Kaplan (1972) who have documented many distinct aphasic syndromes,

each one presumably due to a disruption of the substrate underlying a particular aspect of the grammatical system. Additional evidence for modularity of mental functions can be found in syndromes of selective impairment of various mental abilities, including calculation, music, visuospatial skills etc. (Heilman and Valenstein, 1979; Hecaen and Albert, 1978).

This dissertation is about the degree to which the pattern of language dissolution in Alzheimer's disease supports the assumptions of modular vs. functional theories of language. The research addresses two principle issues which distinguish these models:

(1) the independence of syntax from semantics, and

(2) the independence of linguistic knowledge from nonlinguistic knowledge.

In order to investigate the first issue, I will compare the dissolution of syntactic and lexical semantic abilities in Alzheimer's disease. In order to investigate the second question, I will compare pantomimic gestural impairments with syntactic and semantic deficits. I have chosen to compare gesture with language because these two domains share several important features. First, both gesture and language are reference bearing symbolic systems. In both, abstract elements (words, hand configurations and movements) are used to refer. Secondly, both are communicative systems. And third, both gestural and linguistic elements may be combined into complex units and sequences (i.e., gestural combinations and sentences). These shared features make the two domains prime candidates for exploring the

extent to which either one of them may constitute an independent system.[2]

1.3 ALZHEIMER'S DISEASE

In Alzheimer's disease (AD), progressive cortical degeneration is accompanied by a range of intellectual deficits. Since the cortical degeneration is gradual and eventually affects many areas of the cortex, as the disease progresses, nearly all mental functions become compromised. A recent diagnostically motivated definition hints at this generality by stating that "dementia is the acquired and persistent loss of intellectual function with compromise in at least three of the following spheres of mental activity: language, memory, visuospatial skills, emotion or personality, and cognition (abstraction, calculation, judgement, etc.)" (Cummings and Benson, 1983, p.1).[3]

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[2] The models of grammar discussed above are models of language knowledge (or competence). This dissertation concerns the predictions they make about observable language behavior (i.e., performance). Throughout this dissertation I use observation of spontaneous speech and test performance to infer the state of the subjects' language abilities. In so far as these data are consistent within and across subjects and verifiable through various tasks, we can presume that these performance data reflect linguistic competence.

[3] Although the neuropathologies associated with Alzheimer's disease (e.g., neurofibrillary tangles, senile plaques and granulovacular degeneration) are well documented, the etiology is unknown. Possible etiologies suggested in the literature include premature aging, aluminum intoxication, disordered immune function, viral infection, and deficits in the formation of cellular filaments (Cummings and Benson, 1983).

Memory disturbance is often considered to be the first, most pervasive, and most distinguishing symptom of the disease. The initial memory disturbance is characterized by impaired ability to learn new material and difficulty recalling remote information. AD patients appear to have difficulty encoding auditory information. Information appears to be rapidly lost from short term memory and storage for eventual recall is compromised (Miller, 1971; 1972). Tests of remote memory also show impairment. Memory impairment declines steadily through the course of the disease.

Visuospatial skills are also impaired relatively early in the disease. This is illustrated well by the fact that one of the first signs of the disease (to the family members) is the patient getting lost while out driving or walking. In testing, the patients are often unable to copy three dimensional figures, and spontaneous drawings are often abnormal. The block design subtest of the WAIS, which has a strong visuospatial component, is typically one of the more sensitive tests for detecting dementia early in its course. At later points, dressing disturbances as well as disorientation in familiar surroundings may appear.

In the moderate stages of the disease, other cognitive deficits such as acalculia appear. Poor judgement, agnosias, loss of abstraction capabilities, distractability, left-right confusion and poor concentration may appear at any time and worsen as the disease progresses. "The intellectual deficits combine to devastate cognition, and terminally there is no evidence of ongoing higher

intellectual function" (Cummings and Benson, 1983, p.43). Personality and social behavior remain relatively intact in the early phases. Apathy and depression both may occur early but lessen as intelletual deficits worsen.

Early descriptions of Alzheimer's disease generally stated that language disturbances were restricted to the relatively late stages and consisted primarily of empty, cicumlocutory speech and word-finding difficulties (Critchley, 1964; Obler and Albert, 1981). As such, language disturbances were of little diagnostic help, particularly in the early stages. Recently, however, language changes have been more widely accepted as characteristic of the disease from the very earliest stages. At least one case suggests that language impairment can be an initial symptom, appearing even before notable deficits in memory and orientation. (Wechsler, 1977). Others have noted a marked deficit in word-list generation (generating names from a given semantic category) from the outset (Benson, 1979). Word-finding difficulty in spontaneous speech is often an early-appearing symptom, as is impairment in comprehension. By the moderate stages of the disease, most researchers agree that spontaneous speech becomes empty, anomia apparent, and patients often present symptoms much like those seen in fluent Wernicke's aphasia and transcortical sensory aphasia (Cummings, 1982). As the disease progresses from this point, language comprehension becomes increasingly impaired and, eventually, the patients are reduced to repetition of others' speech (echolalia) or of their own speech (palilalia) (Cummings, 1982; Cummings and Benson, 1983).

Investigating language deterioration in the context of the pervasive cognitive decline seen in AD offers a unique opportunity to investigate the questions set out initially. First, by investigating the differential dissolution of component language abilities we can discover the extent to which each language ability (e.g., syntax and semantics) may be preserved or impaired independently of others.[4] We can also compare the dissolution of language with the dissolution of other, possibly related abilities such as symbolic gesture. Since the disease is progressive we have the opportunity to investigate not only whether various impairments parallel one another, but also to see how these relationships change over time. Intimately tied abilities will presumably decline within a short period of one another, while relatively independent abilities will not degenerate in unison, and may vary in order of decline with respect to one another.

1.3.1 Lexical Impairments in Alzheimer's Disease

Word-finding difficulty in spontaneous speech and a marked deficit in word list generation are early-appearing symptoms in AD (Cummings and Benson, 1983). In the early stages there may be circumlocution, much like that seen in healthy elderly people (Obler and Albert, 1981), but the AD patient may take longer to arrive at the target word and

[4] Clearly, evidence from dissociations in abnormal populations must be used cautiously. To the extent possible, any dissociation should be documented in many individuals and verified through experimental studies of normals. In addition, dissociations of this type should not be attributable to any irrelevant (e.g., task-related or nonlinguistic performance) factors.

benefit less from phonemic cueing. In the early stages AD patients will often self-correct. As the disease progresses there is an increase in both word and sound substitutions (i.e., verbal and literal paraphasias), and less of a tendency to self-correct. On confrontation naming tests (a single item to be named is shown to the patient) there are tendencies toward verbose answers, paraphasias, and misperceptions.

At least two distinct descriptions of the lexical deficit have been proposed. First, Rochford (1971) suggested that perceptual confusion was responsible for naming errors. This was based on the fact that dementia patients made many naming errors which could be interpreted as misperceptions (e.g., calling an anchor a "hammer"), but had no difficulty if the objects to be named were readily recognized (e.g., their own body parts). Subsequent investigation of this hypothesis has turned up little confirming evidence (Bayles, 1979; Bayles and Tomoeda, 1983; Nichols, Obler and Albert, 1982; but cf. Kirshner et al., 1984).

The second theory was proposed by Schwartz, Marin and Saffran (1979) whose report of a longitudinal case study indicates that lexical errors are neither random, nor guided by misperceptions, but rather are determined by the semantic field of the target. For example, their subject would mistakenly call a dog a "cat". Although only a single subject was studied by Schwartz et al., this is the most comprehensive study to date, utilizing several methodologies (verbal and non-verbal match-to-sample paradigms) and a large number of trials

(compare 140 trials with 8 used by Rochford). Schwartz et al. attribute these errors to a breakdown in the underlying conceptual categories, a loss of the ability to use features which distinguish related items. Indirect corroboration for this theory is provided by reports that semantic and/or semantic-visual errors are more frequent than random or phonologically based errrors in naming tasks (Bayles and Tomoeda, 1983).

Still, much is unclear about the lexical deficit associated with AD. It is difficult to determine whether the breakdown is conceptual or perceptual since very little information is available which directly compares word production and word comprehension abilities. Except the single case study of Schwartz et al. (1979) and a recent study by Martin and Fedio (1983) (who use incomparable production and comprehension tasks), this crucial comparison has not been made. In addition, the lexical deficit could be better described if we knew exactly what types of errors the patients made in naming and word comprehension tasks. Although several studies have now investigated large numbers of AD patients, these studies generally report only quantitative results on standardized naming tests (Appel, Kertesz and Fisman, 1982). Few researchers have analyzed in any detail the patients' errors in comprehension or production. Once this information is available, we will be better able to determine whether the breakdown is perceptual, conceptual, or specifically semantic. A study in which comparable comprehension and production measures are used, and attention is paid to error analysis, will allow us to

accurately evaluate the nature of the lexical loss. Then we can then begin to compare the lexical deficits with the range of linguistic and nonlinguistic cognitive difficulties which accompany the disease.

1.3.2 Syntactic Abilities in Alzheimer's Disease

By the moderate stages of AD, spontaneous speech becomes empty, and patients often present symptoms much like those seen in fluent aphasias (Cummings, 1982). As the disease progresses, clinical descriptions note that patients are reduced to repetition. This preservation of repetition when all other aspects of language have degraded has lead to a comparison of AD with transcortical sensory aphasia. The clinically observed "fluency" suggests a preservation of at least some syntactic ability in this population.

Linguistic investigations of language in AD have upheld the clinical impression of preserved syntax. Irigaray (1973; Obler, 1981) was one of the first to carry out psycholinguistic experiments investigating syntactic abilties in dementia. She used a range of tests which tapped specific morphological and syntactic abilities: conjugation of verbs; correction of sentences with morphological errors; transformation of sentences for various features such as number, gender, etc.; judgement of verb-complement anomalies; sentence construction given two to four words; and analyses of spontaneous speech. Analysis of errors from these (predominantly production) tasks lead Irigaray to conclude that the phonological and morphosyntactic levels of language ability are relatively preserved in dementia, while semantic and pragmatic realms are disturbed.

Two case studies have investigated in detail the claim that syntax is relatively preserved in dementia. First, Whitaker (1976) studied a patient who was restricted to echolalic output. The patient spontaneously corrected phonological, morphological and syntactic anomalies in sentences presented to her. In contrast, she did not correct semantic anomalies. This result was taken to suggest the presence of an intact grammatical filter in the context of communicative and cognitive deterioration.

A second case study (Schwartz et al., 1979) also investigated the extent to which syntax is preserved in one dementing individual. Their testing included a task of sentence transformations, on which the subject was able to transform questions to statements, affirmative sentences to negatives, singulars to plurals, and present tense sentences to past tense. Schwartz et al. are unique in having demonstrated, in addition to intact grammatical production, intact comprehension of syntactic forms. An investigation of four semantically reversible syntactic structures (active voice, passive voice, comparative adjectives, and spatial prepositions) revealed intact comprehension when the lexical items were understood. One additional task was used to further establish the apparent dissociation between the ability of their subject to use syntactic vs. semantic knowledge. This was a task of homophone disambiguation. The tester dictated to the subject homophones in three different contexts. One presentation disambiguated the spelling of the homophone with semantic context, e.g., "priest-pope- -nun" vs. "some-many- -none".

The second differentiated the homophone spelling with a limited syntactic context, e.g., "the bee" vs. "to be". The third context used a full sentence to disambiguage the spelling, e.g., "She blew out the candles on her cake." vs. "She wore a blue skirt and white blouse." The results indicated that the subject was able to use the limited syntactic context and the full sentence context to correctly distinguish the spelling of homophones, but was unable to use the information in the semantic cues to help her. This again, suggests the relative intactness of syntactic knowledge in the context of impaired lexical semantic ability.

Two recent population studies have investigated the linguistic disturbance in dementia. Appel, Kertesz and Fisman (1982) administered the Western Aphasia Battery (Kertesz, 1980) to 25 AD patients. The Western Aphasia battery categorizes the patients into aphasia types and the results indicated that Transcortical Sensory and Wernicke's aphasias were frequent but Broca's and Transcortical Motor aphasia were absent. Further investigation of subtest scores reiterates previous findings: AD patients are impaired in semantic and cognitive operations but preserve phonological and syntactic abilities. Problems with the study indicate that further work is needed to describe syntactic preservation and semantic impairment in this population. First, the Western Aphasia Battery assesses "fluency" and "sentence comprehension" but does not contain a test of production or comprehension of syntactic structures abstracted away from lexical and real-world knoweldge. Secondly, since only

quantitative results are given, it is impossible to evaluate the nature of the semantic impairment or syntactic preservation in these patients.

Bayles (1979; 1982) used a combination of standardized measures and new measures in an attempt to identify the most useful language tests for the differential diagnosis of AD. She compared performance on tasks of naming, sentence judgements, sentence correction, lexical and sentence disambiguation, story retelling and verbal description with performance on psychological tasks generally used in diagnosis of the disease (e.g., WAIS block design, Mental Status Questions). Again, Bayles found relative preservation of the syntactic system alongside impairment of semantic abilities.

The studies summarized above all converge on a similar conclusion: syntactic ability is preserved in the context of impaired semantic ability. However, the results of these studies still leave us unsure of the extent to which AD patients present us with preserved syntactic ability. First, several studies (Whitaker, 1976; Bayles, 1979; Irigaray, 1973) have drawn a large portion of their data from sentence correction tasks. One criticism of this methodology is that no control data have been presented to indicate that there are indeed grammatical and semantic filters operating normally. It is probably assumed that there are, since in real-life processing of language we often correct or reinterpret sentences containing what we think to be errors. However, in a task where language is abstracted away from context (such as the ones used in these studies) it is difficult to

see why a semantic reinterpretation filter would be invoked at all and easy to see why a grammatical filter would be. Semantic interpretations of sentences depend largely on contextual information; grammatical structures generally depend only on sentence-level features. Without the context, it is difficult to make sense of (or filter out) a semantic error. This is simply not true for grammatical errors. In addition, the grammatical errors presented are generally "small" errors (e.g., person/number misagreement), which are easily assumed to be misperceptions, and hence more likely to be corrected. Semantic interpretations involve larger units and are more difficult to attribute to misperceptions. It is possible in a repetition task that whatever is attributed to a misperception will be corrected and whatever is not attributed to a misperception will be repeated verbatim. These data may be evidence for grammatical filtering per se, but not necessarily for a dissociation from semantic filtering which (A) may not exist in the same way, and (B) if it does exist, may not be triggered by the same type of stimuli. For these reasons, the repetition-of-anomalies paradigm seems to be difficult to interpret and of little sure value. Second, much of the data is not based on linguistic evaluation, but rather on subjective fluency judgements. Third, the studies, by and large (with the exception of Schwartz et al., 1979), have not evaluated comprehension abilities at all. If a central syntactic processor underlies both comprehension and production and is preserved in these patients, we would expect syntactic abilities to be demonstrable in both comprehension and

production. Fourth, the syntactically sophisticated studies have both been single case studies, which need replication with a larger number of patients. Fifth, few of the studies have used semantic and syntactic tasks of comparable difficulty with which to compare performance. The first part of this dissertation is aimed at documenting, beyond what has been already established, the preservation of syntactic ability in the context of impaired semantic ability in AD.

1.3.3 Gesture and Alzheimer's Disease

The literature on gesture and language in aphasia (language loss due to localized lesions) provides both a methodological and theoretical background for the present study. For many years clinical observation has suggested that aphasia and apraxia[5] more often than not, cooccur (Finkelnburg, 1870; Liepmann, 1908; Duffy and Liles, 1979; Jackson, 1932). However, there has been little agreement on the cause of this correlation. Two theories have been recurrently suggested during the past century. The first, generally attributed to Finkelnburg (1870), is that the two impairments are both symptoms of a single symbolic deficit, asymbolia. The second, championed intially by Liepmann

[5] Apraxia may be defined as an impairment of the ability to carry out purposeful movements by an individual who has normal primary motor skills (strength, reflexes, coordination), and which cannot be accounted for by sensory loss, incomprehension of, or inattention to commands (Geschwind, 1975; Hecaen and ALbert, 1978). Although many different types of apraxia have been described (e.g., dressing apraxia, right-left apraxia, constructional apraxia, kinetic apraxia) I will focus on the inability to execute conventional gestures, particularly pantomimes.

(1908), suggests that the gestural impairment associated with apraxia is a manifestation of the disturbance of a system in the left hemisphere which impairs control of purposive movements, and is essentially independent of aphasia.

A resurgence of interest in the relationship between aphasia and apraxia arose twenty years ago with a population study by Goodglass and Kaplan (1963) which compared several types of gesture with language disturbance in aphasia. They concluded that aphasia and apraxia involve separate mechanisms and that simultaneous symptoms in the two areas are due to disruption of adjacent pathways rather than to a functional relationship between the two symbol systems. Goodglass and Kaplan maintained that the gestural disturbance in aphasia was "an apraxic disorder consequent to a left hemisphere lesion" rather than a consequence of a "general communication disorder" (Goodlgass and Kaplan, 1963, p. 719). This conclusion was in accord with Liepmann's (1908) suggestion that apraxia was primarily a movement disorder.

Since Goodglass and Kaplan's seminal effort, many experimental reports have appeared in the literature. Despite different methods of gesture and language assessment and different subject selection criteria, researchers have consistently found significant correlations between gesture and language disturbance (Gainotti and Lemmo, 1976; Duffy, Duffy and Pearson, 1975; Duffy, Watt and Duffy, 1981; Varney, 1982; Cicone, Wapner, Foldi, Zurif and Gardner, 1979; Kertesz and Hooper, 1982; but cf. Davis, Artes and Hoops, 1979; for reviews, see

Hecaen and Albert, 1978; Bates, Bretherton, Beeghly-Smith and McNew, 1983). These recent studies have consistently replicated the finding that impairments in comprehension and production of gesture are consistently associated with aphasia. This is particularly true for referential gestures, transitive actions used in the recognition or labelling of common objects (e.g., the action of drinking used to indicate a cup).

There is still little agreement regarding the source of this correlation. Four causal theories of the correlation between gesture and language impairments have been proposed and discussed in the literature (Goodglass and Kaplan, 1963; Duffy and Duffy, 1981) and are summarized below along with a fifth possibility I wish to propose.

1. Aphasia is a verbal disorder that is often associated with pantomimic deficits due to limb apraxia. Limb apraxia is a concurrent but independent disorder which causes the pantomime disorder (at least in production). This is the theory originally attributed to Liepmann (1908), subsequently upheld by Goodglass and Kaplan (1963), and supported in some later studies (DeRenzi et al, 1980; Seron et al., 1979; and Kertesz and Hooper, 1982).
2. Nonverbal deficits such as pantomime disturbance are secondary to conceptual deficits which are the result of general intellectual impairment due to brain damage. This theory has some credibility because of the range of intellectual deficits which have been found to accompany brain damage in general and

aphasia in particular (Hamsher, 1981), but has found little empirical support (Duffy and Duffy, 1981; DeRenzi et al., 1968).

3. Aphasia is primarily a language disorder. However, the language deficit may produce secondary nonverbal (e.g., pantomimic) impairments because the nonverbal performance requires verbal mediation for successful execution. Therefore, pantomime deficits would be a secondary result of a primary language deficit. Although this theory has been considered (Ettlinger, 1969; Heilman, 1973), the evidence appears indistinguishable from that for the fourth theory.
4. Nonverbal communicative deficits are an integral part of any aphasic syndrome. There is a central symbolic process underlying communication which is independent of any specific modality. Impairment of this central symbolic process is reflected in simultaneous disruption of verbal and nonverbal modes of behavior. Proponents of this theory include Jackson (1932), Goldstein (1948), (Bay, 1962) Gainotti and Lemmo (1976), Varney (1982) and Duffy, Duffy and Pearson (1975).
5. I would like to add a fifth possibility, a more specific version of the fourth above. Verbal and nonverbal symbolic functioning share basic symbolic capacities, but language consists of symbolic (lexical) and essentially independent nonsymbolic (syntactic) functions. The pantomimic and lexical deficits of aphasia are the results of underlying symbolic

impairment. Other aspects of aphasia, particularly the grammatical deficits seen in some anterior aphasics, may be independent of the central symbolic processor, and may not be accompanied by a simultaneous gestural deficit.

