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I am submitting herewith a thesis written by Deena Lavonne Coleman entitled "The Use of Semiotic Symbols as a Means for Measuring the Identification of Linguistic Concepts for Aphasic Patients." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Speech Pathology.

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THE USE OF SEMIOTIC SYMBOLS AS A MEANS FOR MEASURING THE IDENTIFICATION OF LINGUISTIC CONCEPTS FOR APHASIC PATIENTS

A Thesis

Presented for the

Master of Arts

Degree

The University of Tennessee, Knoxville

Deena Lavonne Coleman

March 1982

ACKNOWLEDGEMENT

I would like to express my most sincere gratitude to Dr. Harold A. Peterson for his guidance, support, and much needed patience throughout the preparation of this thesis. I would also like to extend my appreciation to Dr. Ellen Hamby and Dr. Patrick J. Carney for their time and assistance.

A special thank you is given to my friend, Karen Wheeler, for her confidence and for understanding and putting up with my many moods which accompanied the writing of this study. I would also like to thank her for the countless hours of typing which she so willingly contributed to the completion of this project.

Lastly, to my parents, Mr. and Mrs. B. F. Coleman, I give my love and appreciation for their constant interest and continuing support.

God grant me the serenity
to accept the things I
cannot change, the
courage to change the
things I can, and
the wisdom to know the
difference.
Amen.

(Thank you for being there too!)

ABSTRACT

The purpose of this study was to determine if any differences in the performances on two concept identification tests -- the Boehm Test of Basic Concepts and the Synpro symbol identification test, existed for aphasic adults.

The study included ten aphasic and ten normal subjects who were matched in age and education levels. The data consisted of the subjects responses to the Boehm Test of Basic Concepts and the Synpro symbol identification test. Measurements were recorded in terms of latency (milliseconds) and accuracy of the responses.

Statistical analysis of the data indicated that: 1) the aphasic adults performed better on the Boehm Test of Basic Concepts than the Synpro symbol identification test with ragard to accuracy; 2) the normal adults performed equally well on both the Boehm Test of Basic Concepts and the Synpro symbol identification test with regard to accuracy; 3) there was a significant difference in latency of response between the Boehm Test of Basic Concepts and the Synpro symbol identification test for the aphasic adult; 4) there was not a significant difference in latency of response on either of the two tests for the normal adults; 5) the normal adults performed significantly better than the aphasic adults on the Boehm Test of Basic Concepts and the Synpro symbol identification test in both latency and accuracy of responses; 6) there was a significant relationship between latency scores of the two populations on the Boehm Test of Basic Concepts; 7) there was a significant relationship between latency

scores of the two populations on the Synpro symbol identification test; and 8) there was a significant difference between latency of correct and incorrect responses on the Synpro symbol identification test for the aphasic adults in that there was a greater reaction time for choice of incorrect responses as opposed to correct responses.

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CHAPTER I

INTRODUCTION AND REVIEW OF THE LITERATURE

I. INTRODUCTION

Linguistic concepts are the basis on which language expression is constructed. Concepts are processed symbolically by words, pictures, gestures, etc. Aphasia is a disorder in which there is a deficit in the ability to process symbolic materials. This deficit exists in all stimulus modalities (auditory, visual, tactile) and in all response modalities (speaking, writing, gesturing) (Brookshire, 1978).

A number of investigations have been conducted to determine important factors in the language processing abilities of aphasic patients. Several investigators have discussed the development of specific linguistic abilities as well as the effect of neural insult on those abilities. Some investigations reviewed for use in this study include: concept formation and symbolic processing (Muma, 1978; Hayakawa, 1978; Mowrer, 1967; Rice, 1980; Brown and Desforges, 1979; Carroll, 1967; Whitehead, 1927; Hockett, 1958; Miller, Heise, and Lichten, 1951), linguistic versus non-linguistic symbolic representation (Fodor, 1977; Gilley, 1977; Blaug, 1979; Peterson, Brener, and Lea, 1972), and the effect of neural insult on linguistic abilities (Brookshire, 1978; Goodglass and Blumstein, 1973; Goodglass and Baker, 1976; Wepman, 1951; Bisacchi, Denes, and Semenza, 1976; Melic-Ledent, Gainotti, Messirli, Tissot, 1976; Gardner and Zurif, 1976; Semenza, Deres, Lucchese, and Bisiacchi, 1980; Waller and

Darley, 1978; Goldstein, 1948; Wilcox , Davis, and Leonard, 1978; Gardner, 1974; Helmick and Weber, 1975; Lane and Samples, 1981; Goodglass, Klein, Carey, and Jones, 1966).

The disturbance in aphasia is thought to be the loss of facility and not of the capacity to process language (Goodglass and Blumstein, 1973; Wepman, 1951). Many of the techniques employed in testing for aphasia and in aphasia therapy are concerned with the use of linguistic cues, such as pictures, words, actual objects, etc. (LaPointe, 1978; Schuell, 1965; Porch, 1971; Goodglass and Kaplan, 1972). There is a lack of information on the use of non-linguistic (semiotic) symbols as cues for eliciting responses from the aphasic person.

In agreement with the theory that the aphasic disorder is a problem of processing and is concerned with the loss of facility instead of competence (Wepman, 1951; Goodglass and Blumstein, 1973), also given that the aphasic patient has been successful when using linguistic materials for remediation of their language problem (LaPointe, 1978; Wepman, 1951; Goldstein, 1948), and based on results from studies testing concepts and using non-linguistic symbols for cueing (Gardner and Zurif, 1976; Bisiacchi, Denes, and Semenza, 1976; Waller and Darley, 1978; Lane and Samples, 1981; Helmick and Weber, 1975) it was thought that an aphasic patient with a higher level of receptive language abilities could be tested and taught to communicate by using semiotic symbols from the Synpro-Syntax Programmer. Therefore, the purpose of this study was to determine if differences between performances on a semiotic symbol identification test (Synpro) and a linguistic symbol identification test existed for aphasic patients.

II. REVIEW OF THE LITERATURE

The pertinent literature to be reviewed on this topic is divided into two sections. The first section is concerned with the theories of linguistic concept formation. The second section includes information pertaining to aphasia and the impact of neural insult on the language process.

Linguistic Concept Formation

Linguistic concepts are the core material of which language expression is constructed. Concepts are essentially non-linguistic, as explained by Carroll (1967), because they are classes of experience which an individual comes to recognize as such whether or not he is prompted or directed by symbolic language phenomenon. Because the experiences of individuals tend to be similar in many respects, their concepts are also similar, and through various processes of learning and socialization these concepts come to be associated with words. The meanings of words are socially standardized concepts with which they are associated (Carroll, 1967).

According to the major theoretical formulations of Piaget (Muma, 1978; Brown and Desforges, 1979; and Rice, 1980), Carroll (1967), Mowrer (1967), and Slobin (Rice, 1980), a person acquires the knowledge for concepts even before he attains language expression (i.e., cognition underlies the acquisition of language). One necessary condition for the formulation of a concept is that the individual must have a series of experiences that are similar in one or more respects. The configuration of "respects" in which they are similar

constitutes the "concept" that underlies them. Direct experience, i.e., the recognition of experiences as identical or similar, allows a person to attain concepts that have names such as redness, warmth, softness, heaviness, loudness, etc., in adult language (Carroll, 1967).

The ability to represent these experiences in prototypes or categories is defined by Muma (1978) as symbolic processing. It allows a person not only to represent experiences with language but also to transform them. Thus, symbolic processing is dependent on an individual's conceptual category.

Of all forms of symbolism, language is the most highly developed, most subtle, and most complicated. Human beings, by agreement, can make anything stand for anything (Hayakawa, 1978).

