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**Word-finding abilities of three types of aphasic subjects through
the auditory, reading, oral expressive, and writing modalities**

Silver, Lynn Susan, Ph.D.

City University of New York, 1989

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WORD-FINDING ABILITIES OF THREE TYPES OF APHASIC SUBJECTS
THROUGH THE AUDITORY, READING, ORAL EXPRESSIVE,
AND WRITING MODALITIES

By

LYNN SILVER

A dissertation submitted to the Graduate Faculty in
Speech and Hearing Sciences in partial fulfillment of
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1989

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

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Abstract

WORD-FINDING ABILITIES OF THREE TYPES OF APHASIC
SUBJECTS THROUGH THE AUDITORY, READING, ORAL
EXPRESSIVE, AND WRITING MODALITIES

by

Lynn Silver

Advisor: Harvey Halpern

Word-finding difficulties are often observed among different types of aphasic patients. This investigation analyzed the word-finding abilities of 30 aphasic subjects (10 Broca's, 10 Wernicke's, and 10 anomic). Forty nouns counterbalanced according to word length and frequency of occurrence in English language usage were used as stimuli and presented through four modalities (oral expression, writing, auditory comprehension, and reading comprehension). It was expected that patterns of word finding abilities would help in the classification of the different types of aphasia. In addition, long words, and less frequently occurring words in English language usage should prove more difficult in word-finding ability, regardless of modality. The results of this study found long words and less frequent words were more difficult for aphasic subjects. Among the modalities, long words were significantly harder than short words for the writing modality only. It was also found that semantic errors were the most common errors for all types of aphasic subjects. Broca's subjects produced significantly

more "no response" errors in oral expression; Wernicke's subjects produced significantly more semantic and phonemic errors in reading comprehension; and, Wernicke's subjects produced significantly more unrelated errors in both oral expression and reading comprehension. Clinical implications were also discussed.

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CHAPTER 1
INTRODUCTION

The Problem

Aphasia has been defined as a reduction of language that extends across various modalities. These modalities include speaking, writing, comprehension of spoken language, and reading (Schuell, Jenkins, and Jimenez-Pabon, 1969).

Word-finding difficulties are a frequently observed feature of aphasia. They are characterized as an inability to access words on command or confrontation. The aphasic patient usually produces various types of responses for the correct word. Word-finding difficulties are present across different types of aphasic subjects, not only among the different types of aphasic subjects, but across the different modalities.

The literature contains many attempts at investigating a variety of word parameters which affect the patient's ability to handle vocabulary through the four modalities. Included in this literature are such word features as frequency of occurrence in English language usage (Drummond, Gallagher, & Mills, 1977; Hier & Mohr, 1977; Howes, 1964; Newcombe, Oldfield, Ratcliff, & Wingfield, 1971; Newcombe, Oldfield, and Wingfield, 1965; Rochford and

Williams, 1965; Schuell, Jenkins, and Landis, 1961; Wepman, Bock, Jones, and Van Pelt, 1956), and word length (Bricker, Schuell, & Jenkins, 1964; Duffy, 1986, p. 196-197; Filby, Edwards, & Seacat, 1963; Friederici, Schoenle, & Goodglass, 1981; Goldstein, 1948; Halpern, 1965a, 1965b; Siegel, 1959).

Generally, this body of literature found that long words, and less frequently occurring words in English language usage, cause more difficulty for aphasic subjects in naming tasks, auditory comprehension tasks, and reading comprehension tasks.

Since impaired word-finding abilities persist across the different types of aphasia, some studies (Goodglass, Kaplan, Weintraub, & Ackerman, 1976; Goodglass & Stuss, 1979; Liederman, Kohn, Wolf, & Goodglass, 1983) have dealt with diagnostic implications of this notion.

Other studies (Barton, Maruszewski, & Urrea, 1969; Gardner, Albert, & Weintraub, 1975; Kohn & Goodglass, 1985; Marshall, 1976; Podraza & Darley, 1977; Spinnler & Vignolo, 1966; Williams & Canter, 1982) create taxonomies for aphasic subjects in word retrieval tasks by placing their responses into such categories as semantic errors, jargon, phonemic errors, neologism errors, perseverations, and no responses.

Still another area which has received considerable

attention is the effect of the semantic properties of words on the performance of aphasic subjects (Goodglass & Budin, 1988; Goodglass, Klein, Carey, & Jones, 1966; Goodglass, Wingfield, Hyde, & Theurkauf, 1986; Santo Pietro & Rigrodsky, 1982; Wallace & Canter, 1985; Williams & Wright, 1985). Certain semantic categories of words seem to be easier than others for aphasic subjects to name. For example, the semantic category of "objects" is the most difficult category for aphasic subjects to name. Examples of words belonging to the "object" category would be: "chair, comb, key, glove, and hammock". Perhaps this is due to how pertinent the word is to the subject.

Although aphasia is a multimodality disorder, the majority of the research in the field only looked at one or two of the language modalities in their respective studies. Barton et al. (1969), Kohn and Goodglass (1985), Goodglass and Stuss (1979), Liederman et al. (1983), Newcombe et al. (1965), Rochford and Williams (1965), Siegel (1959), Williams and Canter (1982), and Williams and Wright (1985) investigated naming, which is a part of the oral expressive modality. Another modality explored was auditory comprehension (Gardner et al., 1975; Schuell et al., 1961). Bricker et al. (1964) studied the writing modality in aphasic subjects. Several

researchers looked at two of the modalities (Friederici et al., 1981; Goodglass & Budin, 1988; Goodglass et al., 1966; Goodglass et al., 1986; Halpern, 1965a,b; Santo Pietro & Rigrodsky, 1982; Wallace & Canter, 1985).

Our particular interest here was to determine how various aphasic populations perform on a word-finding task using the four modalities (auditory comprehension, reading comprehension, oral expression, and writing), and varying the word stimuli. The specific purpose of this study was to examine the word-finding ability of three different types of aphasic patients (Broca's, Wernicke's, and anomic). Nouns counterbalanced according to word length and frequency of occurrence in English language usage were used as stimuli and presented within each of the four modalities.

Areas To be Examined

The following areas were investigated:

1. Overall word-finding error patterns to noun stimuli classified according to frequency of occurrence and word length.
2. Error patterns within the modalities of auditory comprehension, oral expression, reading comprehension, and writing.
3. Word-finding error patterns among the

Broca's, Wernicke's, and anomic types of aphasic subjects.

Hypotheses

It was expected that the patterns of word-finding abilities of the subjects used in this study would help in the classification of the various types of aphasia. In addition, long words, and less frequently occurring words in English language usage should prove more difficult in word-finding ability, regardless of modality.

Need and Significance of the Research

Although some studies (Drummond et al., 1977; Goodglass et al., 1976; Goodglass & Stuss, 1979; Kohn & Goodglass, 1985; Liederman et al., 1983; Williams & Canter, 1982) indicate deficits in word-finding abilities among the major aphasic syndromes, it is not totally apparent to what extent they exist and what patterns emerge. More research is needed to explore the word-finding differences among the various aphasic groups as well as to identify the diversity of word-finding responses. Although word-finding difficulty is exhibited by aphasic patients in a variety of language tasks, picture naming (Kohn & Goodglass, 1985; Liederman et al., 1983; Newcombe et al., 1971; Newcombe et al., 1965; Podraza & Darley, 1977; Rochford & Williams, 1965; Williams & Canter, 1982)

has received the most attention in the literature. Except for Hier and Mohr (1977) who investigated naming, writing, and reading comprehension, research dealing with more than one or two modalities rarely exist in the literature. In order to permit cross-modal comparisons, more research is needed to explore the word-finding abilities of different types of aphasic subjects (Broca's, Wernicke's, and anomic) through the modalities of auditory comprehension, reading comprehension, oral expression, and writing.

As an aid in the area of rehabilitation, these findings could assist in improving therapeutic techniques and evaluation procedures for aphasic patients. By taking a closer look at the actual errors and patterns of errors made by the groups of aphasic patients, we hope to acquire a better understanding of what word-finding processes are operating. Finally, the results of this research may lead to the development of a short diagnostic tool to help differentiate the various aphasic groupings.

Further chapters will deal with statistical analyses of the relationships and effects of word length and frequency of occurrence in English language usage and how these variables affect auditory comprehension, reading comprehension, oral expression, and writing within and among the aphasic groups. Other chapters

and sections of this study will deal with analyses of the various word-finding error types in three aphasic groups, and how these may be of significance to the differentiation of the groups. The relationship of age, educational level, and severity of aphasia upon word-finding abilities will be considered.

In addition, implications for future research will be discussed.

Definitions of Terms

The following are definitions of basic terms used throughout this study.

Aphasia

Impairment, as a result of brain damage, of the capacity for interpretation and formulation of language symbols; multimodality loss or reduction in efficiency of the ability to decode and encode conventional meaningful linguistic elements (morphemes and larger syntactic units); disproportionate to impairment of other intellectual functions; not attributable to dementia, confusion, sensory loss, or motor dysfunction; and manifested in reduced availability of vocabulary, reduced efficiency in application of syntactic rules, reduced auditory attention span, and impaired efficiency in input and output channel

selection. (Darley (1982), p. 42)

Broca's aphasia is a form of non fluent aphasia which is characterized by awkward articulation, restricted vocabulary, simplified grammatical constructions, and moderately impaired auditory comprehension. Comprehension of single words is good; more complex structures are usually difficult for this type patient. Reading is mildly impaired while writing is usually as impaired as speech (Goodglass & Kaplan, 1983).

Wernicke's aphasia is a form of fluent aphasia which is characterized by severely impaired auditory comprehension and fluently articulated paraphasic speech. Phonemic or literal paraphasia, semantic or verbal paraphasia, and meaningless jargon are embedded in paragrammatic speech. Reading and writing are usually severely impaired (Goodglass & Kaplan, 1983).

Anomic aphasia is a form of fluent aphasia characterized by word-finding difficulties. Speech is grammatically well formed, but with few substantive words. Circumlocutions are present and auditory comprehension is comparatively good (Goodglass & Kaplan, 1983).

Frequency of occurrence pertains to the number of

times a word exists in English language usage. For purposes of this study, the words will be divided into two frequency levels, high frequency and low frequency. High frequency words will occur 50 times per million or more, and low frequency words will occur 49 times per million or less (Thorndike & Lorge, 1944).

Word length refers to the number of letters and syllables a word contains. For this study, short words are those words which contain one syllable and have no more than four letters. Long words will contain two or more syllables and have a minimum of six letters.

Modality refers to channels of reception or expression of language skills. This study will be concerned with oral expression, auditory comprehension, reading comprehension, and writing.

Word-finding (retrieval) skills refers to the ability to access words from the memory store. This requires the channeling and processing of incoming stimuli through the brain's pathways in order to arrive at the correct response (Schuell, 1966). This term relates to all the modalities under consideration.

Noun is "a word that is the name of a subject of discourse, as a person, animal, plant, place, thing,

substance, quality, idea, action or state" (Webster's
Third New International Dictionary, 1961).

Chapter 2

Review of Related Literature

Previous investigators have demonstrated that there are a number of different factors known to influence the word-finding ability and retrieval process of aphasic subjects in language tasks. Among these factors, frequency of occurrence in English language usage and word length have received considerable attention through the years. The following sections will deal with the literature related to these variables and with the word-finding abilities of aphasic patients.

Word Retrieval in Aphasia

Schuell, Jenkins, and Jimenez-Pabon (1969) viewed a word retriever to be a device which transfers information from the permanent memory and makes it accessible for further processing. In aphasia it appears that one of three conditions may occur. One, the retriever doesn't work at all, and there is no response. In the second condition, the retriever operates with reduced efficiency and activates part of the appropriate pattern in the network. This part-message may or may not contain the exact information needed. The patient may respond with a word that is the correct word or a closely associated one. At this point the patient may be unable to

continue his search. In the third case, the retriever works a little better and the patient may be able to continue his search, and correct a wrong response. At this point, the aphasic subject may produce synonyms, related words, or phrases.

Frequency of Occurrence

In an early study, Wepman et al. (1956) tape recorded the spontaneous speech of one aphasic subject over a period of four sessions. They reported a considerable loss of words in the subject's speech. Further analysis revealed that the words which were present in his speech were those that were the most frequently spoken words. Although these authors felt that aphasic subjects retain general or more frequent words, they did mention that this may not be true for all aphasic subjects. In particular, they reported that one subject did not favor high frequency words, based on extensive recordings of his spontaneous speech.

Schuell et al. (1961) investigated the ability of aphasic subjects to understand spoken words when frequency of usage in the language was considered. The words from the Ammons Full Range Picture test were orally recited by the examiner and the subjects were asked to point to the correct pictures from a series of four pictures. Different levels of frequency of

occurrence were used. The authors concluded that frequency of occurrence was a significant factor in predicting comprehension. That is, more frequently occurring words produced fewer errors.

Howes (1964) was interested in the effect of frequency of occurrence in English language usage on the spontaneous speech of aphasic subjects. Approximately eighty subjects were interviewed informally in a hospital setting for this investigation. The subjects were instructed to speak freely about topics that interested them. The interview stopped when 5000 words were collected. Analysis of the spontaneous output of these subjects indicated a higher incidence of frequent words.

Newcombe et al. (1965) investigated the ability of dysphasic subjects to name 26 objects of different frequency of occurrence levels. The subjects were all males who had acquired aphasia from gun shot wounds. The results demonstrated more errors on the most infrequent words.

Rochford and Williams (1965) performed several language experiments to examine the effects of frequency on word-finding in dysphasia. Their experiments included such tasks as naming objects, naming body parts, naming compound words, naming abbreviations, and naming verb actions. In all

experiments, more errors were found with low frequency words than with high frequency words.

Newcombe et al. (1971) studied the effects of response latencies on men with focal brain wounds. They used words having different frequency levels. Thirty-six outline drawings were projected on a screen. The subjects were to name the pictured objects as quickly as possible. Results of this experiment demonstrated larger response latencies for pictured objects which had lower frequency levels.

Contrary to the findings of previous studies, Hier and Mohr (1977) analyzed naming, writing, and reading comprehension of one Wernicke's aphasic subject and found different results with respect to the variable of frequency of occurrence. These authors used high frequency words and low frequency words for their study. They reported no significant differences for both frequency levels.

Drummond et al. (1977) looked at production responses on auditory comprehension tasks when frequency of occurrence in language usage was accounted for. Eight fluent and eight non-fluent aphasic subjects participated in the study. In two of the tasks, involving picture recognition and antonym production no significant differences were found between either of the aphasic groups. In the sentence

completion task the fluent subjects performed significantly better than the non-fluent subjects. These authors concluded that frequency of occurrence in language usage did not play a major role.

In summary, numerous researchers have presented data which indicate that a correlation exists in the aphasic population between word frequency and performance. High frequency of occurrence words are easier for aphasic subjects than low frequency words. Perhaps high frequency words are more concrete or have been overlearned by the subjects. However, complete agreement does not exist in the research concerning the influence of this variable. For this reason it is appropriate to undertake additional research involving frequency of occurrence in English language usage.

Further studies will be reviewed which reflect an interest in both frequency and another variable, word length.

Word Length and Frequency of Occurrence

In an early publication Goldstein (1948) found aphasic subjects had difficulty with small words. His particular emphasis was on grammatical words such as prepositions, articles, and pronouns. Goldstein also found that small words of different grammatical classes were easier if they were in context, and therefore the language task employed played a role on

performance.

In a study, Siegel (1959) sought to determine the effect of both frequency of occurrence in English language usage and word length on aphasic subjects' performance. Thirteen dysphasic subjects were asked to read aloud a set of stimulus words. Siegel found, in general, that subjects had less difficulty reading high frequency words than low frequency words. With respect to word length, short words were easier for these subjects to read aloud than long words.

In an investigation by Filby et al. (1963), ten aphasic subjects and ten controls were given a matching to sample experimental task. The stimulus materials were controlled for frequency of occurrence and word length. The printed target word was flashed on the top half of a screen while two other printed words (one of which matched the target word) were flashed below it. The subjects were required to press a button next to the word that matched the target word. These authors reported no significant differences between the groups on the number of errors in the variables tested. Since these results were contrary to previous studies, Filby et al. speculated that the variables of frequency of occurrence and word length may not affect a matching to sample task.