Several studies have presented evidence bearing directly on the first two theories (gestural impairment vis-a-vis intelligence and limb apraxia). Goodglass and Kaplan (1963), using the Wechsler Adult Intelligence Scales found that gestural ability was impaired in direct relationship to the loss of intellectual efficiency. However, Duffy and Duffy (1981), using the Ravens Progressive Matrices, a nonverbal test of problem solving, found no difference between apraxic aphasics and their controls. This study supported DeRenzi et al. (1968) who found that the presence of apraxia was not determined by general intellectual functioning and that apraxia was independent from attentional and memory deficits. These last two studies suggest that the gestural deficits in aphasia are not due to general intellectual impairment associated with brain damage.

The issue of a general movement deficit as a contributing factor to gestural impairment in aphasia is yet unsettled. On the one hand, aphasia and limb apraxia do not necessarily cooccur. Several studies have documented that a certain small percentage of apraxics are not aphasic and a certain percentage of aphasics are not apraxic (Liepmann, 1905; DeRenzi et al., 1980; Gainotti and Lemmo, 1976; Heilman et al., 1973; Poeck and Kerschensteiner, 1971). Since the two disorders are dissociable, they are at some level independent.

However, we are told very little about either the tests of aphasia or apraxia used in these studies, so that it remains possible that aspects of aphasia and apraxia (i.e., lexical knowledge and pantomime) do consistently correlate, but that other aspects of aphasia and apraxia (e.g., grammatical impairment and ideational apraxia -- which affects sequencing rather than the symbolic content of movements) do not correlate. These more local correlations may simply be hidden by poor subject selection and relatively insensitive testing. In addition, since in the vast majority of cases, apraxia and aphasia coocur (Hecaen and Albert, 1978; Goodglass and Kaplan, 1963), even if they are dissociable, they are closely related, perhaps for anatomical reasons, perhaps for functional reasons, perhaps both.

The most extensive evaluation of limb apraxia as a general movement disorder (independent of symbolic pantomime ability) has utilized Duffy's (1974) Manual Apraxia Test, consisting of eighty imitative motor reponses of the upper limb. Comparison of results from this test with pantomime assessment indicate a "small but significant correlation (0.38) remaining between limb apraxia and pantomime deficit when aphasia is partialled out" (Duffy and Duffy, 1981, p. 82). This finding, while not contradicting earlier conclusions, must temper the studies which attribute the pantomime deficit to limb apraxia without qualification (Goodglass and Kaplan, 1963; DeRenzi et al., 1980).

Additionally, if pantomime impairment is caused by a disturbance of purposive movements, we might expect it to affect only production.

However, several studies have now documented a correlation between impairment in language comprehension and pantomime comprehension (Duffy and Duffy, 1981; Seron et al., 1979; Varney, 1982; Gainotti and Lemmo, 1976). This may be explained by recourse to a motor theory of perception/recognition (Lieberman, Cooper, Shankweiler and Studdert-Kennedy, 1967), or by attributing both comprehension and production deficits to a single underlying symbolic deficit.

A confound in this literature is caused by the fact that many aphasics are hemiparetic and are generally limited to use of their non-dominant hand in gestural tasks. Even if the patients are capable of imitating gestures, they may prefer to avoid complex gestural displays because they are difficult to execute with the non-dominant hand. Also, hemiparesis in a subject population restricts assessment of pantomime production to those gestures which can be performed single-handedly. In order to further ferret out the contribution of limb apraxia to pantomime impairment, a population which consistently demonstrates language loss without primary motor loss or hemiparesis should be investigated. Individuals with AD present such a profile because motor and sensory control remain intact until the final stages of the disease (Cummings and Benson, 1983).

Distinguishing between positions four and five above (i.e., determining whether or not pantomime deficits are related just to the lexical/semantic aspects of aphasia) is impossible at present. Available data are equivocal regarding the association of gestural disturbance with any one type of aphasia, and therefore one type of

language disorder. Although some researchers have found no difference between aphasic syndromes in terms of the pantomime deficit (serverity or error types) (Seron et al., 1979; DeRenzi et al, 1980), others have found Broca's aphasics to have more severe apraxias than Wernicke's aphasics (Kertesz and Hooper, 1982). Most studies have not reported much information on the distribution of aphasia types in relation to gestural errors (Duffy and Duffy, 1981; Goodglass and Kaplan, 1963).

In addition, methods have varied greatly from study to study, making it even more difficult to determine what type of gestural disturbance is most commonly associated with a particular type of language disorder. Some researchers have asked subjects to imitate both symbolic and nonsymbolic movements (DeRenzi et al., 1980), others verbally ask patients to perform pantomimes (Goodglass and Kaplan, 1963), and still others exclusively test comprehension of pantomime (Varney and Benton, 1982; Seron et al., 1979). Assessment of language abilities is even less consistent. Some studies have used standardized language measures (e.g., the Token Test, The Porch Index of Communicative Abilities, the Western Aphasia Battery) which have the advantage of being replicable, but have the disadvantage of combining many aspects of language ability into a single score or set of scores. Non standardized tests (e.g., letter recognition, analysis of narrative speech, oral reading, reading comprehension, and tests of single word comprehension and production), although not as easily replicable allow for more precise comparisons between gesture and specific language abilities.

That such different measures of language and gesture all result in consistent and significant positive correlations speaks to the robustness of the finding, but makes it difficult to determine the contributing factors and arrive at a precise description of the phenomenon. To determine whether or not pantomime impairment is linked to lexical ability rather than language ability in general, we would ideally test a population which presents an isolated deficit in lexical abilities and intact syntactic knowledge. If pantomimic impairment is specifically related to lexical impairment then we would predict that such a population will demonstrate impaired pantomime. Perhaps more than any typical aphasic population, AD subjects present a profile of impaired lexical knowledge and preserved syntactic ability, and therefore present an ideal population with which to investigate this issue.

Although ideomotor apraxia has been known for some time to occur as one of the symptoms of dementia (Denny-Brown, 1958), it has not been one of the hallmark characteristics, and has never been systematically studied. Two types of gestural apraxia have been noted in AD:[6] ideational apraxia, the failure to correctly pantomime the sequence of events of a complex motor act such as filling and lighting a pipe; and ideomotor apraxia, the inability to do on command an act that can be performed spontaneously. The most common error in ideomotor apraxia is the use of a body part as an object (e.g., using the index finger

[6] Many authors have suggested that these two types of apraxia may only be different in degree, not type (see Hecaen and Albert, 1978, for discussion).

to brush the teeth rather than pretending to hold a toothbrush). It has been noted that the more hypothetic and imaginary a movement is, the more likely it is to be disrupted in dementia (Denny-Brown, 1958). This suggests that the symbolic nature of a gesture may determine the degree of apraxia the gesture will elicit.

Clinical reports suggest that apraxias do not generally occur until the moderate stages of the disease, after language and memory disturbances are firmly established, but before motor disabilities are evident. However, apraxia has also been noted to antedate other features of the illness (Cummings and Benson, 1983). Thus far, then, clinical descriptions have not offered us a clear picture of a systematic pattern of gestural disturbance in AD.

No studies have systematically compared the nature and extent of apraxia in AD with language disturbances. In fact, in Goodglass and Kaplan's (1963) study on the relationship between gesture and language impairment, AD patients were included in the control group. The picture is even further confused by consideration of studies (although not with AD patients in particular) which have investigated the effect of general intellectual deterioration on apraxia. Some researchers report strong correlations between apraxia and intellectual impairment (Goodglass and Kaplan, 1963), while other studies revealed no strong relationship between the two (DeRenzi et al., 1968; Duffy and Duffy, 1981).

One linguistic study of a single AD patient (Schwartz et al., 1979) did note that although their subject misnamed objects, she was able to

"mime the use of depicted objects" (p. 291). This casual observation of gestural compensation for word-finding difficulty has since been cited as evidence that language deficits in AD are specifically semantic, and therefore not symptomatic of general symbolic or recognition deficits (Appel, Kertesz and Fisman, 1982; Martin and Fedio, 1983). Although no serious experimental data from AD patients have been presented, the available inferences from this single case study suggest that AD might be an example of lexical semantic impairment without concommitant impairment in another symbolic domain -- pantomime. If true, these results will force us to reject theories which link lexcial knowledge to pantomime ability through a common symbolic process.

However, the conclusions based on this one study are tenuous for several reasons. First, they are based on observation of a single patient; the observations were not tested in any systematic way comparable to the in-depth assessment of lexical knowledge. Second, there is clinical evidence that gestural disturbances do occur in AD (see above). The only way to determine whether the gestural difficulties of AD patients are truly independent of their lexical difficulties is to test both comprehension and production of language and gesture in a single group of patients.

This proposed study is central to sorting out the reason behind the correlations found between gesture and language in brain damage. If pantomime abilties and language - or specificially lexical abilities - are both dependent on a common symbolic capacity, impairments in the

two domains should parallel one another quantitatively (time of onset and severity), and qualitatively (type of errors which occur). These predictions are tested in the present investigation.

1.3.4 The Plan

In the next chapter, I will describe the subject population and detail the methodology used to evaluate syntactic, semantic and gestural abilities in a population of Alzheimer patients. Chapter III presents data on the relative status of semantic and syntactic abilities in the subject population. Chapter IV presents data comparing the linguistic and gestural abilities in these same subjects. Chapter V presents a general discussion of the results and implications for neurolinguistic and neuropsychological theories of grammar.

Chapter II

METHODOLOGY

2.1 SUBJECTS

The subjects are eight individuals diagnosed as having Primary Degenerative Dementia (PDD) or Dementia of the Alzheimer type (AD), and eight normal controls. The AD and PDD patients (all referred to as AD hereafter) were diagnosed and referred by two sources: (1) The Geriatric Outpatient Clinic at UCLA and (2) Jeffrey L. Cummings, Chief, Neurobehavioral Unit, West Los Angeles Veterans Administration Medical Center. Prior to diagnosis, both referral sources ruled out known non-Alzheimer pathologies (e.g., cerebral infarcts, prior head trauma, infectious processes, drug or alchohol abuse, history of psychiatric problems). Both sources documented a range of cognitive dysfunctions alongside an absence of focal motor, sensory, cerebellar and cranial nerve defects. In the case of the V.A. patients, diagnosis was contingent upon finding compromise in at least three of the following spheres of mental activity: language, memory, visuospatial skills, emotion or personality, and cognition (abstraction, calculation, judgement, etc.). The UCLA diagnoses were made with the use of complete neuropsychological and neurological evaluations. Concurrence from at least two physicians was required for a positive diagnosis at UCLA.

All subjects are given a mental status examination which forms the basis for a severity rating. The Folstein, Folstein and McHugh (1975) Mini Mental Status Examination was used for the majority of patients. For the present purposes, a score of 20 or below (of a possible 30) is consistent with a diagnosis of dementia. I have adopted the following scale for rating severity of the impairment:

Mild impairment: 16-20

Moderate impairment: 10-15

Severe impairment: 9 and below.

Using this scale, of the eight subjects, two are categorized as severe, four as moderate, and two as mild.

All subjects are caucasion, were schooled in Standard American English, and use Standard English in their home and work. Level of education ranges from eighth grade to college. None of the subjects had any known speech or language pathology prior to the diagnosis of AD. All subjects are right handed. The mean age of both the AD and normal control groups is 76.6 years. Subject descriptions are summarized in Table 1. Normal subjects were tested in a single session of about an hour and a half. AD subjects were tested in several sessions, ranging from twenty minutes to one hour in length. Testing for each subject was completed within ten days of the initial interview. Testing was discontinued if the subject requested termination or if the examiner determined that the subject was not performing with maximum attention possible. Consent forms were obtained from family members of the AD patients.

TABLE 1

Subject Information

Subject	Age	Sex	Mental Status Score
AD 1	72	M	19
AD 2	82	M	17
AD 3	87	F	15
AD 4	82	F	15
AD 5	75	F	14
AD 6	65	M	14
AD 7	76	M	6
AD 8	74	M	2
CNTRL 1	71	M	26
CNTRL 2	82	M	30
CNTRL 3	84	F	28
CNTRL 4	78	F	30
CNTRL 5	75	F	30
CNTRL 6	72	M	30
CNTRL 7	76	M	30
CNTRL 8	75	M	28

2.2 LANGUAGE ASSESSMENT PROCEDURES

Language measures were selected and devised in order to evaluate both comprehension and production of grammatical and semantic abilities in comparable formats.

2.2.1 Lexical Comprehension and Production

Comparable single word comprehension and production (naming) tasks were adapted from the procedures and stimuli used by Duffy, Duffy and Pearson (1975) and Duffy and Watkins (in press). Since the goal of this test was to obtain comparable data on lexical recognition and

production which could be directly compared to gestural recognition and production (to be described below), a set of 40 items which could be pictured (i.e. drawn), named and pantomimed was selected. To avoid a familiarity effect, two forms of the test were constructed. In Form A 20 items are named and a different set of 20 items are used to test recognition. In Form B, the items are reversed. The two forms were alternated with consecutive subjects. The items in each form are matched in mean frequency.

In the naming portion, twenty line drawings are shown to the subject and the subject is asked to name each one. A sample line drawing stimulus is shown in Figure 1.

In the comprehension test, the subject is shown four line drawings (on a single sheet of paper) and is required to point to the picture of the object named by the examiner. Each presentation array contains one target (e.g., an iron) and three conceptually related distractors (e.g., a shirt, a dress, and a spool of thread). Target position is randomized. The subject is trained on a maximum of five pretest items. The stimuli are repeated as necessary to elicit a meaningful pointing response. The subject is corrected only on the pretest items. A sample response array is shown in Figure 2.

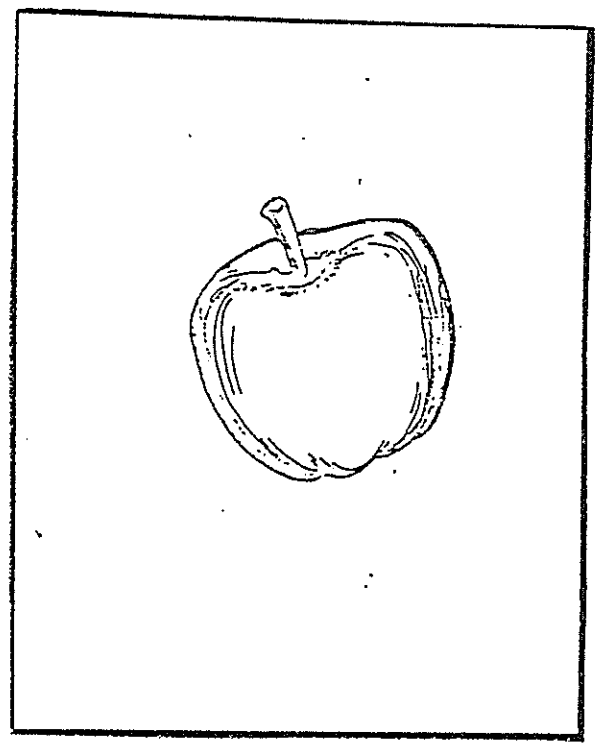

Figure 1: Line Drawing Stimulus to Elicit "APPLE"

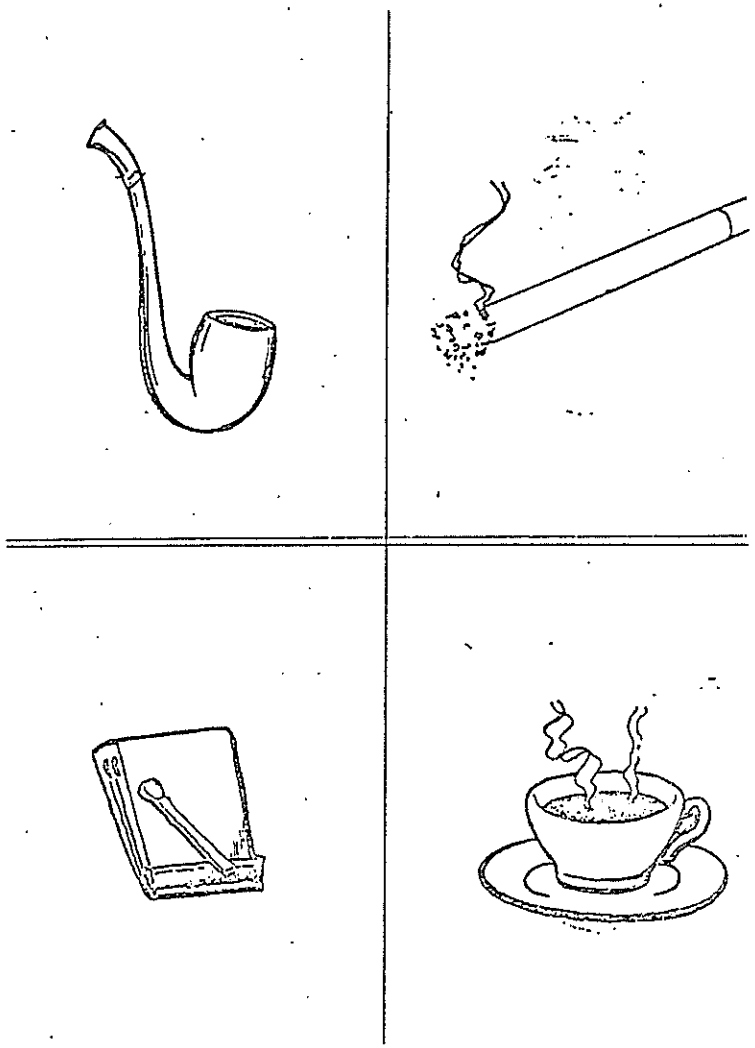

Figure 2: Lexical Comprehension Response Array for "CIGARETTE"

2.2.2 Syntactic Comprehension

The format for testing syntactic comprehension is essentially the same as the lexical comprehension test described above: the subject is shown four line drawings and is required to point to the picture which corresponds to an auditorily presented sentence. The four response choices are presented on two adjacent 8 1/2" X 11" pieces of paper, two on each sheet. The test items are taken from the Curtiss-Yamada Comprehensive Language Evaluation (CYCLE), and test understanding of ten syntactic structures, twice each. The ten structures with examples are listed below.

1. Active voice: The girl is pulling the boy.
2. Passive voice: The boy is being pushed by the girl.
3. Subject relatives: The girl who is mad is pushing the boy.
4. Clefting: It's the girl that the boy pulls.
5. Complex negation: The girl that is standing is not looking at the boy.
6. Object relatives: The boy is pushing the girl who is happy.
7. Subject relatives ending in N-V: The girl who is pushing the boy is happy.
8. Relatives with double function: The girl who the boy is pushing is happy.
9. Double embedding: The clown is chasing the girl that is little is big.
10. Object-object relatives: The girl is kissing the boy that the clown is hugging.

The subjects are all pretested to ensure accurate recognition of the individual participants and actions depicted in the test items. All sentences are semantically reversible to avoid reliance on semantic or probable-event interpretation strategies. The distractors depict the same actors and actions in different relationships to one another. Two sample items are shown in Figures 3 and 4.

Examiner: The girl is pulling the boy.