The word is a symbol, and its meaning is constituted by the ideas, images, and notions (concepts) which it creates in the mind of the listener (Whitehead, 1927). In a semantic communication system the ties between meaningful message-elements and their meanings can be arbitrary or non-arbitrary. In language the ties are arbitrary. The word salt is not salty or granular, dog is not canine (Hockett, 1958). A picture, on the other hand, looks like what it is a picture of.

Many words or higher units of the linguistic system come to stand for, or name the concepts that have been learned pre-verbally (Carroll, 1967). Certainly this is true for a long list of words that stand for particular things or classes of things, qualities, and events. Carroll explained that these classes correspond roughly to proper and common nouns, adjectives, and verbs of action, perception, and feeling. It is less clear that "function words," or grammatical

markers like the past tense can represent concepts. Prepositions such as in, to, above, beside, near, correspond to concepts of relative spatial relationships, and conjunctions like and, but, however, or, correspond to concepts of logical inclusion or exclusion (Carroll, 1967).

The process by which words come to "stand for" or correspond to concepts can best be described in that there is some sort of reinforcing condition that brands a word as being associated with a given concept (Mowrer, 1967). The process by which these words are used is the ability of a person to represent his experiences symbolically.

Words in and of themselves are meaningful (Hayakawa, 1978), however, Miller, Heise, and Lichten (1951) have reported that content words (nouns, verbs, adjectives, adverbs) are more intelligible when appearing in the context of a grammatical sentence than when scrambled and spoken in isolation as terms on a list. They attributed this difference to a contextual reduction in the number of alternative words among which a listener must choose as he hears the successive words in a sentence.

In addition to linguistic context, it is necessary to consider referential context, which pertains to coded available referents (real or presumed), alternative coexisting codes, and communicative intent. These are all needed to deduce underlying meaning (Muma, 1978).

The symbolic representation of linguistic concepts may be in the form of linguistically or non-linguistically referenced symbols. Linguistic symbols are pictures or words. Non-linguistic (semiotic)

symbols are an abstract representation which is not linguistically meaningful in itself but which may be assigned meaning in a comparator context. For example, one dot depicting the verb is in contrast to two dots depicting the verb are.

In conjunction with linguistic (concrete) and non-linguistic (abstract) representation, Fodor (1977) introduced his theory of mental imagery. Mental imagery is described by Fodor as being shifting and arbitrary, and differing both in extent and kind from person to person and from occasion to occasion. For example, one day the word tablecloth may conjure the depressing thought of doing laundry for one person, on another day it may invoke the friendly feeling of a picnic; for someone else tablecloth may be associated with a Christmas present, and yet another person may have no image at all. Fodor explained that there is no stable relationship between imagery and the meanings of expressions heard or uttered. There are probably no images at all which would be associated with words like on, how, around, or to.

Although function words like if, for, the, on and how have no referents (as do lexical words like chair, table, and house) and evoke no mental images or characteristic responses, they do have use. Also, when representing a concrete or lexical concept graphically, it is very easy to draw a picture of a table, bed, or door but what about the abstract concepts such as around, up, or on?

Gilley (1977) and Blaug (1979) used non-linguistic symbol cueing in their research. Gilley reported that three- and four-year old children could more frequently identify positive concepts rather than

negative by the use of non-linguistic cues. Blaug found that there was not a significant difference between the performance of cerebral palsied children on the non-linguistic tasks and linguistic cueing tasks.

The non-linguistic symbols utilized by Blaug (1979) and Gilley (1977) were taken from a syntax programming device called Synpro (Peterson, Brener, and Lea, 1972). Gilley found that the representativeness of the concepts used on the symbol identification task was valid since all items were correctly identified by a group of adult college students. The Synpro symbol identification test included items such as up, down, how many, where, and on. The items on this test were presented in contrast context, i.e., up in relation to down, where in relation to when, etc.

Standardized concept tests such as the Boehm Test of Basic Concepts (BTBC) (Boehm, 1971), the Assessment of Children's Language Comprehension (ACLC) (Foster, Giddan, and Stark, 1973), and the Vocabulary Comprehension Scale (Bangs, 1975), all include the concept element and test the known items in a familiar context. These tests are also all standardized for measuring the understanding of concepts for children.

Aphasia and the Impact of Neural Insult on the Language Process

Aphasia is defined by Brookshire (1978) as a disturbance in the ability to process symbolic materials. This disturbance may occur in the stimulus modalities, response modalities, or both. Wepman (1951) stated that even though a person has suffered a neural insult, which

causes a disturbance in his expressive and/or receptive language skills, and lost his general capacity for language processing, he has not lost the underlying cognitive capability with which to rebuild his linguistic skill.

To further support this idea, Goodglass and Blumstein (1973) hypothesized that aphasic syndromes in general are to be understood as disturbances of complexes of components or subcomponents of the system of performance, while the underlying competence remains intact. In other words, aphasia is a disturbance of the access to the knowledge of language, which is still intact.

Aphasiologists have tended to focus indirectly on conceptual field abilities of the aphasic patient (Zurif, Caramazza, Myerson, and Galvin, 1974; Goodglass and Baker, 1976). A tentative direct approach to the investigation of conceptual field was undertaken by Bisiacchi, Denes, and Semenza (1976) in which target pictures were presented and the subject had to choose between two other pictures on the basis of which one best represented the target. Two recent studies have been completed by Melice-Ledent, Gainotti, Messerli, and Tissot (1976) and Gardner and Zurif (1976). The first study (Melice-Ledent, et al., 1976) utilized a test involving the classification of words. The second study (Gardner and Zurif, 1976) employed verbal stimuli (written words and phrases). Melice-Ledent, et al.(1976) found a significant difference between reactions for Broca's and Wernicke's aphasics. The second study proved nonsignificant.

Semenza, Denes, Lucchese, and Bisiacchi (1980) conducted a study using nonverbal materials to evaluate class versus thematic

relations for conceptual structures in aphasia. Results of this study indicated that particular disruptions of conceptual fields are apparent in certain aphasic syndromes. Selectivity suggests that while conceptual knowledge is widely represented in the brain it is possible to differentiate some of its aspects on the basis of different underlying neurological structures.

Regarding contextual information included in the understanding of concepts, a familiar phenomenon is for an aphasic patient to use a word appropriately in running speech, yet fail to demonstrate understanding of it when he hears it spoken out of context (Goodglass, Klein, Carey, and Jones, 1966). To test this hypothesis, Waller and Darley (1978) investigated the role of prior contextual information on a paragraph comprehension task. Results of their study revealed that prior stimulation can differentially affect performance on paragraph comprehension. This prior stimulation included the use of pictures in that Waller and Darley would present a picture along with a verbal antecedent. The subject was then supposed to answer factual questions with a yes-no response.

A second study was completed by Wilcox, Davis, and Leonard (1978) in which they investigated aphasic's comprehension of contextually conveyed meaning. They reported that redundancy is an important factor in attempting to relate aphasics' context comprehension abilities. Results also revealed that aphasics benefit from extralinguistic context in more natural communicative settings.

Another aspect of concept recognition is the inclusion of concrete versus abstract symbolization. Goldstein (1948) stated

that use of an abstract attitude implies an ability to react to things in a conceptual manner. This attitude is necessary for the formulation of concepts as opposed to sensory impressions of individual objects. It is also utilized to comprehend relationships between objects and events in the world. In many of his examinations of aphasic patients, Goldstein (1948) attempted to identify the defects in the ability of an aphasic patient to reason abstractly. Goldstein found that persons with frontal lobe lesions and those with left hemisphere lesions were more likely to show an impairment of the abstract attitude than a person with a right cerebral lesion. Wepman (1951) stated that the loss of abstract ability demonstrated by the aphasic adult is not an absolute loss and tha these patients are still able to learn.

