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LEXICAL SEMANTICS AND ALZHEIMER'S DISEASE

by

Lynne Wilson Clark

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

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Abstract

LEXICAL SEMANTICS AND ALZHEIMER'S DISEASE

by

Lynne Wilson Clark

Advisor: Professor Edgar Zurif

Individuals with Alzheimer's disease suffer from a clinical naming impairment. However, very little is known about the actual form their naming impairment takes, the processing deficits that underlie their naming difficulty or what the relationship of their naming impairment is to their other known cognitive and neuropathological changes. Moreover, the healthy elderly population also exhibit changes in naming. Thus it remains unresolved as to whether the naming impairment in Alzheimer's disease is related to the normal aging changes.

To investigate these issues in both the Alzheimer's disease and healthy elderly populations, specific clinical, laboratory, experimental and correlational measures were designed and implemented. The clinical and laboratory tasks measured language, (i.e., Boston Diagnostic Aphasia Exam and Boston Naming Test), cognitive (i.e., Orientation, Memory Concentration Test) and neuroradiological/electrical functions (i.e., CAT, EEG).

Four experimental tasks systematically, assessed the ability to deal with various facets of a word's meaning: (1) a nonverbal perceptual triad object comparison sorting task (i.e., Similarity of Judgment) assessed the ability to integrate, semantically relevant perceptual information that embodies a concept; (2) a word-object labeling task (i.e., Labeling) assessed how the ability to integrate relevant perceptual and functional information that embodies an object related to object name recognition ability; (3. & 4.) a speeded category classification (i.e., Categorization) and speeded real word - nonword decision (i.e., Lexical Decision) tasks assessed the ability to trace meaning relations among words when automatic and conscious lexical decisons were required.

Conceptual problems were clearly evidenced by the Alzheimer's subjects' impaired performances on the measures of clinical vocabulary usage and cognitive function, neuropathological changes and the Similarity of Judgment Task. The strong interrelations that existed among these measures revealed that the naming impairment in Alzheimer's Disease could not be divorced from their larger conceptually based problems.

In contrast to the Alzheimer's subjects, the healthy elderly subjects who demonstrated subtle clinical changes in verbal vocabulary usage, performed more like young normal adults on the Similarity and Labeling Tasks. However as seen by their impaired performances on the Lexical Decision and Categorization Tasks, their lexical semantic knowledge was not well structured for its full use in tracing meaning relations among words.

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To the exceptional faculty of The Speech and Hearing Department particularily, Helen Cairns, Irving Hochberg, Maraget Lahey and Harry Levitt, I wish to express my sincere thanks for without their special knowledge and guidance, this doctoral degree would not be possible.

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LEXICAL SEMANTICS AND ALZHEIMER'S DISEASE

I. PROBLEM

The cognitive underpinnings of the capacity to understand and produce words are highly complex, involving considerably more than a series of one-to-one associations between words and objects. Lexical concepts are characterized by locating them in some body of general organized knowledge and beliefs in which they are related to other concepts. This body of knowledge is composed of a set of perceptual, functional and other abstract features that are used jointly to define the members of the category that can be labeled by the word (Miller and Johnson-Laird, 1976). Although some progress has been made in developing theories that describe how this lexical semantic knowlege might be organized, there is no one theory that adequately accounts for all the word-word, word-object and word-concept relations involved in lexical meaning. Moreover, there is no detailed account of how we actually utilize this lexical knowledge for the naming of objects or the identification of objects from their names.

One possible way to approach these issues has been to study how brain damage in adult populations selectively impairs the discrete phonological, syntactic and semantic components of language (Caramazza and Berndt, 1978). An approach such as this allows for an identification of the linguistic and non-linguistic processes that are highly integrated and thus difficult to separate in normal adults.

Specifically, in order to study the complicated basis for vocabulary skills, investigators have examined how naming goes awry in aphasic[1] patients - patients who have obvious language impairments and not other cognitive impairments. A somewhat different approach, taken here, is to seek a neurologically impaired adult population in which both language and cognitive functions are impaired. In this way the extent to which cognitive changes impinge on vocabulary usage can be investigated. Such is the case with the population with Alzheimer's disease.[2] These individuals have progressive impairments both in naming and other cognitive functions. For Alzheimer's disease, it has yet to be determined whether the naming impairments are due to specific linguistic changes or whether they are part of a more generalized conceptual loss which results because of declines in other cognitive areas. Another population of interest is the healthy elderly[3] who also display subtle

[1]Aphasia refers to the disturbance of any or all of the skills, associations and habits of spoken or written language, produced by injury to certain brain areas which are specialized for these functions (Goodglass and Kaplan, 1972). The problem is not one of intelligence, but of communication. Patients remain mentally alert, even though their language ability is impaired (National Institutes of Health, 1979).

[2]Alzheimer's disease - dementia: is a progressive condition attributed to senile brain disease (i.e., cortical cell loss and chemical changes) resulting in a progressive intellectual impairment and behavioral changes. The artificial difference between Alzheimer's disease - presenile dementia and Alzheimer's disease senile dementia is based on age of onset, presenile being age 40 to 65 and senile being age 65 years or older (National Institutes of Health, 1981).

[3]Healthy elderly: consist of individuals, age 65 years and older who are mentally alert, physically healthy and still active in the community.

naming and other cognitive changes. Thus, it is not known whether the naming impairment in Alzheimer's disease population is due in part to normal age related cognitive and neurophysiological/anatomical changes known to the healthy elderly population or whether the naming impairment is a direct behavioral consequence of the underlying disease processes identified with Alzheimer's disease. The body of literature on the cognitive and neurophysiological/anatomical changes in both the healthy elderly and Alzheimer's disease populations is sparse and inconclusive on all these issues.

II. BACKGROUND INFORMATION:

The first part of this section reviews what is known of the cognitive and neurophysiological/anatomical changes occurring in both the healthy elderly and Alzheimer's-disease senile populations. This is followed by a brief description of the currently available models of normal lexical semantics. The last part of this section reviews recent initial efforts to apply notions of normal lexical semantics to the study of defective naming in adult neurologically impaired populations.

II.A. Cognitive and Neurophysiological/Anatomical Changes:

Collectively, the body of literature on the cognitive and neurophysiological/anatomical changes occurring in both the healthy elderly and Alzheimer disease-senile populations fails to provide sufficient information as to how the naming changes in these two elderly populations are related to other cognitive and underlying cortical changes.

Cognitively, both the healthy elderly and Alzheimer disease-senile demented populations exhibit the following changes (the healthy elderly to a lesser degree than Alzheimer's disease patients): 1) a slow rate of processing information (Rabbit and Birren, 1967; Cunningham, 1979; Cohen, 1979) 2) a loss of abstraction, creativity and flexibility (Eisdorfer, 1969); 3) difficulty changing sets and assimilating new material (Albert, 1978; Kaplan, 1980); 4) attentional deficits (Cunningham, 1979); 5) memory deficits (Craik, 1977; Fuld and Katzman, 1979). In addition, Alzheimer disease patients display poor judgment and temporospatial disorientation as well as deficits in vocabulary usage, skilled motor movements (i.e., apraxia) and visual sensory interpretation (i.e., visual agnosia). With the exception of their subtle changes in vocabulary usage, the healthy elderly fail to demonstrate these latter types of "cortical association area" deficits (Botwinick, 1978).

Findings from neurophysiological/anatomical studies have revealed cortical cell loss and chemical brain changes occurring in patients with Alzheimer's disease and the healthy elderly (Brody, 1955, 1976; Constantinidis, Richard and de Ajuriaguerra, 1978; Gustafson, Hagberg and Inguar, 1979; Hachinski, 1976; Buell and Coleman, 1979). It is not totally clear, however, what relationship these changes have to the cognitive changes (including language) observed in both populations. To date, only a few studies (de Leon et al, 1981; Katzman et al, 1981) have shown that a correlation exists between clinical dementia scores, neuroanatomical brain changes on CAT scans and the number of senile plaques[4] upon autopsy in the brains of Alzheimer's patients.

Specifically, both with the healthy elderly (to a lesser extent) and Alzheimer disease populations, as brain weight decreases with cortical atrophy, an increase in the

[4]Senile plaques: are groups of nerve endings that degenerate and hence disrupt the passage of electrochemical activity between cells.

number of senile plaques and neurofibrillary tangles[5] is observed (Newman and Cohen, 1953; Brody, 1976; Terry, 1978; Constantinidis, 1978). The cause of these microscopic lesions remains unknown. Various candidate causes have been proposed: drug/aluminum toxicity (Crapper, Krishman and Dalton, 1980); nutritional deficiencies (Kolata, 1981); a slow latent virus (Terry, 1978); genetic factors (Terry, 1978).

Of importance to this present study is the fact that for both the healthy elderly and Alzheimer's disease populations, cell loss initially involves select cortical areas. EEG (Obrist, 1954), post-mortem (Brody, 1976; Constantinidis, Richard, de Ajuriaguerra, 1978; Buell and Coleman, 1979) and regional blow flow (Gustafson, Hagberg and Inguar, 1979) studies have revealed that the mid-frontal and superior temporal areas of both hemispheres (involving more of the left hemisphere) are initially affected for both populations. Although less conclusive, CAT scan studies (de Leon, 1981) have revealed the parietal and mid-frontal areas as being involved. These findings are of interest since we know that the left parietal area and more importantly the left temporal area, play important roles in the recognition and naming of lexical items (Goodglass, 1973).

[5]Neurofibrillary tangles: are changes that occur in the protein of the nerve cells in the outer layer of the cortex that lead to an accumulation of abnormal fibers appearing as tangles.

Others have investigated the chemical brain changes occurring with the elderly (Coyle, 1982; Drachman, 1978; Kolata, 1981). Many neurotransmitters and their related enzymes are diminished to a varying degree in both Alzheimer's disease and the healthy elderly populations (the healthy elderly to a lesser extent than Alzheimer's disease). In Alzheimer's disease, the greatest reduction in neurotransmitter markers occurs in the cholinergic system where investigators have measured a 90% decrease in the synthetic enzyme for acetylcholine in cortex as compared to age matched controls (Davies and Maloney, 1976). Although the precise origin of these acetylcholine containing neurons in the cortex remains unclear, the results of a recent study (Coyle, 1982) suggest that a profound loss of the neuronal cell bodies in the nucleus basalis occurs in Alzheimer's disease patients and results in loss of cholinergic innervation to the cortex.

In summary, the findings from cognitive and physiological studies fail to resolve the question of whether the naming changes in the healthy elderly and Alzheimer's disease senile populations are secondary to declines in other cognitive areas or whether they are "linguistically encapsulated".

II.B. Semantic Lexicon: Normal and Pathological Literature:

The normal and pathological literature dealing with various aspects of lexical semantics fails to provide a clear understanding of the relationship between language and cognitive activity. Although the linguistic and psycholinguistic literature has presented several relevant theories which attempt to describe the structure of the normal lexicon, no one theory is complete enough to adequately account for all the word-word, word-object and word-concept relations involved in lexical meaning. Recently, theorists involved in information processing research have focused on how we gain access to lexical information. Collectively, theories of the normal organization and access processing of semantic-lexical information fail to account for how we actually utilize this information for object naming and recognition. However, some gains into the normal processes involved in object naming and recognition of objects by their names has been made from the application of these normal lexical semantic theories to the study of naming and lexical comprehension in adult populations with neuropathology. Thus, the following offers first, a brief account of the relevant theories of normal lexical semantics, and second, the application of these lexical theories to the study of defective naming in various adult neurologically impaired populations.

II.B. 1) Theories of the Normal Semantic Lexicon:

Several theories have been proposed to describe the system of lexical relations in which individual words and their meanings are embedded. One conventional way theorists handle word meaning is by semantic networks, the other is by semantic features. Configurational theorists (Collins and Quillan, 1969, 1970; Meyer and Schvaneveldt, 1971; Collins and Loftus, 1975) propose that semantically related words are connected to each other in lexical memory by associational networks of nodes.

Reductionist theorists (Katz and Fodor, 1963) treat word meanings as being represented by an internally stored set of abstract semantic markers/features which serve to distinguish the meaning of a word from the meaning of other words. These markers decompose the meaning of a word into abstract concepts/properties that it expresses. An important theoretical difference between semantic feature and network theories is how each accounts for the underlying causes of semantic facilitation effects as demonstrated on lexical decision tasks.[6] Configurational theorists

[6] A lexical decision task is one in which subjects are required to determine whether a letter string is a real word or not. Reaction times are measured from the offset of stimulus presentation of the target word to the onset of the subject's response. Semantic facilitation (Meyer and Schvaneveldt, 1971) effects are demonstrated by reduced reaction times when a semantically related word (e.g., doctor) as opposed to a semantically unrelated word (e.g., bread) or nonword, is presented prior to a target word (e.g., nurse).

propose that this effect is reflective of a retrieval process whereas feature theorists view it as reflective of comparison process (Glass and Holyoak, 1974). Configurational theorists propose that semantically related words are faster to retrieve from the lexicon than semantically unrelated words since these former words are closer together in the associational network. Feature theorists contend that semantically related words contain more features in common with one another than do semantically unrelated words. Thus they propose that lexical entries are faster to compare when semantically related words are present.

A somewhat different approach from that of configurational and feature theories is to describe the organization of the lexicon within an exemplar or prototypical model. Rosch (1973) proposes that semantic categories are organized around prototypical instances of a category with other instances related through a series of family resemblances to the most typical instance. How these prototypes might be represented in memory remains problematic. On the one hand, some theorists propose that these prototype instances might be stored in the form of images (Rosch, 1973). Thus all instances of a category are to be judged in terms of their perceptual and functional deviations from the prototype instance. On the other hand, other investigators (Medin and Schaffer, 1978) more in line with feature theorists, propose that the prototype might be represented as a list of all the perceptual and functional features that satisfy a category. In this way, an instance could be compared with a feature list.

Regardless of the adequacy of an examplar model, prototypicality appears to be an important aspect of the organization of semantic categories. It is an empirical fact that young adults verify prototypical members of a category more quickly than less typical members, demonstrating that not all members of a category are equally good members (Rosch, 1973).

Of more relevance to this study, however, are theories concerned with specifying more precisely the procedures used to recognize and name objects. In discussing how the referential aspects of a word's meaning are treated within a conceptual theory, Miller (1978) assumes that associated with each nominal concept that can be used to refer to a concrete object, there is a functional and physical perceptual procedure used to recognize and name instances of the concept. These procedures, of course, can be elaborated along feature theoretical lines. Thus, lexical concepts are characterized by locating them in some body of general organized knowledge and beliefs in which they are related to other concepts -- this body of knowledge being itself, described as a set of perceptual, functional and other abstract features. The concrete object takes its meaning from the place its concept occupies in this general conceptual system. The word and the percept of the object provides two routes for gaining access to this conceptual location.

Consistent with Miller's view, Labov (1973) demonstrated the importance of integrating perceptual and functional information in object naming. He also demonstrated the fact that boundaries for conceptual categories are vague rather than discrete. By manipulating perceptual features such as height, width, shape and number of handles he was able to create various line drawings of food containers (i.e., cup, mug or bowl). Here he found that prototypical objects (e.g., clear instances of the concept) were consistently named whereas borderline or vague objects were inconsistently named. In addition, when subjects were asked to imagine a depicted element being poured into a container, subjects were able to consistently name those objects that had been previously shown to have vague or "fuzzy" perceptual boundaries. Thus, Labov was able to demonstrate the importance of integrating perceptual and functional information in the act of naming.

As just discussed, although some progress has been made in developing theories that describe how normal lexical semantic information might be organized, these theories fail to account for how we actually utilize this information for object naming and recognition of objects from their names. Thus, through the application of these normal lexical semantic structural theories to the study of defective naming in adult neurologically impaired populations, Caramazza, Brownwell and Berndt, (1982) have developed a five-stage model of object naming. In their model, they have attempted to specify more precisely how functional and perceptual information in the semantic lexicon is used in object naming and recognition (p. 166, 1982):

1. Low-level perceptual analysis which restricts the initial search for an internal description of the presented object.
2. A parser uses semantic level information to produce "semantically interpreted" components that serve as inputs to a classification algorithm; the semantically interpreted components are modality specific.
3. The classification algorithm assigns category membership by determining whether an object has the critical values that define a category; the category is represented in a modality - independent format.
4. The selected category maps onto a particular lexical item that specifies phonological and syntactical information.
5. Execution of the phonological information specified for the selected lexical item.

These authors propose that a reverse sequence of processes take place for object recognition.

Caramazza et al's model is not strictly a bottom up model. Rather Stage 1 and Stage 2 interact where the perceptual parsing of an object is guided by semantic considerations so that the output of the perceptual parser consists of modality specific semantically interpreted features.

Recently, lexical access theories have provided us with a different means for viewing the lexicon. Theorists of information processing have been more concerned with how we gain access to lexical semantic knowledge rather than with how this knowledge is structured (Posner and Snyder, 1975; Neely, 1977; Shiffrin and Schneider, 1977). Although normal lexical access theories make a distinction between the automatic and conscious use of semantic information for lexical access, such theories fail to account for how these processes are actually involved in object naming and recognition of objects from their names. Posner and Snyder (1975) propose a theory of attention, where retrieval from long term memory is governed by the operation of processes at two distinct levels. The first is an automatic activating process that is rapidly developing, and is initiated by a stimulus without the subject's intention or awareness. The second is a conscious-intentional process that is slow, limited in processing capacity and requires processes that do interfere with other activities. These theories further specify that automatic processing plays a dominant role in the retrieval of overlearned associations and the retrieval of information from well-established memory structures. The conscious processor plays a dominant role in the retrieval of less well-learned information.

II.B. 2) Application of Lexical Theories to Naming Impairments in Neurologically Impaired Adult Populations

By applying these theories of the normal lexicon to the study of defective naming in neurologically impaired populations, we may be able to develop a model which accounts for how lexical knowledge is actually stored and utilized for object naming and recognition. Recently, those theories dealing with the semantic structure of the lexicon and how we access this information have been applied to the study of naming impairments in aphasia and less successfully applied to the naming impairments in Alzheimer's disease.

There is a general consensus that individuals with Alzheimer's disease exhibit a naming impairment which occurs early and is catastrophic (Stengal, 1964; Critchley, 1964; Rochford, 1971; Irigaray, 1975; Schwartz, Marin and Saffran, 1979; Clark, 1981). However, the underlying cause of the naming impairment remains undetermined.

Clinically, the fact that the naming errors are primarily comprised of semantic paraphasic errors provides indirect support for the view that a semantic impairment may be at the root of the naming impairment in Alzheimer's disease (Clark, 1981). Also, the fact that these individuals benefit from semantic cueing during the initial stages may imply that the structure of their lexicon is disorganized and not radically diminished. That is, individuals may not be able to select the correct word on their own because the structure of semantic information in their lexicon is disrupted. On the other hand, the presence of a semantically related word may in fact aid them enough in organizing lexical - semantic information for their vocabulary use. However, the fact that they fail to benefit from cueing at later stages may mean that their semantic knowledge becomes reduced (Clark, 1981). Additionally, given the severity of the naming impairment in Alzheimer's disease, the automatic and conscious aspects of the implementation of lexical semantic knowledge may also be affected by severe lexical - semantic structural problems.