In a study by Bricker et al. (1964) sixty-four

subjects were asked to write 100 words after oral presentation. These investigators were interested in the influence of word length and frequency of occurrence in the language on spelling errors. They concluded that spelling was more difficult as the frequency of the word decreases, and word length increases.

Halpern (1965a) was interested in determining the effects of abstraction level, parts of speech, word length, and frequency of occurrence in English language usage on verbal perseveration of aphasic subjects. He used the visual, auditory, and auditory-visual modalities. For the visual modality, the experimenter showed the subject each of the target words which were printed on a flash card. For the auditory modality, the experimenter orally stated each of the target words to the subject. For the auditory-visual modality, the experimenter orally stated each of the target words, while showing the subject the printed word on the flash card. Regardless of the modality long words produced more verbal perseverations. In a follow-up study, Halpern (1965b) wanted to determine the effects of the above variables on all aphasic verbal errors. He found that regardless of the modality, infrequent words and long words produced more verbal errors.

A study dealing with both writing and naming was performed by Friederici et al. (1981). Parts of this study included the variables of frequency of occurrence and word length. The results demonstrated that Broca's aphasic subjects had more semantic errors, and Wernicke's subjects had more phonemic errors. In addition, Broca's subjects did better in written than oral naming, while Wernicke's subjects did better in oral as opposed to written. Statistical analysis showed frequency of occurrence did not influence performance, while word length, particularly in the writing modality, did.

Santo Pietro and Rigrodsky (1982) looked at the influence of semantic difficulty on oral-verbal perseverations of 30 aphasic male subjects. The semantic difficulty of the words were measured by their frequency of occurrence in the language. The semantically difficult list consisted of words that occurred less frequently in English language usage, and the semantically easy list was composed of words that occurred more frequently in English language usage. In addition, half of the words were one syllable words and the other half were two syllable words. Three language tasks were used in this investigation: sentence completion, picture naming, and word reading. These authors found that verbal

perseveration errors increased on the naming and reading tasks as word frequency decreased. Word length did not significantly affect the number of verbal perseveration errors.

Once again, we note from the above literature there does exist some differences in the results of the investigations. Although in some cases these differences may be due to experimental design, to particular stimuli, or to other linguistic factors, the need still arises to study further the variables of word length and frequency of occurrence. Furthermore, it is important to deal with frequency and word length together as they may interact with each other. It is necessary in a study to counterbalance these variables in order to obtain a more valid picture of their consequences.

We further note that the above research deals with only one or two modalities, usually, naming (oral expression) and auditory comprehension. In only one study reviewed (Hier & Mohr, 1977) did the authors include three modalities. In order to obtain a richer and broader picture of the aphasic population we need to look at their total linguistic profile, that is, what they are doing in all the language modalities.

Diagnostic Studies

The clinical features of word retrieval tend to vary

among the various classifications of aphasia. As a result some researchers have examined the word-finding ability of aphasic subjects and focused on the differences among these groups. It is hoped that learning about the different types of aphasia will allow researchers to make generalizations about the language abilities of aphasic patients and thus expedite rehabilitation procedures.

Goodglass et al. (1976) believed that there were differences in the retrieval patterns of the different types of aphasia. They believed that some aphasic subjects were able to retrieve parts of words while others were not. This relates to the 'Tip of The Tongue' (TOT) phenomenon (Brown & McNeill, 1966). Four types of aphasic groupings (Broca's, Wernicke's, conduction, and anomic) were asked to name words of different syllable lengths. They were also asked to identify the initial letter and the number of syllables each word contained. Based on the results of their data Goodglass et al. found several differences in their groups. All groups produced more failures as word length increased. The conduction aphasic subjects produced the most failures, the anomic subjects produced the least failures, Broca's and Wernicke's subjects were somewhere in the middle. Conduction aphasic subjects were superior to

Wernicke's aphasic subjects and anomic aphasic subjects, in their ability to retrieve parts of words. On the task involving identification of beginning letters, conduction aphasic subjects performed significantly better than Wernicke's and anomic aphasic subjects.

Liederman et al. (1983) were interested in the quality of the naming errors produced by their subjects. Ten Broca's and eight Wernicke's subjects were compared with normal adults on a confrontation naming task. They found on the whole that Wernicke's patients' errors were less meaningful linguistically than those produced by the Broca's patients and the normal population.

Two naming tasks were employed in a study by Goodglass and Stuss (1979) to determine if three groups of aphasic subjects (Broca's, Wernicke's and anomic), would perform differently on two language tasks. Twenty-three aphasic subjects were used in this study. One task was a visual naming task, and the other was an oral description task. For the visual confrontation task, the subject was presented with a total of twenty pictures from the Boston Naming Test. Each subject was asked to name each picture. For the oral description task, the experimenter described each of the twenty pictures and the subject

had to name the picture that was described by the experimenter. Statistical analysis proved insignificant between Broca's and Wernicke's subjects on the visual confrontation task, but a significant difference did exist on the naming to oral description task. Broca's subjects performed better than the Wernicke's subjects. Anomic subjects performed similarly on both tasks.

Classification of Errors

Several studies contain a detailed analysis of the error responses with aphasic groups. For example, certain groups of aphasic subjects produce more semantic errors (e.g., "boy"/"girl"), some produce more acoustic errors (e.g., "cat"/"cap"), some produce more unrelated errors, (e.g., "carrot"/"tape recorder"), etc. By categorizing their results, researchers hope to acquire information about the retrieval process which will allow them to gain insight into the processes of diagnosis and therapy. The following section reviews these studies.

Spinnler and Vignolo (1966) examined both normal and aphasic subjects' ability to match a sound in the environment with a picture. The subjects were asked to listen to a sound played by a tape recorder. Each task contained ten nouns. After playing each sound on the tape recorder, the experimenter asked the subject

to choose the picture that represented the natural source of the sound. The subject had to choose one of four pictures. One picture was the target word itself (e.g., "canary singing"); another picture was an object or event which was acoustically similar to the target word (e.g., "someone whistling"); the third picture was an object belonging to the same semantic category of the natural source of the target sound (e.g., "a cock crowing"); and the fourth picture was totally unrelated to the target word (e.g., "a train"). The results of this study demonstrated that aphasic subjects made more semantic errors than acoustic errors on this auditory comprehension task. Furthermore, aphasic subjects with poorer comprehension, usually Wernicke's subjects, were found to have the most errors.

Barton et al. (1969) varied the stimulus context in order to study the word-finding abilities of thirty-six aphasic subjects. Their subjects had anomic, Wernicke's, Broca's, and conduction aphasia. Twenty-five common one syllable nouns of high frequency of occurrence were used in this study. Three different stimulus contexts were employed. The first task required the subject to name a picture of an object. The second task required the subject to finish a sentence using one of the twenty-five words

(naming to open ended sentences). The third task required the subject to name each of the twenty-five nouns after a description of each noun was given (naming to description). Their research analyzed five error categories: no response (patient fails to respond to stimulus), semantic verbal paraphasias (patient responds with a common noun in the meaning sphere of the target noun), literal verbal paraphasias (patient responds with a word in which a phoneme is substituted for another phoneme, but the syllabic structure of the target word is the same), random paraphasias (patient responds with a meaningful word which does not fit into the other paraphasic categories) and jargon (patient responds with a word which does not have a correspondence in the given language, but does have proper word structure). They found naming to open ended sentences caused the least difficulty, and naming to description caused the most difficulty. These results were fairly uniform across the aphasic types. While analyzing the errors they noted patterns between the groups. Their findings indicated that Broca's and conduction aphasic subjects had similar error patterns as did anomic and Wernicke's subjects. No differences were found between the groups for the error categories called "no response" and "semantic paraphasias". The anomic

subjects made more random verbal paraphasias than conduction aphasic subjects, and Wernicke's subjects made fewer literal paraphasias than conduction and Broca's aphasic subjects.

Gardner et al. (1975) administered an auditory comprehension task to 39 aphasic subjects. There were 4 anterior aphasic subjects with little or no comprehension difficulty, 16 anterior aphasic subjects with a comprehension deficit, 10 posterior aphasic subjects without a comprehension deficit, and 9 posterior aphasic subjects with a comprehension deficit. Lesion sites were anterior or posterior to the Rolandic fissure of the dominant hemisphere, and were verified by EEGs, brain scans, and surgeons' reports. Gardner et al. asked the subjects to choose the correct picture after the word was presented orally. The words were all common high frequency nouns. The aphasic subjects had to choose from the target word itself (e.g., "cat"), a semantically related word (members of the same semantic category as the target word, e.g., "sheep"), acoustically related word, e.g., "can" would be the same beginning sound, and "hit" would be the same final sound) and an unrelated word (no association to the target word, e.g., "towel"). In accord with Spinnler and Vignolo (1966) statistical analysis revealed that both groups

made more semantic errors than acoustic errors. These investigators also found that those patients whose comprehension was poor made more random errors.

Gardner et al. found that semantic errors were more frequent with anterior subjects and acoustic errors were more frequent with posterior subjects.

Marshall (1976) looked at types of word retrieval behaviors of eighteen aphasic subjects. He distinguished subjects by severity of aphasia rather than group. He analyzed five error types: delay (patient uses additional time to produce the word), semantic association (patient produces words that are semantically related to the target word, such as opposites and part-whole relationships), phonetic association (patient produces a word phonetically similar to the target word), description (patient gives a verbal description of the word), and generalization (patient produces general or empty words). He concluded that description, which was similar to circumlocution, and semantic associations were the most common behaviors. Delayed behaviors were used most often by higher level aphasic subjects; generalization was used by lower level subjects. The results of Marshall's study suggested that delay was the most effective strategy. He also stated that semantic and phonetic associations often led to the

successful production of the target word.

Podraza and Darley (1977) administered several naming tasks to five aphasic subjects. They analyzed the types of errors produced by these subjects. The subjects were not differentiated according to aphasic grouping. Responses were classified into the following error categories: circumlocutory descriptive errors (any response that gives some information relevant to the stimulus picture but is not a naming response); unrelated verbal paraphasias (an identifiable English word that is not related to the target word conceptually, physically, or causally); phonemic paraphasias (responses that retain the same number of syllables and at least half the phonemes of the target word); and jargon responses (responses in which fewer than half the phonemes of the target word are retained in the response and the response is not an identifiable English word). Darley and Podraza found that subjects 1 and 5 made more circumlocutory descriptive errors than did subjects 2, 3, and 4. Subject 1 made more unrelated verbal paraphasic and jargon responses than did the other 4 subjects. Subject 3 made more phonemic errors than any of the other subjects. Since this investigation did not give information relating to the type of aphasia for each subject, no further generalizations may be made

concerning the correlation of types of errors and aphasia grouping.

Williams and Canter (1982) also examined the feasibility of categorizing errors. Two naming tasks were employed to determine the effects of each on the naming performance of forty aphasic subjects. Ten each of Wernicke's, conduction, anomic, and Broca's subjects were used in this study. The two naming tasks were picture description and confrontation naming. Williams and Canter classified errors according to 12 categories: phonemic errors (e.g., "smail"/"snail"), indefinite terms (e.g., "thing"/"ball"), circumlocutions (e.g., "you use it to dry with"/"towel"), related words (e.g., "chair"/"stool"), unrelated words (e.g., "clothes"/"hands"), phonemic attempts (e.g., "bi"/"bicycle"), semantic phonemic errors (e.g., "stair"/"chair"), grammatical errors (e.g., "girls"/"girl"), perseverations (repetition of previous utterances), and inadequate responses (patient does not respond or there is a delayed response). They found that delayed responses, phonemic attempts, and related words (semantic paraphasias) were the most commonly produced errors. Broca's subjects produced more delayed responses, related words, and grammatical errors than the other

groups. Wernicke's subjects produced more circumlocutions and jargon errors than the other groups. Conduction subjects produced more perseverations and phonemic errors than other groups.

In a study patterned after Williams and Canter (1982), Kohn and Goodglass (1985) investigated the naming behavior of four classifications of aphasic subjects: Wernicke's, Broca's, frontal anomic subjects and posterior anomic subjects. Frontal anomic subjects generally had neurological damage limited to the left frontal lobe. Their speech was fluent, grammatical, and well articulated. Posterior anomic subjects had exclusively temporal and/or parietal damage. Their speech was also fluent, grammatical, and well articulated. Small amounts of paraphasias were present in the conversation of the posterior anomic subjects. Comprehension was relatively good. The errors were classified into the following categories: semantic errors (e.g., "plant"/"flower"), phonemic errors (e.g., "bran"/"broom"), perceptual errors (e.g., "lasso"/ "noose"), whole-part errors (e.g., "eraser"/"pencil"), unrelated errors (e.g., "on-ram"/"pendulum"), nonwords (referred to phonological distortions of the target word e.g., "rhinosteros"/"rhinoceros"), perseverations (included words that were repetitions of previous responses),

neologisms (referred to responses that were phonologically flawed to the point of not being recognized, e.g., "waf"/"raft"), negated responses (e.g., "no", "not", etc.), circumlocutions (e.g., "dangerous"/"darts"), and no responses. These authors did not find significant differences among the groups in their naming abilities and therefore they concluded that naming abilities were poor diagnostic indicators. They did, however, find some general consistencies. The most common errors were semantic and phonemic errors. There were more semantic than phonemic errors. Multi-word errors and circumlocutions followed next. Both groups of anomic subjects produced more circumlocutions than the other groups. Broca's subjects produced more negated responses than any other group. The anomic group produced the least phonemic errors.

Several generalizations emerge from the previous research with respect to types of word-finding errors: semantic errors seem to be the most frequent errors, phonemic errors follow next. Posterior patients made more semantic errors than anterior patients, and circumlocutions are quite frequent with the anomic patients.

Semantic Categories and Relationships of Stimuli

Naming performance may also be influenced by the

semantic category of the stimulus. Examples of individual semantic categories would be objects, letters, numbers, action words, body parts, and colors. Aphasic subjects, in their various classifications, may perform differently on the various semantic categories. Systematic analysis of the aphasic groups should increase understanding of the retrieval process and in turn aid in the development of better therapeutic strategies. Frequency of occurrence in English language usage has been related to semantic categories. Therefore, this variable must be considered as it may be a contributing factor to the performance of the aphasic subjects.

Goodglass et al. (1966) investigated the effect of different semantic categories on the naming ability and auditory comprehension of 72 fluent and non-fluent aphasic subjects. There were 37 Broca's subjects, 18 Wernicke's subjects, and 17 amnesic subjects. The fluent group consisted of the Wernicke's and amnesic subjects. Amnesic subjects were defined as having naming difficulty disproportionately severe in relation to the fluent small talk of these patients. They also exhibited runs of rapid, fluently articulated speech (Goodglass, Quadfasel, & Timberlake, 1964). These authors investigated the

following semantic categories: objects, geometric forms, letters, action words, numbers, and colors. The results of their study demonstrated that objects were the most difficult category to name and the easiest category to comprehend. Letters on the other hand presented opposite findings. That is, letters were the easiest category to name and the most difficult to comprehend. In pursuing a more detailed analysis of three diagnostic groups, Wernicke's, Broca's, and amnesic subjects, it was found that fluent subjects did poorly on object naming and better on letter naming. Goodglass et al. also pointed out that Wernicke's subjects did poorer on auditory comprehension of body parts. The subjects with Broca's aphasia showed no significant differences in their naming performance across the different semantic categories.

Williams and Wright (1985) investigated the naming performance of related and unrelated stimuli on fluent and non-fluent aphasic subjects. Related words were defined as words which belonged to the same semantic category. They used two lists of related words: one, all words that were animals; two, all words that were foods. The unrelated list of words were selected from different semantic categories, such as, toys, tools, clothing, and transportation. These authors were also

interested in analyzing the types of naming errors. They classified the errors into 12 categories: phonemic (substitution of one or more phonemes), indefinite terms (vague, general words substituted for the target word), extended circumlocutions (extended utterances related to the target word), related words (responses semantically related to the target word), unrelated words (responses that show no phonological or semantic relationship to the target word), neologisms (responses that are neither related words or phonemic approximations of the target word), phonemic attempts (phonemic or syllabic attempts of the target word), semantic-phonemic errors (responses that are phonemically similar and are also real words), grammatical errors (responses that contain grammatical errors), perseverations (repetitions of previous whole word utterances), inadequate responses (patient fails to respond), and delayed responses (correct responses, but with a 3-second or more delay). The results of their study demonstrated that fluent subjects made fewer naming errors than non-fluent subjects. Several types of errors helped to distinguish the groups. Fluent subjects produced more extended circumlocutions and non-fluent subjects produced more delayed responses and phonemic attempts. Related word errors (same semantic category, e.g., all

words that are foods, such as orange, butter, pie, ham, cookie, banana, and celery) were produced most often for all types of aphasic subjects. Thus, the authors did not find that either group had better naming scores when the stimuli were of the same category .

