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THE EFFECT OF A SMALL-STEPPED COMPUTER-BASED PROGRAM
ON THE
GRAPHIC OUTPUT OF CHRONICALLY APHASIC ADULTS

BY

CYNTHIA RUBIN
B.A., Queens College, 1968

THESIS

Submitted in partial fulfillment of the requirements
for the Master of Arts degree in Communicative Disorders
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ABSTRACT

The purpose of this study was to examine the effects of an especially designed small-stepped treatment program utilizing the Apple II microcomputer on the graphic output of eight chronically aphasic adults. The subjects manifested moderate/severe to severe communicative impairment as determined by performance on the Aphasic Language Performance Scales (ALPS) (Keenan and Brassell, 1974) and were receiving management at the Communicative Disorders Clinic at the University of Central Florida.

Pretreatment status of each subject was measured via a visual and hearing screening. In addition, the Aphasia Language Performance Scales were administered as an indicant of overall communicative ability. Spelling proficiency was measured via a written spelling test.

Each subject then initiated a ten-session (one-half hour twice weekly) treatment program. Treatment objective progressed in increasingly complex small steps from prelinguistic (letter-matching) through linguistic (spelling single words) levels. The Apple II microcomputer was utilized in the areas of stimulus presentation, response contingency, and data keeping.

Subsequent to the completion of the treatment condition, the Aphasia Language Performance Scales (Keenan and Brassell, 1974) and the written spelling test were readministered to each subject.

Pretreatment and post-treatment scores were subjected to statistic analysis.

Findings indicated a significant correlation between pretreatment scores on the Aphasia Language Performance Scales (Keenan and Brassell, 1974) and changes in spelling proficiency. No significant changes were noted in pretreatment and post-treatment scores on the Aphasia Language Performance Scales (Keenan and Brassell, 1974). Significant changes were observed in pretreatment and post-treatment written spelling test scores with evidence that skills learned on the computer keyboard transferred to manual writing. The implications of the results of this study were discussed within the framework of future treatment and research in the area of aphasia.

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CHAPTER I

INTRODUCTION

Aphasia is a language disorder subsequent to dominant hemisphere brain damage that is reflected in all linguistic modalities: reading, writing, listening, and speaking (Schuell and Jenkins, 1961; Duffy and Ulrich, 1976; Kertesz, 1978; Marquardt, 1981). The most frequently cited precipitative factor related to such cortical insult is the sustaining of a cerebrovascular accident (stroke). Trauma to the brain or an infection which reaches the brain are the next two most prevalent causes (Brookshire, 1978; Lesser, 1978). Leske (1981) reported there are approximately 250,000 stroke veterans in the United States. An estimated 10 to 30 percent of these survivors have resultant communicative impairment.

Dysarthria, apraxia, and aphasia are the most frequent manifestation of communicative impairment resulting from cerebral insult. While aphasia is a more broad-based disorder of language, dysarthria and apraxia are disorders primarily involving speech production. In the dysarthric patient, weakness, incoordination, or sensory loss exists in those body parts involved in speech production. The intrinsic deficits are not linguistic although a language disorder may co-exist with dysarthria. In the apraxic patient, impaired functioning is manifested in the planning and carrying out of the appropriate sounds corresponding to communicative intent (Buckingham, 1981).

The language disorder characterizing aphasia may manifest itself in clinically variable patterns of general and specific behaviors. The general behaviors include reduction in the following areas: ability to comprehend the spoken word, retrieval of appropriate words to express communicative intent, use of correct grammatical structures, ability to read with understanding or calculate with numbers, writing, and the ability to repeat verbally what has just been said (Brookshire, 1978).

A linguistic overview to the study of aphasia presupposes a hierarchical structure in language (Lesser, 1978). Linguistic performance and competence are analyzed along the interrelated parameters of the sounds involved (phonology), the structural arrangements (syntax), and the system of meaning (semantics) involved. Pragmatic considerations of language in this population relate to the appropriateness of the aforementioned variables within the context of the communicative situation.

Patterns of impaired linguistic performance to aphasics reflect both classification and severity of the patient's disorder (Duffy and Ulrich, 1976; Goodglass and Kaplan, 1972). Linguistic deficits of anterior aphasics can be demonstrated via tests of comprehension and verbal/graphic expression. Indicators of this syndrome include reduced lexicon, and articulation is frequently impaired. Oral reading ability is frequently nonfunctional, but comprehension of reading material may be relatively intact. In general, research has indicated that the nature of the graphic output characteristics in anterior aphasics is reflective of the other expressive modalities but may show more severe deficits (Goodglass and Kaplan, 1972; Duffy and Ulrich, 1976). The

verbal output of posterior aphasics is characterized by relatively fluent, seemingly grammatical speech, with deficits in wordfinding, recognition, and naming aspects of language. There is a tendency for speech to be both paraphasic and lacking in substantive meaning. Graphic output responses in this population are frequently consonant with those responses involving spoken language in that they tend to be rambling, disorganized, and paraphasic (Goodglass and Kaplan, 1972).

Writing is one of the latest language skills to be acquired and is considered to reflect a highly integrated form of language use. It involves a visual-symbolic means of reflecting comprehension, concept development, and abstraction (Mercer, 1979).

The writing disturbance typical of an aphasic disorder is not the result of problems with the mechanics of writing. Although the patient frequently is no longer able to write with his preferred hand, there is no impairment of the non-dominant writing musculature (Broida, 1979). The writing impairment is a reflection of the cortico-linguistic processing disturbance (Brookshire, 1978).

Over the years, an extensive body of research literature of both a descriptive and experimental nature has evolved regarding linguistic deficits in the aphasic population. The focus of the present study is an outgrowth of previous investigations specific to linguistic performance as manifested by graphic output characteristics. A recurring concept integrated into these studies is that there are patterns of disordered graphic output. Errors do not tend to occur randomly.

This suggests an impaired ability to retrieve and utilize linguistic rules effectively. It further implies a rule-based orientation for a treatment paradigm.

Investigations of Graphic Output in Aphasia

Bricker, Schuell and Jenkins (1964) investigated the relationship between written spelling errors and the variables of frequency of word usage (as determined by classification on the Lorge Magazine Count), and word length (as determined by the number of letters contained in the word). The Wide Range Achievement Spelling Test (WRAST) (Jasak, 1946) was administered to 64 aphasic patients at the Minneapolis Veterans Administration Hospital. Analysis of obtained performance data revealed an overall pattern of increasing errors as the frequency of word usage decreased. Concurrently, it was demonstrated that as word letter length increased, spelling errors also tended to increase. These error patterns were consistent over the written responses for all aphasic classifications as determined by patient performance on the Minnesota Test for Differential Diagnosis of Aphasia (MTDDA) (Schuell, 1965).

Pizzamiglio and Black (1968) observed patterns of disordered graphic output responses compatible with those demonstrated in the investigation by Bricker and colleagues (1964). Sentence completion and picture-naming tasks were presented to eighteen aphasic patients, and response patterns were collated. The writers noted a significant predilection toward errors characterized by (1) anticipating letters which would occur subsequently within the word, and (2) perseverating

on letters which had recently been written. The authors also observed that increased word length had a deleterious effect on graphic output proficiency. Errors occurred most commonly at the medial position of a word, with greater letter accuracy at the beginning and end.

In an analysis of the graphic output characteristics of aphasic patients, Friederici, Schoenle and Goodglass (1981) made observations compatible to those of Pizzamiglio and Black, but for longer units--three syllable words. Analysis of graphic output samples from twelve male aphasic patients receiving management from the neurobehavioral unit of the Boston Veterans Administration Hospital revealed that errors were more likely to occur in the medial position of three-syllable words than at the beginning or end.

The above findings were supported by the clinical observations of Schuell (cited in Sies, 1974). She noted that there is always an impairment in the ability to spell and there may be additional problems depending on the presence and degree of visual process involvement. Observable manifestations of visual process involvement include confusion of letters which have similar appearance, distortions and reversals of letter forms, phonetic spelling, and special difficulty with words containing double consonants or double vowels.

Duffy and Ulrich (1976) studied the relative impairment of expressive and receptive modalities among aphasic patients. Forty-four patients were administered the Minnesota Test for Differential Diagnosis of Aphasia (MTDDA) (Schuell, 1955). The authors noted that writing skills tended to show more severe deficits than any of the other

parameters measured. This observation was consistent for patients across all diagnostic categories represented.

