

INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

**ProQuest Information and Learning
300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA
800-521-0600**

UMI[®]

A

**GRAMMATICAL CATEGORY AMBIGUITY IN APHASIA:
Systematic versus Unsystematic Homographs**

by

ELMERA GOLDBERG

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.

2002

UMI Number: 3047221

**Copyright 2002 by
Goldberg, Elmera**

All rights reserved.

UMI[®]

UMI Microform 3047221

**Copyright 2002 by ProQuest Information and Learning Company.
All rights reserved. This microform edition is protected against
unauthorized copying under Title 17, United States Code.**

**ProQuest Information and Learning Company
300 North Zeeb Road
P.O. Box 1346
Ann Arbor, MI 48106-1346**

2002

ELMERA GOLDBERG

All Rights Reserved

This manuscript has been read and accepted by the Graduate Faculty in Speech and Hearing Sciences in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

5/1/02
Date


ROBERT GOLDFARB, Ph.D.
Chair of Examining Committee

5/1/02
Date


ROBERT GOLDFARB, Ph.D.
Executive Officer

HELEN CAIRNS, Ph.D.

MARTIN R. GITTERMAN, Ph.D.

Supervisory Committee

MARY JO SANTO PIETRO

External Examiner

The City University of New York

ABSTRACT**GRAMMATICAL CATEGORY AMBIGUITY IN APHASIA:****Systematic and Unsystematic Homographs**

by

Elmera Goldberg

The purpose of this study was to examine the effect of aphasia on the retrieval of nouns and verbs. The stimuli were homophonic homographs, words that are ambiguous as to grammatical category and that are orthographically and phonologically indistinguishable from one another. There was an additional variable--*systematicity*, which describes the relationship between the noun and verb meanings of the word, systematic words having a transparent relationship to one another, as in *love/love*; unsystematic words having no apparent relationship to one another, as in *sink/sink*. There were three tasks of increasing complexity, in each of which the target word was featured in two contexts, or in an ambiguous context. In all tasks, the subjects were asked to select the setting or usage that seemed most appropriate to them. The words were presented visually and were read aloud simultaneously by the examiner. The subjects were fluent and nonfluent aphasic adults. Because the former are considered to be more impaired with respect to nouns and the latter with respect to verbs, aphasic adults were deemed to be a uniquely suitable subject population to examine the neurolexical status of these two grammatical categories.

The theoretical framework of the study is that nouns are processed, stored and retrieved separately from verbs, implying separate status in the mental lexicon. The hypotheses motivating this study were as follows: 1) fluent aphasic adults will tend to

select the verb meaning over the noun meaning of a homograph, whereas nonfluent aphasic adults will tend to select the noun meaning; 2) the effect of frequency will prevail; the meaning with higher frequency will be selected over the meaning with lower frequency; 3) systematicity will have an effect, though the nature of that effect cannot be predicted; and 4) the noun meaning of the homograph will be more robust than the verb meaning, and will be selected more often. The dependent variable was verbs; the independent variables were fluency, frequency, systematicity and task.

A 2 X 3 X 2 X 3 ANOVA revealed main effects of fluency, frequency and task; there was no significant effect of systematicity. The first hypothesis was confirmed: fluent adults selected the verb meaning over the noun meaning, whereas nonfluent aphasic adults selected the noun meaning. The second hypothesis was confirmed: the effect of frequency was significant. The third hypothesis was not confirmed: systematicity did not have an effect on word retrieval. The fourth hypothesis was disconfirmed: the verb meaning proved to be more robust than the noun meaning and was selected more often.

ACKNOWLEDGMENTS

I am grateful to everyone who encouraged and supported me along the way. I want to thank Dr. Loraine K. Obler, who opened the door to neurolinguistics for me. Words cannot express my gratitude to Dr. Robert Goldfarb, Chief of the Graduate Program in Speech and Hearing Sciences Program at CUNY, as well as my dissertation advisor, who has made a difficult project ever easier with his sage counsel and warm heart. The other members of my Committee, Dr. Helen Cairns and Dr. Martin Gitterman, have been wonderful advisors. I am especially grateful to Dr. Cairns for teaching me the meaning of “mean” and the significance of “significance” And the CUNY machine would be very creaky without the services of Loretta Walker, Assistant Program Officer.

The Department of Veterans Affairs has loomed large in my history, as source of both experience and research. Dr. Joyce West and Dr. Stephen Gonzenbach, Deborah Guida, Department of Audiology and Speech Pathology, Barbara-Seibert Crossland and Sheila Sumrell, Administrator and Assistant, Research, have all been enormously supportive. David Brooks, St. Albans and Warren Sweeney, Brooklyn VA, Carolyn McCarthy at Lehman College Speech and Hearing Center, Judy Josephson at Terence Cardinal Cooke, and Pamela Mathews, helped me find participants for this study. Dr. Dianne Bradley made critical suggestions early on which helped clarify my methodology. Andrea Weber of GC-CUNY magically converted a batch of numbers into meaningful statistics. Gary Chant has been wonderfully patient with this technologically-challenged student. And at last, I want to thank my great and dear friend, Connie Atkinson, who, from the beginning, has been stalwart in her unceasing support and understanding, one day at a time.

TABLE OF CONTENTS

I INTRODUCTION AND PURPOSE

1) General purpose.....	1
2) Specific aims.....	2
3) Outline of proposed study.....	5
4) Rationale.....	6

II LITERATURE REVIEW

1) General characteristics of nouns and verbs.....	8
2) Language acquisition.....	11
3) Neuroanatomy of nouns and verbs.....	14
4) Brain damage.....	16
5) Homographic homonyms.....	19
6) Summary.....	26

III RESEARCH PLAN

1) General description.....	27
2) Participants.....	28
3) Method.....	29
4) Procedure.....	33
5) Tasks.....	35
6) Recording.....	38
7) Data analysis.....	38
8) Specific methods to prevent confidentiality and anonymity.....	39

9) Results.....	40
10) Discussion.....	48
IV PILOT STUDY.....	60
APPENDICES:	
A. Tasks: Frequency Counts by Target Code.....	68
B. Sets in Numerical Order.....	84
C. Record of Participant Responses.....	91
D. Sample Forms:.....	96
E. Participant Description.....	104
F. F-Table: Summary of analysis of variance.....	107
REFERENCES.....	109

LIST OF TABLES

TABLE 1: Table of Means.....	34
TABLE 2: Tests of Effects.....	35
TABLE 3: Fluency/Frequency Means.....	36
TABLE 4a: Paired Samples Test of Differences.....	37
TABLE 4b: Task Significance Levels.....	38
TABLE 4c: Task 1: Systematicity/Frequency Means.....	38
TABLE 5a: Fluency/Frequency Means: Task 1.....	39
TABLE 5b: Fluency/Frequency Means: Task 2.....	39
TABLE 5c: Fluency/Frequency Means: Task 3.....	40
 <u>PILOT STUDY</u>	
TABLE PS1: S1 and U1: Nouns > Verbs.....	55
TABLE PS2: S2 and U2: Verbs > Noun.....	55
TABLE PS3: S3 and U3: Nouns ~ Verbs.....	56
TABLE PS4: Grammatical Class x Aphasia Type.....	56

CHAPTER ONE

INTRODUCTION AND PURPOSE

1) General purpose

A fundamental property of human language is the distinction between nouns and verbs (Koenig and Lehmann, 1998). Normal adult speakers are able to retrieve and process both forms with facility, though there are many differences between the two. The differences begin with acquisition, continue through use and are finally reflected in breakdown. One of the ways breakdown can occur in adults is as the result of a cerebral vascular accident (CVA), which is frequently accompanied by aphasia, a reduction of efficiency in the comprehension and production of language symbols. It has been demonstrated that the processing of nouns and verbs can be selectively affected in aphasia, some subjects showing preferential sparing or impairment of one grammatical class, some of another.

Theories of lexical organization differ widely as to the representation and retrieval of individual words. Some theories propose a central lexicon where all words are stored; other theories postulate separate modules for the different modalities: one lexicon for written words, another for oral expression. There can be further further subdivisions within these modules: one subcomponent for output--expressive language, a separate subcomponent for input--receptive language. It is also proposed that different grammatical categories are processed in different areas of the brain. Further, it has been observed that adults with Broca's-type aphasia show greater impairment in the retrieval of verbs than of nouns, whereas patients with Wernicke's-type aphasia show greater impairment in the retrieval of nouns. The fact that patients show differential responses with respect to

different grammatical categories and within different modalities suggests the possibility of duplicated, some say redundant (Caramazza and Hillis, 1991), storage of individual words.

The purpose of this study is to examine in a systematic fashion the effect of aphasia on the retrieval of words which are ambiguous as to grammatical category, noun/verb homographs like *kiss* and *squash*. The theoretical framework of the study is that nouns are processed, stored, and retrieved separately from verbs, implying separate status in the mental lexicon. The disparity between the two grammatical classes is displayed particularly well in English, in which, unlike more morphologically complex languages, the same word can serve as both noun and verb (or as adjective), depending on context. It is hoped that the noun/verb disparity can be demonstrated with special clarity by using these homographs, and that studying the retrieval of homographs by aphasic adults will add to our understanding of the system of lexical organization in the brain.

2) Specific aims

Because English has many words that serve as both verb and noun, homonyms such as *crack*, *love* and *fight*, contrastive effects can be strikingly demonstrated by different responses from the same subject to the same phonological form, depending on grammatical word class. We seek to understand the reason for these differential responses, hoping to find evidence of these differences by testing the responses of two different groups of adult aphasic patients to words that are ambiguous with respect to grammatical class, one subject group typically demonstrating difficulty with nouns, the other group, difficulty with verbs. In trying to identify characteristics in the words themselves that may

contribute to the noun/verb dissociation, the difference between systematic (*wish*) versus unsystematic (*squash*) words would appear to offer the greatest contrast in homonymic forms. In systematic pairs, the relationship between the noun and verb forms is transparent and derivative. In unsystematic pairs, there is no obvious relationship between the meanings of the verb and noun forms.

We may ask if nouns are represented in one part of the lexicon, verbs in another: clinical research has shown that there is a functional distinction between lexical classes. We may also look at the different status of nouns and verbs with respect to sentence structure. Verbs are seen as central to the development of the syntactic frame; impaired verb retrieval may be causally linked to the poor production abilities of subjects with Broca's aphasia. Specifically, we will ask how the choice of noun or verb is affected by whether the homonymic forms are systematically related or not, and what this tells us about relations between nouns and verbs in the mental lexicon. Concerning lexical organization, a crucial question with respect to both systematic and unsystematic homographs is whether they are stored as separate entries or stored as a single entry "tagged" for different functions. It might be expected that unsystematic pairs will be stored separately, since their relationship is purely phono-orthographic. The case is different, and more complicated, for the systematic pairs, since their noun/verb meanings are intertwined. We wonder if the noun and verb usages of systematic homographs are more or less vulnerable to dissolution because of their neural, associative, and semantic connectedness as compared with unsystematic homographs. Even more, we wonder if verbs are more vulnerable than nouns because of their greater complexity. Verbs are

widely held to be more abstract, less memorable and more difficult to interpret than nouns, harder to translate and retranslate than nouns, more variable in meaning and having a greater range of meaning than nouns, and used more broadly by both children and adults than nouns (Bates et al. 1991; Berndt et al. 1997; Gentner, 1978; Gentner, 1981; Gentner, 1982; Gomes et al. 1997; Pease et al. 1989; Reyna, 1987; Rice and Bode, 1993; Rice et al. 1994; Watkins, Rice and Moltz, 1993, among others). Also to be considered are modality-dependent dissociations, which the literature leads us to expect (Caramazza and Hillis, 1991; Caramazza, et al., 1994; Chen and Bates, 1998; Hillis and Caramazza, 1995; McCarthy and Warrington, 1988; Miceli et al. 1988; Orpwood and Warrington, 1995, among others). It is hoped that insight into the reason for these differential responses by impaired speakers will provide some understanding of lexical organization in the brain.

There are, of course, strong implications for therapy in these efforts to understand the working of the brain. Knowledge of language processes makes it easier to communicate with and help clients. Understanding the effects of different types of brain damage is helpful in targeting specific areas of therapy. Appreciation of the limitations due to the reduction of efficiency in the processing of language should allow for a more productive allocation of therapeutic resources. Awareness of the patient's difficulties can help avoid the expenditure of energy on futile rehabilitation efforts that may cause frustration to both patient and therapist. Because nouns and verbs are so central to language, and because specific types of brain damage typically result in a deficit in one of these grammatical categories or the other, it is particularly important to know as much as

possible about precisely nouns and precisely verbs if we are to be maximally effective in our therapy.

3) Outline of proposed study

To meet the specific goals, the subjects will be asked to perform a number of tasks that use specific words as targets. The target words will all be homophonic homographs, words that are spelled and pronounced the same, but that are ambiguous as to grammatical category. They each can function as a noun or as a verb. The tasks have been created to elicit responses that require an understanding of the meaning of the target word, in other words, that can distinguish whether a given word is being used as a noun or as a verb. As noted, the material will employ contrasts between systematic and unsystematic homonyms and will be manipulated with respect to a range of variables, chiefly *frequency of occurrence*, which has shown itself to be an extraordinarily robust factor in word retrieval (Forster and Bednall, 1976; Rubenstein et al. 1970 and Rubenstein et al. 1971).

Because aphasia imposes serious limitations on performance, using reaction time as an independent variable would not be reasonable. Rather, we will be looking at choices. Our pilot study has shown us that grammatical class selection is indeed affected by aphasia type, and that differences between verbs and nouns, between systematic and unsystematic homographs, and between fluent and nonfluent aphasic subjects, can be elicited by tasks that ask the aphasic subject to choose between noun and verb usages in a given context. The responses will be analyzed statistically. Results from the analysis will be used to test the proposed hypotheses and will form the basis for discussion and conclusions.

4) Rationale

The most intriguing displays of the noun/verb disparity of impairment are those which have been reported in anecdotal accounts of individual patients. In these accounts (specifically, Caramazza and Hillis, 1991; Hillis and Caramazza, 1991; Hillis and Caramazza, 1995), a patient has been able to retrieve one meaning of a homonym, for example, *check* as a verb, in one modality, writing, but has been unable to retrieve the other meaning, *check* as a noun, in the same modality. The same patient shows a reversal of impairment in another modality, verbal production. Most strikingly, another patient manifested the opposite pattern, retrieving *check* as a verb in speech, but not in writing. Although highly suggestive, the data from these case studies do not provide the kind of evidence that is required to substantiate a specific theory of lexical organization. It is hoped that a systematic study of the phenomenon described above, the differential responses to the same form depending on grammatical category, will yield results that can form the foundation of a supported theory of lexical organization.

With this in mind, our most basic question is whether the effects of aphasic damage are so potent that they override that most robust of variables, frequency of occurrence, in determining the choice of grammatical class by a given subject. Another experimental question asks whether aphasia results in a difference in the retrieval of systematic homographs (*crack*) from unsystematic homographs (*squash*). Addressing the second question, Rubenstein et al. (1970) and Rubenstein et al. (1971), suggested that with a systematic homograph, both forms, noun and verb, are stored as a unit. In contrast, Forster and Bednall (1976) claim that the two meanings of a homograph are accessed

independently of one another, implying a model in which the verb meaning and the noun meaning of a homograph are stored separately. The implications of the results of the third study (Forster and Bednall, 1976) contradict those of the first two studies (Rubenstein et al. 1970 and Rubenstein et al. 1971). Hargroot (1990), takes a position in support of Forster and Bednall. He postulates that for homonyms, there are separate semantic nodes for nouns and for verbs. With a series of tasks manipulating the variables of systematicity and nonsystematicity in homographs, as well as the differences in frequency of occurrence between the noun and verb form of the word, we hope to shed further light on the issue of lexical retrieval.

CHAPTER TWO

LITERATURE REVIEW

In the Old Testament, we read that Jehovah brought “every beast of the field, and every bird of the heavens; and brought them unto the man to see what he would call them: and whatsoever the man called every living creature, that was the name thereof.” But, according to Jackson (1879), “Single words are meaningless... To speak is not simply to utter words, it is to propositionize. The unit of speech is a proposition.” A proposition requires a noun and a verb. Without nouns and verbs, there is no language. Indeed, the distinction between nouns and verbs is a fundamental property of human language (Koenig and Lehmann, 1998). Though there are important differences between nouns and verbs, all languages require that normal adult speakers retrieve and process both forms. As noted above, the differences begin with acquisition, are demonstrated in normal usage, and are ultimately reflected when language breaks down. In this introduction, I will first discuss some of the characteristics that distinguish nouns from verbs, then briefly touch upon features of acquisition, neuroanatomy and neural impairment as related to nouns and verbs. Finally, I will discuss homographic homonyms, the featured category of this proposal.

1. General Characteristics of Nouns and Verbs

In her seminal work, Gentner (1978, p. 988) speaks of the “fundamental difference between the *relational* meanings expressed by verbs and the *referential* meanings expressed by simple nouns.” (Italics mine.) (“Simple nouns” are defined by Gentner as concrete nouns and proper nouns.) Verb relations often include nouns whereas nouns have

an identity independent of verbs, in that nouns represent things whereas verbs represent relations between those things. Nouns are acquired earlier and more quickly than verbs; the difference in rate of acquisition persists over time through early childhood. Gentner suggests that the acquisition of verb meaning relies on the accretion of components to a greater degree than does the acquisition of noun meaning. (But see Clark, 1987, for a different view. She claims that only certain semantic features of a noun are learned, and that the process of noun acquisition, like verb acquisition, is cumulative.) Finally, verbs are used more broadly by both children and adults than are nouns; a fairly limited number of verb forms can be used to convey a wide variety of meanings. (The expanded use of a few general purpose verbs as an aspect of specific language impairment in children is discussed below. It is also true that aphasic adults have been known to use generic nouns in the same way. An example is the reliance of many aphasic adults on such general nouns as *thing* and *stuff* as substitutes for more specific nouns.)