The healthy elderly also exhibit naming changes but these are of a subtle nature. It is not known whether their naming changes are similar in nature to those seen in Alzheimer's disease. Thus, it remains unresolved whether the naming impairment in Alzheimer's disease is due in part to aggravated but normal age related cognitive and neuro-physiological/anatomical changes known to the healthy elderly population, or whether the naming impairment, apart from these changes of the healthy elderly, is a direct behavioral consequence of the underlying process that occurs in Alzheimer's disease.

Now let us consider the naming impairment in more detail in Alzheimer's disease. Clark (1981) in documenting the language impairments which occur at the various stages of Alzheimer's disease, found that the naming errors primarily consisted of semantic paraphasic errors at all stages of Alzheimer's disease. However, the quality of these semantic paraphasic errors changed over time. At the initial stages of the disease, semantic paraphasic errors involved closely related items from the same semantic class; at moderate stages, these errors involved out-of-class items but from closely related semantic classes; at the final stages, these errors involved unrelated items and/or use of vague generic terms. In addition to the semantic paraphasic errors and with less frequency, Clark observed the use of specific circumlocutory phrases at the initial stages; object misrecognition naming errors and use of nonspecific circumlocutory phrases at the moderate stages; neologistic and semantic jargon, echolalia and even mutism at the final stages. Literal paraphasic errors were rarely displayed and occurred with equal frequency at each of the various stages. At initial stages, mainly nouns of a low frequency of occurrence were affected. However, at moderate and severe stages nouns and main verbs of both low and high frequency were affected.

On a confrontation naming task, Clark (1981) observed that whereas individuals fully benefited from semantic cueing in the initial stages and only partially benefited from it in the moderate stages, they fail to benefit at all from semantic cueing in the final stages. Additionally, their performance in confrontation naming both quantitatively and qualitatively paralleled their performance on word recognition tasks.

Even less is known about the naming changes in the healthy elderly. Data from conversational speech samples and confrontation naming reveal that the healthy elderly make types of naming errors similar to those seen in individuals in the early stages of Alzheimer's disease (Goodglass, 1978; Clark, 1981; Obler and Albert, 1982). Semantic paraphasic errors and to a lesser extent, object-misrecognition naming errors occur most frequently. Of less frequency, elaborate and evaluative naming responses as well as use of highly specific circumlocutory phrases are observed. Literal paraphasic errors are rarely displayed.

Only one experimental study has been carried out implicating a possible disruption in the structure of the lexicon with Alzheimer's disease (Schwartz, Marin and Saffran, 1979). While the data are intriguing, we must keep in mind that this was a case study of only one moderately demented individual. On experimental tasks, the subject demonstrated loss of referential specifity in the face of preservation of more general aspects of semantic meaning, including superordinate class membership. On an object/picture to word matching task utilizing various types of word distractors, the subject consistently overextended verbal labels for closely associated semantic words (e.g. fork/spoon). On a second experimental task, the subject was required to sort animal pictures into three animal categories (i.e. dog, cat, bird) when provided with a sample picture of each of these categories. On this nonverbal task, the subject overextended the category of "cat" to include "dog" items as well. It should be pointed out that by the very nature of this latter task, Schwartz et al's subject may not have treated the sample picture items as depicting superordinate category items. Rather their subject may have treated these items as base level objects for comparison, using the bird item as a default item.

From the results of their investigation, Schwartz and her co-workers (1979) suggested that a conceptual breakdown is at the basis of their subject's lexical loss. Moreover, this lexical loss in Alzheimer's disease involves the concrete referential aspects of a word's meaning and not the more abstract interlexical aspects of a word's meaning. Specifically, Schwartz et al propose that there is a loss of the more distinguishing semantic features which must be perceptually parsed and fully integrated to signal the referential aspects of a word's meaning. Given the questionable nature of Schwartz et al's categorization task, it is difficult to agree with their reasoning. Rather, one might expect both conceptually based problems with words that make reference to an object and also problems in the ability to trace meaning relations among words. Both facets of a word's meaning might be related to a common underlying conceptual, deficit. We might be able to resolve this issue, as the present study attempts to do, by designing tasks that assess how a conceptual breakdown might affect both the referential and interlexical aspects of a word's meaning in Alzheimer's disease.

Other evidence to support the view of a semantic impairment being at the root of the naming impairment in Alzheimer's disease comes from recent application of normal lexical-semantic theories to the study of defective naming in aphasia. Collectively, studies of lexical comprehension in aphasia have shown that posterior aphasics[7] (i.e., Wernicke's and anomic) display severe difficulty carrying out lexical semantic analysis. In addition, the studies show a close link existing between posterior aphasics' naming and lexical comprehension impairments when the semantic component of the lexicon is disrupted.

[7]Posterior Aphasia (Wernicke's and Anomia): These individuals suffer from focal lesions of the left hemisphere, posterior to the Rolandic fissure. More specifically, Wernicke's aphasics suffer from lesions of the left temporal area and Anomic Aphasics more commonly suffer from leisons of the left parietal area. Clinically, Wernicke's aphasics speak fluently and prosodically but suffer from word finding difficulties, so that their speech is empty of informational content. Their comprehension is moderate to severely impaired. Anomic Aphasics speak fluently but display extreme word finding difficulties, particularly on confrontation naming tasks. Their comprehension is relatively intact. Word finding difficulties for both Wernicke's and Anomic Aphasics are primarily characterized by substitution of semantically related words for the intended word (Goodglass and Kaplan, 1972).

On sorting tasks (Zurif, Caramazza, Meyerson and Galvin, 1974; Lhermitte, Derouesne and Lecours, 1971), posterior aphasics demonstrated disorganization of hierarchial structures for lexical items. On speed categorization (Grober, Perecman, Kellar and Brown, 1980) and free word association tasks (Grossman, 1978), posterior aphasics exhibited disruptions in the semantic organization of superordinate categories. Moreover, Grober et al. and Grossman showed that posterior aphasics were not as sensitive as normals to the notion of typicality (Rosch, 1973). Goodglass and Baker (1976) assessed the ability of aphasics with "good" and "poor" comprehension to recognize words associated with a pictured object. Their aphasics with poor comprehension (presumably posterior aphasics) failed to recognize functional associates and functional contexts for those objects they could not name. Of more relevance to this present study, are the results of a study by Caramazza, Berndt and Bronwell (1981) which provide evidence for a close link between the semantic structure of words and visual - perceptual and categorical processes. On a similarity of judgment task, Caramazza et al's posterior-anomic aphasic patients failed to integrate two dimensions of perceptual variations (i.e., width and handle/no handle) in judging perceptual similarity of object-container items. Additionally, on an object classification task, their posterior aphasic patients failed to integrate these perceptual features with functional context information (i.e., cereal being poured) in correctly labeling the object-container items as either "cups" or "bowls".

Although most studies of lexical comprehension in posterior aphasia implicate a disruption in the semantic structure of the lexicon, the results of a recent study by Milberg and Blumstein (1981) showed that Posterior Aphasics have difficulty accessing lexical semantic information for the purpose of a conscious but not an automatic decision concerning a word's meaning. On a lexical decision task, their posterior aphasics demonstrated semantic priming effects where nonword-word decisions were faster when preceded by semantically related as opposed to semantically unrelated and nonword primes. However, on their second task, a semantic judgment task, their aphasics were significantly impaired in making judgments as to whether pairs of semantically associated and unassociated words were related. It remains, unclear however, from the results of Milberg and Blumstein's study whether this disruption in the volitional access of lexical semantic information arises from a slight structural dislocation of lexical semantic information. That is, the structure of their lexical semantic information may be sufficient for automatic but not for conscious accessing of semantic information for their linguistic use and interpretation.

As just reviewed, one way to study the complicated basis for vocabulary skills has been to examine how naming goes awry in aphasic patients - patients who have obvious language impairments and not other cognitive impairments. A somewhat different approach, taken here, is to seek a neurologically impaired adult population in which both language and cognitive functions are impaired. In this way, the extent to which cognitive changes impinge on vocabulary usage can be investigated. Such is the case for Alzheimer's disease. Therefore the present study is designed to investigate whether the naming impairment in Alzheimer's disease is due to specific linguistic changes or whether it is part of a more generalized conceptual loss which results because of declines in other cognitive areas.

III. METHODOLOGY AND RESULTS:

A. Subjects:

All subjects were sought on a volunteer basis. Individuals were excluded from the study if they showed uncooperative behavior, less than a 5th grade education, poor visual and/or auditory acuity to the degree that it would affect testing procedures, extremely poor physical health or acquired English as a second language after five years of age. Further, any subjects with a previous history of: alcoholism or drug intoxification, metabolic disorders, psychoses, mental retardation, speech or language disorders, neurological disease or brain injury, were excluded from the study.

Subjects were classified into two major groups. Group I (SDAT) subjects consisted of eleven elderly individuals with a clinical diagnosis of Senile Dementia of the Alzheimer's type. There were five male and six female SDAT subjects who were selected from outpatient geriatric health centers. These individuals ranged in age from 63 to 84 years old, with a mean age of 71.3 years (Appendix: Exhibit I). Since a definitive medical diagnosis of Alzheimer's disease can only be established upon autopsy, a clinical diagnosis is arrived at through a thorough medical and behavioral workup which is designed to rule out the presence of other types of dementia such as those associated with vascular disease, nutritional deficiencies, drug intoxification or specific neurological disease.

A complete workup of Group I subjects consisted of compiling detailed family and psychosocial histories, physical and neurological exams (including mental status testing, EEG, CAT and occasionally lumbar puncture testing), a psychiatric exam (including psychometric testing), laboratory tests (including blood count and blood chemistry workups, vitamin B-12 level, folate levels, thyroid studies and VDRL tests). In addition to these diagnostic criteria for selecting SDAT subjects, only those individuals in the mild to moderate stages of the dementing process (as determined by the medical and behavioral workup) were sought. At the actual time this study was being conducted, the range for the clinical onset of Alzheimer's Disease for the SDAT subjects varied from 13 to 36 months, with a mean of 34.7 months (Appendix: Exhibit I). This onset was determined by careful questioning of subjects' relatives as to when they first noticed overt classsical symptoms of the disease. Additionally, it reportedly took relatives an average of 12 to 24 months before they sought a complete medical workup for their relative to determine a clinical diagnosis of SDAT (Appendix: Exhibit I).

Group II (HE) subjects consisted of nine elderly individuals, ranging in age from 63 to 84 years old with a mean age of 71.3 years, who were still alert, healthy, active in the community and who presented with no obvious clinical neurological involvement. These six male and three female HE subjects were sought from outpatient health clinics and/or senior citizen centers. My initial healthy elderly subject selection, as based on their functional level in the environment, erroneously included two other subjects. These two subjects were excluded from my analyses of the data since they failed to behave on clinical tasks as normal healthy elderly control subjects (Appendix: Exhibit I).

Subjects from Group II were matched with Group I subjects according to age level (i.e., 60-64 years; 65-69 years; 70-74 years; 75+ years) and prior occupational status. With regards to prior occupational status, 65% of both the HE and SDAT subjects fell into high (i.e., 4 - professional/executive) and middle (i.e., 3 - middle management/clerical) occupational levels as compared to lower occupational levels (i.e., 2 - unskilled/skilled manual labor, 1 - housewife). Although educational level was only grossly controlled for, interestingly, a majority of both the HE and SDAT subjects fell into High (i.e., 13+ years) and middle (i.e., 9 - 12 years) educational levels (100%; 82% respectively). For more specific demographic data, refer to Exhibit I in the Appendix.

All clinical measurements and experimental tasks were administered separately to each subject.

B. General Procedure

Once the appropriate individuals were selected, they were then seen informally to: 1) explain the general purpose of the study; 2) explain what was expected; 3) establish rapport. Before any testing began, individuals who agreed to participate in the study were required to sign a Consent Form (Appendix: Exhibit II). In those instances where an individual had been declared incompetent, a legal guardian signed the form.

C. Clinical and Laboratory Assessment Tests:

This section is comprised of two parts: separate descriptions of the methodology for each of the clinical and laboratory assessment tests followed by a collective summary of the results for these tests.

1. Clinical and Laboratory Assessment Tests and Procedures:

Five clinical and laboratory assessment measurements were used to complete this study.

a) Patient Data Questionnaire: (Appendix: Exhibit III) provided biographical information such as educational level, prior occupational status, health history and general level of daily functioning. This was completed prior to formal testing by either the individual subject, his/her family and/or from medical records.

b) Computerized Tomography (CAT) and Electroencephalography (EEG):

All SDAT subjects were required to have recent CAT and EEG testing completed. Initially, it was hoped that both the density and distribution of the cortical atrophy could be inferred from these tests and later used to correlate with SDAT subjects' clinical naming and lexical semantic impairments. However, upon analysis of the CAT and EEG data, no one area of cortical atrophy was prominent. Rather, the cortical atrophy proved to be widespread across both cerebral hemispheres. Therefore, only the density of the cortical atrophy was correlated with the clinical and experimental data. CAT density data were classifed as: 1 - normal; 2 - abnormal generalized cortical atrophy; 3 - abnormal generalized cortical atrophy with enlarged lateral ventricles. The EEG data was classified as either 1 - normal or 2 - abnormal generalized cortical dysfunction.

c) <u>Orientation - Memory - Concentration Mental Status Test (OMC):</u>

This cognitive test battery (Blessed et al, 1968) of 33 items was administered to all subjects. The test grossly assesses long and short term memory, attention, rate of processing information, orientation and factual information abilities.

As derived from the test's score, subjects were classified according to their general level of cognitive functioning: 1) 0 - 8 errors as normal/minimally impaired; 2) 9 - 19 errors as moderately impaired; 3) 20 - 33 errors as severely impaired (Appendix: Exhibit IV).

Previous investigators (Katzman et al, 1981) have shown that the OMC test scores correlate well with post-mortem pathological changes (i.e., Senile plaques) in the brains of both healthy elderly and SDAT individuals. Therefore, the OMC's scores provided another means by which to infer the degree of the SDAT subjects' cortical changes. It also provided a way to correlate the HE and the SDAT subjects general level of cognitive functioning with their naming and lexical-semantic impairments.

d) Boston Diagnostic Aphasic Examination:

Specific subtests from the BDAE (Goodglass and Kaplan, 1972) were administered individually to each subject in order to assess their various linguistic abilities and to obtain an overall level of language functioning, particularly for the SDAT subjects.

These specific subtests included: auditory comprehension; verbal repetition; oral and verbal agility; automatic, conversational and expository speech. All visual stimulus cards from BDAE were enlarged to avoid any visual acuity difficulties. Spontaneous speech samples and descriptions of the "Cookie Thief" pictured from the BDAE were used to rate each subject's speech characteristics (i.e., BDAE's Rating Scale Profile). These characteristics included: Melodic Line (i.e., intonation contour); Phrase Length (i.e., number of words in longest phrases); Articulatory Agility (i.e., facility at phonemic and syllabic levels); Paraphasias in running speech (i.e., phonemic and semantic word substitutions); Word Finding (i.e., informational content relative to fluency level); Grammatical Form (i.e., variety and complexity of grammatical constructions, word order and morphological usage) and Discourse Style (i.e., usage of personalized and evaluative statements; pronominal reference; connectives with logical entailments). This latter characteristic was added since the BDAE fails to include this area for analysis.

The overall severity of subjects' language involvement was rated by the test's Severity Rating Scale: 6.0 normal; 4.5 - Mild; 3.0 - moderate; 1.5 - severe; 0 - marked.

e) Boston Naming Test (Kaplan, Goodglass and Weintraub, 1976): This test was administered to formally assess each subject's naming ability. The test's administration and scoring procedures were maintained in strict accordance with the guidelines outlined by its authors. The test consists of 85 pictures arranged in order of decreasing English word frequency. Initial pictures are of high frequency items and later pictures are of low frequency items. A stimulus cue, semantic in nature, is provided for each picture. The cue is only given when a subject has clearly misnamed a picture. If a subject is totally unable to name a picture in 20 seconds, a phonemic cue is then provided. A naming score is derived by summing the number of spontaneously correct responses plus the number of correct responses following a category cue. In this present study, subjects were classified by their raw test scores as good, borderline or poor namers according to Obler, Nichols and Albert's unpublished raw test score norms based on age and sex for the healthy elderly population (communication, 1982):

	AGE	$\bar{x}$	SD		AGE	$\bar{x}$	SD
Female:	60-69	72.7	6.6	Male:	60-69	74.5	7.0
	70-80	68.5	8.8		70-80	66.7	8.1

In this way, the adequacy of subjects' naming performance could later be correlated with their performance on the three experimental lexical semantic tasks, with their general level of cognitive functioning and with the degree of their cortical dysfunction (for the SDAT subjects only).

It took approximately the first two weeks of testing (i.e., 4 1-hour sessions) to administer these clinical tests.

All the clinical assessment measures were analyzed for between group differences using the Mann-Whitney U-Test. A Mann-Whitney-Wilcoxon matched Pairs Signed Rank Test was used to analyze within group differences only in those instances where response categories for the individual clinical measures were determined to be of importance. Finally a Spearman Rank-Order Correlational Coefficient analysis was performed with each of the groups to establish which of the clinical measures were related.

C.2) <u>Results of the Clinical and Laboratory Assessment Tests:</u>

Collectively, the results from the clinical assessment measures revealed far more differences than similarities exist with regard to both the severity and type of HE and the SDAT groups' clinical involvement (Appendix: Exhibit I).

In terms of differences, the HE subjects displayed mainly changes in verbal vocabulary usage in the face of intact auditory comprehension and general cognitive abilities. None of the nine HE subjects was impaired in either his/her overall language functioning as measured by the BDAE's Language Severity Rating (i.e., 5.5 - 6.0) or general level of cognitive functioning as measured by the OMC (i.e., 0-1). Verbal vocabulary usage was the only clinical area where HE subjects displayed language involvement (Appendix: Exhibits I & V).

By marked contrast to the HE subjects, all eleven SDAT subjects were impaired in varying degrees in their overall language functioning: 3 mildly (i.e., 4.0 - 4.5); 5 moderately (i.e., 2.5 - 3.5); 3 severely (i.e. 1.5 - 2.0). The language impairment involved vocabulary usage for both verbal naming and auditory word recognition as well as overall auditory comprehension abilities (Appendix: Exhibit V). Although the SDAT subjects were impaired on most measures of the BDAE, they displayed the most severe impairments on the measures of Confrontation (i.e., $\bar{x}$ 88.10) and Responsive Naming (i.e. $\bar{x}$ 27.10), Word Finding (i.e., $\bar{x}$ 2.85), Paraphasias (i.e., $\bar{x}$ 5.75), Sentence Repetition of Low Probability Words (i.e., $\bar{x}$ 5.40), Commands (i.e., $\bar{x}$ 12.6) and Complex Material (i.e., $\bar{x}$ 6.9). Different from the HE subjects, all SDAT subjects were cognitively impaired: 1 mildly (i.e., 4-9); 9 moderately (i.e., 10-19); 1 moderate-severely impaired ((i.e., 20)

(Appendix: Exhibit I)). Their cognitive impairments primarily took the nature of orientation, short term memory and attentional deficits.