In contrast to the findings of Duffy and Ulrich cited above, Friederici and colleagues (1981) reported that a subgroup of patients within the general classification of anterior aphasics demonstrated written naming superior to oral naming. Analysis of writing errors within that subgroup showed them to be more graphemically (letter relevant) and semantically (meaning) motivated than were the errors of the remaining subjects, posterior aphasics who were more proficient at naming verbally than graphically. The latter group produced proportionately more phonemically (sound relevant) errors.

The findings of Friederici and colleagues suggest a direct link in some aphasics between reading and comprehension which is not phonemically mediated. Error patterns are consistent with the concept that words, when presented individually, are perceived and comprehended as whole units and not as combinations of graphemes. Comparable results were obtained by Locke and Deck (1982). Those investigators studied reading comprehension via a letter-identification task. Subjects were presented with a written word list and directed to cross off certain predetermined letters. These letters were represented in both modal (expected) and nonmodal contexts. Results demonstrated that modal or expected spellings were more often correctly identified than were non-modal, even though each word was read. Although the research design was not extended to include a specific measure of graphic output, the findings suggest that aphasic patients may derive meaning from whole-word units, and not primarily from the graphemic components of the words.

Observations of word spelling deficit patterns via the visual/graphic modalities are somewhat consistent with findings obtained via auditory/verbal channels. Noll and Hoops (1967) investigated the relationship between word letter length and grammatical class on verbal spell performance. Twenty-five mildly aphasic subjects were directed to spell 100 words presented orally. Results were tape recorded. Words selected for inclusion represented certain parts of speech--nouns, verbs, descriptive modifiers, and nonpropositional morphemes--length of word, and frequency of usage. Those investigators found an increase in word letter length. Concurrently, they observed that more spelling errors tended to occur on words included within the grammatical category of nonpropositional morphemes. These included pronouns, conjunctions, propositions and interjections.

The aforementioned studies added to available information describing disordered spelling patterns and graphic output deficits specific to the aphasic population. In general, findings revealed that (1) word letter length and frequency of usage were significant variables in graphic output error performances, (2) anticipation and perseveration accounted for types of errors observed, (3) the medial position of words was especially vulnerable to error responses, (4) writing impairments in the aphasic was indicative of the person's communicative disorder, though it may have been more severe, and (5) it was possible that for some aphasics, word meaning was derived from whole-word units and not from the graphemic components of the word. The focus of the following investigations is on graphic output treatment programs specific to the adult aphasic.

Treatment of Graphic Output in Aphasia

Pizzamiglio and Roberts (1967) utilized a typewriter keyboard to study reeducation of writing function among aphasics. They employed a structured approach with a specifically designed teaching machine, the Language Retrieval Unit. The machine was programmed to print on paper the words typed by the aphasic patient. The subjects were directed to supply the final word for each of eight sentences (cloze technique) and type the name of ten pictured objects. If a subject pressed a wrong key, the correct one would light up as a visual cue. In addition to investigating the effects of a teaching machine based intervention program, this study examined the relative benefits of daily treatment contrasted to every-other-day treatment. The results indicated that daily treatment was more beneficial as demonstrated by the more rapid learning of the tasks. Retesting the subjects one week subsequent to the termination of the treatment condition showed the daily treatment groups retained a higher level of ability.

Sarno, Silverman and Sands (19770) conducted an extensive investigation of the relative effectiveness of structured as compared to non-structured intervention programs on 31 severely impaired aphasics. The authors obtained a baseline of functional language abilities via the Functional Communication Profile (FCP) (Taylor-Sarno, 1969). Scores were obtained for each subject prior to participation in the treatment portion of the intervention paradigm. Each group was presented with stimulus material from the Bell and Howell Language Master Program. Tasks included (1) completion of partially completed geometric forms, (2) filling-in of letters and words, and (3) copying exercises.

Post-test scores on the FCP, which includes graphic output indicants, revealed no significant differences for either of these groups or a third control group.

Schwartz, Nemeroff and Reiss (1974) compared standardized test scores of matches groups of aphasics. One group received a writing program using stimulus materials from the Bell and Howell Language Master. The second group received an individualized nonspecific program with a multimodality orientation. Upon completion of the study, the authors found no significant differences in standardized communication test scores as reflected by performance on the Porch Index of Communicative Ability (PICA) (Porch, 1967).

Boone and Friedman (1976) manipulated the variables of cursive versus manuscript writing in an attempt to determine if either was preferable in facilitating proficient graphic output responses. Subjects in the study were 30 aphasic adults who were participating in various rehabilitation programs in Tucson, Arizona. No significant differences in performances were determined for tasks requiring either the production or comprehension of written responses.

Seron, Deloche, Moulard and Rousselle (1980) conducted the most recent investigation of the treatment of graphic output in aphasic individuals. They examined the effects of a computer-based treatment program on the writing skills of five such patients. Initially, the subjects were administered a spelling test in which responses were written manually. Computer-based programs requiring response via typewriter key board were then designed for each subject as determined by spelling test performance scores. Subsequent to the treatment

condition the authors found significant improvement upon the administration of a post-test. Four of the subjects showed improved ability to correctly type stimulus words with carryover to manual writing. In addition, there was evidence of generalization of newly acquired skills to words not specifically included in the program of writing management.

Although there exists a lack of information specific to the efficacy of various approaches to the enhancement of graphic output in the aphasic population, previous studies considering management in general have tended to be directional in that they reflected increasing attention to structured tasks and objective quantifiable response measurement. Within those reported findings, varying degrees of emphasis have been directed toward the graphic output parameter. Limitations in the design and implementation of many of these studies may bias the scope of generalizations that can be applied to their findings.

Statement of the Problem

The study conducted by Pizzamiglio and Roberts (1967) was limited in that the authors did not incorporate into their research design any means to determine if the skills their subjects acquired utilizing the Language Retrieval Unit transferred to manual writing or to previously untaught stimulus words. Also, no data regarding the possible effects of the intervention program on the overall communicative ability of the subjects were obtained.

As noted previously, the generalizing of specific tested writing skills to overall communicative abilities was considered by Schwartz and colleagues (1974) who found no differences in Porch Index of

Communicative Abilities (PICA) (Porch, 1967) performances for the subjects involved. In reporting the study, however, the authors did not mention the presence or nature of feedback and criteria for movement within a given program or the nature and schedule of reinforcement. Decisions regarding the type and immediacy of these variables may have negatively affected the research design.

Sarno and colleagues (1970) included only severely impaired individuals in their investigation. Benefits that may have been derived by individuals presenting a lesser degree of communicative impairment might have been masked.

The study by Seron and colleagues (1980) introduced the idea of a computer-based program of writing management specifically suited to the aphasic adult. They also addressed two serious criteria not previously considered by other investigators: the consistent and immediate signaling of error responses and the prevention of the patient from learning error responses via visual reinforcement. Limitations of the study were the extremely small sample size, the lack of a sufficiently discrete treatment hierarchy, the failure to control for the effects of spontaneous remission on the part of one of the subjects, and the omission of any indicant of possible generalization of newly acquired abilities to overall communicative skills (speaking, listening, reading, and writing) via standardized assessment instrumentation.

The treatment emphasis of aphasics is frequently directed toward enhancing spoken output and auditory comprehension, but too often there is little focus devoted to graphic output. The lack of attention to

structured treatment of writing is controvertible since the graphic output emphasis also appears highly compatible with cortical integration approaches to aphasia management; it considers the relation of several complex variables interacting simultaneously to affect a response.

Some of the significant considerations relative to a graphic output program have been discussed by Bollinger and Stout (1976). Those authors suggest that if a graphic output program is to control significant variables and allow the maximum improvement by an individual with cerebral dysfunction, it must (1) clearly specify the communicative tasks addressed during treatment, (2) accommodate flexibility in the rate of progress, (3) allow for the greatest opportunity for the patient to experience success during each presentation, and (4) provide a method of ongoing assessment. The authors devised a treatment method accommodating these criteria, Response-Contingent Small Step Treatment (Bollinger and Stout, 1976) a method whose basic design is compatible to computer instruction. This program provides for (1) the obtaining of baseline data of patient performance on a treatment-by-treatment basis, (2) the progression along discrete small-stepped targets, and (3) the inclusion of feedback, reinforcement, and assessment.

Because writing is the most readily observed output means and is amenable to a very small-stepped programming approach; i.e., programming from nonlinguistic to linguistic steps, it would appear to lend itself to reeducation via a "drill type" of treatment program structured to patient needs. A writing program has the potential to

enhance the ability of the patient to monitor his behavior and attend to task through a feedback and reinforcement system incorporated into the program. By accommodating such factors as attention, response speed, response accuracy, and feedback consistency, cortical processing efficiency may be enhanced. With such a program, there would be the potential that improvement in graphic output would generalize to improved function in other communicative areas.