In later studies, Gentner (1981a) found evidence for a verb-central model of sentence storage, suggesting that verbs provide the core relational frames for sentences. Gentner (1981b) reiterated the aspects of verbs and nouns discussed in the earlier papers, as well as adding that memory for verbs is poorer than memory for nouns. She also expanded on the difference in breadth of meaning between the two class forms: verbs have more senses per word than do nouns. The 20 most frequent verbs in Francis and Kucera (1967) (average frequency, 1745.9) had an average of 12.4 meanings each; the 20 most frequent nouns (average frequency, 663.7) had an average of 7.3 meanings each. You will note that the average frequency of the verbs is almost three times as high as the average frequency of

the nouns, substantiating the point made in the previous paragraph, that a relatively small number of verb forms is used to express a broad range of meanings. The six phenomenological aspects of verbs and nouns--memory, acquisition, breadth of meaning, mutability under paraphrase, cross-linguistic variability and translatability--were discussed and held to be subsumed under two core processing differences, the greater adjustability of verbs and the greater compositional latitude of relational terms. In language processing, verb structures were found to be more adjustable during comprehension than nouns. Whereas noun meanings are more or less "given by the world", verb meanings vary more across languages. In this paper, Gentner (1981b) touched upon another interesting distinction in the natures of verbs and nouns. Whereas nouns *increase* in number as their frequency decreases, verbs, like closed-class items, *decrease* in number as frequency decreases. This similarity to closed-class patterning raises the question of exactly how "open" the class of verbs is, compared to nouns.

In another discussion of the differences between nouns and verbs, Reyna (1987) claimed that the prototypical concept for verb is *relation*, whereas for noun it is *object*. Like Gentner (1981), to whom she often referred, she pointed out that verbs differ from nouns in that they are usually more abstract and less memorable, are learned later, are more difficult to interpret, are harder to translate (and retranslate), and have a greater range of meaning and are more variable in meaning than are nouns. Reyna described several experiments using "selectively deviant" sentences ("The thundercloud scolded the child.") in which subjects were asked to perform various tasks such as paraphrasing, rating difficulty of comprehension, and evaluating the aptness of or verifying the accuracy of a

suggested interpretation. Depending on the structure of the sentence, the subjects chose to modify the verb rather than the noun in 78% to 92% of the cases. The paradox Reyna elucidated is the fact that whereas verbs are more difficult to understand, at the same time, they are more flexible in meaning. Compared to nominal meaning, verbal meaning is underspecified; because there is less detail in the meaning of a verb, there are fewer restrictions on its use. (Another way of describing the difference: rather than think of a verb as “underspecified”, we might think of it as “multispecified”.) Thus, although the subjects could have chosen to modify the noun in the deviant sentence, because they saw the noun as more “fixed”, less mutable, they chose to modify the verb.

Supporting the view that verbs are more complex than nouns, Berndt et al. (1997a) found that verbs are not only acquired later, they are more difficult to process, have a greater range of meanings and are more difficult to comprehend under certain conditions than nouns. (Though some studies show a bias toward verbs, suggesting that nouns do not have universal superiority in processing [Berndt et al. 1997b].) Evidence suggests that nouns are processed more quickly than verbs (Gomes et al. 1997). Verbs are considered to be more complex syntactically and morphologically than nouns, factors which may contribute to the differences in processing times (Bates et al. 1991).

2) Language Acquisition

Overall, theories of word learning are less well developed than theories having to do with acquisition of grammar; lexical information would seem to be more dependent on input from the speech environment than would syntax (Cairns, 1996). The earliest use of words is usually referential; to provide a name for an object in the environment is the first

and most basic linguistic challenge that a child has to meet. Nouns--words for objects--are commonly thought to be learned more quickly and more easily. They are the first words acquired and they comprise the greatest proportion of words of any kind in a child's vocabulary.

The acquisition of verbs is not as well-understood as is the acquisition of nouns. Theories of verbal learning are subject to more controversy than are those dealing with the acquisition of nouns. One theory of verbal development is that a child identifies structural features of a verb, then discovers other verbs with the same syntactic properties (Maratsos, 1988). The classification of like verbs is made easier if verbs that share structural features are also found to share semantic features. Maratsos speaks of the centrality of form classes to grammar, and asks how a child learns the system of rules that informs a particular grammatical category. The major form class categories have an important semantic core in common but ultimately take their central definition from structural properties shared by their members. Maratsos devotes most of his attention to the acquisition of verbs, saying that "The picture may be simpler for nouns for many reasons." He claims that in verbal acquisition, there is no empirical evidence for the intuitive notion that the "action" category serves as the organizational base for the emerging structure of the verb category. The implication is that the syntactic structure is related to but not reliant on obvious semantic categorization.

In asking "Why Nouns are Learned Before Verbs", Gentner (1982) examined a number of different languages and finds that in all of them, without exception, nouns are learned earlier and in greater numbers than are verbs. She wondered if the word frequency of adult

speech, the child's initial input, can explain the earlier acquisition of nouns compared to verbs. Surprisingly, the opposite frequency pattern from what would be expected (i.e., nouns more frequent than verbs) is found: adults use a small number of verbs frequently, and a larger number of nouns less frequently. (The use of a small number of verbs is typical of the SLI children described below, who, in their use of a few all-purpose verbs, would seem to be exaggerating the normal adult pattern: high reliance on a relatively few verbs.) Of the 100 most frequent words in written English, verbs comprise 20% whereas nouns comprise only 6% of the total. Gentner points out that if word frequency were the chief determinant of lexical acquisition, children would learn verbs before nouns, and function words before content words, with *the* leading the list by far. She concludes that "Object-reference mappings may provide natural entry points into language--an initial set of fixed hooks with which children can bootstrap themselves into a position to learn the less transparent aspects of language" (Gentner, 1982, p. 329).

Gleitman (1990) frames her proposal under the rubric of "syntactic bootstrapping": children deduce verb meanings in "procedures that are sensitive to syntactic privileges of occurrence." The learning of verbs entails the acquisition of semantically relevant information within a syntactic structure. Naigles (1990) supports this position, claiming that children use syntactic information to learn new verbs. The child's choice of referent is informed by the syntactic structure in which the verb has appeared. A different view is held by Radford (1990), whose argument is housed within the edifice of Universal Grammar, and who claims that the categorical component of early child grammars is purely lexical in character. Yet another proposal for the way children learn words is called

the “semantic bootstrapping hypothesis” (Pinker, 1984). While the emphasis is on word learning in general, not specifically the acquisition of verbs, it is the semantic rather than the syntactic or lexical aspect of language that is seen as dominant.

Most studies of language acquisition agree that both typical and language-impaired children seem to learn object words more quickly and easily than they learn action words (see, for example, Camarata and Schwartz, 1985; Gentner, 1968; Leonard et al. 1982; Pease et al. 1989, et alia). In a study examining the effect of frequency of input (how often a word is presented) on word-comprehension of language-impaired children, it was found that in retention testing (how well the word is retained), verbs proved weaker than nouns (Rice et al. 1994). Comparing specific language impaired children to both non-impaired adults and to typical children, Watkins, Rice and Moltz (1993) and Rice and Bode (1993) found that the language-impaired children relied on a more limited set of verb forms than the controls, implying a constrained set of verbal resources. Although the language-impaired children made more efficient use of high-frequency verbs, this “efficiency” may be the price they pay for the scarcity of forms available to them in their verbal lexicon. (Still, you will recall that in the discussion above, Gentner [1981b] pointed out that typical adult usage favors heavy reliance on a relatively small number of verbs. It would thus appear that language-impaired children, rather than exhibiting abnormal usage, are only demonstrating an exaggerated version of a normal pattern.)

3) Neuroanatomy of Nouns and Verbs

Neurological studies indicate that there are different anatomical substrates for nouns and for verbs, further evidence that the two forms are processed differently in normal

language users (Daniele et al. 1994; Gomes, et al., 1997; Kersten, 1998; Koenig and Lehmann, 1996; Pulvermuller, 1996). Citing the contrasting patterns of modality-specific grammatical-class impairments reported in case studies of Caramazza and Hillis (1991), Daniele et al. proposed that grammatical category information is represented redundantly in the lexical components involved in spoken and written production, and that the lexical system is organized by grammatical class. The dominant hemisphere, they claim, has separate neural systems for the different categories: the temporal lobe for nouns, the frontal lobe for verbs. Since the frontal lobe is involved with the planning and execution of movement, to couple this movement center with “action” words is intuitively appealing. Warrington and McCarthy (1987) suggested that the motor channel provides information crucial to comprehension of action verbs.

Rather than speak of “neural substrates”, Damasio and Tranel (1993) use the term “distributed neural systems” in discussing the retrieval of nouns and verbs. The authors propose an interactive network rather than a permanent, integrated neural site for the representation of concepts and word forms. The relationship between concept and word-form implementation is indirect, depending on the mediation of “neural structures that use convergence zones and feedforward-feedback connections to link separate regions... Systems that mediate access to concrete nouns are anatomically close to systems that support concepts for concrete entities... Systems that mediate access to verbs... are anatomically close to those that support concepts of movement and relationship in space-time” (p. 4959). The findings suggest that nouns and verbs are organized so to operate from different neural systems.

Though differences in information processing along noun/verb dimensions correspond to different spatial patterns of neurological activity in the brain, the neural organization and recognition of grammatical class distinctions are similar across different individuals (Koenig and Lehmann, 1998). Experiments using event-related potentials (ERPs) suggest that different neural populations represent different grammatical word classes in language processing. The fundamental grammatical class distinction is demonstrated in the neural organization of recognition of nouns and verbs across languages. As with the papers discussed above, Koenig and Lehmann claim that the differences in brain information processing correspond to different spatial patterns of neural activity in the brain.

4) Brain Damage

Focal brain damage causes disruptions in processing along many dimensions. Some breakdown occurs with respect to semantic classification, selectively affecting the processing of such categories as living things versus nonliving things, fruits, tools, vegetables, etc. (Goodglass et al. 1966; Hargoort, 1990; Hart et al. 1985; Hillis and Caramazza, 1991; McCarthy and Warrington, 1985; Robinson et al. 1996; Warrington, 1975; Warrington and McCarty, 1983; Warrington and McCarty, 1987; Warrington and Shallice, 1984; Yamadori and Albert, 1973). Breakdown also occurs along the lines of grammatic classes, often producing selective deficits in either nouns (Wernicke's aphasia, anomia) or verbs (Broca's aphasia) (Bates et al. 1991; Berndt et al. 1997a; Berndt et al. 1997b; Lapointe, 1985; Miceli et al. 1984; Miceli et al. 1988; Zingeser and Berndt, 1988; Zingeser and Berndt, 1990). "The ability to produce verbs may be dissociated from the ability to produce nouns in aphasic patients." (Miceli et al. 1988, p. 351). Grammatical

class dissociation exists for both production and comprehension, suggesting that this principle of organization is duplicated for both input and output components of the lexicon. Bates et al. (1991), found a double-dissociation between object and action naming in Chinese Broca's versus Wernicke's aphasic patients: Chinese Broca's aphasic patients demonstrate a selective deficit in action naming (and/or a selective sparing of object naming), whereas the Chinese Wernicke's aphasia patients exhibited the opposite syndrome. Goodglass et al. (2001), suggested that agrammatics have particular difficulty with verbs because it involves *predication*, an aspect of language to which they no longer have unrestricted access..

Daniele, et al. (1994) studied the language of three aphasic patients, two nonfluent and one fluent. Not unexpectedly, the two nonfluent patients had difficulty with verbs; also to be expected, the fluent patient had difficulty with nouns. However, while the two nonfluent patients had virtually no errors in noun production, the fluent noun-impaired patient also had trouble with verbs. Though his errors on nouns were proportionately greater than his errors on verbs, his difficulty with verbs suggested that verbs present a processing challenge to even typically noun-impaired patients. In their study of the retrieval of nouns and verbs, Damasio and Tranel (1993) found that their three patients provided evidence for a double dissociation between noun and verb retrieval. The two patients who were impaired with respect to verbs had left premotor cortex lesions, suggesting the neural association of an equivalent mediation system for verbs in the left frontal region. The third patient, whose retrieval of common and proper nouns was impaired, had damage to the left anterior and middle temporal lobe, suggesting that the

system for the retrieval of nouns that denote concrete entities is located in this section of the left hemisphere. Pulvermuller (1996) suggests that lesions in the frontal lobe produce problems with verbs whereas lesions in the inferior temporal lobe produce problems with nouns.

Grammatical class selectivity can be modality specific, affecting phonology but not orthography, or affecting nouns in one modality, verbs in another (Caramazza and Hillis, 1991; Caramazza, et al., 1994; Hillis and Caramazza, 1995; McCarthy and Warrington, 1988; Orpwood and Warrington, 1995). In Caramazza and Hillis (1991), the selective damage was modality-specific. Both patients had difficulty with verbs, but the difficulty expressed itself with reading for one patient, writing for the other. In Hillis and Caramazza (1995), the patient made more errors on nouns than on verbs in oral production, but more errors on verbs than on nouns in written comprehension. These, and other studies, suggest autonomy of input and output lexicons, as well as autonomy of phonological and orthographic modalities.

A study of major interest to this proposal is that of Caramazza and Hillis (1991), case studies of two patients, one with semantic errors in reading and oral naming, the other with semantic errors in writing and written naming. Patients' errors were not uniformly distributed across nouns and verbs, reflecting the fact that, although reading verbs has been reported to be more difficult for brain-damaged subjects than reading nouns (Coltheart, Patterson and Marshall, 1980), there are other reports of subjects having more difficulty naming objects than actions (Miceli et al. 1984). It has been observed that patients with Broca's-type aphasia show greater impairment in the retrieval of verbs than

of nouns, whereas patients with Wernicke's-type aphasia show greater impairment in the retrieval of nouns. In the Caramazza and Hillis (1991) study, both patients had difficulty in producing verbs though there was a dissociation across modalities: one was impaired with respect to the oral production, the other with respect to the written production of verbs. It was the simple homonym *crack* that provided the clearest evidence of the modality-specific nature of the damage. The two patients were selectively impaired in producing the verb form of the word in only one modality of output: oral for one, written for the other. This suggested to the authors that knowledge of the phonological and orthographic forms of the words are organized by grammatical category, with "the possibility that grammatical category information is represented separately and redundantly in each modality-specific lexical system." (Caramazza and Hillis, 1991, p. 789.) The anecdotal evidence presented here is so intriguing that it not only invites, it virtually demands a systematic examination of the phenomenon.

5. Homographic Homonyms

As seen above, the disparity between the two grammatical classes is most elegantly displayed in English homonyms. Unlike more morphologically complex languages, in English, the same word can serve as both noun and verb (or as adjective), depending on context. A subset of homonyms are homographs, words whose orthographic representation is the same, but whose meanings and even pronunciations may vary. In this study, we are choosing to look at the differences in the retrieval of homographs which function as both verb and noun. The homographs we are investigating are all homophonic, i.e., words having the same pronunciation. In this subset is yet another dichotomy,

systematic versus unsystematic homographs. Systematic homographs are those whose noun/verb connection is apparent: crack/crack, plow/plow. Unsystematic homographs are those which present with no connection between the noun form and the verb form: squash/squash (action and vegetable) or steer/steer (action and animal).

Rather than comprise a small proportion of words in the language, homographs are ubiquitous: almost half the words in the English language have more than one meaning. Twilley et al. (1994), reported that as many as 44% of a random sampling of English words, and that 85% of a sample of high-frequency English words, had more than a single meaning. Of the 566 homographs listed as stimuli in their study, 230 had more than two meanings. Another feature of homographs is that they are typically responded to more rapidly than are words with only a single meaning (Kellas et al. 1988; Nelson et al. 1980; Rubenstein et al. 1970; Rubenstein et al. 1971)

With respect to frequency of occurrence, surveys of approximately 690 homographs compiled by this writer, 566 homographs compiled by Twilley et al. (1994) and 100 homographs compiled by Kruez (1987) suggests that primary associations favor the noun meaning, and that noun meanings are of higher frequency than verb meanings in 75% of the cases. Also, analysis reveals that systematic homographs outnumber unsystematic homographs by a ratio of approximately four to one. In a study investigating the relative contributions of probabilistic lexical information versus discourse context in syntactic ambiguity resolution, it was claimed that probabilistic lexical information plays a primary role in structure generation (i.e., in generating the syntactic structure of the incoming information), and that syntactic (i.e., grammatical class) alternatives are stored in the

lexicon and are weighted by frequency information (Boland, 1997). Here, nouns again demonstrated their dominance: the average frequency of nouns was 51; the average frequency of verbs, 18. In this study, even with frequency factored in, nouns were favored (“He saw her duck.”) (It has been pointed out by Professor Helen Cairns [personal communication] that the verb reading produces a complex sentence, while the noun reading produces a simple sentence with SVO structure. It is possible that simplicity alone accounts for favoring the noun reading.)

Twilley et al. (1994), did not examine frequency per se, but only word associations. In that study, which involved several hundred subjects and 566 homographs, each homograph was responded to by an average of 192 subjects. The subjects were asked to write down the first word they thought of as they read each homograph. This method yielded primary, secondary and in some cases, tertiary associations to each of the stimulus words. Twilley et al. were not interested in grammatical class distinctions, though they did point out that homographs whose meanings differed in parts of speech are more ambiguous (i.e., yielded less accord as to primary meaning) than homographs whose meanings belong to the same grammatical class. The study paid particular attention to homograph balance: the two meanings of *balanced* homographs are relatively equal; *polarized* homographs have a primary meaning that is much more frequent than the next most common meaning. (*Balanced* homographs have two meanings of relatively equal frequency; *polarized* homographs have a primary meaning of much higher frequency than the next most common meaning. This is similar to the *equiprobable* and *nonequiprobable* categories of Rubenstein, et al., [1970], discussed below.) It was found that the stability of

homograph-meaning is affected by the frequency of its primary meaning: homographs whose primary meaning has a high relative frequency are more stable than homographs whose primary meaning is less frequent. (Twilley refers to Gorfain et al. [1982], who derived the stability of association from testing homographs in separate sessions at different times. The stability of a word is the probability of producing the same meaning across several associations.)

Surprisingly, given the strong effect phonology has on reading, heterophones (words that are spelled the same but that have different pronunciations, such as *wind*, *bass* and *bow*), were not more ambiguous than homophones. The connection between phonology and reading is demonstrated by children learning to read. Ehri and Wilce (1980) found that phonemic segmentation may be a consequence of as well as a prerequisite to learning to read words, and that visual spellings are retained in memory through the sound symbolization process. Further evidence of this connection is manifest in the difficulty deaf children have in learning to read. Locke (1978) speaks of the relationship between phonology and reading by pointing out that because “Deaf children, as a group, do not effectively mediate print with speech,” their ability to become normal readers is seriously impaired. In normal readers, the phonological and orthographic representation of words are so closely interrelated that they are usually coactivated, even when such coactivation may be misleading (Landerl et al. 1996). However, it is possible that this effect diminishes with maturity, which would explain the Twilley et al. (1994) findings. Supporting this is evidence from Coltheart (1980) that suggests that pre-lexical and post-lexical recoding play negligible roles in adult comprehension of single words. (In some models of

generative grammar, “pre-lexical” refers to the first stage in a two-stage generation of deep structures, in which phrase markers with terminal nodes are used to denote parts of speech. In the second “post-lexical” stage, lexical items are inserted into these positions. [Crystal, 1991, p. 274].) For access to lexical entries in lexical decision experiments, phonological recoding of visually- presented words was not a prerequisite (Coltheart, et al., 1979).