Few studies have been performed with the aphasic adult using non-linguistic, or abstract, symbols as a means for measuring object/concept identification. However, Gardner (1974) conducted an investigation in which line drawings were utilized to elicit the recognition of objects. Those symbols which were more familiar and required less specialized knowledge, and those symbols for which well-established routines of decoding exist (words) were easier to identify. Gardner reported no data that simplicity of the symbols in a geometric (perceptual) sense influenced recognition scores.

Helmick and Weber (1975) investigated the effects of non-linguistic, linguistic, and nonsense stimulus forms on the concept identification performance of aphasic adults. Results indicated that the effect of stimulus form on time to criterion was found to be

highly significant in that the subjects identified non-linguistic stimulus forms faster than either of the other two stimulus forms with relatively equal accuracy measures.

Blissymbols, a visual-graphic symbol system was an investigation conducted by Lane and Samples (1981). The symbols used in Blissymbolics communication include: simple pictographs depicting concrete terms, arbitrary symbols, abstract representational symbols indicating relational concepts, simple ideographs, and compound ideographs. Lane and Samples studied the use of Blissymbols over a period of eight months with four adult aphasic patients who also exhibited severe verbal apraxia. Lane and Samples investigated the patients' ability to use Blissymbols as a facilitating technique for communication, the capacity for learning Blissymbols, attitudes towards the use of Blissymbols, and the ability of the patients to learn Blissymbols in a group setting. Results indicated that the use of Blissymbols was successful for facilitating communication for aphasic patients with adequate auditory comprehension, good visual-perceptual skills, and high motivation levels. Blissymbols were found to encourage verbal language and writing skills.

All testing materials investigated reported the use of linguistic symbols for representation of linguistic concepts. For example, the Aphasia Language Performance Scales (Keenan and Brassel, 1975), Boston Diagnostic Aphasia Examination (Goodglass and Kaplan, 1972), Minnesota Test for Differential Diagnosis of Aphasia (Schuell, 1965), Porch Index of Communicative Ability (Porch, 1971), and Sklar Aphasia Scale (Sklar, 1973) all employ the use of naming objects, pointing to

objects, naming pictures, pointing to pictures, matching pictures, matching printed words to pictures, writing, answering questions, carrying out spoken commands, reading, etc. to test the linguistic ability of aphasic patients.

Summary of the Review

A review of the literature revealed that many investigators (Carroll, 1967; Muma, 1978; Whithead, 1927; Hockett, 1978; Fodor, 1977; Hayakawa, 1978) have studied the formulation and representation of linguistic concepts. It is noted that concepts are the basis on which language expression is constructed and that this expression takes place through symbolic processing.

The investigators (Wepman, 1951; Goodglass, Klein, Carey, and Jones, 1973; Schuell, 1966; Gardner and Zurif, 1976; Waller and Darley, 1978; Wilcox, Davis, and Leonard, 1978; Goldstein, 1948; Helmick and Weber, 1975; Lane and Samples, 1981) who have studied the effect of neural insult on the language abilities of aphasic patients, and whose studies were reviewed for this particular investigation, have concurred that although an aphasic patient has lost the facility for language he has not lost the competence. Redundancy and contextual cues play an important role in the identification or use of linguistic concepts; however, the aphasic patient has evidenced the ability to identify concepts even when represented non-linguistically and out of context.

Examination tasks as well as therapy techniques for aphasic patients have included the use of linguistic cues for the identification

of linguistic concepts. The performance of the aphasic adult as well as the normal adult on concept ifentification tasks using semiotic symbols has been given a minimal amount of consideration. It has been shown (Helmick and Weber, 1975; Lane and Samples, 1981), however, that there are significant differences between the performance of aphasic adults when identifying concrete (lexical word) concepts using non-linguistic representations as opposed to linguistic symbols. It is possible that these differences may prove beneficial in developing new testing and/or treatment techniques for the aphasic patient.

III. PURPOSE OF THE STUDY

The purpose of this study was to determine if differences between the performances on a semiotic symbol identification test and a linguistic symbol identification test existed for aphasic patients when identifying abstract (functional word) concepts.

IV. EXPERIMENTAL QUESTIONS

The following questions will be answered:

1. Are there significant differences between mean percentage of correct performances on the Boehm Test of Basic Concepts and on the identification of Synpro symbols for the aphasic adult?

2. Are there significant differences between mean latency performances on the Boehm Test of Basic Concepts and on the identification of Synpro symbols for the aphasic adult?

3. Are there significant differences between mean percentage of correct performances on the Boehm Test of Basic Concepts and on the

identification of Synpro symbols for the normal adult?

4. Are there significant differences between mean latency performances on the Boehm Test of Basic Concepts and on the identification of Synpro symbols for the normal adult?

5. Are there significant differences between mean percentage of correct performances of the aphasic and normal adults on the Boehm Test of Basic Concepts?

6. Are there significant differences between mean latency performances of the aphasic and normal adults on the Boehm Test of Basic Concepts?

7. Are there significant differences between mean percentage of correct performances of the aphasic and normal adults on the identification of Synpro symbols?

8. Are there significant differences between mean latency performances of aphasic and normal adults on the identification of Synpro symbols?

9. Is there a significant relationship between mean latency of responses for the aphasic and normal adults on the Boehm Test of Basic Concepts?

10. Is there a significant relationship between mean latency of responses for the aphasic and normal adults on the identification of Synpro symbols?

11. Is there a significant relationship between mean percentage of correct responses for the aphasic and normal adults on the identification of Synpro symbols?

12. Is there a significant relationship between mean percentage of

correct responses for the aphasic and normal adults on the Boehm Test of Basic Concepts?

13. Is there a significant difference between the mean latency of correct and incorrect responses of the aphasic adults on the Boehm Test of Basic Concepts?

14. Is there a significant difference between the mean latency of correct and incorrect responses of the aphasic adults on the identification of Synpro symbols?

CHAPTER II

METHODS AND PROCEDURES

I. SUBJECTS

A total of twenty adult subjects were selected to participate in this study. Ten of the twenty were designated as the experimental group and satisfied the following selectional criteria: 1) clinically diagnosed as mildly aphasic based on results from the Boston Diagnostic Aphasia Examination (Goodglass and Kaplan, 1972) and/or the Minnesota Test of Differential Diagnosis of Aphasia (Schuell, 1965); 2) at least three months post onset of aphasia; 3) no reported premorbid communication impairment; and 4) functional visual-perceptual ability, hearing functionally adequate, and functional motor ability for pointing based on at least a seven year age level on the Revised Peabody Picture Vocabulary Test (Dunn, 1981). The experimental group ranged in age from 33 to 81 years, with a mean of 62.5 years and in educational level from the eighth grade to completion of a Master's Degree, with a mean of 12.6 years of schooling.

The other ten subjects were designated as the control group and satisfied the following selectional criteria: 1) no reported history of neurological pathologies; 2) no previous speech or language problems or therapy intervention; and 3) observed functional ability for hearing, visual, and motor skills based on at least a seven year age level on the Revised Peabody Picture Vocabulary Test. The control group ranged in age from 50 to 84 years, with a mean of 62.8 years and in educational

level from the fourth grade to completion of a Master's Degree with a mean of 12.8 years of schooling.