The efficacy of a small-stepped, computer-based program in the treatment of graphic output and its influence upon overall communicative ability of aphasic adults has not been determined. The following research questions will be addressed by the present study:

1. Is there a difference in pretreatment and post-treatment communicative abilities of aphasic adults as demonstrated by performance scores on a standardized test of communicative ability (Aphasia Language Performance Scales, ALPS, Keenan and Brassell, 1974)?

2. Is there a difference between pretreatment and post-treatment spelling abilities of aphasic adults as demonstrated by performance on a written spelling test?

3. Is there a correlation between pretreatment communicative performance as measured by the ALPS scores and differences in spelling test performance?

4. Is there a correlation between post-treatment communicative ability as measured by the ALPS and differences in written spelling test performance?

5. Is there a correlation between the number of treatment steps a subject successfully completes and his pretreatment communicative ability score (ALPS)?

6. Is there a correlation between the number of treatment steps a subject successfully completes and this post-treatment communicative ability score (ALPS)?

7. Is there a correlation between the number of treatment steps a subject successfully completes and differences in written spelling test performance?

CHAPTER II

METHOD

In this study, the communicative abilities of aphasic adults were examined as a function of participation in a small-stepped computer-based treatment program directed toward enhancing graphic output proficiency. The study was designed to address many of the limitations which biased previous research in this area and to qualify, as much as possible, the specific variables relative to subject performance.

Prior to the initiation of the treatment condition, baseline data regarding background information, and quantifiable data concerning the nature and severity of the aphasic disorder were obtained from each subject. Criteria for participation in this program included (1) documentation of left hemisphere cerebrovascular accident, (2) diagnosis of aphasia by a certified speech-language pathologist, and (3) a minimum of at least twelve months post-onset of the aphasic disorder. The last criterion was included to control for the possible effects of spontaneous remission (Smith, 1972; Vignolo, 1964; Culton, 1969; Hagen, 1973).

The pretreatment communicative status of each subject was evaluated via three different measurements (1) the administration of a visual and auditory screening battery, (2) the administration of the Aphasia Language Performance Scales (Keenan and Brassell,

1975), and (3) a written spelling test. The visual screening assessed the ability of each subject to match letters of approximately the same size as those that would subsequently be shown on the computer monitor, via an informal test, and the tasks involving letter-matching and geometric form-matching on the Minnesota Test for Differential Diagnosis of Aphasia (Schuell, 1965). A pure-tone screening was administered to determine auditory sensitivity. Minimal criteria for inclusion in the program was 40 dB estimated SRT in the better ear.

Information referring to previous treatment was recorded but not controlled for in this design. All subjects were administered the Aphasia Language Performance Scales (ALPS) (Keenan and Brassell, 1975) by a speech-language pathologist a maximum of two weeks prior to the onset of the treatment condition of this investigation. The ALPS is a standardized assessment instrument designed to evaluate language behaviors of aphasic individuals. It consists of four scales, each including a continuum of increasingly complex tasks, designed to evaluate communicative function along the modalic parameters of listening, talking, reading, and writing. Patient responses are qualitatively scored on a three-point scale (0 - $\frac{1}{2}$ - 1) corresponding to incorrect, prompted, or corrected answers. The ALPS has been demonstrated to be a psychometric instrument sensitive to the nature and severity of the aphasic disorder with construct validity relative to the Porch Index of Communicative Ability (PICA) (Porch, 1967) (Basili, Diener, Flugrath, Horsfall and Syski, 1975). Following the administration of the ALPS, each subject was presented with an informal spelling test consisting of nine words representative of both novel

words and words which were included in the treatment condition. Written responses were obtained for the spelling test. Two subjects refused administration of the spelling test, indicating inability to perform the task.

Subjects

Eight chronically aphasic adult males receiving group treatment at the Communicative Disorders Clinic of the University of Central Florida were included as subjects in this investigation. Table 1 shows the relative age, etiology, months-post-onset, and diagnostic classification for each subject. Subject ages ranged from 60 to 67 years with a mean of 63.8 years. In each case, the aphasic disorder was diagnosed as resultant from a cerebrovascular accident. Months-post-onset of the aphasic condition ranged from 24-149 with a mean of 50.8 months. Each subject was considerably past the period when performance gains could be attributable to the effects of spontaneous remission.

The diagnostic categories represented by these subjects include three Global Aphasics (each with concomitant apraxia), four Broca's Aphasics (each with concomitant apraxia), and one Transcortical Motor Aphasic. All subjects were classified as presenting moderate/severe to severe communicative impairment.

It was determined that for the duration of the investigation, no intervention strategies incorporating the graphic output modality would be included in the group treatment paradigm at the Communicative Disorders Clinic of the University of Central Florida.

Table 1

Age, Etiology, Months-Post-Onset (MPO) and Diagnostic
Classification for Eight Aphasic Subjects

Subject	Age	Etiology	MPO	Diagnostic Classification
1	67	CVA	24	Broca's Aphasia - severe
2	65	CVA	24	Broca's Aphasia - moderate/ severe
3	63	CVA	26	Global Aphasia - severe
4	64	CVA	26	Global Aphasia - severe
5	62	CVA	60	Transcortical Motor Aphasia - moderate/severe
6	60	CVA	54	Broca's Aphasia - moderate/ severe
7	67	CVA	149	Broca's Aphasia - moderate/ severe
8	62	CVA	39	Global Aphasia - severe
Mean	63.8		50.8	
Range	60-67		24-149	

This was to allow for the maximum potential of isolating the possible effects of the computer-based program.

Instrumentation

Stimuli were presented, response contingencies administered, and data kept via an Apple II plus, 48K, microcomputer. The computer package for this study included one Zenith CRT monitor with a 12" green screen, two Apple II disk drives, a computer carrying case, and a Centronics #739 dot matrix printer.

Program Design and Implementation

It was determined that there was a lack of available treatment programs suited to both computer applications and the graphic modality of aphasic adults. The one utilized in the treatment condition of this investigation was especially designed for this project. The general theoretical foundation for its design was drawn from learning theory in the hierarchical nature of the stimulus presentation and behavior modification theory in the nature of reinforcement and feedback presented. The structural framework for manipulation of stimulus power and number, feedback, and criteria for progression was drawn more specifically from the constructs addressed by Response-Contingent Small Step Treatment (Bollinger and Stout, 1976).

The program comprises units of "targets" and "steps." Appendix B is a schematic representation of the program. Major variables related to word letter length and morpheme/grapheme relationships were manipulated in increasingly complex tasks in the progression from target to target.

Each target includes a varying number of steps contingent upon the complexity of the objective. From step to step within a single target, stimulus presentation modalities were manipulated and novel stimulus words may have been introduced. Each step included eight stimulus presentations of essentially equal difficulty. Criteria for progression from step to step include a minimum of seven out of eight correct responses to the presented stimuli.

The program was designed to span prelinguistic (letter matching) through linguistic (word spelling) levels. Stimulus words were selected and ranked for inclusion in this program from those utilized in Clinician Controlled Auditory Stimulation for Aphasic Adults (Marshall, 1975). All were picturable common nouns. Word letter length and morpheme/grapheme relationships were among the variables manipulated in determining order and method of presentation.

At the onset of the program, each subject was issued a floppy disk containing a copy of the entire computer-based aspect of the program and provisions for data keeping specific to this response levels and accuracy.

During each session, each subject sat at a table directly facing the Apple II microcomputer. The speech-language pathologist was seated to the right of the subject. A secretarial typing stand which carried both the graphic and pictorial card functions was situated on the table to the right of the microcomputer. See Figure 1 for a pictorial representation of a subject at the microcomputer. In the course of the treatment condition, modifications were made in the placement of the secretarial stand. It was determined that left side placement

of the card function facilitated correct responses in subjects #1 and #3, who previously had not been attending to it.

Each subject was acquainted with use of the Apple II keyboard via a simple letter matching task. When a criterion of five correct responses were met, Step 1, Target 1 of the treatment program was initiated.

At this level, the targeted behavior included matching a single letter presented via the computer monitor and the card function. Subjects were instructed to strike the correct key corresponding to the presented letter.