Three earlier studies that focus on homographs are particularly worth reviewing. The first is Rubenstein et al. (1970), which asked whether word recognition involved a search process that consulted the internal lexicon. Using a lexical decision task, they found that the more meanings a form had, the quicker it was recognized, and that homographs were recognized more quickly than nonhomographs. The authors speculated that the faster response times occurred because homographs have more entries in the mental lexicon than nonhomographs. The homographs in this study varied as to the *equiprobability* of the frequency of each meaning; both equiprobable and nonequiprobable homographs were used. It was found that homographs with equiprobable meanings had faster response times than those with nonequiprobable meanings.

Following this study, systematicity per se was addressed specifically in a second paper (Rubenstein et al. 1971). Again using a lexical decision task, here the question was whether the recognizability of a homograph was affected by relative frequency and/or by systematicity. While both studies found frequency of occurrence to be the most critical variable in word retrieval, in Rubenstein et al. (1971), frequency of meanings was found to be significant in recognition of unsystematic homographs only. Systematic homographs

(plow/plow) do not differ from nonhomographs, indicating that systematic homographs have fewer lexical entries than unsystematic homographs, which had just as many as nonhomographs. **One implication of this finding is that with systematic homographs, both forms, noun and verb, are stored as a unit.**

The third study that speaks to our particular interest is Forster and Bednall (1976), which also asked whether lexical access involves a search process. The first experiment, using an *ambiguity decision* task, asked whether an item had one meaning (L1) or more than one meaning (L2). (L1 and L2 are terms generally used to refer to first and second languages of bilingual speakers. Following Forster and Bednall, we are using it here to represent the two meanings of a homograph, where L1 has a frequency f_1 , L2 has a frequency f_2 , $f_1 > f_2$.) The items used in this experiment were ambiguous words, unambiguous words and orthographically legal nonwords (eg., *flink*, *scarmor*, p. 57). The ambiguous words in this experiment were unsystematic homographs. In this task, nonwords were classified faster than nonambiguous words. The second experiment, a *syntactic function* decision task, asked the subject to classify words according to their syntactic class (noun or verb. *the box* or *to box*). In this experiment, many of the words used were systematic homographs. In this task, nonwords were classified more slowly than nonambiguous words. For our purposes, the interesting findings were that there was no difference between nouns and verbs in the search process (i.e., as a class, neither was accessed more quickly than the other); that L1 was accessed faster with a homograph when compared to an unambiguous word; and, that both meanings of a homograph were accessed sequentially according to frequency of occurrence. The

unexpected finding was that in both experiments, access times for L1 and L2 were not positively correlated to frequency for systematic or nonsystematic homographs: the additional time required to access L2 was not predictable from frequency data, leaving the status of L2 unexplained. According to Forster and Bednall, "...accessing of the two meanings of a homograph appear to be quite independent events." (1976, p. 61) This conclusion would not be surprising with a model in which the verb meaning and the noun meaning of an unsystematic homograph are stored separately.

It would be appropriate here to review several studies that address the responses of aphasic subjects to homographs in a systematic way. Along with the abovementioned selective impairment with nouns or with verbs, it has been shown that aphasic subjects were less able than normal subjects to retrieve the various meanings of homographs. Pierce (1984) examined the influence of the following two factors on meaning-retrieval by aphasic patients: 1) the number of meanings associated with a homograph, and 2) the extent to which each meaning is used. Patients heard and were shown the target word and were asked whether different meanings were associated with that word. There were three correct meanings and five foils for each target word. Pierce found that, although aphasic subjects demonstrated a similar pattern of recognition to that of the normal controls, 1) they did not recognize the multiple meanings of homographs as accurately as did the normal subjects, and 2) recognition deteriorated when the meanings were less typical. Performance was not affected by the number of meanings associated with a homograph, except for meanings of low typicality in homographs having eight or more principal meanings. Aphasia type was not significant in influencing performance.

Sherman and Schweickert (1989) asked if Broca's aphasics relied on semantic constraints instead of syntactic information for sentence comprehension, as had been concluded from previous studies. The stimuli for the test that interests us, the Grammatical Category Set, were sentences using homophonic homographs that varied in their grammatical category membership. The words could be interpreted as either nouns or verbs, depending on sentence context. With cartoons as illustration, grammatical category membership was determined by the function word immediately preceding the sentence, as in "The girl likes the play" versus "The girl likes to play" (p. 429). Control subjects were 98.9% correct in their interpretation of the sentences; the aphasic subjects were 89.9% correct in their interpretation, indicating that the aphasic subjects were able to use function words to determine the grammatical category of the lexical items presented.

6) Summary

The literature that has been reviewed suggests that nouns and verbs are separate and separable grammatical entities. With respect to storage and retrieval, acquisition, neuroanatomy and breakdown, there is a fundamental difference in the two different word forms. Studies of homographs, the particular form that is the focus of this proposal, postulate contradictory models of storage, one holding that the form is stored as a single entity, all meanings included; the other model suggesting that each meaning is stored separately. By studying the retrieval of homographs by aphasic subjects with damage in different parts of the brain, purportedly, the "noun" center and the "verb" center, we hope to be able to find evidence in support of one model or the other, and to further our understanding of the organization of the mental lexicon.

CHAPTER THREE

RESEARCH PLAN

1) General description

To meet the goals of the study, the participants will be asked to perform a number of tasks that require them to select either the noun meaning or the verb meaning of the target word. The central question is this: How does the participant's noun or verb impairment affect the performance of the task? We would expect that the noun/verb imbalance would be reflected in a differential ability to retrieve either the noun or the verb meaning of the target word. By using frequency of occurrence as the chief variable, which tells us the likelihood of one form being chosen over the other, we will know from the participants' responses whether this variable is able to function as it would with a non-aphasic participant, or if the aphasic impairment has taken its toll. The responses will be analyzed statistically to discover whether there are significant differences in responses between participant populations with respect to grammatical class, and whether systematicity has an effect on word retrieval.

The hypotheses are as follows:

- 1) Fluent aphasic adults will tend to select the verb meaning over the noun meaning of a homograph, whereas nonfluent aphasic adults will tend to select the noun meaning.
- 2) The effect of frequency will prevail; the meaning with higher frequency will be selected over the meaning with lower frequency.
- 3) Systematicity will have an effect, though the nature of that effect cannot be predicted.

(See conflicting results, Rubenstein et al. [1971] versus Forster and Bednall [1976].)

4) The noun meaning of the homograph will be more robust than the verb meaning, and will be selected more often.

The questions are as follows:

- a) Is there selective impairment/sparing in the retrieval of nouns/verbs?**
- b) Is there differential retrieval between nouns and verbs in the two types of aphasia?**
- c) Is there selective impairment/sparing of systematic or unsystematic homographs?**
- d) Is there a difference in the two types of aphasia with respect to the selective retrieval of either systematic or unsystematic homographs?**
- e) Is there selective impairment/sparing in the retrieval of nouns/verbs per homograph-type, systematic versus unsystematic?**
- f) Does the effect of frequency vary with aphasia-type, grammatical class or the fact of systematicity versus non-systematicity?**

2) Participants

The participants will be aphasic adults who have suffered brain damage due to a single left-hemisphere cerebral vascular accident (CVA) that will have affected their capacity to comprehend and/or produce language. The participant pool will be drawn from the New York Metropolitan area and will be comprised of a minimum each of 15 nonfluent aphasic adults and 15 fluent aphasic adults. Age and gender will be noted but are neither inclusionary nor exclusionary criterional factors. Participants will be native speakers of English, raised and educated in the United States, with corrected hearing and visual acuity and discrimination within normal limits for their age. A minimum of a high school education will be required. Participants will be medically stable at time of testing.

Reference to medical records will provide the diagnosis of the aphasic type. (For our purposes, participants described as having Broca's or transcortical-motor aphasia will be considered "nonfluent"; those described as having Wernicke's, conduction, transcortical-sensory aphasia or anomia will be considered "fluent".)

3) Method

Participants will be asked to perform tasks that were developed in order to elicit a preference for either nouns or verbs. The materials consist of target words, homophonic homographs, positioned in a phrase or a sentence so to permit them to be interpreted as either verb or noun but not both. In all cases, it is expected that participants with noun impairment will show a preference for verbs disproportionate to verb dominance with respect to frequency, and those with verb impairment will show the opposite, a preference for nouns disproportionate to noun dominance with respect to frequency.

a) Frequency

A special section is being devoted to a discussion of frequency because of its importance to this study. The frequency of occurrence of a word in the language, in this case, written English, has shown itself to be the most robust factor in word retrieval: the higher the frequency of a given word, the faster and the greater the likelihood of its retrieval. This robustness has been demonstrated in studies with non-impaired populations (Bradley, 1980; Rubenstein, et al., 1970) as well as in studies of subjects with aphasia (Berndt, et al., 1997a; Berndt, et al., 1997b; Zingeser and Berndt, 1988; Zingeser and Berndt, 1990.) Word frequency is highly variable, from a word like *grunt*, which, as a

noun, has a frequency of one (per million, cf. Francis and Kucera, 1982) to *the*, which, stunningly, has a frequency of 69,975. (Britton, [1978], points out that 41% of the words in Francis and Kucera [1982], have a frequency of one per million.) Consulting Francis and Kucera as to overall representation of nouns and verbs, we find that nouns comprise 60% of the sum of nouns and verbs, verbs comprise 40%.

For the homographs in this study, the frequency of the word as a noun is often very different from the frequency of that word as a verb. For example, the word *wage* has a frequency of 95 as a noun; 11 as a verb. In this case, the noun form is more frequent than the verb form. In contrast, the noun frequency of *wash* is 28; its frequency as a verb is 83; its frequency as a verb is higher than its frequency as a noun. A third possibility is illustrated by the word *gulp*: both noun and verb meanings have a frequency of 3. There are thus three possible categories of homographs: in systematic pairs, the noun form can be higher than the verb form, the verb form can be higher than the noun form, or the noun form and verb form can be roughly equivalent in frequency. The same three groupings can be made with unsystematic pairs, giving us six sets in all. The manipulation of these disparities (or equivalences) can be expected to elicit differential responses, given the effect of frequency on word retrieval. As Bradley (1980) demonstrated, manipulation of frequencies can be used to powerful effect. Though she used reaction times to gauge responses, while we will be using choices, we have every reason to expect that the variable of frequency will serve our purposes as they did hers.

Though the frequency counts of the words in our stimulus list show ample variation, the range is within tighter boundaries than the range from *grunt* to *the*. On our list, the

homograph with the highest frequency is *time*, with a count of 1901, followed by *take*: 1575, *state*: 1421 and *fine*: 1033. (The latter is clearly not usable due to its trifunctional nature: noun, verb and adjective.) It should be noted that only 83 words in Francis and Kucera have frequencies of 1000 or more. An informal assessment of our sample suggests that at least 80% of the words have frequencies (in both noun and verb categories) of less than 100; there are many words with a frequency of one.

In an effort to impose some order to the range of frequencies, we will operationally classify the entries in terms of the ratio of noun to verb frequencies rather than by reference to specific numbers. In $N > V$ pairs and $V > N$ pairs, the N and V counts will differ at least fourfold. In $N \sim V$ pairs, the N and V counts will have a difference of less than twofold. We will attempt to be sparing in our use of words with very low frequencies, in order to avoid small number error. However, the attempt may be unrealizable, given the fact, as noted above, that many of the entries are words of low frequency.

There is another issue respecting the Francis and Kucera frequency tabulations that has to be dealt with. Taking the word *bite* as an example, we find, *bite*, noun, 9, broken down into *bite*, 3 and *bites*, 6. Under *bite*, verb, 26, we find the breakdown *bite*, 7; *bites*, 2; *bit*, 7; *bitten*, 3, *bit*, 1 and *biting*, 6. Which number are we going to use, and why? I have chosen to use the summation figure, in the case of *bite*, noun, 9 and verb, 26, following the principle that when inflectional processes are involved, the meaning doesn't change. Thus, all representations of *bit* are examples of use of the verb form/meaning of that homophone. ("It is to the stem that inflectional affixes are attached.", Crystal, 1991).

To reiterate, for purposes of this study, we will use the summation figures for verbs and nouns.

b) Stimuli

The experimenter has created a stimulus list of approximately 665 words, 505 (76%) of which are systematic, 160 (24%) unsystematic homographs. The frequency counts of their noun and verb meanings were taken from Francis and Kucera (1982). The following criteria have been observed:

- No nonhomophonic homographs (*tear N/ tear V*)
- No third-category (i.e., adjectival) meaning (*light: noun, verb, adjective*)
- All words must have frequencies reported in both noun and verb categories.
- Attempt to use a given word as a target only one time throughout the test.*
- Attempt to exclude idiomatic or colloquial use of words.
- Attempt to exclude prepositional/phrasal aspect of verbs ("*care for...*" inevitably creates ambiguity re noun versus verb meanings)

Presentation:

- Placement: Centered
- Font: Large and bold

* This is been effected in all but one category. U2, unsystematic homographs in which the verb meaning is of higher frequency than the noun meaning, proved particularly resistant to development. Given the requirement of the four-to-one ratio between verb and noun meanings noted above, 16, rather than the necessary 18, words were discovered. Thus, in this category only, duplication was unavoidable.

The attempt to exclude words that have both systematic and unsystematic meanings (*bank*) is noble, but unrealistic. Because such a huge proportion of homographic homophones are in fact both systematic and unsystematic, the best that can be hoped is that glaring examples like *bank* will be excluded. It would be narrowing the stimulus base too drastically to exclude less glaring examples, such as *lock* and *bolt*.

4) Procedure

The experiment will feature tasks that have been created to elicit contrasts between the two categories of noun/verb homographs. Participants will be presented with different kinds of phrases or sentences in a format which combines the visual with the aural; i.e., they will be presented with cards on which will be written phrases or sentences featuring the target words. At the same time, the experimenter will read aloud those same phrases or sentences. The stimuli will be presented to the participants in one-on-one individual sessions. There will be a introductory session, to introduce the experimenter to the participant and to help insure a comfortable rapport during the testing. At that session, a general explanation of the project will be provided, so that the participant will understand the nature of the experiment. The initial encounter will also enable the experimenter to screen out participants who are not suitable and cannot perform the tasks required. A Letter of Informed Consent will be presented, the contents and procedures read by the participant, and also read and explained to the subject orally. Pertinent medical and biographical information will be obtained.

The testing will be done under conditions that are comfortable and familiar to the participant. The words will be presented at a reasonable conversational level. The pace

will be set by the participants, who will be encouraged to take breaks if they feel fatigued or restless. They will also be advised that not only can testing be terminated at any time, but also that their participation in the project can be terminated without any prejudice to them or to their current or future treatment. There will be a pretest warm-up for each experiment to familiarize the participants with the nature of the specific task at hand. The participants will be required to respond to the requirements of the task using their extant language skills in comprehension and expression.

At the outset of testing, the participants will be told that they are going to be looking at words, and that words can have different meanings. For all tasks, they will first be shown the target word in isolation, printed on one side of the 5 ½" by 8" sheet. The tester will then turn the page over and present the other side, with the target word featured in either two phrases or sentences, or in a single sentence. This procedure will be followed for each word, each task. Two of the tasks follow a forced choice, two-item format. In these tasks, the participants will be asked to pick which of the two phrases or sentences has as use of target word that is most like the one that first comes to mind when they see it by itself. The third task asks the participant to paraphrase a sentence which is ambiguous as to the target word's grammatical category, which can be interpreted as either a noun or a verb. The phrases and sentences are all grammatically well-formed and presented in semantically acceptable conditions. Efforts have been made to eliminate combinations of words which are idiomatic or overly-familiar ("twist of fate"), and to keep the expressions emotionally neutral ("dress for dinner") rather than risk titillation ("dress to kill"). As stated above, it is expected that nonfluent aphasic adults will disproportionately select expressions that

feature the noun meaning, whereas fluent aphasic adults will select those that feature the verb meaning.

The instructions will be presented in language appropriate to the comprehension level of the participant. However, to ask an aphasic adult to perform an explicitly metalinguistic task may strain that person's already-restricted language resources, which includes a deficit in auditory comprehension (Friederici, et al., 1982; Wulfeck, 1988; Zurif and Grodzinsky, 1983). Further, an increase in communicative responsibility has been shown to be inversely proportional to success in test performance (Goldfarb, et al., 1994). "Communicative responsibility" refers to the demand for creativity in responding to a communicative task, how much information, initiative, output, etc., is required of the communicant. In the Goldfarb et al. study, five levels of probes at increasing degrees of communicative responsibility were presented to aphasic participants. The findings were that performance decreased with increased level of communicative responsibility.

5) Tasks

At this point, it might be useful to describe the prospective tasks in greater detail, in order to illustrate the way the homographic stimuli are going to be utilized. (For purposes of brevity, the following code will be used: N = noun; V = verb; S = systematic; U = unsystematic.) It should be noted that the participant will be asked to point in order to signal a preference rather than asked to "Fill in the blank" or "Make a check mark", which are more common ways of indicating choice. Because aphasia is often accompanied by hemiparesis or hemiplegia, i.e., partial paralysis of one side of the body, and because most

people are right-handed, patients who suffer an insult to the left side of the brain are often unable to write with their preferred hand.

As previously noted, the stimuli are divided into two groups, systematic and unsystematic homographs. These groups are further partitioned according to frequency of occurrence of noun meaning versus verb meaning, giving us 6 sets to work with: noun meaning of higher frequency than verb meaning ($N > V$); verb meaning of higher frequency than noun meaning ($V > N$); and noun meaning of similar frequency to verb meaning ($N \sim V$). (See above for categorization of frequencies.) The following terms are the code references for the sets:

- S: $N > V$ is S1; $V > N$ is S2; $N \sim V$ is S3.
- U: $N > V$ is U1; $V > N$ is U2; $N \sim V$ is U3.