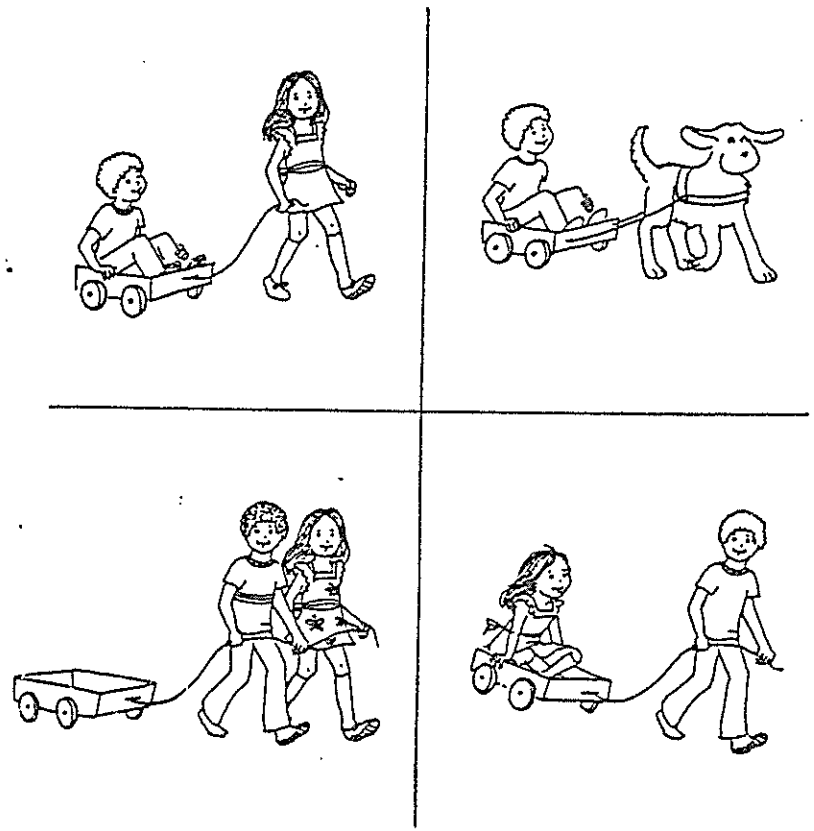

Figure 3: Active Voice Word Order Comprehension Item

Examiner: The boy is kissing the girl who the clown is hugging.

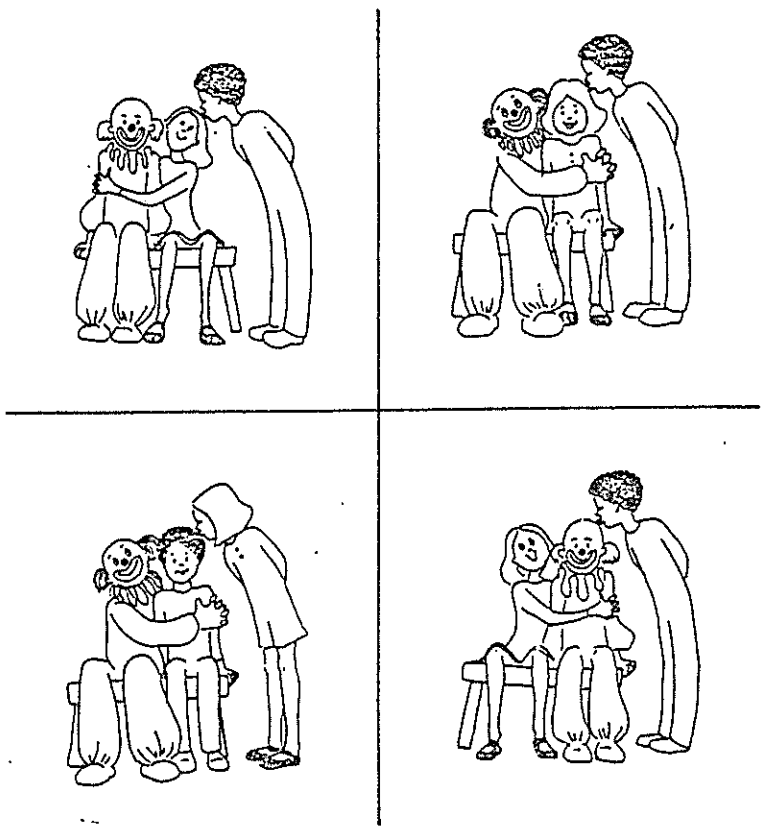

Figure 4: Object-Object Relative Clause Comprehension Item

2.2.3 Automatic Verbal Sequences

In order to evaluate the extent to which overlearned verbal material is affected in AD, each subject is asked to recite the days of the week and count from one to ten.

2.2.4 Spontaneous Language Samples

Two spontaneous language samples are tape recorded and transcribed for analysis. One consists of a biographical interview, including questions about family background and employment. A mimimum of fifty utterances are obtained from this interview. The fifty utterances are contiguous when possible, and exclude

1. single word responses (e.g., "Yes", "No")
2. repetitions of self or examiner (as in questions of confirmation)
3. sentences containing more than one unintelligible word
4. formulaic or unanalyzed utterances (e.g., "Oh Lord!", "Let's see now")

The second sample is a narrative description of the Cookie Theft Picture from The Boston Diagnostic Aphasia Examination (Goodglass and Kaplan, 1972). Both speech samples are analyzed for:

(1) frequency, range and well-formedness of grammatical structures including obligatory grammatical markers, various grammatical structures (e.g., passives, relative clauses), and sentence types (e.g., simple conjoined vs. embedded), and

(2) lexical use, including pronouns and deictic terms with unclear referents, frequency of empty forms (e.g., "thing", "do"), and instances of lexical mischoice.

Each of these analyses will be described in more detail along with the results.

2.2.5 Elicitation

A sentence completion format is used elicit various grammatical structures. The test items are taken from the CYCLE (Curtiss and Yamada, 1983). Two versions of the elicitation test were constructed: a screening version of twenty items and a longer version of forty two items. Due to testing limitations, subjects received only one version. Each version elicits a particular grammatical structure with two different sentence frames. Pictures accompany each item to further clarify and constrain the possible responses. The structures tested include:

1. Prepositions: behind, with, for, out, in.
2. Noun morphology: comparative '-er', superlative '-est', reflexives.
3. Quantifiers: none, many.
4. Verb morphology: verb plural/singular, past perfect tense.
5. Auxiliary morphology: will, would, won't, can't, wouldn't, couldn't.
6. Sentence Structures: Passive voice, verb complements with promise and ask.

Samples are presented in Figures 5 and 6.

Examiner: This doll is dirty.

This doll is even dirtier.

But this doll is the_____.
(dirtiest)

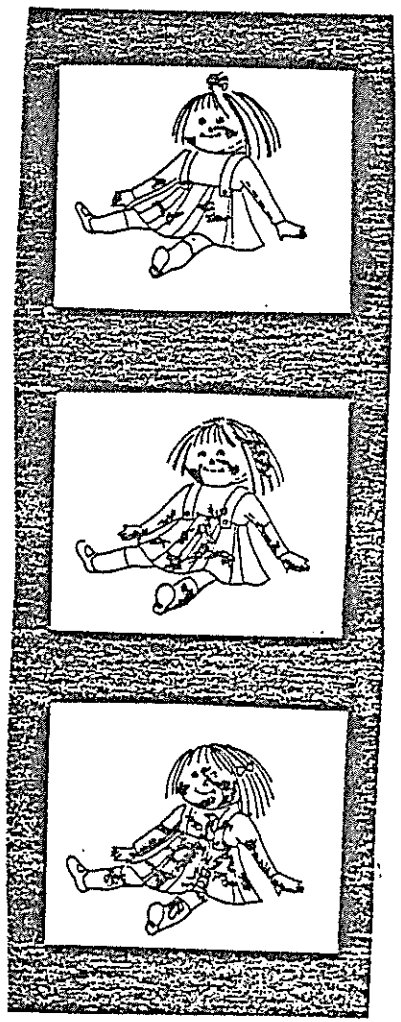

Figure 5: Elicitation Item for Superlative Morphology

Examiner: This girl is skating too fast.
If she skated any faster, _____.
(she would fall down)

Figure 6: Elicitation Item for Counterfactual Conditional

Although the elicitation measure was designed to test production of grammar, the responses can be usefully analyzed for semantic well-formedness as well. Grammatical form is judged by comparing the response with the grammatical dependency relations set up in the sentence frame (in conjunction with the picture). Semantic correctness can be ascertained by the (mis)use of specific words to describe the picture which accompanies the sentence frame.

2.2.6 Writing Homophones to Dictation

In a task adapted from Schwartz et al. (1979), the subjects are asked to write to dictation short phrases and word pairs. Each item contains a homophone and either a syntactic or a semantic cue to disambiguate the spelling. Five pairs of homophones are presented, each item twice, once with a syntactic cue and once with a semantic cue. The homophone pairs are matched in frequency. For instance the homophone pair **see** and **sea** are presented in the following contexts:

(1) with syntactic cues as in " I see" and " the sea", and

(2) with semantic cues as in " look - see" and " lake - sea". The number of errors made with each type of cue indicates the degree to which the subject is able to use semantic and syntactic information in spelling. The set of phrases and word pairs are listed in Figure 7.

Semantic Cues	Syntactic Cues
mouth-nose	my nose
thinks-knows	she knows
lake-sea	the sea
look-see	I see
read-write	I write
wrong-right	be right
day-hour	an hour
mine-our	our dog
spells-prints	she prints
king-prince	a prince

Figure 7: List of Homophones with Syntactic and Semantic Cues

2.3 PANTOMIME ASSESSMENT PROCEDURES

Prior to the pantomime test, the subjects are given a ten item apraxia evaluation consisting of five facial and five simple manual movements. This is used to screen the subjects for deficits in motor ability which are irrelevant to the production of the symbolic content tested in the pantomime measures. The subjects are asked to imitate any of these gestures they cannot perform on command. The gestures are:

1. Stick out your tongue.
2. Pucker (show me how you kiss someone).
3. Close your eyes.
4. Blow (out a match).
5. Bite your lower lip.
6. Make a fist.
7. Scratch your head.

8. Snap your fingers.
9. Wave goodbye.
10. Clap.

Both pantomime production and recognition are tested using techniques and materials adapted from Duffy, Duffy and Pearson (1975) and Duffy and Watkins (in press). The materials are identical to the lexical assessment materials described above. Subjects are given the same form (A or B) for the pantomime tasks as they are given for the lexical assessment. Therefore the subjects must produce the same item twice, once by naming it and once by pantomiming it. The subjects do not hear or see the examiner produce any item (in a recognition paradigm) which they are asked to produce.

Pantomime recognition is given before pantomime production so that it can be used to illustrate the task demands. In the recognition task the examiner pantomimes the use of an object and the subject selects from four line drawings the correct object. The examiner was trained via video tape to perform each pantomime in a similar manner to the Duffy et al. (1975) experiment. In the production task, the subject is told to show the examiner "how to use" or what they "do with" each of twenty objects. If the subject appears confused, he is shown the same line drawing used to elicit the object name and encouraged to pretend to use it. Minimal use is made of the pictures since pilot testing indicated that this patient population tends to become fixated with the picture, perseverating on tracing the outline or attempting to lift the object off the page. All pantomime production is video recorded for analysis.

Chapter III

LANGUAGE LOSS: SEMANTICS VS. SYNTAX

> If I have anything to do, I get something that has something doing, or I have some reason for being.
> (Excerpt from an AD transcript)

Speech of Alzheimer patients is fluent but empty. The goal of this chapter is to verify and extend this characterization through linguistic evaluation. Two topics are of particular concern. First, does the observed fluency in this population reflect truly intact syntactic knowledge? Second, how can we best describe the lexical semantic deficit which appears to contribute to the emptiness of Alzheimer speech?

The results of the methods described in Chapter II will be reported. A general summary and discussion follows. Implications of these findings for theories of language, mind and brain will be presented in the final chapter.

3.1 CONVERSATIONAL SPEECH

Analysis of conversational speech has one distinct advantage over analysis of other data sets: since no extraneous test demands are placed on the subject, conversation about familiar topics may display the subject's optimal performance level.

Measures of conversational speech were designed to gauge:

(1) type and frequency of syntactic errors,

(2) type and frequency of correctly used syntactic constructions,

(3) type and frequency of lexical errors, and

(4) type and frequency of correctly used semantic functions.

Measures of each are described below.

(1) All morphosyntactic errors were tallied, including morpheme and argument omission (e.g., "*she could been drinking"), ill-formed noun and verb morphology (e.g., "*Mom and Dad is gone"), and word order and movement/deletion violations (e.g., "*...which it was broken...").

(2) To gauge the range and frequency of correctly used morphosyntactic categories, a pre-selected set of constructions were counted. Since even the most impaired subjects were facile with many morphosyntactic categories (e.g., subject-verb agreement, auxiliary morphology) only more complex constructions were included. A list, with examples from the AD transcripts is presented in Table 2.

(3) Three categories of semantic errors were tabulated.

1. Errors of lexical choice, in which the subject used one word where another word was clearly intended or would have been more appropriate, even if an alternate target could not be readily identified.
2. Errors of excessively vague anaphora, such as deictic terms (here, there, this, that) and pronouns (he, she), with no clear or recoverable referent.
3. Errors of lexical vagueness, in which empty words (thing, place, something, whatchamacallit), convey too little information to be useful in interpreting the sentence.

Identifying errors of these types often required consideration of not only a single sentence, but the larger conversational and communicative contexts as well. Only single words which were inappropriate or uninterpretable considering both conversational and communicative context were regarded as errors.

(4) To assess range and frequency of correctly used semantic functions, eleven semantic categories were tallied and compared with normal use. They are listed, with examples in Table 3. Excerpts from three typical AD conversations are presented in the Appendix.

TABLE 2

Grammatical Categories

1. Simple Sentence:
   "I was just talking."

2. Conjoined Sentences:
   "They're interesting and they're nice."
   "I could drive even, but Celia won't..."

3. Questions:
   "Did I have anything written there before?"
   "What do you want to know from me?"

4. Subject Relative Clauses:
   "These people that have money and time,
   they think that's fun."

5. Object Relative Clauses:
   "They had a house that they sold."

6. Adverbial Clauses:
   "..instead of getting married before I was old enough."
   "I do it myself if I want to."

7. Infinitival Clauses:
   "We wanted to take a little trip."
   "Did I give you the stuff to read...?"

8. Passives:
   "This is handled by the whatchacallit."

9. Other Topicalization:
   "It was in New York City they landed."

10. Comparatives:
    "I used to be a little smarter than I am (now)."

11. Other Complements:
    "You've got a scheme for finding out
    what you want."
    "You tell me what you want them for."
    "And I said, 'Just leave me alone.'"
    "I think I'm spelling it right."

TABLE 3

Semantic Categories

1. Noun Phrase Modification: red, big, etc.
2. Verb Phrase Modification: quickly, almost, etc.
3. Irrealis/Possibility: "I can go if I want."
4. Negative: not, don't, can't, etc.
5. Temporal: 5 O'Clock, last winter, etc.
6. Locative/directional: there, New York, etc.
7. Causal: "because I have this intention tremor, I can't do any drafting."
8. Comparative: younger, smarter, more than, etc.
9. Active: running, falling, fishing, etc.
10. Stative: know, be tired, have, etc.
11. Equational: "I am a librarian", "She is a great grandmother"

3.1.1 Morphosyntactic Production

The error analysis reveals at least superficial intactness of morphosyntactic production. Only 12 morphosyntactic errors (in 400 utterances) were identified. Four subjects made no errors at all. One subject made only one error. One morphosyntactic error appeared in the normal control transcripts. The AD errors, along with putative targets are listed in Table 4.

TABLE 4

Morphosyntactic Errors

(1) ?...there's laws.../there are laws
(2) *...Mom and Dad is gone/are gone
(3) *...Anybody tries to breaks it up/to break it up
(4) *...that she learn/that she learns or learned
(5) *...things that makes conversation/make conversation
(6) ?...I sure wish they can help me/they could help me
(7) *...I'll give anything if I could/I'd give anything
(8) *...which it was broken.../which was broken
(9) *..could been drinking.../could have been drinking
(10) *..I don't see of them/see any of them
(11) ?..knocked her/knocked her down
(12) ?..when I found about it/when I found out about it

It should be mentioned that at least some of these errors can be explained in non-morphosyntactic terms. For example, "I sure wish they can help me.", may have arisen by mischoice of the matrix verb. If "hope" rather than "wish" was the target, the morphosyntax is in fact correct. Omission of verb particles (e.g., "found" for "found out") may also be attributed to an error in lexical choice rather than omission of a syntactic element. In addition, some apparent grammatical violations may be colloquially acceptable (e.g., the presentative construction with singular copula in "There's laws"). Regardless, some truly morphosyntactic errors remain unexplainable on lexical grounds. Notably, however, these errors are few in number and are similar in type to speech errors made by normal speakers (Fromkin, 1973; 1980). The majority (at least 96%) of spontaneous utterances

used in conversation by the AD subjects are fully grammatical. This does not contrast greatly with the control subjects who made only one morphosyntactic error.

Crucial to documenting the morphosyntactic intactness in AD, is demonstrating that AD production parallels normal production in range and frequency of syntactic constructions. That is, do AD subjects use the same variety of constructions as normals, and do they do so with the same frequency? After all, it is possible that the AD subjects achieve relatively error-free speech and observed fluency by relying on greatly reduced syntactic complexity or frequent production of a very few constructions. To establish the degree to which AD language is syntactically normal (in addition to being essentially error free) each of the syntactic categories listed in Table 2 were counted. Table 5 lists the results of this analysis.

The figures in Table 5 illustrate the great similarity between the two populations in the use of various syntactic constructions. Further, in order to determine the relative complexity of AD speech, a complexity score was computed for each subject. This score consists of the percentage of utterances which contained predetermined complex constructions (all those listed in Table 2 except simple and conjoined sentences, and same-subject infinitival complements). The individual complexity scores, along with group means are presented in Table 6.

Table 6 shows that the AD subjects' syntax is as complex as the normals'. The difference between the two groups on this measure is not significant (Matched Pairs T Test, T=1.565). In addition as can

TABLE 5

Frequency of Syntactic Constructions in Conversation

Construction	AD		CONTROL	
	Total	Mean	Total	Mean
Simple Sentence	211	30.0	261	32.6
Conjunction	46	5.8	48	6.0
Questions	18	2.3	17	2.1
Subj. Relatives	2	0.3	9	1.1
Obj. Relatives	22	2.8	18	2.3
Adverbial Clauses	61	7.6	56	7.0
Same Subj. Infin.	10	1.3	13	1.6
Diff. Subj. Infin.	5	0.6	3	0.4
Passive	8	1.0	9	1.1
Topicalization	3	0.4	6	0.7
Comparative	5	0.6	2	0.2
Other complements	81	10.1	40	5.0

TABLE 6

Percent Complex Utterances in Conversation

Subject	Score	Subject	Score
AD 1	32%	CONTROL 1	20%
AD 2	42%	CONTROL 2	42%
AD 3	54%	CONTROL 3	30%
AD 4	48%	CONTROL 4	32%
AD 5	40%	CONTROL 5	30%
AD 6	24%	CONTROL 6	18%
AD 7	28%	CONTROL 7	52%
AD 8	56%	CONTROL 8	30%
MEAN AD:	41%	MEAN CONTROL:	32%

Difference between groups: t = 1.565, not significant.

be seen in Table 5, this complexity cannot be attributed to repeated use of a single complex construction, since the AD and the normal subjects use approximately the same number of each construction counted. It should be mentioned that individual AD subjects did not use a disproportionate amount of any particular forms. That is, no single subject relied on any particular form or construction to the exclusion of others. Exact repetitions of full sentences were not included in the analysis.

3.1.2 Semantic Production

The semantic analysis parallels the syntactic analysis in that it consists of both error scores and correct-use scores. Table 7 summarizes the number of clear errors found in each of the lexical error categories.

TABLE 7

Lexical Errors in Conversation

Error Category	AD	CONTROL
Lexical Choice	43	1
Anaphora	28	2
Empty words	48	0

In all three categories, the AD subjects made strikingly more errors than the controls. Several observations can be made about the

lexical choice errors. First, the errors always preserve form class. That is, verbs are substituted for verbs and nouns are substituted for nouns. Second, the errors occur in both open and closed classes. In addition to the more common noun-noun, verb-verb substitutions, several errors in choice of prepositions and conjunctions were made. Third, although the intended targets cannot always be identified, many errors seem to preserve some aspect of meaning of a presumed target. For example, several errors substituted one family member (e.g., son) for another (e.g., father). Other examples include the substitution of "spelling" for "pronouncing", "know" for "remember", and "from" for "for".