Abnormal EEG and CAT results were more prevalent than not for SDAT subjects. Of the eleven SDAT subjects, only seven subjects had EEG's performed. Out of these seven subjects, five presented with abnormal EEG results (i.e., abnormal generalized cortical dysfunction). All eleven SDAT subjects received CATs. Eight of these subjects presented with abnormal CAT results ((i.e., generalized cortical atrophy with/without enlarged lateral ventricles and sulci (Appendix: Exhibit I)). The SDAT subjects' impairments in vocabulary usage (as measured by the BNT) strongly correlated with their level of general cognitive functioning (as measured by the OMC) and with the degree of their cortical changes (as measured by EEG and CAT).

To the extent that there was a noticeable similarity between the HE and the SDAT (to a larger extent) Groups, it turned on changes in verbal discourse style at the supra-sentential level, with both showing use of: personalized statements; and the connective "and" without any logical entailments (Appendix: Exhibit VI).

Now let us consider the naming difficulties in more detail for the HE and the SDAT groups. The SDAT group differed markedly from the HE group, both in regard to the severity of their naming impairment and the form their naming impairment took. First in terms of severity, the naming impairment varied widely for SDAT subjects. On the BNT, raw naming scores ranged from 67 to 2 with a mean score of 43.2. Of the eleven SDAT subjects, one subject presented with unimpaired ("good") naming abilities and another subject presented with borderline naming abilities. The remaining nine SDAT subjects presented with naming impairments ranging from mild to marked impairments (Appendix: Exhibit I). By contrast to the SDAT group, the mean raw naming score on the BNT for the HE group was 75.8. Seven of the nine HE subjects exhibited subclinical naming impairments. The remaining two HE subjects bordered toward exhibiting mild impairments in naming.

Clinically, the form the word finding difficulties took for the SDAT subjects was quite different from that of HE subjects. For the SDAT group, word finding difficulties were primarily characterized by semantic paraphasic and object misrecognition naming responses. Additionally, semantic jargon and neologisms were displayed by those SDAT subjects who were most severely impaired in terms of both their cognitive and language functioning. By contrast to the SDAT group, the HE group's word finding difficulties primarily took the form of circumlocutions and delayed responses. However, some semantic paraphasic naming errors were present. Additionally, the correlational data for the SDAT group showed strong relationships among vocabulary usage, cognitive and cortical changes. Specifically, strong relations existed among the BNT, BDAE's Language

Severity Rating; BDAE's measures of vocabulary usage (i.e., Paraphasias, Word Finding, Responsive and Confrontation Naming, Word Fluency, Sentence Repetition of Low Probability Words, Body Part Identification and Word Discrimination); BDAE's measures of auditory comprehension (i.e., Commands and Complex Material); OMC; CAT; and EEG variables (Appendix: Exhibits VII, VIII, & IX). Few correlations existed among the clinical measures for the HE group. Relations existed among the BDAE's Severity Rating, the BDAE's naming measures (i.e., Paraphasias, Word Finding and Confrontation Naming) and the BNT (Appendix: Exhibits IX, X & XI).

D. Experimental Tasks; Stimuli, Procedures and Results:

Four experimental procedures were designed to systematically assess the HE and the SDAT group's ability to deal with the various facets of a word's meaning: 1) to assess the ability to integrate, presumably semantically relevant perceptual information even apart from using this information in naming and object name recognition (Experiment I); 2) to determine more directly how this ability relates to name recognition (Experiment II); 3) to assess the ability to trace meaning relations among words and how these types of word tracings are different reflections of conscious and automatic aspects of the implementation of lexical semantic knowledge (Experiments III & IV).

The specific tasks, stimuli, procedures and results for the four experimental tasks are now presented.

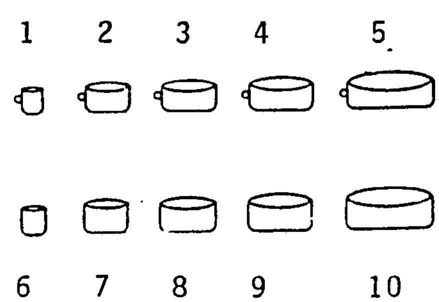
1. EXPERIMENTS I AND II: Judgment of Similarities and Labeling

a) Tasks:

Experiments I and II consisted of a similarity of judgment task and a name labeling task, respectively. These tasks tapped knowledge about the ability to integrate functional and perceptual information used in the service of recognizing a name and in the service of naming.

b) Stimuli:

Stimuli consisted of ten of fourteen line drawings of cup-like or bowl-like objects used by Caramazza, Brownell and Berndt (1978). The first five of the stimuli varied on a dimension defined by ratio of diameter to height. Thus these object-drawings represened five points along a continuous dimension of width from a narrow cup-like container to a wide bowl-like container. The other five stimuli items were identical to the first five stimuli items with regard to the height/width dimensions, however they differed by also being depicted with a handle. The ten container-like drawings were combined with each other



to form triads. In total, there were 120 such triads (C^{10}_{3}). These container-like drawings were used in Experiment I and Experiment II. In addition, two line drawings depicting either cereal being poured from a box or coffee being poured from a pot, were combined with each of the container-like drawings to produce composite context pictures. These composite pictures were only used in the Labeling Task (Appendix: Exhibits XIIa and XIIb).

A triadic set of geometric forms varying along the dimensions of size, color and shape were used as training materials for the Similarity Judgment Task. Both the geometric forms and the container-like drawings forming each triad were arrayed in a triangular fashion to permit the grouping of non-adjacent pictures.

c) Procedures:

1. Experiment I: Similarity of Judgment Task

To ensure that subjects understood the nature of the Judgment of Similarity Task, a training procedure was employed where subjects were required to carry out ten triadic comparisons using the geometric forms. The dimensions of variation were pointed out to subjects if they failed to appreciate them spontaneously. The instructions and the training task were repeated if subjects had difficulty understanding the nature of the training task. As part of the initial subject selection criteria, it was necessary that the HE and the SDAT subjects be able to carry out this type of low level perceptual analysis.

Subjects were then required to make triadic comparisons using the container-like drawings. The subjects were first instructed to consider the three possible combinations within each triad. Then subjects were instructed to point to the two pictures within each triad that they felt were "most similar to one another". Each of the triads were presented once in a predetermined quasi random order to all subjects. Two one-hour sessions were necessary for each subject to complete this task.

It should be noted that triadic comparison procedures were choosen over scaling procedures. With scaling procedures, it was felt that subjects might only use the far ends of the scale in making their decisions. On the other hand, by the very nature of triadic comparisons, subjects would be forced to appreciate the complete range of perceptual variation in making their decisions.

For each subject there were 120 responses with forty five possible pairs of combinations of the container items. For each of the forty-five combinations there was only a maximum of 8 times a subject could choose a particular pair of container combinations. A matrix was made for each subject which illustrated the number of times a subject chose a particular container combination (e.g., 8 times for 1 & 9; 5 times for 3 & 6). In order to determine whether subjects used the perceptual features (i.e., diameter to height ratio dimension and presence or absence of the handle feature) to guide their similarity judgments, the forty-five combinations of the container items were pre-classified. In some instances, because of the very nature of the response items, they were classified into two categories. For example, a combination of 1 & 5 response items was considered as both a Handle II response and a Semantic Boundary Error response.

Handle dimension response items consisted of those responses where the combination of the container items both contained the presence or both contained the absence of the handle feature. These Handle response items were further sub-classified according to their closeness to each other on the continuum of the width to height ratio dimension. Therefore, Handle I response items consisted of those combinations of the two container items that were directly adjacent to each other on the continuum of width to height ratio (e.g., 1 & 2; 9 & 10). Handle II response items consisted of those combinations of two container items that were only one space removed from each other on the continuum of width to height ratio (e.g., 1 & 3, 8 & 10). Handle III response items consisted of those combinations of two container items that were two or more spaces removed from each other on the continuum of width to height ratio (e.g., 2 & 5, 6 & 10).

Whereas Handle responses consisted of those responses where the handle feature was either present or absent for both container items, Diameter/Height Ratio dimension response items consisted of those responses where the handle feature was present for the first of the two container items and absent for the second of the two container items. These Diameter/Height Ratio response items were futher subclassified according to their distance from each other on the continuum of width to height ratio dimension. Thus Diameter/Height Ratio I response items consisted of those combinations of two container items that were identical to each other in respect to the diameter to height ratio dimension (e.g., 1 & 6, 4 & 9). Diameter/Height Ratio II response items consisted of those combinations of two container items that were directly adjacent to one another on the continuum of width to height ratio (e.g., 1 & 7, 4 & 10). Diameter Height Ratio III response items consisted of those combinations of two container items that were more distantly removed from each other on the continuum of width to height ratio (e.g., 1 & 8, 4 & 6).

Two other types of responses were also examined as a basis for classification. Semantic Boundary Error response items include: 1 & 4, 1 & 5, 1 & 9, 1 & 10, 2 & 4, 2 & 5, 2 & 9, 2 & 10, 6 & 9, 6 & 10, 4 & 5, 4 & 7, 5 & 6, 5 & 7, 7 & 9, 7 & 10. As seen, these response items consisted of those combinations of the two container items where regardless of their distance from one another on the continuum of width to height ratio, the first of the two container items could be considered by definitional terms either "cup-like" (i.e., handle feature present and/or small diameter to height ratio) and the second container could be considered "bowl-like" (i.e., handle feature absent and/or large diameter to height ratio). These response items did not include those container items with "fuzzy" "cup" or "bowl" like boundaries (i.e., stimulus items #3 & 8). Anomaly responses included items 1 & 10 and 5 & 6). These responses consisted of those combinations of two container responses where neither the diameter to height ratio dimension and/or presence or absence of the handle feature distinction was present.

The number of times each subject chose a particular type of classification response item was totaled. These tabulations were then used for analyzing between group differences using the Mann-Whitney U-Test.

2) Experiment II: Labeling Task Procedure

In a later session, subjects were asked to identify whether the container drawings look more like a cup or bowl by pointing to either the printed name "cup" or "bowl" when these container-like drawings were either presented alone or combined with the "coffee/cereal" context drawings as a composite picture. These container drawings were the same ones used in the Similarity of Judgment Task. Each of the 24 stimuli were manually presented two times to the subject in a predetermined quasi random order; For half of the trials (10), the container-like drawings were shown with the picture of a cereal box. For the other half of the trials (10), no context picture was provided. Four other trials, in which a container was shown with the coffee pot picture, was randomly interspersed with the other 20 stimulus items. This was to ensure that subjects would not interpret the no-context items as "no-cereal context." The four container items paired with the coffee-pot picture were randomly selected. These four items were not scored. It took one hour for subjects to complete this task.

A four-way analysis of variance was performed on the data from the Labeling Task to determine if between-group differences existed in regard to their utilization of the physical perceptual features and context information in making their decisions. The "cup" response was the dependent variable, and the independent variables were: Handle (i.e., presence/absence), Group (HE/SDAT), Diameter to Height ratio and Context (i.e., presence/absence cereal context).

d) Results:

Before proceeding to separately discuss the results of the Similarity of Judgment and the Labeling-Classification Experiments, an important finding should be emphasized. The patterns of behavior that resulted for the HE and the SDAT groups on both the Similarity of Judgment and Labeling-Classification Experiments were not due to subjects misunderstanding the nature of either of these experimental tasks. Clearly subjects understood the nature of these tasks for all subjects were able to correctly perceive and label those very clear perceptual configurations on the extreme ends of the continuum of width to height ratio (i.e., stimulus items #1, 6, 5, & 10). This finding would not have resulted if subjects had not been capable of understanding the instructions for these experimental tasks.

1) <u>Experiment I: Similarity of Judgment</u>

Table I illustrates the mean and standard deviations for the various types of classification response items on the Similarity of Judgment Task for the HE and the SDAT groups. Additionally, Table I presents the results of the Mann-Whitney U-Test analysis for between HE and SDAT group differences for each type of classification response. As seen in Table I, the results of the Similarity of Judgment Task revealed both differences and similarities in performance for the HE and SDAT groups.

First with response to the more obvious perceptual features, the HE group like normals subjects (Caramazza, Brownwell and Berndt, 1978) but in marked contrast to the SDAT group, was able to fully appreciate the perceptual dimensions of diameter/height ratio and absence or presence of the handle feature. Not only did the HE group integrate the features for deciding which two of the three container items looked more similar (i.e., as measured by the equalness of Handle and Diameter/Height Ratio responses) but like young normal adults, the HE group was fairly accurate in detecting perceptual variation as seen by the largest number of responses being Handle I and Diameter/Height Ratio I responses and the progressive decrease in the number of other Handle and Diameter/Height Ratio responses. Unlike the HE group, the SDAT group failed to integrate the

TABLE I: MEANS AND STANDARD DEVIATIONS ON SIMILARITY OF JUDGMENT TASK BY HE AND SDAT GROUPS CLASSIFIED BY NATURE OF CLASSIFICATION ITEM[1]

	GROUP				
	SDAT		HE		
NATURE OF CLASSIFICATION ITEM	$\bar{X}$	SD	$\bar{X}$	SD	Zu[2]
HANDLE I	40.62	8.95	43.62	4.10	.23
DIAMETER/HEIGHT RATIO I	16.50	6.59	28.25	3.80	3.92***
HANDLE II	29.16	7.07	24.83	4.83	1.91
DIAMETER/HEIGHT RATIO II	15.62	7.45	15.75	4.92	.16
HANDLE III	12.74	6.52	9.37	3.74	1.51
DIAMETER/HEIGHT RATIO III	8.37	4.84	3.87	1.25	1.48
ANOMALY	4.25	4.02	.13	.35	2.49*
SEMANTIC BOUNDARY ERROR	8.35	.94	6.01	1.41	.99
HANDLE & DIAMETER/HEIGHT RATIO I	57.12	7.50	71.87	3.92	2.15*

[1] 120 possible measurements per cell.

[2] Mann-Whitney U-tests, corrected for ties and expressed as normal deviates (Z).

*$p < .05$, **$p < .01$, ***$p < .001$, two tailed.

perceptual information that was present. As seen by the larger number of Handle responses, particularly Handle I responses, as opposed to lower number of Diameter/Height Ratio responses, particularly Diameter/Height Ratio I, the SDAT group relied heavily on the presence or absence of the handle feature in making their decision. Additionally, the SDAT groups' number of Diameter/Height Ratio I responses was significantly ($p < .001$) less than they were for the HE groups.

The SDAT group also differed from the HE group in terms of anomalous behaviors ($p < .05$). The majority of the SDAT subjects made Anomalous responses where their responses failed to reflect reliance on any of the perceptual information that was present to guide their decisions. Additionally, there were three HE subjects (i.e., #5, 6, 8) and three SDAT subjects (i.e., #15, 17, 18) who displayed idiosyncratic behaviors where they failed to behave like their group's general pattern. These six subjects adopted an idiosyncratic strategy where they relied solely on the presence or absence of the handle features. However, the three SDAT subjects differed from the HE subjects in that they also displayed Anomalous responses (Appendix: Exhibit XIII).

With respect to the less obvious physical features, the HE and the SDAT groups showed similarities in performance. Both the HE and the SDAT groups failed in varying degrees to make use of the semantic feature information that characterize the categorical concepts of "cup" and "bowl" to help guide their decisions. This fact was evidenced by the substantial number of Semantic Boundary Errors (i.e., response combinations consisting of both a "bowl-like" and "cup-like" container items) made by both groups.

2) <u>Experiment II: Labeling - Classification</u>

The results of the Labeling Experiment are summarized in Table II and graphically displayed in Figues I and II. Table II shows the results of a four way analysis of variance that was performed on the Labeling Task data. The "cup" response was the dependent variable, and the independent variables were: Handle (i.e., presence or absence), Group (i.e., HE or SDAT), Diameter to Height Ratio and Context (i.e., presence or absence of cereal context).

Figures I and II graphically represent the HE and the SDAT Groups object-classification performances, respectively. For each of the figures, subjects' responses were collapsed within each group to obtain classification profiles as a function of the diameter to height ratio, presence/absence of a handle, and presence/absence of functional context. In these figures, the vertical axis represents the percentage of times a stimulus was called "cup". The numbers on the horizontal axis only represent the systematic change in diameter-to-height ratio of the stimulus items. Thus the smaller numbers represent the

TABLE II: SUMMARY OF ANOVA TO TEST FOR DIFFERENCES IN MEAN NUMBER OF LABELING CLASSIFICATION DECISIONS FOR HE AND SDAT GROUPS FOR THREE CONDITIONS

Source	SS	df	MS	F	p
Group	4.669	1	4.669	0.91	0.353
Error	81.900	16	5.118		
Diameter/Height Ratio	3.600	1	3.600	8.83	0.009**
D/HR x Group	0.711	1	0.711	1.74	0.205
Error	6.525	16	0.407		
Handle	110.002	1	110.002	16.62	0.009**
Handle x Group	0.336	1	0.336	0.05	0.824
Error	105.900	16	6.618		
Context	1.653	1	1.653	1.531	0.237
Context x Group	1.877	1	1.877	3.33	0.086
Context x Handle x Group	0.544	1	0.544	0.97	0.340
Error	9.025	16	0.564		