For all tasks, the order of presentation of the cards will be predetermined to guard against list effects, and the sequence of presentation (first or second) of the noun- and verb-indicator phrases will be varied in a pseudo-random order throughout the test. The order of presentation is such that any target category set (say, U2), will be followed by at least two different sets before being repeated. There will be six tokens per set. The stimuli will be presented in 5 ½ by 8" loose-leaf binders. There will be a separate binder for each task, 3 tasks, 3 binders. Each stimulus item will be printed on a separate page. Each page will be enclosed in a transparent sheet protector.

TASK 1: (See Appendix for a list of all stimuli.)

The target word is set in two different phrases, one in which it features as a noun, the other as a verb. The participants will be asked to select the phrase in which the word was

used in a way that is closest to the meaning they thought of when they saw the word by itself. The specific instructions, presented in a conversational way, were as follows: “You are going to see a word all by itself. Think about what the word means to you. Then you’ll see the word used in two different ways. Which one is most like the one you thought of when you saw the word by itself?”

squash

Squash the bug. (verb)

Squash and beans. (noun)

TASK 2:

The target word is set in two different sentences, one in which it features as a noun, the other as a verb. The participants will be asked to select the sentence in which the word is used in a way that is closest to the meaning they thought of when they saw the word by itself. (See Task 1 for specific instructions.)

toast

They burn the toast. (noun)

They toast the winner. (verb)

TASK 3:

The target word is set in a single sentence in which it is featured in an ambiguous manner, so that it can be interpreted as either a verb or a noun. Originally the task was created to elicit a paraphrase from the participants. That proved to be unrealistic, well beyond the capabilities of these adults with aphasia. Thereupon the task was modified as follows: The target word is first seen capitalized, in a sentence. The sentence is read aloud

by the examiner. The participant then sees two interpretations of the sentence (as well as again hearing them read aloud), one in which the homograph serves as a noun, the other as a verb. The specific instructions for this task are as follows: “You are going to see a sentence with a word in capital letters. Think about what that word means to you. Then you are going to see two ways of understanding the word in the sentence. Which one is most like the one you thought of when you first saw the word?” Example:

They saw her CRASH at the corner.

...saw the accident.

... saw her bump into another car.

The use of *her* makes the sentence ambiguous as to the noun or verb meaning of the target word. Selection of the first phrase indicates that the target word, *crash*, was interpreted as a noun. Selection of the second phrase indicates that *crash* was interpreted as a verb.

6) Recording

For all tasks, there will be a Participant Response Record sheet which contains not only the target word but also the response words, the noun-indicator and the verb-indicator.

The examiner will check off the word the participant has selected as it is produced. There are four Practice Examples, A, B, C, and D, which can be recorded, but which will not be used for analysis. The results will be recorded by the experimenter as the test is progressing.

7) Data analysis

An analysis of variance (ANOVA) will be conducted comparing and contrasting the following variables:

A: Fluency (aphasia type)

B: Frequency

C: Systematicity

D: Task

The design will be a 2 (fluency) x 3 (frequency) x 2 (systematicity) x 3 (task) ANOVA, the first analysis between groups, the latter three repeated measures (between participants). The dependent variable is grammatical class, specifically verbs. Multiple means comparisons will be made. The results will be analyzed and discussed.

8) Specific methods to protect confidentiality and anonymity

As noted above, the participants will be asked to sign a Letter of Informed Consent before embarking on the project. The forms for the initial interview will contain the participant's name and other pertinent biographical information. The information will be kept in a locked filing cabinet. Records will be maintained for a minimum of 5-7 years, after which they will be destroyed.

The results will be treated with full confidentiality; the participants' identities will be coded. Records of their responses will be kept in a secure place and will be available only to the investigator of this study and to immediate members of her advisory committee. Experimental data will be identified only by the code initials of participants. Participants will never be referred to by name, either verbally or in writing. The data will be entered into PC programs for coding and analysis and will be transferred to computer disks as a precautionary measure against loss. The disks will be kept under secure conditions.

9) Results

A 2 X 3 X 2 X 3 ANOVA was done for all three tasks combined. The between-groups variable was Fluency, with two levels; repeated measures variables were Task (3 levels), Systematicity (2 levels) and Frequency (3 levels). As *verbs* were the dependent variable, and as there were six items in each set, a mean of 3 signifies that an equal number of verbs and nouns was selected; any number over 3 means that verbs were favored. To review, the two categories under Fluency were fluent (F) and nonfluent (NF) aphasic adults. The three categories under Frequency refer to the frequency of occurrence of the noun meaning as compared to the verb meaning: in Fr1, $N > V$, the noun meaning was (at least 4 times) more frequent than the verb meaning; in Fr2, $V > N$, the verb meaning was (at least 4 times) more frequent than the noun meaning; in Fr3, $N \sim V$, noun and verb frequency differ by less than twofold. The two categories under Systematicity were Systematic (S: *love/love* and *kiss/kiss*), and Unsystematic (U: *squash/squash* and *bolt/bolt*).

TABLE 1: Table of Means

Task	Fluency		Frequency			Systematicity	
	F	NF	Fr1	Fr2	Fr3	S	U
1. 3.01	3.16	2.85	3.07	3.35	2.60	2.76	3.24
2. 2.94	3.20	2.69	3.10	2.96	2.76	3.05	2.82
3. 3.35	3.50	3.20	3.10	3.70	3.23	3.30	3.40
M 3.10	3.29	2.91	3.09	3.34	2.86	3.04	3.15

Table 1, Table of Means, demonstrates the findings. Table 2 below, Tests of Effects, shows the significance levels of the differences within and between variables. Both Tables will be referred to in the following discussion.

TABLE 2: Tests of Effects

VARIABLES	SIGNIFICANCE
Task	.009
Task X Fluency	NS
Systematicity	NS
Syst X Fluency	NS
Frequency	.003
Freq X Fluency	NS
Task X Syst	.009
Task X Syst X Fluency	NS
Task X Freq	.042
Task X Freq X Fluency	NS
Syst X Freq	NS
Syst X Freq X Fluency	NS
Task X Syst X Freq	NS
Tsk X Syst X Frq X Flcy	NS
Fluency	.005

As seen in Table 2, the ANOVA revealed main effects of Fluency, Frequency and Task, and interactions of Task with Frequency and Task with Systematicity. With respect to Fluency, Table 1 shows that fluent participants preferred verbs to nouns, $M = 3.29$, and that nonfluent participants preferred nouns to verbs, $M = 2.91$; the differences are significant, $F(1, 2) = 9.331$; $p = .005$. It would seem, with 3 as the midpoint, that fluent participants preferred verbs more strongly than the nonfluent participants rejected them. It is also not surprising to find a main effect of Frequency, $F(2, 58) = 6.282$; $p = .003$; the

literature is quite clear that the frequency of occurrence of a word in the language is the most robust variable affecting its retrieval. There was an expectation that Systematicity would be a factor in word retrieval; the fact that it was not significant is both interesting and surprising. It is also surprising to find a main effect of Task, $F(2, 58) = 5.119$; $p = .009$. Although it was apparent that the tasks differed from one another, it was not anticipated that Task would be significant nor that there would be significant interactions with other variables. In fact, there were significant interactions of Task with Frequency, $F(4, 116) = 2.557$; $p = .042$, and of Task with Systematicity, $F(2, 18) = 5.119$; $p = .009$.

The finding that Fluency is significant was not unanticipated. As illustrated in the Literature Review, it is well-accepted that nonfluent aphasic adults are more impaired in their processing of verbs than of nouns, whereas fluent aphasic adults are more impaired in their processing of nouns than of verbs. (Another way to look at it is that fluent aphasic adults are less impaired in their processing of verbs than are nonfluent aphasic adults.) It is notable that fluency, a major variable, did not interact with any other variable. Apparently, in this study, the effect of fluency is so strong that it persists across all variables.

TABLE 3: Fluency/Frequency Means

Frequency	Fluent	Nonfluent	Mean
Fr1 (N>V)	3.28	2.89	3.09
Fr2 (V>N)	3.57	3.12	3.34
Fr3 (N~V)	3.02	2.71	2.86
Mean	3.29	2.92	3.10

With respect to Frequency, if participants performed perfectly according to type, one would expect fluent participants to prefer verbs in all cases, nonfluent participants to prefer nouns in all cases. That being improbable, one might at least expect that the fluent participants would prefer verbs in Fr2 ($V > N$), while the nonfluent participants would prefer nouns in Fr1 ($N > V$). One might also expect Fr3 ($N \sim V$) to fall somewhere between Fr1 and Fr2 for both groups. Though this pattern held in some cases, in others, contradictory results were found. While there is a significant main effect for Frequency, $F(2, 58) = 6.282$; $p = .003$ (see Table 2, Tests of Effects), paired samples t -test revealed significant differences between Fr1, $M = 3.08$, and Fr2, $M = 3.35$, $t_{58} = -2.123$; $p = .042$ and between Fr2, $M = 3.35$, and Fr3, $M = 2.89$, ($t_{58} = 4.226$; $p = .0001$) but not between Fr1 and Fr3 (see Table 3, Fluency/Frequency Means).

Because it proved to be a significant main effect, it is worth reviewing the Task variable at this juncture. A brief description of the nature of each task will be followed by an analysis of the findings. The Tasks were not only different from one another, but were presented in order of complexity. In Task 1, two 3-word phrases (with the exception of an occasional 4-word phrase) were contrasted with one another. And while it is true that one phrase was grammatically more “complete” than the other (“squash the bug” versus “squash and beans”), presentationally they were quite similar. Task 2 presented two sentences, each grammatically complete, matched for content and sentence-length as closely as possible (“The hunters track the scent.” versus “The hunters follow the track.”). Task 3 presents an ambiguous sentence in which the ambiguity in and of itself provides a challenge (“He saw her dress in the bedroom.”).

TABLE 4a: Paired Samples Test of Differences

Pair	Tasks	Sig.
1	1 vs 2	.665
2	2 vs 3	.004
3	1 vs 3	.010

Table 4a, Paired Samples Test of Differences, reveals significant differences between Tasks 2 and 3 ($t_{30} = 3.098; p = .004$) and Tasks 1 and 3 ($t_{30} = -2.755; p = .010$) but not between Tasks 1 and 2.

TABLE 4b: Task Significance Levels

Task	Systematicity	Frequency	Fluency
One	.001	.005	NS (.059)
Two	NS	NS	.041
Three	NS	.016	NS

To investigate the interaction between Task and the other variables, a 2 X 3 X 2 ANOVA was done for each task individually. The between-groups variable was Fluency, with 2 levels; repeated measures variables were Frequency, with 3 levels, and Systematicity, with 2 levels. Table 4b, Task Significance Levels, reveals that in Task 1, there was a significant effect of Frequency, $F(2, 58) = 5.924; p = .005$, and of Systematicity, $F(1, 29) = 12.718; p = .001$. A paired samples *t*-test of Frequency revealed that Fr1 did not differ significantly from either Fr2 or Fr3, but there was a significant difference ($t_{30} = 3.3795; p = .002$) between Fr2 ($M = 3.35$) and Fr3 ($M = 2.60$) (see Table 1, Table of Means).

TABLE 4c: TASK 1: Systematicity/Frequency Means

Frequency	Systematic	Unsystematic	Mean
1 (N > V)	2.80	3.23	3.02
2 (V > N)	3.14	3.58	3.36
3 (N ~ V)	2.36	2.90	2.63
Mean	2.76	3.24	3.0

Notably, Task 1 is the only task in which Systematicity is significant. A paired samples *t*-test revealed a significant difference between Systematic and Unsystematic categories ($t_{33} = -3.539; p = .001$), the preference being for the verb meaning of Unsystematic compared to Systematic words. Apparently, in this most basic Task, the contrast between the two categories was compellingly in favor of Unsystematic ($M = 3.24$) rather than Systematic ($M = 2.76$) verbs (see Table 4c, Systematicity/Frequency Means).

TABLE 5a: Fluency/Frequency Means: TASK 1

Frequency	Fluent	Nonfluent	Mean
1 (N > V)	3.14	2.90	3.02
2 (V > N)	3.60	3.13	3.36
3 (N ~ V)	2.74	2.53	2.64
Mean	3.16	2.85	3.01

Even though there was no Task by Fluency interaction, we decided to look at the fluency effect within each task. In Task 1, it approached significance, $F(1, 29) = 3.850; p = .059$ (see Table 5a, Fluency/Frequency Means, Task 1).

TABLE 5b: Fluency/Frequency Means: TASK 2

Frequency	Fluent	Nonfluent	Mean
1 (N > V)	3.34	2.88	3.11
2 (V > N)	3.24	2.69	3.01
3 (N ~ V)	3.04	2.50	2.77
Mean	3.20	2.69	2.94

Task 2 was the only Task in which Fluency was significant, $F(1, 29) = 4.574; p = .041$, and was also the only task in which neither Systematicity nor Frequency were significant. Referring to Table 5b, Fluency/Frequency Means, Task 2, it is evident that fluent participants preferred verbs in all three frequency categories ($M = 3.20$), while nonfluent participants preferred nouns in all three frequency categories ($M = 2.69$).

TABLE 5c: Fluency/Frequency Means: TASK 3

Frequency	Fluent	Nonfluent	Mean
1 (N > V)	3.32	2.88	3.10
2 (V > N)	3.87	3.53	3.70
3 (N ~ V)	3.32	3.19	3.25
Mean	3.50	3.20	3.35

In Task 3, as in Task 1, Fluency was not significant, but there was a significant effect of Frequency, $F(2, 58) = 4.412; p = .016$. A paired samples *t*-test revealed that Fr1 ($M = 3.10$) differed significantly from Fr2 ($M = 3.70$), $t_{28} = -3.045; p = .005$, and Fr2 differed significantly from Fr3 ($M = 3.25$), $t_{28} = 2.065; p = .048$, but Fr1 and Fr3 did not differ significantly from one another (see Table 5c, Fluency/Frequency Means, Task 3). Of the three Tasks, Task 3 called forth the strongest preference for verbs, as reflected in the

overall means, $M = 3.35$. In this Task, fluent participants selected verbs over nouns in every single category, and nonfluent participants selected verbs in 7 out of 9 categories.

At this point, a brief review of grammatical-class preference of each Task might be useful. In Task 1, participants were asked to choose between two phrases, both, on the surface, quite similar to one another. Given this choice, they more or less came down squarely in the middle, selected a virtually equal proportion of nouns and verbs ($M = 3.01$). Task 2 presented two sentences, again superficially not terribly different from one another. Yet here, verbs were underselected. In sentences such as, “We *milk* the cow.” versus “The cow gives *milk*.”, the noun meaning was slightly stronger ($M = 2.94$). In Task 3, ambiguous sentence such as, “They saw her *head* through the crowd.”, “They heard her *laugh* again.” and “He watched her *farm* through the Winter.”, elicited a higher mean number of verbs of any of the Tasks ($M = 3.35$). One would not necessarily expect ambiguity to lead towards the verb meaning, yet this is what was found. This touches on one of the most interesting findings of this study, the robustness of verbs. The Grand Mean, $M = 3.10$, is quite unexpected. If anything, it was anticipated that nouns would prevail; after all, the literature suggested that verbs would be less robust than nouns. A fuller consideration of these effects will be conducted in the Discussion section.

As a coda, it is worth mentioning briefly that additional analyses were made of “Participants Minus Outliers” data. There were four participants who performed uncharacteristically, preferring the opposite grammatical category from that which was expected from their aphasic type: three in the nonfluent group, one in the fluent group. It was feared that the presence of outliers would dilute the significance of the differences.

Thus, it is especially notable that the effects including these outliers are as strong as they are. In fact, rather than sharpen the effects, eliminating the outliers attenuated all the effects except Fluency, in which the significance for "All Participants" was $F(1, 29) = 9.331; p = .005$, for "Participants Minus Outliers", $F(1, 25) = 40.171; p < .0001$.

10) Discussion

The purpose of this study was to examine the effect of aphasia on the retrieval of nouns and verbs. The stimuli were homophonic homographs, words that are ambiguous as to grammatical category and that are orthographically and phonologically indistinguishable from one another. The reason for using homographic homophones was to neutralize the effects of phonology and orthography. There was an additional variable--*systematicity*, which describes the relationship between the noun and verb meanings of the word, systematic words having a transparent relationship to one another, as in *love/love*; unsystematic words having no apparent relationship to one another, as in *sink/sink*. There were three tasks of ascending complexity, in each of which the target word was featured in two contexts, or in an ambiguous context. The first task consisted of two short phrases in which the target word served as noun in one, verb in another. The second task displayed the target word in two different sentences, again featured as noun in one, verb in another. The third task featured the target word in a single ambiguous sentence in which the word could be interpreted either as a verb or as a noun. In all tasks, the participants were asked to select the setting or usage that seemed most appropriate to them. The words were presented visually and were simultaneously read aloud by the examiner. The participants were fluent and nonfluent aphasic adults. Because the former are considered to be more

impaired with respect to nouns and the latter with respect to verbs, aphasic adults were deemed to be a uniquely suitable subject population to examine the neurolexical status of these two grammatical categories.

The theoretical framework of the study is that nouns are processed, stored and retrieved separately from verbs, implying separate status in the mental lexicon. The hypotheses motivating this study are: 1) fluent aphasic adults will tend to select the verb meaning over the noun meaning of a homograph, whereas nonfluent aphasic adults will tend to select the noun meaning; 2) the effect of frequency will prevail; the meaning with higher frequency will be selected over the meaning with lower frequency; 3) systematicity will have an effect, though the nature of that effect cannot be predicted; and 4) the noun meaning of the homograph will be more robust than the verb meaning, and will be selected more often.

a) Fluency

Compelling evidence was found for the first hypothesis. There was a main effect of fluency. However, although one participant group, fluent aphasic adults, selected the verb meaning over the noun meaning, the other group, nonfluent aphasic adults, did not respond in kind; they did not select the noun meaning over the verb meaning. This is notable because, given the hypothesis that nouns would be more robust than verbs, it was anticipated that, of the two groups, the nonfluent participants would benefit from the expectation of noun robustness as well from their own (putative) predilection and select nouns. (Further discussion of verb strength below.) Fluent participants preferred verbs in all three Tasks. Nonfluent participants were less consistent, selecting nouns (as would be

expected) in Tasks 1 and 2, but selecting verbs in Task 3 (see Table 1, Table of Means). As was noted in the Results section, it would appear that the fluent participants preferred verbs more strongly than the nonfluent participants rejected them.