The anaphoric and empty-word errors also contribute to the uninterpretability of AD speech. The excessive use of proforms (including deictics, indefinites, pronouns, and empty words) makes tracking participants through discourse difficult. Although an anlysis of each proform error is impossible, it is possible to compare the extent to which AD subjects and the normal controls use proforms. To do this, I took the number of proforms (appropriate and inappropriate) and calculated the percentage of proforms to all nominal references. For the purposes of this analysis, verbal proforms (do, use, handle) and other proforms (e.g., adverbial proforms: awhile, a certain amount of time), were excluded. Table 8 shows that while approximately 34% of the normals' nominal references are proforms, approximately 55% of the AD nominal references are proforms. This difference is significant at the $p<.005$ level ($T=3.894$), and accounts at least in part for the emptiness of AD speech.

TABLE 8

Percent Proforms of Nominal References in Conversation

#	AD	CONTROL
1	46%	39%
2	30%	23%
3	64%	50%
4	65%	33%
5	72%	24%
6	40%	35%
7	65%	31%
8	61%	34%
Mean:	55%	34%

Difference between groups: t=3.894, p < .005.

As in the syntactic analysis, the appropriate use of semantic categories was also investigated. Table 9 summarizes these results.

No striking differences emerge comparing the use of semantic functions between the two groups. Both groups clearly make use of a similar range of semantic notions, and generally, to a similar extent. The AD patients, then, are not semantically impaired at this level. They do not appear to be bound to talking about the present or the real (in fact, more negatives and irrealis elements appear in the AD conversations), and they appear to be able to modify propositions with attributes, locations, times, compare one object with another, and impute causality. This preservation of rather abstract semantic functions is accompanied by a preservation of abstract lexical items.

TABLE 9

Use of Semantic Functions

Semantic Categories	AD No.	AD Mean	CONTROL No.	CONTROL Mean
Noun attribuition	121	15.1	195	24.4
Verb attribution	95	11.9	86	10.8
Irrealis/Possibility	59	7.4	28	3.5
Negation	80	18.0	35	4.4
Temporal	62	7.5	165	20.6
Locative/Directional	120	15.0	142	17.8
Causal	13	1.6	22	2.8
Comparative	19	2.4	7	0.9
Active	256	32.0	319	39.9
Stative	227	28.4	174	21.7
Equational	21	2.6	39	4.9

Throughout the transcripts one can see not only appropriate use of abstract words (e.g., "statistics", "incorporates", "relationships", "intelligence", "properties", "scheme", "influence") but also the use of somewhat more embellished forms than is necessary (e.g., "a certain phase of conversation"; "locate" for "find"; "composed of" for "made up of"; "I can't bring it forth" for "I can't say it" etc.). Their difficulty, as analyzed here, appears to be in accurately matching lexical items with (particularly concrete) arguments, not in expressing abstract semantic concepts or functions. This is particularly interesting in light of their general cognitive impairment.

In sum, the AD patients and normals were found not to differ significantly on any measure except that of lexical errors. The AD subjects used equally complex syntax and expressed equally complex semantic functions, both with approximately the same frequency as the normals. The AD speech was found to be semantically uninterpretable largely due to (1) lexical mischoice and (2) excessive use of proforms without recoverable referents.

One major difficulty with accurately analyzing errors in conversational speech is our inability to identify intended lexical or morphosyntactic targets. Unfortunately, the AD patients cannot be profitably interrogated as to their intended choice of words or sentence structures. The next two sections (Narrative Description and Elicitation) both present data which, although not as natural as conversation, constrain both syntactic and semantic output. These constraints allow more accurate identification of target forms and structures, and therefore permit comparison between errors and their targets.

3.2 NARRATIVE DESCRIPTIONS

Narrative descriptions of the Cookie Theft picture were transcribed and analyzed similarly to the conversation data. I hoped to verify the results of the conversational analysis, and by controlling the topic more closely, be able to shed more light on the nature of the lexical errors. The Cookie Theft picture, three AD narrative descriptions are included in the Appendix.

Two obvious differences between the AD and the normal group emerge on this task. First, comparing means, the AD subjects took approximately twice as many sentences to describe the picture as the normals (AD mean=15.9; Control mean= 8.25). This finding reflects not only the patients' willingness to talk, but also suggests the disinhibition of speech production. The additional sentences generally did not add new or necessary information to the description. Rather, they went beyond simple description and often included motives, and mention of the characters' mental states, as in: "They're trying to do the best they can. And they're nice to each other, which is pleasant."

Second, the same types of lexical errors seen in conversation appeared in the narrative. The lexical error rate and the use of proforms are summarized in Tables 10 and 11 below.

TABLE 10

Lexical Errors in Narrative Description

	AD	CONTROLS
Lexical Choice	20	0
Anaphora	11	0
Empty words	26	0

As in conversation, the AD and normal narratives were similar in use of syntactic and semantic categories, as well as in degree of

TABLE 11

Percent Proform Use in Narrative

Subject	AD	CONTROLS
1	31%	05%
2	42%	44%
3	42%	29%
4	74%	39%
5	53%	72%
6	47%	22%
7	83%	07%
8	33%	25%
Mean:	50.6	30.4

syntactic complexity (AD = 31% complex sentences; Control = 38% complex sentences).

Since the narrative is tied to a specific context (the picture), it should be relatively simple to identify and analyze particular lexical errors. To a great extent, this was true. Several examples will illustrate. One subject described the boy falling off the stool as, "He's gonna fall out of there". Another subject described the cookie theft as "Children are taking jam or jelly or something from the jar." Presumably, she could both read and see that the children were taking cookies. These cases (and others) furnish evidence that the lexical errors are semantically related to targets. However, not all errors fall into this category. Several lexical errors are novel forms (e.g., "overflooding the sink"), and others are uninterpretable (e.g.,

"They're very well done you know, by a single jar no, I mean single pencil.") Of the twenty clear errors of lexical choice in the AD narratives, sixteen (80%) could be identified as semantically related to the target. The fact that lexical errors are rarely phonologically or visually related to the target suggests that the impairment does not disrupt all aspects of lexical use, only access to or representation of the elements within their semantic fields. This is consistent with a theory of lexical access in which direct access to semantic information and phonological information within a lexical entry proceed independently. In AD (as in certain forms of aphasia and dyslexia), access to semantic information is impaired, but independent access to the phonological representation may remain intact.

3.3 ELICITATION

The elicitation task allows us to further constrain speech output in both form and content. The subject is shown a picture and prompted to complete a sentence or answer a question about the same, or a closely related picture. In this way, both semantic and syntactic production are strongly constrained. However, these constraints are not without their costs. In addition to picture interpretation (which was also required in the narrative description), this task requires substantial task orientation, auditory comprehension, attention and memory.

Two hundred and ninety five elicitation items were administered to the AD subjects, and a total of 84 errors were made. The errors can

be divided into several categories which are summarized in Table 12. The most common error type (35%) consisted of a "comment" as in:

> All of these sheep do the same thing. Everyday this sheep jumps and every day these sheep:
> Target: jump
> Comment Response: They're just practicing their jumping.

The next most common error types were caused by misinterpretation of the sentence frame (20%), and inappropriate word choice (20%). Misinterpretations of the sentence frame were due to either reinterpreting or ignoring a single word in the sentence frame. Examples include interpretation of as as in:

> Sherry promised Doug to fix the wagon. What did she say?
> Response: My wagon is broken. The wheel came off. Can you fix it?

and examples when the subject may have ignored a (usually unstressed grammatical) word as in this example which is accompanied by three pictures of dolls, each consecutive one dirtier than the last:

> This doll is dirty; this doll is even dirtier; and this doll is the:
> Target: dirtiest
> Response ignoring the: filthy

Of the errors in word choice, most (65%) were due to use of semantically related words as in:

> Here the boy is getting ready to pour the juice. But here the boy has already:
> Target: poured the juice
> Semantically related response: spilled it

It is notable that even semantically wrong responses are often properly inflected for tense and number (and any other relevant morphosyntactic specifications). As with the lexical errors in

conversation and in narratives, there were also some unrelated lexical substitutions, as in:

> Here the girl is getting ready to open the present. But here she has already:
> Target: opened it
> Semantically unrelated response: ate it.

The next most common error category was misinterpretation of the stimulus picture. This most frequently occurred when the subject described the wrong picture of a two picture set, or did not see clearly what was depicted in the drawing. This accounted for 12% of the errors. For example,

> One of these boys (top picture) is riding the horse. One of these boys (bottom picture) is not riding the horse. This (pointing to the bottom picture) is the boy:
> Target: who is not riding the horse
> Response describing wrong picture: with the horse, with his feet up

Syntactic errors (7%) and Do-Not-Knows/Repetitions (6%) were the least common errors. The fact that syntactic errors did occur at all suggests that the patients do not maintain full control over syntactic operations. However, since each construction is elicited twice, we can observe whether any syntactic errors were made consistently. A true syntactic deficit would most likely result in consistent syntactic errors. However, none of the subjects erred on both tokens of any one construction. This error pattern indicates that syntactic competence is not generally impaired, but rather that attentional and other (i.e., task related) factors intermittently interfere with syntactic production.

TABLE 12

Elicitation Error Types and Frequencies

Error Type	Number	% of Total
Comments	29	35%
Misinterp. of Sentence	17	20%
Lexical Errors	17	20%
Misinterp. of Picture	10	12%
Grammatical Errors	6	7%
Do-Not-Know/Repetitions	5	6%
Total	84	100%

The normal subjects made no syntactic errors, but did make fifteen errors of misinterpretation of the sentence frame and one innaccurate picture interpretation. Many of the errors were identical to the AD errors (eight misinterpretations of promise as ask; five responses ignoring the in items eliciting superlatives) and several others. For instance:

> Laura wanted Jimmy to help her sweep the floor, so she asked him and asked him, but Jimmy just:
> Target: wouldn't
> Response interpreting just as said or just said: absolutely not!

Although the elicitation task places more attentional and memory demands on the subjects, the results parallel the other two speech production tasks. Grammatical errors exist, but are far outnumbered by lexical errors, and in this task by comments, errors which reflect lack of task orientation rather than a linguistic deficit.

3.4 WRITING TO DICTATION

Writing homophones to dictation, more than the other production tasks, allows us to compare the subject's ability to use syntactic and semantic information for identical purposes: to disambiguate the spelling of a word. Recall that the patient is read two words, one of which is either a semantic or syntactic cue, and the other, a homophone. If the subject is able to use the cue, the homophone will be spelled correctly (e.g., the sea; look-see), and if he/she is unable to use the cue, the homophone may not be spelled correctly (e.g., the see; look-sea). Naturally, if the subject cannot make use of the cue, but knows the two words, there is still a 50% chance of accurate spelling.

One of the eight AD subjects was unable to write legibly, but data from nine additional AD subjects are included, yeilding a total of sixteen data points for this analysis.[7] Only those items in which the subject accurately transcribed the cue were included in the analysis. The results are reported as the number of errors (i.e., misspellings of homophones) with each type of cue. One error using a semantic cue was made by a normal subject.

Number of AD errors using syntactic cues (mean = 1.25) is significantly less than the number of errors made using semantic cues (mean = 3.5; $P<.0005$, $T = 5.084$). Again, as with oral production, AD

[7] These subjects were seen at the UCLA Geriatric Outpatient Clinic and given a screening evaluation which included this writing task. They were not included in the larger study because they were unavailable for further testing. No controls for this additional group were tested.

subjects make errors with both syntax and semantics, but their semantic disabilities far outstrip their syntactic impairments.

3.5 CONFRONTATION NAMING

Naming a picture or an object may require different skills than using a word in spontaneous speech (Buckingham, 1981). However, because it is the easiest and most controlled measure of word finding, it is the most widely used index of lexical knowledge. Its value lies in enabling us to compare naming errors with known targets. Analysis of these errors can illuminate more specifically the type of anomia associated with AD.

A total of 48 errors were made in 160 trials by the AD subjects (while 1 error was made by the normals). Thirty two (66%) of these errors were semantically related to the target. However, not all of these errors consisted of a substitution of hyponyms, or one contrast coordinate for another. Only four (13%) of the semantically related errors can be described as a substitution at this level of meaning (e.g., "truck" for "car"; "moon" for "sun"). Four other categories of semantically related errors were identified.

1. Forty two percent (14) of the naming errors consisted of functional descriptions. Some of these descriptions were abbreviated and incomplete (e.g., ROWBOAT: "for fishing"; TELEPHONE: "hear things"), while other descriptions were essentially complete (UMBRELLA: "something to keep you from getting too wet if its stormy or too hot if its sunny";

IRON: "I think its a thing you use to make things look nice and smooth with").

2. Twenty four percent (8) of the errors held a part-whole relationship to the target, often involving the name of the target itself. For instance, one subject called a banana a "banana peel". Another subject called picture of a window a "house".
3. Fifteen percent (5) of the errors were novel forms (e.g., "salt holder" for salt shaker).
4. Six percent (2) of the errors were physical descriptions of the object. One subject said of the sun: "it has a glitter to it."

A total of sixteen errors (33%) were not semantically related. Seven of these (44%) appeared to be the result of a visual error, confusing the object with something that looks similar (e.g., calling a balloon an "egg"). Five of the semantically unrelated errros (31%) were Do-Not-Know or perseverations (names of previously seen objects). And lastly, four errors (25%) were unrelated and/or uninterpretable (e.g., GLASS: "the thing you put in the reflex"). The error types and frequencies are summarized in Table 13.

The majority of naming errors (66%) are semantically related to the target. These data corroborate the findings reported above. In addition, these data reveal that within semantically related errors, at least five distinct categories can be identified. All five categories (contrast coordinates, function, part/whole, novel forms,

TABLE 13

Confrontation Naming Error Types and Frequencies

Semantically Related (32)	Semantically Unrelated (16)
Functional Descriptions: 14	Visual Errors: 7
Part/Whole Confusions: 8	Do-Not-Know/Perseverations: 5
Novel Forms: 5	Uninterpretable: 4
Hyponyms: 4	
Physical Descriptions: 2	
Total: 32	Total: 16

and physical descriptions) convey accurate (although not always sufficient) information about the object. A consistent picture of the naming problems of AD patients is beginning to emerge. Although they consistently have difficulty retrieving names, they can often retrieve related semantic information. That information may be the name of a closely related word, a functional description, or one of several other possibilities mentioned above. This suggests that they may be able to access an appropriate lexical representation or network, but that the desired aspects of that representation are impossible to find. The name of the object is the aspect of the lexical representation which we asked for in this experiment. But if this description of the naming problem is correct, the patients would be equally unable to find other aspects of the lexical representation (e.g., function) when asked to.

3.6 AUTOMATIC VERBAL SEQUENCES

This is the only task on which all subjects performed perfectly, illustrating that there is no compromise in the production of overlearned sequences (numbers, days of the week) in AD.

3.7 COMPREHENSION

Assessing comprehension is important for several reasons. First, no AD population (i.e. more than one case) has been evaluated with carefully constructed tests of lexical and syntactic comprehension comparable to production measures. Second, if lexical representations are disturbed, and not just lexical access, we would expect to see a comprehension impairment.[8] Third, if underlying syntactic competence is preserved, we would predict that comprehension of syntax, when lexical comprehension and extraneous nonlinguistic factors such as memory are not at issue, should be largely intact.

It is clear from the conversation data that comprehension is not fully intact. Consider the following exchange:

> Examiner: When you got married, did you have any kids?
>
> Patient: Yeah, I had children. I think I had four. Yeah. Two boys and two girls, I believe I had.
>
> Examiner: What are their names?

---

[8] It should be noted that while a deficit at the level of lexical representation would create a comprehension impairment (as well as a production impairment), the reverse is not necessarily true. That is, if we find both comprehension and production impaired, the deficit could be caused by either a representational problem or accessing problems which interfere with both production and comprehension processes.

Patient: Well, the boys were Stuart, William, Woody and Ted Murphy. But we were a little shy on girls. We had one sister, four brothers and one sister. She was of course, quite somebody to have, one sister and four boys.

Examiner: What about your kids? YOUR children? What are their names? You said you had two boys and two girls?

Patient: I think that's right, let's see. I had an older brother Stuart, and then I came in, and my brother....

Obviously, there was some confusion about whether the topic of conversation was the patient's children or his siblings. This might be attributed to his miscomprehension of the word "children" or misassignment of a coreferent of "they"/"their". As such, it would be an example of a lexical comprehension error much like the errors we saw in lexical production: understanding one word as if it were another closely related word. However, other interpretations are also possible. For instance, the memory deficit in AD generally affects recent memory before it affects remote memory. Therefore, it is possible that this patient was just talking about family that he remembered. It is unclear.

Hints of lexical miscomprehension also appeared in the elicitation task, when for instance, a subject would interpret promise as ask. However, comprehension errors in conversation and elicitation are not always easy to interpret, and they do not occur with enough frequency to use as a reliable metric of language comprehension.

In order to accurately evaluate comprehension, tests of lexical and syntactic comprehension were administered. These tests have the drawbacks of all tests: they require attention, memory and task

orientation. In addition, the tests are not exactly equated for complexity. The test of syntax comprehension involves selecting one of four large pictures, each with two people doing something, while the lexical comprehension test contains four pictures of single objects.

The normal controls made two errors on the syntax comprehension measure and one error on the lexical comprehension measure. The results of the AD subjects are presented in Table 14. The scores indicate that comprehension of individual words and syntactic constructions (containing words that were understood in a pretest) are impaired.

TABLE 14

Alzheimer Comprehension Errors

Subject	No. Lex. Errors	No. Synt. Errors
1	0	6
2	1	6
3	4	5
4	3	6
5	3	11
6	1	12
7	5	4
8	4	6
Means:	2.6	7.1

Comparing just the lexical production and comprehension data it appears that there is a comprehension deficit alongside the word-finding problems. The comprehension deficit appears to be milder than the production deficit: 21 comprehension errors vs. 49 naming errors. This finding demonstrates that lexical retrieval as seen in naming tasks is not the sole problem in AD. Either the process of mapping auditory stimuli onto lexical representations for comprehension or the lexical representations themselves are deficient. On the other hand, comparing syntactic comprehension and syntactic production, we have a striking contrast, with syntactic production appearing intact and syntactic comprehension severely impaired.

3.8 DISCUSSION

3.8.1 Morphosyntactic Abilities

One goal of this chapter is to determine whether this population disproportionately retains syntactic abilities in the face of general intellectual and lexical deficits. Spontaneous and elicited speech as well as writing showed that in production these patients maintain near perfect control over syntax. Very few morphosyntactic errors are made in spontaneous speech; they correctly use a normal range of syntactic constructions with normal frequency. In addition, they are able to use syntactic cues in a writing task far more effectively than semantic cues.

To a large extent, this is not surprising. Two case studies (Whitaker, 1976; Schwartz et al., 1979) have previously demonstrated

some intact syntactic abilities. However, neither they, nor recent population studies (Appel et al., 1982; Bayles, 1979) looked in detail at the type and frequency of grammatical constructions in spontaneous speech. In view of this, our results have extended the characterization of AD speech from fluent to syntactically normal.

This point is of some consequence, not only in terms of characterizing the language abilities of this population but also for neurolinguistic theory. If syntactic abilities are selectively preserved in this population, we will be able to demonstrate the double dissociation of lexical and syntactic knowledge in brain damage and thereby illustrate the neuropsychological basis of the lexical/syntactic distinction. Agrammatic aphasics furnish the other side of of the dissociation: intact lexical knowledge and impaired syntactic knowledge (Caramazza and Zurif, 1976; Caramazza, Zurif and Gardner, 1978; Heilman and Scholes, 1976). If there is a simple neuropsychological distinction between lexical and syntactic abilities, a dissociation should be demonstrable in both comprehension and production abilities. Thus far, however, we have only been able to demonstrate part of this theoretically possible dissociation: the indpendence of syntactic and lexical production.

It is of some theoretical interest to establish whether or not lexical and syntactic abilities can be (A) doubly dissociated as would be possible if each were controlled by distinct processors or (B) quadruply dissociated as would be possible if comprehension and production processes were dissociable in addition to the dissociation between lexical and syntactic abilities.