Goodglass et al. (1986) were interested in the effects of type of stimulus characteristics on 24 aphasic subjects. Seven Broca's subjects, 3 anomic subjects, 1 Wernicke aphasic subject, 2 conduction subjects, 3 non-fluent subjects, 3 mixed non-fluent subjects and 5 fluent subjects participated in the study. Diagnostic classifications were determined by the Boston Diagnostic Aphasia Examination. The fluent categories consisted of those subjects who could not be classified as having anomic, Wernicke's, or conduction aphasia. Similar to the Goodglass et al. (1966) study, this study dealt with the effects of certain semantic categories on the performance of aphasic subjects. In agreement with Goodglass et al. (1966), they concluded that the aphasic subjects did better with letters, colors, and body parts on naming tasks, but had more difficulty with those categories on the auditory comprehension task. This finding was particularly characteristic of the fluent subjects.

Goodglass and Budin (1988) studied the auditory

comprehension and reading comprehension of a 62-year-old Broca's subject. On the whole, this subject had the most difficulty with auditory comprehension of body parts, colors, numbers, and letters. In the other categories (household and personal items, clothing, fruit, vegetables, tools, desk implements, and bicycle parts), he demonstrated better auditory comprehension. Regardless of the semantic category, this subject demonstrated good reading comprehension.

In a study examining personally relevant materials as stimuli, Wallace and Canter (1985) administered a naming task, an auditory comprehension task, a repetition task, and a reading comprehension task to 24 aphasic subjects. The aphasic group comprised 16 mixed non-fluent subjects and 8 Wernicke's subjects. The stimuli were divided into 20 items, 10 of which were personally relevant, and 10 of which were not personally relevant. Personally relevant test items were related to the subject's background or immediate environment. Examples of a personally relevant item would be topics related to birth, marital status, and number of children. Non-personal items involved information not directly related to the subject. An example of a non-personal item would be the question "Does a bird live in a church?" The results of this

study demonstrated that severely aphasic subjects performed better on all language tasks which involved the personally relevant materials.

We see from the above studies that certain qualities or characteristics of the stimuli can affect the language abilities of the subjects. The above articles reviewed the semantic qualities of stimuli on aphasic subjects' performance. In three articles, (Goodglass & Budin, 1988; Goodglass et al., 1966; Goodglass et al., 1986), aphasic subjects had more errors on naming body parts and objects, and fewer errors on naming letters. In general, personally relevant words were easier for aphasic subjects to retrieve. This information is significant to clinicians if they are going to provide the most effective therapeutic environments for their patients.

Summary

Based upon the review of the literature we find several major variables that are responsible for influencing the word-finding performance of aphasic subjects. The following generalizations may be made from the results of the research.

- 1- High frequency words are easier for aphasic subjects than low frequency words in naming and auditory comprehension.

- 2- Short words are easier for aphasic subjects than long words in naming, auditory comprehension, writing, and reading aloud.
- 3- Posterior subjects make more semantic errors and anterior subjects make more phonemic errors in the naming and writing modalities.
- 4- The two most common error types made by aphasic subjects are semantic errors and phonemic errors in naming and auditory comprehension. Semantic errors occur more often than phonemic errors.
- 5- The semantic category of "objects" was the most difficult category to name and the easiest category to comprehend for aphasic subjects.
- 6- The semantic category of "letters" was the most difficult category to comprehend and the easiest category to name.

Although I have outlined some points which have surfaced repeatedly, the fact remains that differences do exist in the results of many of the studies. Earlier aphasia was defined as a multimodality disorder. If this is true, then all the modalities must be taken into account when assessing aphasic language performance. Additionally, several groups of aphasic subjects must be studied to see if there are differentiating features among them. All these factors together are vital if we are to arrive at

valuable and productive conclusions for the issues concerned.

The present investigation examines the word-finding ability of three types of aphasic subjects (Broca's, Wernicke's, and anomic). Forty nouns counterbalanced according to word length and frequency of occurrence in English language usage were used as stimuli and presented through the four modalities of auditory comprehension, reading comprehension, oral expression, and writing.

Research Hypotheses

On the basis of the research reviewed, the following hypotheses were formulated:

- 1- Long words are more difficult than short words for aphasic subjects, regardless of modality.
- 2- Infrequent words are more difficult than frequent words for aphasic subjects, regardless of modality.
- 3- Different error patterns among the modalities of oral expression, writing, auditory comprehension, and reading comprehension will emerge.
- 4- Different error patterns among the Broca's, Wernicke's, and anomic types of aphasic subjects will emerge.

CHAPTER 3
SUBJECTS, MATERIALS, AND PROCEDURES

Subjects

The Boston Diagnostic Aphasia Examination (1983) was administered to each of the thirty subjects used in this study. The Appendix (Tables 15, 16 and 17) displays the Profile of Speech Characteristics for each subject. They were selected from various nursing homes and clinics in the New York City Metropolitan area. The 30 subjects were evenly distributed among the three aphasic groups: 10 Broca's, 10 Wernicke's, and 10 anomic.

Clinical types of aphasia were verified by using the guidelines set up in Goodglass and Kaplan (1983). In addition, results from previous neurological and speech and language reports, obtained from clinical charts, were used to identify and describe the aphasic subjects. The three aphasic types had the following characteristics:

The Broca's aphasic subjects (Table 1) had non-fluent, short phrased, effortful speech, with awkward articulation, and good comprehension. The subjects ranged in age from 53 to 81, with a mean of 64.3 years. The number of years of education

TABLE 1
CHARACTERISTICS OF 10 BROCA'S SUBJECTS

Sex	Age	Years Post Onset	Years of Educat.	Severity Scale	Auditory Comp.
M	53	5	12	1	53
M	59	19	20	2	60
M	60	13	12	1	58
M	66	3	12	1	55
M	67	2	18	3	90
F	51	7	12	1	55
F	62	26	12	1	58
F	69	14	12	1	50
F	75	3	12	1	50
F	81	1	12	1	55
MEAN	64.3	9.3	13.4	1.3	58.4

completed for this group ranged from 12 to 20, with a mean of 13.4 years. The time post onset ranged from 1 year to 26 years, with a mean of 9.3 years. The Severity Scale on the BDAE ranged from 1 to 3, with a mean level of 1.3. The severity rating is a scale for oral communication, ranging from 0 for no communication, to 5 for no communication handicap. A score of 1 indicates that all communication of the subject is through fragmentary expression; a score of 2 indicates that the subject can have a conversation about familiar subjects, but often has difficulty conveying his ideas; and a score of 3 indicates that the subject can have a conversation about most everyday subjects, but due to a reduction of speech and/or conversation more advanced topics of conversation cause difficulty. Auditory Comprehension on the BDAE ranged from 50 to 90, with a mean of 58.4. The Auditory Comprehension score is the mean percentile of four auditory comprehension sub-tests: word discrimination, body part identification, commands, and complex ideational material. There were 5 males and 5 females in the Broca's group.

The Wernicke's aphasic group (Table 2) was characterized by fluent, well articulated, paragrammatic speech. In addition, they had poor comprehension, and their speech contained many

TABLE 2
CHARACTERISTICS OF 10 WERNICKE'S SUBJECTS

Sex	Age	Years Post Onset	Years of Educat.	Severity Scale	Auditory Comp.
M	67	2	12	3	45
M	77	4	8	1	13
M	80	4	8	2	15
M	83	2	12	2	45
F	34	6	16	2	30
F	74	1	8	2	30
F	75	2	12	3	40
F	75	7	8	1	4
F	77	9	10	3	35
F	79	2	10	2	23
MEAN	72.1	3.9	10.4	2.1	28.0

semantic paraphasias. Wernicke's subjects ranged in age from 34 to 79 years, with a mean of 72.1 years. The number of years of education completed for this group ranged from 8 to 16, with a mean of 10.4 years. The time post onset for these subjects ranged from 1 to 9 years, with a mean of 3.9 years. Their Severity Rating on the BDAE ranged from 1 to 3, with a mean of 2.1. Auditory comprehension on the BDAE ranged from 4 to 45, with a mean of 28. There were 4 males and 6 females in the Wernicke's group.

The anomic aphasic group (Table 3) was characterized by pronounced word-finding difficulties. Speech was fluent, well articulated, and grammatical, but it contained few substantive words. The age range of this group was from 54 to 80 years, with a mean age of 66.9 years. The number of years of education completed for this group ranged from 8 to 16, with a mean of 10.7 years. The time post onset was 1 to 9 years, with a mean of 4.1 years. The Severity Rating on the BDAE ranged from 3 to 4, with a mean of 3.6. A score of 3 on the Severity Rating Scale indicates that the subject can have a conversation about most everyday subjects, but due to a reduction of speech/and or conversation, more advanced topics cause difficulty. A score of 4 indicates that there is some loss in speech or comprehension but this does not

TABLE 3
CHARACTERISTICS OF 10 ANOMIC SUBJECTS

Sex	Age	Years Post Onset	Years of Educat.	Severity Scale	Auditory Comp.
M	54	9	8	4	75
M	59	3	12	4	80
M	61	3	12	3	78
M	66	4	16	4	90
M	69	2	12	3	74
F	62	4	12	3	78
F	65	5	8	4	88
F	75	5	8	4	82
F	78	5	8	3	67
F	80	1	11	4	61
MEAN	66.9	4.1	10.7	3.6	77.3

interfere significantly with the subject's ability to express ideas. Auditory Comprehension on the BDAE ranged from 61 to 90, with a mean of 77.3. There were 5 males and 5 females in the anomic group.

The age range for all the aphasic subjects in this study was 34 to 81 with a mean of 67.7 years. The time post onset for all subjects was 1 to 26 years with a mean of 5.7 years. The range of education level for all subjects extended from eighth grade to Ph.D., with a mean of 11.6 years.

The following subject data were gleaned from clinical records. Twenty-nine subjects were right handed and one subject was left handed. All subjects were free from documented bilateral brain damage, gross visual or hearing problems, and were considered physiologically and psychologically stable at the time of the experiment. English was their native language and all subjects had at least an elementary school education. In addition, all subjects were considered within the normal range of intelligence prior to the onset of aphasia and had undergone speech therapy. At the time of the present investigation 25 of the 30 subjects were receiving speech therapy. Three anomic subjects, 1 Wernicke's subject, and 1 Broca's subject were not receiving speech therapy.

MATERIALS

The forty word stimuli used for the tasks involving auditory comprehension, reading comprehension, oral expression, and writing were all nouns counterbalanced according to frequency of occurrence in English language usage and word length. There were 20 short nouns and 20 long nouns. Of the 20 short nouns, 10 were frequent, and 10 were infrequent. Of the 20 long nouns, 10 were frequent and 10 were infrequent (Table 4).

Frequency of occurrence in English language usage was determined from the Thorndike and Lorge (1944) list and the words were classified as either frequent or infrequent. The frequent words were designated by "A" and "AA". "A" were defined as being at least 50 per million, but not so many as 100 per million. "AA" were defined as 100 or more per million. The less frequent words were those that were fewer than 49 per million. For less frequent words the number "1" was equivalent to at least one occurrence per million, but not so many as 2 per million; the number "2" was equivalent to 2 per million but not so many as 3 per million, and so on up to 49. The length of words were determined by the number of letters and number of syllables. Long words contained two or more syllables

TABLE 4
 THE 40 NOUN STIMULI COUNTERBALANCED ACCORDING TO
 TO WORD LENGTH AND FREQUENCY OF OCCURRENCE
 IN ENGLISH LANGUAGE USAGE AND PRESENTED
 FOR AUDITORY COMPREHENSION, READING
 COMPREHENSION, ORAL EXPRESSION,
 AND WRITING

Frequent		Infrequent	
arm	S	balloon	L
bear	S	banana	L
bottle	L	bat	S
cake	S	bathroom	L
cat	S	belt	S
circle	L	cane	S
coat	S	carrot	L
doctor	L	deer	S
ear	S	dragon	L
egg	S	fan	S
eye	S	fork	S
farmer	L	hammer	L
fingers	L	lamb	S
flower	L	mask	S
matches	L	pajamas	L
rain	S	pencil	L
ring	S	plug	S
soldier	L	sandwich	L
vegetables	L	toilet	L
window	L	vest	S

and had a minimum of six letters. Short words contained one syllable, and had no more than four letters. The list of words with their frequency of occurrence numbers are shown in the Appendix (Table 18). All nouns used in this study were no higher than a fifth grade reading level. A noun was defined as "a word that is the name of a subject of discourse as a person, animal, plant, place, thing, substance, quality, idea, action, or state" (Webster's 3rd New International Dictionary, 1961).

For the oral expressive and writing tasks, pictures representing the forty stimulus nouns were black line drawings. Figure 1 displays examples of pictures used for the oral expression and writing tasks.

For the reading comprehension task, the words were printed on 5 X 7 inch cards. The array of choice of response pictures for the auditory and reading comprehension tasks were black line drawings displayed on an 8 X 10 sheet of white paper. This sheet of paper was divided into 4 quadrants. One quadrant contained the target picture (e.g., "arm"); another quadrant contained a picture that was semantically related to the target word (e.g., "hand"). Semantically related words were defined as those words which were related in meaning or context to the target word. Another quadrant contained a picture that was

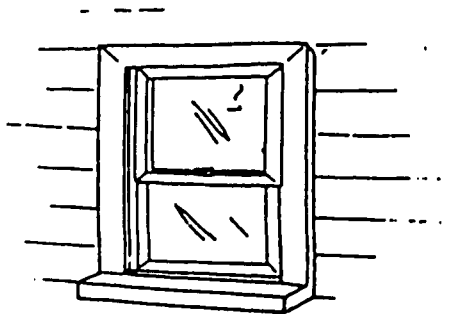
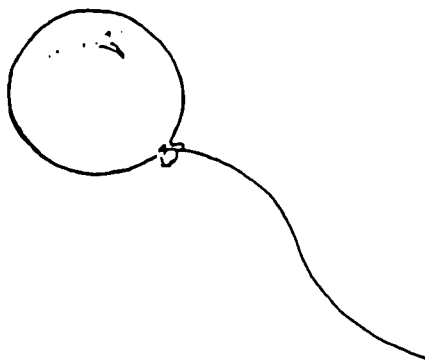


Figure 1. Two examples of pictures used for Oral Expression and Writing Tasks.

phonemically related to the target word (e.g., "farm"). Phonemically related words were those words which contained substitutions, omissions, or additions of phonemes of the target word. The fourth quadrant contained a picture that was unrelated to the target word (e.g., "apple"). Figure 2 shows a representative picture plate for the auditory and reading comprehension tasks. The location of the quadrants were varied for each of the target words. The forty target words and their respective semantic, phonemic, and unrelated words are shown in Table 5.

PROCEDURE

Each of the thirty subjects was seen individually in a quiet private room by this investigator. An audiotape recorder was used to record all subject responses. The examiner recorded by hand any additional pertinent non-verbal responses. Four different tasks representing four modalities were given to each of the subjects.