This view is somewhat at odds with that of Daniele, et al. (1994), who found that, whereas the two nonfluent patients had virtually no errors in noun production, the fluent noun-impaired patient also had trouble with verbs, leading them to conclude that verbs present a processing challenge to even typically typically noun-challenged patients. The finding in this study suggests that verb-impaired patients had trouble with nouns. Even more, it questions the generally-accepted view that verbs are difficult to process for aphasic adults of any type whereas nouns are difficult for fluent aphasic adults only. In a paired sample test of differences, the fluent subjects in this study selected verbs significantly more than they selected nouns, $t_{14} = 4.236$; $p = .001$, suggesting that for this group of subjects, verbs were more accessible than were nouns.

b) Frequency

The second hypothesis was grossly confirmed. There was a main effect of frequency, but surprisingly, given its status as the most robust of variables, it did not prevail in every task. It was significant in Task 1 and in Task 3, but not in Task 2. Also surprising, the expectation that the noun meaning would prevail in Frequency level 1 ($N > V$) and that the verb meaning would prevail in Frequency level 2 ($V > N$), and that Frequency level 3 ($N \sim V$) would see figures somewhere between those of Frequency levels 1 and 2, were not met. In fact, the noun meaning in Frequency level 1 ($N > V$) did not prevail in any of the Tasks. The verb meaning in Frequency level 2 ($V > N$) prevailed, as expected, in Tasks 1

and 3, but not in Task 2. In Frequency level 3 (N ~ V), the noun meaning prevailed in Tasks 1 and 2, the verb meaning in Task 3.

This inconsistency was not expected. As reported earlier, the robustness of frequency as a paramount factor in word retrieval has been demonstrated in studies with aphasic adults (Berndt, et al., 1997a; Berndt, et al., 1997b; Zingeser and Berndt, 1988; Zingeser and Berndt, 1990.) as well as with non-impaired subjects (Bradley, 1980; Rubenstein, et al., 1970). In Zingeser and Berndt (1988), we read that “frequency was a strong predictor of performance” (p. 483). Bradley (1980) talks about the “*frequency effect*” (her italics), describing the regularity of the association between the frequency of occurrence of a word and the reaction time for its categorization. It was expected that the manipulation of frequencies, used to such strong effect by Bradley, would have an equally robust effect here.

Looking to the literature for support for our findings, we recall that in a study featuring ambiguous words, it appeared that frequency was not a predictor of access time (Forster and Bednall, 1976). Orpwood and Warrington (1995) concluded that, “For nouns, there were no significant effects of frequency. For verbs, only written naming showed a significant frequency effect” (p. 251). Further, many of the studies (Forster and Bednall, 1988; Zingeser and Berndt, 1988; Zingeser and Berndt, 1990) used two groups of words, high and low frequency. In this study, the concern was the relationship between frequencies rather than their absolute values. Our finding was that the mean of Frequency level 1 (N > V) was essentially flat, the mean of Frequency level 2 (V > N) favored verbs,

and the mean of Frequency level 3 (N ~ V) favored nouns. We conclude that frequency did not figure as strongly in this study as it has in other studies.

c) Systematicity

There was no main effect of Systematicity, its only significance being in an interaction with Task in Task 1. Although the hypothesis did not predict the nature of effect of Systematicity, it is surprising how irrelevant it actually proved to be. The thinking was that either one type or the other would prevail, as follows: (Given that the dependent variable is verb meaning, it is the sparing/impairing of the verb meaning that is being considered.)

- The verb meaning of an unsystematic homograph is *more* vulnerable to breakdown than that of a systematic homograph:

The homophony/homography between the two (or more) forms of an unsystematic homograph is purely accidental and are the only features that they share. Since the words are otherwise completely unrelated, there is nothing to link them together once one meaning-form is lost. In contrast, systematic homographs, derivative and highly productive, are identical not only phonologically but also semantically. It is entirely possible that some vestige of the intimate meaning-association would serve as a preservative, and render them less vulnerable to dissolution than unsystematic homographs.

- The verb meaning of an unsystematic homograph is *less* vulnerable to breakdown than that of a systematic homograph.

Since phonological identity is the only tie binding unsystematic homographs, there is no reason to expect that damage to one form to have any effect on the retrieval of the other

form. In contrast, because the two meaning-forms of a systematic homograph are closely related, are, in fact, derivative, it seems plausible to assume that damage to one meaning-form would affect the retrieval of the other meaning-form.

The reason our hypothesis offered no prediction was that the literature, sparse as it was, was ambivalent as to the actual effect of systematicity. Rubenstein et al. (1971) suggested that with systematic homographs, both forms, noun and verb, are stored as a unit. The implication of this is that there is a mutual dependency between noun and verb meaning, and that they are spared or impaired as a unit. In contrast, Forster and Bednall (1976) found that access to one meaning was independent of access to the other, allowing the conclusion that the two meanings are stored separately. Further, in Sherman and Schweickert (1989), aphasic participants were able to use function words to determine the grammatical category of the homographs. Although our format was slightly different--“We milk the cow.” versus “The cow gives milk.”--the participants in this study did not show the same kind of grammatical sensitivity. We have to conclude, from the lack of evidence of significant differences between systematic and unsystematic homographs, that grammatical category so far eclipses homographic similarity/dissimilarity, as to render it virtually meaningless in word retrieval. With respect to an issue of expressed interest, the organization of the mental lexicon, the findings of this study suggest that separate storage is the most reasonable explanation for the lack of effect of systematicity. The null hypothesis, that vulnerability to breakdown is totally dependent on grammatical class membership and is not affected by the systematic or unsystematic nature of the relationship between noun and verb, prevails.

d) Verbs versus Nouns

The fourth hypothesis was not confirmed. The verb meaning of the homograph proved to be more robust; contrary to expectations, it was selected more often than the noun meaning. The vigor of verbs as manifest in this study is at odds with the entire bent of the literature on nouns and verbs. In the Literature Review, study after study testified to the greater complexity and vulnerability of verbs. As was noted above, verbs are widely held to be more abstract, less memorable and more difficult to interpret than nouns, harder to translate and retranslate than nouns, more variable in meaning and having a greater range of meaning than nouns, and used more broadly by both children and adults than nouns (Bates et al. 1991; Berndt et al. 1997; Gentner, 1978; Gentner, 1981; Gentner, 1982; Gomes et al. 1997; Pease et al. 1989; Reyna, 1987; Rice and Bode, 1993; Rice et al. 1994; Watkins, Rice and Moltz, 1993, among others). Aphasic adults often use general nouns such as *thing* and *stuff* as substitutes for more specific nouns. Specific language impaired children tend to rely on a few general purpose verbs such as *put* or *get* as replacements for more specific verbs (Watkins, Rice and Moltz, 1993; Rice and Bode, 1993).

The strength of verb retrieval in aphasia is surely the most interesting finding in this study. It is possible that because fewer verbs are used more heavily than multiple nouns, they are actually more imbedded in the mental lexicon than are nouns. (See Gentner, 1982, who pointed out that adults use a small number of verbs frequently and a larger number of nouns less frequently.) It is also possible to think of verbs as more immutable than nouns, having more of a closed-class nature than do nouns; it is easier to think of new nouns that

have come into the language than new verbs. If the results of this study persist over other studies using similar material, we may have to modify our thinking about grammatical category retrieval in aphasia. To quote Berndt, et al. (1997b), "...selective and consistent difficulty with the production of verbs and nouns was not perfectly correlated with the clinical classifications of the patients" (p. 129).

e) Task

As was mentioned in the Results section, the main effect of Task was unexpected. The reason for using more than one task was to present the nouns and verbs in a variety of formats, the thought being that presenting 106 different words in the same context (three-word phrase, Task 1) would be boring and repetitive. In fact, the contexts were apparently different enough to elicit significantly different results, and this warrants commentary. Task also was examined with respect to the other variables of fluency, frequency and systematicity, and the results of these associations are also worth noting.

Task 1 was the first conceived, was the Task used in the Pilot Study, and was carried through the testing virtually unchanged. It was the least demanding task, ostensibly providing a simple choice between one phrase and another. With a mean of 3.01 (see Table 1, Table of Means), it also elicited the least divergent responses from the midpoint of 3.0, the nonfluent participants underselecting verbs to the same degree as fluent participants overselected verbs. Of the three tasks, it was the only one with more than one significant interaction: although there was no interaction with Fluency, Task 1 had significant interactions with both Frequency and Systematicity (see Table 4b, Task Significance Levels). Whereas nouns were unexpectedly underselected in Frequency Level

1 ($N > V$), and were expectedly underselected in Frequency Level 2 ($V > N$), they were overselected in Frequency Level 3, the Level in which nouns and verbs have about the same frequency of occurrence.

Task 2 increased the complexity by presenting two sentences rather than two phrases. Although the effects are not evident in a between-task analysis (Task 2 did not differ significantly from Task 1, [see Table 4a, Paired Samples Test of Differences], the fluent participants appearing to overselect verbs to about the same degree as the nonfluent participants overselected nouns), an ANOVA reveals that Fluency was significant in this task (see Table 4b, Task Significance Levels). Apparently, in the sentential context, presented with two competing possibilities, nonfluent participants had significant difficulty selecting verbs. Zingeser and Berndt (1990) anticipated this in suggesting a link between poor verb retrieval and poor sentence production. At least in Task 2, this suggestion was borne out.

Paradoxically, in Task 3, with only a single sentence, verbs were selected more often than nouns. Whereas the nonfluent participants underselected verbs in the first two tasks, all participants overselected verbs in Task 3. Apparently, the fact of ambiguity in and of itself would appear to have favored verbs. This may be attributable to the fact that verbs carry a greater range of meaning per word than do nouns. Encased in ambiguity, the word-form lends itself to more multiple interpretations as a verb than as a noun.

f) Anecdote

Although not statistically significant, several participants, all fluent aphasic adults, demonstrated interesting effects. Two participants, one incident each, while selecting the

noun meaning, changed the noun to a verb in repeating the phrase, as in “Stack of cards” becoming, “Stack *the* cards”. Another participant, selecting the verb meaning, added the article “the” while reading two phrases, “*the* cut of veal...” and “*the* bolt of cloth...”, thus strengthening the *nounness* of the noun. While this is insufficient material for theory, it goes to suggest that verb and noun categorization may be unexpectedly fluid in aphasic grammar.

g) Clinical implications

There are strong implications for therapy in these efforts to understand the working of the brain. Knowledge of language processing makes it easier to communicate with and help clients. Understanding the effects of different types of brain damage is helpful in targeting specific areas of therapy. Appreciation of limitations due to the reduction of efficiency in the processing of language should allow for a more productive allocation of therapeutic resources. Awareness of patients’ difficulties may avoid the expenditure of energy on rehabilitation efforts that prove futile and end in frustration. Because nouns and verbs are so central to language, and because specific types of brain damage typically result in a deficit in at least one of these categories, it is important to know as much as possible about them if we are to be maximally effective in our therapy.

h) Suggestions for future research

One suggestion for future research would be to use this stimulus material with other neurogenically impaired populations, patients suffering from Alzheimers Disease, Multi-Infarct Dementia, Traumatic Brain Injury, or schizophrenia. These studies might lead to improved differential diagnosis of language impairment in adults with neurogenic

communication disorders. For example, Goldfarb, et al. (1994) found significant differences in communicative responsibility and semantic ability when comparing aphasic adults to adults with chronic undifferentiated schizophrenia. Goldfarb and Goldberg (2001) found differential patterns of impairment in adults with multi-infarct and Alzheimer's Dementia, using the above measures.

Another application of this material would be to focus on modality. As has been demonstrated, the impairment or sparing of words in a grammatical category may vary depending on modality (see Caramazza and Hillis, 1994; Hillis and Caramazza, 1991). Rather than present the material both visually and auditorily, as was done in this study, it could be presented in either modality alone, or both modalities separately. Different tasks, such as oral reading, repetition and writing to dictation, might be expected to elicit different effects.

Finally, a strong recommendation for research might be to test nonaphasic control participants using the same material. It is true that the purpose of this study was to examine the effects of aphasia on language. But the variables of frequency, systematicity and task, and the underlying issue of grammatical category, are interesting in and of themselves, and are too important to limit to a specific population. The original plan for Task 3 was to have the participants respond to the ambiguous sentence with a paraphrase, the nature of the paraphrase signalling whether the target word was interpreted as a verb or as a noun. This plan could be executed more easily with a non-impaired population. With respect to the variables, this study suggests that word frequency is not quite so robust a factor in word retrieval. The effect of systematicity, which appears to divide

words so neatly (*squash/ squash* versus *love/love*) was virtually ignored in the present study. This study suggests that the nature of the task--phrases versus sentences, for example--has an effect on the outcome of results. Having a participant base of non-language disordered adults would surely serve to clarify the effects of these variables even more forcefully.

CODA: Pilot Study

A Pilot Study, a full description of which is included below, has been conducted, using the methodology and materials in Task 1: Complete the Phrase. The results of that study will be used to inform the development of the other three tasks, especially with respect to stimulus material. Because there were some significant effects that came out of the study, we have renewed confidence in our thesis and in the material used to test that thesis. However, some of the couplets proved to be less successful than others in eliciting differential responses from the subjects. Since one function of a pilot study is to reveal the errors of our ways, we made the amendments and changes as needed in order to make each task as clean and well-designed as possible.

CHAPTER FOUR

PILOT STUDY

The topic of this study is Grammatical Category Ambiguity in Aphasia, namely, the effects of aphasia on the retrieval of nouns and verbs. It has been demonstrated that the processing of nouns and verbs can be selectively affected in aphasia; fluent aphasic adults tend to be more impaired in their retrieval of nouns, whereas nonfluent aphasic adults tend to be more impaired in their retrieval of verbs. The theoretical framework of the study is that nouns are processed, stored, and retrieved separately from verbs, implying separate status in the mental lexicon. The disparity between the two grammatical classes is displayed particularly well in English, in which, unlike more morphologically complex languages, the same word can serve as both noun and verb (or as adjective), depending on context. It is hoped that the noun/verb disparity can be demonstrated with special clarity by using these homographs, and that studying the retrieval of homographs by aphasic adults will add to our understanding of the system of lexical organization in the brain.

The stimuli being used are homophonic homographs, words that are spelled and pronounced the same. The contrast being employed is the putative difference between systematic pairs, like *kiss/kiss* and *love/love*, in which the noun and verb meanings are transparently related, and unsystematic pairs, like *steer/steer* and *sink/sink*, in which the noun and verb meanings are unrelated. It might be expected that the fact of systematicity would have an effect on the processing of noun or verb meaning, making the pair either more or less vulnerable to neurological damage.

Hypotheses:

- 1) **Aphasia type:** Fluent aphasic adults will tend to select the verb meaning over the noun meaning of a homograph, in contrast, nonfluent aphasic adults will tend to select the noun meaning.
- 2) **Systematicity:** Systematicity will have an effect, although the effects cannot be predicted in advance.
- 3) **Grammatical class:** The verb meaning of the homographic pair will have a greater spread of responses than the noun meaning. (The standard deviation for verbs will be greater than for nouns.)
- 4) **Frequency:** The effects of frequency will be more robust with unsystematic than with systematic homographs, since their meanings are completely unrelated.

METHODS:**Task: COMPLETE THE PHRASE****Subjects:**

8 non-fluent and 4 fluent aphasic adults, tested at the Lehman College Speech and Hearing Center.

Organization:

The frequency of occurrence of a word in the language, in this case, written English, has shown itself to be the most robust factor in word retrieval: the higher the frequency of a given word, the faster and the greater the likelihood of its retrieval. In the development of the stimuli, the concern was not frequency per se, but the relationship between the frequencies of the noun and verb meanings of the word. Thus, we have six sets as follows:

- Two groups: Systematic (S) and unsystematic (U) homographs.
- Three frequency orderings (sets) per group: Noun > Verb, Verb > Noun, Verb ~ Noun

Material:

In all tasks, the subject will be asked to make a choice between two phrases or sentences, each featuring a homograph as its target. The ambiguity of the homograph makes either a noun or a verb interpretation plausible. Each phrase/sentence will be printed on a separate 5" by 8" card, and be presented individually to the subject. There will be 36 cards, 6 cards per set per task. Each card will feature the target word plus two continuations (conditions) for that word. The order of presentation of the cards is predetermined in order to guard against list effects, and the sequence of presentation (first or second) of the noun-indicator and verb-indicator phrases will be varied in a pseudo-random fashion throughout the test.

Task 1: Complete the Phrase: The subject was asked to indicate which of two continuations (conditions) best completed the target word.

Fear.....

the truth

of mice

In this example, in the first condition, "...the truth", the target word "Fear", is being used as a verb. In the second condition, "...of mice", the target word is being used as a noun.

Procedure:

Subjects were tested individually, and were presented with the cards, one by one, subjects had difficulty reading, the examiner read the material to the subjects as follows: "Fear the truth.", "Fear of mice." The subjects indicated their choice by pointing to or by repeating the phrase that they had selected. Both phrases are semantically acceptable, though not syntactically equivalent: the verbal phrase is a complete sentence, while the nominal phrase is grammatically incomplete.

Recording:

There was a Subject Record Sheet for each respondent, with all choices listed. The examiner recorded each selection as it was presented.

Results:

An analysis of variance (ANOVA) was conducted comparing and contrasting the following variables: aphasia type, systematicity, frequency. The dependent variable was grammatical class, specifically verbs. The design was a 2 (aphasia groups) x 2 (systematicity) x 3 (frequency) ANOVA, the first analysis being between groups, the latter two being repeated measures (between subjects). Multiple means comparisons were made. Standard deviations were examined. The results were analyzed and discussed.

*** NOTE:** For the formal study, the testing procedure will be amended as follows: At the outset, the subjects will be told that they are going to be looking at words, and that a word in isolation can have different uses. They will be asked to pick the phrase or sentence that has a use of the word that is most like the one that first comes to mind when they see it by itself. Two-sided cards will be used, with the target word on one side, and in its two settings on the other side. For each item, the subject will first be shown the word in isolation. Then the card will be turned over and the subject will see the word in its forced choice, two-item format. This procedure will be followed for each word, each task.

The first set of three analyses was Pair Type (re frequency relationships) x Aphasia Type:

TABLE 1:

S1 and U1: Nouns > Verbs

Subject Type	N	Verbs M	Nouns M	SD
Fluent	4	7.50	4.50	1.29
Nonfluent	8	5.63	6.37	1.69

There were no main effects for frequency or aphasia type, but the interaction between frequency and aphasia type was significant, $p < .05$ (.0120).