Schwartz et al. (1979) demonstrated that if lexical items were accurately understood, syntactic comprehension in a single AD patient was intact. This is the single piece of available evidence relevant to syntactic comprehension in this population. In contrast, our results on a test of syntactic comprehension suggest substantial impairment. These results, since they are discrepant with previous findings must be examined. First, it is possible that our results may be explained as artifacts of methodology. The comprehension task may simply have been too complicated. The visual array along with the auditory stimuli may simply have overwhelmed the attentional and memory capacity in these patients. Rather than two-picture arrays (as in the Schwartz et al. study) we used four-picture arrays. In addition, some of our test sentences are longer and more complex than those used by Schwartz et al. However, length and complexity do not appear to be the crucial differences since our subjects did not perform well on even the active and passive voice items, which presumably were similar in length and identical in complexity to Schwartz et al.'s active and passive items. Even so, the additional difficulty of a four-picture array may have exceeded the patients' attentional capacity, and account for the discrepant results. In order to circumvent these methodological problems, simpler tasks are now being developed for use with this same population. One possible solution is to use an enactment paradigm (Slobin and Bever, 1982; Bates et al., 1981) in which the patients are required to enact a sentence with small figures. Another related method is to require the

subject only to respond by identifying the actor in response to "Who did it?" questions about auditorily presented sentences. These methods should be attempted before we conclude that we have uncovered a dissociation between syntactic comprehension and production.

On the other hand, if future research (possibly using the alternate methods suggested above) reveals intact syntactic production and incontrovertibly impaired syntactic comprehension, we may be able to speculate that we have uncovered a true dissociation between syntactic production (intact) from syntactic comprehension (impaired). Dissociations of this nature are logically possible, but imply that comprehension and production utilize different representations and/or different access processes which can be dissociated from one another. Although this type of redundancy in a model of language use may seem unparsimonious, it has found some support in development (Bever, 1975) and adult function (Garrett, 1982). In addition, if production is intact in the absence of comprehension, then we need to explain how production can be maintained independently of any informed (i.e. comprehending) monitor or feedback.

3.8.2 Lexical Abilities

Lexical abiltities were found to be impaired across all tasks, including speech production, writing and comprehension. Production errors, when a lexical target could be identified, appeared to be semantically related to the target at least 66% of the time. The absence of any other consistent and frequent error type suggests that

the major problem is one of either access to or representation of semantic information. Comprehension errors, although not as numerous as production errors, significantly exeeded the controls' error rate. This incidence of comprehension errors on a task methodologically equivalent to the production task suggests that the problem goes beyond retrieval. Either comprehension processes or lexical representations themselves are degraded in this population.

Recall that one theory of the naming problem in dementia held that the source of the problem was visual agnosia (Rochford, 1971; Kirshner et al., 1984). Although this theory was not upheld as the primary source of errors in the present investigation, the patients did consistently have difficulty with picture recognition. Still, picture recognition errors accounted for only a very small percentage of lexical errors (15% in confrontation naming, 12% in elicitation). While misrecognition does appear to be the origin of some naming errors, it does not account for the bulk of them.

Another theory of the naming disorder in dementia proposed that the deficit is due to a loss of the ability to use features which distinguish semantically related categories (Schwartz et al., 1979). This was based on the fact that one patient demonstrated comparable errors in naming and comprehension, and her errors were of the type where one member of a coordinate pair is substituted for another (e.g., "cat" for "dog"). In general, our data are in accord with theirs: both comprehension and production were impaired and at least some errors were consistent with a breakdown in distinguishing

features within a semantic-conceptual representation. For example, several errors were similar to those reported by Schwartz et al., a substitution of one member of a coordinate pair for another (e.g., "moon" for "sun"). Another type of error, the substitution of a part for the whole (and vice versa) (e.g., "banana peel" for "banana"; "house" for "window") is also consistent with a loss of semantic features. However, these errors suggest that features which mark hierarchical boundaries within a category are disturbed along with those features which distinguish between same-level categories.

Importantly, only some of the confrontation naming errors were semantic coordinates (8%) or part/whole substitutions (24%). Three other error categories (described above) occurred with considerable frequency. Many of these other naming errors were fully appropriate circumlocutions, suggesting that the conceptual category (and its distinguishing features) are intact. These errors also suggest intact ability to locate accurate but non-prototypical semantic information (i.e., everything but the object name). This could be explained by an access deficit in which access to the target within a semantic category is blocked but other related information remains available. Equally plausible is an interpretation in which the the naming deficit is due to a scrambled semantic reprsentation, in which typically correct access strategies would yield non-typical (i.e., semantically related) results.[9]

[9] In keeping with currently popular theories of category structure (e.g. Rosch, 1978), I will assume that lexical representations are organized around prototypes, with the most central information

To further address this issue, we can look at data from lexical comprehension. If there is a disturbance at the level of category representation, we would expect it to effect lexical comprehension as well as production (although as mentioned before, the presence of both comprehension and production deficits does not necessarily indicate a representational deficit or rule out an access deficit). To the extent that scores on measures of production and comprehension parallel one another in quantity, we may propose that a single deficit, which may lie at the level of representation, is causing these errors.

To compare lexical comprehension and production errors, the number of naming errors which were semantically related were correlated with the total number of comprehension errors for each subject. In general, as comprehension errors increase, so do production errors ($r=.744$, $p<.02$). In so far as the correlation holds in further investigations, we can suggest that both the comprehension and naming errors are due to a single deficit in a semantic representation or processes which are central to both word production and word recognition.

In order to explain our results, we need a model of the naming disorder which allows for use of various parts of the targeted semantic category and neighboring categories, but does not allow

(i.e., object name) at the representation's epicenter and less central information (functions, gestural name, etc.) away from the epicenter. Therefore the errors discussed here indicate successful access to the targeted semantic network, but not to the prototype within that network.

access to specific parts of the target (e.g., the object name). The model might be similar to the model suggested by Schwartz et al. in that it includes the possibility of a breakdown in the structure of underlying categories. The breakdown in category boundaries would explain some of the misnamings (e.g., "moon" for "sun"; "truck" for "car"). However, this model must also account for naming errors which demonstrate fully accurate semantic information and intact category boundaries (as in the complex functional descriptions). In these cases there is no evidence for a breakdown in semantic features which distinguish categories. Instead of attributing the problem exclusively to disintegration of distinguishing features, a more general theory might propose that the problem is one of locating precise semantic information within a semantic/conceptual representation. As the comparison between comprehension and production suggested, this might be due to a representational deficit rather than an accessing deficit. In this theory, the lexical entry is disorganized so that typical accessing strategies do not yield intended targets. This model assumes that the disorganized semantic representation retains the original information in disarray, so that related information is still found within the relevant network. For example, in the lexicon, each piece of information (including name, function, physical attributes, gestural name and other distinguishing information) may have an address with semantically related items sharing a network or neighborhood. When we want to name something, we go, typically, to the center of the relevant semantic entry. For

other information, we go (generally with ease and speed) to other areas of the lexical entry. The AD patients appear not to be able to find the correct address for information. They can, however, usually get into the right neighborhood. The instructions which generally lead us to the object name, in the case of AD patients, lead them to closely related names or other related information.

This notion is consistent with other available information on naming deficits in AD. For instance, AD patients are consistently poor at word-list generation (e.g., "name all the animals you can") (Benson, 1979), although they appear to understand the task and be able to name some, just not many, animals. This suggests that although they can access a specific category, they have trouble locating specific information within that category.

The errors of lexical choice which we have been discussing clearly reflect a failure to use (for whatever reason) a specific lexical target, and therefore are unequivocally lexical errors. Errors in the use of proforms, however, are open to more than one interpretation. On the one hand, they may be reflexes of a word finding problem. When unable to find the appropriate word, a proform may serve to fill-in or cover-up the lexical gap. On the other hand, the use of proforms may reflect pragmatic or memory disturbance which leaves the subject unable to judge what information is clear from context and what is not. This type of deficit would lead to violations of Gricean rules of conversation (e.g., be clear), but may not be the result of a deficit in either lexical access or lexical representation.

What evidence is there that these proforms are part of the same lexical problem discussed above? First, there is the fact that the proforms, like the lexical errors, preserve some aspect of the target's meaning: location is conveyed in "here" and "there"; number and animacy distinctions are preserved in indefinites and pronouns; even tense and aspect are preserved in proverbs (e.g., "do"). In this regard, the proforms qualitatively resemble the lexical errors. However, if the two types of errors were caused by the same phenomenon (e.g., faulty category representations) then we would expect quantitative similarity as well. Unfortunately the percent proform measure and the naming measure are based on different data and are nearly impossible to compare. In addition, five of the eight AD subjects have very similar percent proform scores, all within eleven percentage points. One quantitative similarity, however, is suggestive. Three of the AD subjects received essentially normal proform scores (Subjects 1, 2 and 6 all scored below 46%). These same three subjects had the fewest errors in both naming and lexical comprehension. This finding appears not to be an artifact of overall severity since one of the three (number 6) is rank ordered third most severe on the memory and orientation scale. Although not by any means conclusive, there appears to be a rough correlation between these three lexical scores (naming, word comprehension and % proforms) which is not predicted by overall severity. This suggests that proform use may be a reflex of the same lexical problem which causes errors in naming and comprehension tasks.

Chapter IV

SYMBOLIC ABILITIES IN ALZHEIMER'S DISEASE

The second section of this research involves the relative interdependence between language and nonlinguistic cognitive abilities. In particular, I will focus on the relationship between lexical ability and the ability to comprehend and produce meaninful pantomimic gestures. The question here is whether the lexical deficits of AD are accompanied by a parallel difficulty with comprehension and production of gestural pantomimes for the same referential objects.

4.1 PANTOMIME COMPREHENSION

The most straightforward comparison is in comprehension. The results of the lexical and pantomime comprehension tests are presented in Table 15. First, the lower mean and the higher standard deviation for pantomime suggest that the pantomime task was harder for the subjects than the lexical test. This is not surprising since the gestural system and task is undoubtedly less familiar.

Second, recall that each subject was given the same items for verbal recognition and for pantomime recognition. If each item (e.g., comb, book) shared a single representation for both words and pantomimes, we might expect that the same items would be missed in

both tests. This does not seem to be the case: more than twice as many pantomime items than lexical items were missed (51 vs. 21). Closer inspection does reveal that all overlapping items (i.e., items on which a subject missed both the lexical and the pantomime) occurred in half of the subjects. For these four subjects, 71% of their lexical errors are matched by pantomime errors on the same item. This uneven distribution of overlapping pantomime and lexical errors suggests that for four of the subjects, the same referential items are often difficult to name and pantomime. This may reflect a representational deficit involving just those items. For other subjects, however, a representational deficit should not be posited since there is no overlap in missed items across modalities. The notion of subgroups in a population of eight subjects is obviously speculative but does warrant further investigation with a larger population.

Third, if the errors in the two domains are caused by deficits which are common to both modalities, we would expect to see an increase in errors in one paralleled by an increase in errors in the other. To address this question, Pearson product-moment correlations were calculated for the number of correct responses in word and gesture comprehension. The two correlate significantly ($r = .811$, $p<.01$). However, remembering that some investigators have argued that apraxia is due to a general intellectual deterioration, we must ask whether this finding is an artifact of overall severity of the disease, which might affect all tasks equally and simultaneously. To

TABLE 15

Comprehension of Words and Pantomimes: No. Correct

Subject Number	Pant. Comp.	Lexical Comp.
1	19	20
2	17	19
3	14	16
4	09	17
5	16	17
6	15	19
7	08	15
8	08	16
Mean:	13.375	17.375
S.D.:	4.470	1.767
Range:	8-19	15-20

determine whether or not this is true, we can partial out the severity as measured by the Mental Status Score. The resulting correlation (r = .553) is less significant but this drop in significance is small when considering (1) the small number of subjects (the same value would be significant with two more subjects) and (2) a particular confound in the measure of severity: the Mental Status Score is arrived at by scoring answers to thirty questions, only one of which is nonverbal (copying a drawing). The overt reliance on language in the measure of severity suggests that it is not a language-independent measure of severity at all. More independent indices may be phyisiological measurements (EEG latencies) or interviews with family members about the patient's daily living skills. In sum, although we

have shown a high correlation between pantomime and lexical comprehension, we have not established the degree to which this correlation is caused by overall severity of intellectual impairment.

4.2 PANTOMIME PRODUCTION

While comparison of comprehension scores allows a quantitative comparison, an analysis of pantomime production will allow us to compare both number of errors and type of errors.

Sixty seven pantomime production errors were made out of a total of one hundred and sixty trials (42%). This exceeds the error rate for misnamings on the confrontation naming task by eighteen (31%). These numbers, along with a lower mean number correct for pantomime (pantomime: 12, words: 14.5), a larger standard deviation (pantomime: 6, words: 3.9), and a larger range (pantomime: 4-19, words: 9-19), suggest that the pantomime task, overall, was more difficult than the naming task. Again, this is not surprising when one considers the relative familiarity of names when compared with pantomimes. To determine whether difficulty in one domain parallels difficulty in the other, the correlation between total number correct on the two tasks was calculated. The resulting correlation coefficient (r=.806) is strongly significant ($p<.01$).

This calculation, however, does not give credit to partially correct answers which were common in both modalities. In order to more accurately compare abilities across tasks, lexical and pantomime scores were calculated for each subject which credit 2 points for a

fully accurate response, 1 point for a partially accurate response, and 0 points for no reponse or an incorrect response. This correlation was almost identical to the previous one ($r = .808$, $p<.01$), and suggests that a somewhat finer grained analysis upholds the quantitative parallel between word and pantomime production.

In addition to these numerical comparisons, we can make qualitative comparisons. The goals of this analysis are to:

1. describe the gestural errors of AD patients
2. determine the relative frequency of each type of gestural error, and
3. compare types and frequencies of pantomime errors with types and frequencies of naming errors.

This error analysis differs from previous analyses (in aphasia studies) in several ways. First, most investigators score responses on a scale and report results as a single derived number, usually a mean. Few discuss error types or the distribution of distinct error types, other than to note that apractic pantomimes include incomplete, awkward, poorly sequenced and wrong movements (Heilman, 1979), and that the most common errors, according to one report are perserverations (i.e., persistence of a previously requested response) (Lehmkuhl, Poeck, and Willmes, 1983). A more specific analysis is necessary in order to make a meaningful comparison with naming errors. Second, with hemiparetic populations (i.e. many aphasics) scoring must make allowance for the use of a partially paralyzed or non-preferred hand. In the present study, we are free from this constraint, and are

able to determine more precisely how the gestures of AD patients differ from normals.

Some of the gestural errors can be seen as analagous to certain naming errors, but comparison beyond a superficial level is difficult since the two modalities impose different constraints. For instance, recall that 29% of the naming errors consisted of functional descriptions. Since the pantomime target generally is a functional mime (e.g., drinking out of a glass for glass), no gestural analogue to the functional naming errors can be constructed. In the following section I will present the observed gestural error types, noting where appropriate the similarity to naming errors.

One type of error has consistently been observed and discussed in the aphasia literature: the use of a body part to stand for the object. Four such errors appeared in our data (6% of errors). However, since three body part errors appeared in the controls' pantomimes, these errors do not clearly distinguish the normal from the AD pantomimes. Although our results are discrepant with Goodglass and Kaplan's (1963) findings (i.e., the number of body part errors distinguished the aphasic from the control groups), our data are consistent with a "more concrete gestural representation" (and the consequent use of body parts as objects) noted to characterize both dementing patients and the elderly (Kaplan and Goodglass, 1981, p. 319). Interestingly, since the AD and controls made a similar number of body part errors, the concreteness may be attributed to age, with relatively little contribution from dementia.

Two types of errors are unanalyzable. Fourteen items (21% of errors) yielded no response, sometimes in the form of "do not know", sometimes in the form of a refusal. This is a substantially greater number of these errors than appeared in naming, where there were only three (6%). The second type of unanalyzable error is an uninterpretable or wrong gesture (e.g., typing in response to telephone ;sticking little finger in ear in response to book -- n=6, 9%). These responses bear some obvious resemblance in quality and quantity to the use of unrelated words or uninterpretable descriptions in the naming test (e.g., "the thing you put in the reflex" for glass, n=4, 8%).

The remainder of the errors (n = 42, 63% of the errors) are related to the target in some identifiable way. These errors are analagous to the 33 (67%) naming errors which were semantically related to the target. The correlation between number of related errors in naming and pantomime is .677 ($p<.05$). Partialling out severity with Mental Status Scores yields a correlation of .596.

Like the semantically related naming errors, the related pantomime errors can be further divided into subtypes. The most frequent subcategory consists of pantomimes in which part of the pantomime (handshape, hand orientation, movement, or location) was incorrect (n = 18, 27% of errors). These pantomimes are essentially complete, just partially wrong. For example, two such errors occured in the mime for cigarette, in which the subjects either "chewed" or "kissed" instead of inhaling and exhaling. The remainder of the gestures (hand shape

and position) were correct. Another such error occured when, for salt shaker, one patient pretended to pick up, hold and shake a salt shaker, but did not turn it over toward the table.

Thirteen errors (19% of all errors) were incomplete pantomimes. In these pantomimes, the gesture is correct, but does not contain enough gestural information so that the resulting pentomimes do not fully distinguish the object from closely related objects. For example, in pantomiming apple, all controls pretended to pick up an apple, bring it to the mouth and bite it. Two AD subjects did only part of this action. One pretended to chew without the hand and arm movement. Another pretended to pick up the apple but omitted pretend eating/biting. These errors are similar to some of the lexical errors in so far as they give enough information to identify the class (e.g., food for apple in the first example above), but not to fully identify the object. Like the naming errors of this sort, these pantomime errors suggest intact access to relevant semantic fields, but insufficient access to specific internal features within the semantic representation.

Four errors (10%) consisted of the use of complete and uniquely identifying gestures, but were not the prototypical gestures used by the controls. For example, while all normals demonstrated the use of a gun by pretending to aim and shoot, one AD subject pretended to load a gun. Similarly, while normal subjects consistently pretended to wash hands or dishes in response to sink, one AD subject demonstrated the use of a sink by pretending to scrub it. These pantomimes, while

adequate and certainly not wrong, were not seen in the control sample and suggest that the AD population has difficulty accessing prototypical gestural names. This is similar to the lexical errors in which they use more sophisticated or formal terms than necessary (e.g., "statistics" for "numbers"; "doff" for "tip"). Rather than central exemplars of categories, they select peripheral category members in both word retrieval and pantomimes. These parallel errors suggest that the AD patients have difficulty accessing prototypical responses in both modalities.

Three pantomimes (4%) were appropriate but excessively vague or cursory. Again, while these are not wrong, they are reminiscent of the excessive use of proforms (thing, somewhere) in AD speech. Neither the use of proforms nor the cursory mimes are necessarily in error, but often give less precise information than requested or expected.

Three errors (4%) were associated with the use of a picture cue. Recall that if the subject appeared not to understand the initial verbal command, they were shown a picture of the object to be pantomimed. In three such cases, the patient relied on the the size of the picture in the pantomime, resulting in an inappropriate hand shape. For example, one subject mimed saw with an imaginary toy saw, held between the thumb and index finger rather than with the whole hand.

Finally, a single error, while fitting into the partially correct category, is particularly illustrative. In pantomiming the use of a

drum, one subject pretended to hold drumsticks, but instead of beating the drum, he swayed back and forth humming a melody. This intrusion error suggests that he had located the proper semantic field (music), but only part of the information relevant to the particular instrument (drumsticks). As with naming errors, the majority of pantomime errors maintain some semantic information about the target. These examples illustrate that AD pantomime errors are not random, and that in the majority of cases the errors can be described as semantically related rather than wrong or awkward, as pantomime errors in aphasia have often been described.