In order to eliminate practice effect and bias on data collection, order of presentation of stimuli was set up in a quasi-random fashion. A critical part of the design procedure dictated that task 3, in which the experimenter orally stated the word, was always given last. This was done to eliminate the bias that would have resulted from the subject completing one or

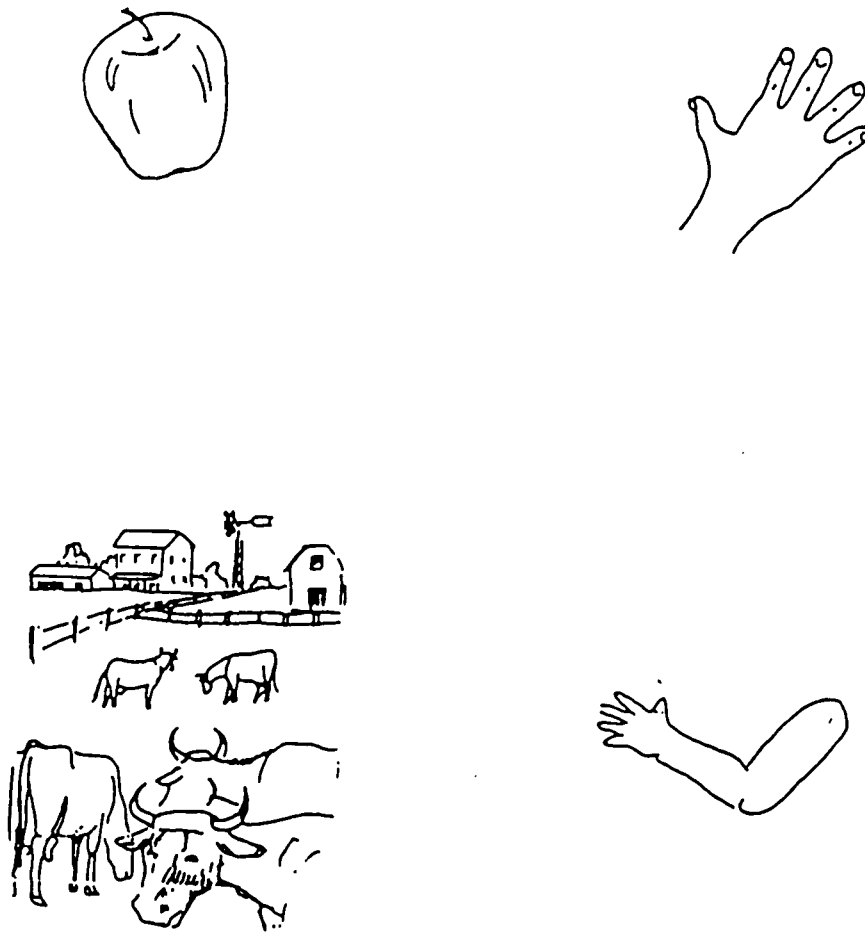


Figure 2. An example of a Picture Plate used for the Auditory Comprehension and Reading Tasks.

TABLE 5
 THE 40 STIMULUS (TARGET) WORDS AND THE CHOICE OF
 RESPONSE PICTURES (SEMANTIC, PHONEMIC,
 UNRELATED) FOR THE AUDITORY AND
 READING COMPREHENSION TASKS

Target Word	Semantic	Phonemic	Unrelated
1- arm	hand	farm	apple
2- balloon	kite	raccoon	hat
3- banana	apple	bandana	pocketbook
4- bat	ball	hat	nails
5- bathroom	kitchen	broom	cake
6- bear	elephant	chair	key
7- belt	tie	bell	piano
8- bottle	glass	rattle	monkey
9- cake	ice-cream	rake	skirt
10- cane	wheelchair	rain	turtle
11- carrot	celery	carriage	drum
12- cat	dog	bat	guitar
13- circle	square	sickle	duck
14- coat	pants	goat	television
15- deer	lamb	peer	book
16- doctor	nurse	dock	wagon
17- dragon	fire	wagon	pencil
18- ear	nose	pear	pot
19- egg	milk	leg	wagon
20- eye	nose	tie	skate
21- fan	radiator	man	skateboard
22- farmer	cows	arm	chair
23- fingers	toes	hangers	pocketbook
24- flower	vase	shower	dog
25- fork	spoon	stork	desk
26- hammer	wrench	camera	bathrobe
27- lamb	pig	lamp	bus
28- mask	glasses	desk	tree
29- matches	fire	watches	baby
30- pajamas	suit	pigeons	ladder
31- pencil	pen	fence	couch
32- plug	outlet	rug	butterfly
33- rain	umbrella	chain	owl
34- ring	necklace	king	hoe
35- sandwich	dinner	sandbox	dog
36- soldier	rifle	shoulder	chair
37- toilet	sink	boiler	pineapple
38- vegetables	fruits	tables	television
39- vest	coat	nest	stool
40- window	door	windmill	rabbit

more of the other tasks after hearing the word. Each subject was randomly assigned to one of the sequences. The Appendix (Table 19) shows each of these sequences.

Presentation of Oral Expression and Writing Tasks

- (1) In the first task the experimenter showed one of the pictures (Table 4) and asked the subject to name the picture oral expressively. All forty stimulus nouns were presented in this manner. To orient the subject to this task, the following instructions were given by the experimenter: "I am going to show you some pictures. Here is the first picture. Please name the picture." An exemplary picture was shown to each subject. If the subject did not give the correct response on the exemplary picture, the experimenter repeated the instructions. If the subject continued to give the wrong response or no response, a new exemplary picture was introduced. The experimenter did not proceed until a correct response was given by the subject.
- (2) In the second task the experimenter showed the subject a picture (Table 4) and asked the subject to write or print the name of the picture. All forty stimulus nouns were presented in this manner. To orient the subject to this task, the following directions were given by the experimenter: "I am going to show you

some pictures. Here is the first picture. Please write or print the name of the picture." An exemplary picture was shown to each subject. If the subject did not give the correct response on the exemplary picture, the experimenter repeated the instructions. If the subject continued to give the wrong response or no response, a new exemplary picture was introduced. The experimenter did not proceed until a correct response was given by the subject.

Presentation of Auditory Comprehension and Reading Comprehension Tasks

- (3) In the third task the experimenter orally stated the target word (e.g., "arm") and asked the subject to point to a picture of the word just spoken. The subject was given four pictures to choose from (Table 5 shows all stimulus words and their alternative choices). One picture was semantically related to the target word (e.g., "hand"); another picture was phonemically related (e.g., "farm") to the target word; another picture was totally unrelated (e.g., "apple") to the target word; and the final picture (e.g., "arm") was the target word itself (Figure 2). All forty stimulus nouns were presented in this manner. To orient the subject to this task the following instructions were given by the experimenter:

"I am going to show you a paper that has four pictures on it. I will say the name of a word and I would like you to point to the picture of that word." An exemplary array of pictures was shown to each subject before this task. If the subject did not give the correct response on the exemplary array of pictures, the experimenter repeated the instructions. If the subject continued to give the wrong response or no response, a new exemplary array of pictures was introduced. The experimenter did not proceed until a correct response was given by the subject.

- 4) In the fourth task the subject was shown the printed word and asked to point to the correct picture (Table 5) from a choice as described above in task (3). All forty stimulus nouns were presented in this manner. To orient the subject to this task the following instructions were given by the experimenter: "I am going to show you a paper that contains four pictures. I will ask you to read a word and then point to the picture of that word. Here is the first word. Please point to the picture of this word." An exemplary array of pictures was given to each of the patients. If the subject did not give the correct response on the exemplary array of pictures, the experimenter repeated the instructions. If the subject continued to give the wrong response or no response, a new exemplary

array of pictures was introduced. The experimenter did not proceed until a correct response was given by the subject.

Each subject was given 15 seconds to respond to the oral expression task, the auditory comprehension task and the reading comprehension task. In the writing task, the subject was allowed to write the word at his own pace. To minimize possible effects of learning, fatigue, and/or boredom, each of the experimental tasks was administered to each of the subjects on separate occasions. Each subject was involved in the study for approximately a six week period. The entire experimental data collection and testing procedures took place over a 7 month period.

Scoring

A total of 160 responses was obtained for each of the subjects involved in this study. Forty-eight hundred responses were collected in the entire study. Oral expressive and writing responses were systematically categorized. A slightly revised version of the classification system used by Williams and Canter (1982) was employed in this study. The oral expressive and writing responses were ranked as follows.

- (1) Correct response

- (2) Phonemic errors = words having omissions, substitutions, additions, of phonemes of the target word (e.g., "mouse"/"house").
- (3) Semantic errors = words related in meaning or context (e.g., "girl"/"boy").
- (4) Syntactic errors = word order and morphology (e.g., "cars"/"car").
- (5) Perceptual errors = words that have visual similarities (e.g., "windmill"/"fan").
- (6) Neologisms = a. recognizable words but not real words (e.g., "dripork"/"dragon").
- (7) Jargon = b.= non-recognizable words (e.g., "ugrigen")
- (8) No response = not answering
- (9) Unrelated responses = real words which were neither semantically, phonemically, syntactically, or perceptually related.
- (10) Perseverations = reutterance of previous words or parts of words (prefixes, suffixes, sounds, syllables).
- (11) Negations = saying no after a response
- (12) Automatic responses = these included such statements as "You know", "Oh God", "Oh dear".
- (13) Circumlocutions = a group of words used to describe the target word. For example, for the word arm, the subject may say, "The thing attached to the body".
- (14) Miscellaneous = instead of writing or printing the

target word, the subject draws a picture or design.

The auditory and reading comprehension tasks were classified in the following manner (Table 5):

- (1) Correct Response = subject points to the target word.
- (2) Semantic error = subject points to a picture of a word which is related in meaning or context to the target word (e.g., "ear"/"nose").
- (3) Phonemic error = subject points to a picture of a word which contains omissions, substitutions, or additions of phonemes of the target word (e.g., "egg"/"leg").
- (4) Unrelated error = subject points to a picture of a word which is neither semantically nor phonemically related to the target word (e.g., "bear"/"key").

CHAPTER 4

RESULTS

The Problem

The present study investigated the word-finding abilities of three types of aphasic subjects (Broca's, Wernicke's, and anomic). Forty nouns, counterbalanced according to word length and frequency of occurrence in English language usage were used as stimuli and presented through four modalities (oral expressive, writing, auditory comprehension, and reading comprehension). The following areas were investigated: 1) Overall word-finding error patterns to noun stimuli classified according to frequency of occurrence and word length; 2) Error patterns within the modalities of expression, writing, auditory comprehension, and reading comprehension; 3) Word-finding error patterns among the diagnostic groups.

The four hypotheses mentioned in chapter 1 will be examined. These are:

- 1- Long words are more difficult than short words for aphasic subjects, regardless of modality.
- 2- Infrequent words are more difficult than frequent words for aphasic subjects, regardless of modality.
- 3- Different error patterns among the modalities of oral expression, writing, auditory comprehension,

and reading comprehension will emerge.

- 4- Different error patterns among the Broca's, Wernicke's and anomic types of aphasic subjects will emerge.

Overview of Data Analysis

Due to the fact that error categories were coded separately, initial analysis of errors, in total, was done by examining the number of correct responses. Hence, any significant differences in correct responses imply significant differences in the incorrect or total error responses.

For purposes of statistical analysis the raw data were converted into 16 scales. They were as follows:

- 1-Expressive^a, 10 short frequent words
- 2-Expressive, 10 short infrequent words
- 3-Expressive, 10 long frequent words
- 4-Expressive, 10 long infrequent words
- 5-Writing, 10 short frequent words
- 6-Writing, 10 short infrequent words
- 7-Writing, 10 long frequent words
- 8-Writing, 10 long infrequent words
- 9-Auditory Comprehension, 10 short frequent words

^a= For data analyses, the term Expressive is used for the oral expressive modality.

10-Auditory Comprehension, 10 short infrequent words

11-Auditory Comprehension, 10 long frequent words

12-Auditory Comprehension, 10 long infrequent words

13-Reading Comprehension, 10 short frequent words

14-Reading Comprehension, 10 short infrequent words

15-Reading Comprehension, 10 long frequent words

16-Reading Comprehension, 10 long infrequent words

The results were analyzed in terms of correct responses of the above sets of 10 words. Mean correct scores were calculated for each of the 16 scales.

In order to be able to look at these variables over sets of 10 words, a reliability analysis was performed on each set (scale). We were interested in obtaining alpha values greater than .8. The mean alpha for all 16 sets was .811, with a range for 14 of the scales of .76 to .92. Two scales, however, were lower, consisting of the long infrequent versions of auditory comprehension and reading comprehension, with values of .60 and .67, respectively. Both scales were compromised by two words that were too easy: banana and hammer. The reliability analysis suggests that we may look at the patterns of responses within the four domains of short frequent, short infrequent, long frequent, and long infrequent, for each modality. A complete list of the alpha values is included in the Appendix (Table 20).

The mean correct responses were analyzed in an Analysis of Variance (Datatext), where diagnostic group (Broca's, Wernicke's, and anomic) was the independent factor; length (short/long), frequency (frequent/infrequent), and modality (oral expressive, writing, auditory comprehension, and reading comprehension), were the repeated measures. Post hoc tests (Scheffé) were performed in order to interpret the actual differences among the individual means.

To examine the individual error categories, one-way analysis of variance (SPSS Program) for each error type/modality by diagnostic group was performed. In addition, one-way analysis of variance for the sum of the modalities (tasks) was performed. For semantic, phonemic, and unrelated errors, all modalities were tested. For the syntactic, perceptual, neologism, jargon, no response, perseveration, automatic response, circumlocution, and miscellaneous error types, the modalities of expression and writing were tested. All significant results were further examined using the Scheffé procedure. Overall, we looked at 10 of the 11 error categories. Statistical analyses were performed on all except perceptual errors as these error totaled only 5 for all tasks. Individual perceptual errors will be discussed later in this chapter.

The results will be presented in two major sections corresponding to the aforementioned analyses.

Analysis of Variance on Correct Responses

Table 6 summarizes the mean number of correct responses produced by the three aphasic groups through the 4 modalities. To determine whether the differences suggested by Table 6 are statistically significant, analysis of variance was performed on the data. Table 7 displays a summary of the analysis of variance of correct responses of the 3 aphasic groups for the 4 modalities. Post hoc testing (Scheffé) was performed on the significant differences. The following sections will discuss these results.

Word Length

The main effect of word length was significant ($F(1,27) = 14.060, p < .001$). Long words produced significantly more errors overall than short words.

Frequency of Occurrence

The main effect of frequency was also significant ($F(1,27) = 4.561, p < .05$). Infrequent words produced significantly more errors than frequent words.

Modality

The main effect of modality was highly significant ($F(3,81) = 146.161, p < .001$),

TABLE 6

MEAN NUMBER OF CORRECT RESPONSES BY 3 GROUPS OF APHASIC
SUBJECTS THROUGH THE FOUR MODALITIES -

Modality	Broca's	Wernicke's	Anomic
Expressive			

ShortFrequent	3.0	3.5	8.2
ShortInfrequent	2.6	1.9	7.5
LongFrequent	1.9	2.9	5.8
LongInfrequent	1.7	2.1	6.4
<hr/>			
Writing			

ShortFrequent	2.2	1.9	5.1
ShortInfrequent	1.3	0.9	4.3
LongFrequent	0.7	0.6	2.4
LongInfrequent	1.1	0.1	3.2
<hr/>			
Auditory Comp.			

ShortFrequent	9.0	7.4	9.6
ShortInfrequent	9.2	7.9	9.9
LongFrequent	9.0	8.3	9.7
LongInfrequent	9.0	7.6	9.1
<hr/>			
Reading Comp.			

ShortFrequent	8.1	6.7	9.4
ShortInfrequent	8.3	6.3	9.5
LongFrequent	8.0	6.6	9.6
LongInfrequent	8.7	6.8	9.4

TABLE 7
SUMMARY OF ANALYSIS OF VARIANCE OF CORRECT RESPONSES
OF 3 APHASIC GROUPS THROUGH THE 4 MODALITIES

Source	df	ss	ms	F	p
Group	2	763.153	381.577	11.798	under 0.001
Unit	27	873.218	32.341		
Modality	3	3881.737	1293.912	146.161	under 0.001
Group by Modality	6	209.313	34.885	3.941	0.002
Modality by Unit	81	717.066	8.853		
Length	1	35.208	35.208	14.060	0.001
Group by Length	2	13.304	6.652	2.656	0.0879
Length by Unit	27	67.612	2.504		
Frequent	1	4.800	4.800	4.561	0.042
Group by Frequency	2	6.913	3.456	3.284	0.053
Frequency by Unit	27	28.412	1.052		
Modality by Length	3	42.542	14.181	9.641	under 0.001
Group by Modality by Length	6	7.196	1.199	0.815	over 0.500
Modality by Length by Unit	81	119.137	1.471		
Modality by Frequency	3	6.917	2.306	2.578	0.06
Group by Modality by Frequency	6	5.521	0.920	1.029	0.413
Modal. by Freq by Unit	81	72.437	0.894		
Length by Frequency	1	3.675	3.675	2.665	0.115
Group by Length by Frequency	2	0.462	0.231	0.168	over 0.500
Length by Freq by Unit	27	37.238	1.379		
Modality by Length by Frequency	3	15.308	5.103	5.360	0.003
Group by Modality by Length by Frequency	6	5.204	0.867	0.911	0.492
Modality by Length by Frequency by Unit	81	77.112	0.952		

demonstrating that the overall performance on the modalities was not the same. A post hoc test (Scheffé, $p < .01$) revealed that overall performance on auditory and reading comprehension were significantly better than oral expression, which in turn was better than writing. However, the overall performance on auditory comprehension and reading comprehension were not significantly different.