TABLE 2:

S2 and U2: Verbs > Nouns

Subject Type	N	Verbs M	Nouns M	SD
Fluent	4	6.25	5.75	.96
Nonfluent	8	6.88	5.12	1.36

When verbs have higher frequency than nouns, the differences between fluent and nonfluent aphasic subjects were more clearly exposed: $p < .05$ (.0159).

TABLE 3:

S3 and U3: Nouns ~ Verbs

Subject Type	N	Verbs M	Nouns M	SD
Fluent	4	6.25	5.75	.50
Nonfluent	8	5.25	6.75	1.39

When noun and verb frequency is at relative parity, there was no significant main effect or interaction for grammatical class versus aphasia type.

TABLE 4:**Grammatical Class x Aphasia Type**

Subject Type	N	Verbs M	Nouns M	SD
Fluent	4	20.00	16.00	2.16
Nonfluent	8	17.75	18.25	2.49

There were no main effects, but the interaction between aphasia type and grammatical class was significant, $p < .05$ (.0403), the fluent subjects showing a preference for verbs, the nonfluent subjects showing a preference for nouns. There were no significant main effects nor interactions when examining ANOVA for systematicity vs aphasia type.

DISCUSSION:

The hypothesis that fluent aphasic adults are less impaired with respect to verbs, nonfluent aphasic adults with respect to nouns, was upheld by the results. These results are especially notable given that the verb phrase in our stimuli was grammatically more complete than the noun phrase, which syntactic imbalance favored verb preference by all subjects. That we found any significant difference at all testifies to the true disparity in noun/verb retrieval of aphasic subjects. Fluent aphasic subjects selected the verb meaning over the noun meaning in all conditions, with the greatest difference in means occurring when the verb meaning was of greater frequency than the noun meaning ($VM = 7.50$ to $NM = 4.50$). When the verb meaning was of greater frequency or similar frequency to the noun meaning, the differences were smaller ($VM = 6.25$ to $NM = 5.75$, in both cases). The nonfluent aphasic subjects favored the noun meaning over the verb when the noun meaning was of higher frequency ($NM = 6.37$ to $VM = 5.63$), favored the verb meaning

over the noun meaning when the verb meaning was of higher frequency ($VM = 6.88$ to $NM = 5.12$), and favored the noun meaning when noun and verb meanings were of similar frequency ($NM = 6.75$ to $VM = 5.25$). Preference for nouns was demonstrated in two cases, but not in the third. From this very scanty evidence, it would appear that the nonfluent subjects were more sensitive to frequency effects than were the fluent subjects, who selected verbs over nouns in all cases.

There was no significant relationship between systematicity and grammatical class, thus we have no evidence for the hypothesis that systematicity is a factor in word retrieval. The results of this study suggest that vulnerability to breakdown is associated with grammatical class membership and is not affected by the systematic or unsystematic nature of the relationship between noun and verb.

The most unexpected finding stemmed from differences in standard deviations: in pairs in which the verb meaning was of higher frequency than the noun meaning, the standard deviation was 1.23; in pairs in which the noun meaning was of higher frequency than the verb meaning, the standard deviation was 1.76. Thus, responses when the verb meaning was of higher frequency showed less spread than when the noun meaning was higher. Readings in the literature suggested that verbs are more difficult and more complex than nouns, leading us to expect that, all things being equal, the verb meaning of a homograph would be more vulnerable to dissolution than its noun counterpart. Given this expectation, our hypothesis was that there would be less concordance with verbs than with nouns. The facts appear to disconfirm that hypothesis.

One way of understanding the unexpected robustness of verbs is again to look at word frequency. Of the 100 most frequent words in written English, verbs comprise 20% whereas nouns comprise only 6% of the total. Furthermore, the average frequency of these verbs is almost three times higher than that of the nouns. It would appear that adults use a small number of verbs very often, and a larger number of nouns less often. This pattern of stronger representation of verbs apparently survives aphasic damage, at least as is indicated by the results of this study.

APPENDIX A:

Tasks: Frequency Count by Target Code

TASKS: Frequency Counts by Target Code

(For all Tasks, the numbers after the dots following the target word are frequency counts, Noun/Verb: Ratio. In all cases, even where $V > N$, the first number represents Noun frequency.)

TASK 1: Practice

A. Love.....S1: 179/45: 3.9
 your enemy
 of books

B. Brush.....U3: 109/186: 1.7
 and comb
 your hair

C. Cause.....U3: 109/186: 1.7
 of trouble
 the problem

D. Lance.....U1: 5/1: 5
 the boil
 of steel

TASK 1: Systematic

S1: $N > V$

Tax..... 241/27: 8.9
 the rich
 on cigarettes

Time..... 1901/16: 118
 the race
 to relax

Stroke..... 30/5: 6
 of the brush
 the cat

Bag..... 51/2: 25
 of fruit
 the groceries

Cloud.....64/7: 9
 of steam
 the issue

Frame..... 96/23: 4.2
 the painting
 of wood

S2: V > N**Pack..... 17/44: 8.5****the bag
of gum****Cut.....35/245: 7****of veal
the cake****Mix.....2/56: 28****the paint
of people****Show.....108/640: 5.9****of respect
your hand****Turn.....96/566: 5.9****the key
of events****Spread..... 18/90: 5****of the flu
the news**

S3: N ~ V**Trace..... 22/36: 1.6****of gold
the scent****Change..... 284/225: 1.26****of clothes
your socks****Stack.....8/11: 1.38****the deck
of cards****Slice..... 12/7: 1.7****of bread
the cheese****Share..... 100/105: 1****the wealth
of honor****Spark..... 12/7: 1.7****an idea
of energy**

TASK 1: Unsystematic**U1: N > V**

Race.....120.30: 4
of giants
for the train

Pound.....96/11: 8.7
the table
of grapes

Stage.....224/21: 10.7
of life
the play

Mind.....350/41: 8.5
the store
and body

Page.....102/1: 102
of a book
the doctor

Tip..... 33/7: 4.7
the scale
on a horse

U2: V > N

Watch..... 31/209: 6.74
the show
for sale

Drop.....34/159: 4.7
of water
the ball

Miss.....5/95: 19
the game
or mister

Run.....94/431: 4.6
for office
of luck

Start.....61/386: 6.3
to move
of surprise

Boil.....6/27: 4.5
the water
on the neck

U3: N ~ V

Check..... 53/88: 1.7
the coat
in the mail

Groom..... 5/5: 1
and bride
the horses

Bolt.....9/10: 1.1
the door
of cloth

Squash..... 2/2: 1
the bug
and beans

Blow.....28/52: 1.9
to the head
the whistle

Chop.....5/9: 1.8
with peas
the wood

TASK 2: Practice

A. Deal: U3. 99/124: 1.25 They deal cards at the casino./ The business deal fell through.

B. Ride: S2. 21/126: 6 We took a long ride./ We ride in the car.

C. Cage: S1. 11/1: 11 The tigers were in a cage./ They cage tigers at the zoo.

D. Smoke: S3. 33/26: 1.26 We smoke cigars after dinner./ The air was full of smoke.

TASK 2: Systematic

Noun placement: I = phrase initial; F = phrase final.

S1: N > V

Milk: 49/2: 24.5 We milk the cow./ The cow gives milk. I

Snow: 56/12: 4.6 We watch it snow./ The snow is white. I

Storm: 31/5: 6.2 They storm the building./ The storm was raging. I

String: 34/7: 4.9 We string beads together./ The beads were on a string. F

Track: 48/8: 6 The hunters track the deer./ The hunters follow the track. F

Trick: 32/2: 11.5 The magicians trick the audience./ The magicians perform a trick. F

S2: V > N

Move: 45/447: 9.9 We move every winter./ It was a good move. F

Pay: 39/325: 8.3 We pay our bills./ The pay was late. I

Raise: 8/188: 23.5 They raise the price./ The raise was too low. I

Yell: 6/31: 5.2 They yell at each other./ The yell was very loud. I

Try: 8.471: 59 We try to be good./ We gave it a good try. F

Walk: 40/287: 7.1 I walk to the store./ I took a long walk. F

S3: N ~ V

Bloom: 11/17 1.5 The trees bloom in Spring./ The cherry bloom was pink. I

Dance: 94/59: 1.6 We dance to the music./ We went to the dance. F

Drain: 15/16: 1.1 We drain the water./ The drain was clogged. I

Drink: 75/93: 1/24 They drink every day./ They need a drink every day. F

Roast: 8/8: 1 We roast meat in the oven./ The roast was in the oven. I

Tap: 9/10: 1.1 I tap at the door./ There was a tap at the door. F

TASK 2: Unsystematic**U1: N > V**

Bark: 13/1: 13 The dogs bark at night./ The tree bark was peeling. I

Block: 98/20: 4.9 The player blocks the pass./ The children play with blocks. F

Bill: 133/3: 44.33 They bill us every month./ The bird had a yellow bill. F

Coast: 67/3: 22.33 We coast down the hill./ We fly to the coast. F

Rock: 91/20:4.55 The waves rock the boat./ The rock is very heavy. I

Sock: 10/2: 5 They sock each other./ His sock is torn. I

U2: V > N

Build: 2/249: 124.5 They build brick houses./ He had a muscular build. F

Draw: 10/222: 22.2 We draw pictures in class./ The draw for the lottery is tomorrow. I

Leave: 2/26: 13 The woman leaves the room./ The leaves fall in Autumn. I

Spit: 2/21: 10.5 They spit on the ground./ They cooked meat on the spit. F

Spoke: 3/37: 12.3 She spoke to her friend at work./ The spoke on the wheel fell off. I

Stoop: 1/11: 11 We stoop in the doorway./ We sit on the stoop. F

U3: N ~ V

Cast: 26/28: 1.1 He cast the statue in bronze./ The cast in the play was great. I

Chip: 16/10: 1.6 They chip away at the paint./ He had one chip left in the game. F

Stick: 42/50: 1.2 We always stick together./ We found a stick in the woods. F

Park: 116/61: 1/8 I park at the curb./ I ride around the park. F

Press: 107/82: 1.3 We press their own shirts./ The press prints the news. I

Seal: 17/20: 1.2 They seal the envelope./ The seal swims in the pool. I

TASK 3: Practice

A. Crash: S3. 15/23: 1.5 They saw her **CRASH** at the corner.

...saw the accident.

...saw her bump into a car.

B. Prop: U3. 8/6: 1.33 We saw her **PROP** up on the stage.

...saw her pushing a piece of scenery.

...saw what she had in her hand.

C. Battle: S1. 91/6: 15.2 We saw her **BATTLE** with the bottle.

...saw the fight she had with booze.

...saw her trying to stop drinking.

D: Tape: S1. 39/1: 39 They heard her **TAPE** during the concert.

...heard her making a recording.

...heard the record she had made.

TASK 3: Systematic

S1: N > V

Farm: 137/16: 8.6 He watched her **FARM** through the winter.

...looked after her property.

...saw her working in the fields.

Garden: 91/3: 30 We saw her **GARDEN** last week.

...saw how the yard looked.

...saw her planting seeds.

Head: 449/87: 5.2 They saw her **HEAD** through the crowd.

...saw her making her way.

...saw the top of her skull.

Order: 426/90; 4.7 We heard her **ORDER** at the restaurant.

...heard her talking to the waiter.

...heard what she chose from the menu.

Phone: 53/12: 4.4 He heard her **PHONE** in the next room.

...heard the ring of the telephone.

...heard her making a call.

Signal: 87/10: 8.7 I saw her **SIGNAL** before I turned.

...saw her moving her arm.

...saw the blinking lights of her car.

S2: V > N

Call: 76/627: 8.25 She heard her CALL for help.
...heard the plea that she made.
...heard her yelling for someone to come.

Knock: 5/47: 9.4 We heard her KNOCK at the door.
...heard the sound of the tap-tap-tap.
...heard her banging to get in.

Laugh: 22/89: 4 They heard her LAUGH again.
...heard the happy sound in her voice.
...heard her giggling with joy.

Shout: 5/77: 15.4 He heard her SHOUT in the living room.
...heard the loud sound.
...heard her raising her voice.

Talk: 55/275: 5 We heard her TALK at the conference.
...heard the speech that she made.
...heard her speaking to the audience.

Wash: 40/287: 7.2 She saw her WASH in the tub.
...saw her scrubbing the clothes.
...saw her laundry soaking.

S3: N ~ V

Cry: 35/64: 1.8 We heard her CRY last night.

...heard her weeping.

...heard the sound of her sos.

Dress: 63/67: 1.1 She saw her DRESS in the bedroom.

...saw the garment in the room.

...saw her putting on her clothes.

Glance: 35/43: 1.2 He saw her GLANCE at the usher.

...saw her looking at him.

...saw the look that she gave him.

Glow: 14/19: 1.4 They saw her GLOW when she smiled.

...saw the warmth in her face.

...saw her light up.

Gulp: 3/3: 1 I heard her GULP when she got the news.

...heard the sound in her throat.

...heard her making a funny noise.

Work: 680/496: 1.4 They saw her WORK in the gallery.

...saw her hanging up the paintings.

...saw her paintings on the wall.

TASK 3: Unsystematic**U1: N > V**

Band: 64/3: 21/33 He saw her BAND with the drummers.
 ...saw the group of musicians.
 ...saw her stick with the musicians.

Board: 285/15: 19 We saw her BOARD too late.
 ...saw her getting on the plane.
 ...saw the wooden plank.

Box: 82/4: 20.5 They saw her BOX in the alley.
 ...saw her fighting.
 ...saw the wooden crate.

Flag: 18/3: 6 We saw her FLAG at the finish line.
 ...saw the banner with her name.
 ...saw her slowing down.

Trip: 109/6: 18.2 They watched her TRIP down the aisle.
 ...watched the path that she took.
 ...watched her falling down.

Iron: 46/8: 5.75 She saw her IRON in the kitchen.
 ...saw her pressing her clothes.
 ...saw the iron on the table.

U2: V > N

Hide: 8/61: 7.6 I saw her HIDE behind the shed.

...saw her leather pelt.

...saw her sneaking around.

Mount: 11/62: 5.6 He saw her MOUNT before the race.

...saw the horse she was riding.

...saw her getting on the horse.

Nod: 62/8: 7.75 He saw her NOD after the show.

...saw her falling asleep.

...saw the shake of her head.

Stoop: 11/2: 5.5 They saw her STOOP in front of the house.

...saw her bending down.

...saw the steps in front of her house.

Watch: 31/209: 6.7 We saw her WATCH through the window.

...saw her wristwatch.

...saw her looking out the window.

Lie: 9/224: 24.9 They saw her LIE in court.

...saw the falsehood that she told.

...saw her stretching out on the floor.

U3: N ~ V

Bat: 18/23: 1.3 He saw her BAT over the fence.

...saw her pet animal.

...saw her swinging at the ball.

Brush: 36/38: 1.1 I saw her BRUSH against the wall.

...saw her touching the wall.

...saw her hairbrush.

File: 59/87: 1.5 She saw her FILE at the office.

...saw the folder with her papers.

...saw her manicuring her nails.

Tire: 31/46: 1.5 He saw her TIRE after the race.

...saw the wheel of her car.

...saw how exhausted she was.

Toast: 14/9: 1.6 We saw her TOAST at the banquet.

...saw her raising her glass.

...saw the pieces of bread on her plate.

Train: 86/130: 1.5 They saw her TRAIN at the track.

...saw the railroad car she was waiting for.

...saw her exercising down on the field.

APPENDIX B:

Sets in Numerical Order

TASK 1: Sets in Numerical Order

1. S1 Tax V/N
2. S2 Pack V/N
3. U1 Race N/V
4. U2 Watch V/N
5. S3 Trace N/V
6. U3 Check V/N
7. U1 Pound V/N
8. U2 Drop N/V
9. S1 Time V/N
10. S2 Cut N/V
11. U3 Groom N/V
12. U2 Miss V/N
13. S1 Stroke N/V
14. S3 Stack V/N
15. U1 Stage N/V
16. S2 Mix V/N
17. U2 Run N/V
18. S3 Change N/V
19. U1 Mind V/N
20. S1 Bag N/V
21. S2 Show N/V

- 22. U3 Bolt V/N
- 23. S3 Slice N/V
- 24. U2 Start V/N
- 25. U1 Page N/V
- 26. S2 Turn V/N
- 27. S1 Cloud N/V
- 28. U3 Squash V/N
- 29. U1 Tip N/V
- 30. S3 Share V/N
- 31. U3 Blow N/V
- 32. S1 Frame V/N
- 33. S2 Spread N/V
- 34. U2 Boil V/N
- 35. S3 Spark V/N
- 36. U3 Chop N/V

TASK 2: Sets in Numerical Order

1. U3 Cast I
2. S3 Bloom I
3. U2 Build F
4. S2 Move F
5. S1 Milk I
6. U3 Chip F
7. S3 Dance F
8. U1 Bark I
9. U3 Stick F
10. S1 Snow I
11. S2 Pay I
12. U1 Block F
13. U2 Draw I
14. S3 Drain I
15. U3 Park F
16. S2 Raise I
17. S1 Storm I
18. U1 Bill F
19. S3 Drink F
20. U2 Leave(s) I
21. S2 Yell I

- 22. U1 Coast F
- 23. S3 Roast I
- 24. S1 String F
- 25. U2 Spit F
- 26. U3 Press I
- 27. S2 Try F
- 28. U1 Rock I
- 29. U2 Spoke I
- 30. S1 Track F
- 31. U3 Seal I
- 32. S3 Tap F
- 33. U2 Stoop F
- 34. U1 Sock I
- 35. S2 Walk F
- 36. S1 Trick F

TASK 3: Sets in Numerical Order

1. U1 Band
2. U2 Hide
3. S1 Farm
4. S2 Call
5. U3 Bat
6. S3 Cry
7. S1 Garden
8. S2 Knock
9. U1 Board
10. U2 Mount
11. S3 Dress
12. S2 Laugh
13. U1 Box
14. U3 Brush
15. S1 Head
16. U2 Nod
17. S2 Shout
18. U3 File
19. S1 Order
20. U1 Flag
21. U2 Stoop

22. S3 Glance

23. U3 Tire

24. S2 Talk

25. S1 Phone

26. U2 Watch

27. U1 Trip

28. S3 Glow

29. S1 Signal

30. U3 Toast

31. S3 Gulp

32. U1 Iron

33. U2 Lie

34. S2 Wash

35. U3 Train

36. S3 Work

APPENDIX C:

Record of Participant Responses

PARTICIPANT RESPONSE RECORDS

(NOTE: The initials in Bold font under the first column, "Par" [Participants] represent the identifying code for each participant. The numbers under the initials, for example, N60, V48, represent participant-total N [noun] and V [verb] output. The N/V numbers under the last column, "Total", represent noun/verb output per task.)