4.3 DISCUSSION

The ultimate goal of this investigation of pantomime in AD is to determine if and how language is related to another symbolic domain. Through the study of pantomime deficits in cases of focal aphasia, several theories (reviewed above) have been proposed to explain the consistent high correlation between language and gestural impairments. In addition to these, we proposed that the correlation may hold only between the lexical aspects of language and symbolic gesture, reflecting the underlying symbolic basis of lexical knowledge and pantomime.

A population of AD patients offer a unique perspective on this issue since they demonstrate lexical impairment in both comprehension and production, but preserved syntactic ability. In addition, the lack of motor deficits in this population bypasses difficulties

analyzing gestures produced by hemiparetic patients. If lexical and pantomime ability are linked, we would expect to see a significant parallel in impairment of the two domains in AD patients.

The data presented thus far illustrate that there is a significant quantitative parallel between impairment in the two domains across both comprehension and production (see Table 16). However, as has been pointed out by Duffy and Duffy (1981) "high correlations between variables cannot prove a causal relationship" (p. 80). Therefore, several other aspects of the pantomime-lexical relationship were investigated. First, it was shown that the majority of non-accurate responses in both naming (67%) and pantomime production (68%) can be described as semantically related since they maintain certain elements of the target, but not others. Other more specific analogues were discussed (e.g., nonprototypical responses and vagueness in both domains).

TABLE 16

Words/Gestures: Mean No. Correct and Correlations

	WORDS	GESTURES	CORRELATIONS
COMPREHENSION	17.375	13.375	r=.811, p<.01
PRODUCTION	14.5	12.0	r=.806, p<.01
PART. CORRECT	4.0	5.5	r=.677, p<.05

The parallel in number and type of errors across praxis and language must be explained. If the two domains are functionally independent, the similarity in error patterns suggests that the words and pantomimes are similar in underlying structure, and that this structure is affected in much the same way and to the same degree by AD. For example, the structure of lexical and pantomime respresentations may both consist of complex engrams. In each lexical entry there is semantic and phonological information, while each pantomime representation contains hand-shape, movement and meaning information. Lexical and pantomime entries are embedded in matrices of other similar representations, strongly connected to items close in form and meaning. In AD, access to semantic targets in both domains is disrupted in a random manner, sometimes allowing access to relatively complete information, at other times allowing access only to partial or nonprototypical information. There does not appear to be a systematic loss of any one type of semantic information (e.g., central vs. peripheral aspects of semantic categories; name vs. function). At the very least, then, we can suggest not only that the representation for words and pantomimes are simultaneously disrupted, but that similar internal structures in these representations produce similar error patterns in cases of damage. Of course, these similarities may also be explained by recourse to a single underlying symbolic capacity which nourishes both lexical and gestural knowledge. The common structure to the errors in both domains could, in this case, be caused by a single deficit in the underlying symbolic system

which impedes access to full semantic specification in either modality.

In order to further investigate an alternate explanation, that pantomime impairment is due to a movement disorder which affects all purposive movements and not due to a symbolic deficit, we can look at imitative movement. It has often been noted that apraxics make errors with no visual model (as in our study) as well as when they are asked to imiatate movements (Denny-Brown, 1958; DeRenzi, Motti and Nichelli, 1980; Hecaen and Albert, 1978; Heilman, 1979). If the disorder were due to a symbolic deficit, we would predict improved or perfect execution of movements in imitation or when symbolic content is lessened in any way. Two results from our study suggest that pantomime performance is greatly improved when the symbolic content is lessened. Each subject was asked prior to the pantomime expression test to perform five facial and five upper limb movements. Some of these were conventional and weakly symbolic (e.g., clap) and others were not symbolic at all (e.g., scratch your head). All errors in production to verbal command were followed by a request to imitate the movement. To the extent to which the lessened symbolic content or the use of a visual model improves performance, the deficit may be attributed to the symbolic system, and not to a system underlying all purposive movements. The results of this assessment are as follows. Eight errors were made in spontaneous production. This is a considerably lower error rate (10%) than observed in the pantomime expression test (42%), suggesting that more symbolic actions are more

difficult. Five of these errors were corrected in imitation. Two errors were not corrected in imitation, and one was not attempted by the subject in imitation. Imitation clearly helps (70% effective), but not always and not uniformly.

Imitation was also assessed inconsistently during the pantomime expression test proper. Of eleven attempts at imitating when initial errors were made, nine gestures were perfectly imitated, and two were close approximations. These data suggest that the gestural problem is greatly diminished in non-mimetic gestures and under conditions of imitation where a visual model essentially removes symbolic content.

Another argument against a movement disorder explanation is the fact that both production (which requires complex purposive movements) and comprehension (which requires only a simple pointing response) are equally impaired ($r = .8844$, $p<.005$). As mentioned earlier, if the two deficits are related, only a motor theory of recognition could explain this concommitant impairment in production and comprehension. Such a theory, in general, is problematic since it predicts that motor impairment creates recognition impairment. This is clearly not upheld in light of the many reports of aphasic deficits in which (lexical) production is impaired disproportionately to comprehension (Benson, 1979). Consistent dissociation of comprehension and production (in lexical abilities, and by analogy in pantomime abilities) argues against a strict motor theory of perception for either domain.

Our findings therefore support the symbolic theory of pantomime disturbance attributed to Finkelnburg and upheld by Duffy and Duffy

(among others), rather than the adjacent pathways or movement disorder explanation offered by Liepmann and supported by Goodglass an Kaplan. However, the explanation offered here is not the only possible explanation. It should be noted that, we have not intentionally collected any evidence which can differentiate between a gesture-language link based on language mediating gesture and one in which language and gesture are both mediated by a common underlying symbolic capacity. Some of our data do bear on this issue indirectly. In comprehension there was a very poor correlation between items failed on the word recognition test and those failed on the pantomime recognition test. If the pantomime problem were one of verbal mediation, pantomime should have been intact when comprehension or production of the word was intact. This did not appear to be the case. In order to further address this issue, we must investigate whether or not systematically supplying verbal cues vs. visual cues aids pantomime performance.

This investigation has not satisfactorily evaluated the contribution of general intellectual decline to the dual impairment in language and praxis in AD. In order to prove that lexical and pantomime abilities are inherently linked, we should be able to show that lexical and pantomime impairment are more significantly correlated with each other than either of them are with overall cognitive impairment. It is methodologically possible to partial out the effect of overall cognitive impairment, given a reliable nonlinguistic measure of overall severity. The only measure of

severity available on this subject population is Mental Status Score, which, with the exception of one question is based both directly and indirectly on verbal ability. Although such Mental Status Scores are widely used diagnostic/rating measures, the contribution of language is too large for them to be a viable independent indicator of severity.[10] Ideally, we could use physiological measurements (P300 latency, ventricle dilation), Activity of Daily Living scales, or nonverbal intelligence test scores (e.g., Ravens Progressive Matrices) as nonverbal measures of intellectual impairment.

Another point to be addressed with these data is the issue of the generality of the correlation between language and pantomime. We have demonstrated that in the absence of syntactic impairment, pantomime and lexical deficits are highly correlated. However, this does not rule out the possibility that isolated syntactic impairment would also correlate with pantomime deficits. To investigate the other side of this association we need to test a population which presents syntactic impairment with lexical ability intact. This profile may hold for some anterior aphasics. However, it should be remembered that all aphasics are argued to have some anomia (Benson, 1979), so finding a syntactic deficit in isolation from a lexical deficit is not easy. In

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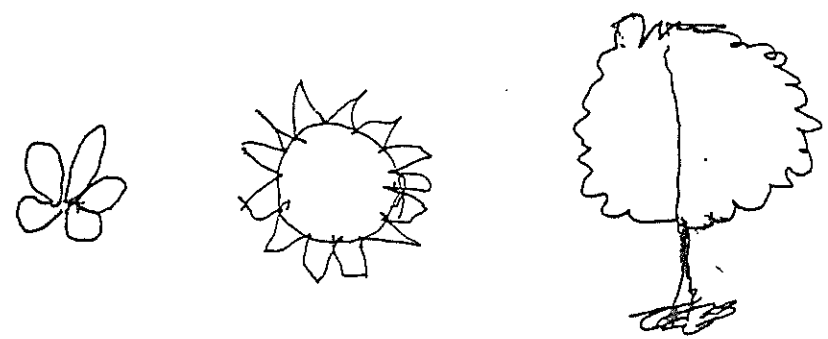
[10] Although partialling out severity with the Mental Status Scores does reduce otherwise significant correlations between language and gesture to below the .05 level, it is notable that (1) correlations between pantomime and lexical measures are generally higher than those between either, pantomime and mental status or lexical ability and mental status, and (2) the correlations remain high generally ($p<.10$), and would reach significance ($p<.05$) with one or two additional subjects.

this regard we have made only a first step towards evaluating the local theory of the language-pantomime relationship.

One final point must be made about implications and further investigation. If, as we have proposed, language and pantomime abilities are compromised due to impairment in an underlying symbolic function, then reflexes of this deficit should be seen in other symbolic activities. One such area to investigate is representational drawing. I began to address this issue informally by asking the subjects to draw simple pictures (e.g., a house, a daisy). Since drawing differs from both language and pantomime, it is difficult to apply the same standards of analysis. However, if all symbolic functioning is disrupted similarly, we would predict that as the pantomime and lexical deficits worsen, we will see an equivalent deterioration in drawing ability. Based on pilot data, at least superficially, this appears be the case. Figure 8 shows examples of daisies drawn by normal and AD subjects. As the disease progresses, the figures become less complete and less daisylike, although they generally retain enough information to be identified minimally as a plant, if not a flower.

Eventually, similar critera may be applied to drawing as we have used for pantomime and language. We can then compare deficits across domains in terms of severity. Additionally we should be able to see if there is an improvement under conditions of copying as we saw with pantomime imitation. We can also systematically investigate the impairment in production and apprehension of various other symbols

Alzheimer patients' drawings of a daisy.



Normal controls' drawings of a daisy.

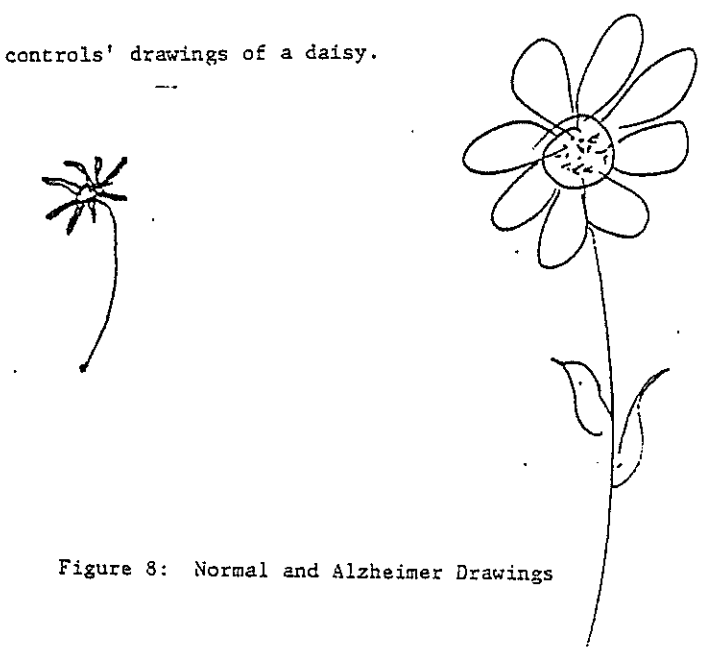


Figure 8: Normal and Alzheimer Drawings

(e.g., logos, punctuation marks, numbers, written words) as has been attempted with aphasics and alexics (Bay, 1962; Gardner, 1974).

In closing this discussion we must consider a very important caveat to the theory proposed. It is possible that all symbolic activities (like all mental activities) may not be equally tied to one another in normal function and in cases of deterioration. Lexical semantic ability appears to be relatively more tied to symbolic gesture than either of them are tied to syntactic abilities. We have demonstrated a substantial link between pantomime and word knowledge but such a close tie (1) may not be absolute, and (2) may not exist between other symbolic domains. As mentioned above, there is evidence that gestural and language impairments do occasionally occur independently of one another. This dissociation, if upheld with methods comparable to those used here must be taken to indicate that the two domains, despite possible neurological and functional similarities are not merely mapped one onto the other. With regard to the second point, it has been shown that aphasics with a deficit in symbolic use of language are capable of learning to use other symbol systems (Glass, Gazzaniga and Premack, 1973). In addition, many category specific asymbolias (e.g., alexia, agraphia, acalculia) have been described (Hecaen and Albert, 1978), demonstrating that containing symbolic content does not necessarily imply that two domains are closely tied functionally or anatomically. We have not shown that gesture and language are inseparable, but rather that in at least one relatively homogeneous population, gesture and one aspect of language -the

lexicon- are impaired in a parallel manner, while other aspects of language (e.g., syntax) do not deteriorate in the same fashion.

Chapter V

ISSUES AND IMPLICATIONS

This final chapter summarizes the findings of this research and discusses them in light of the questions raised in Chapter I.

5.1 SELECTIVE PRESERVATION OF SYNTAX

The first issue investigated was whether syntactic ability is independent of lexical semantic ability. Functional theories of grammar predict generalized language impairment in cases of cognitive dissolution, while modular theories predict possible selective impairment and/or preservation of components of the grammar. To the degree that we find syntax selectively impaired or preserved in cases of brain damage, modular theories of language and the mind are supported.

Past research on aphasia has addressed this issue by investigating the extent to which syntax is selectively impaired or preserved in relation to semantics in classical syndromes of focal aphasia. Broca's aphasia has been described as agrammatism,[11] a syndrome which impairs an individual's ability to use syntactic cues to apprehend and

[11] It is not widely accepted that the deficit should be described as agrammatism. Many scholars still hold that the impairment is primarily motor, with agrammatic symptoms being artifacts of a central motor deficit (e.g., Darley, Aronson and Brown, 1975).

produce language structures in controlled tasks (e.g., Zurif and Carammaza, 1976). This impairment usually leaves intact the patients' ability to use lexical semantic information in the same tasks. The syntactic deficit of Broca's aphasia is "assumed to involve a central component of the linguistic system and should be manifested in all modalities" (Berndt and Caramazza, 1981, p. 177). As this notion finds empirical support, we can argue for the existence of a highly specialized module or processor necessary for, and dedicated to, syntactic processing. In addition, this theory of agrammatism leads us to postulate that a relatively localized area in the anterior portion of the left hemisphere is essential for syntactic functions, and therefore moves us one step closer to a fully specified neurolinguistic theory.

If syntactic ability constitutes an independent module, it should be consistently dissociable from semantic knowledge in deficit conditions. Therefore, we would logically expect to see aphasic syndromes which selectively preserve syntax as well as those which selectively impair it. Wernicke's aphasia is often described as if it were a mirror immage of Broca's aphasia: Broca's aphasia is due to anterior left hemisphere lesions and is characaterized by non-fluent production and good comprehension; Wernicke's aphasia is due to posterior left hemishpere lesions and is characterized by fluent production and impaired comprehension. If Wernicke's aphasia is truly a mirror image of Broca's aphasia, then it would supply the other side of the predicted double dissociation between syntax and semantics.[12]

However, the picture is not that clear. The presence of severe lexical semantic disturbance and the severe comprehension deficit associated with Wernicke's aphasia make syntactic competence difficult to assess. While some studies suggest intact syntactic abilities in this population (Goodglass and Kaplan, 1972; von Stockert and Bader, 1976), several studies indicate syntactic impairment. For instance, Gleason et al. (1980) found that Wernicke's narratives were much less syntactically diverse than normals in so far as they relied on simple conjoined clauses and used very few embedded constructions. Acoustical analyses of Wernicke's speech has demonstrated that their fundamental freqency patterns differ from normals in ways which indicate that these patients fail to take into account overall sentence length when programming an utterance, and are not influenced by major clause boundaries as normals are (Danly and Cooper, 1983). In addition, on semantically reversible sentences (e.g., "The boy was kissed by the girl") fluent aphasics present a deficit in syntactic comprehension which cannot be attributed to extraneous factors such as lexical miscomprehension or memory impairment (Martin and Friederich, 1983).

[12] Although there are several types of nonfluent aphasias including Broca's and Transcortical Motor, and several fluent aphasias including Wernicke's, Transcortical Sensory, and Conduction, I discuss Broca's and Wernicke's here as prototypes of the aphasias. The other aphasias may be equally illuminating, but do not differ from Broca's and Wernicke's in the relevant characteristics discussed here.

The data presented here and elsewhere on syntactic preservation in AD (Schwartz et al., 1979; Whitaker, 1976), provide an important piece of the puzzle. These studies present a more consistent profile of relatively intact syntax in the presence of substantial semantic impairment than has been presented for any classical focal aphasia. The data presented in this dissertation confirm and extend this characterization by documenting intact range and frequency of syntactic productions and intact syntax alongside impaired semantics across a series of comparable tasks.[13]

Linguistically, this dissociation makes sense since the lexicon and syntax are generally described as distinct components of the grammar. However, neurolinguistic questions go beyond confirming that theoretically independent components can be dissociated in deficit conditions. A full account of the syntactic preservation in AD will include an explanation of why syntax is spared in the context of (1) widespread cortical degeneration, and (2) general cognitive decline.

[13] However, the present data also call into question the intactness of syntactic conprehension, which was shown to be deficient on our tasks. Although this may be an artifact of testing procedures, it may also suggest an independence of production and comprehension processes in language, with the production of syntax being more resiliant to brain damage and more dissociable from semantics than comprehension.

5.1.1 Three Problematic Explanations of Syntactic Preservation

One anatomical explanation has been offered to explain the preservation of syntactic fluency in the context of widespread cortical degeneration. Cummings and Benson (1983, p. 52) claim that we see a fluent aphasia in AD and not an agrammatic aphasia because the neurological degeneration is more marked in posterior portions of the brain. This pattern of degeneration would presumably yield a posterior-like (i.e. fluent) aphasia, at least until the degeneration progresses to encompass wider areas of cortex. However, several pieces of data can be used to argue against this explanation. First, as indicated above, the language associated with AD appears to be somewhat different than that typically associated with posterior aphasias. Although the posterior focus of degeneration does help explain why AD language is relatively more similiar to posterior aphasias than it is to anterior aphasias, it leaves unexplained the dissimilarities between posterior, fluent aphasias and language disturbance in AD. Second, anterior areas are affected by various degenerative processes in the course of the disease (Foster et al., 1983; Gustafson et al., 1972), but nonetheless AD patients do not present a non-fluent language pattern, even when cortical activity is reduced in the anterior portion of the left hemisphere.[14] Even in advanced stages of the disease where much of the cortex and essentially all higher cortical functions are destroyed, speech

[14] In fact, non-fluent language patterns are often used to suggest a focal lesion, indicating a possible diagnosis of Multi-Infarct Dementia as opposed to AD.

generally maintains its fluency in the form of echolalia and palilalia. Although thorough testing is impossible with such patients, even those who are reduced to echolalia appear to retain some operative syntactic filter (Whitaker, 1976). It seems then, that even when cortical degeneration extends to the anterior portions of the cortex, it does not result in Broca-type (agrammatic) symptoms. This anatomically based posterior-focus explanation does not account for these data.

An alternate linguistically based explanation might maintain that syntax is selectively preserved because it is largely preprogrammed or innate, and therefore not susceptible to the same sorts of damage that more clearly learned (e.g., lexical) knowledge is. There is substantial support for an innate left hemisphere predisposition for language, including a larger planum temporale on the left side at birth (Wittleson and Pallie, 1973), and suggestions that the acquisition of syntactic structure cannot be explained by learning based on available input (Hyams, 1983; Newport, Gleitman and Gleitman, 1977; Wexler and Culicover, 1980). However, this nativist approach does not take into account a general fact of cognitive dissolution in AD: syntax is not the only ability which is preserved, and semantics is not the only ability which deteriorates. Ideally, an explantion of syntactic preservation and semantic impairment will be consonant with, and possibly illuminate, the more general picture of cognitive impairment and preservation. Although I have mentioned an array of impaired abilities (e.g., gesture, visuo-spatial skills, memory), we

have said very little about preserved abilities other than syntax. The most preserved functions, along with syntactic fluency, are sensory and motor functions. Anatomically, the most preserved areas of cortex are the primary motor and sensory cortex and the primary occipital cortex (Cummings and Benson, 1983). Of particular interest is the fact that the primary motor area which is preserved, is adjacent to the areas thought to underly grammatical ability -- the association cortex abutting the motor strip area devoted to oral-facial control (Mohr, 1976). A parsimonious explanation would account for the preservation of cortical areas and cortical function of both sensory-motor abilities and syntactic fluency. The theory sketched above would regard the sparing of syntax and sensory-motor skills as a coincidence of anatomy: two functionally independent but anatomically adjacent areas of the cortex happen to be spared simultaneously.