The analysis revealed a significant interaction for modality by length ($F(3,81) = 9.641, p < .001$). Post hoc testing (Scheffé, $p < .01$) showed that long words were significantly harder than short words, but only for the writing modality. For the other modalities, length was not a significant factor.

The interaction of modality and frequency did not reach significance at the 5% level ($F(3,81) = 2.578, p = .06$). Thus, performance on the modalities was similar for the parameters of frequency of occurrence.

Significant differences were obtained for the interaction of modality by length by frequency ($F(3,81) = 5.360, p < .01$). A post hoc test (Scheffé, $p < .01$) showed, in the writing modality only, that long words were more difficult than short words when the words were frequent. However, when the words were infrequent, no significant differences were found.

There were no other significant relationships found in the other modalities for the parameters of length and frequency.

Group

The main effect of group type was highly significant ($F(2,27) = 11.798, p < .001$). This indicated that there were indeed significant differences among the groups in terms of overall performance. A post hoc test (Scheffé, $p < .01$) showed that overall, anomic subjects produced significantly more correct responses than the Broca's and Wernicke's subjects. A post hoc test (Scheffé, $p < .001$) further revealed that anomic subjects did significantly better than Broca's subjects.

The analysis just failed of significance for the interaction of group and length ($F(2,27) = 2.656, p = .089$), as well as the interaction of group by frequency ($F(2,27) = 3.284, p = .053$).

The interaction of group by length by frequency was also not significant ($F(2,27) = .168, p > .5$).

Significant differences were obtained for the interaction of group by modality ($F(6,81) = 3.941, p < .05$). In the previous analysis when modality was not taken into consideration, an overall difference was found for anomic subjects, that is, the anomic subjects did significantly better than Broca's or Wernicke's

overall. However, taking modality into consideration, post hoc testing (Scheffé, $p < .01$) revealed in auditory comprehension and reading comprehension, no significant difference between the groups. In oral expression, anomic subjects did significantly better than the other groups. Post-hoc testing (Scheffé, $p < .01$) also showed that writing was significantly better than oral expression, but only with the anomic subjects.

The group by modality by length interaction did not reach significance ($F(6,81) = .815, p > .50$) showing that the responses of the aphasic groups for each of the modalities did not vary significantly with the parameters of length.

The interaction of group by modality by frequency also was not significant ($F(6,81) = 1.029, p = .413$), indicating that the responses of the aphasic groups were similar for the modalities with respect to frequency.

The analysis of variance also revealed no significant results for the interaction of group by modality by length by frequency ($F(6,81) = .911, P = .492$).

Analysis of Variance on Error Types

Figure 3 is a graphic representation of the mean

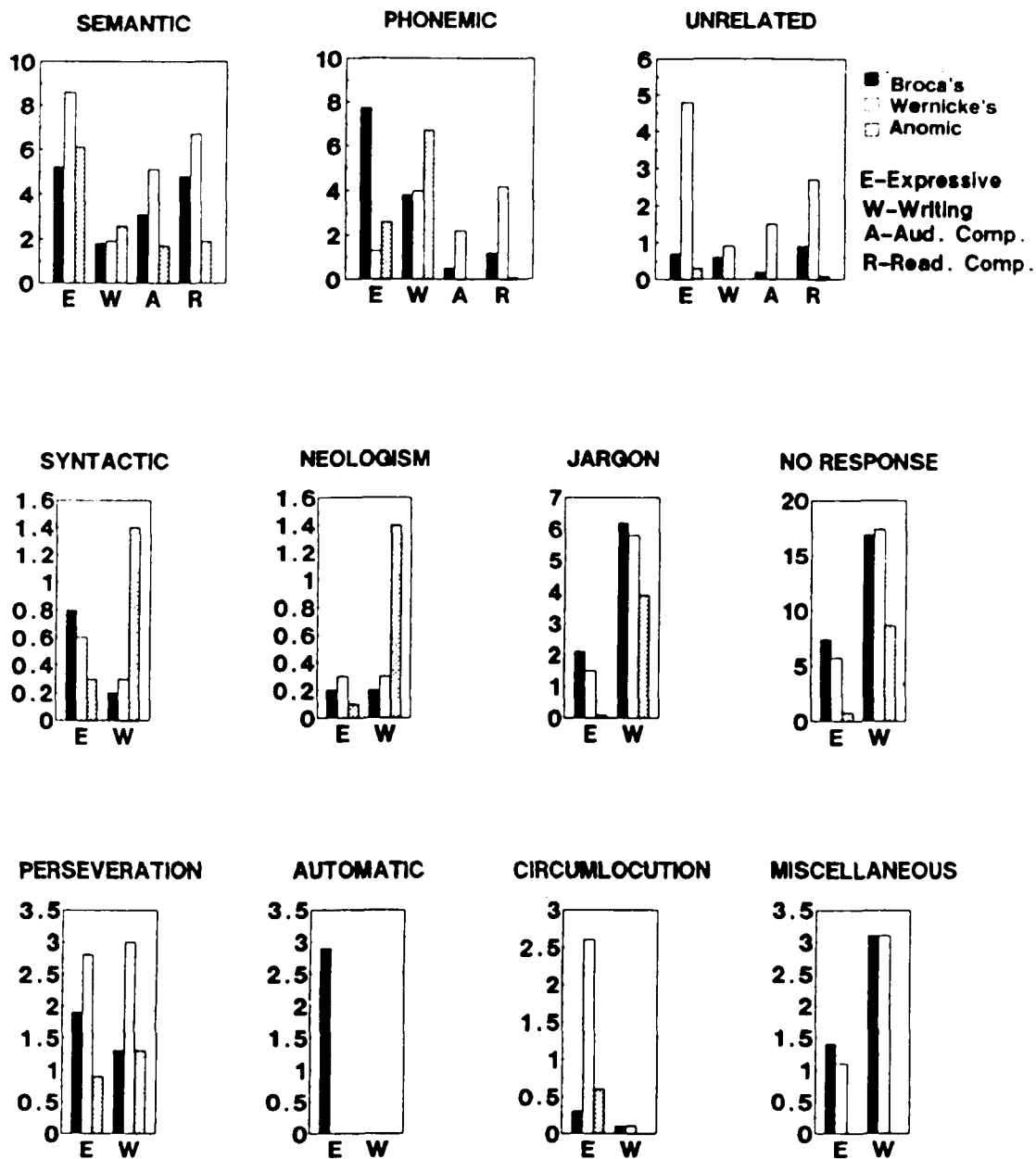


Fig. 3. Mean number of errors for 3 aphasic groups for each of the error categories.

number of errors for each of the three aphasic groups for each of the error/modality categories.

Statistical analysis of these data shows the significant differences among the groups for errors/modality categories. One-way analysis of variance was performed on each error, where each error type, within each modality, was the dependent variable, and aphasia group was the independent variable. In addition, analyses were performed on the sum of the error type for all the modalities, by group. Post hoc tests (Scheffé) were then applied to the means in order to determine the relationship among the 3 groups of aphasic subjects. Table 8 displays a summary of all the analyses of variance performed. Detailed results of these statistical analyses are displayed in the Appendix (Table 21). Ten of the 11 errors were analyzed. As mentioned earlier, because there were so few perceptual errors, statistical analysis of this error type was not performed.

Semantic Errors

There were no significant differences among the aphasic groups for semantic oral expression, semantic writing, and semantic auditory comprehension errors, ($F(2,27) = 2.188, p = .131$; $F(2,27) = .331, p = .721$; $F(2,27) = 3.01, p = .066$, respectively. There was, however, a significant difference for groups and

TABLE 8
SUMMARY OF ANALYSIS OF VARIANCE OF 3 APHASIC
GROUPS FOR EACH ERROR CATEGORY

Error Type/Modality	df	F
Semantic/Expressive	2,27	2.188
Semantic/Writing	2,27	0.331
Semantic/Auditory Comprehension	2,27	3.010
Semantic/Reading Comprehension	2,27	5.704 **
Semantic Sum	2,27	5.982 **
Phonemic/Expressive	2,27	3.840 *
Phonemic/Writing	2,27	0.899
Phonemic/Auditory Comprehension	2,27	2.492
Phonemic/Reading Comprehension	2,27	7.410 **
Phonemic Sum	2,27	0.625
Unrelated/Expressive	2,27	15.537 ***
Unrelated/Writing	2,27	2.433
Unrelated/Auditory Comprehension	2,27	2.555
Unrelated/Reading Comprehension	2,27	4.357 *
Unrelated Sum	2,27	12.276 ***
Syntactic/Expressive	2,27	0.851
Syntactic/Writing	2,27	1.087
Syntactic Sum	2,27	0.404
Neologism/Expressive	2,27	0.409
Neologism/Writing	2,27	1.168
Neologism Sum	2,27	0.638
Jargon/Expressive	2,27	2.325
Jargon/Writing	2,27	0.161
Jargon Sum	2,27	0.497
NoResponse/Expressive	2,27	4.085 *
NoResponse/Writing	2,27	1.178
NoResponse Sum	2,27	2.871
Perseveration/Expressive	2,27	0.815
Perseveration/Writing	2,27	0.637
Perseveration Sum	2,27	0.794
Automatic/Expressive	2,27	1.511
Automatic/Writing	2,27	no errors
Automatic Sum	2,27	1.511
Circumlocution/Expressive	2,27	4.183 *
Circumlocution/Writing	2,27	0.500
Circumlocution Sum	2,27	4.344 *
Miscellaneous/Expressive	2,27	0.566
Miscellaneous/Writing	2,27	1.037
Miscellaneous Sum	2,27	1.568

* p < .05

** p < .01

*** p < .001

semantic reading comprehension errors ($F(2,27) = 5.704$, $p < .01$) The post hoc test (Scheffé, $p < .01$) showed that Wernicke's subjects made significantly more semantic errors in reading comprehension than anomic subjects. Additionally, the analysis showed a significant difference among the groups for semantic errors and the sum of the modalities ($F(2,27) = 5.982$, $p < .01$).

The post hoc test (Scheffé, $p < .01$) indicated that Wernicke's subjects had more semantic errors, for the sum of the modalities, than anomic subjects.

Phonemic Errors

No significant differences were found among the groups for phonemic writing errors ($F(2,27) = .899$, $p = .418$); phonemic auditory comprehension errors ($F(2,27) = 2.492$, $p = .10$); and phonemic errors for the sum of the modalities ($F(2,27) = .625$, $p = .542$). Thus, the groups did not perform differently for the number of phonemic errors in these modalities or the sum of the modalities. On the other hand, the analysis of variance yielded significant results among the diagnostic groups for phonemic oral expressive errors ($F(2,27) = 3.80$, $p < .05$), as well as phonemic reading comprehension errors ($F(2,27) = 7.41$, $p < .01$), indicating that the groups performed differently in oral expression and reading comprehension for phonemic

errors. A post hoc test (Scheffé, $p < .05$) showed that Broca's subjects had significantly more phonemic errors in oral expression than did Wernicke's subjects. A post hoc test (Scheffé, $p < .01$) also showed that Wernicke's subjects produced more phonemic errors in reading comprehension than anomic subjects. In addition, the results of the post hoc test (Scheffé, $p < .05$) revealed that Wernicke's subjects had significantly more phonemic errors in reading comprehension than did Broca's or anomic subjects.

Unrelated Errors

Significant differences were not found among the groups for unrelated writing errors ($F(2,27) = 2.433$, $p = .106$) or for unrelated auditory comprehension errors ($F(2,27) = 2.555$, $p = .096$), indicating that there was no significant variation for these types of errors. The analysis did yield a significant result among groups for unrelated oral expressive errors ($F(2,27) = 15.537$, $p < .001$), as well as, unrelated reading comprehension errors, ($F(2,27) = 4.357$, $p < .05$), indicating that the groups were differentially affected for these error categories. The post hoc test (Scheffé, $p < .01$) revealed that Wernicke's subjects had more unrelated errors in oral expression than did anomic or Broca's subjects. A post hoc test (Scheffé, $p < .05$) showed that Wernicke's subjects produced more

unrelated errors than anomic subjects in reading comprehension. There was also a significant difference by group for the sum of the modalities for unrelated errors ($F(2,27) = 12.276, p < .001$). The results of a post hoc test (Scheffé, $p < .01$) showed that Wernicke's subjects produced more unrelated errors for the sum of the modalities than anomic subjects and Broca's subjects.

Syntactic Errors

The analyses revealed no significant differences among the groups for syntactic oral expressive errors ($F(2,27) = .851, p = .438$), syntactic writing errors ($F(2,27) = 1.087, p = .352$), or the sum of the two modalities for syntactic errors ($F(2,27) = .404, p = .672$), indicating that the groups were not differentially affected for this error category.

Perceptual Errors

As mentioned above, because of the few errors made, no statistical analysis was performed on this error category. There were only five perceptual errors. All five errors were on long words.

Neologism Errors

There was no significant difference among the groups for neologism oral expressive errors ($F(2,27) = .409, p = .668$), neologism writing errors ($F(2,27) = 1.168, p = .326$), or the sum of these two modalities ($F(2,27) =$

.638, $p = .536$).

Jargon Errors

The groups did not differ significantly for jargon oral expressive errors ($F(2,27) = 2.325$, $p = .117$), jargon writing errors ($F(2,27) = .161$, $p = .852$), or the sum of these modalities by groups for jargon errors ($F(2,27) = .497$, $p = .614$), indicating that the groups were statistically indistinguishable for this error category for these modalities .

No Response

The differences among the groups proved non-significant for no response writing errors ($F(2,27) = 1.178$, $p = .323$) and the sum of the two modalities for no response errors ($F(2,27) = 2.871$, $p = .074$), indicating that there was no differential variation for the groups for these error categories. On the other hand, our analysis did yield a significant result between the groups for no response oral expressive errors ($F(2,27) = 4.085$, $p < .05$). The post hoc test (Scheffé, $p < .05$) showed that Broca's subjects had significantly more no responses in oral expression than did anomic subjects.

Perseverations

The analysis of variance found no significant differences among the groups for perseveration oral expression errors ($F(2,27) = .815$, $p = .453$),

perseveration writing errors ($F(2,27) = .637, p = .537$), or the sum of the modalities for perseveration errors ($F(2,27) = .794, p = .463$), demonstrating no statistically significant variation among the groups for this error category.

Automatic Responses

There were no significant variations among the groups for automatic responses oral expressive errors ($F(2,27) = 1.511, p = .239$), automatic responses writing errors ($F(2,27) = 0, p = 0$), or the sum of the two modalities for automatic responses errors ($F(2,27) = 1.511, p = .239$).

Circumlocutions

The results of the analysis for circumlocution writing errors ($F(2,27) = .5, p = .612$) did not reach significance. There was, however, a significant result for circumlocution oral expressive errors ($F(2,27) = 4.183, p < .05$), demonstrating that the groups performed differently in oral expression for circumlocution errors. The post hoc test (Scheffé, $p < .05$) showed that Wernicke's subjects produced more circumlocutions in oral expression than did Broca's subjects. A significant result was also obtained for the sum of the modalities for circumlocution errors ($F(2,27) = 4.344, p < .05$), indicating that the groups performed differently for this error classification for

the sum of the modalities. The post hoc test (Scheffé, $p < .05$) showed that the Wernicke's subjects produced significantly more circumlocutions for the sum of the modalities than the Broca's subjects.