*$p < .05$, **$p < .01$, ***$p < .001$

FIGURE I: STIMULUS CLASSIFICATION ON LABELING TASK FOR HE GROUP

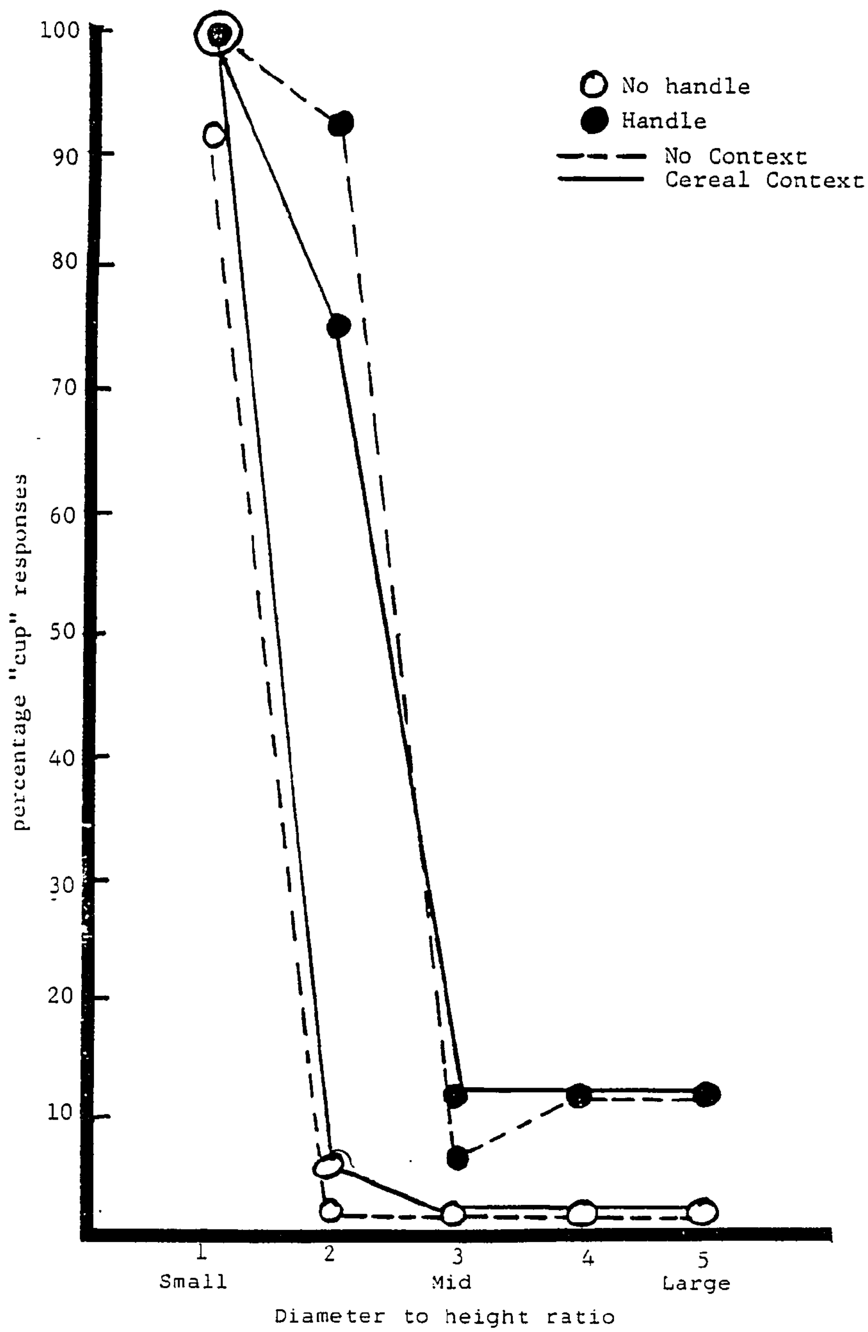
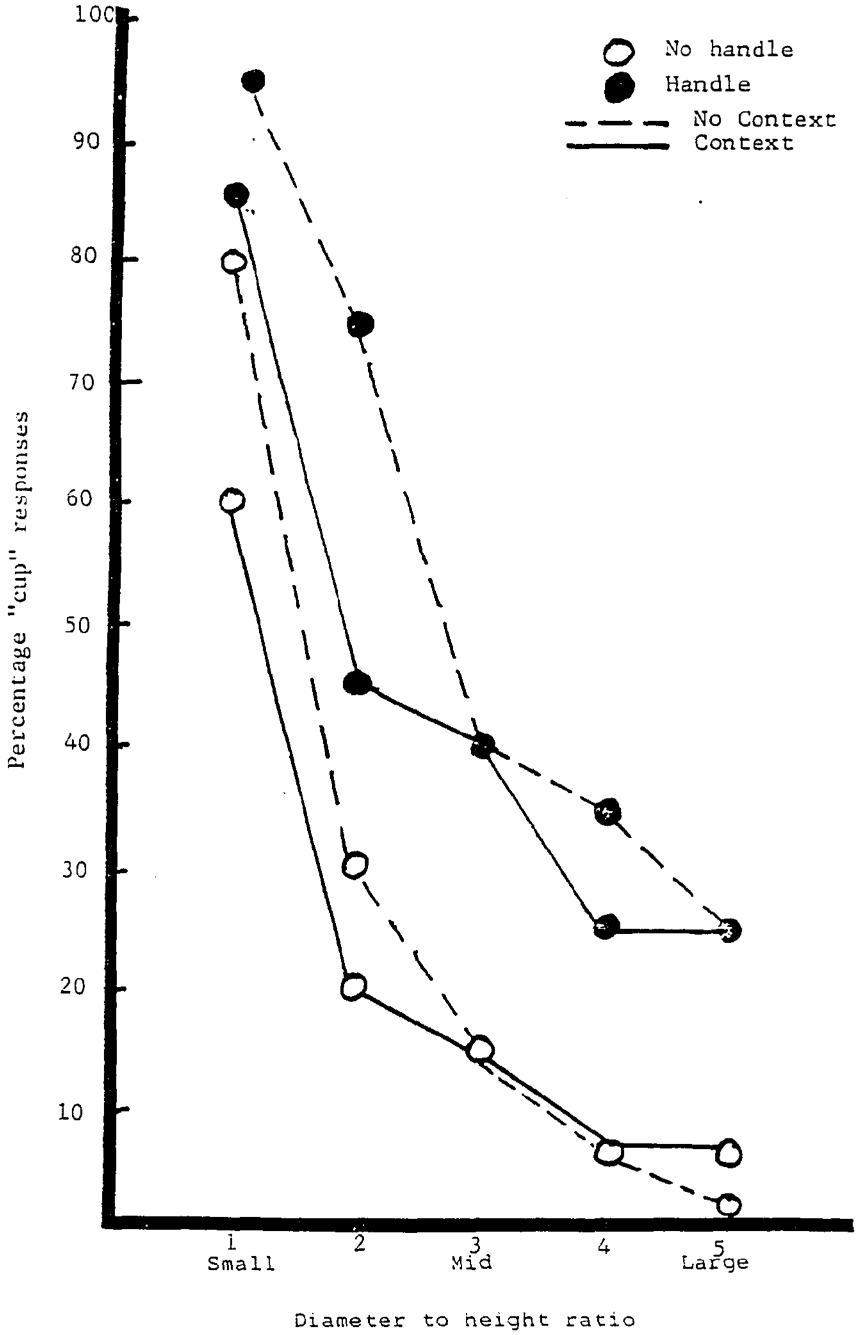


FIGURE II: STIMULUS CLASSIFICATION ON LABELING TASK FOR SDAT GROUP



narrower, more "cup" like stimuli and the larger numbers represent the wider, more "bowl" like stimuli. Within each figure, four profiles are represented for each subject group: one for stimuli with handles in the no context condition; one for stimuli with handles in the cereal condition; one for stimuli without handles in the no context condition and one for stimuli without handles in the cereal context.

On a majority of the Labeling Task measures, the HE and the SDAT groups, as total groups, showed similar patterns of performance. However, in analyzing individual subjects performances within each group, a critical difference in the two groups performance emerged with regard to their use of the important semantic information that establishes a separation between categories (e.g. "cup" and "bowl").

First, in regard to the similarity in their performances, the SDAT group and in some respect the HE group, as total groups, failed to perform like young normal adults (Labov, 1973). While normal young adults demonstrate the integration of the physical perceptual feature (i.e., absence/presence of the handle) and functional context information (i.e., cereal being poured from a box) with the diameter to height ratio dimension in determining the category of an object (i.e., "cup, bowl"), the two groups failed to do so. Rather both groups used the two physical perceptual features separately and in most instances even failed to take into account the contextual information. This fact is clearly evidenced in Table II. As seen there were no significant interactive effects among diameter/height ratio, handle or context for either group. There was, however, significant main effects for the diameter/-height ratio ($p < .05$) and the handle ($p < .01$) variables but not for the groups and Context variables. This is also visually displayed in Figures I and II, where there was a substantial increase in the number of "bowl" responses as a function of increasing the diameter to height ratio and an increase in number of "cup" responses as a function of the handle.

What sharply differentiated the SDAT group from the HE group was the inability of individual subjects within each group to make use of the important semantic information that establishes a separation between categories (e.g., "cup" and "bowl"). This fact was evidenced in a number of ways by the response behavior of individual subjects within each group. First, the numerous anomalous responses made by the individual SDAT subjects, as compared to the individual HE subjects, clearly differentiated the two groups. The individual HE subjects performed more like normal young adults (Labov, 1973) by demonstrating a systematic movement of the boundary for "cup" and "bowl" as a function of changes in the diameter to height ratio dimension and/or absence/presence of the handle feature and contextual information. On the other hand, the individual

SDAT subjects displayed inconsistent responses where the addition of this perceptual and contextual information resulted in unsystematic movement of the boundary for "cup" and "bowl". (Appendix: Exhibit XIV). With regard to normal expectations, individual subjects should display the following: (1) With the diameter/height ratio dimension, subjects should have displayed a systematic decrease in "cup" responses as a function of increased diameter to height ratio e.g., CC B BB (C = cup response, B = bowl response). (2) With regard to the handle feature, subjects should have displayed a systematic increase in "cup" responses as a function of the presence (as opposed to the absence) of the handle feature e.g., CCC CB. (3) With regard to the contextual information, subjects should have displayed a systematic increase in "bowl" responses as a function of the presence (as opposed to the absence) of the contextual information e.g., CB BBB. Thus, inconsistent responses were determined by calculating the number of times a subject's response failed to show these systematic boundary shifts for each of these conditions e.g., CC BB(C).

For all three variable conditions, the individual HE subjects either displayed no or few inconsistencies in their responses. However, the individual SDAT subjects displayed numerous inconsistent responses, particularly for the diameter to height ratio variable. These difference between the two group's behaviors for the three variable conditions were determined to be statistically significant when the inconsistent responses made by individual subjects within each group were totaled and then analyzed for between - group differences using the Mann Whitney - U Test (e.g. Diameter to height ratio: $p < .02$; Handle: $p < .05$; Context $p < .05$, Exhibit XIV).

Two other behaviors distinguished the HE group from the SDAT group with regard to their use of important categorical information. The HE group (Figure I) behaved more like young normals where their decisions were heavily weighted by the diameter to height ratio dimension. By definitional terms, this feature alone is considered to be a critical feature for distinguishing clear cut instances of the categories "cup" and "bowl". Unlike the HE group, the SDAT group's decisions were heavily weighted by the secondary distinguishing feature of absence or presence of the handle feature (Figure II). Even where the individual HE subjects showed integration of the handle and/or contextual information with the diameter to height ratio dimension in deciding the label of a fuzzy object (i.e., Stimulus Item #3), the SDAT subjects relied solely on the presence or absence of the handle feature (Appendix: Exhibit XIV).

This inability of the SDAT group to use semantic categorical information to guide their object classification decisions was further evidenced by the large percentage of times (72.2%) they semantically misclassified stimulus items (i.e., cup for bowl and vice versa) as compared to the HE groups's (41%). As derived from the definitional terms for "cup" (e.g., 1, 2, 6 & 7) and "bowl" (e.g., 4 & 5, 9 & 10), the "cup" or "bowl" label could be assigned to a stimulus item. Thus, the percentage of misclassifications was determined by calculating the number of times subjects mislabeled a stimulus item as opposed to the number of times they correctly labeled a stimulus item. Responses for the fuzzy category Stimulus Item #3 were excluded from this calculation.

Lastly, inspection of individual subjects' performances within each group revealed that there were two HE subjects (i.e., #5 and 8) and two SDAT subjects (i.e., #15 and 18) whose response classification profiles deviated from the pattern that characterized their group as a whole (Appendix: Exhibit: XIV). These four subjects appeared to adopt an idiosyncratic classification strategy where their decisions were solely based on the absence/presence of the handle feature. During testing, they verbalized the fact by stating "when there is a handle it's a 'cup' and when there is not a handle it's a 'bowl'." These subjects were also the same four of the six subjects on the Similarity of Judgment Task who based their judgments on the handle feature alone.

2) EXPERIMENT III: Categorization Task:

a) Task:

A speeded categorization task was used to determine whether: 1) the superordinate-subordinate structure that underlies the interlexical aspects of word's meaning was intact; 2) subjects could adquately access information from the semantic lexicon when a conscious lexical decision was required; 3) subjects were sensitive to the dimension of typicality (Rosch, 1973).

b) Stimuli:

Stimuli consisted of category - instance pairs drawn from published norms (Palermo and Jenkins, 1964; Postman and Keppel, 1970; Rosch, 1975).

For each of the semantic categories (e.g., bird), there were positive and negative response items. Positive within-category response items were of two types: typical (e.g., robin) and atypical (e.g., ostrich) instances. The negative-out of category response items were of two types: semantically related instances drawn from a category related to the target category (e.g., nest); and instances unrelated to the target category (e.g., paper). Thus there were four typical, four atypical, four semantically related and four semantically unrelated instances, totaling 16 instances for each of the five semantic categories (Appendix: Exhibit XV).

The following describes what events went into my decisions for selecting the specific instances for each of the target categories. With regard to the positive-within category response items, typical and atypical subordinate instances for each of the superordinate categories were selected from Rosch's (1975) Goodness of Example Lists for each of her superordinate categories. The typical instances were drawn from the top one-third and the atypical instances were drawn from the bottom one-third of her lists. Those items which appeared within the middle third of her lists were excluded for selection.

Unlike the rigid adherence to Rosch's items for within-category items, the negative-out of category response items were selected from a wider pool of words. These included semantically related instances drawn from a category related to the target category and instances semantically unrelated to the target category. The semantically related instances were chosen from lists of standard association norms. It was necessary to use several lists since standard association lists generally include both: items subordinately related to the superordinate target category and items semantically related in some other way than subordinately to the superordinate target category. Only those semantically but not subordinately related category instances that appeared consistently across the different association lists were selected. Depending on the specific target category, these instances represented a variety of types of semantic relatedness: 1) Attribute: a word describing a feature of the target (e.g., table-wood). This also included part-whole relations (e.g., orange-seed); 2) Functional Associate: verb designating an action carried out or upon a target (orange-eat); 3) Functional Context: a word describing a situation in which the target occurs or another situationally determined object (e.g., apple-orchard); 4) Functional Coordinate: another object from a different superordinate category that has the same action as those objects in the target category (e.g., bird-airplane). It should be noted that the semantically related items consisted of both nouns and verbs and were items of a high English word frequency.

Lastly, content words, which had a high frequency of English occurrence and which were unrelated to any of our target categories, were chosen as our negative out-of-category semantically unrelated instances.

All items as well as the names of the categories were printed separately in large black capital letters against a white background for slide reproduction.

The 16 instances for each of the four semantic categories were presented randomly once in block form to each subject. The 16 category - instance pairs from the fifth category served as practice for subjects.

c) Apparatus:

The slides were placed in standard carousel trays and projected on a white screen using a standard Kodak carousel projector. Attached to the projector was a Gerbrands milli-second timer. Coincident with the presentation of the slide was the onset of the timer. The depression of one of two 2" x 4" keys mounted on a movable board marked YES and NO stopped the timer.

d) <u>Procedure</u>:

Subjects were run individually during one session lasting approximately 45 minutes. The subjects were seated in a semi-darkened room, approximately 162 cm from the projection wall.

Stimuli were presented via a carousel slide projector onto a screen. Subjects were required to decide as quickly as possible whether or not an item was a member of a prespecified category and to indicate their decision by pressing the "yes" or "no" key on the board.

Before each block of 14 trials began, the name of the category being tested was presented both visually and auditorially. The visual card bearing the name of the category was kept in view until all 16 items of a block were completed. The experimenter signaled "ready" to each subject just prior to presenting an item on the screen. Once subjects made a decision, the item was removed and a blank slide appeared for two seconds. Then the next item appeared. Reaction time was measured from the onset of the stimulus presentation to the onset of the subject's response. Between each of the blocks, subjects were provided with a two-minute rest period.

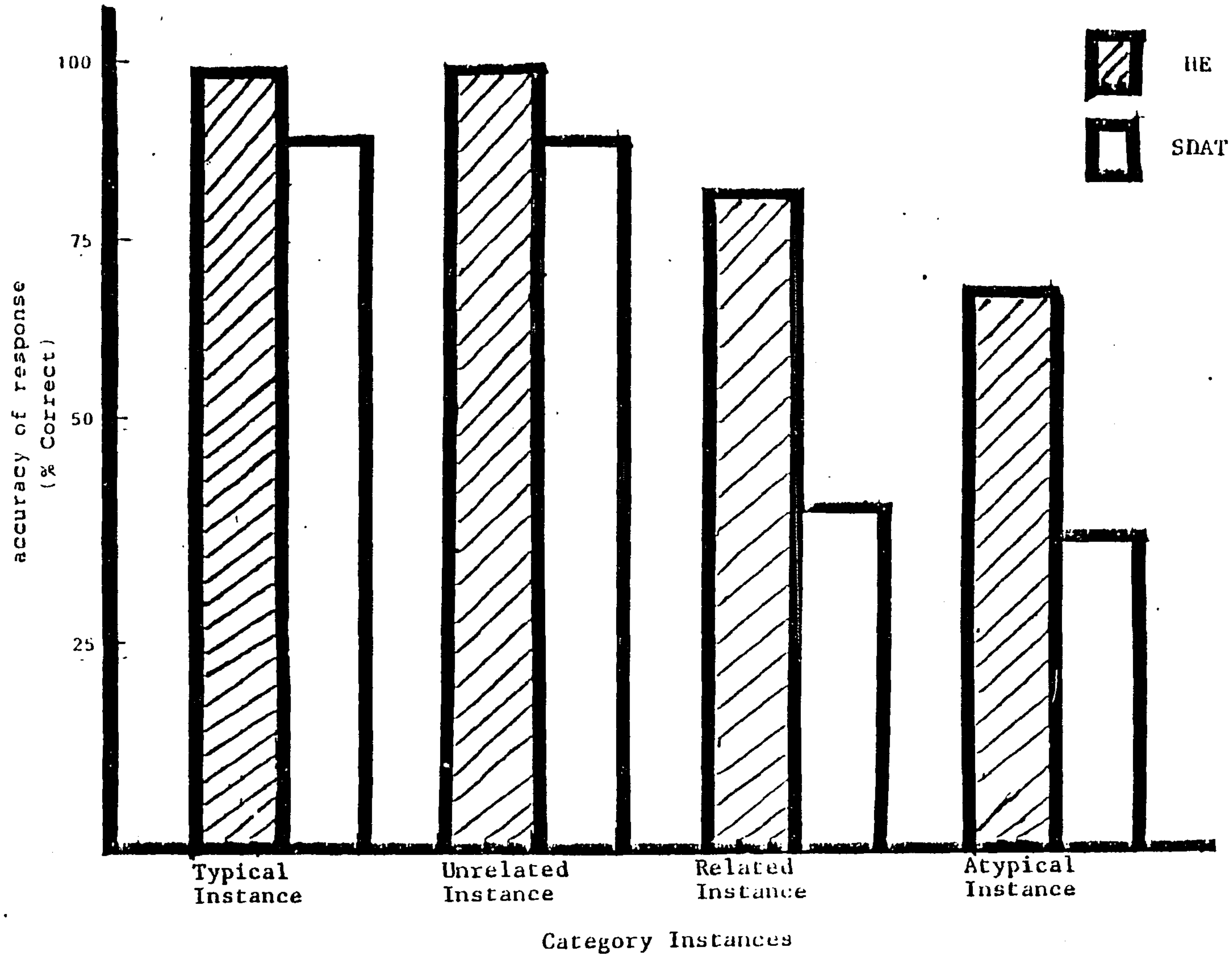
Both the accuracy and latency data for the positive-within category and the negative-out category instances were analyzed for between - group differences using the Mann-Whitney U-Test. The same data were analyzed for within group differences, using the Mann-Whitney Wilcoxon Matched Pairs Signed Rank Test.

e) Results of Experiment III - Categorization Task:

The results of latency data for the Categorization Task are not included here since these latency data are uninterpretable given the large number of errors that were made by all subjects on the task (Appendix: Exhibits XVI & XVII). Accordingly, only the accuracy results of this task will be discussed in this section.

Figure III represents a comparison of the response accuracy on the negative - out of category (i.e., semantically unrelated and semantically related instances) and postive - within category (i.e., typical and atypical instances) trials for both groups. In terms of the accuracy results, both the HE and the SDAT groups displayed varying degrees of difficulty in tracing meaning relations among words when conscious level lexical processing decisions were required. As seen in Figure III, where similarities among the two groups existed for judging clear-cut (i.e., Typical and Unrelated Instances) category members, differences among the two groups existed for judging fuzzy (i.e., Atypical and Related Instances) category members. Also, the SDAT group's patterns of

FIGURE III: ACCURACY SCORES FOR WORDS ON POSITIVE AND NEGATIVE INSTANCES OF A CATEGORY ON CATEGORIZATION TASK BY GROUP



difficulty on this task is reminiscent of their performance with the fuzzy category boundary stimulus item #3 on the Labeling Task.