Nonfluent participants:

Par	Tsk	S1		S2		S3		U1		U2		U3		Total	
		N	V	N	V	N	V	N	V	N	V	N	V	N	V
HM	1	4	2	4	2	2	4	1	5	5	1	5	1	21	15
N60	2	3	3	3	3	3	3	3	3	5	1	4	2	21	15
V48	3	3	3	3	3	2	4	3	3	2	4	5	1	18	18
MK	1	2	4	2	4	4	2	2	4	1	5	3	3	14	22
N43	2	3	3	2	4	4	2	3	3	1	5	2	4	15	21
V65	3	1	5	3	3	2	4	3	3	2	4	3	3	14	22
GT	1	3	3	3	3	4	2	3	3	3	3	4	2	20	16
N70	2	6	0	5	1	5	1	6	0	4	2	6	0	31	5
V38	3	4	2	2	4	4	2	3	3	2	4	4	2	19	17
WC	1	3	3	4	2	4	2	2	4	3	3	4	2	20	16
N53	2	1	5	4	2	3	3	3	3	4	2	4	2	19	17
V55	3	2	4	1	5	4	2	1	5	4	2	2	4	14	22
JC	1	2	4	3	3	3	3	1	5	2	4	3	3	14	22
N56	2	2	4	4	2	5	1	4	2	4	2	5	1	24	12
V52	3	4	2	3	3	3	3	4	2	2	4	2	4	18	18
LB	1	4	2	4	2	2	4	4	2	3	3	3	3	20	16
N64	2	5	1	3	3	4	2	4	2	5	1	2	4	23	13
V44	3	5	1	4	2	3	3	4	2	3	3	2	4	21	15
CT	1	6	0	4	2	2	4	3	3	3	3	3	3	21	15
N55	2	3	3	4	2	3	3	4	2	2	4	4	2	20	16
V53	3	3	3	1	5	3	3	3	3	2	4	2	4	14	22
IV	1	2	4	3	3	4	2	4	2	3	3	3	3	19	17
N56	2	3	3	5	1	2	4	1	5	5	1	5	1	21	15
V52	3	3	3	2	4	3	3	4	2	2	4	2	4	16	20

Nonfluent participants, continued:

Par	Tsk	S1		S2		S3		U1		U2		U3		Total	
		N	V	N	V	N	V	N	V	N	V	N	V	N	V
KK	1	2	4	4	2	4	2	4	2	2	4	2	4	18	18
N55	2	1	5	0	6	3	3	2	4	4	2	5	1	15	21
V53	3	4	2	3	3	5	1	2	4	4	2	4	2	22	14
WF	1	5	1	4	2	4	2	4	2	1	5	4	2	22	14
N60	2	3	3	4	2	5	1	3	3	3	3	4	2	22	14
V48	3	2	4	3	3	3	3	3	3	2	4	3	3	16	20
EG	1	4	2	4	2	4	2	4	2	1	5	2	4	19	17
N58	2	4	2	2	4	3	3	3	3	5	1	4	2	21	15
V50	3	33	3	3	3	3	3	4	2	3	3	2	4	18	18
IP	1	3	3	3	3	4	2	3	3	2	4	2	4	17	19
N48	2	0	6	5	1	3	3	3	3	5	1	3	3	19	17
V60	3	5	1	3	3	2	4	1	5	1	5	0	6	12	24
RM	1	4	2	3	3	4	2	2	4	2	4	5	1	20	16
M56	2	3	3	5	1	4	2	2	4	2	4	5	1	20	16
V52	3	4	2	1	5	3	3	3	3	2	4	3	3	16	20
JB	1	1	5	5	1	4	2	2	4	4	2	3	3	19	17
N53	2	4	2	2	4	1	5	3	3	3	3	3	3	16	20
V55	3	3	3	1	5	5	1	4	2	2	4	3	3	18	18
NW	1	4	2	2	4	6	0	4	2	1	5	3	3	20	16
N58	2	4	2	2	4	2	4	5	1	2	4	3	3	18	18
V50	3	5	1	4	2	2	4	3	3	4	2	2	4	20	16
GT	1	3	3	3	3	5	1	4	2	1	5	2	4	18	18
N45	2	2	4	3	3	2	4	3	3	3	3	3	3	16	20
V63	3	2	4	2	4	1	5	2	4	3	3	1	5	11	25

Fluent Participants:

Par	Tsk	S1		S2		S3		U1		U2		U3		Total	
		N	V	N	V	N	V	N	V	N	V	N	V	N	V
DC	1	3	3	3	3	4	2	3	3	3	3	4	2	20	16
N61	2	3	3	4	2	2	4	4	2	3	3	4	2	20	16
V47	3	4	2	3	3	3	3	4	2	3	3	4	2	21	15
KS	1	5	1	2	4	5	1	1	5	1	5	2	4	16	20
N42	2	4	2	1	5	2	4	1	5	3	3	3	3	14	22
V66	3	4	2	1	5	3	3	1	15	1	5	2	4	12	24
WV	1	3	3	2	4	2	4	3	3	3	3	0	6	13	23
N51	2	3	3	3	3	4	2	5	1	3	3	3	3	21	15
V57	3	4	2	2	4	3	3	3	3	3	3	2	4	17	19
RY	1	2	4	1	5	4	2	3	3	1	5	3	3	14	22
N47	2	4	2	4	2	1	5	5	1	4	2	3	3	21	15
V61	3	2	4	2	4	2	4	3	3	1	5	2	4	12	24
JS	1	4	2	3	3	3	3	3	3	3	3	1	5	15	21
N45	2	4	2	2	4	3	3	2	4	2	4	2	4	17	19
N63	3	2	4	2	4	5	1	4	2	2	4	4	2	13	23
MK	1	3	3	2	4	5	1	4	2	2	4	4	2	20	16
N52	2	4	2	4	2	3	3	2	4	2	4	4	2	19	17
V56	3	1	5	3	3	3	3	2	4	3	3	1	5	12	23
JA	1	2	4	3	3	3	3	3	3	3	3	5	1	19	17
N42	2	2	4	2	4	2	4	3	3	3	3	3	3	15	21
V66	3	1	5	1	5	2	4	1	5	3	3	0	6	8	28
AW	1	2	4	3	3	2	4	2	4	3	3	3	3	15	21
N51	2	3	3	4	2	5	1	3	3	4	2	1	5	20	16
V57	3	4	2	4	2	4	2	3	3	0	6	1	5	16	20

Fluent participants, continued:

Par	Tsk	S1		S2		S3		U1		U2		U3		Total	
		N	V	N	V	N	V	N	V	N	V	N	V	N	V
AP	1	4	2	3	3	2	4	3	3	2	4	5	1	17	19
N44	2	2	4	0	6	3	3	1	5	3	3	4	2	11	25
V64	3	3	3	0	6	3	3	2	4	3	3	1	6	16	20
CR	1	4	2	3	3	4	2	2	4	3	3	4	2	20	16
N47	2	1	5	1	5	1	5	1	5	2	4	3	3	9	27
V61	3	1	5	3	3	3	3	3	3	4	2	4	2	18	18
AT	1	5	1	1	5	4	2	2	4	5	1	3	3	20	16
N51	2	3	3	1	5	2	4	1	5	5	1	5	1	17	19
V57	3	2	4	2	4	1	5	2	4	3	3	4	2	14	22
MS	1	2	4	3	3	4	2	2	4	3	3	4	2	18	18
N49	2	3	3	3	3	6	0	1	5	3	3	1	5	17	19
V59	3	1	5	1	5	3	3	2	4	2	4	5	1	14	22
LQ	1	2	4	1	5	5	1	3	3	3	3	2	4	16	20
N47	2	2	4	1	5	3	3	3	3	2	4	3	3	14	22
V61	3	4	2	3	3	3	3	2	4	2	4	3	3	17	19
OG	1	3	3	2	4	2	4	2	4	1	5	1	5	11	25
N51	2	4	2	2	4	3	3	2	4	5	1	5	1	21	15
V57	3	3	3	3	3	2	4	5	1	3	3	3	3	19	17
SH	1	3	3	2	4	4	2	3	3	2	4	4	2	18	18
N46	2	2	4	4	2	2	4	2	4	3	3	3	3	16	20
V62	3	3	3	0	6	2	4	4	2	1	5	2	4	12	24

APPENDIX D:

Sample Forms: Informed Consent Form

Participant Response Forms

INFORMED CONSENT FORM

I, the undersigned, agree to participate in a project that will study the effects of a stroke on the use of language. It is hoped that this research will shed some understanding on how words are organized in the brain. I will be asked to select words from phrases or sentences that I will be reading or hearing. The testing will be done in a single session, and will probably last less than an hour. During the testing, I will be able to take all the time I need to complete the tasks, and will be able to take a break, or to end the session, whenever I please. I also understand that I can withdraw from the project at any time

I understand that my responses will be treated with full confidentiality, and that if the results of this study are published, my anonymity will be preserved and my identity will be coded. A record of my responses will be kept in a secure place and will be available only to the investigator of this study and to immediate members of her advisory committee. I understand that there are no known risks involved in this study, either mental, physical or emotional, and that any benefits accrued will be nonmaterial. A further benefit of the study is knowing that the results might contribute to the advancement of knowledge of language.

The investigator, Elmera Goldberg, has explained the study to me. She answered all my questions and told me that I can call any of the three people listed below if I have any more questions. She assured me that test conditions will be comfortable and familiar, and that the tasks will impose no special stress on me. My participation and consent are completely voluntary.

She has also told me that if I have questions about this research, I can call her at (212) 877 7931 or call her advisor, Dr. Robert Goldfarb, at (212) 817 8802. If I have questions about my rights as a participant in this study, I can contact Hilry Fisher, Sponsored Research, Graduate Center, City University of New York, (212) 817 7525.

Participant: _____ Date: _____

Investigator: _____ Date: _____

RESPONSE RECORD: TASK 1

DOE: _____ Subject ID: Initials: _____ Fluent/Nonfluent _____ Male/Female _____

#	Target	Code	N Indicator	V Indicator
A	Love	S1	Books	Enemy
B	Brush	U3	Comb	Hair
C	Cause	U3	Trouble	Problem
D	Lance	U1	Steel	Boil
1.	Tax	S1	Cigarettes	Rich
2.	Pack	S2	Gum	Bag
3.	Race	U1	Giants	Train
4.	Watch	U2	Sale	Show
5.	Trace	S3	Gold	Scent
6.	Check	U3	Mail	Coat
7.	Pound	U1	Grapes	Table
8.	Drop	U2	Water	Ball
9.	Time	S1	Relax	Race
10.	Cut	S2	Veal	Cake
11.	Groom	U3	Bride	Horses
12.	Miss	U2	Mister	Game
13.	Stroke	S1	Brush	Cat
14.	Stack	S3	Cards	Deck
15.	Stage	U1	Life	Play

RESPONSE RECORD: TASK 1 Continued

Subject ID: Initials: _____

16.	Mix	S2	Colors	Paint
17.	Run	U2	Luck	Office
18.	Change	S3	Clothes	Socks
19.	Mind	U1	Body	Store
20.	Bag	S1	Fruit	Groceries
21.	Show	S2	Respect	Hand
22.	Bolt	U3	Cloth	Door
23.	Slice	S3	Bread	Cheese
24.	Start	U2	Surprise	Move
25.	Page	U1	Book	Doctor
26.	Turn	S2	Events	Key
27.	Cloud	S1	Steam	Issue
28.	Squash	U3	Beans	Bug
29.	Tip	U1	Horse	Scale
30.	Share	S3	Honor	Wealth
31.	Blow	U3	Head	Whistle
32.	Frame	S1	Wood	Painting
33.	Spread	S2	Flu	News
34.	Boil	U2	Neck	Water
35.	Spark	S3	Energy	Idea
36.	Chop	U3	Dinner	Wood

RESPONSE RECORD: TASK 2

DOE: _____ Subject ID: Initials: _____ Fluent/Nonfluent _____ Male/Female _____

#	Target	Code	Noun Form	Verb Form
A.	Deal	U3	..business..	..cards..
B.	Ride	S2	..long..	..car..
C.	Cage	S1	..in a cage..	..zoo..
D.	Smoke	S3	..air full..	..cigars..
1.	Cast	U3	..play..	..statue..
2.	Bloom	S3	..cherry..	..trees..
3.	Build	U2	..muscular..	..brick houses..
4.	Move	S2	..good..	..every year..
5.	Milk	S1	..cow gives..	..milk the cow..
6.	Chip	U3	..game..	..paint..
7.	Dance	S3	..went to..	..music..
8.	Bark	U1	..tree..	..dogs..
9.	Stick	U3	..long..	..together..
10.	Snow	S1	..white..	..watch..
11.	Pay	S2	..late..	..on time..
12.	Block	U1	..child..	..players..
13.	Draw	U2	..lottery..	..pictures..
14.	Drain	S3	..clogged..	..water..
15.	Park	U3	..ride around..	..at the curb..

RESPONSE RECORD: TASK 2 Continued

Subject ID: Initials: _____

16.	Raise	S2	..too small..	..price..
17.	Storm	S1	..raging..	..building..
18.	Bill	U1	..yellow..	..every month..
19.	Drink	S3	..need..	..every day..
20.	Leave	U2	..Autumn..	..woman..
21.	Yell	S2	..loud..	..children..
22.	Coast	U1	..fly..	..hill..
23.	Roast	S3	..The roast..	..We roast meat..
24.	String	S1	..on a string..	..together..
25.	Spit	U2	..cook..	..ground..
26.	Press	U3	..news..	..shirts..
27.	Try	S2	..We gave..	..We try..
28.	Rock	U1	..heavy..	..waves..
29.	Spoke	U2	..wheel..	..friend..
30.	Track	S1	..follow..	..deer..
31.	Seal	U3	..swims..	..envelope..
32.	Tap	S3	..There was..	..I tap..
33.	Stoop	U2	..sit..	..doorway..
34.	Sock	U1	..torn..	..each other..
35.	Walk	S2	..long..	..store..
36.	Trick	S1	..perform..	..audience..

RESPONSE RECORD: TASK 3

DOE: _____ Subject ID: Initials: _____ Fluent/Nonfluent _____ Male/Female _____

#	Target	Code	Noun Form	Verb Form
A.	Crash	S3	..accident..	..bump..
B.	Prop	U3	..hand..	..pushing the scenery..
C.	Battle	S1	..fight with booze..	..trying to stop drinking..
D.	Tape	S1	..record she had made..	..making a recording..
1.	Band	U1	..group of musicians..	..stick with the drummers..
2.	Hide	U2	..leather pelt..	..sneaking around..
3.	Farm	S1	..property..	..working in the fields..
4.	Call	S2	..plea..	..yelling..
5.	Bat	U3	..pet animal..	..swinging..
6.	Cry	S3	..sound of her sobs..	..weeping..
7.	Garden	S1	..yard..	..planting seeds..
8.	Knock	S2	..sound of tap-tap-tap..	..banging..
9.	Board	U1	..wooden plank..	..plane..
10.	Mount	U2	..horse she was riding..	..getting on her horse..
11.	Dress	S3	..garment..	..putting on her clothes..
12.	Laugh	S2	..happy sound..	..giggling with joy..
13.	Box	U1	..wooden crate..	..fighting..
14.	Brush	U3	..hairbrush..	..touching the wall..
15.	Head	S1	..top of her skull..	..making her way..

RESPONSE RECORD: TASK 3 Continued

Subject ID: Initials: _____

16.	Nod	U2	..shake of her head..	..falling asleep..
17.	Shout	S2	..loud sound..	..raising her voice..
18.	File	U3	..folder..	..manicuring her nails..
19.	Order	S1	..menu..	..waiter..
20.	Flag	U1	..banner..	..slowing down..
21.	Stoop	U2	..steps of her house..	..bending down..
22.	Glance	S3	..look she gave him..	..looking at him..
23.	Tire	U3	..wheel..	..exhausted..
24.	Talk	S2	..speech..	..speaking to the audience..
25.	Phone	S1	..ring..	..making a call..
26.	Watch	U2	..wristwatch..	..looking through window..
27.	Trip	U1	..path..	..falling down..
28.	Glow	S3	..warmth..	..light up..
29.	Signal	S1	..blinking lights..	..moving her arm..
30.	Toast	U3	..pieces of bread..	..raising her glass..
31.	Gulp	S3	..sound in her throat..	..funny sound..
32.	Iron	U1	..on the table..	..pressing her clothes..
33.	Lie	U2	..falsehood..	..stretching on the floor..
34.	Wash	S2	..laundry..	..scrubbing the clothes..
35.	Train	U3	..railroad car..	..exercising..
36.	Work	S3	..on the wall..	..hanging up..