Miscellaneous Errors

There were no significant differences found among the groups for miscellaneous oral expressive errors ($F(2,27) = .566, p = .575$), miscellaneous writing errors ($F(2,27) = 1.037, p = .368$), and the miscellaneous errors for the sum of the modalities ($F(2,27) = 1.568, p = .227$).

Summary

In analyzing the responses, significant differences were found for the main effects of group, modality, length, and frequency. In addition, the analyses of variance produced significant interactions for group by modality, modality by length, and modality by length by frequency. Tables 9 and 10 presents a summary of the significant results. The following section will review the statistical results and their relevance to the hypotheses.

Hypothesis 1: Long words are more difficult than short words for aphasic subjects, regardless of modality.

Long words produced significantly more errors (or fewer correct responses) overall than short words. Among the modalities, long words were only

TABLE 9
 SUMMARY OF SIGNIFICANT ANALYSIS OF VARIANCE OF
 CORRECT RESPONSES AND POST HOCS

SOURCE	POST HOCS
Group	Anomic subjects produced more correct responses than Broca's and Wernicke's subjects
Modality	Overall performance on Aud. Comprehension and Read. Comprehension was better than Oral Expression; Oral Expression was better than Writing
Group by Modality	In Oral Expression, Anomic subjects performed better than Broca's and Wernicke's
Length	Long words were more difficult than short words
Frequent	Infrequent words were more difficult than frequent words
Modality by Length	In Writing, long words were more difficult than short words
Modality by Length by Frequency	In Writing, long words were more difficult than short words, if the words were frequent

TABLE 10
 SUMMARY OF SIGNIFICANT ERROR TYPES AND POST HOCS

ERROR TYPE/MODALITY	POST HOC
Semantic/Reading Comprehension	W > A
Phonemic/Oral Expressive	B > W
Phonemic/Reading Comprehension	W > A,B
Unrelated/Oral Expressive	W > A,B
Unrelated/Reading Comprehension	W > A
No Response/Oral Expressive	B > A
Circumlocution/Oral Expressive	W > B

> = more errors

A = Anomic; B = Broca's; W = Wernicke's

significantly harder than short words for writing.

Hypothesis 2: Infrequent words are more difficult than frequent words for the aphasic subject, regardless of the modality.

Infrequent words produce significantly more errors overall than frequent words. The interaction between frequency of occurrence and the modalities was not significant at the 5% level.

Hypothesis 3: Different error patterns among the modalities of oral expression, writing, auditory comprehension, and reading comprehension will emerge.

The overall performance on auditory comprehension and reading comprehension were significantly better than oral expression. In addition, the overall performance on oral expression was significantly better than writing.

Long words were significantly harder than short words in the writing modality only. No significant differences were found among the modalities for frequency of occurrence.

The interaction of frequency of occurrence, word length, and modality demonstrated that, in writing, long words were significantly harder than short words, if the words were frequent.

Hypothesis 4: Different error patterns among the Broca's, Wernicke's, and anomic types of aphasic

subjects will emerge.

Anomic subjects produced significantly more correct responses overall, than Broca's and Wernicke's subjects.

We further found significant differences with the anomic group when modalities were considered. That is, anomic subjects performed significantly better on writing than on oral expression. In oral expression, anomic subjects performed significantly better than the other two groups. No other significant differences were found for the groups that differentiated their abilities among the modalities.

In addition, statistically, the groups were not differentially influenced by the variables of word length or frequency of occurrence.

With respect to types of errors we find five error categories yielding significant results for groups: semantic errors, phonemic errors, unrelated errors, no response errors, and circumlocutions.

Semantic Errors: In reading comprehension, Wernicke's subjects made significantly more semantic errors than anomic subjects. Wernicke's subjects had significantly more semantic errors for the sum of the modalities than anomic subjects.

Phonemic Errors: Broca's subjects made significantly more phonemic errors in oral expression than Wernicke's

subjects. Wernicke's subjects produced significantly more phonemic errors in reading than anomic subjects.

Unrelated Errors: Wernicke's subjects produced significantly more unrelated errors in oral expression than did the other aphasic groups. Wernicke's subjects produced significantly more unrelated errors in reading comprehension than the anomic aphasic subjects.

Wernicke's subjects produced significantly more unrelated errors for the sum of the modalities than anomic subjects and Broca's subjects.

No Response: Broca's subjects had significantly more no responses in oral expression than did anomic subjects.

Circumlocutions: Wernicke's subjects produced significantly more circumlocutions in oral expression than did Broca's subjects. Wernicke's subjects produced significantly more circumlocutions in oral expression for the sum of the modalities than Broca's subjects.

In addition to the statistically significant results cited above, visual observation of Table 6 and Figure 3 point to the existence of other distinguishing relationships. These will be discussed in the next chapter.

CHAPTER 5

DISCUSSION, RECOMMENDATIONS, CONCLUSIONS, SUMMARYDiscussion

The present study was undertaken to explore the effects of frequency of occurrence in English language usage and word length on the word-finding abilities of three types of aphasic subjects (Broca's, Wernicke's, and anomic). Four modalities, oral expression, writing, auditory comprehension, and reading comprehension were investigated.

This chapter will present a discussion of the significant results for the above variables as well as some general trends observed. Diagnostic and clinical implications will also be presented, in addition to recommendations for future research.

Word Length

The results of this investigation were consistent with prior evidence that long words produced significantly more errors than short words (Bricker et al., 1964; Filby et al., 1963; Friederici et al., 1981; Goldstein, 1948; Goodglass et al., 1976; Halpern, 1965a,b; Siegel, 1959). There are several possible explanations for the significant effects of this parameter. First, the longer the word, the more phonetic information a subject has to process, and

thus more chance for error. Secondly, the longer the word, the more possibilities the aphasic subject could get confused with semantic similarities to other words. For example, with the word "sandwich" the aphasic subject might first look at the beginning of the word and process "sand" as grains of rock, but as he looks at the end of the word "wich" he might possibly think of a wicked person. Putting those two syllables together could confuse him, and thus cause errors in responses.

Frequency

Data obtained in this study demonstrated that overall infrequently used words were more difficult in word-finding abilities for aphasic subjects than frequently used words. This supports the studies of Bricker et al. (1964), Halpern (1965b), Howes (1964), Newcombe et al. (1971), Newcombe et al. (1965), Pizzamiglio and Black (1968), Rochford and Williams (1965), Schuell et al. (1961), Siegel (1959), Thurston (1954), Wepman et al. (1956), and Williams and Canter (1982) who found that infrequent words are more difficult for aphasic subjects than frequent words. A possible explanation for this is that high frequency words are usually those words which are learned earlier in life. These words may be necessities of both childhood and adulthood, and might

not be lost due to their survival nature. That is, the aphasic subject may need them in order to communicate simple daily necessities. Because of this, they also may be words that are overlearned and therefore the aphasic subject may produce them in an almost automatic fashion. In addition, the aphasic subject could be constantly stimulated with high frequency words. That is, he may be verbally over-exposed to these words in his daily environment. Thus, the constant stimulation might lead to learning.

Modality

The results of the present study showed that word-finding performance varied within the modalities. This finding concurs with Drummond et al. (1977), Friederici et al. (1981), Goodglass and Budin (1988), Goodglass et al. (1966), Goodglass et al. (1986), Hier and Mohr (1977), Santo Pietro and Rigrodsky (1982), and Wallace and Canter (1985) who also found different performance patterns for the modalities they investigated. The present investigation revealed that the overall performance on auditory comprehension and reading comprehension was significantly better than on oral expression, and oral expression was significantly better than writing. For the tasks involving auditory comprehension and reading comprehension, the present

investigation required the subjects to point to the correct picture when given an array of pictures. This procedure may have contributed to the large number of correct responses obtained for these modalities. Auditory comprehension and reading comprehension are more passive because there is only linguistic search involved. A possible explanation for the fact that writing was the most difficult modality may be that it involves both linguistic search as well as productive or formative activities, both of which can be impaired in aphasic subjects. Furthermore, a possible reason for writing being more impaired than oral expression may be that it is traditionally the last modality learned. Typically that which is learned last in the acquisition of language is the most difficult and more advanced skill.

Modality and Word length

A significant effect was observed for word length and modality. Long words were significantly harder (i.e., fewer correct answers), than short words, but only in the writing modality. This finding concurs with Bricker et al. (1964) and Friederici et al. (1981) who stated that long words cause more spelling and writing errors than short words. Longer words typically are more difficult because there is more linguistic processing and a longer retention span

needed for a longer word. As stated previously, the writing modality is probably the hardest modality and it takes not only linguistic search, but also production or formulation. Table 11 displays the mean number of correct responses for the interaction of modality by length.

Modality by Frequency of Occurrence

The interaction between the modalities and frequency of occurrence failed to reach significance. These results were in general agreement with Hier and Mohr (1977) who found that their aphasic subject was not differentially affected by frequency of occurrence in the three modalities of naming (a part of the oral expressive modality), writing, and reading comprehension. In addition, Drummond et al. (1977) found word frequency was not a significant factor. Results of the present study contradict those found by Halpern (1965a,b), who reported significant differences for the variables of frequency of occurrence in the auditory and visual modalities. It may be that some of the target words in the present study may be said more often in the nursing home setting. In addition, since the patients were tested in this same nursing home environment or context, the target words may have been more easily processed and produced. Table 12 displays the means.

TABLE 11
MEAN NUMBER OF CORRECT RESPONSES FOR MODALITY BY LENGTH

Modality	Length	
	Short	Long
Oral Expression	4.5	3.5
Writing	2.6	1.4
Auditory Comprehension	8.8	8.8
Reading Comprehension	8.1	8.2

TABLE 12

MEAN NUMBER OF CORRECT RESPONSES FOR MODALITY BY FREQUENCY

Modality	Frequency	
	Frequent	Infrequent
Oral Expression	4.2	3.7
Writing	2.2	1.8
Auditory Comprehension	8.8	8.8
Reading Comprehension	8.1	8.2

Group

Performance overall by group was statistically significant at the .05 level. Through all the modalities, anomic subjects performed better than Broca's subjects, who in turn, performed better than Wernicke's subjects. This is in general agreement with Goodglass and Stuss (1979), Goodglass et al. (1976), and Liederman et al. (1983) who found that anomic subjects had the best performance among their aphasic groups. The time post onset for the anomic subjects in the present investigation was the median for all the groups (Wernicke's, 3.9 years; anomic, 4.1 years; and Broca's 9.3 years). Perhaps being in the middle as such adds to success linguistically as these subjects might have recovered enough language skills, but have not plateaued for too long a period. Motivation and attitude may be higher. Two of the anomic subjects also had part-time jobs. This might have contributed to their general motivation as well as fund of linguistic knowledge. In addition, although anomic subjects are known to have word-finding difficulties, other language problems such as attention deficits, comprehension deficits, and writing deficits are usually rather mild in anomic subjects compared to other aphasic subjects. Perhaps, these better language skills are interacting to assist

other language skills.

Group by Word length

The analysis failed to reach significance for the interaction of group by length. Table 13 displays the means. Filby et al. (1963), Schuell (1953), and Wepman (1951) also found similar results. However, Goodglass et al. (1976) found that the aphasic subjects were differentially affected by word length, in terms of the "tip-of-the-tongue" phenomenon, with anomic subjects the least affected. This disagrees with the present study which found no significant differences among the aphasic groups in regard to word length. Perhaps, as Schuell (1953) has suggested, some short words may be more difficult than long words because they contain fewer distinguishing visual characteristics. They also tend to be unstressed with less force and less time given to them.

Group by Frequency of Occurrence

Statistical results for the variable frequency of occurrence by group just failed to reach significance at the .05 level. That is, the groups were not differentially affected by the variable of frequency. This agrees with Williams and Canter (1982), Filby et al. (1963), and Drummond et al. (1977). Williams and Canter believed that the lack of significant findings may have resulted from too small a difference

TABLE 13

MEAN NUMBER OF CORRECT RESPONSES FOR GROUP BY LENGTH

Word Length	Broca's	Wernicke's	Anomic
Short	5.5	4.6	7.9
Long	5.0	4.4	7.0

between the high frequency words and their low frequency words in their investigation. Background, vocation, personal experience, and residence of the subject may have played a role in the results that frequency was not significant in the present investigation. Table 14 displays the means for the interaction between group and frequency of occurrence.

Group by Modality

The present data revealed a significant difference for aphasic groups by modality. In oral expression, anomic subjects were found to perform statistically significantly better than the other two aphasic groups. No significant differences were found among the groups for the modalities of auditory comprehension and reading comprehension. Drummond et al. (1977), Friederici et al. (1981), and Goodglass et al. (1986) also found differences in the modalities they investigated and the effects on the aphasic subjects. For a possible explanation of the superiority of anomic subjects in oral expression in the present study we might consider that four of the subjects were not in an institutional setting. Perhaps continuous exposure to the outside world would lead to better oral expressive responses by the anomic subjects. In addition, two subjects had part-time

TABLE 14
MEAN NUMBER OF CORRECT RESPONSES FOR
GROUP BY FREQUENCY OF OCCURRENCE

Frequency of Occurrence	Broca's	Wernicke's	Anomic
Frequent	5.2	4.7	7.5
Infrequent	5.2	4.2	7.4

jobs. This may also have contributed to their success. That is, exposure to the outside world might have contributed to a broader background and usage of language. Sometimes when a subject is in a more self-sufficient environment, this forces the subject to experience and do more.

Group by Modality by Word Length

Statistical findings for the interaction of group by modality by word length did not reach significance at the .05 level. Thus the parameter of word length did not differentiate the groups and the modalities. The results agree with Friederici et al. (1981) in that they could not find group differences among the modalities with respect to the parameter of word length. To understand further why length was not significant in this interaction, it is helpful to examine some of the stimuli. Some of the long words such as, "banana", "pajamas", "bathroom", and "vegetables", elicited a high rate of correct responses for the aphasic subjects. Because of their importance to communication for the aphasic subject, these words may have been taught or introduced to them previously by speech-language pathologists or other professionals. In addition, some of the above words may be repeated more often in a nursing home setting than in the outside world due to limited activity in a

nursing home. That is, there is constant repetition of words related to foods, dressing, and bathroom activities. Therefore, the subjects' present performance may have been better than would be expected on some of the target words.

Group by Modality by Frequency

The results of our investigation demonstrated that the groups could not be distinguished statistically for the modalities and the parameter of frequency of occurrence. These results confirm those reported by Friederici et al. (1981) who also found frequency of occurrence not statistically significant. These authors speculated that infrequent words by their very nature of being unusual, might be remembered more than frequent words.

In summary, when we look at the role group plays, the results of our investigation show that anomic subjects perform significantly better than the other aphasic groups. When modality was considered with respect to groups, anomic subjects performed significantly better than the other two groups in oral expression. Long words were harder than short words in the writing modality only. Finally, when the variables of length and frequency interact with groups and modality, we do not find any significant differentiating features.

Patterns of Error Types Among the Modalities For the Three Aphasic Groups

This investigation further revealed ways in which the aphasic groups may be distinguished among the modalities by the types of word-finding errors they produced. The following discussion will focus on the significant results.

There were five error categories (semantic, phonemic, unrelated, no response and circumlocutions), which reached significance for group type within the modalities of oral expression, writing, auditory comprehension, and reading comprehension. Figure 4 illustrates only these errors types. Inspection of this figure reveals several important relationships.