A third theory might explain the simultaneous preservation of motor[15] and syntactic functions by reducing both functions to a set of common features. One current theory ties language and motor skills to the left hemisphere and suggests that the left hemisphere is specialized, not for language per se, but rather for complex sequencing (Kimura and Archibald, 1974). The common link between the two domains is seen to involve sequencing skills necessary to execute complex speech articulation on the one hand, and all other complex, ...

[15] For the remainder of this discussion I will focus on the links between only motor skills and language, because it is easier to observe and evaluate motor behavior and compare it to observable language behavior. It is assumed that parallels also hold between sensory abilities and language reception.

sequenced motor skills (both meaningful and non-meaningful) on the other. In this view, language is not lateralized because of its symbolic or linguistic content, and aphasia consequent to left hemisphere lesions is not necessarily considered to be a symbolic or linguistic deficit, but rather it is seen as an impairment in sequencing complex units. Therefore it is no coincidence that Broca's area surrounds primary motor cortex.

However this characterization has three weaknesses in explaining the present data. First, this theory does not account for the distinction between syntactic (non-symbolic, linguistic) and lexical semantic (symbolic, linguistic) functions. Both of these functions appear to involve the left hemisphere and the sequencing of complex units, yet they can be, and frequently are, dissociated in cases of focal aphasia and AD. Second, the commonality between motor and language abilities is plausible only if we assume that speech production (which must include syntax) is at its base a product of motor sequencing. This in fact, is not widely accepted. One fundamental tenet of syntactic theory has been that syntactic descriptions require in addition to sequencing, mention of hierarchical relationships and manipulations of abstract elements (Chomsky, 1977; Emonds, 1976). Third, even if we accept the assumption that syntax and motor skills both require finely coordinated motor sequencing, this theory does not explain why these two functions might be preserved in AD. Shared functional bases and anatomical proximity do not necessarily imply neurological resistance in cases of brain damage.

In order to explain the preservation of syntax and motor skills, we need to identify a link bewteen them and a compatible neurological model. This model must account for the preservation of these two functionally diverse but anatomically proximal abilities, while the great remainder of cortex and higher cognitive functions are decimated. A partial answer to this puzzle might be found in the notion of automaticity, and the neurology which might underly automatic behaviors.

5.1.2 Automaticity and Syntactic Preservation

Although the psychological literature on automaticity in attention (Schneider and Shiffrin, 1977; Shiffrin and Schneider, 1977) does not specifically mention syntactic abilities, it gives us tentative definitions of automatic processes and the opposing controlled processes. In their proposal for two distinguishable modes of processing (automatic vs. controlled), Schneider and Shiffrin (1977) claim that automatic processes "operate independently of the subject's control....do not require attention....and they do not use up short-term capacity" (p.51). In contrast, a controlled process "requires attention...(and) uses up short-term capacity" (p.52). While automatic processes appear to develop where the range of alternatives is limited (i.e., consistent or frequent mapping between stimuli and responses), controlled processes are called upon when the range of alternatives is broad and unpredictable (i.e., varied mapping between stimuli and responses).

Preserved motor behaviors in AD can be easily categorized as automatic. For instance, the mechanics of walking and driving, while varying in complexity, utilize the same general pattern repeatedly (consistent mapping), and require little attention or short term capacity. Only a limited range of alternatives is ever encountered. The behaviors are frequent, and therefore become overlearned.

Syntax can be similarly characterized as automatic. The range of alternatives in syntactic structure are relatively limited (consistent mapping), particularly when compared with lexical choice which involves selection from a broad array of possibilities (variable mapping). In general, there are only a limited number of possibilities for verbal inflection (e.g., tense and aspect marking), nominal inflection (e.g., case markings) and word order in any given language. At the slightly more abstract level, there are equally limited possiblities for phrase structures (e.g., linear, hierarchical, and dependency relations between elements). Each of these possbilities, whether it is a particular verbal inflection or a particular phrase marker, are relatively frequent when compared with the occrrence of individual lexical items. Each word is encountered only a fraction of the number of times a syntactic structure is used. Notice that what syntax has in common with motor skills here is not degree of complexity or sequencing, but rather the qualities of high frequency and consistency. These qualities, I will claim, are responsible for their dual preservation.

One major qualification must be made before pursuing this argument further. Motor behaviors and syntax are not simply automatic. They are not devoid of novel variation, and they may at times take up attention and short-term capacity. But they are more automatic than controlled processes, such as lexical selection. Within a general ability such as "motor skills" or "syntax", there is much variation in degree of automaticity, probably determined by relative frequency of forms and combinations. For example, in languauge, some sequences are virtually unbreakable, and frequently used without variation: e.g., the days of the week, counting, social interaction formulas. Similarly, in motor skills, one foot always goes in front of the other to walk, spoons and forks are almost always brought to the mouth to eat, ignition keys turn to the right, etc. On the other hand, there is a whole range of items in both domains which require the integration of automatic and novel elements: familiar sentence frames require insertion of novel forms (Pawley and Syder, 1977) and all novel sentences require the insertion of lexical items into common (e.g., SVO) structures. In motor sequences, driving requires stopping at appropriate places and consideration of what other cars are doing; opening doors requires accommodation of knob size, location, etc. In short, neither domain is completely automatic. Both require integration of novel information in normal use.

If motor skills and syntax are largely automatic, and automatic processes are preserved in AD, we can make several predictions. We should see maintenance of those aspects of motor skills and speech

which do not require integration of novelty. Also, we should see errors in those instances which do require the integration of automatic and controlled processing. These predictions appear to be borne out. Motor skills which do not require taking new information into account are fully maintained: getting around familiar locations, basic aspects of dressing, the mechanics of cooking and driving, etc. Also, fully automatic verbal sequences (days of the week, counting) and social interaction formulas are maintained.[16]

It is when the patient needs to integrate new information into automatic verbal and motor sequences that we see a dissociation. For instance, although AD patients can turn on water to boil, they often forget that it has been started. Also, although they can carry out the mechanics of driving perfectly well, they continually get lost since they are unable to integrate new or relatively unfamiliar information into old patterns. Likewise, although they can mechanically construct a sentence with normal form, they substitute proforms for content words and therefore communicate very little. It should be remembered that word choice is the most novel aspect of sentence construction. Less novel (i.e., more overlearned and frequent) aspects of sentence construction such as subject-verb agreement and word-order are maintained and produced without error. In a sense, a structurally

[16] While social interaction formulas are almost always well formed, and often used appropriately, occasional errors in their use reflect a similar difficulty in accurate selection as seen in word choice. For instance, in attempting to get out of a testing session, one patient said "Let's do this tomorrow, or at a time when it is more convenient for you", regardless of the fact that it was convenient for the tester at that time.

correct sentence with no meaning is analagous to driving around a city lost. In both, there is an automatic component which at one time, with meaning integration, functioned to accomplish something (transportation, communication). Now, with only the automatic sequences intact, the motions are no longer purposeful, and can no longer function to acheive a particular aim.

Given that motor skills and syntax can both be classified as automatic behavior, it becomes less surprising that they are simultaneously preserved in the context of cognitive dissolution. Automaticity has long been used to explain why certain skills are maintained in the case of brain damage. For example, Anton Pick (cited in Gardner, 1975, p.279) used automatization to account for exceptions to the rule that earlier acquired skills are better maintained in brain damage:

> Occasionally on an accidental basis, the greater automatization of later acquired functions provides an exception to the rule and shows that it is not age itself but rather its resultant degree of automatization that determines the increased resistance. (emphasis added)

According to Gardner (1975), skills developed to a high level during early life "may achieve an independent autonomous status, so that they can 'run off' or function smoothly even when the brain is otherwise deranged" (p. 279). This has also been predicted with respect to certain language processes by Flores d'Arcais (1983) who stated that automatic processing components of language comprehension "would be rather robust and resistant to disturbances, while control units would be more sensitive to disruption."

Although the notion of automaticity has been used to explain preservation of function, to my knowledge, no specific theory of the underlying neurology of overlearned or automatic function has been offered. If automaticity is to be truly explanatory of preserved neuropsychological function, it must eventually be translated into neurological (e.g., structural or chemical) notions.

A recent anatomical model of hemispheric asymmetry[17] (Woodward, 1984) may offer some direction in this regard. This model, based on Anderson's (1977) model of cortical memory, focuses on two distinct cytoarchitectural dimensions -- horizontal and vertical -- to explain functional asymmetries between the left and right cerebral hemispheres. In this theory, the apical dendrites of pyramidal cells (the vertical dimension) and the basal dendrites of these same pyramdial cells (the horizontal dimension) contribute substantially different functions to cognition, and offer a basis on which to predict preservation of certain (overlearned) functions and degeneration of other (underlearned) functions in AD. A brief review of essential aspects of the model follows.

The vertical dimension is modularized into vertically oriented columns consisting of 300 to 3000 pyramidal cells. Further, within each column, there appear to be bundles which include the apical dendrites of 20 to 30 cells. Each bundle may function as a unit,

[17] This model, it should be acknowledged, is new and speculative at this point. I do not claim that it is the only neural model possible to account for the data presented here. However, to my knowledge, it is one of the few available models which provide a neural basis for the dissociations discussed throughout this work.

since "the response characteristics of the cells whose apical proceses share a single bundle are likely to be strongly interdependent...the vertical system...appears to be a vast array of autonomous, vertically-oriented modules which have intense internal connectivity" (Woodward, 1984, p. 6-8). This dimension appears adapted to process frequently repeated stimuli through a positive feedback matrix by which elements' outputs are fed back as input. The positive feedback matrix "learns" so that over repetitions of a stimulus, trace elements that encode stabile features become increasingly coupled to themselves. After sufficient repetition, such elements are driven to maximum firing whenever the eliciting stimulus is presented, and so, come to dominate the response characteristics of the trace. The stimulus is now represented in memory exclusively by a reduced set of elements encoding historically stabile features. This mechanism has been used to simulate behavioral characteristics of feature detection, including categorical perception (Anderson, Silverstein, Ritz and Jones, 1977). Woodward proposes that due to certain inhibitory factors which prevent the epileptogenic spread of powerful foci of excitation (seen in the verticle bundles), the columns of the verticle substrate include minimum numbers of elements, and are described as focal (p. 13).

The horizontal circuitry, in contrast, contains no obvious subunits (i.e., columns or bundles) and is marked by extensive overlapping. "Looking only at the horizontal dimension...cortex appears...to be a vast and seamless reticulum in which each cell delicately influences

thousands of others." As Woodward points out, "since the cells being considered in each case are the pyramidal cells, the cortex is both a modular array and a seamless reticulum, at the same time" (p.8). Since the horizontal dimension allows pyramidal cells to communicate over a greater array of cells, it is particularly suited to recognition memory which involves searching over a store of memories and requires a large number of simultaneous comparisons between new and old memory traces. Unlike the focal organization of the vertical dimension, because the horizontal elaboration is laterally extensive and based upon reticular rather than upon bundled internal connectivity, "horizontal traces might be aptly described as diffuse" (p.14).

Woodward goes on to argue that the left hemisphere is better equipped to deal with feature detection through its more extensive and efficient focally organized system of vertical columns and bundles. This substrate appears particularly able to deal with overlearned, familiar material, such as language. By contrast, the right hemisphere appears to be disproportionately geared toward processing complex underlearned stimuli (such as faces) through its disproportionately rich and diffuse horizontal system of cell connections. Woodward is careful to point out that this is not a dichotomy, but rather a continuum. In fact, he proposes that the relative distribution of the two types of traces may be e.g., 70/30% for feature detection in the left and right hemispheres respectively.

This theory offers a plausible neurolgical correlate to automatic vs. controlled processes. Automatic processes, since they deal with overlearned material, undoubtedly rely on feature detection. Controlled processes, in this theory, would correspond to recognition memory, which require choices and comparisons across much larger sets of data. Automatic processes are thus translated into focal, vertical representation and controlled processes into diffuse, horizontal representations.

If this theory is to account for the behavioral data seen in AD, then we must posit that either the horizontal substrate is particularly vulnerable to the degeneration in AD or that the vertical substrate is particularly resiliant. Both appear to have some support. The vertical modules have been reported to yield high resistance to cell loss in general (Roney, Scheibel, and Shaw, 1979; Shaw, Harth and Scheibel, 1980). On the other hand, progressive degeneration of dendrites in AD appears to affect the horizontal dendritic branches first (Cummings and Benson, 1983). While these data do not suggest full preservation of the vertical dimension, they do explain relative sparing of this aspect of cortical structure.

This theory has two advantages. First, it accounts for the functional and anatomical preservation of automatic processes in AD. Second, it furnishes us with a neurological distinction between the impairments caused by incidious relatively diffuse damage, and the focal disruptions seen in strokes, gunshot wounds, etc. In AD, we would expect preservation of the more focally defined (and therefore

automatic) functions, and that is exactly what we find. In cases of focal damage, we would predict that, if specific foci were hit, their functions would be destroyed, while diffusely represented functions would not be as affected.

5.2 LANGUAGE AND OTHER COGNITIVE ABILITIES

The second section of research reported here was aimed at illuminating the degree to which language abilities are linked to nonlinguistic cognitive abilities. Recall that some psycholinguistic theories view language as a system which is intrinsically "of a piece" with nonlinguistic cognition while others view language as an independent psychological system (see Piatelli-Palmarini, 1980, for discussion). To the extent that we find language and other cognitive abilities equally impaired in pathology, we can support the former theories. To the extent that language is selectively impaired or preserved, we can support modular theories of the mind.

Towards this end, I compared the language dissolution of AD with the dissolution of another symbolic domain, pantomimic gesture. We found quantitative and qualitative parallels between the deterioration of lexical and pantomime abilities, while neither paralleled the striking preservation of syntax. The similar patterns of disruption of the two systems suggested that the organization of the two systems is similar. In both, we can presume there are networks which connect object names with associated functions, descriptions, other related names, etc. In the lexicon, "related" means semantically related,[18]

while for pantomime, "related" takes on an additional motoric aspect. In AD, access to, or representation of these two systems are equally impaired such that errors consist largely of contamination from related nodes in the representational network. This similar internal organization may be caused by the fact that both lexical and pantomime systems are used to refer and communicate about semantically related entities.

Since we have shown that syntax is not related to lexical or pantomime disturbance, and that lexical and pantomime disturbance are significantly related to each other, it is clear that language cannot be unitarily linked to or independent from another symbolic abilitiy such as gesture. Therefore, any theory linking language and nonlinguistic cognitive abilities must relate only specific components of language to specific cognitive abilities. This, in fact, has been proposed and supported for the analysis of language-cognition interactions in development (Bates, 1979). It appears that such a "specific homology" model of language-cognition interactions is applicable to adult neuropsychological functions as well.

A neurolinguistic account of the data presented here must include an explanation of (1) the dissociation of syntax from other cognitive abilities, and (2) the parallel between lexical semantic abilities and pantomime abilities.

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[18] Words are obviously phonologically related in the lexicon as well. The point here is that the AD errors can generally be explained by recourse to semantically related elements. Few phonological errors exist.

In the preceeding section, I borrowed and revised a theory of automaticity to account for the functional and anatomical preservation of motor and syntactic functions, and the impairment of lexical and other cognitive abilities (#1 above). The distinction drawn between automatic and controlled processing can be further refined to explain why pantomime abilities would pattern with lexical abilities in AD (#2 above). Individual pantomimes are relatively infrequent and require memory of past movements associated with specific objects. It would stand to reason that such behavior would not become overlearned or automatic, and by default, would be accessed and recognized by controlled processes. Consequently, these functions would be represented in the horizontal cortical substrate, along with lexical functions.

This analysis explains why pantomime and lexical abilities, together, would be dissociated from automatic processes like syntax, but does not predict any further differentiation between lexical/pantomime skills on one hand and all other non-automatic cognitive abilities on the other. It predicts that lexical and all other nonautomatic cognitive skills would degenerate to a degree commensurate with overall severity of the disease. However, I have shown that lexical and pantomime skills only weakly correlate with overall severity, while they highly correlate with one another. The theory must be further refined to account for these facts.

Anatomically, there is evidence that lexical and pantomime ability are both similar to each other and different from other impaired

cognitive abilities. A comprehensive review of naming disorders by Benson (1979) reports anomia as a result of lesions throughout the left hemisphere, including temporal, parietal and occipital lobes. Results from lexical decision tasks suggest that there is no substantial difference between the type of lexical disturbance associated with anterior vs. posterior aphasia (Milberg and Blumstein, 1981).[19] PET studies with AD patients who were particularly impaired in lexical abilities indicate reduced cortical activity across various (i.e., not localized) regions of the left hemisphere (Foster et al., 1983). Notwithstanding evidence that under certain conditions the right hemisphere is capable of substantial lexical comprehension (Zaidel, 1976; 1977; Dennis, 1982), most researchers conclude that the left hemisphere is normally dominant for lexical knowledge, and moreover, that this ability appears not to be as distinctly localized within the left hemisphere as syntactic ability is.

Striking parallels exist with anatomical localization of pantomime. Basso, Luzzatti and Spinnler (1980) attempted to localize ideomotor apraxia within the left hemisphere. They compared lesion data (via CT scans) with apraxia data from 123 left hemisphere stroke cases. They found no differences between the patients with (N=48) and those without (N=75) ideomotor apraxia on anterior-posterior dimensions. It appears from these data that ideomotor apraxia, like lexical deficits, are largely left lateralized but not easily localizable within the

[19] But there is some evidence that posterior lesions create more severe and conceptually based lexical disorders than anterior lesions (e.g., Caramazza and Berndt, 1982).

left hemisphere.

This diffusely left lateralized characterization of both lexical and pantomime abilities contrasts with other cognitive abilities which are impaired in AD. For instance, the range of visuo-spatial deficits observed are typically associated with either right hemisphere or bilateral control. The memory disturbances have been associated with left and right temporal lobes, frontal lobes and numerous subcortical areas, particulary the hippocampus (Hecaen and Albert, 1978).

If, as proposed, all of these nonautomatic cognitive functions are primarily represented in the horizontal cortical substrate, we need to explain why two predominantly left hemisphere functions would parallel each other more closely than the group of cognitive functions as a whole. Two explanations are available. First, the left hemisphere may be relatively more affected in some patients. Foster et al. (1983) support the notion of relatively lateralized and localized impairment in some AD patients. If this were the case in my subject population as a whole, no other explanation would be needed. However, where detailed neuropsychological information is available on these patients, (e.g., visual integration tasks, block design, copying), it appears that right hemisphere functions are not preserved. Although it is impossible to compare the extent of left vs. right hemisphere involvement with such incomparable tasks, it is clear that their deficits are not restricted to left hemisphere functions.

Another theory which may explain the degenerative parallels between these two systems rests on the following premises:

1. Gestural and lexical knowledge are primarily supported by the horizontal pyramidal system.
2. The horizontal pyramidal system is relatively lateralized such that the right hemisphere has substantially more (e.g., 70%) than the left hemisphere (e.g., 30%).
3. Lexical and pantomime abilities, unlike visuo-spatial and memory functions, are predominantly lateralized to the left hemisphere.