Both the HE and the SDAT group's lexical knowledge still included some information about the organizational structure of semantic categories. Both groups performed at near normal levels of accuracy when evaluating membership of Typical (HE: 100%, SDAT: 92.5%) and Unrelated (HE: 100%, SDAT: 92.5%) Instances. The fact that all the HE and nearly all the SDAT subjects performed well in judging Typical Instances is an important finding in itself. The notion of prototypicality has been demonstrated in normal young adults as an important aspect of the organization of semantic categories (Rosch, 1973). Interestingly, those SDAT subjects with marked clinical naming impairments were also those subjects that displayed errors on Typical Instances (Appendix: Exhibit XVII). However, where the two groups significantly ($p < .01$) differed, was in judging fuzzy boundary members of a category. The HE group like young normal adults displayed high level of accuracy in judging Related Instances ((85% (Rosch, 1973)). The SDAT group on the other hand displayed low levels of accuracy (50%) when judging Related Instances. Differences between the groups also resulted when their errors on Related Instances were analyzed in terms of functional versus physical perceptual attribute items. Significantly more errors ($p < .05$) occurred on the attribute items (HE: 15.2%;

SDAT 28.8%) than on the functional items (HE: 0.5%; SDAT 9.6%). Additionally, both groups (to a larger extent the SDAT group) displayed varying levels of accuracy when judging Atypical Instances (HE: 74.8%; SDAT: 47.0%).

The semantic category (e.g., fruit, clothing) to which an instance belonged failed to significantly affect either the HE or SDAT group's accuracy of response.

3) EXPERIMENT IV: LEXICAL DECISION TASK:

a) Task:

Experiment IV was a lexical decision task, requiring subjects to make real word or nonword judgments in a variety of contexts. Previous investigators (Neely, 1978) have shown that semantically related information facilitates the speed of automatically accessing a lexical item from the lexicon. On lexical decision tasks, young normal adults demonstrate reduced reaction times when semantically related words as opposed to semantically unrelated words or nonwords are presented prior to the target words (Meyers and Schvaneveldt, 1971). Therefore, by selecting a semantic priming task, a determination could be made as to whether subjects automatically access lexical semantic information for their linguistic use and interpretation.

b) Stimuli:

Five types of three-word/letter sequences (i.e., instances of real words and/or nonwords), representing different combinations of semantic relatedness were constructed from 18 homonymous words used by Schvaneveldt, Meyer and Becker, (1976). Three of these homonymous words and their different contexts served as training items. In each three-word/letter sequence, the middle word always appeared as a homonymous word, having at least two possible meanings but with the same pronunciation.

The homonymous word varied in its relations to the first and third words in the three-word letter sequences in the following ways:

1) Concordant Associates: in which the first and third words of a triple were both related to the same meaning of the homonymous word.
   Example: money-bank-save

2) Discordant Associates: in which the first and third words of a triple were related to the two different meanings of the homonymous word.
   Example: river-bank-save

3) Separated Associates: in which the first and third words were related to each other in meaning but neither was related to the second word. These words were selected randomly by interchanging the second word among the Concordant Associates.
   Example: money-date-save

4) Unrelated Associates: in which none of the three words were related to each other. These words were selected by interchanging the second word among the Discordant Associates.
   Example: gun-date-save

5) Nonword Associates: in which the first and second letter strings were nonwords. The

third letter string was a real word, selected from one of the meanings of the homonymous word.

Example: truit-ody-save

In addition to the 90 word/letter triples for the homonymous words (Appendix: Exhibit XVIII), 42 word/letter sequences were constructed as foils (Appendix: Exhibit XIX). These letter nonword strings varied in several ways. Thirty-six of the sequences were obtained by randomly taking two of the letter/word sequencs from each of the 18 homonymous words and substituting the last word/letter in a sequence with a nonword (e.g., river-bank-time as river-bank-torse). The remaining six sequences were made up of a new word/nonword combination: three consisting of word-nonword-word sequences (e.g., hard-ning-bus); three consisting of nonword-word-nonword sequences (e.g., cleep-truck-vair). These types of sequences helped to insure that subjects did not anticipate a determined order for the stimuli items. Stimuli items acting as foils were not scored.

All pronounceable nonwords of equal length to the real words (i.e., no more than six letters) were obtained by altering the initial letters of common words and inter-changing syllables among words. All 132 of the three word/letter test sequences were randomized for presenta-tion. This type of randomized stimulus presentation is different from that used by Schvaneveldt et al (1976).

These investigators included all combinations of their three word/letter sequences for each of the homonymous words in separate presentation blocks.

Stimuli were printed on cards in large black capital letters against a white background for slide reproduction.

c) Apparatus

The same apparatus and set as described in the previous Experiment III were used for this task.

d) Procedure

Fifteen practice trials were carried out to ensue that the subjects could accurately follow the instructions.

Stimuli were presented via a carousel projector onto a screen. Three letter/word sequences were presented successively on each trial. Before the start of each trial, the examiner signaled "ready" to each subject just prior to presenting an item on the screen. The subjects were required to press the "yes" key on the keyboard if the string was a real word, or the "no" key if the string was a nonword. Subjects were required to respond as quickly and as accurately as possible. Following the subject's response, the first letter string was removed and the next string appeared. Again subjects judged whether the letter string was a word or a nonword by pressing the appropriate key. The third letter string in the triple was then presented. Subjects again made a judgment, thus ending the trial. After the response to the third string on the trial was completed, the display remained black for about two seconds before the next trial.

The stimuli were presented once to each subject. Three 45 minute sessions were needed to complete the task. Reaction times were measured from the onset of the nonword/word presented on the screen to the actual pressing of the key on the keyboard. Only those reaction times for the third word/nonword of each of the 90 three word/nonword sequences were measured. The latency measures for each of the various associates were later subjected to between-group analyses using the Mann-Whitney U-Test. The Mann-Whitney Wilcoxon Matched-Pairs Signed Rank Test was used to analyze the latency data for within-group difference for each of the various associates.

e) Results of Experiment IV - Lexical Decision Task:

Unlike the numerous errors that subjects made on the Categorization Task, very few errors (i.e., .006%) were made by subjects on the Lexical Decision Task. These errors were equally distributed across the various real word and non-word conditions. Thus the latency data was considered to be highly valid for analysis.

Table III displays the mean reaction times and standard deviations for each of the real word and nonword associates by the HE and the SDAT groups on the Lexical Decision Task. Additionally, this table contains the statistical data for the between and within group differences with the various associates for the HE and SDAT

TABLE III: MEAN REACTION TIMES AND STANDARD DEVIATIONS ON LEXICAL DECISION TASK BY HE AND SDAT GROUPS CLASSIFIED BY NATURE OF ASSOCIATION[1]

GROUP

Nature of Association	SDAT $\bar{X}$	SDAT SD	SDAT WILCOXON[2] T_1	T_2	T_3	T_4	HE $\bar{X}$	HE SD	HE WILCOXON[2] T_1	T_2	T_3	T_4	Zu[3]
NONWORD	2.37	0.48					1.72	0.51					2.68**
UNRELATED	2.13	0.53	(8)*				1.46	0.16	(5)**				2.96**
SEPARATE	2.13	0.48		(8)*			1.44	0.16		(5)**			3.03**
DISCORDANT	2.07	0.44			(3)**		1.46	0.14			(5)**		2.89**
CONCORDANT	2.03	0.42				(3)**	1.44	0.15				(5)**	3.10**

[1]165 measurements per cell, in seconds

[2]Wilcoxon Matched-Pairs Signed Ranks Test: circled numbers indicate computed value of Wilcoxon circled T.

[3]Mann-Whitney U-Test, corrected for ties and expressed as normal deviates (Z)

*p $<$ .05, **p $<$ .01, ***p $<$ .001

groups. As seen in Table III, the HE and the SDAT Groups' response patterns for the latency data are more similar than dissimilar. Unlike normal young adults (Schvaneveldt, Meyer and Becker, 1976) the two groups failed to show that they automatically access lexical semantic information. That is, no significant differences in mean reaction times among the Concordant or Related Associates and Discordant or Unrelated Associates resulted for either group. Rather for both groups, the only significant effect (better than $p < .05$) in response times occurred between the various real word Associates and the nonword Associate. Here mean reaction times were faster for the real word than nonword Associates. Additionally, the only difference displayed between the groups was the differences in their overall mean reaction times for the various Associates. That is, the HE group's response times for all the various Associates were significantly faster ($p < .01$) than those for the SDAT group. Although the latency data failed to provide clues as to why the HE and the SDAT groups failed to use semantic information to facilitate automatic lexical access, some possible explanations can be considered. First, subjects may have failed to have a sufficient amount of semantic information available for their use because of a structural semantic impairment. Second, the elderly population possibly uses a level of processing that is different from that of young normal adults and thus does not use semantic information at all for automatic lexical access (Craik and Lockhart, 1972; Craik and Tulving, 1975). Longer latencies of response by young normal adults on a lexical decision task have been shown to be reflective of conscious and not automatic lexical processing (Neely, 1977). Moreover, they experience a faster loss of information through storage by either decay and/or interference effects than do young normal adult subjects (Hulicka, 1967). A third explanation is that subjects' reaction times may have been so elevated as to cancel out any significant effects that may have actually been present.

The data for each group as a whole failed to reveal any meaningful differences in performance between the two groups. However, inspection of individual subjects' response patterns for the various Associates did reveal important group differences (Appendix: Exhibit XX). More importantly, the nature of subjects' response patterns within each group revealed meaningful differences between the groups in regard to their subjects' use of semantic information for automatic lexical access. Individual subjects' performances were measured in two ways. First, subjects' response patterns were compared against the normal expected pattern. That is, on a lexical decision task similar to the one employed in this study, young normal adults have been shown to respond faster to Concordant and Related real word Associates than to Discordant and Unrelated real word Associates and faster to the real word than nonword Associates (Schvaneveldt, Meyer and Becker, 1976). Second, the specific number of times subjects from each group reversed their responses for each of the Associates from that of the expected normal pattern was tabulated for each group. These tabulations were used for analyzing between group differences using the Mann-Whitney U-Test.

With regard to subjects' overall response patterns, the SDAT subjects deviated more from the expected normal pattern than did the HE subjects where their responses reflected an inability to use semantic information for automatic lexical access. All eleven of the SDAT subjects displayed anomalous response patterns where their responses were faster to Unrelated and/or Discordant Associates than to Concordant and/or Separate real word Associates. Additionally, four of the SDAT subjects displayed responses that were even faster to the nonword Associate than to many of the real word Associates. These latter four subjects were also those subjects who demonstrated severe clinical naming impairments. On the other hand the HE subject's response patterns were more like the normal pattern where they used semantic information for automatic lexical access. Specifically, seven of the nine HE subjects responded faster to Concordant and Separate Associates than to Discordant and Unrelated real word Associates. The remaining two HE subjects responded more like the SDAT subjects. Unlike the SDAT subjects, none of the HE subjects responded faster to nonword than real word

Associates. This difference in patterns of performance between the two groups was even more pronounced when the actual number of times subject's from each group reversed their responses from those of the expected normal pattern for the various Associates, was totaled. The number of times the SDAT Group (i.e., 8 times) reversed their responses was significantly ($p < .05$) more than the number seen for the HE group ((i.e., 21 times) Exhibit XX).

E. CORRELATIONAL DATA:

This section first offers an account of the results of the correlation analyses performed among the experimental task measures and second, an account of the results of the correlation analyses performed among the clinical, laboratory and experimental task measures. It should be noted that although fewer correlations were expected for the HE group because of less subject variability within this control group, some correlations did in fact emerge.

Tables IV and V display the correlation data among the experimental task measures for the HE and SDAT groups, respectively. In order to understand the various measures used for the correlation analyses, all experimental task measures are described as follows. On the Categorization Task, the Instance Error Sum was derived by totaling the number of response errors for all the category instances. On the Lexical Decision Task, the mean reaction times for each of the various real word - nonword associates are listed. On the Similarity of Judgment Task there are three measures. The Anomaly measure was derived by totaling the number of response decisions that failed to reflect any reliance on the perceptual features of the container - like objects. The Strategy measure was derived by determining whether subjects overall judgment patterns reflected reliance on the handle feature and/or diameter to height ratio demension. The Semantic Boundary Error measure was derived by totaling the number of times a judgment

TABLE IV: Spearman Product-Moment Coefficients of Correlation Among Experimental Tasks' Measures for HE Grou

Experimental Task's Measures	Categorization Task I. Error Sum	Lexical Decision Task Con.A.	Dis.A.	Sep.A.	Unr.A.	Nwd.A.
Categorization Task						
Instances Error Sum		.873*	.819*	.873*	.855*	.886*
Lexical Decisions Task ($\bar{x}$ R.T.)						
Concordant Associate			.813*	.886*	.846*	.801*
Discordant Associate				.871*	.881*	.879*
Separate Associate					.814*	.855*
Unrelated Associate						.813*
Nonword Associate						
Similarity of Judgment Task						
Anomaly						
Semantic Boundary Error						
Strategy						
Labeling Task						
Strategy						
No context Condition						
Context Condition						
Semantic Boundary Error						
No Context Condition						
Context Condition						
Anomaly						
No Context Condition						
Context Condition						

*Significant at 0.05 level or better.

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..	Anom.	Similarity Judgment Task Sem. B. Err.	Strat.	St.NC	Labeling Task St.C.	S.E.Err.NC.	S.B.Err.C.	An.NC	AN.C.
	.240	.176	.127	.633*	.640*	.153	.310	.241	.250
	.354	.300	.310	.368	.125	.284	.400	.200	.250
	.454	.378	.388	.330	.200	.281	.220	.378	.283
	.516	.185	.176	.171	.631*	.125	.516	.505	.514
	.419	.368	.418	.240	.514	.226	.351	.300	.315
	.240	.238	.420	.597*	.598*	.378	.440	.185	.201
		.514	.832*	.460	.310	.297	.418	.240	.012
			.454	.418	.504	.466	.310	.200	.134
				.220	.383	.300	.514	.201	.153
					.871*	.325	.223	.125	.238
						.460	.454	.050	.176
							.513	.220	.124
								.855*	.225
									.466

TABLE V: Spearman Product-Moment Coefficients of Correlation Among Experimental Tasks' Measures for SDAT Group

Experimental Task's Measures	Categorization Task I. Error Sum	Lexical Decision Task Con.A.	Dis.A.	Sep.A.	Unr.A.	Nwd.A.	Anom.
Categorization Task							
Instances Error Sum		.589*	.787*	.598*	.583*	.705*	.599
Lexical Decisions Task ($\bar{x}$ R.T.)							
Concordant Associate			.855*	.873*	.873*	.988*	.580*
Discordant Associate				.880*	.855*	.803*	.516
Separate Associate					.871*	.879*	.454
Unrelated Associate						.938*	.378
Nonword Associate							.579*
Similarity of Judgment Task							
Anomaly							
Semantic Boundary Error							
Strategy							
Labeling Task							
Strategy							
No Context Condition							
Context Condition							
Semantic Boundary Error							
No Context Condition							
Context Condition							
Anomaly							
No Context Condition							
Context Condition							

*Significant at 0.05 level or better.

om.	Similarity Judgment Task Sem. B. Err.	Strat.	St.NC	Labeling Task St.C.	S.E.Err.NC.	S.B.Err.C.	An.NC	AN.C.
99	.514	.419	.590*	.648*	.460	.466	.223	.221
80*	.368	.354	.378	.603*	.539*	.153	.410	.705*
16	.354	.378	.220	.642*	.538*	.125	.312	.588*
54	.193	.297	.297	.630*	.540*	.226	.378	.780*
78	.176	.185	.284	.783*	.596*	.127	.151	.771*
79*	.300	.310	.419	.198	.504	.310	.297	.724*
	.284	.516	.368	.419	.300	.200	.590*	.630*
		.705*						
			.310	.220	.466	.383	.286	.297
				.643*	.368	.597*	.532*	.599*
					.127	.589*	.778*	.771*
						.514	.460	.419
							.514	.368
								.284

consisted of both an item from within the definitional boundary for 'cup' and an item from within the definitional boundary for 'bowl'. On the Labeling Task, there were also three measures. The Strategy measures for both the context and no context conditions were derived by determining whether subjects' overall labeling patterns reflected reliance on the perceptual feature(s) and/or functional context information. The Semantic Boundary Error measures reflected the number of times an item was incorrectly classified as a 'cup' or 'bowl' according to the definitional terms for 'cup' and 'bowl'. The Anomaly measures were derived by totaling the number of times a response deviated from the overall expected response patterns for the context or no context conditions (e.g., 1 - Cup, 2 - Cup, 3 - Bowl, 4 - Bowl, 5 - Cup).

With regard to the results of the correlation data for the experimental task's measures, similar relations existed among these measures for both the HE and the SDAT groups. However, there were important differences regarding each groups use of the physical perceptual information that embodies a concept for the identification of an object into a category. In terms of similarities, both the HE and the SDAT groups showed strong relations existing among those measures that trace meaning relations among words when automatic (i.e., Lexical Decision - Associate mean reaction times) and conscious (i.e., Categorization - Instance Error Sum) lexical decisions are required.

Unlike the HE group, the SDAT group displayed strong relations among the measure that taps the ability to make appropriate perceptual judgments based on the physical perceptual information that embodies a concept/object (i.e., Similarity of Judgment - Anomaly) and those measures that assess the ability to use perceptual and functional information for identifying an object by its word label (i.e., Labeling - Anomaly) and assesses the ability to use relevant semantic information for adequately tracing meaning relations among words (i.e., Lexical Decision - mean reaction times; Categorization - Instance Error Sum). As seen in Table IV for the HE group, the Similarity of Judgment measures failed to correlate with any of the other experimental tasks' measures. Rather for the HE group, only the Strategy measure on the Labeling task correlated with the Instance Error Sum on the Categorization Task and with the Separate and Nonword Associate mean reaction time measures on the Lexical Decision Task.