The experimental group subjects were selected from the in-patient caseloads of Shannondale Retirement Home and the Knoxville Health Care Center, and also from the out-patient caseloads of St. Mary's Medical Center and the Patricia Neal Rehabilitation Center. Control group subjects were selected from available populations in Knoxville, Tennessee and Fairmont, West Virginia.

II. MATERIALS

In addition to the Revised Peabody Picture Vocabulary Test, two tests for concept identification were employed in this study: the Boehm Test of Basic Concepts (Boehm, 1971) and Synpro (Peterson, Brener, and Lea, 1972), a symbol identification task. The Boehm Test was designed to measure the mastery of concepts on a seven year age level. The pictures utilized represented concepts such as inside, around, most, between, etc. The symbol identification test was designed to measure the comprehension of related abstract concepts. Specific categories presented included designators (here, there), connectors (and, or), verbs, prepositions, pronouns, describers (big, small), questions, plurals, and negatives. Different degrees of difficulty were included in some of the categories. For example, two pictures of the face of a clock were used to identify the concepts of time and when. Another hierarchy was the identification of plurals. Singular-plural distinctions were made between: 1) girl-girls; 2) man-men; 3) he-they; and 4) is-are. Each of these items is an

increasingly more abstract representation of plurality (Gilley, 1977). A majority of the 72 symbols (Appendix A) on the test were taken from the Synpro-Syntax Programmer (Peterson, et al., 1972). Additional symbols were formulated by the experimenter to broaden the number of concepts tested.

Reaction/latency time measurements were obtained by utilizing a pressure-sensitive plate under the stimulus pages. A voice operated relay started a millisecond counter when the stimulus word was given; the subject touching the pictured stimuli stopped the counter. The responses were timed on the assumption that latency of response may be an index of decision difficulty for both the experimental and the control group subjects.

III. METHODS

A total of three test procedures were administered to each subject in the experimental group. The Revised Peabody Picture Vocabulary Test (R-PPVT), which was a selection criteria measurement, was administered during the first contact in addition to a review of case history information of the patient. For the administration of the R-PPVT, the subject was asked to point to one of four pictures presented on a page which best represented the spoken word stimulus. Stimulus words were presented by live voice.

During a second and third contact, those subjects who met the selection criteria for the study were administered the Boehm Test of Basic Concepts and the symbol identification test, respectively. The Boehm Test required the subject to point to pictorial representations

which best identified the linguistic concepts expressed. The symbol identification test, which was the final procedure administered, included 72 semiotic picture symbols developed for the use with a syntax programming device (Synpro). The symbol identification test also required that the subject point to symbol representations which best identified the linguistic concepts expressed. The symbol identification test was arranged so that four picture symbols appeared on each page. The symbols were arranged in contrasting pairs (e.g., is-are, now-then, here-there, etc.) with each pair being displayed on two separate pages along with a different pair, thus enabling each symbol to be identified. For example, the symbols for is and are appeared first with the symbols for now and then; the concepts is and then were to be identified. Later, the symbols for is and are reappeared with but and if, and now and then with over and under to allow the identification of are and now.

For the control group, one contact was made in which an informal interview was completed to note previous medical history and previous accounts of speech or language intervention. The R-PPVT, Boehm Test for Basic Concepts, and Synpro were also administered using the same procedures formerly described for the experimental group.

For both groups, the stimulus words for administering the Boehm Test and the symbol identification test were presented by live voice. Latency measures were obtained with the use of a pressure sensitive plate, electric counter, amplifier, and hand switch. The counter was set to begin measuring reaction time 100 msecs. after the end of

phonation and was activated by depressing the hand switch when the beginning of the last syllable of the verbal stimulus was spoken. The reaction measure was completed when the subject pointed to the picture response (the pictures were placed on the pressure-sensitive plate) which stopped the activity of the counter. Reaction measurements were recorded in millisecond units.

IV. RELIABILITY

In order to ascertain the test-retest reliability of the Boehm Test and the Synpro symbols, ten items were randomly chosen from each test and were readministered to all subjects at the end of each test procedure. This method was used to assess the reliability for latency as well as accuracy.

V. ANALYSIS OF THE DATA

An analysis of variance 2 x 2 repeated measures design (Dixon and Massey, 1969) was utilized to test for possible significant differences between performances on each of the concept identification tests, according to mean latency and mean percentage of correct response measures, for the aphasic and normal adults. For those differences which were significant, Duncan's Multiple Range test (Brunning and Kintz, 1977) was utilized in order to determine the point at which the significance occurred. In viewing the raw data obtained for both groups (Appendix B), a t-test for related measures (Brunning and Kintz, 1977) was also completed to determine if significant differences existed between performances on the Boehm Test of Basic Concepts and

and the Synpro symbol identification test for the aphasic group patients. The Spearman Rank-Order Correlation (rho) (Brunning and Kintz, 1977) was utilized to determine if there was a significant relationship between the mean percentage of correct responses on the Boehm Test of Basic Concepts for the aphasic and normal group subjects, and to determine if there was a significant relationship between the mean latency scores on the Boehm Test of Basic Concepts for the aphasic and normal group subject. The Spearman Rank-Order Correlation (rho) was also utilized to determine if there was a significant relationship between the mean percentage of correct responses on the identification of Synpro symbols for the aphasic and normal group subjects, and to determine if there was a significant relationship between the mean latency scores on the Synpro symbol identification test for the aphasic and normal adults. A t-test for related measures was also used to determine if there was a significant difference between the mean latency of correct and incorrect responses for each of the two experimental groups.

CHAPTER III

RESULTS AND DISCUSSION

I. RESULTS

This study was designed to determine differences between performances on two tests of linguistic concepts -- one test utilizing linguistic symbols and the second test utilizing non-linguistic symbols, of aphasic and normal adults. Data was recorded in terms of latency (milliseconds) and accuracy of responses. Rank order correlation statistics were also completed to determine if significant relationships existed for mean latency of responses between the two populations on each of the two tests. Since the normal adults achieved 100% accuracy on both test procedures, rank order correlations were not completed for accuracy measures. A t-test for related measures was completed to determine if significant differences existed between the mean latency of correct and incorrect responses of the aphasic subjects. In Appendix B the data obtained from the aphasic and normal subjects are shown.

To answer the questions of whether there are significant differences between performances on the Boehm Test of Basic Concepts and the Synpro symbol identification test of aphasic and normal adults (experimental questions 1-8), mean scores of latency were compared as well as mean percentage of correct responses. Table I shows the difference between the performance of the two groups, the difference between the performances on the two tests, and the interaction effect

TABLE I

2 X 2 ANALYSIS OF VARIANCE SUMMARY TABLE
FOR MEAN PERCENTAGE OF
CORRECT RESPONSES

Source	SS	df	MS	F	P
Between groups	.480	1	.480	34.286*	.01
Between tests	.056	1	.056	4.000	NS
Interaction	.056	1	.056	4.000	NS
Subtotal	.592	3			
Within groups	.505	36	.014		
Total	1.097	39			

between the groups and tests for mean percentage of correct responses. Table II shows the difference between the performance of the two groups, the difference between the performance on the two tests, and the interaction effect between the groups and tests for mean latency scores.

Statistical analyses using an analysis of variance 2 x 2 repeated measures design for mean percentage of correct responses indicated that the difference between the means was significant ($F=34.286$, probability less than .01) for performances between the aphasic and normal group subjects on the two tests. There was a nonsignificant ($F=4.000$, $F_{.05}(1,36)=4.17$) performance difference between the Synpro symbol identification test and the Boehm Test of Basic Concepts for the normal and aphasic subjects. The interaction effect for the independent and dependent variables also proved nonsignificant ($F=4.000$, $F_{.05}(1,36)=4.17$). The percentage of correct responses for the Boehm Test of Basic Concepts covered a range of .40 - 1.00, with a mean of .856, and a standard deviation of .172 percent for the aphasic subjects. The percentage of correct responses for aphasic adults on the Synpro symbol identification test covered a range of .40 - .88, with a mean of .706, and a standard deviation of .162 (Table III). The normal adults achieved 100% accuracy on both tests.