These assumptions suggest that even relatively diffuse degeneration (say a 50% deficit) of the horizontal substrate, leaves the left hemisphere with a much smaller horizontal resource (15%) than the right hemisphere (35%). This much smaller residual base may greatly impede the left hemisphere's ability to compensate for lost function. In addition, as mentioned above, some patients may have relatively more degeneration in one hemisphere than the other. Relatively advanced degeneration in the left hemisphere would reduce the residual horizontal base even further. In this way, the notion of controlled processes being localized in the horizontal substrate of cortex (which is unequally distributed between the two hemispheres) gives us a way to understand the parallels observed between aspects of language and non-language impairment.

5.3 CONSTRUCTING A NEUROPSYCHOLOCIAL THEORY OF LANGUAGE

The data and ideas presented thus far can be incorporated into the construction of a realistic neuropsychologcial theory of language. We have shown that a modular theory of language can be supported to a certain extent. That is, syntactic ability constitutes a relatively autonomous system from lexical semantic ability.[28] Further, by investigating the cortical and functional preservations which accompany preservation of syntax, we proposed that syntactic ability is resistant to the cortical degeneration in AD because of its automatic character, which translates into representation in the vertical subsystem of pyramidal columns and bundles in the cerebral cortex. This neurological subsystem is relatively impervious to cell loss, and degenerates after the horizontal subsystem in AD.

On the other hand, I have demonstrated that lexical semantic ability is relatively less modular than syntactic ability since it deteriorates in concert with certain nonlinguistic cognitive systems. This deterioration can be explained by recourse to its lack of automatization, and possible representation in the horizontal substrate of the cortex. This substrate is less resistant to cell loss and degenerates earliest in normal aging and AD. We cannot be sure why lexical and pantomime are so closely parallel. It may be

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[28] Syntactic ability here includes morphology and syntax. In addition, although not discussed in this dissertation, phonological ability remains intact. The preserved language component therefore includes phonology, morphology and syntax, sometimes referred to as the "computational" component of the grammar.

attributed to their mutual dependence on the left hemisphere horizontal substrate, their symbolic nature, or to general severity of overall cognitive and cortical degeneration.

From these conclusions, I propose a theory of language function in which the computational aspects of language (with syntax being the central exemplar) are relatively autonomous. Semantic aspects of language are not modular to the same degree, and are interdependent with many other systems, which include at least other symbolic systems (gesture, representational drawing). In other words, certain aspects of grammar are relatively more modular than others.

5.4 FURTHER QUESTIONS AND FUTURE RESEARCH

This model raises more specific questions than it answers. One related question is how this model of neurolinguistic function relates to theories of language acquisiton. Compatible theories of language development have been proposed (Roeper, 1980; Curtiss, Kempler and Yamada, 1981). Like the present theory, they attribute autonomous (although not automatic) status to the computational component (phonology, morphology, syntax), while specifying that semantic knowledge is crucially more interdependent with other cognitive developments. (Since no specific neurological explanation was proposed in the developmental models, there may be no conflict on that point.)

One major difference between the developmental and adult models must be acknowledged. When syntactic development is described as

"autonomous" it is generally assumed that its autonomy is due to innate, domain specific principles rather than degree of overlearning, as suggested here (Wexler and Culicover, 1980; Curtiss, in press; Hyams, 1983). There is much evidence for some pre-wiring or predispositions for language acquisition. Anatomical asymmetries is one of the more convincing pieces of evidence. The acquisition of complex, abstract syntactic structures on the basis of a paucity of input and corrective feedback is also marshalled as an argument for innateness. However, the truth of these arguments does not preclude in any way the ultimate automatization of those same functions. The innate predisposition, in fact, may lend a helping hand to the process of overlearning. These functions might be somehow overlearned at birth. The distinction between ultimately automatic functions with an innate predisposition and those without may quickly dissolve in development. Both innately overlearned functions like syntax and "learned and overlearned" functions like driving end up with nearly identical cortical representations (i.e., in the vertical substrate). They are then susceptible and resistant to the same types of damage. Considering this, it would appear that a neurolinguistic theory of development and a neurolinguistic theory of maintenance may be fundamentally different in specifying interrelations between language (i.e., syntax) and other cortical functions.

Future research will undoubtedly attempt to relate other language functions to the two focussed on here. We will want to know how, for instance, social, conversational, and presuppositional abilities

interact with syntactic and semantic abilities. Equally important will be fleshing out the nonlinguistic side of the picture with information on the degenerative pattern of both symbolic and nonsymbolic (and left and right hemisphere) functions.

Several more precise questions were posed but not answered in this research. First, discrepancies appear in our data between language comprehension and language production (where more than single words are concerned). This relationship requires closer inspection and comparison with data from development, where it has been found that comprehension and nonlinguistic symbolic abilities pattern together while language production appears relatively independent of both (Kamhi, Catts, Koenig and Lewis, 1984).

Another question which was not satisfactorily addressed by our data relates to the precise nature of the lexical deficit. We have not been able to prove that the deficit is one of faulty representation rather than one of access. Further investigation, perhaps using lexical decision tasks would be helpful. For instance, it has been shown that some aphasic patients preserve normal patterns of response latency to object names and various associates, while other aphasics do not (Goodglass and Baker, 1976). If the semantic disruption were at the representational level in AD, we would predict that their pattern of responses on such a task would differ from normals. Also relevant to the nature of the lexical deficit would be an investigation of response consistency to (a) the same words across time and (b) particular word classes, to determine whether the degeneration is specific to any particular aspects of the lexicon.

Future research should also address the proposed theory of automaticity. Crucial to this theory is the preservation of other, overlearned, possibly nonlinguistic functions such as music in trained musicians. If music contains highly overlearned patterns and less overlearned patterns, then we would predict a dissociation with the overlearned aspects preserved and the less familiar patterns impaired.

5.5 SUMMARY AND CONCLUSION

In this dissertation I have documented how aspects of language fall apart in one syndrome of dementia, Alzheimer's disease. As in other forms of brain damage and cognitive impairment, the resulting behavioral patterns are not random. Certain mental functions are consistently impaired, while others are preserved. Particularly striking is the relative resiliance of expressive syntactic ability in the context of pervasive cognitive and cortical degeneration.

The first section of research compared lexical semantic and syntactic abilities across several tasks in both comprehension and production. The production data clearly suggest that syntactic ability remains intact in Alzheimer's disease, while lexical semantic ability progressively degenerates. These results lead us to speculate that syntactic ability is neuropsychologically modular and resiliant to the type of cortical degeneration seen in AD. A model is discussed in which more automatic functions (e.g., syntax) are represented in the focally organized vertical subsystem of cortical (pyramidal) cells while less automatic functions (e.g., lexical knowledge) are

represented in the more diffuse horizontal substrate of these same cells. Some support for this notion is found in data suggesting that the horizontal substrate degenerates first in normal aging and in AD, while the vertical substrate remains relatively undisturbed.

The second section of research compared language dissolution in AD with degeneration of another symbolic domain -- pantomimic gesture. The results suggested striking parallels between lexical and pantomime errors, in both production and comprhension. These data are used to argue that lexical ability, unlike syntactic ability, is not strictly modular: gesture and lexical abilities may have similar neuropsychological organizations. Both, it is suggested, may be represented in the diffuse horizontal substrate of cortical cells.

The consistent patterns of in(ter)dependence between and among cognitive abilities discussed here move us closer to a realistic neuropsychological description of language. We can now be more confident of the autonomous nature of expressive syntactic ability and the interdepence of lexical semantic with other nonlinguistic functions. Importantly, we must revise current conceptions to language as modular or functional to include degrees of modularity. Certain aspects of language are clearly more modular (i.e., neuropsychologically independent and unique) than others. In this way, the study of how the mind falls apart illuminates how complex mental activities are constructed, represented and executed.

Appendix A

SAMPLE CONVERSATIONS AND NARRATIVES

A.1 CONVERSATIONS WITH ALZHEIMER PATIENTS

The following three conversations with AD subjects comprise part of the data base for the conversational analysis. The examiner is transcribed on the left. The subject is transcribed on the right.

A.1.1 Conversation with Alzheimer Subject 3

First, I want to ask you general questions. Can you tell me something about your family?

My own family?

Your own family.

Oh, Lord.

I'm just interested in talking.

I have some very long king, you know. They came over from europe.

Where abouts in europe?

And they located in the east, in New York for awhile. Stayed there quite some time I think. Of course, I'm so old now I don't know those things that happened there, but they didn't stay there, and uh-

Do you know where they came from in europe?

Uh, let's see now, they could have been in Russia a certain length of time, but whether they stayed there long enough, I don't know. And then they, at that time, you know, they were fighting, so the Jews were getting in trouble at that time. They moved as fast as they could,

and they came, they came to America. And I think it was in New York City they landed.

Uh-huh

Now I really can't give you that as honest-to-God, you know, things, but if you want me to find out, I can do that very easily.

No. I'm more interested in your recollections, in what you remember.

Oh, well, you mean how I felt about it.

And what you remember about it.

They, I do. They did, they landed in eur- in New York City I think it was. Now I'm not- That's the only thing I'm not very sure about. But where could they have landed?

I think New York is a good guess. Most of the immigrants-

That's why I keep saying it all the time, because I think it is.

I think you're probably right.

And they settled in New York for awhile. And they moved out to the suburbs - the very lovely suburbs they have in New York. And uh, from there, they didn't come out here right away, I'm sure about that. I know they didn't come out here, that part of it I'm positivemight come later. They're still not here. Most of 'em aren't back east, still there.

So, were you born in the east, or were you born out here?

Uh-

That's a tough one, huh?

Yeah, I don't know. I never did ask them where I was born, or they never told me. If I want all those statistics, I can get them from you.

Sure.

A.1.2 Conversation with Alzheimer Subject 4

Can you tell me about your family?

My families?

Yeah.

Well, my family's diff- I think I have a very very nice family. They're people that were interested in doing things for one another, for their families, for their children. A great many different things were done.

Who all is in your family? Do you have sisters or brothers or children?

I have a sister, Olivia, she was just recently down in Palo- in here. Just down a little bit more. They had a house that they sold. And she went up to Palo Alto because she didn't want to keep on just with these people that she didn't know in Brentwood very much, and didn't. Still had friends in Palo Alto, so she's actually living there now, in one part or another. She invited me to come up there, and I was up there a little while ago - a few months and stayed there for awhile. But it's interesting.

What about- Do you have children?

Do I have children? Yes, I have some children, but they're pretty well, and my son, I've got a son up, way up north. And a grandson, and various grands-children here- grandchildren.

So you just have the one son?

No, I have some others. There are some.

How many children do you have?

I don't remember. I don't pay any attention to counting it out. But they're interesting and they're nice. I have various relationships with them.

That's nice. Do they come to visit?

They do occasionally. They do come and stay. There's a picture of one of them right here. But it doesn't xxxx. I've put it here. My son. But they're various places. My daughter is in San-

uh, La- -over here. She's uh, working. She teaches in the school. Los Angeles. Goes down to the longest, lowest school in . the city of Los Angeles school system.

Down in South L.A.? Down there? So does she work with alot of black children?

Quite a few black children, but not all black. And she isn't against anybody black. She had a very bad time when she first went there. She went up to the room and she found that there was a girl there who had broken a glass, like something, which it was broken, and she was angry because somebody had said something that she didn't like to her. So she took out this broken glass and started to put, uh, the glass, hit it across her face.

Uh, that's scary.

My daughter, just the first time she'd been in this school.

What did she do?

She simply bolted, she got over by that girl and she knocked her, she took the two herself, and that girl and got down on the floor, and left that other possibility of touching that other girl's face with the broken glass. Couldn't do anything, and the girl who was down the st- a little bit farther away, she said, "I wouldn't be laying on the floor."

A.1.3 Conversation with Alzheimer Subject 7

I just want to get to know you, and find out something about you. Tell me, where are you from?

From here. Right here, from-

Right here - did you grow up here?

Right where you're lookin', here.

Right where I'm lookin'?

Sure.

Were you born here, and you grew up here?

No, I wasn't born here, but I was born further up.

Where abouts?

All the way across the country.

Oh yeah?

Why sure.

Wow. Do you remember the name of the place?

I do, but - sure, all the big, uh, all the big joints up there on the, uh, on the hilltops.

Oh, that was in the mountains?

Sure, I got two, uh, two, two boys of mine there.

You have kids?

Huh?

Your children?

My friend's, uh, son.

You have sons?

Yeah, one of 'em.

One son?

One son, yeah.

Uh huh.

I can't think xxxx they've got maybe more of 'em.

OK.

They did all kinds of work.

Tell me, speaking of work, what kind of work did you do?

did I do?

Yeah. You're retired-

floor countryflo- floor- floor- uh, any kind of whatchacallit- floorwork, and-

Floor work? Law work?

Aw, hell, I did all that by hand (pointing to walls and floor). All of it. Every bit of it.

So you were a professional? It looks great.

I'd have to be a professional. Y' squeeze the juice in there and it better stay there for years. Anybody tries to ge- breaks it up, why, you, you tell me about it. If they did any damage, why, uh, I'll clobber their heads. I will.

I bet you will.

I'll put 'em to place. It's the only way you can do it. I got some properties up here.

Oh yeah? some other houses?

huh?

You have other houses?

Several of 'em!

Oh yeah? Right around here?

Well, up to the top of the hill, and then you can go around under the mountain, you know.

Hmmm. Do you rent them out? Does somebody live there?

Well, yeah. We uh, we got some of it, uh, is, used over there, and others are uh, being, uh, being, uh, put into place. If you buy it, and tell 'em what you want, and I've got about six, seven acres out in there.

Wow. Get back to what you, what you did. You did wall work, and you did floor work?

I did all of that. Yeah, all by hand.

Did you work with other people?

I did it all by myself!

What about when you did it in other people's houses?

The same thing.

Did you work with other people, or you worked by yourself?

I worked by myself.

Bt yourself?

I do it by myself, if I want to, or I can get somebody to help, you know, push it along.

So you were your own boss.

That's right.

That's good. It's a good place - a good situation to be in.

Well, there ain't, there ain't anybody than can put the stuff together as good as I can. At least I don't see of 'em!

It looks perfect to me. Much better job than I could do!

This (pointing to linoleum floor) went all the way around there, and tied up over there in the corner, on the inside there. Shut off over here, and this is all, uh, handled by, uh, by the whatchacallit, but what's that-

So you put the rug in too?

Everything, yeah.

You did the rug too?!

Everything.

Tell me, what kind of family do you come from? A big family?

I'm a Hungarian!

A.2 ALZHEIMER NARRATIVE DESCRIPTIONS

Each subject was asked to describe the Cookie Theft Picture from the Boston Diagnostic Aphasia Exam (Goodglass and Kaplan, 1972). The picture is shown (reduced in size) in Figure 9. Three AD and three control descriptions of this picture are presented here.

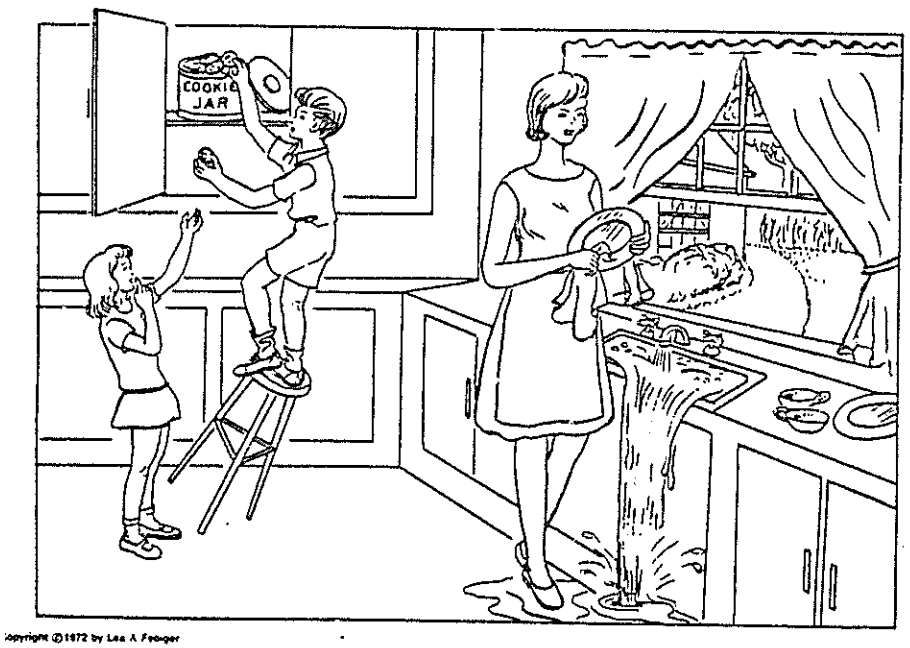

Figure 9: The Cookie Theft Picture

A.2.1 Narrative of Alzheimer Subject 3

Examiner: I want you just to tell me what's going on in the picture.

AD3: Momma's washing dishes and children are taking jam or jelly or something from the jar, and the little fella's about ready to fall on the floor. And momma's washing dishes.

Examiner: Good. Anything else?

AD3: Well, the overflow of the water.

Examiner: That's right. What about that?

AD3: That's the overrun of, I said, of the dishwater on the floor.

Examiner: Why do you think that's happening?

AD3: You can see her mouth is open and she is talking, and not paying any attention. That's about all I can think of. Or somebody's doing, one of the children are about to climb, or something like these one, these ones. My teacher should be here and they'd throw me out the door.

Examiner: Oh, you're doing a good job. What about here?

AD3: The little one? She's asking her mother for a cookie. It's very easy. They're very, uh, well done, you know, by a single, uh, jar, no, I mean, single pencil, whatever they're using.

Examiner: Great.

A.2.2 Narrative of Alzheimer Subject 4

Examiner: Tell me what's going on here. Will you just describe that for me?

AD4: Well, this is a mother that Emily -and she's seeing that things are all run- getting in nice condition. She has two children here but she isn't paying much attention to this boy that's nearly falling over. But otherwise, she seems to be allright. Things are going along. I would not want to have this because it's running out and going down onto the floor and I don't know -ought- it's not a very desireable set-up there. Too much -- now this isn't -- this is awful.

Examiner: What's going on over here?

AD4: Over here. Well, this boy thinks he can get up and do this but he should't be doing that because I don't think he knows how to take care of his things down here. It's just that -- the way things are built. What do you think?

Examiner: I think you're right. What about that?

AD4: Well, that's a younger child, a little girl. And I think that she's not so terribly bright, or so terribly grown big, or anything, but I think she's sharper in a way than the boy.

Examiner: Why do you think that?

AD4: Because she's well, she's keeping herself away from all the things that are going to be endan- this boy's gonna have trouble. Don't you think so?

Examiner: I do. I think you're absolutely right.

AD4: And this mother doesn't seem -- she's young. She's a young married woman, and doesn't know quite what she's doing. And she's trying to do the best she can. And it isn't being entirely successful, I would say.

Examiner: No, it certainly isn't. Why don't you think it is? I mean why do you think that's happening?

AD4: Well, I think they're young people, and don't really know quite what they're all going after and they're trying to do the best they can. And they're nice to one another, which is pleasant. And that is probably the most important part. And it'll work out better and they'll all, I think they'll pull together and go along. What do you think? Examiner: I pretty much agree with you.

A.2.3 Narrative of Alzheimer Subject 8

Examiner: I want you just to describe what's going on in this picture. Tell me what's going on here.

AD8: This picture incorporates a certain amount of going and coming, and coming and going, and cheating, and doing the things in the world that....planning some for uh money on the floor, not worrying about it. Falling over onto the ground.

Examiner: Speak a little louder.

AD8: Oh that he has the ability to- she has the ability to change the timing and then and then the wind is blowing in the wind, blowing in the floor. Wind is blowing on the canned goods.

Examiner: The wind is blowing on the canned goods?

AD8: Yeah. Splattering.

Examiner: What's she doing?

AD8: She is not only losing, doings, washing her pay- plate there, but also being careful of the child, apparently because he has a tendency to be falling this, slipping. And then there's a child slipping again or more normally.

Examiner: more normally?

AD8: Yeah. Politically well-known.

Examiner: Politically well-known. What's going on over here?

AD8: Well, it seems to be that they're trying to, filling up and ideal of it inside there...things that we eat...play with and maybe get hurt. Candy or something.

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