When a correct response was made, YES appeared on the CRT and the next stimulus provided. When an incorrect response was typed into the computer and the "return" bar pressed, an auditory signal in the form of a short buzz sounded in conjunction with the appearance of NO on the CRT screen. The next stimulus was then provided. When a subject indicated via verbal or gestural responses that he wished to change a response prior to completion ("return" bar pressed), he was allowed additional trials without a scoring penalty. Feedback response accuracy was automatically provided on the CRT screen subsequent to the completion of each step. The speech-pathologist then programmed the initiation of the next step, at either a more or less advanced level, contingent upon criterion objective.

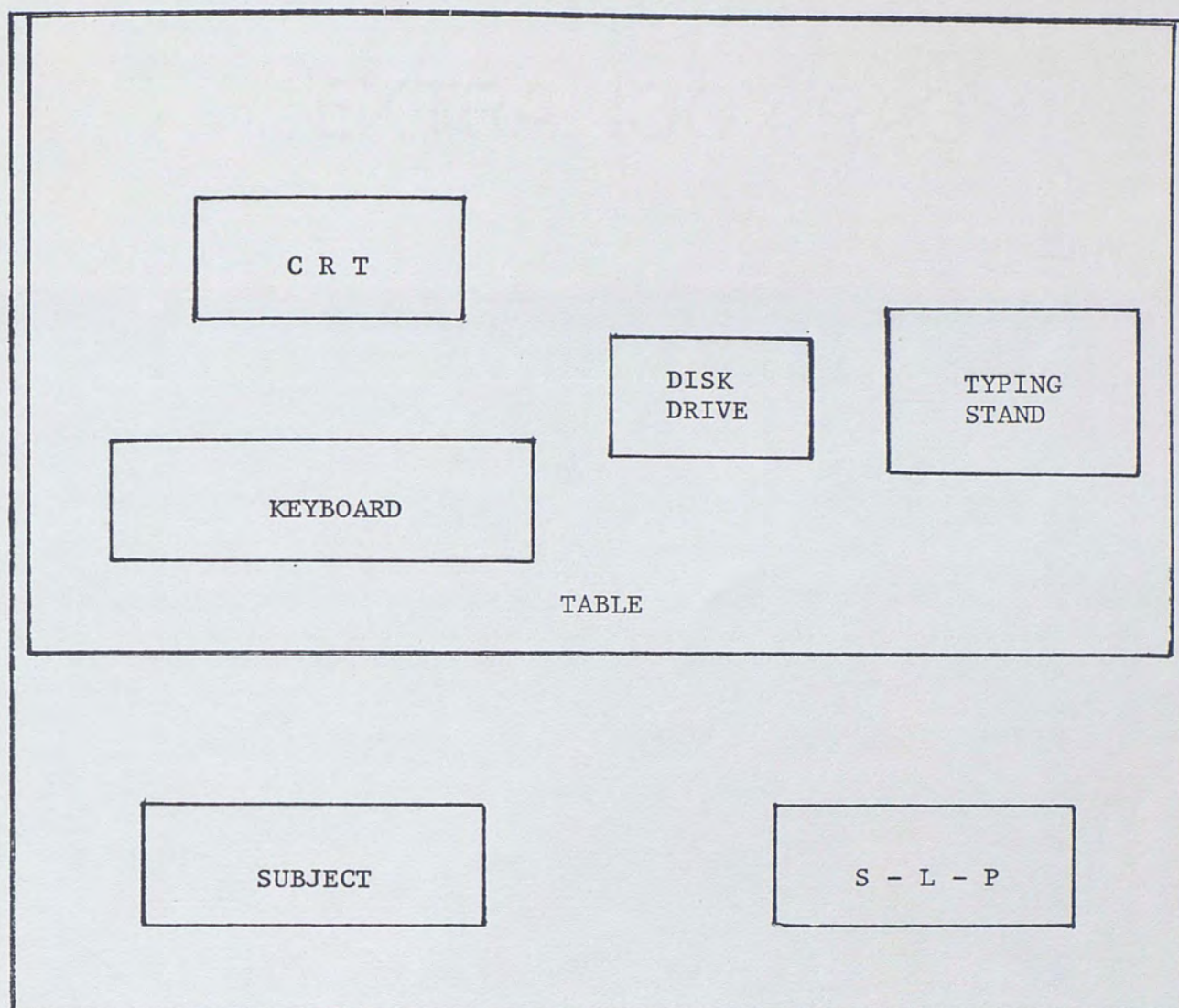


Figure 1. Treatment Situation

For purposes of this investigation, the program was designed to span a maximum of ten one-half hour treatment sessions. Each subject continued through single step increments at his own progression rate until the conclusion of the treatment condition, or until he failed to meet criteria on any discrete step subsequent to three presentations within a single treatment session. In this later condition, the subject's performance was considered to have plateaued.

At the conclusion of the ten treatment sessions, or plateau condition, the Aphasia Language Performance Scales (Keenan and Brassell, 1974) and written spelling test were readministered to evaluate changes in graphic output proficiency, overall communicative status, and transfer of writing skills from the keyboard to manual writing. Data obtained from the aforementioned parameters were subjected to nonparametric statistic analysis. Results are given in the following chapter.

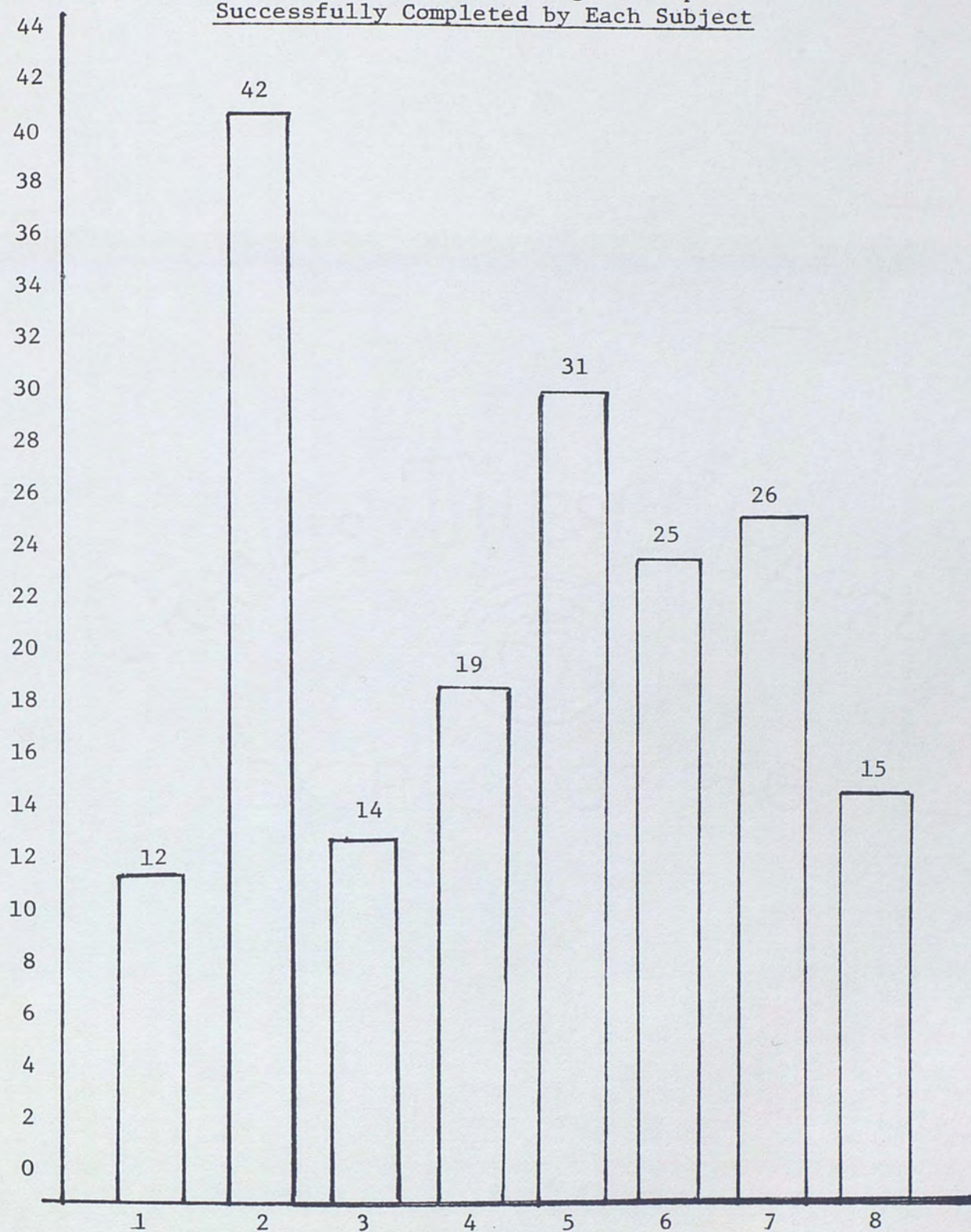
CHAPTER III

RESULTS

The distribution of the overall and intra-modality ALPS scores obtained pretreatment and post-treatment and the spelling test scores are presented in Table 2. Minimal variation in ALPS scores was observed for the eight subjects. Wilcoxon signed rank scores (Siegel, 1956) were calculated for these data. The resultant T was not significant ($p > .10$). Data obtained from the administration of the spelling test was subjected to the same procedure. Results indicated a significant ($p < .025$) positive direction from pretreatment to post-treatment administration.