Statistical analysis using an analysis of variance 2 x 2 repeated measures design for mean latency indicated that a difference between the means was significant ($F=13.491$, probability less than .001) for performances between the aphasic and normal populations on the

TABLE II

2 X 2 ANALYSIS OF VARIANCE SUMMARY TABLE
FOR MEAN LATENCY SCORES

Source	SS	df	MS	F	P
Between groups	65.309	1	65.309	13.491	.001
Between tests	7.316	1	7.316	1.511	NS
Interaction	1.259	1	1.259	.260	NS
Subtotal	73.884	3			
Within groups	174.272	36	4.841		
Total	248.156	39			

TABLE III

MEANS, STANDARD DEVIATIONS, AND RANGES OF THE MEAN PERCENTAGE OF CORRECT RESPONSES ON THE BOEHM TEST OF BASIC CONCEPTS (BTBC) AND THE SYNPRO SYMBOL IDENTIFICATION TEST (SSIT) FOR THE APHASIC AND NORMAL SUBJECTS

	Aphasic Subjects			Normal Subjects		
Test	Mean	S.D.	Range	Mean	S.D.	Range
BTBC	.856	.172	.40-1.00	1.00	0	1.00
SSIT	.706	.162	.40- .88	1.00	0	1.00

two tests. There was a nonsignificant ($F=1.511$, $F_{.05}(1,36)=4.17$) difference for both groups between their performances on the Synpro symbol identification test and the Boehm Test of Basic Concepts. The interaction effect between the two groups and the two tests was nonsignificant ($F=.26$, $F_{.05}(1,36)=4.17$). The latency of response for the Boehm Test of Basic Concepts covered a range of .724 - 10.262, with a mean of 3.023, and a standard deviation of 2.691 milliseconds for the aphasic subjects. The latency of response for the aphasic adults on the Synpro symbol identification test covered a range of 1.422 - 13.227, with a mean of 4.233, and a standard deviation of 3.337 milliseconds. For the normal adults, the latency on the Boehm Test of Basic Concepts covered a range of .187 - 2.290, with a mean of .818, and a standard deviation of .687. The latency scores for normal adults on the Synpro symbol identification test covered a range of .299 - 2.513, with a mean of 1.323, and a standard deviation of .687 (Table IV).

Based on results from the analysis of variance 2 x 2 repeated measures design, a Duncan's Multiple Range test was utilized to make a more accurate analysis of the data. In answer to the experimental questions concerning differences between the performances of the aphasic and normal adults on the two tests, significance was found for both the mean percentage of correct responses and the mean latency measures: 1) between the performances of aphasic adults on the Synpro symbol identification test and normal adults on the Boehm Test of Basic Concepts (Mean percentage of correct responses, $k=2.86$, C. diff.=.106, difference between means=.294; mean latency measures,

TABLE IV

MEANS, STANDARD DEVIATIONS, AND RANGES OF THE MEAN LATENCY SCORES ON THE BOEHM TEST OF BASIC CONCEPTS (BTBC) AND THE SYNPRO SYMBOL IDENTIFICATION TEST (SSIT) FOR THE APHASIC AND NORMAL SUBJECTS

	Aphasic Subjects			Normal Subjects		
Test	Mean	S.D.	Range	Mean	S.D.	Range
BTBC	3.023	2.691	.724-10.262	.818	.687	.187-2.290
SSIT	4.233	3.337	1.422-13.227	1.323	.687	.299-2.513

k=3.10, C. diff.=2.17, difference between means=3.414); 2) between the performances of aphasic and normal adults on the Boehm Test of Basic Concepts (Mean percentage of correct responses, k=2.86, C. diff.=2.107, difference between means=2.20; mean latency measures, k=3.01, C. diff.= 2.107, difference between means=2.20); and 3) between the performances of aphasic and normal adults on the Synpro symbol identification test (Mean percentage of correct responses, k=3.10, C. diff.=.115, difference between means=.294; mean latency measures, k=3.01, C. diff.=2.107, difference between means=2.914). The normal adults performed significantly better, both in terms of latency and accuracy, than the aphasic adults on both tests. The response data obtained from the aphasic and normal subjects for the Boehm Test of Basic Concepts and the Synpro symbol identification test are shown in Appendices C and D.

From the raw data for responses of the normal adults on the Boehm Test of Basic Concepts and the Synpro symbol identification test, it was apparent that they achieved 100% accuracy on both tests. In light of this fact, a t-test for related measures was completed to test if a significant difference between mean percentage of correct performances on the Boehm Test of Basic Concepts and the Synpro symbol identification test existed for the aphasic adults. Results of the t-test for related measures yielded a significant difference (t=88.235, probability less than .001) in that the mean percentage of correct responses of the aphasic group was much higher for the Boehm Test of Basic Concepts than it was for the Synpro symbol identification test. The percentage of correct responses covered a range of .40 - 1.00,

with a mean of .856, and a standard deviation of .172 (Table III).

To answer experimental questions nine and ten, further statistical analyses were performed to determine if significant relationships existed between latency measures on the Boehm Test of Basic Concepts and on the Synpro symbol identification test for the aphasic and normal group subjects. A Spearman Rank-Order Correlation test indicated a significant relationship (rho=.695, probability less than .05) between the two populations on the Boehm Test of Basic Concepts. Rank order correlations completed for the Synpro symbol identification test indicated a significant relationship (rho=.652, probability less than .05) between the two populations. Statistical analysis for experimental questions 11 and 12 were not completed due to the normal adults achievement of 100% accuracy on both tests.

In answer to experimental questions 13 and 14, a t-test for related measures was completed to determine if significant differences existed between the mean latency scores of correct and incorrect responses on the Boehm Test of Basic Concepts and the Synpro symbol identification test for the aphasic subjects. Results for the Boehm Test of Basic Concepts revealed a nonsignificant (t=1.151, probability less than .05) relationship between latency and accuracy responses. Results for the Synpro symbol identification test indicated that the time required to make incorrect responses was significantly greater (t=2.443, probability less than .05) than the time required to make correct responses.

Although not a major area of interest in this study, a statistical analysis was performed to determine if choice of response was

dependent on placement of the symbol on the Synpro symbol identification test for the aphasic subjects. A simple chi-square was completed on the items of the Synpro symbol identification test. Results indicated that there was not sufficient reason to say that the choice of item response was dependent on the placement of the picture symbol on each plate of the Synpro symbol identification test.

Test-retest reliability scores for accuracy on the Boehm Test of Basic Concepts were 100 percent for the normal adults and 100 percent for the aphasic adults. For latency, reliability scores were 97 percent for the normal adults and 88 percent for the aphasic adults. Reliability scores for latency on the Synpro symbol identification test were 96 percent (normal) and 81 percent (aphasic). Reliability scores for accuracy were 100 percent for normal and 73 percent for aphasic adults. The aphasic adults showed consistent improvement in their ability to identify the semiotic symbols when they were repeated.

In summary, the normal subjects showed the expected advantage over the aphasic subjects. The aphasic subjects showed greater accuracy and shorter latency on the Boehm Test of Basic Concepts than on the Synpro symbol identification test. The latency of responses was in agreement for both populations as measured by the correlation of the mean response latencies, and there was a significant difference between latency of correct and incorrect responses for the aphasic adults.