Table VI and VII display the correlation data among the experimental, laboratory and clinical assessment measures for the HE and the SDAT groups, respectively. As seen on these tables, the clinical and demographic measures included OMC, BNT, BDAE subtests and Occupational and Educational levels. The laboratory measures of EEG and CAT are displayed only for the SDAT group (Table VII). As previously mentioned, only the SDAT group had CAT and EEG's

TABLE VI: Spearman Product-Moment Coefficients of Correlation Among the Experimental Task, Demographic and Clini

Experimental Task Measures	Demographic/Clinical Measures Occup. Level	Educa. Level	BNT	OMC	Severity Rate	Boston Diagnostic Aphasi Discourse Style	Aud. Compreh.	
Similarity Judgment Task								
Anomaly	.241	.584*	.454	.456	.466	.283	.388	.
Semantic Boundary Error	.171	.221	.512	.368	.372	.300	.240	.
Strategy	.185	.120	.460	.518	.417	.240	.504	.
Labeling Task								
Strategy								
Context Condition	.220	.600*	.440	.420	.418	.389	.418	.
No Context Condition	.225	.602*	.418	.460	.516	.583*	.388	.
Semantic Boundary Error								
Context Condition	.300	.466	.514	.513	.454	.320	.378	.
No Context Condition	.223	.418	.420	.458	.462	.311	.440	.
Categorization Task								
Instances' Error Sum	.540*	.514	.810*	.517	.440	.454	.513	.
Lexical Decision Task ($\bar{x}$ R.T.)								
Concordant Associate	.566*	.238	.813*	.456	.514	.223	.418	.5
Discordant Associate		.354	.598*	.225	.460	.185	.351	.5
Separate Associate	.598*	.419	.787*	.513	.223	.238	.240	.4
Unrelated Associate	.598*	.127	.855*	.460	.517	.300	.310	.6
Nonword Associate	.418	.223	.705*	.517	.454	.127	.226	.5

*Significant at 0.05 level or better

linical Measures for HE Group

nasia Examination Subtest Measures

Para-phasia	Phrase Length	Wd. Fly.	Wd. Find.	Complex Mat.	Conf. Name	Sent. Rep.Lo	Sent. Rep.Hi	Wd. Discrim.
.400	.124	.250	.513	.418	.420	.466	.220	.315
.454	.185	.460	.456	.310	.458	.454	.225	.297
.419	.127	.506	.410	.419	.389	.516	.176	.185
.855*	.200	.461	.720*	.535*	.649*	.657*	.227	.238
.873*	.050	.504	.706*	.540*	.633*	.660*	.220	.315
.513	.134	.400	.456	.466	.240	.516	.238	.325
.220	.012	.547*	.771*	.300	.419	.466	.225	.153
.458	.200	.506	.758*	.389	.456	.400	.221	.327
.583*	.223	.517	.531*	.503	.561*	.501	.388	.327
.583*	.124	.513	.648*	.520	.540*	.497	.504	.283
.454	.153	.513	.771*	.525	.540*	.501	.300	.300
.600*	.201	.466	.593*	.497	.514	.525	.302	.420
.598*	.200	.378	.758*	.521	.520	.457	.320	.127

TABLE VII: Spearman Product-moment Coefficients of Correlation Among the Experimental Task, Laboratory and Clinical Measures for SDAT Group

Experimental Task Measures	EEG	Occup. Level	Educa. Level	CAT	OMC	BNT	Severe Rate	Discourse Style	Para-phasia	Word Find.
	Demographic/Clinical Measures						Boston Diagnostic Aphasia Examination Subtest Me			
Similarity Judgment Task										
Anomaly	.939*	.454	.540*	.525	.587*	.652*	.769*	.771*	.525	.721*
Semantic Boundary Error	.576*	.300	.479	.588*	.525	.542*	.521	.497	.758*	.504
Strategy	.590*	.420	.423	.505	.497	.520	.420	.454	.517	.519
Labeling Task										
Strategy										
Context Condition	.540*	.379	.501	.879*	.479	.576*	.600*	.602*	.564*	.790*
No Context Condition	.773	.400	.479	.788*	.503	.517	.702*	.632*	.540*	.712*
Semantic Boundary Error										
Context Condition	.668*	.401	.502	.525	.515	.517	.521	.525	.525	.793*
No Context Condition	.879*	.420	.521	.525	.517	.501	.517	.517	.521	.500
Categorization Task										
Instances' Error Sum	.723*	.300	.120	.668*	.720*	.590*	.646*	.647*	.656*	.594*
Lexical Decision Task ($\bar{x}$ R.T.)										
Concordant Associate	.594*	.548*	.538*	.787*	.804*	.501	.724*	.988*	.525	.649*
Discordant Associate	.521	.511	.517	.783*	.808*	.503	.648*	.783*	.523	.562*
Separate Associate	.502	.513	.517	.787*	.705*	.503	.680*	.787*	.523	.611*
Unrelated Associate	.511	.513	.501	.787*	.707*	.520	.680*	.783*	.501	.649*
Nonword Associate	.988*	.525	.501	.922*	.855*	.572*	.780*	.873*	.547*	.643*

*Significant at 0.05 level or better

Measures

Resp. Name	Word Fluency	Artic. Agility	Sent. Rep. Hi	Sent. Rep. Lo	Conf. Name	Aud. Compre.	Word. Disc.	Command	B.T.I.	Complex Mat.
.648*	.787*	.400	.300	.518	.588*	.599*	.818*	.540*	.561*	.725*
.511	.550*	.420	.327	.633*	.525	.589*	.535*	.783*	.650*	.501
.503	.523	.457	.302	.520	.501	.523	.810*	.780*	.516	.500
.700*	.597*	.200	.183	.582*	.438	.821*	.525	.577*		
.899*	.649*	.560*	.187	.513	.420	.660*	.500	.569*	.421	.787*
									.543*	.640*
.580*	.525	.388	.297	.523	.461	.440	.454	.479	.645*	.645*
.479	.498	.201	.310	.517	.454	.479	.465	.522	.501	.525
.561*	.665*	.521	.577*	.783*	.648*	.583*	.501	.456	.705*	.523
.793*	.647*	.521	.589*	.584*	.721	.686*	.535*	.594*	.818*	.782*
.660*	.650*	.501	.588*	.501	.740*	.720*	.584*	.583*	.720*	.706*
.787*	.649*	.501		.501	.695*	.758*	.534*	.576*	.673*	.783*
.788*	.630*	.300	.646*	.502	.801*	.757*	.525	.583*	.773*	.816*
.879*	.708*	.302	.598*	.502	.740*	.706*	.600*	.580*	.705*	.821*

performed. The measures for the four experimental tasks are the same measures just described for the experimental task correlation analyses.

The pattern of correlation that existed among the clinical, laboratory and experimental task measures for the SDAT group revealed that their clinical naming impairment could not be divorced from their other conceptually based problems. Additionally, these conceptually based problems, as seen with the correlation data, affected their ability to recognize objects by their labels and trace meaning relations among words when conscious and automatic lexical decisions were required. Specifically for the SDAT group, the laboratory measures for the degree of neuropathological brain involvement (i.e., EEG and CAT), the cognitive measure (i.e., OMC) and all the clinical measures of vocabulary usage and auditory comprehension (i.e., BNT, BDAE subtest measures) related positively with the experimental task's measures of: Semantic Boundary Error and Anomaly on the Similarity of Judgment Task; Instance Error Sum on the Categorization Task; Word-nonword Associate mean reaction time on the Lexical Decision Task and Strategy on the Labeling Task. To a lesser extent, the Similarity of Judgment Task's measure of Strategy and the Labeling Task's measure of Semantic Boundary Error also correlated with many of the clinical and laboratory measures for the SDAT Group (Table VII).

In constrast to the Alzheimer's group, few correlations existed for the HE group. Interrelations soley existed among the clinical measures of verbal vocabulary usage (i.e., BNT, BDAE's Word Finding Paraphasia, Confrontation Naming) and the experimental task's measures that trace meaning relations among the words (i.e., Categorization Task's Instance Error Sum and Lexical Decision Task's Separate and Nonword Associates' latency measures) and those that tap the ability to the use of perceptual and functional context information for the identification of an object by its name (i.e., Labeling Task's Strategy and Semantic Boundary Error Measures). The Similarity of Judgment Task measures failed to correlate with any of the clinical measures (Table VI). This pattern of correlations suggested that the HE naming changes were linguistically "encapsulated".

III. DISCUSSION:

I will now relate my findings to the questions posed in the introductory portion of this thesis. I will first examine the basic question --- Whether the naming impairment in Alzheimer's Disease is related to specific linguistic changes or whether it is part of a more generalized conceptual impairment associated with the other cognitive declines. By defining the similarities and differences in the nature of the naming changes and the underlying cause of such changes in the HE and the SDAT groups, I can then shed some light on my second question --- Whether the naming impairment in Alzheimer's Disease is due in part to normal age-related cognitive and neurophysiological/anatomical changes, and/or whether it is a direct consequence of the underlying disease processes identified with Alzheimer's disease.

Collectively, the results from both the clinical and experimental data lead to the conclusion that the naming changes in Alzheimer's disease are clinically different in both form and severity than those of the healthy elderly and more importantly, that these differences in naming reflect involvement at different levels of the naming process for these two elderly populations.

From a clinical perspective, the type and severity of the naming changes, as well as its relation to other clinical changes was seen as more different than similar for the HE and the SDAT groups. First, the SDAT group displayed mainly object misrecognition and semantic paraphasic error naming responses and the HE group mainly displayed circumlocutions and delayed responses. Whereas semantic paraphasic responses occurred with rare frequency for the HE group, the frequency of semantic paraphasic responses increased in direct relation to the severity of the SDAT subjects' naming impairment.

Second, whereas, the SDAT group presented with severe clinical involvement affecting language and cognitive functions, the HE group solely displayed clinical changes in verbal vocabulary usage. In terms of language, the SDAT group were impaired on all tasks of vocabulary usage (as measured by the BDAE, BNT) and presented with overall impaired auditory compehension abilities (as measured by the BDAE). Moreover, as seen in the correlation data, the severity of the SDAT subjects' naming impairment was related positively to the severity of their other language impairments (as measured by BDAE's Word Discrimination and Auditory Comprehension measures); with their cognitive impairments (as measured by the OMC) and with the degree of their neuropathological brain changes (as measured by EEG and CAT findings). This latter fact may imply, that the naming impairment in Alzheimer's Disease may be only part of a larger more generalized conceptual impairment associated with the cognitive and underlying neuropathological changes of Alzheimer's disease.

Unlike the SDAT group, the HE group's clinical involvement encompassed solely their naming abilities. More over this naming involvement was seen as changed rather than clinically impaired. The HE group performed well on the clinical word recognition task (e.g., BDAE's Word Discrimination) and presented with intact auditory comprehension and cognitive functioning. Correlations among the clinical measures were sparse. The difference in clinical involvement for the HE and the SDAT groups implies that their naming changes are reflective of involvement at different levels of the naming process.

Turning to the findings of the experimental tasks, and the correlation data, we can see that the naming inpairment for the SDAT group could not be divorced from their other conceptual problems, whereas the naming involvement for the HE group appeared "linguistically encapsulated".

With regard to the results of the experimental tasks, the SDAT group's conceptual problems were clearly evidenced by their impaired performance on the Similarity of Judgment task (a task which unlike the Lexical Decision and Categorization tasks, fails to place time constraints on performance). On this nonverbal perceptual sorting task, the SDAT group displayed an inability to perceive relevant information that embodies a concept. Rather than integrating the perceptual information that was present, their judgments either reflected heavily reliance on the secondary feature of absence (or presence) of the handle feature over the critical object distinguishing feature of diameter/height ratio dimension or reflected no reliance on any of the perceptual information (i.e., Anomalous responses).

The results of the correlation data for the SDAT group revealed that a close link exists between naming, lexical comprehension and semantic concepts. The strong interrelations that existed among the Similarity of Judgment measures with the clinical measures of vocabulary usage (i.e., BNT, BDAE subtests) and cognitive functioning (i.e., OMC) and the cortical involvement measures (i.e., CAT and EEG) revealed that the naming impairment for the SDAT could not be divorced from their other conceptual problems. Additionally, these conceptually based problems affected the SDAT group's ability to recognize objects by their word labels and to adequately trace meaning relations among words when conscious and automatic lexical decisions were required. This fact was demonstrated by their impaired performances on the Labeling Categorization and Lexical Decision Tasks and the strong interrelations that existed among these latter measures and the Similarity of Judgment Task measures.

On the Labeling Task, the individual SDAT subjects failed to use relevant semantic information in classifying objects by their labels. Unlike young normal adults (Labov, 1973) and the HE subjects, the SDAT subjects displayed numerous inconsistent responses where the addition of the perceptual and functional context information resulted in the unsystematic movement of the boundary for "cup" and "bowl". Additionally, a majority of the SDAT subjects labeling decisions, like with the Similarity of Judgment Task, were heavily weighed by the presence or absence of the handle feature.

Inspection of the individual data for the SDAT group on the Lexical Decision and Categorization Tasks revealed that they failed to fully use semantic information for tracing meaning relations among words. This finding for the SDAT group is contradictory to that found by Schwartz et al (1979). By the very nature of the tasks (i.e., Lexical Decision and Categorization Tasks) used in this study, as opposed to those used by Schwartz et al., we see that a conceptual impairment affects both the referential aspects and the interlexical aspects of a word's meaning. Specifically on the Lexical Decision Task, the numerous reversals in the individual SDAT subject's response patterns indicated that they failed to use semantic information for their lexical decisions. Not only did all the SDAT subjects respond faster to the Discordant and/or Unrelated real word Associates than to the Concordant and Related real word Associates, but four of the SDAT subjects even responded faster to the nonword Associate than many of the various real word Associates.

On the Categorization Task, the SDAT group displayed difficulty using semantic information for deciding category membership of fuzzy instances of a category (i.e., Atypical and Related Instances). This difficulty with fuzzy instances of a category is also reminescent of the SDAT group's difficulty in choosing the appropriate label for Stimulus Item #3 on the Labeling Task. Even those SDAT subjects with severe clinical naming impairments experienced difficulty in deciding category membership of clear cut instances of a category. This was evidenced by their errors with Typical Instances on the Categorization Task. It was also evidenced by their large number of inconsistent responses (i.e., responses that caused unsystematic shift of the boundary for "cup" and "bowl") and by semantic misclassification errors (i.e. cup/bowl and vice versa) by the clear cut instances of an object on the Labeling Task.

In contrast to the SDAT group, the results of the experimental task and correlation data revealed that the naming changes in the HE group were "linguistically" encapsulated. On the Similarity of Judgment and Labeling Tasks, the HE group performed more like young normal adults. Their response decisions on these two tasks not only reflected their ability to integrate the perceptual and functional information that embodies a concept/object, but their ability to use such information for the appropriate recognition of objects by their word labels. However, the HE group's impaired performances on the Lexical Decision and Categorization Tasks revealed that their lexical semantic information is not well structured for use in fully tracing meaning relations among words when automatic and conscious lexical decisions were required. On the Lexical Decision task, the individual HE subjects overall response patterns resembled those of young normal adults where responses were faster to Concordant and Related real word Associates than Discordant and Unrelated real word and Nonword Associate. However, mean reaction times for the HE subjects were significantly longer than those seen by young normal adults. On the Categorization Task, the HE group displayed partial difficulty in using semantic information for deciding category membership of fuzzy - Atypical Instances of a category.

For the HE group, strong interrelations existed solely among the clinical measures of verbal vocabularly usage (BNT, BDAE naming subtests) and the experimental task measures for the Lexical Decision and Categorization Tasks. This relationship suggests that a lexical semantic structural impairment underlies the "linguistically" encapsulated naming changes in the HE group.

In conclusion, the clinical, experimental task and correlation data for the HE and the SDAT groups sheds some light on my second issue -- Whether the naming impairment in Alzheimer's disease is due in part to known normal age related cognitive and neurophysiological/anatomical changes, or whether it is a direct consequence of the cognitive and underlying disease processes identified with Alzheimer's disease.

First, one might assume that the similarities shared by the SDAT group and the HE group on the clinical and experimental tasks' measures imply that the SDAT group's naming impairment is associated with normal age related changes. Additionally, one might assume that the SDAT group's differences on the clinical and experimental tasks' measures from those of the HE group, imply that the SDAT group's naming impairment involves more than age related changes operating. However, the real issue here is not whether these differences or similarities in the clinical and experimental tasks' measures for Alzheimer's disease reflect differences in terms of the severity of their naming impairment or differences in the naming processes involved. Rather, the real issue is that the HE and SDAT groups both have lexical semantic structural problems which take different forms. These different forms stem from the different underlying basis for their lexical semantic structural impairments. HE group exhibits a "linguistically encapsulated" lexical-semantic naming impairment and the SDAT group exhibits a lexical-semantic naming impairment that cannot be divorced from their other conceptual impairments. If we look at the various stages involved in normal object naming as proposed by Caramazza, Berndt and Brownell (1982), we can see that the naming problems in Alzheimer's disease and the healthy elderly involve different stages of the naming process. This is due to the differences in the underlying nature of their lexical semantic structural impairments. For the Alzheimer's disease population, their naming impairment stems from an impairment in perceptual parsing. This perceptual parsing impairment is not strictly a perceptual one for they are able to perform preliminary low level object analyses at Stage I of the naming process. Rather their perceptual parsing impairment arises at the leveling of perceptual representation that corresponds to semantically relevant information that defines a concept. A disruption of the conceptual representation, consequently affects their ability to use active top down semantically interpretable components to parse an object for object naming (Stage II). As previously illustrated, such a conceptual impairment also affects their ability to make use of lexical semantic information for recognition of objects by their labels and for tracing meaning relations among words when conscious and automatic lexical decisions are required. This conceptual impairment in Alzheimer's disease is probably largely related to declines in other cognitive areas, such as difficulty processing information, and to their underlying cortical changes.

For the healthy elderly population, their naming changes involve Stage III of the naming process. Because of a slight dislocation of the structure of their lexical semantic information, they fail to have full use of the critical semantic information that determines category membership of an object. Additionally, this disruption affects their ability to use lexical semantic information for fully tracing meaning relations among words when conscious and automatic lexical decisions are required.

APPENDIX-EXHIBIT: 1: MEANS, STANDARD DEVIATIONS AND RANGES OF RAW SCORES FOR DEMOGRAPHIC, LABORATORY AND CLINICAL MEASUREMENTS BY SUBJECT AND BY GROUP.

Group Subject	Sx	CA	Ed. Level	Occup. Level	Mts. Since Clinical Onset	CAT	EEG	OMC	BDAE Severity Rate	BNT
Healthy Elderly										
01	M	63	14	4	--	--	--	00	6.0	82
02	F	62	14	3	--	--	--	00	6.0	81
03	M	74	16	4	--	--	--	00	6.0	81
04	M	84	21	4	--	--	--	00	6.0	77
05	F	69	16	1	--	--	--	00	5.5	76
06	M	72	12	3	--	--	--	00	6.0	71
07	M	65	14	4	--	--	--	01	6.0	71
08	M	67	16	4	--	--	--	00	6.0	70
09	F	64	18	1	--	--	--	00	5.5	67
*10	F	83	14	2	--	--	--	01	5.0	57
*11	M	82	12	2	--	--	--	04	4.5	40
$\bar{X}$		71.4	15.2	2.9	--	--	--	.5	5.7	71.8
SD		8.3	--	-	--	--	--	.4	0.5	12.0
Range		(62-84)	(12-21)	(1-4)	--	--	--	(0-4)	(4.5-6.0)	(40-82)
SDAT										
12	M	73	18	4	38	1	1	10	4.0	67
13	F	63	14	1	21	3	2	15	2.5	68
14	F	66	16	1	27	3	2	11	4.5	61
15	M	64	14	4	24	2	--	12	3.5	59
16	M	68	12	4	76	1	2	11	4.0	53
17	M	69	12	4	66	3	--	07	1.5	33
18	M	84	14	2	30	2	2	18	3.5	27
19	F	74	8	3	15	1	--	19	3.0	26
20	F	77	12	2	24	3	1	15	2.5	21
21	F	75	18	4	26	3	--	11	2.0	18
22	F	60	12	3	30	2	2	20	1.5	02
$\bar{X}$		71.3	13.6	2.9	34.7	2.7	1.1	13.5	3.1	43.2
SD		6.5	--	--	20.2	1.4	1.0	3.6	1.0	19.2
Range		(60-84)	(8-18)	(1-4)	(15-76)	(1.-3.)	(1-2)	(7-20)	(1.4-4.5)	(2-68)

*These subjects were excluded from final analysis for the HE Group.