The number of different program steps successfully completed to criteria by each of the eight subjects are summarized in Figure 2. A Spearman Rank correlation (Siegel, 1956) was calculated for each subject's pretreatment overall ALPS scores relative to the number of steps successfully completed in the course of the program. An obtained r of .82 was significant at the .05 level. Obtained Spearman rank correlations of .64 for post-treatment ALPS scores in relation to the number of steps successfully completed approached, but did not reach significance. Data pertaining to pretest ALPS scores in relation to differences of obtained spelling test scores were subjected to statistical analysis via Spearman r . The obtained value of .33 was not significant. A negative nonsignificant Spearman r

Number of Different Program Steps
Successfully Completed by Each Subject



Subjects
Figure 2

Table 2

Pretreatment and Post-treatment ALPS and Spelling Test Scores for Eight Aphasic Subjects

Subject	<u>ALPS Scores</u>						<u>Spelling</u>					
	Total		Listening		Talking		Reading		Writing		Number Correct	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	13.5	19.5	2	4	4	6	1	3.5	6	6	2	7
2	21.5	23.5	4	5	7.5	8	7	5.5	3	5	2	4
3	7.5	9.5	3	4	.5	1	1	1.5	3	3	N/A	N/A
4	11.5	11.0	4	3	1	1	3.5	4.0	3	3	0	0
5	20.0	20.0	5.5	5.0	7	9	2	3	3.5	3	0	2
6	17.5	14.0	3.5	3	5	3	4	3.5	5	4.5	2	4
7	15	14.5	1	3.5	6	3.5	5	4.5	3	3	0	1
8	6	9	2	3	1	2.5	1	2	2	2	N/A	N/A
Mean	14	15.1	3.1	3.8	4	4.4	3.1	3.4	3.6	3.7	1	3.2
Range	6-21.5	9-23.5	1-5.5	3-5	107.5	1-8	1-7	1.5-5.5	2-6	2-6	0-2	1-7

correlation of $-.07$ was obtained when analyzing the number of steps completed successfully by each subject with the obtained differences in spelling test scores.

In summation, the following results to the previously asked research questions were obtained:

1. No significant differences in pretreatment and post-treatment communicative abilities of aphasic adults were found as demonstrated by performance scores on a standardized test of communicative ability (ALPS).

2. Significant differences were found in pretreatment and post-treatment spelling performance abilities of aphasic adults as demonstrated by performance on a written spelling test.

3. No significant differences were found between pretreatment communicative performance as measured by the ALPS scores and differences in spelling test performance.

4. A nonsignificant correlational trend was found between post-treatment communicative ability as measured by the ALPS and differences in written spelling test performance.

5. A significant correlation was found between the number of treatment steps a subject successfully completed and his pretreatment communicative ability score (ALPS).

6. A nonsignificant correlational trend was found between the number of treatment steps a subject successfully completed and his post-treatment communicative ability score (ALPS).

7. A nonsignificant correlation was found between the number of treatment steps a subject successfully completed and differences in spelling test performance.

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CHAPTER IV

DISCUSSION

Subjects participating in this study were neurologically stable chronic aphasics who were an average of fifty-one months post-onset. In view of the chronicity of the language disorder, dramatic changes in writing ability were not anticipated. Although overall results of this research were essentially equivocal, they were directional in that they suggest the efficacy of additional, increasingly refined research in the area of micro-computer application to the small-stepped treatment structure for chronically aphasic adults. The consideration of several inter-related variables may lead to a more clear direction for subsequent intervention directions.

The six subjects for whom pretreatment and post-treatment written spelling test data were collected demonstrated significantly higher scores. These findings were obtained even though neither the computer-based treatment paradigm nor the co-occurring group treatment included any manual graphic activities. When examined within the context that each subject did complete to criteria from 12 to 23 different program steps, there is the indication that the Aphasia Language Performance Scales (Keenan and Brassell, 1974) may not have been an instrument comprising sufficiently discreet indicants to be of sufficient sensitivity to

detect the subtle performance changes evidenced. For example, steps in the writing subtest reflect larger increments in the skills necessary to successfully progress from one item to the next. The graphic subtests and overall administration of the Porch Index of Communicative Ability (Porch, 1967), or the writing subtest of the Western Aphasia Battery (Kertesz, 1980) may have contained more sensitive indices of small changes in behavior.

The combination of clinician assisted computer based small-stepped treatment appeared positive. The subjects who demonstrated higher scores on both pretreatment and post-treatment administration of the Aphasia Language Performance Scales (Keenan and Brassell, 1974) generally made more advances in terms of program steps successfully completed within the treatment condition. A statistically significant correlation was obtained between pretreatment ALPS scores and program steps completed. This may indicate that the subjects functioning at a more severely depressed communication level benefitted from the program relating opportunities in enhancing attending skills. The repetitive drill-like nature of the stimulus presentations was likely to facilitate improved competence in attending and monitoring. Concomitantly, the subjects functioning at a higher communicative level as demonstrated by ALPS scores may have benefitted more directly from the linguistic nature of the program. The influence of the co-occurring group treatment activities must be considered even though subjects were not receiving any attention to graphic output

in that treatment. Attending and processing behaviors were being addressed. The general influence of the group treatment may well have interacted with structured computer graphic emphasis resulting in enhanced listening and spelling performance. However, it was not within the scope of this study to control for the group treatment variable.

In constructing the program, an attempt was made to manipulate power and number relative to stimulus presentation and reinforcement schedule consistent with Response Contingent Small Step Treatment (Bollinger and Stout, 1976) principles. Ordinality was assumed. In the course of the treatment condition, it was observed that visual input (the card function) was a markedly stronger variable than word length, morpheme/grapheme relations or any of the other variables considered. All except subject number two consistently demonstrated difficulty when the graphic aspect of the card function was removed (Target II, Step 7). Many fewer errors were evidenced, for example, in Target IV, Step 1, in which new stimulus words were introduced. These words contained more complex morpheme/grapheme relations than the previous target (silent letters, non-modal spellings), but the graphic aspect of the card function was reinstated. Apparently, steps sufficiently small enough to enable phasing out of the visual input had not been established.

An especially favorable feature of the computer was that it allowed for response monitoring by the subjects. Subjects viewed the keys they pressed via the CRT screen and were able to self-correct perceived error responses prior to pushing the return bar.

An especially favorable feature of the computer was that it allowed for response monitoring by the subjects. Subjects viewed the keys they pressed via the CRT screen and were able to self-correct perceived error responses prior to pushing the return bar. It was noted that several subjects directed verbalizations to the CRT consistent with letter pushed and/or evaluation of correctness. Once the return bar was pressed, the subject received immediate notification of accuracy of response. At the completion of each step, performance feedback was provided in the form of a percentage score and in terms of number of correct responses. No provision was incorporated into the program to automatically backstep in the event that the subject did not meet criteria. This might have proved beneficial modification of the treatment paradigm.

More finite patterns of subject performance may have been observed if the number of subjects involved were larger and if more diagnostic classifications were represented within the population. The lack of intensity of treatment (one-half hour twice weekly for five weeks) would appear to be a significant contributory factor in the lack of strong directional patterns observed although three subjects did plateau.

With the research direction relative to the graphic output modality in the chronic aphasic population becoming increasingly structured, the implementation of a small-stepped computed-based treatment program are encouraging. The tentative results suggested by the present investigation show positive direction in

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With the research direction relative to the graphic output modality in the chronic aphasic population becoming increasingly structured, the implementation of a small-stepped computer-based treatment program is encouraging. The tentative results suggested by the present investigation show positive direction in that they add to the body of knowledge in aphasia treatment and point to a directive for management with an encouraging potential for effectiveness.

It may be that in the future, the aphasiologist will program the patient's computer for intensive self-treatment and utilize traditional management settings to emphasize pragmatic behavior in different contexts. As the patient moves farther in time from the onset of the aphasic disorder, the treatment may move more toward computer use and away from direct treatment.