II. DISCUSSION

The discussion of the results is divided into three sections. The first section discusses the performance of the aphasic subjects on the two tests. The second section is concerned with the easiest and most difficult items on the Synpro and Boehm Tests. The final section is concentrated on a discussion of the symbols.

Performance of the Aphasic Subjects on the Two Tests

The data indicate that there was a significant difference between performances on the Boehm Test of Basic Concepts and the Synpro symbol identification test for the aphasic adults, with regard to mean percentage of correct responses and mean latency scores. One possible factor which may have contributed to the superior performance of the aphasic subjects on the Boehm Test of Basic Concepts as compared to their performance on the identification of Synpro symbols may be the concreteness or abstractness of the pictures/symbols used. Goldstein (1948), in attempting to identify the defects in the abilities of aphasic patients to reason more abstractly, found that persons with left hemisphere lesions were more likely to show an impairment of the abstract attitude than a person with a right cerebral lesion. All of the aphasic subjects employed in this study suffered left hemisphere damage.

Another factor which may have influenced the performance of the aphasic subjects is that of contextual cues. The Boehm Test of Basic Concepts utilizes contextual cues in that complete sentences are given as stimuli. The Synpro symbol identification test, on the other hand,

utilizes geometric figures to represent linguistic concepts and is presented in contrasting pairs of concepts rather than in context. The use of contrasting pairs could be viewed as being more advantageous in that concepts presented out of context would appear in a purer form, i. e., they are not affected by use of other linguistic cues.

Even though the aphasic patients responded with less accuracy on the Synpro symbol identification test than they did on the Boehm Test of Basic Concepts, the data obtained for the test-retest reliability of the Synpro suggests a factor of practice effect in that the subjects did consistently better the second time the symbols were presented. This improvement also lends support to the idea that the semiotic symbols used on the Synpro symbol identification test can be identified linguistically.

In spite of the fact that the items on the Boehm Test of Basic Concepts were identified with more accuracy, it would not be feasible to use for training due to the simplicity of the pictures, i. e., the pictures used are designed for preschool to seven-year-old children. Also there were fewer chances for error on the Boehm Test of Basic Concepts as it utilizes the identification of 50 linguistic concepts as opposed to 72 on the Synpro symbol identification test.

Easiest and Most Difficult Items on the Synpro and Boehm Tests

There was a significant relationship between mean latency performances for the aphasic and normal adults on both the Boehm Test of Basic Concepts and the Synpro symbol identification test. This relationship was determined by mean latency score rather than accuracy

due to the 100 percent accurate performance of the normal subjects. The results of this relationship indicates that the item difficulty for the aphasic and normal subjects were similar on both tests. The length of the stimuli may have influenced the latency performances for both groups. Long stimulus to account for poorer performances in some instances and better performances in others. For example, the most difficult items for both groups to identify on the Boehm Test of Basic Concepts were in order, equal, right, several, and matches. For these particular concepts, the verbal stimulus was given in longer sentences and required that the subject compare pictures for equal, matches, and in order. For equal, the subject was required to count the number of lollipops in one group and find another group with the same amount. The same type of situation was included for the identification of matches. The easiest items for both groups on the Boehm Test were almost, top, few, and some but not many. In the instance of identifying some but not many, the stimulus was long enough that the subject had already identified the picture which represented the concept of some before the latency count began. Many of the verbal stimuli utilized on the Boehm Test of Basic Concepts included the keyword in the middle of the phrase which in turn yielded a shorter latency score.

In terms of latency, the most difficult items for both groups to identify on the Synpro symbol identification test included don't, soft, from, where, and now. The difficulty encountered in the identification of these items could be explained by the contrasting symbol with which they appeared. For example, the symbol for soft was often misinter-

preted for hard in that the subjects viewed the arrow as being soft instead of the block being soft (Appendix A). The easiest items to be identified on the Synpro symbol identification test were fruit, full, little, and down.

The Symbols

Response data for normal group subjects indicated that the Synpro symbols were adequately representative of the concepts tested, in that the group achieved 100 percent accuracy in their responses. All of the concepts were represented in paired contrasts.

The lexical referent items, such as the nouns and verbs, were more easily pictured and identified by the aphasic subjects. The functional nonreferent items including adjectives such as big and little were also easily identified by the aphasic group. Verbs such as is and are were more difficult to recognize. Although these concepts were not equally picturable, the correct identification of all the symbols made by the normal adults indicated that the symbols did convey enough of the significant semantic features of the concept.

Some of the symbols were misinterpreted by the aphasic subjects. For example, the symbol for can't was frequently chosen for don't, left for right, over for under, and take for give. These misinterpretations could be a result of the close resemblance of the two symbols included in the contrasting pair. For example, the symbols for give and take are of a hand with an arrow pointing away from it and a hand with an arrow pointing toward it. Of all errors and misinterpretations, 86 percent of the responses were either correct or within category, leaving only 14 percent for random choice.

CHAPTER IV

SUMMARY AND CONCLUSIONS

I. SUMMARY

The purpose of this study was to determine if performances were different on the Boehm Test of Basic Concepts and the Synpro symbol identification test for aphasic and normal adults. Data was recorded for latency (milliseconds) as well as accuracy of performances.

The experimental study included ten aphasic and ten normal adults who were matched in age and education levels. The subjects were required to point to pictures or symbols in response to concept words named by the examiner. The data consisted of the subjects' response to the Boehm Test of Basic Concepts (BTBC) and the Synpro symbol identification test (SSIT). Evaluation of the data included an analysis of variance 2 x 2 repeated measures design, Duncan's Multiple Range test, comparison of scores on the BTBC and SSIT for the aphasic subjects, correlation of latency responses for the two subject groups on the two tests, and dependence of choice response on placement of the items on the SSIT for the aphasic subjects.

The results of the study were as follows:

1. The normal adult subjects performed better than the aphasic group on the two linguistic concept tests, in both mean latency and mean percentage of correct response scores.

2. The aphasic subjects performed better on the Boehm Test of Basic Concepts than on the Synpro symbol identification test.

Abstractness of the symbols used, and lack of contextual cues provided for on the Synpro symbol identification test probably contributed to the decrease in accuracy and increase latency of response.

3. Significant differences existed between reaction time and correctness of responses for the aphasic group on the Synpro symbol identification test, in that time required for incorrect responses was significantly greater than time required for correct responses.

4. The choice of item response was not dependent on placement of the symbol on the Synpro symbol identification test for the aphasic adults.

II. CONCLUSIONS

Based on the results of this study, and considering the restricted area of neural insult for the aphasic subjects and the relatively small population of subjects, the following conclusions can be tentatively drawn:

1. Normal adults identify pictures and symbols from named concept words better than aphasic adults.

2. Pictures representing concepts are easier to identify than abstract symbols representing concepts for aphasic patients.

3. Order of difficulty for the identification of concept using pictures and semiotic symbols were the same for aphasic and normal subjects.

Suggestions for Further Study

1. The experimental design could be used to test other groups of aphasic adults (e.g. right hemisphere damage, anterior aphasic

syndromes, posterior aphasic syndromes) to determine if their performance is different from that of left hemisphere aphasic adults on the two tests.

2. To further chart the practice effect of semiotic symbols as a possible means for a training technique in aphasia therapy.

3. Redesigning or replacement of some of the symbols may aid in the identification of linguistic concepts when using semiotic symbols.