APPENDIX-EXHIBIT II:

Department of Speech and Hearing Sciences
The Graduate School and University Center Of New York

CONSENT FORM

I have been fully advised as to: 1) the nature of the research study involving language problems in elderly individuals; 2) my responsibilities as a subject participating in this study.

I understand that any personal reference to myself as a subject will be kept strictly confidential by the individual conducting the study. In addition, I am aware that I may discontinue participation in this experiment at any time.

(signature)

(date)

(witness)

APPENDIX-EXHIBIT III:

PATIENT DATA QUESTIONNAIRE

(a) "How are you today?"

1. Name: ______________________

2. Date: ______________ Age: __________

3. Date of Birth: ________ Country of Birth: ________

   Time in the U.S. ______________________

4. Institution: ______________________

   Date of Entry to Institution ______________

   Length of time in Institution ______________

   Previous Institutionalization ______________

   ____

5. Racial/Ethnic: Black, White, Oriental, Spanish, American, American Indian, Other

   ____

6. Marital Status: single, married, widowed, divorced, separated ______________

7. Education: Grade School ______________ grade
   High School ______________ grade
   Post H.S. (Business or incompleted College
   College (4 years)
   Post Graduate

8. Occupational Status: Retired since when ________
   Wage earner: part-time, full time ________

9. Highest Occupational Level Attained (or Former Employment):
   Professional ______________
   Executive ______________
   Managerial ______________
   Administrator ______________
   Middle Management ______________
   Clerical ______________
   Skilled Manual ______________
   Unskilled Manual ______________

10. Socioeconomic Status: ______________________________

11. Premorbid Communication

12. Nature of Illness ______________________________
____
____
____

Medical Diagnosis ______________________
____

Onset of Illness ______________________
____

Severity of Illness ______________________
____

Previous Illnesses or Operations _________
____
____
____

13. Medications: Present (how long and dosage) _______
____
____

14. Handedness: right, left, ambidextrous ___________

15. Vision: (glasses) ______________________________

16. Hearing ______________________________

17. General Physical Condition: ambulatory, non-ambulatory, Independent in ADL ______________

To be filled out by examiner:

1) EEG/CT Scan: ______________________________
____
____

2) Hearing Tests Results: ____________________
____
____

3) Other pertinent medical and behavioral information:

____

____

____

____

4) Comments:

APPENDIX-EXHIBIT: IV:. Orientation-Memory-Concentration Test

Score each item 0 if correct, 1 if wrong____Starting time___

CL. #

B Name________________

B K Age________________

B K When born________________
Month Year

B Where born________________ Say: Some Q's easy, some will be hard

B K Name of this place________________

B K What street is it on________________

B How long are you here________________(Adm.)

B Name of this city________________

B K Today's date________________(within a day)
B K Month________________
B K Year________________
B Day of week________________
B Part of day________________
B Time (best guess)________________(Time:)(within 1 hour)

B Season________________

Something to remember

_____John___Brown_____42_____Market St._____Chicago

B Mother's first name____________(any sensible resp.)
How much schooling did you have________________

B Name of one specific school________________

B What kind of work have you done________________

B K Who is the president now ________________

B K Who was the last president________________

B Date of WW I (1914-18) ________________
Date of WW II (1938-45)________________

Next 3 items: for uncorrected errors, score 2;
for corrected errors score 1.

BB Months of the year, backwards: start with December
D N O S A JL JN M AP MCH F JA

BB Count 1 - 20
BB Count 20 - 1. 20 19 18 17 16 15 14 13 12 11
10 9 8 7 6 5 4 3 2 1

BBBBB Recall name & address ___J___B___42___M___C
(Cue with "John Brown" only. Score to 6 errors.
Total Blessed Total Kahn Finishing Time_____

APPENDIX-EXHIBIT: V: MEANS, STANDARD DEVIATIONS AND RANGES FOR THE BDAE'S SUBTESTS BY HE AND SDAT GROUPS

SUBTESTS	HE X̄	HE SD	HE RANGE	SDAT X̄	SDAT SD	SDAT RANGE	Zu[2]
SPEECH CHARACTERISTICS (7)[1]							
Melodic Line	7.00	--	---	6.70	.48	6.0 - 7.0	.23
Phrase Length	7.00	--	---	6.85	.34	6.0 - 7.0	.16
Artic. Agility	6.59	.49	6.0 - 7.0	6.20	.85	6.0 - 7.0	1.52
Gram. Form	6.97	--	6.7 - 7.0	6.40	.49	6.0 - 7.0	.20
Discourse Changes	6.95	.15	6.5 - 7.0	6.40	.49	6.0 - 7.0	.98
Paraphasias	6.82	.41	6.0 - 7.0	5.75	.13	5.5 - 7.0	2.49*
Word Finding	3.77	.34	3.0 - 4.0	2.85	.47	1.0 - 3.5	3.90***
Aud. Comprehension (-2.0-1.0)[3]	.96	.08	.8 - 1.0	.60	.32	-2.0 - .5	2.96**
AUDITORY COMPREHENSION							
Word Discrimination (72)	71.55	1.03	69 - 72	67.60	4.74	59 - 72	2.75**
Complex Material (12)	11.00	1.18	9 - 12	6.90	3.93	2 - 12	3.93***
Commands (15)	14.91	.30	14 - 15	12.60	2.27	9 - 15	3.91***
Body Part Identif.	20.00	--	---	19.50	.71	18 - 20	2.17
NAMING							
Responsive Naming (30)	30.00	--	---	27.10	3.45	21 - 30	3.66**
Confrontation Naming (105)	102.64	4.34	91 - 105	88.10	12.92	63 - 101	3.94***
Word Fluency (23)	21.64	6.3	10 - 35	9.40	6.06	3 - 32	2.81**
REPETITION							
Word Repetition (10)	10.00	--	---	9.90	3.16	9 - 10	1.47
Sent Rep. Lo (8)	7.46	1.04	5 - 8	5.40	2.07	2 - 8	2.13*
Sent Rep. Hi (8)	7.73	.65	6 - 8	7.50	.71	6 - 8	1.93

[1]( ) maximum possible raw score

[2]Mann-Whitney U-tests, corrected for ties and expressed as normal deviates (Z).

[3]Converted from objective Z - score mean.

*$p < .05$, **$p < .01$, ***$p < .001$ two tailed.

APPENDIX-EXHIBIT VI: FREQUENCY OF CHANGES IN DISCOURSE STYLE AND SYNTACTIC-MORPHOLOGICAL USAGE BY HEALTHY ELDERLY AND SDAT GROUPS

TYPE OF CHANGE	FREQUENCY % OF TOTAL USAGE	
Discourse Style Changes	HE	SDAT
Personalized Statements	18.2	45.5
Evaluative Statements	0.0	27.3
Pronouns w/o Referents	0.0	63.6
Adverbs Used as Fillers/ Asides	9.1	9.1
Redundant Phrases	0.0	36.4
Abortive/Incomplete Phrases	18.2	72.7
"And" Connective without Logical Entailments	3.6	27.3
Syntactical-Morphological Changes		
Conjuctives without Logical Entailments	0.0	18.2
Inappropriate Word Order	0.0	0.0
Decrease Usage of Çomplex Embedded Constructions	0.0	18.2
Morphological Errors	18.8	36.4

APPENDIX-EXHIBIT VII: Spearman Product-Moment Correlation Coefficients Among Various BDAE's Subtests for SDAT

Subtests	M.L.	P.L.	A.A.	D.S.	Para.	Wd. Find.	Aud. C.	Wd. C.	B.P.
Melodic Line		.200	.284	.153	.783*	.325	.643*	.176	.419
Phrase Length			.125	.220	.105	.220	.151	.504	.200
Artic. Agility				.661*	.535*	.646*	.633*	.466	.548*
Discourse Style					.504	.814*	.819	.745*	.378
Paraphasia						.873*	.783	.368	.516
Wd. Finding							.579*	.686*	.611*
Aud. Comprehension								.581*	.561*
Wd. Discrimination									.368
Body Part Identif.									
Complex Material									
Commands									
Response Name									
Confront. Name									
Wd. Fluency									
Wd. Repetition									
Sent. Repet. - Low									
Sent. Repet. - Hi									
Severity Rating									

*Significant at 0.05 level or better.

AT	Group								
P.I.	Comp. M.	Comm.	Resr.N	ConF.N.	Wd. Flv.	Wd. Rep.	Sent.R.Lo	Sent.R.Hi	Sev. Rate
19	.325	.657*	.226	.127	.286	.363	.660*	.284	.535*
00	.419	.383	.185	.310	.127	.297	.151	.220	.200
48*	.584*	.755*	.592*	.531*	.676*	.466	.532*	.419	.720*
78	.810*	.791*	.873*	.779*	.819*	.755*	.575*	.552*	.751*
16	.780*	.855*	.630*	.720*	.706*	.460	.899*	.648*	.813*
11*	.800*	.599*	.680*	.899*	.821*	.580*	.855*	.681*	.814*
51*	.855*	.988*	.810*	.547*	.818*	.504	.783*	.354	.819*
58	.185	.297	.547*	.592*	.779*	.368	.201	.466	.720*
	.540*	.240	.649*	.783*	.660*	.661*	.240	.610*	.660*
		.813*	.871*	.583*	.819*	.426	.787*	.454	.835*
			.79[illegible]*	.604*	.873*	.404	.808*	.800*	.873*
				.418	.787*	.504	.649*	.514	.800*
					.643*	.676*	.670*	.821*	.730*
						.284	.795*	.400	.819*
							.105	.220	.633*
								.589*	.783*
									.514

APPENDIX-EXHIBIT VIII: Spearman Product-Moment Correlation Coefficients Among BDAE's Subtests, Demographic Laboratory And Other Clinical Measurements For SDAT Group

BDAE Subtests	Clinical, Laboratory and Demographic Measurements					
	BNT	CT	EEG	Ed. Level	OMC	Occup. Level
Sentence Repet. High	.716*	.355	.547*	.783*	.724*	.153
Confrontation Naming	.783*	.419	.516	.715*	.855*	.383
Artic. Agility	.454	.685*	.584*	.284	.758*	.607*
Word Finding	.813*	.709*	.648*	.220	.783*	.355
Commands	.810*	.466	.583*	.200	.706*	.419
Sentence Repet. Low	.819*	.514	.745*	.050	.609*	.466
Body Part Identification	.452	.516	.434	.535*	.835*	.603*
Discourse Style	.777*	.814*	.335	.286	.800*	.297
Response Naming	.648*	.463	.466	.297	.594*	.378
Aud. Comprehension	.771*	.508	.492	.516	.598*	.451
Wd. Fluency	.873*	.516	.514	.503	.720*	.419
Complex Material	.787*	.460	.517	.501	.660*	.466
Paraphasias	.873*	.720*	.503	.355	.686*	.354
Word Repetition	.504	.540*	.496	.601*	.649*	.200
Melodic Line	.649*	.383	.310	.176	.297	.178
Wd. Discrimination	.633*	.335	.504	.185	.514	.220

*Significant at 0.05 level or better.

APPENDIX-EXHIBIT IX: Spearman Product-Moment Correlation Coefficients Among the Various Demog

Demographic, Laboratory & Clinical Measures	Age		Educa.		Occup.		OMC		BNT	
	HE	SDAT	HE	SDAT	HE	SDAT	HE	SDAT	HE	SDAT
Age			.200	.368	.779*	.419	.284	.300	.176	.240
Educa. Level					.185	.297	.220	.657*	.300	.419
Occup. Level							.378	.220	.378	.105
OMC									.011	.721
BNT										
BDAE's Severity Rate										
CAT[1]										
EEG[1]										

[1]HE Group did not receive CAT or EEG testing.

*Significant at the .05 level or better.

mographic, Laboratory and Clinical Measurements for HE Group and SDAT Group

	BDAE		CAT[1]	EEG[1]
DAT	HE	SDAT	SDAT	SDAT
240	.514	.460	.516	.454
419	.419	.310	.193	.592*
105	.127	.354	.354	.592*
721*	.466	.751*	.771*	.693*
	.773*	.821*	.758*	.821*
			.818*	.816*
				.583*

APPENDIX-EXHIBIT X: Spearman Product-Moment Correlation Coefficients Among the Various BDAE's Subtests For HE

Subtests	M.L.	P.L.	A.A.	D.S.	Para.	Wd. Find.	Aud. C.	Wd.D.	B.
Melodic Line		.873*	.200	.633*	.646*	.538*	.200	.185	.1
Phrase Length			.125	.645*	.645*	.540*	.325	.514	.3
Artic. Agility				.589*	.284	.153	.226	.466	.3
Discourse Style					.640*	.740*	.297	.598*	.1
Paraphasia						.740*	.819*	.592*	.1
Wd. Finding							.676*	.720*	.2
Aud. Compreh.								.300	.0
Wd. Discrim.									.3
Body Part Ident.									
Complex Material									
Commands									
Response Name									
Confront. Name									
Wd. Fluency									
Wd. Repetition									
Sent. Repet. Low									
Sent. Repet. Hi									
Severity Rating									

*Significant at 0.05 level or better.

or HE Group

B.P.I.	Comp.M.	Comm.	Resp.N.	ConF.N.	Wd. Fly.	Wd. Rep.	Sent.R.Lo	Sent.Rep.Hi	Sev. Rate
.176	.460	.660*	.200	.355	.220	.193	.533*	.354	.525*
.383	.286	.668*	.419	.193	.191	.270	.540*	.383	.547*
.354	.240	.185	.504	.097	.516	.517	.097	.176	.135
.127	.368	.297	.310	.846*	.193	.454	.581*	.496	.776*
.198	.300	.813*	.419	.668*	.547*	.387	.706*	.252	.617*
.284	.783*	.504	.873*	.855*	.252	.193	.286	.886*	.813*
.011	.561*	.649*	.050	.787*	.686	.151	.460	.318	.569*
.353	.105	.466	.300	.751*	.318	.310	.353	.466	.777*
	.149	.200	.378	.754*	.335	.193	.492	.463	.230
		.378	.151	.501	.649*	.226	.011	.052	.819*
			.220	.473	.686*	.452	.649*	.325	.873*
				.193	.220	.501	.193	.335	.284
					.454	.473	.127	.514	.503
						.501	.198	.456	.584*
							.516	.185	.500
								.508	.200
									.814*

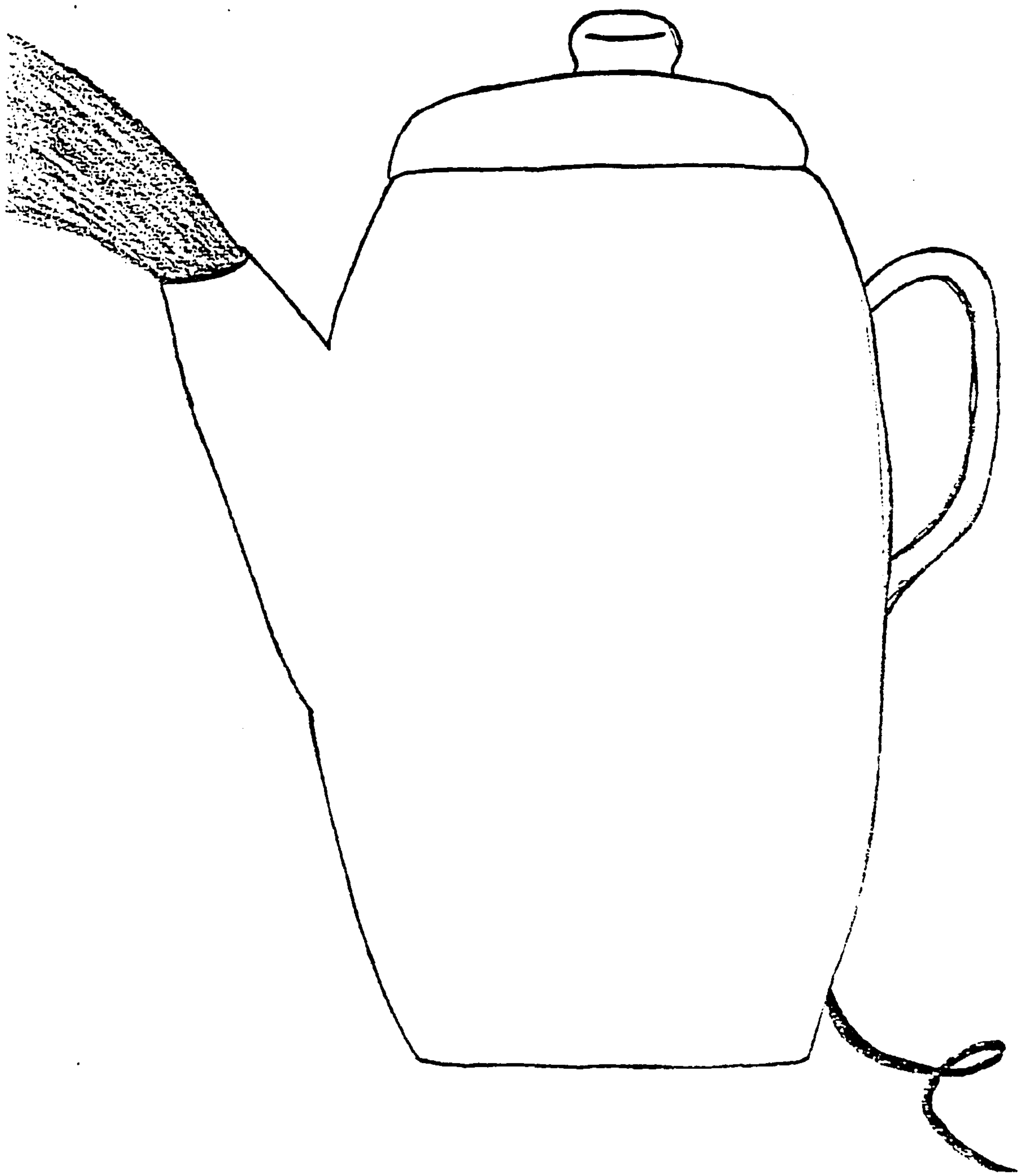
APPENDIX-EXHIBIT XI: Spearman Product-Moment Correlation Coefficients Among BDAE's Subtests, Demographic And Other Clinical Measurements for HE Group

	Clinical and Demographic Measurements			
BDAE Subtests	BNT	Age	Ed. Level	Occup. Level
Aud. Comprehension	.819*	.466	.705*	.473
Wd. Discrimination	.200	.387	.454	.355
Complex Material	.477	.516	.660*	.531*
Word Finding	.873*	.501	.200	.286
Confrontation Naming	.813*	.460	.135	.135
Sent. Repet. Low	.592*	.589*	.284	.012
Sent. Repet. High	.193	.676*	.011	.012
Paraphasias	.777*	.368	.581*	.151
Artic. Agility	.191	.125	.052	.547*
Discourse Style	.593*	.452	.127	.226
Commands	.581*	.252	.335	.335

*Significant at 0.05 level or better.