There is probably no real question as to the efficacy of the personal computer as a treatment mode. Such a tool offers covert benefits to the patient, the aphasiologist, and the field. Treatment printouts will enable careful analysis of and responsiveness to patient performance. Data collected over time will enable hypothesis testing and treatment redesign. Development of computer based programs in aphasia treatment is becoming more commonplace. This period of time relative to aphasia management represents one of experimentation and reorientation. The aphasiologist in the future will have available greater demands and choices in treatment options.

APPENDIX A
CONSENT FORM

I, _____, consent to participate in the study, "The Effects of a Computer-Based Small-Step Intervention Program on the Graphic Output of Chronically Aphasic Adults." The information collected through the program may be used, though all identifying information concerning my spouse will be held in the strictest of confidence.

Signature of Subject

Signature of Spouse

APPENDIX B

CALL -151
x3000LLLLLLLLLLLL

3000 - 8C F0 B7	STY	\$B7F0	3035 - 18	CLC
3003 - AC C4 AA	LDY	\$AAC4	3036 - 60	RTS
3006 - 8C F1 B7	STY	\$B7F1	3037 - 20 45 B0	JSR \$B045
3009 - AE FA B5	LDX	\$B5FA	303A - AE 97 B3	LDX \$B397
300C - A0 00	LDY	#\$00	303D - AC 98 B3	LDY \$B398
300E - 4C 52 B0	JMP	\$B052	3040 - A9 02	LDA #\$02
3011 - 08	PHP		3042 - 4C 52 B0	JMP \$B052
3012 - 20 45 B0	JSR	\$B045	3045 - AD C5 AA	LDA \$AAC5
3015 - 28	PLP		3048 - 8D F0 B7	STA \$B7F0
3016 - B0 08	BCS	\$3020	304B - AD C6 AA	LDA \$AAC6
3018 - AC BD B3	LDY	\$B3BD	304E - 8D F1 B7	STA \$B7F1
301B - AE BC B3	LDY	\$B3BC	3051 - 60	RTS
301E - D0 0A	BNE	\$302A	3052 - 8E EC B7	STX \$B7EC
3020 - AE BC B4	LDX	\$B4BC	3055 - 8C ED B7	STY \$B7ED
3023 - D0 02	BNE	\$3027	3058 - 8D F4 B7	STA \$B7F4
3025 - 38	SEC		305B - C9 02	CMP #\$02
3026 - 60	RTS		305D - D0 06	BNE \$3065
3027 - AC BD B4	LDY	\$B4BD	305F - OD D5 B5	ORA \$B505
302A - 8E 97 B3	STX	\$B397	3062 - 8D D5 B5	STA \$B505
302D - 8C 98 B3	STY	\$B398	3065 - AD F9 B5	LDA \$B5F9
3030 - A9 01	LDA	#\$01	3068 - 49 FF	EDR \$FF
3032 - 20 52 B0	JSR	\$B052	306A - 8D EB B7	STA \$B7EB

306D - AD F7 B5	LDA	\$B5F7	30B0 - A0 08	LDY	#\$08
3070 - 8D E9 B7	STA	\$B7E9	30B2 - 98	TYA	
3073 - AD F8 B5	LDA	\$B5F8	30B3 - 4C 85 B3	JMP	\$B385
3076 - 8D EA B7	STA	\$B7EA	30B6 - AD E4 B5	LDA	\$B5E4
3079 - AD E2 85	LDA	\$B5E2	30B9 - CD E0 B5	CMP	\$B5E0
307C - 8D F2 B7	STA	\$B7F2	39BC - D0 08	BNE	\$30C6
307F - AD E3 B5	LDA	\$B5E3	30BE - AD E5 B5	LDA	\$B5E5
3082 - 8D F3 B7	STA	\$B7F3	30C1 - CD E1 B5	CMP	\$B5E1
3085 - A9 01	LDA	#\$01	30C4 - F0 66	BEQ	\$312C
3087 - BD EB B7	STA	\$B7E8	30C6 - 20 1D AF	JSR	\$AF1D
308A - AC C1 AA	LDY	\$AAC1	30C9 - AD E5 B5	LDA	\$B5E5
308D - AD C2 AA	LDA	\$AAC2	30CC - CD DD B5	CMP	\$B500
3090 - 20 B5 B7	JSR	\$B7B5	30CF - 90 1C	BCC	\$30ED
3093 - AD F6 B7	LDA	\$B7F6	30D1 - D0 08	BNE	\$30DB
3096 - 8D BF B5	STA	\$B5BF	30D3 - AD E4 B5	LDA	\$B5E4
3099 - A9 FF	LDA	#\$FF	30D6 - CD DC B5	CMP	\$B5DC
309B - 8D EB B7	STA	\$87EB	30D9 - 90 12	BCC	\$30ED
309E - B0 01	BCS	\$30A1	30DB - AD E5 B5	LDA	\$B5E5
30A0 - 60	RTS		30DE - CD DF B5	CMP	\$B5DF
30A1 - AD F5 B7	LDA	\$87F5	30E1 - 90 10	BCC	\$30F3
30A4 - A0 07	LDY	#\$07	30E3 - D0 08	BNE	\$30ED
30A6 - C9 20	CMP	#\$20	30E5 - AD E4 B5	LDA	\$B5E4
30A8 - F0 08	BEQ	\$30B2	30E8 - CD DE B5	CMP	\$B5DE
30AA - A0 04	LDY	#\$04	30EB - 90 06	BCC	\$30F3
30AC - C9 10	CMP	#\$10	30ED - 20 5E AF	JSR	\$AF5E
30AE - F0 02	BEQ	\$30B2	30F0 - 90 D7	BCC	\$30C9

316D - 8E BF B5 STX \$B5BF	31AA - 86 43 STX \$43
3170 8C CO B5 STY \$B5C0	31AC - EE C3 B5 INC \$B5C3
3173 - EB INX	31AF - DO 03 BNE \$31B4
3174 - DO 01 BNE \$3177	31B1 - EE C4 B5 INC \$B5C4
3176 - CB INY	31B4 - 60 RTS
3177 - CC E9 B5 CPY \$B5E9	31B5 - AC C1 B5 LDY \$B5C1
317A - DO 11 BNE \$318D	31B8 - DO 08 BNE \$31C2
317C - EC EB B5 CPX \$B5E8	31BA - AE C2 B5 LDX \$B5C2
317F - DO OC BNE \$318D	31BD - FO 07 BEQ \$31C6
3181 - A2 00 LDX #\$00	31BF - CE C2 B5 DEC \$B5C2
3183 - AO 00 LDY #\$00	31C2 - CE C1 B5 DEC \$B5C1
3185 - EE EA B5 INC \$B5EA	31C5 - 60 RTS
3188 - DO 03 BNE \$318D	31C6 - 4C 7F B3 JMP \$B37F
318A - EE EB B5 INC \$B5EB	31C9 - 20 F7 AF JSR \$AFF7
318D - 8E EC B5 STX \$B5EC	31CC - AD C3 B5 LDA \$B5C3
3190 - 8C ED B5 STY \$B5ED	31CF - 85 42 STA \$42
3193 - 60 RTS	31D1 - AD C4 B5 LDA \$B5C4
3194 - EE E6 B5 INC \$B5E6	31D4 - 85 43 STA \$3
3197 - DO 08 BNE \$31A1	31D6 - A9 01 LDA #\$01
3199 - EE E4 B5 INC \$B5E4	31D8 - 8D 9D B3 STA \$B39D
319C - DO 03 BNE \$31A1	31DB - A9 00 LDA #\$00
319E - EE E5 B5 INC \$B5E5	31DD - 8D D8 B5 STA \$B5D8
31A1 - 60 RTS	31EO - 18 CLC
31A2 - AC C3 B5 LDY \$B5C3	31E1 - EE D8 B5 INC \$B508
31A5 - AE C4 B5 LDX \$B5C4	31E4 - 20 11 B0 JSR \$B011
31A8 - 84 42 STY \$42	31E7 - B0 51 BCS \$323A