4. To test the reliability of the Synpro symbol identification test.

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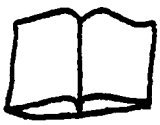
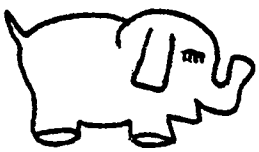
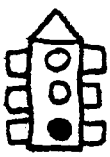
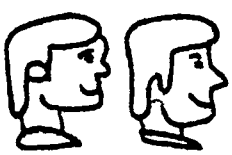
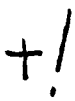
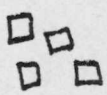
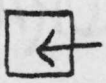
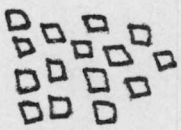
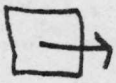
APPENDICES

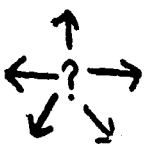
APPENDIX A

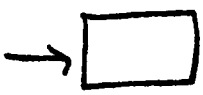
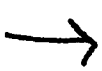
SYMBOLS AND REFERENTS

Symbol	Referent	Symbol	Referent
	book read		him
	time		her
	fruit		under
			over
	more		little
	less		big
	a		go
	some		stop

Symbol	Referent	Symbol	Referent
	he		this
	she		that
	it		how many
	they		which
	around		and
	beside		
	here		or
	there		if
	men		but
	man		is
			are

Symbol	Referent	Symbol	Referent
	on		hard
	off		soft
	full		slow
	empty		fast
	hate		right
	love		left
	can't		up
	don't		down
	few		in
	many		out

Symbol	Referent
	who
	what
	when
	where
	girl
	girls
	before
	after

Symbol	Referent
	by
	through
	give
	take
	toward
	from
	now
	then

APPENDIX B

RAW DATA

Listing of the subjects with Boehm Test of Basic Concepts (BTBC) scores and Synpro symbol identification (SSIT) scores

Aphasic Subjects	BTBC score (accuracy/latency*)	SSIT score (accuracy/latency*)
S_1	82%/ 2.868	69%/ 3.409
S_2	100%/ 1.822	88%/ 2.386
S_3	92%/ 1.143	44%/ 1.422
S_4	100%/ 2.087	82%/ 4.090
S_5	94%/ 0.724	81%/ 2.052
S_6	90%/ 2.975	68%/ 3.407
S_7	40%/10.262	40%/13.227
S_8	88%/ 1.980	75%/ 4.504
S_9	82%/ 2.688	78%/ 3.022
S_{10}	88%/ 3.685	81%/ 4.818
Normal Subjects		
S_{11}	100%/ 0.187	100%/ 0.299
S_{12}	100%/ 0.201	100%/ 0.389
S_{13}	100%/ 0.377	100%/ 1.579
S_{14}	100%/ 0.369	100%/ 1.295
S_{15}	100%/ 2.290	100%/ 2.513
S_{16}	100%/ 0.929	100%/ 1.745
S_{17}	100%/ 0.802	100%/ 0.907
S_{18}	100%/ 0.793	100%/ 1.389
S_{19}	100%/ 1.719	100%/ 1.994
S_{20}	100%/ 0.516	100%/ 1.122

*Latency scores shown represent the mean latency, in milliseconds, for each subject.

APPENDIX C

RESPONSE DATA--SYNPRO[1]

Raw scores obtained from the aphasic and normal subjects.

Correct Words (category)	Aphasic Subjects 1	2	3	4	Normal Subjects 1	2	3	4
1. he (pronoun)	8/ 2.323	2/ 4.277			10/1.322			
2. it								
3. they (pronoun)			9/ 2.455	1/17.253			10/1.343	
4. she								
1. then (time)	5/ 2.979	1/12.514	1/ 4.371	3/ 5.088	10/3.536			
2. is (quantity)	3/ 7.379	5/10.152	2/ 2.317			10/1.568		
3. now								
4. are								
1. here								
2. there (space)	4/ 5.118	4/ 6.743		2/11.411		10/1.456		
3. less (quantity)	2/ 3.782		8/ 1.804				10/0.770	
4. more								
1. before (time)	3/ 4.123	3/ 3.464	4/12.310		10/1.840			
2. after								
3. her								
4. him (pronoun)	1/ 6.224			9/3.631				10/1.077

[1]The row numbers (1, 2, 3, 4) correspond to the column numbers (1, 2, 3, 4) so that a (1:1) or a (2:2) correspondence indicates a correct answer. A (1:2) correspondence indicates that the second word was chosen for the first stimulus word. For example, eight of the aphasic subjects chose he and two chose it when the stimulus word he was given. All ten of the normal subjects correctly identified he.

Correct Words (category)	Aphasic Subjects 1	2	3	4	Normal Subjects 1	2	3	4
1. what								
2. under								
3. over (space)	1/ 1.282	4/ 7.479	5/ 2.569				10/0.900	
4. who (pronoun)	2/ 4.852		3/10.841	5/ 2.783				10/1.010
1. read (intran. verb)	8/ 3.318	2/ 3.134			10/0.907			
2. time								
3. beside (space)			8/ 3.157	2/10.906			10/1.156	
4. around								
1. many (quantity)	5/ 3.457		3/ 1.241	2/ 3.136	10/0.621			
2. from (space)	1/ 5.495	5/ 7.420	3/ 9.675	1/ 3.975		10/1.848		
3. toward								
4. few								
1. if (conjunction)	6/ 9.437	4/ 8.147			10/1.998			
2. but								
3. man								
4. men (quantity)			1/10.601	9/ 1.545				10/0.797
1. in (space)	5/ 5.918	1/ 3.300	1/ 1.217	3/ 7.565	10/1.579			
2. right								
3. left (space)		1/ 2.996	7/ 2.061	2/ 2.754			10/1.380	
4. out								
1. where (space)	6/ 7.845	2/ 5.221	2/ 9.738		10/2.323			
2. full								
3. when								
4. empty (quantity)				10/ 3.472				10/1.097

Correct Words (category)	Aphasic Subjects 1	2	3	4	Normal Subjects 1	2	3	4
1. slow (adjective)	10/ 1.862				10/0.696			
2. fast								
3. on (space)			9/ 3.265	1/ 7.094			10/0.885	
4. off								
1. take								
2. girl								
3. give (trans. verb)	2/ 6.912	1/ 7.348	7/ 2.231				10/1.914	
4. girls (quantity)	1/ 1.009	1/ 9.397		8/ 2.288				10/0.774
1. down								
2. which								
3. up (space)	1/ 5.082		9/ 2.552				10/1.170	
4. how many (quantity)	1/ 1.374	1/13.845		8/ 5.339				10/1.173
1. by								
2. through (space)		8/4.205	1/ 1.896	1/ 5.100		10/1.615		
3. don't								
4. can't (negated verb)	2/ 3.364	1/ 9.612		7/ 5.356				10/3.070
1. little								
2. big (adjective)		9/ 1.707		1/ 1.767		10/0.695		
3. book (noun)			10/ 1.387				10/0.911	
4. fruit								
1. and (conjunction)	5/ 8.209	1/ 2.148	3/11.338	1/ 6.986	10/1.035			
2. love								
3. or								
4. hate (trans. verb)	1/ 9.204			9/ 3.321				10/0.623