Semantic errors were produced with higher frequency than any other type of errors. Phonemic errors were the next most frequent. This was in agreement with the studies of Kohn and Goodglass (1985), Marshall (1976), Schuell et al. (1961), Spinnler and Vignolo (1966), Williams and Canter (1982), and Williams and Wright (1985). A semantic error involves a process where the subject tends to produce words that are associated or related to the target word. Several possible explanations may be advanced for this result. One is that children learn words in categories. A mother might speak to a child while she is feeding him

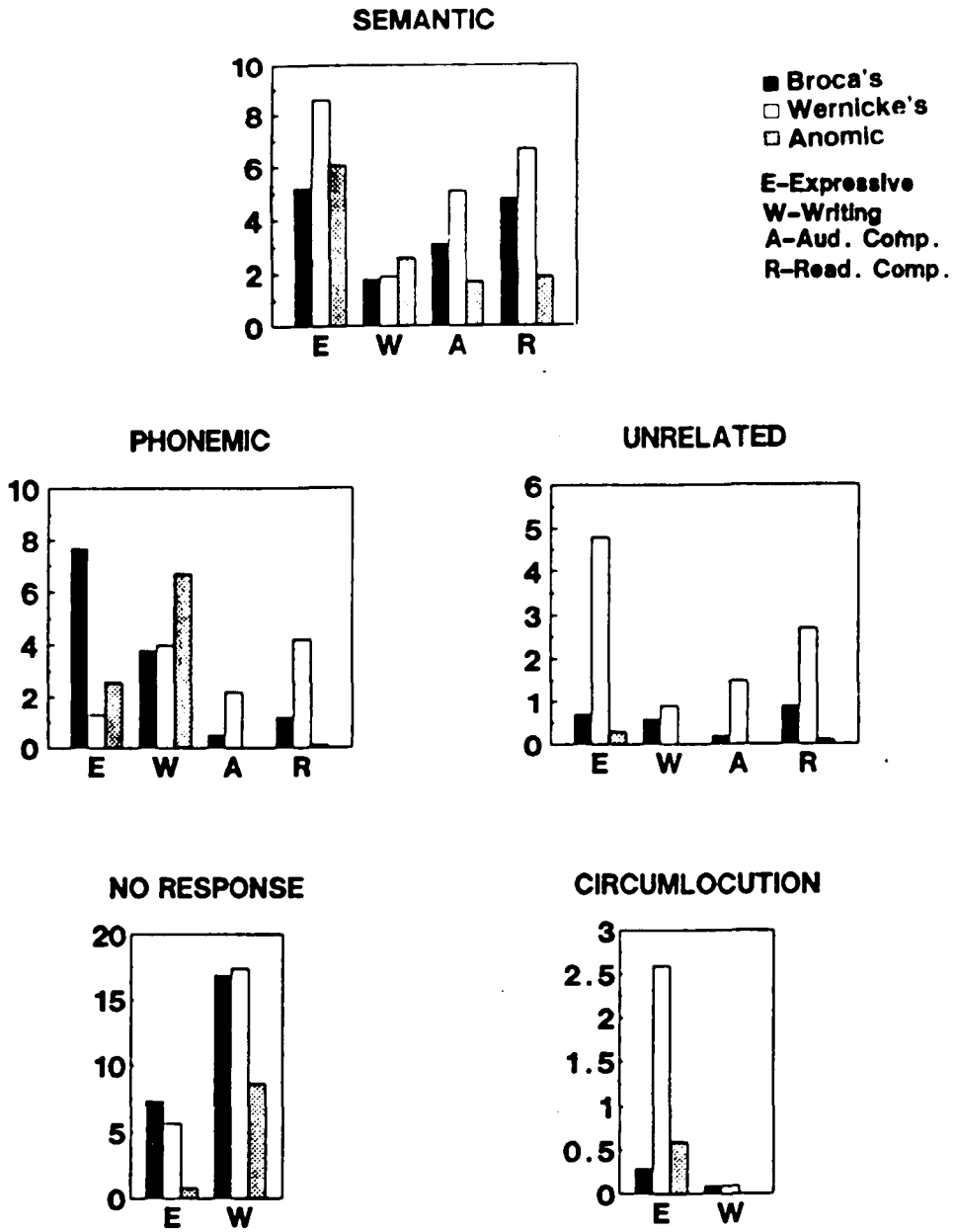


Fig. 4. Mean number of errors for 3 aphasic groups for each of the significant error categories.

and say "Here is a fork, a knife, and a spoon". Secondly, when we view and discuss things in our environment they are usually in categories. For example, at the dinner table a conversation could involve words pertaining to food, dinnerware, or eating utensils. Quite often, topics of conversation are related semantically within discourse. A third possible explanation for semantic error responses may be related to the stimulus picture itself. For example, when a patient is shown a picture of a "sandwich", the picture shows bread, and perhaps ham, cheese, or lettuce is sticking out of the side (visual contiguity). Therefore, the patient might easily substitute one of these semantically related words for the target word of "sandwich".

Observation of figure 4 reveals the performance patterns on semantic errors. Wernicke's subjects made significantly more semantic errors in reading comprehension than anomic subjects. This finding appears to contradict those found by Kohn and Goodglass (1985). Those investigators found no significant differences among the aphasic groups for picture naming. A possible explanation for the results of the present study might lie in fact that posterior lesions which produce Wernicke's aphasia may hit semantic processing or word selection areas of the

brain (Benson 1979). Lesions extending into the angular gyrus have been associated with reading comprehension deficits.

For phonemic errors, our analysis of the data revealed two significant occurrences. In oral expression, Broca's subjects made significantly more phonemic errors than Wernicke's subjects. This tends to concur with the findings of Williams and Wright (1985) who reported that their nonfluent aphasic subjects produced a high amount of phonemic errors on a naming task. This is also consistent with the "Tip-of-the-Tongue" theory advanced by Brown and McNeill (1966) which contends that Broca's subjects can give partial information when producing a word, whereas anomic and Wernicke's aphasic subjects follow the all or none response by producing words that are further away from the target word (i.e. semantic error) than one that is closer (i.e. phonemic error). The present investigation also found that Wernicke's subjects produced significantly more phonemic errors in reading comprehension than anomic subjects.

Further inspection of Figure 4 reveals that Wernicke's subjects produced more unrelated errors than any of the other aphasic groups in all the modalities tested. Wernicke's subjects produced more statistically significant unrelated errors in oral

expression than the other groups. In reading comprehension Wernicke's subjects produced significantly more unrelated errors than anomic subjects. This finding agrees with Kohn and Goodglass (1985) who reported that Wernicke's aphasic subjects produced more unrelated errors than any of the other aphasic groups in their naming task. Wernicke's subjects have been described as fluent, having poor comprehension, and being resistant to pauses in communication. Perhaps Wernicke's subjects in their desire for social contact, desire to keep in touch with their environment, and desire to please the listener in a communicative setting, respond, rather than keeping silent. Due to their poor monitoring system they cannot understand others, nor can they understand themselves, therefore excessive conversation is produced, much of which can contain unrelated words.

In oral expression, Broca's subjects had statistically significantly more no response errors than anomic subjects. Although the data analysis did not reach significance between Broca's and Wernicke's aphasic subjects, there was a tendency for Broca's subjects to have more no response errors than Wernicke's subjects (Figure 4). The latter trend is in agreement with the results obtained by Williams and

Wright (1985), and Barton et al. (1969). Anterior lesions which cause Broca's aphasia are closer to the word production center of the brain. Pathology in this area often produces little speech output (Benson, 1979). Perhaps because Broca's subjects are typically non-fluent, and have sparse output, the chances of obtaining more no response errors from these subjects are greater than with the fluent aphasic subjects, where there is excessive verbiage.

In oral expression Wernicke's subjects produced more circumlocution errors than Broca's subjects. This finding supports those reported by Williams and Canter (1982). This might be indicative of a more severe word-finding deficit. That is, the Wernicke's subject continues to search for the word, thus producing circumlocutions.

Clinical Implications

The results of the word-finding ability of the aphasic subjects in this study suggest a number of diagnostic and therapeutic implications.

Since short words and frequently occurring words are easier for aphasic subjects, it is recommended that therapy commence with these types of stimuli. After the patient is comfortable with the preceding stimuli, the clinician should proceed utilizing stimuli that contain longer words and less frequently

occurring words. In addition, it might be a good idea for both the clinician, families, and friends of the aphasic subjects to speak to them using shorter words and high frequency words. The present study further indicated that Wernicke's subjects were more affected by frequency, while anomic and Broca's subjects were more influenced by word length. The clinician should also take this into consideration when devising therapeutic strategies.

The results of the current investigation show that there is a hierarchy of aphasic abilities among the modalities. Auditory comprehension and reading comprehension were the easiest for all the aphasic subjects in this study. Next in order of difficulty were oral expression and writing. This information suggests that therapy begin with the least difficult modality and proceed to the most difficult. If linguistic success in therapy is reached early this would facilitate the development of rapport between the aphasic patient and the clinician, as well as heighten the patient's confidence in the efficacy of language therapy.

Diagnostic Significance of this Investigation.

Several results obtained in this investigation might be beneficial in diagnostic evaluations of aphasic patients:

1-This study reinforces the already known picture of Wernicke's patients producing more semantic errors and Broca's patients producing more phonemic errors in oral expression. Thus after testing the reading comprehension modality, and finding patients who exhibit more semantic errors it might be reasonable to assume a clinical picture of Wernicke's aphasia. In those patients who have more phonemic errors, a tentative diagnosis reinforced by this study and suggested by previous literature would be Broca's aphasia.

2-It was also found that Wernicke's subjects were more influenced by frequency of occurrence in English language usage, while Broca's and anomic subjects were influenced by word length. This information might be used for diagnostic purposes.

In summary, the influence of the parameters varies with the aphasic group, the modality, and sometimes with the individual aphasic subject; therefore, therapeutic strategies should reflect this.

Conclusions

Word-finding difficulties are a classical symptom of aphasia. It has been said that aphasic subjects

have reduced access to lexical words from their premorbid vocabulary (Goodglass et al., 1976; Schuell et al., 1969). The results of this study allow us to go beyond this notion and make speculations concerning the retrieval mechanism, its breakdown, and strategies taken by aphasic subjects to deal with this breakdown.

We said earlier that Schuell et al. (1969) believed a word retriever to be a device which allowed information to be transferred from the permanent memory unit in order to make it accessible for further processing. Word-finding deficits are caused by the breakdown of this unit. They believed that there were varying levels of breakdown: the first level, and most severe, would be "no response" from the subject; at the next level of breakdown the subject would produce an associated response; and, at the third level, the subject would be able to continue his search, which would enable him to arrive at a more advanced level of response that more closely approximates the target word.

Following this model, it can be speculated from the results of the present investigation that Broca's subjects, in oral expression, were operating in the most severe state since they produced more "no response" errors. Further observing the results, it was found that Wernicke's subjects produced

significantly more semantic and phonemic errors in reading comprehension. Perhaps this implies, that for this modality, the system has broken down somewhere in the middle for Wernicke's subjects, and thus the retriever is working with a little more efficiency. Our results further reveal that anomic subjects had the least number of errors in oral expression. Thus under this model the retrieval mechanism of anomic subjects might be considered to be less impaired for this modality.

With respect to the parameters of word frequency and word length, overall, aphasic subjects had less difficulty with high frequency words and short words, than with their counterparts. It would seem that these words are more intact and thus less disturbed by the damage caused in aphasia. We might consider them to be more easily accessed. Perhaps this is because words of high frequency of occurrence are closer to the automatic level, and thus require less linguistic prowess and ability than words of low frequency; and because aphasic patients typically have a reduced verbal retention span, linguistic processing for short words would be easier than for long words.

Thus it would appear that the results of the present investigation support and further clarify the theories postulated by Goodglass et al. (1976),

Schuell et al. (1969), and Schuell et al. (1961) that aphasia involves reduced access to vocabulary as well as a reduction in efficiency in the retrieval mechanism. Furthermore, differences do exist for the strategies of word retrieval among the aphasic groups and across the different modalities.

Recommendations For Future Research

Since the majority of subjects were obtained from nursing homes, this investigation might be replicated using subjects from a variety of settings. Perhaps a larger buffer in number of occurrences per million for words in the frequent vs. infrequent list could be used. In addition, for future studies, investigators may test word-finding abilities by using different methods of stimuli and response formats, such as sentence completions, opposites, or through description of the target word.

Summary

The purpose of this investigation was to examine the effects of frequency of occurrence in English language usage and word length on the word-finding abilities of three types of aphasic subjects (10 Broca's, 10 Wernicke's, and 10 anomic). Forty nouns counterbalanced according to word length and frequency of occurrence in English language usage were presented

to all aphasic subjects through four modalities: oral expression, writing, auditory comprehension and reading comprehension.

Statistical analysis was performed on the total number of correct responses. In addition, an analysis was performed on error categories within each modality for the aphasic groups.

Hypotheses

The following section presents a discussion of the four hypotheses addressed in the study and the findings relevant to those hypotheses.

1-Long words are more difficult than short words for aphasic subjects, regardless of modality.

Long words overall were statistically significantly harder than short words. Among the modalities, only long words were statistically significantly harder than short words for writing.

2-Infrequent words were more difficult than frequent words for aphasic subjects, regardless of modality.

The data analyses indicated that infrequent words were statistically significantly more difficult than frequent words overall. When modality was considered, no significant effects were found.

3-Different error patterns for the aphasic subjects will emerge among the modalities of oral expression, writing, auditory comprehension, and reading

comprehension.

The overall performance in auditory comprehension and reading comprehension was statistically significantly better than oral expression, and oral expression was statistically significantly better than writing. Long words were statistically significantly harder than short words in the writing modality only. 4-Different error patterns among the Broca's, Wernicke's, and anomic types of aphasic subjects will emerge.

Overall, anomic subjects performed statistically significantly better than Broca's subjects, who in turn performed statistically significantly better than Wernicke's subjects.

It was also found that in oral expression, anomic subjects performed statistically significantly better than Broca's or Wernicke's subjects.

The variables of word length and frequency of occurrence in English language usage did not significantly differentiate the groups.

Types of Errors

In addition to the above analysis, tests were performed on the various word-finding error categories. The results give rise to information concerning differences for the aphasic subjects across the modalities. The results of the word-finding error

type analysis yielded the following conclusions:

Oral Expression

---In oral expression, Broca's subjects made statistically significantly more phonemic errors than Wernicke's subjects.

---In oral expression, Wernicke's subjects produced statistically significantly more unrelated errors than Broca's or anomic aphasic subjects.

---In oral expression, Broca's subjects produced statistically significantly more no response errors than anomic subjects.

---In oral expression Wernicke's subjects produced statistically significantly more circumlocution errors than Broca's subjects.

Reading Comprehension

---In reading comprehension Wernicke's subjects made statistically significantly more semantic errors than anomic subjects.

--- n reading comprehension, Wernicke's subjects produced statistically significantly more phonemic errors than anomic subjects.

---In reading comprehension, Wernicke's subjects produced statistically significantly more unrelated errors than anomic subjects.

Writing

---In the writing modality there were no statistically significant differences found among the aphasic groups for any of the error types.

Auditory Comprehension

---In the auditory comprehension modality there were no statistically significant differences found among the aphasic groups for any of the error types.

The overall findings of this study suggest that therapy follow a plan which utilizes the easiest modalities first, auditory comprehension and reading comprehension, then proceed to oral expression and writing. Stimulation materials should begin with short words and high frequency words. Furthermore, the short length of the tasks administered in this investigation might be used in evaluation to analyze individual patterns of response. With this information, the speech-language pathologist can then tailor the therapy session to meet the patient's needs.

APPENDIX A
TABLE 15
PROFILE OF SPEECH CHARACTERISTICS OF BROCA'S SUBJECTS

Patient Number	Severity ^a Scale	Melodic ^b Line	Phrase ^c Length	Artic. ^d Agility	Grammat. ^e Form	Para- ^f phasia	Repeti- ^g tion	Word ^h Find.	Auditory ⁱ Compre.
2	1	1	2	3	1	7	4	7	50
3	1	4	3	4	2	7	3	6	53
6	1	1	1	1	1	7	2	4	50
14	3	3	3	3	4	6	1	4	90
15	1	3	3	2	2	7	2	6	55
16	1	2	3	4	3	6	3	5	55
19	1	2	3	3	2	7	1	6	55
20	1	3	3	2	1	7	0	7	58
23	1	2	2	4	1	7	0	6	58
24	2	4	4	4	4	4	0	4	60
Mean	1.3	2.5	2.7	3.0	2.1	6.5	1.6	5.5	58.4

^aBased on a 6 step scale from 0 (no communication) to 5 (no discernible speech handicap) as specified in the Boston Diagnostic Aphasia Examination.

^bBased on a 7 step scale from 1 (absent) to 7 (runs through entire sentence) as specified in the Boston Diagnostic Aphasia Examination.

^cBased on a 7 step scale from 1 (one word) to 7 (seven words) as specified in the Boston Diagnostic Aphasia Examination.

^dBased on a 7 step scale from 1 (always impaired) to 7 (never impaired) as specified in the Boston Diagnostic Aphasia Examination.