30F2 -	60	RTS		312C -	20 10 AF	JSR	\$A10
30F3 -	38	SEC		312F -	AC E6 B5	LDY	\$B5E6
30F4 -	AD E4 B5	LDA	\$B5E4	3132 -	18	CLC	
30F7 -	ED DC B5	SBC	\$B5DC	3133 -	60	RTS	
30FA -	OA	ASL		3134 -	8C 9D B3	STY	\$B39D
30FB -	69 OC ADC	#SOC		3137 -	20 44 B2	JSR	\$B244
30FD -	A8	TAY		313A -	AC 90 B3	LDY	\$B39D
30FE -	20 OC AF	JSR	\$AFOC	313D -	CB	INY	
3101 -	B1 42	LDA	(\$42),Y	313E -	91 42	STA	(\$42),Y
3103 -	DO OF	BNE	\$3114	3140 -	8D D7 B5	STA	(\$B507
3105 -	AD BB B5	LDA	\$B5BB	3143 -	88	DEY	
3108 -	C9 04	CMP	#S04	3144 -	AD F1 B5	LDA	\$B5F1
310A -	FO 02	BEQ	\$310E	3147 -	91 42	STA	(\$42),Y
310C -	38	SEC		3149 -	8D D6 B5	STA	\$B506
310D -	60	RTS		314C -	20 10 AF	JSR	\$AF10
310E -	20 34 B1	JSR	\$B134	314F -	20 D6 B7	JSR	\$B7D6
3111 -	4C 20 B1	JMP	\$B120	3152 -	A9 C0	LDA	#SCO
3114 -	8D D6 B5	STA	\$B5D6	3154 -	OD D5 B5	ORA	\$B505
3117 -	C8	INY		3157 -	8D D5 B5	STA	\$B505
3118 -	B1 42	LDA	(\$42),Y	315A -	60	RTS	
311A -	8D D7 B5	STA	\$B507	315B -	AE EA B5	LDX	\$B5EA
311D -	20 DC AF	JSR	\$AFDC	315E -	8E BD B5		\$B5BD
3120 -	AD E4 B5	LDA	\$B5E4	3161 -	AE EB B5	LDX	\$B5EB
3123 -	8D E0 B5	STA	\$B5E0	3164 -	8E BE B5	STX	\$B5BE
3126 -	AD E5 B5	LDA	\$B5E5	3167 -	AE EC B5	LDX	\$B5EC
3129 -	8D E1 B5	STA	\$B5E1	316A -	AC ED B5	LDY	\$B5ED

APPENDIX C

SMALL STEP GRAPHIC-OUTPUT PROGRAM

TARGET I - VISUAL - MOTOR MATCHING - LETTERS

(COPYING)

Stimuli:

Steps 1 - 4: A, S, M, E, N. C, R, W

Steps 4 - 5: T, P, I replace R, C, W

Steps 7 - 8: D, B, U replace M, S, A

Steps 9 -12: Random use of 8/10
previously introduced
letters.

- 1) Individual letters which will subsequently be included in context of CVC words for Target II.
- 2) Top half of frequency list from Weiss, Lillywhite, and Brown

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<u>Step 1 - Input Sequence</u>	1. A 2. S 3. M 4. E 5. N 6. C 7. R 8. W	Gestural-Subject types letter.	<u>If correct:</u> "YES" appears on CRT screen in conjunction with beep. Next stimuli presented. S-L-P says "Yes"	7/8 Pica 10 or above
<u>Visual</u> - <u>CRT Function</u>				
Letter shown, remains on screen four seconds. Blank appears.				
- <u>Card Function</u>			<u>If error:</u> "NO" appears* on CRT screen. S-L-P says "No"	
Remains throughout trial.				

*See paper for specific instances of program changes contingent upon subject errors.

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<u>Step 2 - same as Step 1</u> <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> Varied Order of Stimulus Presentation </div>	1. N 2. E 3. C 4. W 5. A 6. R 7. S 8. M	same as Step 1	same as Step 1	same as Step 1
<u>Step 3 - Input Sequence</u> <u>Auditory</u> - S-L-P names letter. Subsequently repeats letter. <u>Visual</u> - <u>CRT Function</u> Letter shown, remains on screen four seconds. Letter removed from screen. Blank appears. <u>Card Function</u> Remains throughout trial. <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> S-L-P does not point to correct key. </div>	1. S 2. W 3. N 4. R 5. A 6. M 7. E 8. C	same as Step 1	same as Step 1	same as Step 1

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<u>Step 4 - same as Step 3</u> <div>Varied Order of Presentation</div>	1. M 2. S 3. R 4. A 5. W 6. C 7. E 8. N	same as Step 1	same as Step 1	same as Step 1
<u>Step 5 - same as Step 1-3</u> <div>Stimulus Change: Remove: R, C, W Replace with: T, P, I</div>	1. A 2. T 3. S 4. P 5. C 6. I 7. N 8. E	same as Step 1	same as Step 1	same as Step 1
<u>Step 6 - same as Step 3</u> <div>Varied Order of Presentation</div>	1. I 2. S 3. C 4. N 5. E 6. T 7. A 8. P	same as Step 1	same as Step 1	same as Step 1
<u>Step 7 - same as Step 3</u> <div>Stimulus Change: Remove: M, S, A Replace with: D, B, U</div>	1. T 2. P 3. U 4. E 5. B 6. I 7. 8.	same as Step 1	same as Step 1	same as Step 1

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<u>Step 8 - same as Step 3</u> <div>Varied Order of Presentation</div>	1. B 2. E 3. N 4. I 5. T 6. D 7. U 8. P	same as Step 1	same as Step 1	same as Step 1
<u>Step 9 - same as Step 3</u> <div>Reintroduction of Previously Removed Letter - Random</div>	1. D 2. N 3. S 4. P 5. U 6. B 7. S 8. W	same as Step 1	same as Step 1	same as Step 1
<u>Step 10 - same as Step 3</u> <div>Varied Stimulus Letters</div>	1. R 2. A 3. C 4. I 5. T 6. D 7. U 8. M	same as Step 1	same as Step 1	same as Step 1
<u>Step 11 - same as Step 3</u> <div>Combination of Letters in CV Form</div>	1. MA 2. DI 3. TU 4. WE 5. NA 6. BE 7. SU 8. CA	same as Step 1	same as Step 1	same as Step 1

TARGET II - VISUAL - MOTOR MATCHING - CVC WORDS
(COPYING)

Stimuli:

Steps 1, 2: MAN, SUN, HAT, PIN
 BED, BUS, CUP, DOG
 Steps 3, 4: Remove MAN, BUS
 Replace with PEN, CAN
 Steps 5-10: Random use of eight/step

CVC Words (3 phonemes)
 1 : 1 phoneme : grapheme
 relation picturable nouns
 from Marshall Program

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<p><u>Step 1 - Input Sequence</u></p> <p><u>Auditory</u> - S-L-P names and spells word.</p> <p><u>Visual</u> - <u>Card Function</u> Picture and key word are presented.</p> <p><u>CRT Function</u> Word appears, one letter at a time. Completed word remains on screen four seconds. First two letters and one blank appear. Three blanks appear.</p> <p><u>Auditory</u> - S-L-P names and spells word a second time. Directs subject to type whole word.</p>	<p>1. MAN 2. SUN 3. HAT 4. PIN 5. BED 6. CUP 7. DOG 8. BUS</p>	<p>Gestural- Subject types word.</p>	<p>If <u>correct:</u> "YES" appears on CRT screen in con- junction with a beep. Next stimulus word is presented. S-L-P says "Yes"</p> <p>If error: "NO" appears* on CRT screen. S-L-P says "No"</p>	<p>Pica 10 or above</p>

*See paper for specific instances of program changes contingent upon subject errors.

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<u>Step 2 - same as Step 1</u> <div style="border: 1px solid black; padding: 10px; width: fit-content; margin: 10px auto;"> <div style="border: 1px solid black; padding: 5px; width: 80%;"> Varied Order of Presentation </div> </div>	1. CUP 2. HAT 3. SUN 4. BUS 5. MAN 6. PIN 7. BED 8. DOG	same as Step 1	same as Step 1	same as Step 1
<u>Step 3 - same as Step 1</u> <div style="border: 1px solid black; padding: 10px; width: fit-content; margin: 10px auto;"> <div style="border: 1px solid black; padding: 5px; width: 80%;"> Varied Order of Presentation </div> </div>	1. PEN 2. CAN 3. HAT 4. DOG 5. CUP 6. SUN 7. PIN 8. BED	same as Step 1	same as Step 1	same as Step 1
<u>Step 4 - same as Step 1</u> <div style="border: 1px solid black; padding: 10px; width: fit-content; margin: 10px auto;"> <div style="border: 1px solid black; padding: 5px; width: 80%;"> Varied Order of Presentation </div> </div>	1. DOG 2. CUP 3. PEN 4. BED 5. SUN 6. HAT 7. PIN 8. CAN	same as Step 1	same as Step 1	same as Step 1