Correct Words (category)	Aphasic Subjects 1	2	3	4	Normal Subjects 1	2	3	4
1. go								
2. hard								
3. stop (intrans. verb)			9/ 2.874	1/ 4.330			10/0.923	
4. soft (adjective)	1/ 2.768	5/ 8.934		4/ 8.125				10/2.218
1. some (quantity)	5/ 2.377	3/ 4.989		2/ 3.772	10/2.615			
2. a								
3. this (space)	3/ 2.534	3/ 9.035	3/ 3.891	1/ 6.010			10/2.263	
4. that								
1. many								
2. there								
3. here (space)	1/ 1.890		8/ 6.464	1/16.989			10/1.282	
4. few (quantity)			1/15.873	9/ 1.460				10/0.511
1. time (time)	10/ 1.903				10/0.781			
2. read								
3. toward (space)		1/ 8.392	5/ 3.927	4/ 3.170			10/1.071	
4. from								
1. it (pronoun)	6/12.220		4/ 6.240		10/1.958			
2. they								
3. him								
4. her			1/20.969	9/ 2.205				10/0.971
1. he								
2. after (time)		5/ 2.345	5/ 5.885			10/1.545		
3. before								
4. she (pronoun)		1/1.085		9/ 2.964				10/0.604

Correct Words (category)	Aphasic Subjects 1	2	3	4	Normal Subjects 1	2	3	4
1. can't								
2. where								
3. when (time)	1/ 3.838	3/ 8.237	6/ 3.570				10/1.913	
4. don't (negated verb)	6/ 6.137	2/ 3.303		2/15.400				10/3.540
1. over								
2. now (time)		6/ 8.893	4/ 4.220			10/1.853		
3. then								
4. under (space)			1/ 0.404	9/ 8.515				10/0.778
1. are (quantity)	6/ 5.357	3/11.154	1/17.643		10/1.659			
2. but (conjunction)		2/11.095	2/ 7.197	6/ 7.370		10/1.815		
3. is								
4. if								
1. men								
2. man (quantity)	1/27.278	9/ 1.686				10/0.573		
3. more (quantity)	1/ 0.593		9/ 3.302				10/0.785	
4. less								
1. left								
2. beside								
3. around (space)	2/ 6.101	1/ 6.206	7/ 2.657				10/1.106	
4. right (space)				10/ 5.505				10/1.021
1. on								
2. fruit (noun)	1/11.399	9/ 1.243				10/0.498		
3. off (space)		1/10.168	9/ 3.100				10/1.077	
4. book								

Correct Words (category)	Aphasic Subjects 1	2	3	4	Normal Subjects 1	2	3	4
1. who								
2. what (pronoun)	1/16.002	6/ 4.673	2/ 2.920	1/18.989		10/1.146		
3. take (trans. verb)	1/10.207		5/ 3.854	4/ 1.861			10/0.936	
4. give								
1. which (space)	6/ 5.101		4/ 4.907		10/2.466			
2. by (space)	1/13.317	4/ 4.446	1/13.948	4/ 1.572		10/1.512		
3. how many								
4. through								
1. or (conjunction)	5/ 5.503		3/ 1.683	2/ 0.840	10/1.844			
2. a (quantity)	1/ 1.403	6/ 4.633	2/ 5.409	1/ 9.628		10/1.730		
3. and								
4. some								
1. big								
2. little (adjective)		10/2.312				10/0.677		
3. down (space)			10/ 2.476				10/0.666	
4. up								
1. in								
2. hard (adjective)	2/ 7.978	4/ 4.851	4/ 2.114			10/0.982		
3. soft								
4. out (space)	1/ 2.730		2/ 9.842	7/ 3.311				10/1.158
1. empty								
2. full (quantity)	1/ 3.591	8/ 1.176	1/ 0.642			10/0.621		
3. stop								
4. go (intrans. verb)	1/ 0.777		1/ 2.163	8/ 5.012				10/1.212

Correct Words (category)	Aphasic Subjects 1	2	3	4	Normal Subjects 1	2	3	4
1. fast (adjective)	9/ 1.674			1/ 4.919	10/0.721			
2. girl (quantity)		10/5.496				10/0.803		
3. girls								
4. slow								
1. love (trans. verb)	10/ 3.108				10/0.817			
2. this								
3. hate								
4. that (space)		3/11.693	2/ 2.325	5/ 4.318				10/1.540

APPENDIX D

RESPONSE DATA--BOEHM

Raw scores obtained from the aphasic and normal subjects.

Concept (category)	Aphasic Subjects		Normal Subjects	
	Correct/Latency	Incorrect/Latency	Correct/Latency	Incorrect/Latency
1. top (space)	9/1.338	1/ 1.498	10/0.416	
2. through (space)	10/2.243		10/0.779	
3. away from (space)	7/1.658	3/ 2.987	10/0.480	
4. inside (space)	8/3.714	2/ 3.394	10/0.956	
5. next to (space)	9/2.284	1/ 4.840	10/0.699	
6. some but not many (quantity)	10/1.476		10/0.277	
7. middle (space)	10/2.889		10/0.659	
8. few (quantity)	6/1.058	4/ 1.730	10/0.439	
9. farthest (space)	8/1.278	2/ 3.571	10/0.468	
10. around (space)	10/2.574		10/0.524	
11. over (space)	10/1.548		10/0.352	
12. widest (quantity)	10/2.136		10/0.641	
13. most (quantity)	10/1.850		10/0.326	
14. between (space)	6/2.657	4/ 3.381	10/1.179	
15. whole (quantity)	10/1.497		10/0.714	
16. nearest (space)	9/2.042	1/ 5.463	10/0.570	
17. second (quantity)	6/2.554	4/ 5.002	10/0.645	
18. corner (space)	8/2.077	2/ 2.576	10/0.557	
19. several (quantity)	10/6.458		10/1.448	
20. behind (space)	9/2.000	1/ 9.499	10/0.378	
21. row (space)	9/1.697	1/20.351	10/0.823	
22. different (adjective)	9/2.170	1/18.998	10/0.883	
23. after (time)	8/1.645	2/ 7.056	10/1.334	
24. almost (quantity)	9/1.052	1/ 3.704	10/0.269	
25. half (quantity)	9/1.468	1/ 7.122	10/0.479	
26. center (space)	9/1.830	1/ 4.203	10/0.480	
27. as many (quantity)	8/2.479	2/ 9.357	10/0.775	
28. side (space)	5/4.069	5/ 2.940	10/1.305	
29. beginning (time)	9/1.085	1/ 1.240	10/0.892	
30. other (adjective)	7/1.580	3/ 3.754	10/0.536	

Concept (category)	Aphasic Subjects Correct/Latency	Aphasic Subjects Incorrect/Latency	Normal Subjects Correct/Latency	Normal Subjects Incorrect/Latency
31. alike (adjective)	8/4.905	2/ 5.138	10/1.537	
32. not the first or last (quantity)	7/4.045	3/ 8.685	10/0.911	
33. never (time)	7/3.674	3/10.782	10/1.219	
34. below (space)	10/2.389		10/1.136	
35. matches (trans. verb)	8/2.840	2/16.578	10/1.395	
36. always (time)	7/2.608	3/11.127	10/1.412	
37. medium-sized (quantity)	9/1.696	1/ 5.877	10/0.722	
38. right (space)	9/4.388	1/22.223	10/1.491	
39. forward (space)	9/2.605	1/ 1.537	10/1.006	
40. zero (quantity)	9/3.212	1/32.367	10/0.548	
41. above (space)	7/1.469	3/ 5.500	10/0.435	
42. every (quantity)	9/1.206	1/24.594	10/0.841	
43. separated (space)	9/1.573	1/ 5.918	10/0.914	
44. left (space)	8/2.737	2/10.141	10/0.884	
45. pair (quantity)	10/2.221		10/0.457	
46. skip (intrans. verb)	6/3.299	4/ 2.109	10/0.532	
47. equal (quantity)	10/6.607		10/1.888	
48. in order (space)	9/3.997	1/35.443	10/1.788	
49. third (quantity)	10/3.799		10/0.932	
50. least (quantity)	10/4.356		10/0.712	

VITA

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