^eBased on a 7 step scale from 1 (none available) to 7 (normal range) as specified in the Boston Diagnostic Aphasia Examination.

^fBased on a 7 step scale from 1 (present in every utterance) to 7 (absent) as specified in the Boston Diagnostic Aphasia Examination.

^gBased on an 9 step scale from 0 (no words repeated) to 8 (eight words repeated) as specified in the Boston Diagnostic Aphasia Examination.

^hBased on a 7 point scale from 1 (fluent without information) to 7 (speech exclusively content words) as specified in the Boston Diagnostic Aphasia Examination.

ⁱBased on the mean percentile scores of 4 auditory comprehension tests (word discrimination, body part identification, commands, and complex ideational material).

APPENDIX B
TABLE 16
PROFILE OF SPEECH CHARACTERISTICS OF WERNICKE'S SUBJECTS

Patient Number	Severity ^a Scale	Melodic ^b Line	Phrase ^c Length	Artic. ^d Agility	Grammat. ^e Form	Para- ^f phasia	Repeti- ^g tion	Word ^h Find.	Auditory ⁱ Compre.
1	2	7	7	7	6	3	5	3	45
5	1	6	6	6	6	3	0	2	4
7	3	6	6	6	5	4	4	3	35
9	2	6	6	6	5	3	3	2	23
10	2	6	6	7	5	2	0	4	30
13	3	6	6	7	6	4	2	3	45
22	2	7	7	6	2	2	1	2	30
27	3	6	7	7	6	3	4	4	40
29	1	6	7	7	5	2	2	2	13
30	2	7	7	7	6	2	0	2	15
Mean	2.1	6.3	6.5	6.6	5.2	2.8	2.1	2.7	28.0

^aBased on a 6 step scale from 0 (no communication) to 5 (no discernible speech handicap) as specified in the Boston Diagnostic Aphasia Examination.

^bBased on a 7 step scale from 1 (absent) to 7 (runs through entire sentence) as specified in the Boston Diagnostic Aphasia Examination.

^cBased on a 7 step scale from 1 (one word) to 7 (seven words) as specified in the Boston Diagnostic Aphasia Examination.

^dBased on a 7 step scale from 1 (always impaired) to 7 (never impaired) as specified in the Boston Diagnostic Aphasia Examination.

^eBased on a 7 step scale from 1 (none available) to 7 (normal range) as specified in the Boston Diagnostic Aphasia Examination.

^fBased on a 7 step scale from 1 (present in every utterance) to 7 (absent) as specified in the Boston Diagnostic Aphasia Examination.

^gBased on an 8 step scale from 0 (no words repeated) to 8 (eight words repeated) as specified in the Boston Diagnostic Aphasia Examination.

^hBased on a 7 point scale from 1 (fluent without information) to 7 (speech exclusively content words) as specified in the Boston Diagnostic Aphasia Examination.

ⁱBased on the mean percentile scores of 4 auditory comprehension tests (word discrimination, body part identification, commands, and complex ideational material).

APPENDIX C
TABLE 17
PROFILE OF SPEECH CHARACTERISTICS OF ANOMIC SUBJECTS

Patient Number	Severity ^a Scale	Melodic ^b Line	Phrase ^c Length	Artic. ^d Agility	Grammat. ^e Form	Para- ^f phasia	Repeti- ^g tion	Word ^h Find.	Auditory ⁱ Compre.
4	3	7	7	7	6	6	6	3	78
8	4	6	7	6	6	6	6	4	88
11	3	6	6	6	6	5	7	4	74
12	4	7	7	7	7	5	7	4	82
17	4	7	7	7	6	6	7	4	61
18	3	6	6	6	6	6	6	3	78
21	4	7	7	7	7	6	7	4	90
25	3	6	7	6	7	5	8	4	67
26	4	7	7	7	7	6	6	4	75
28	4	7	7	7	6	7	7	4	80
Mean	3.6	6.6	6.8	6.6	6.4	5.8	6.7	3.8	77.3

^aBased on a 6 step scale from 0 (no communication) to 5 (no discernible speech handicap) as specified in the Boston Diagnostic Aphasia Examination.

^bBased on a 7 step scale from 1 (absent) to 7 (runs through entire sentence) as specified in the Boston Diagnostic Aphasia Examination.

^cBased on a 7 step scale from 1 (one word) to 7 (seven words) as specified in the Boston Diagnostic Aphasia Examination.

^dBased on a 7 step scale from 1 (always impaired) to 7 (never impaired) as specified in the Boston Diagnostic Aphasia Examination.

^eBased on a 7 step scale from 1 (none available) to 7 (normal range) as specified in the Boston Diagnostic Aphasia Examination.

^fBased on a 7 step scale from 1 (present in every utterance) to 7 (absent) as specified in the Boston Diagnostic Aphasia Examination.

^gBased on an 8 step scale from 0 (no words repeated) to 8 (eight words repeated) as specified in the Boston Diagnostic Aphasia Examination.

^hBased on a 7 point scale from 1 (fluent without information) to 7 (speech exclusively content words) as specified in the Boston Diagnostic Aphasia Examination.

ⁱBased on the mean percentile scores of 4 auditory comprehension tests (word discrimination, body part identification, commands, and complex ideational material).

APPENDIX D

TABLE 18

THE 40 NOUN STIMULI WITH WORD LENGTH AND FREQUENCY COUNT

Short Words		Long Words	
arm	AA	balloon	17
bat	19	banana	13
bear	AA	bathroom	9
belt	48	bottle	A
cat	A	carrot	9
cane	19	circle	AA
cat	A	doctor	AA
coat	AA	dragon	22
deer	35	farmer	AA
ear	AA	fingers	AA
egg	AA	flower	AA
eye	AA	hammer	34
fan	38	matches	A
fork	31	pajamas	6
lamb	45	pencil	40
mask	17	sandwich	23
plug	9	soldier	AA
rain	AA	toilet	11
ring	AA	vegetables	A
vest	21	window	AA

AA = 100 or over per million.

A = At least 50 per million and not so many as 100 per million.

Nos. 1-49 = The number 1 would equal at least one occurrence per million and not so many as two per million; the number 2 would equal two per million and not so many as three per million; and similarly up to 49.

APPENDIX E

TABLE 19

ORDER OF PRESENTATION OF STIMULI TO THE 30 APHASIC SUBJECTS

Task #			Task #		
Subject 1	1	Forward	Subject 9	1	Forward
	2	Backward		2	Backward
	4	Forward		4	Forward
	3	Backward		3	Backward
Subject 2	2	Forward	Subject 10	2	Forward
	1	Backward		1	Backward
	4	Forward		4	Forward
	3	Backward		3	Backward
Subject 3	1	Backward	Subject 11	1	Backward
	2	Forward		2	Forward
	4	Backward		4	Backward
	3	Forward		3	Forward
Subject 4	2	Backward	Subject 12	2	Backward
	1	Forward		1	Forward
	4	Backward		4	Backward
	3	Forward		3	Forward
Subject 5	1	Forward	Subject 13	1	Forward
	2	Backward		2	Backward
	4	Forward		4	Forward
	3	Backward		3	Backward
Subject 6	2	Forward	Subject 14	2	Forward
	1	Backward		1	Backward
	4	Forward		4	Forward
	3	Backward		3	Backward
Subject 7	1	Backward	Subject 15	1	Backward
	2	Forward		2	Forward
	4	Backward		4	Backward
	3	Forward		3	Forward
Subject 8	2	Backward	Subject 16	1	Backward
	1	Forward		2	Forward
	4	Backward		4	Backward
	3	Forward		3	Forward

TABLE 19--Continued

	Task #			Task #	
Subject 17	1	Forward	Subject 24	2	Backward
	2	Backward		1	Forward
	4	Forward		4	Backward
	3	Backward		3	Forward
Subject 18	2	Forward	Subject 25	1	Forward
	1	Backward		2	Backward
	4	Forward		4	Forward
	3	Backward		3	Backward
Subject 19	1	Backward	Subject 26	2	Forward
	2	Forward		1	Backward
	4	Backward		4	Forward
	3	Forward		3	Backward
Subject 20	2	Backward	Subject 27	1	Backward
	1	Forward		2	Forward
	4	Backward		4	Backward
	3	Forward		3	Forward
Subject 21	1	Forward	Subject 28	2	Backward
	2	Backward		1	Forward
	4	Forward		4	Backward
	3	Backward		3	Forward
Subject 22	2	Forward	Subject 29	1	Forward
	1	Backward		2	Backward
	4	Forward		4	Forward
	3	Backward		3	Backward
Subject 23	1	Backward	Subject 30	2	Forward
	2	Forward		1	Backward
	4	Backward		4	Forward
	3	Forward		3	Backward

Task 1 = Naming modality.

Task 2 = Writing modality.

Task 3 = Reading comprehension.

Task 4 = Auditory comprehension.

Forward = The 40 stimulus words are in alphabetical order; starting at the beginning of the alphabetical sequence.

Backward = The 40 stimulus words are in alphabetical order; starting at the end of the alphabetical sequence.

APPENDIX F

TABLE 20

SUMMARY OF RELIABILITY ANALYSIS FOR EACH SET OF 10 WORDS

Scale	Alpha Value
Expressive/ShortFrequent	0.84503
Expressive/ShortInfrequent	0.91041
Expressive/LongFrequent	0.78718
Expressive/LongInfrequent	0.81375
Writing/ShortFrequent	0.89899
Writing/ShortInfrequent	0.90375
Writing/LongFrequent	0.85891
Writing/LongInfrequent	0.92409
AuditoryComprehension/ShortFrequent	0.80556
AuditoryComprehension/ShortInfrequent	0.79984
AuditoryComprehension/LongFrequent	0.75748
AuditoryComprehension/LongInfrequent	0.60347
ReadingComprehension/ShortFrequent	0.76634
ReadingComprehension/ShortInfrequent	0.81833
ReadingComprehension/LongFrequent	0.81686
ReadingComprehension/LongInfrequent	0.66991

APPENDIX G

TABLE 21

SUMMARY OF ANALYSIS OF VARIANCE FOR 3 APHASIC
GROUPS FOR EACH ERROR CATEGORY

SOURCE	df	ss	ms	F	p
Semantic/Expressive by Diagnosis					
Between Groups	2	62.066	31.033	2.188	0.132
Within Groups	27	382.8998	14.1815		
Semantic/Writing by Diagnosis					
Between Groups	2	3.800	1.900	0.331	0.721
Within Groups	27	154.899	5.737		
Semantic/Aud. Comprehension by Diagnosis					
Between Groups	2	58.400	29.200	3.010	0.066
Within Groups	27	261.899	9.7		
Semantic/Read Comprehension by Diagnosis					
Between Groups	2	116.867	58.433	5.704	0.860
Within Groups	27	276.599	10.2444		
Semantic Sum by Diagnosis					
Between Groups	2	538.397	269.985	5.982	0.007
Within Groups	27	1215.4961	45.0037		
Phonemic/Expression by Diagnosis					
Between Groups	2	228.867	114.433	3.840	0.034
Within Groups	27	804.599	29.8		

Table 21 -- Continued.

SOURCE	df	ss	ms	F	p
Phonemic/Writing by Diagnosis					
Between Groups	2	52.467	26.233	0.900	0.419
Within Groups	27	787.6995	29.174		
Phonemic/Aud.Comprehension by Diagnosis					
Between Groups	2	26.600	13.300	2.492	0.102
Within Groups	27	144.1	5.337		
Phonemic/Read Comprehension by Diagnosis					
Between Groups	2	90.067	45.033	7.410	0.003
Within Groups	27	164.0999	6.0778		
Phonemic Sum by Diagnosis					
Between Groups	2	73.269	36.633	0.625	0.543
Within Groups	27	1582.099	58.596		
Unrelated/Expressive by Diagnosis					
Between Groups	2	124.067	62.033	15.537	0.000
Within Groups	27	107.8	3.9926		
Unrelated/Writing by Diagnosis					
Between Groups	2	4.200	2.100	2.433	0.107
Within Groups	27	23.3	0.863		
Unrelated/Aud.Comprehension by Diagnosis					
Between Groups	2	13.267	66.333	2.555	0.963
Within Groups	27	70.1	2.5963		

Table 21 -- Continued.

SOURCE	df	ss	ms	F	p
Unrelated/Read Comprehension by Diagnosis					
Between Groups	2	35.467	17.733	4.357	0.229
Within Groups	27	109.8999	4.0704		
Unrelated Sum by Diagnosis					
Between Groups	2	501.667	250.833	12.276	0.000
Within Groups	27	551.699	20.433		
Syntactic/Expressive by Diagnosis					
Between Groups	2	1.267	0.633	0.851	0.438
Within Groups	27	20.1	0.7444		
Syntactic/Writing by Diagnosis					
Between Groups	2	8.867	4.433	1.087	0.352
Within Groups	27	110.1	4.0778		
Syntactic Sum by Diagnosis					
Between Groups	2	3.800	1.900	0.404	0.672
Within Groups	27	127.000	4.704		
Neologism/Expressive by Diagnosis					
Between Groups	2	0.200	0.100	0.409	0.668
Within Groups	27	0.6	0.2444		
Neologism/Writing by Diagnosis					
Between Groups	2	2.467	1.233	1.168	0.326
Within Groups	27	28.5	1.0556		

Table 21 -- Continued.

SOURCE	df	ss	ms	F	p
Neologism Sum by Diagnosis					
Between Groups	2	1.867	0.933	0.638	0.536
Within Groups	27	39.5	1.463		
Jargon/Expressive by Diagnosis					
Between Groups	2	21.067	10.533	2.325	0.117
Within Groups	27	122.3	4.5296		
Jargon/Writing by Diagnosis					
Between Broups	2	30.200	15.100	0.101	0.852
Within Groups	27	2534.0981	93.8555		
Jargon Sum by Diagnosis					
Between Groups	2	101.266	50.633	0.497	0.614
Within Groups	27	2750.198	101.859		
NoResponse/Expressive by Diagnosis					
Between Groups	2	234.867	117.433	4.085	0.028
Within Groups	27	776.0993	28.7444		
NoResponse/Writing by Diagnosis					
Between Groups	2	477.265	238.632	1.178	0.323
Within Groups	27	5469.3979	202.5703		
NoResponse Sum by Diagnosis					
Between Groups	2	1351.465	675.733	2.871	0.074
Within Groups	27	6355.498	235.388		

Table 21 -- Continued.

SOURCE	df	ss	ms	F	p
Perseveration/Expressive by Diagnosis					
Between Groups	2	18.067	9.033	0.815	0.453
Within Groups	27	299.3999	11.0889		
Perseveration/Writing by Diagnosis					
Between Groups	2	19.267	9.633	0.637	0.537
Within Groups	27	408.1997	15.1185		
Perseveration Sum by Diagnosis					
Between Groups	2	69.067	34.533	0.794	0.463
Within Groups	27	1174.800	43.511		
Automatic/Expressive by Diagnosis					
Between Groups	2	56.067	28.033	1.511	0.239
Within Groups	27	500.8992	18.5518		
Automatic/Writing by Diagnosis					
Between Groups	2	0.000	0.000	0.000	0.000
Within Groups	27	0	0		
Automatic Sum by Diagnosis					
Between Groups	2	56.067	28.033	1.511	0.237
Within Groups	27	500.899	18.552		
Circumlocution/Expressive by Diagnosis					
Between Groups	2	31.267	15.633	4.183	0.026
Within Groups	27	100.8999	3.737		

Table 21 -- Continued.

SOURCE	df	ss	ms	F	p
Circumlocution/Writing by Diagnosis					
Between Groups	2	0.067	0.033	0.500	0.612
Within Groups	27	1.8	0.0667		
Circumlocution Sum by Diagnosis					
Between Groups	2	32.467	16.233	4.344	0.023
Within Groups	27	100.900	3.737		
Miscellaneous/Expressive by Diagnosis					
Between Groups	2	10.867	5.433	0.566	0.575
Within Groups	27	259.2999	9.6037		
Miscellaneous/Writing by Diagnosis					
Between Groups	2	64.067	32.033	1.037	0.368
Within Groups	27	833.7993	30.8815		
Miscellaneous Sum by Diagnosis					
Between Groups	2	126.600	63.300	1.568	0.227
Within Groups	27	1090.099	40.374		

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