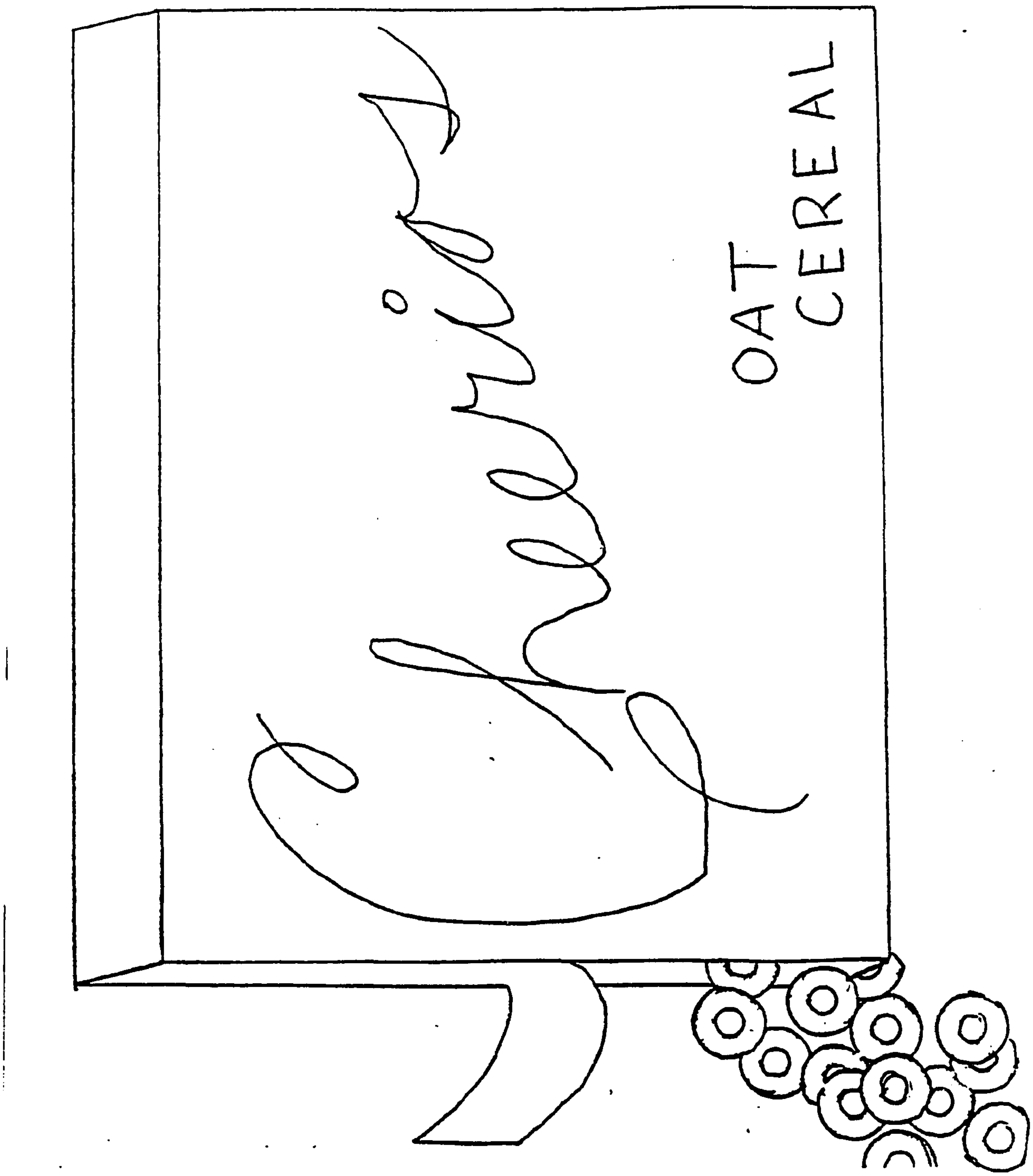
APPENDIX-EXHIBIT: XIIa

Functional Context Coffee Container



APPENDIX-EXHIBIT: XIIb

Functional Context - Cereal Container



APPENDIX-EXHIBIT XIII: Similarity of Judgment Task: Mean Percentage Of Responses For Classification Items By Individual Subjects

	Classification Items (%)[1]					
Subjects	H1	H2	H3	D/H1	D/H2	D/H3
HE Group						
01	37.5	13.3	10.0	20.8	15.0	2.5
02	31.1	21.0	9.2	29.4	6.7	2.5
03	38.3	16.7	9.2	22.5	10.0	3.3
04	40.0	18.3	7.5	20.8	10.0	3.3
05	43.2	26.3	17.8	7.6	3.3	1.7
06	35.0	11.7	6.6	24.2	19.2	3.3
07	30.8	19.2	8.3	17.5	11.6	0.0
08	45.8	26.7	26.7	0.1	0.0	0.0
09	38.3	21.7	11.7	20.0	6.7	1.7
SDAT Group						
10	40.8	13.3	2.5	24.2	15.0	4.2
11	33.3	15.8	5.0	26.7	16.7	2.5
12	35.3	14.3	12.6	20.2	12.6	5.0
13	44.2	20.8	10.0	12.5	8.3	3.3
14	44.2	25.8	23.3	1.6	0.1	1.6
15	43.7	16.0	8.4	22.7	8.4	.8
16	34.2	20.8	7.5	17.5	16.6	3.3
17	37.5	19.2	11.7	13.3	10.0	5.0
18	27.5	17.5	9.2	20.0	15.0	8.3
19	30.0	11.7	6.7	15.0	20.8	13.3
20	28.3	15.0	6.7	15.0	15.8	10.0

[1] H=absence/presence of handle: D/H=Diameter/height ratio.

APPENDIX-EXHIBIT XIII:(continued)

Classification Items (%)[1]

Subjects	Anomalous	Semantic Boundary	H123	D/H123
HE Group				
01	.8	19.0	60.8	38.3
02	0	22.0	61.3	38.6
03	0	21.0	64.2	35.8
04	0	22.0	65.8	34.1
05	0	22.0	87.3	12.6
06	0	32.0	86.5	12.6
07	1.6	27.0	57.3	39.1
08	0	43.0	99.2	00.1
09	0	24.0	71.7	28.4
SDAT Group				
10	0	12.0	56.6	43.4
11	0	18.0	49.0	45.9
12	0	22.0	62.2	37.8
13	0.1	19.0	75.3	24.1
14	2.5	41.0	93.3	3.3
15	0.0	16.0	68.1	31.9
16	0.0	22.0	62.5	37.4
17	2.5	24.0	68.4	28.3
18	2.5	29.0	54.2	43.3
19	2.5	15.0	48.4	49.1
20	9.1	25.0	50.0	40.8

APPENDIX-EXHIBIT XIV: Classification Responses[1] on Labeling Task By Individual Subjects

Stimulus Item

Sub-ject#	No Context Condition: No Handle Stimulus Item #					No Context Condition: Handle Stimulus Item #					Context Condition: No Handle Stimulus Item #					Context Condition: Handle Stimulus Item #					Inconsistent[2] Responses (#)		
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	H	D/He	C
HE Group																							
01	2	0	0	0	0	2	2	0	0	0	2	0	0	0	0	2	2	0	0	0	0	0	0
02	2	0	0	0	0	2	2	1	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0
03	1	0	0	0	0	2	2	1	0	0	2	0	0	0	0	2	1	0	0	0	0	0	1
04	2	0	0	0	0	2	2	0	0	0	2	0	0	0	0	2	2	0	0	0	0	0	0
05	2	0	0	0	0	2	2	2	2	2	2	0	0	0	0	2	2	2	2	2	0	0	0
06	2	0	0	0	0	2	2	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	1
07	2	0	0	0	0	2	2	1	0	0	2	0	0	0	0	2	2	0	0	0	0	0	0
08	0	0	0	0	0	2	2	2	2	2	0	0	0	0	0	2	2	2	2	2	0	0	0
09	2	0	0	0	0	2	1	0	0	0	2	0	0	0	0	2	1	0	0	0	0	0	0
SCAT Group																							
10	1	1	0	0	0	2	1	0	0	1	0	1	0	0	0	2	2	0	0	0	0	2	1
11	2	0	0	0	0	2	1	0	0	0	2	0	0	0	0	2	0	0	0	1	0	1	1
12	2	1	1	0	0	2	2	1	1	2	1	1	2	0	0	2	1	1	1	2	1	3	1
13	2	0	0	0	0	2	2	1	0	0	1	0	0	0	0	2	1	0	1	0	0	1	1
14	2	1	2	0	0	2	2	1	1	0	2	1	1	0	1	2	1	2	0	0	2	3	1
15	0	0	0	0	0	2	2	2	2	2	0	0	0	0	0	2	2	2	2	2	0	0	1
16	2	2	0	0	0	1	2	2	0	0	2	1	1	0	0	1	2	0	1	0	3	4	0
17	1	1	1	1	0	2	0	0	0	1	2	0	0	0	0	2	0	2	0	0	3	2	1
18	0	0	0	0	0	2	2	2	2	1	0	0	0	0	0	2	2	2	1	2	0	1	1
19	2	0	0	0	0	2	2	0	2	0	0	0	0	0	0	2	0	2	0	0	0	2	1
20	2	1	1	0	0	2	1	1	1	0	2	1	0	1	0	0	0	1	1	0	2	3	1

[1] Number of cup responses with a maximum of two responses per cell.

[2] Number of times subjects responses reversed the expected normal pattern for conditions of Handle (H), Diameter to Height Ratio (D/He) and Context (C).

APPENDIX-EXHIBIT XV: Stimuli Items For Categorization Task

1) Furniture[1] (category)

Typical	Atypical	Sem. Related	Sem. Unrel.
chair	rug	seat	frog
table	shelf	wood	pearl
bed	stool	sit	drill
desk	lamp	room	powder

2) Bird

Typical	Atypical	Sem. Related	Sem. Unrel.
robin	bat	beak	mortar
sparrow	penquin	airplane	jello
bluejay	ostrich	flying	hammer
dove	turkey	nest	tin

3) Clothing

Typical	Atypical	Sem. Related	Sem. Unrel.
pants	apron	pocket	card
shirt	slippers	wool	tea
dress	mittens	wear	bomb
coat	scarf	formal	month

4) Fruit

Typical	Atypical	Sem. Related	Sem. Unrel.
orange	olive	juice	paper
apple	kumquat	eat	man
banana	coconut	orchard	snail
grapes	date	peas	whip

5) Vehicle

Typical	Atypical	Sem. Related	Sem. Unrel.
truck	elevator	engine	salt
car	skis	wheels	knife
bus	horse	driving	pen
train	tricycle	road	doll

---

[1]The items in this category served as trial items.

APPENDIX-EXHIBIT XVI: MEAN REACTION TIMES AND STANDARD DEVIATIONS ON CATEGORIZATION TASK BY HE AND SDAT GROUPS CLASSIFIED BY CATEGORY RESPONSE ITEMS[1]

SUBJECT GROUP

CATEGORY RESPONSE ITEM	SDAT $\bar{X}$	SDAT SD	SDAT WILCOXON[2] T_2	SDAT WILCOXON[2] T_3	HE $\bar{X}$	HE SD	HE WILCOXON[2] T_1	HE WILCOXON[2] T_2	HE WILCOXON[2] T_2	HE WILCOXON[2] T_3	Zu[3]
RELATED	4.52	2.49			2.43	0.77					2.75**
ATYPICAL	4.51	2.24			3.05	2.23	(5)**	(5)**		(5)**	2.39*
UNRELATED	3.80	1.83	(3)**		1.90	0.50			(5)**		
TYPICAL	2.80	0.74		(3)**	1.76	0.26					3.66**

[1]176 measurements per cell, in seconds.

[2]Wilcoxon Matched-Pairs Signed-Ranks Test: circled numbers indicate computed value of Wilcoxon circled T.

[3]Mann-Whitney U-Test, corrected for ties and expressed as normal deviates (Z).

*p < .05, **p < .01, ***p < .001, two tailed.

APPENDIX-EXHIBIT XVII: MEAN REACTION TIMES AND NUMBER OF ERRORS ON CATEGORIZATION TASK BY INDIVIDUAL SUBJECTS CLASSIFIED BY CATEGORY RESPONSE ITEMS[1]

Category Response Item (Mean R.T. and # of errors)

	Typical		Unrelated		Atypical		Related	
Subject #	$\bar{X}$ R.T. (Msec)	# Error	$\bar{X}$ R.T. (Msec)	# Error	$\bar{X}$ R.T. (Msec)	# Error	$\bar{X}$ R.T. (Msec)	# Error
HE Group								
01	149		146		182	2	168	
02	155		172		210	3	180	1
03	166		177		245		225	2
04	165		159		164	2	173	
05	192		209		301	4	273	1
06	164		175		297	6	214	1
07	163		170		224	5	217	1
08	153		170		191	1	212	1
09	188		211		234	2	211	2
SDAT Group								
10	205		162		274	3	220	1
11	332	2	328		415	7	360	
12	263	1	475		435		554	1
13	155		172		210	3	180	1
14	207		196		268	7	242	2
15	278		523		599	3	637	2
16	451	2	446		735	9	594	1
17	272		290		300	1	313	5
18	322		414		452	2	439	4
19	716		1037		634	2	952	5
20	632		996	5	762	2	936	11

[1] 16 measurements per cell

APPENDIX-EXHIBIT XVIII: CONTEXT ITEMS FOR THE LEXICAL DECISION TASK

* 1) ball (homonymous word)

a) Concordant Associates:
dance ball gown

b) Discordant Associates:
round ball gown

c) Separate Associates:
dance fan gown

d) Unrelated Associates:
money date gown

e) Nonword Associates:
nush chirt gown

2) date

a)	fig	date	fruit
b)	time	date	fruit
c)	fig	ball	fruit
d)	muscle	punch	fruit
e)	duzzle	buper	fruit

3) bank

a)	money	bank	save
b)	river	bank	save
c)	money	tick	save
d)	gun	tire	save
e)	skruit	tarny	save

4) hide

a)	fur	hide	skin
b)	seek	hide	skin
c)	fur	stable	skin
d)	pine	calf	skin
e)	bripe	tagle	skin

5) tick

a)	clock	tick	second
b)	insect	tick	second
c)	clock	mold	second
d)	wise	light	second
e)	pold	zoke	second

6) ring

a)	phone	ring	bell
b)	finger	ring	bell
c)	phone	hide	bell
d)	drink	riddle	bell
e)	lonth	tus	bell

7) jar

a)	shake	jar	jolt
b)	bottle	jar	jolt
c)	shake	bark	jolt
d)	yours	ball	jolt
e)	tirst	ret	jolt

8) fan

a)	cheer	fan	sports
b)	cool	fan	sports
c)	cheer	jar	sports
d)	mouth	tie	sports
e)	dight	greal	sports

9) bridge

a)	game	bridge	cards
b)	span	bridge	cards
c)	game	box	cards
d)	seed	jam	cards
e)	cleath	boz	cards

10) tap

a)	knock	tap	touch
b)	faucet	tap	touch
c)	knock	fair	touch
d)	dark	bridge	touch
e)	meer	bair	touch

11) box

a)	gloves	box	fight
b)	carton	box	fight
c)	gloves	bowl	fight
d)	hunger	spit	fight
e)	nove	tan	fight

12) calf

a)	cow	calf	baby
b)	muscle	calf	baby
c)	cow	fleet	baby
d)	write	stern	baby
e)	ven	meach	baby

13) tire

a)	rubber	tire	wheel
b)	weary	tire	wheel
c)	rubber	race	wheel
d)	peach	lock	wheel
e)	cleep	vair	wheel

14) bark

a)	birch	bark	tree
b)	howl	bark	tree
c)	birch	mint	tree
d)	slow	tap	tree
e)	tind	mord	tree

* 15) pick

a)	shovel	pick	tool
b)	choose	pick	tool
c)	shovel	stern	tool
d)	span	ring	tool
e)	sevel	doth	tool

16) jam

a)	jelly	jam	toast
b)	wedge	jam	toast
c)	jelly	fast	toast
d)	chest	pick	toast
e)	stoon	hing	toast

17) punch

a)	fist	punch	hit
b)	drink	punch	hit
c)	fist	sage	hit
d)	carton	bank	hit
e)	staze	tridge	hit

*18) mold

a)	mildew	mold	stale
b)	shape	mold	stale
c)	mildew	date	stale
d)	gold	fleet	stale
e)	turch	miger	stale

* trial items

APPENDIX-EXHIBIT XIX: NONWORD FOILS FOR LEXICAL DECISION TASK

*	1.	pouse	chair	sorld	22.	jelly	jam	yirt
*	2.	flexas	leaf	bocket	23.	drink	punch	quist
*	3.	mond	warm	moil	24.	mildew	mold	fless
*	4.	pillow	learth	blang	25.	round	ball	zouch
*	5.	clip	jeko	shen	26.	fig	ball	tup
*	6.	wood	stin	rez	27.	gun	tire	ledium
	7.	dance	ball	torse	28.	bripe	tagel	zass
	8.	fig	date	nuler	29.	clock	mold	slith
	9.	money	bank	sloud	30.	drink	riddle	nabel
	10.	fur	hide	zite	31.	tirst	ret	samel
	11.	insect	tick	tump	32.	mouth	tie	tiz
	12.	finger	ring	terox	33.	cleath	boz	tissor
	13.	bottle	jar	lood	34.	meer	bion	larrow
	14.	cheer	jar	wegal	35.	carton	box	fatch
	15.	game	box	mird	36.	write	stern	mize
	16.	dark	bridge	flape	37.	rubber	race	relver
	17.	gloves	box	klup	38.	tind	mord	louth
	18.	cow	calf	chape	39.	sevel	loth	freat
	19.	weary	tire	hirk	40.	stoon	ning	stange
	20.	howl	bark	wank	41.	carton	bank	tappy
	21.	shovel	stern	flord	42.	mildew	date	zeight

* NWN and WNN stimulus items not occurring elsewhere.

APPENDIX-EXHIBIT XX: MEAN REACTION TIMES ON LEXICAL DECISION TASK BY INDIVIDUAL SUBJECTS CLASSIFIED BY NATURE OF ASSOCIATION[1]

Nature of Association ($\bar{X}$ R.T. Msec)

Subject	Concordant	Separate	Unrelated	Discordant	Nonword
HE Group					
01	1225	1254	1277	1317	1366
02	1384	1450	1465	1459	1500
03	1410	1421	1467	1550	1753
04	1455	1488	1450	1538	1639
05	1180	1188	1218	1187	1325
06	1384	1450	1465	1459	1501
07	1615	1582	1605	1663	1705
08	1552	1487	1625	1508	1643
09	1575	1721	1711	1576	3130
SDAT Group					
10	1273	1268	1286	1254	1459
11	2583	2678	2736	2650	3048
12	2011	2113	2390	2056	2150
13	2133	2542	2424	2139	2350
14	1809	1970	1788	2124	2238
15	2561	2349	2431	2418	2918
16	2126	2401	2038	2569	2545
17	1855	1779	1776	1909	2103
18	2346	2642	2891	2003	2811
19	1598	1535	1545	1532	2051
20	2278	2297	2301	1320	2358

[1] 15 measurements per cell in seconds.

Circled reaction times for subjects, indicate which of the Associate response times failed to follow the normal expected pattern (Schvaneveldt, Meyer and Becker, 1976).

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