APPENDIX E:
Participant Description

PARTICIPANT DESCRIPTION

Nonfluent Participants:

Initials	Gender	DOB	Date of Test	Date of Onset	Time post-onset (yrs)	Age when tested
HM	M	11/26/29	3/19/01	1969	32	71:8
MK	M	8/17/21	3/14/01	2/96	5	79:7
GT	F	10/01/15	3/28/01	2/28/99	2	85:5
WC	M	10/18/35	5/8/01	1988	3	65:10
JC	M	11/01/53	8/8/01	8/00	1	47:9
LB	M	5/14/30	8/8/01	1/96	5:7	71:3
CT	F	12/20/48	9/24/01	2/4/01	7 mos	52:9
IV	F	3/12/39	2/15/01	9/01	7 mos	62:6
KK	M	3/1/23	9/21/01	1989	2	78:6
WF	M	1/5/12	9/24/01	1955	46	89:8
EG	M	5/01/47	9/26/01	3/17/01	6 mos	54:4
IP	F	8/3/48	10/3/01	4/17/98	3:6	53:2
RM	M	7/10/37	10/3/01	1992	9	64:3
JB	M	11/18/43	10/14/01	8/01	2 mos	57:11
NW	F	1/5/46	10/14/01	6/98	2:4	55:9
GT	F	6/15/52	9/15/01	6/01	3 mos	49:3

Mean age at testing: 65 years

Mean time post-onset at testing: 6 years

Fluent Participants:

Initials	Gender	DOB	Date of Test	Date of Onset	Time post-onset (yrs)	Age when tested
DC	M	10/30/25	7/27/01	1/13/01	6 mos	75:9
KS	M	8/19/57	7/17/01	6/19/94	5	43:11
WV	M	1/19/46	7/17/01	8/12/97	4	55:6
RY	M	3/29/37	7/17/01	1/91	2:6	64:4
JS	M	2/23/49	5/4/01	3/27/99	2:2	52:3
MK	M	5/6/33	8/8/01	1995	6	68:3
JA	F	12/4/20	9/15/01	10/01	1 mo	80:9
AW	F	12/21/22	9/21/01	1995	6	78:9
AP	M	8/15/12	3/12/01	8/00	7 mos	88:5
CR	F	12/8/34	3/14/01	2/99	2	66:9
AT	M	6/12/26	3/21/01	10/30/98	2:5	74:9
MS	F	1/20/59	3/22/01	10/00	5 mos	42:2
LQ	M	5/25/50	3/29/01	5/10/01	1:2	50:10
OG	M	8/6/31	9/24/01	5/00	1:4	70:1
SH	F	6/12/32	9/15/01	2/01	7 mos	69:3

Mean age at testing: 65:3 years

Mean time post-onset at testing: 2:3 years

APPENDIX E:

F-Table: Summary of analysis of variance

F-TABLE: Summary of analysis of variance of paradigmatic responses to English homophonic homographs

Between-Subjects Effects					
Source	ss	df	ms	F	P
Fluency	19.669	1	19.669	9.331	.005
Within-Subjects Effects					
Source	ss	df	ms	F	P
Task	18.254	2	9.127	5.178	.009
Task x Fluency	1.307	2	.654	.371	.692
Systematicity	1.629	1	1.629	1.073	.309
Systematicity x Fluency	1.213	1	1.213	.799	.379
Frequency	19.337	2	9.669	6.282	.003
Frequency x Fluency	.584	2	.292	.190	.828
Task x Systematicity	11.443	2	5.722	5.119	.009
Task x Systematicity x Fluency	1.665	2	.833	.745	.479
Task x Frequency	12.527	4	3.132	2.557	.042
Task x Frequency x Fluency	.957	4	.239	.195	.940
Systematicity x Frequency	1.483	2	.741	.649	.527
Systematicity x Frequency x Fluency	6.286	2	3.143	2.749	.072
Task x Systematicity x Frequency	2.822	4	.705	.570	.685
Task x Systematicity x Frequency x Fluency	5.115	4	1.279	1.034	.393

REFERENCES

- Anderson, S.R. 1982. Where's Morphology? *Linguistic Inquiry*, Vol. 13, No. 4, Fall, 571-613.
- Andrews, S. 1986. Morphological Influences on Lexical Access: Lexical or Nonlexical Effects? *Journal of Memory and Language* 25, 726-740.
- Bates, E., Chen, S., Tzeng, O. and Li, P. and Opie, M. 1991. The Noun-Verb Problem in Chinese Aphasia. *Brain and Language* 41, 203-233.
- Berndt, R., Mitchum, C., Haendiges, A. and Sandson, J. 1997a. Verb Retrieval in Aphasia. I: Characterizing Single Word Impairments. *Brain and Language*, Jan. Vol. 56/1, 68-106.
- Berndt, R., Mitchum, C., Haendiges, A. and Sandson, J. 1997b. Verb Retrieval in Aphasia. II: Relationship to Sentence Processing. *Brain and Language*, Jan. Vol. 56/1, 107-137.
- Boland, J.E. 1997. Resolving Syntactic Category Ambiguities in Discourse Context: Probabilistic and Discourse Constraints. *Journal of Memory and Language* 36, 588-615.
- Bradley, Dianne. 1980. Lexical Representation of Derivational Relation. In Mark Aronoff and Mary-Louise Kean (Eds.), *Juncture*, Anna Libri, Ca.
- Britton, B.K., 1978. Methods & Designs: Lexical ambiguity of words used in English text. *Behavior Research Methods & Instrumentation*, Vol. 10 (11), 1-7.
- Cairns, H.S. 1996. *The Acquisition of Language*. ProEd, Austin, Texas.
- Camarata, S.M. and Schwartz R.G. 1985. Production of Object Words and Action Words: Evidence for a Relationship Between Phonology and Semantics. *Journal of Speech and Hearing Research*, Vol. 28, September, 323-330.
- Caramazza, A. and Hillis, A.E. 1991. Lexical Organization of Nouns and Verbs in the Brain. *Nature (London)* 349, 788-790.
- Caramazza, A., Hillis, A.E., Leek, E.C. and Miozzo, M. 1994. The organization of lexical knowledge in the brain: evidence from category-and-modality specific deficits. In L.A. Hirschfield and S.A. Gelman (Eds.), *Mapping the Mind: Domain Specificity in Cognition and Culture*. Cambridge University Press, Cambridge, pp. 68-84.

Chen, S. and Bates, E. 1998. Dissociation between Nouns and Verbs. *Aphasiology*, Jan., Vol. 12/1, 5-36.

Chomsky, N. 1970. Remarks on Nominalization. In R. Jacobs and E. Rosenbaum (Eds.), *Readings in English Transformational Grammar*, Ginn & Co., Waltham, Mass.

Clark, E. 1987. On the logic of contrast. *Journal of Child Language*, 15, 317-335.

Coltheart, M., Besner, D., Johansson, J.T. and Develaar, E. 1979. Phonological encoding in the lexical decision task. *Quarterly Journal of Experimental Psychology*, Vol. 31, 489-507.

Coltheart, M., Patterson, K.E., and Marshall, J.C., (Eds.), *Deep Dyslexia*. Rutledge and Kegan Paul, Publishers, London.

Coltheart, Max. 1980. Reading, phonological recoding and deep dyslexia. In M. Coltheart, K.E. Patterson and J.C. Marshall (Eds.), *Deep Dyslexia*. Rutledge and Kegan Paul, Publishers, London.

Crystal, David. 1992. *A Dictionary of Linguistics and Phonetics*. Basil Blackwell, Publisher, Cambridge, Mass.

Damasio, A.R. and Tranel, D. 1993. Nouns and verbs are retrieved with differently distributed neural systems. *Proceedings of the National Academy of Sciences of the United States of America*, 90, 4957-4960.

Daniele, A., Guistolisi, L., Silveri, M., Colosimo, C. and Gainotti, G. 1994. Evidence for a possible neuroanatomical basis for the lexical processing of nouns and verbs. *Neuropsychologia*, Vol. 32/11, 1325-1342.

Ehri, L. And Wilce, L.S. 1980. The influence of orthography in readers' conceptualization of the phonemic structure of words. *Applied Psycholinguistics*, November, Vol. 1 (4), 371-385.

Forster, K.I. and Bednall, E.S. 1976. Terminating and exhaustive search in lexical access. *Memory and Cognition*, Vol. 4/1, 53-61.

Francis, W.N. and Kucera, H. 1982. *Frequency Analysis of English Usage: Lexicon and Grammar*. Houghton Mifflin Company, Boston.

Friederici, A.D., Schonle, P.W. and Garrett, M.F. 1982. Syntactically and Semantically Based Computations: Processing of Prepositions in Agrammatism. *Cortex* 18, 525-534.

Fromkin, V.A. 1988. Grammatical aspects of speech errors. In Newmeyer (Ed.), A Survey of Linguistic Science, Vol. II, 117-138, Cambridge University Press, Cambridge, Mass.

Gentner, D. 1978. On Relational Meaning: The Acquisition of Verb Meaning. Child Development, 49 988-998.

Gentner, D. 1981a. Verb Semantic Structures in Memory for Sentences: Evidence for Componential Representation. Cognitive Psychology 13, 56-83.

Gentner, D. 1981b. Some Interesting Differences Between Verbs and Nouns. Cognition and Brain Theory, 4 (2), 161-178.

Gentner, D. 1982. Why Nouns are Learned Before Verbs: Linguistic Relativity versus Natural Partitioning. In S. Kuczaj (Ed.), Language Development, Volume 2: Language, Thought and Culture. Lawrence Erlbaum, Hillsdale, New Jersey.

Gleitman, L. 1990. The Structural Sources of Verb Meanings. Language Acquisition 1(1), 3-55.

Goldfarb, R., Eisenson, J., Stocker, B. and DeSanti, S. 1994. Communicative Responsibility and Semantic Task in Aphasia and "Schizophasia". Perceptual and Motor Skills 79, 1027-1039.

Goldfarb, R. and Goldberg, E. 2001 Communicative Responsibility and Semantic Task in the Language of Dementia. Poster Session, American Speech-Language-Hearing Association (ASHA) Convention, New Orleans, LA.

Gomes, H., Ritter, W., Tartter, V.C., Vaughan, H.G. Jr., and Rosen, J.J. 1997. Lexical processing of visually and auditorily presented nouns and verbs: evidence from reaction time and N400 priming data. Cognitive Brain Research. BRESC: 30117, 1-16.

Goodglass, H., Klein, B., Carey, P. and Jones, K.J. 1966. Specific semantic word categories in aphasia. Cortex 2, 74-89.

Goodglass, H. and Kaplan, E. 1983. The assessment of aphasia and related disorders. Lea and Febiger, 2nd Edition, Philadelphia, PA.

Goodglass, H., Hyde, M.R., Gleason, J.B., Ward, S.E., Lindfield, K.C. and Wingfield, A. 2001. Aphasia patients' access to nouns and verbs: discourse versus confrontation naming. Academy of Aphasia, Boulder, CO.

Hagoort, P. 1990. Tracking the Time Course of Language Understanding in Aphasia. Koninklijke Wohrmann b.v., Zutphen.

Hart, J., Berndt, R.S. and Caramazza, A. 1985. Category specific naming deficit following cerebral infarction. *Nature* 316, 439-440.

Hillis, A.E. and Caramazza, A. 1991. Category specific naming and comprehension impairment: A double dissociation. *Brain*, 114, 2081-2094.

Hillis, A.E. and Caramazza, A. 1995. Representation of Grammatical Categories of Words in the Brain. *Journal of Cognitive Neuroscience* 7:3, 396-407.

Hughlings Jackson, J. 1915. On Affection of Speech from Disease of the Brain. *Brain*, Vol. 38, 107-129. [From *Brain*, 1879, p. 304...]

Jaeger, J.J., Lockwood, A.H., Kemmerer, D.L., Van Valin, R.D. Jr., Murphy, B.W., and Khalak, H.G. 1996. A PET Study of Regular and Irregular Verb Morphology in English. *Language*, Vol. 72, No. 3, 451-497.

Kellas, G., Ferraro, F.R. and Simpson, G.B. 1988. Lexical Ambiguity and the Timecourse of Attentional Allocation in Word Recognition. *Journal of Experimental Psychology: Human Perception and Performance*, Vol. 14/4, 601-609.

Kertesz, A. 1982. *Western Aphasia Battery*. Grune and Stratton, Inc. London, Ontario, Canada.

Kersten, Alan W. 1998. A Division of Labor Between Nouns and Verbs in the Representation of Motion. *Journal of Experimental Psychology: General*, Vol. 127, No. 1, 34-54.

Koenig, T. and Lehmann, D. 1996. Microstates in Language-Related Brain Potential Maps Show Noun-Verb Differences. *Brain and Language* 53, 169-182.

Kreuz, R.J. 1987. The subjective familiarity of English homophones. *Memory and Cognition* 15, 154-168.

Kucera, H. And Francis, W.N., 1967. *Computational analysis of present-day American English*. Brown University Press, Providence, RI.

Landerl, K., Frith, U., and Wimmer, H. 1996. Intrusion of orthographic knowledge on phoneme awareness. *Applied Psycholinguistics* 17, 1-14.

Lapointe, Steven G. 1985. A theory of verb form use in the speech of agrammatic aphasics. *Brain and Language* 24, 100-155.

Leonard, L.B., Schwartz, R.G., Chapman, K., Rowan, L.E., Prelock, P.A., Terrell, B., Weiss, A.L and Messick, C. 1982. Early Lexical Acquisition in Children with Specific Language Impairment. *Journal of Speech and Hearing Research*, Vol. 25, December, 554-564.

Locke, John L. 1978. Phonemic effects in the silent reading of hearing and deaf children. *Cognition* 6, 175-187.

MacKay, D.G. 1978. Derivational Rules and the Internal Lexicon. *Journal of Verbal Learning and Verbal Behavior* 17, 61-71.

Maratsos, M. 1988. The Acquisition of Formal Word Classes. In Y. Levy, I.M. Schlesinger and M.D.S. Braine (Eds.), *Categories and Processes in Language Acquisition*, 31-44. Erlbaum, Hillsdale, N.J.

Marslen-Wilson, W.B., Tyler, L.K., Waksler, R., and Older, L. 1994. Morphology and Meaning in the English Mental Lexicon. *Psychology Review*, 101, 3-33.

McCarthy, R.A. and Warrington, E.K. 1985. Category Specificity in an Agrammatic Patient: The Relative Impairment of Verb Retrieval and Comprehension. *Neuropsychologia*, Vol. 23, No. 6. 709-727.

McCarty, R.A. and Warrington, E.K. 1988. Evidence for modality-specific meaning systems in the brain. *Nature (London)* 334, 428-430.

Miceli, G., Silveri, M.C., Villa, G. and Caramazza, A. 1984. On the basis of the agrammatic's difficulty in producing main verbs. *Cortex* 20, 207-220.

Miceli, G., Silveri, M.C., Noncentini, U. and Caramazza, A. 1988. Patterns of dissociation in comprehension and production of nouns and verbs. *Aphasiology*, Vol. 2, No. 3/4, 351-358.

Naigles, L. 1990. Children use syntax to learn verb meanings. *Journal of Child Language* 17, 357-374.

Nelson, D.L., McEvoy, C.L., Walling, J.R. and Wheeler, J.W. 1980. The University of South Florida homograph norms. *Behavior Research Methods and Instrumentation* 12, 16-37.

Orpwood, L. and Warrington, E.K. 1995. Word specific impairments in naming and spelling but not reading. *Cortex*, June, Vol. 3/2, 239-265.

Pease, D.M., Gleason, J.B. and Pan, B A. 1989. Gaining Meaning: Semantic Development. In J. Berko Gleason (Ed.), The Development of Language, Merrill, Columbus, OH.

Pierce, R.S. 1984. Comprehending Homographs in Aphasia. Brain and Language 22, 339-349.

Pinker, S. 1984. Language Learnability and Language Development, 37-62. Harvard University Press, Cambridge, MA.

Pinker, S. 1991. Rules of Language. Science, Vol. 253, 530-535.

Pulvermeuller, F. 1996. Hebb's concept of cell assemblies and the psychophysiology of word processing. Psychophysiology, 33, 317-333.

Radford, A. 1990. Categorization in Early Child English. In A. Radford (Ed.), Syntactic theory and the acquisition of English syntax: the nature of early child grammars of English. Basil Blackwell, Oxford, England.

Reyna, V. 1987. Understanding Verbs: Easy Extension, Hard Comprehension. In A. Ellis (Ed.), Progress in the Psychology of Language. London, Erlbaum.

Rice , M.L. and Bode, J.V. 1993. GAPS in the verb lexicons of children with specific language impairment. First Language 13, 113-131.

Rice, M.L., Oetting, J.D., Marquis, J., Bode, J. And Pae S. 1994. Frequency of Input Effects on Word Comprehension of Children with Specific Language Impairment. Journal of Speech and Hearing Research, Vol. 37, February, 106-122.

Robinson, K., Grossman, M., White-Devine, T. and D'Esposito, M. 1996. Category-specific difficulty with verbs in Alzheimer's disease. Neurology, July, Vol. 47/1, 178-182.

Rubenstein, H., Garfield, L. and Millikan, J.A. 1970. Homographic Entries in the Internal Lexicon. Journal of Verbal Learning and Verbal Behavior, Vol. 9, 487-494.

Rubenstein, H., Lewis, S.S. and Rubenstein, M.A. 1971. Homographic Entries in the Internal Lexicon: Effects of Systematicity and Relative Frequency of Meanings. Journal of Verbal Learning and Verbal Behavior, Vol. 10, 57-62

Sherman, J.C. and Schweickert, J. 1989. Syntactic and Semantic Contributions to Sentence Comprehension in Agrammatism. Brain and Language 37, 419-439

Taft, M. 1988. A Morphological-Decomposition Model of Lexical Representation. *Linguistics* 26, 657-667.

Taft, M. and Forster, K.L. 1975. Lexical Storage and Retrieval of Prefixed Words. *Journal of Verbal Learning and Verbal Behavior* 14, 638-647.

The Holy Bible, Old and New Testaments, American Revision Committee Edition, 1901. Thomas Nelson and Sons, New York, NY

Twilley, L.C., Dixon, P., Taylor, D. and Clark, K. 1994. University of Alberta norms of relative meaning frequency for 566 homographs. *Memory and Cognition* 22/1, 111-126.

Warrington, E.K. 1975. Selective impairment of semantic memory. *Quarterly Journal of Experimental Psychology* 27, 635-657.

Warrington, E.K. & McCarthy, R. 1983. Category specific access dysphagia. *Brain* 106, 859-878.

Warrington, E.K. and Shallice, T. 1984. Category specific semantic impairments. *Brain* 107, 829-853.

Warrington, E.K. and McCarthy, R.A. 1987. Categories of Knowledge. *Brain* 110, 1273-1296.

Watkins, R.V., Rice M.L. and Moltz, C.C. 1993. Verb use by language-impaired and normally developing children. *First Language* 13, 133-143.

Wulfeck, Beverly B. 1988. Grammaticality Judgments and Sentence Comprehension in Agrammatic Aphasia. *Journal of Speech and Hearing Research*, Volume 31, 72-81.

Yamadori, A. and Albert, M.L. 1973. Word-category aphasia. *Cortex* 9, 112-125.

Zingeser, L.B. and Berndt, R.S. 1990. Retrieval of Nouns and Verbs in Agrammatism and Anomia. *Brain and Language* 39, 14-32.

Zingeser, L.B. and Berndt, R.S. 1988. Grammatical Class and Context Effects in a Case of Pure Anomia: Implications for Models of Language Production. *Cognitive Neuropsychology* 5/4, 473-516.

Zurif, E. and Grodzinsky, Y. 1983. Sensitivity to grammatical structure in agrammatic aphasics: A reply to Linebarger, Schwartz and Saffran. *Cognition* 15, 207-213.