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<p><u>Step 5 - Input Sequence</u></p> <p><u>Auditory</u> - S-L-P names and spells word.</p> <p><u>Visual</u> - <u>Card Function</u> Picture and key word are presented.</p> <p><u>CRT Function</u> Word appears, one letter at a time. Completed word remains on screen four seconds. Completed word removed from screen. First letter and two blanks appear. Three blanks appear.</p> <p><u>Auditory</u> - S-L-P names and spells word a second time.</p> <div style="border: 1px solid black; padding: 10px; margin-top: 20px;"> <p>One less letter appears. Varied order of 8 of 10 stimulus words.</p> </div>	<ol style="list-style-type: none"> 1. BED 2. HAT 3. BUS 4. DOG 5. SUN 6. PIN 7. CAN 8. CUP 	<p>same as Step 1</p>	<p>same as Step 1</p>	<p>same as Step 1</p>

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<p><u>Step 6 - Input Sequence</u></p> <p><u>Auditory</u> - S-L-P names and spells word.</p> <p><u>Visual</u> - <u>Card Function</u> Picture and key word are presented.</p> <p>- <u>CRT Function</u> Word appears, one letter at a time. Completed word remains on screen four seconds. Completed word is removed from screen. Three blanks appear.</p> <p><u>Auditory</u> - S-L-P names and spells word a second time.</p> <div style="border: 1px solid black; padding: 10px; margin-top: 20px;"> <p>One less blank appears. Varied order of 8/10 words.</p> </div>	<ol style="list-style-type: none"> 1. CAN 2. DOG 3. BUS 4. PEN 5. HAT 6. PIN 7. MAN 8. CUP 	<p>same as Step 1</p>	<p>same as Step 1</p>	<p>same as Step 1</p>

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<u>Step 7 - Input Sequence</u> <u>Auditory</u> - S-L-P names and spells word. <u>Visual</u> - <u>Card Function</u> Picture presented. - <u>CRT Function</u> Word appears, one letter at a time. Completed word remains on screen four seconds. Completed word removed from screen. First two letters and one blank appear. Three blanks appear. <u>Auditory</u> - S-L-P names and spells word a second time.	1. PEN 2. SUN 3. HAT 4. PIN 5. CUP 6. CAT 7. MAN 8. BED	same as Step 1	same as Step 1	same as Step 1
<div style="border: 1px solid black; padding: 10px; margin: 10px;"> <p>No key word presented w/picture from this point on. Varied order of 8/10 words.</p> </div>				

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
Step 8 - same as Step 5 <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> Varied Presentation Order of 8/10 Words One Less Blank </div>	1. HAT 2. PEN 3. BUS 4. CUP 5. MAN 6. CAT 7. CAN 8. PIN	same as Step 1	same as Step 1	same as Step 1
Step 9 - same as Step 6 <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> Varied Presentation Order of 8/10 Words </div>	1. CAT 2. BUS 3. PIN 4. BED 5. HAT 6. MAN 7. SUN 8. PEN	same as Step 1	same as Step 1	same as Step 1
<u>Step 10 - Input Sequence</u> <u>Auditory</u> - S-L-P names and spells word. <u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> Word appears, one letter at a time. Completed word remains on screen four seconds. Completed word removed from screen. Three blanks appear. <u>Auditory</u> - S-L-P names word. <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> Omit second spelling. Varied Order of Presentation of 8/10 words. </div>	1. HAT 2. MAN 3. PEN 4. CAT 5. PIN 6. BUS 7. CUP 8. CAN	same as Step 1	same as Step 1	same as Step 1
END OF TARGET II				

TARGET III - VISUAL - MOTOR SPELLING - CVC WORDS

(CLOZE)

Stimuli

For each step: 8/10 presentations of stimulus words from Target II

CAN, MAN, DOG, CUP, HAT

CUP, BUS, PEN, PIN, BED

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<p><u>Step 1 - Input Sequence</u></p> <p><u>Auditory</u> - S-L-P names and spells word.</p> <p><u>Visual</u> - <u>Card Function</u> Picture presented.</p> <p><u>CRT Function</u> First letter and two blanks appear on screen. Three blanks appear.</p> <p><u>Auditory</u> - S-L-P names word.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Word No Longer Appears on CRT Screen</p> </div>	<ol style="list-style-type: none"> 1. CAN 2. BUS 3. PEN 4. CUP 5. BED 6. PIN 7. MAN 8. HAT 	<p>Gestural-Subject types whole word.</p>	<p><u>If correct:</u> "YES" appears in conjunction with a beep. Next stimulus word is presented. S-L-P says "Yes"</p> <p><u>If error:*</u> "NO" appears on CRT Screen. S-L-P says "No"</p>	<p>7/8 Pica 10 or above</p>

*See paper for specific instances of program change contingent upon subject errors.

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<p><u>Step 2 - Input Sequence</u></p> <p><u>Auditory</u> - S-L-P names and spells word.</p> <p><u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> First letter and two blanks appear on screen. Three blanks appear.</p> <p><u>Auditory</u> - S-L-P names word.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;">Omit One Blank</div>	<p>1. PIN 2. BUS 3. DOG 4. CAN 5. CUP 6. SUN 7. HAT 8. BED</p>	<p>same as Step 1</p>	<p>same as Step 1</p>	<p>same as Step 1</p>
<p><u>Step 3 - Input Sequence</u></p> <p><u>Auditory</u> - S-L-P names and spells word.</p> <p><u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> Three blanks appear.</p> <p><u>Auditory</u> - S-L-P names word.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;">No Visual Graphemic Cues</div>	<p>1. DOG 2. PEN 3. CUP 4. BED 5. HAT 6. CAN 7. PIN 8. MAN</p>	<p>same as Step 1</p>	<p>same as Step 1</p>	<p>same as Step 1</p>

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<u>Step 4 - Input Sequence</u> <u>Auditory</u> - S-L-P says word. <u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> Three blanks appear. <u>Auditory</u> - S-L-P names word. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;">Omit S-L-P Spelling</div>	1. HAT 2. PIN 3. PEN 4. BUS 5. CAN 6. HAT 7. CUP 8. DOG	same as Step 1	same as Step 1	same as Step 1
<u>Step 5 - Input Sequence</u> <u>Auditory</u> - None <u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> Three blanks appear. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;">Omit Auditory Cue</div>	1. BUS 2. CUP 3. DOG 4. PEN 5. MAN 6. CAN 7. HAT 8. PIN	same as STEP 1	same as STEP 1	same as Step 1
END OF TARGET III				

TARGET IV - VISUAL - MOTOR MATCHING - WORDS

(COPYING)

Stimuli: Three-letter Words
Steps 1-3: TIE, SAW, BUG, LOG
 JAR, RUB, COW, BOY
Step 4: Remove BUG, SAW
 Replace with BEE, PIE
Step 5: Varied Order of Presentation
 of 8/10 words

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<u>Step 1 - Input Sequence</u> <u>Auditory</u> - S-L-P names and spells word. <u>Visual</u> - Card Function Picture and key word are presented. CRT Function Word appears one letter at a time. Completed word remains on screen four seconds. Completed word removed from screen. First two letters and one blank appear. Three blanks appear. <u>Auditory/Gestural</u> S-L-P names and spells word a second time. S-L-P points to correct keys.	1. TIE 2. SAW 3. BUG 4. LOG 5. JAR 6. RUG 7. COW 8. BOY	Gestural-Subject types words.	If <u>correct:</u> "YES" appears on CRT screen in conjunction with a beep. Next stimulus word is presented. S-L-P says "Yes" If <u>error:*</u> "NO" appears on CRT screen. S-L-P says "No"	7/8 Pica 10 or above

*See paper for specific instances of program changes contingent upon subject errors.

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<u>Step 2 - same as Step 1</u> <div style="border: 1px solid black; padding: 10px; width: fit-content; margin: 10px auto;"> <p>Varied Order of Presentation</p> </div>	1. COW 2. RUG 3. TIE 4. LOG 5. BOY 6. SAW 7. BUG 8. JAR	same as Step 1	same as Step 1	same as Step 1
<u>Step 3 - Input Sequence</u> Auditory - S-L-P names and spells word. Visual - <u>Card Function</u> Picture and key word presented. <u>CRT Function</u> Word appears, one letter at a time. Completed word remains on screen four seconds. Completed word removed from screen. First two letters and one blank appear. Three blanks appear. Auditory - S-L-P names and spells word a second time. <div style="border: 1px solid black; padding: 10px; width: fit-content; margin: 10px auto;"> <p>Omit Gestural Cue- -Pointing to Correct Key</p> </div>	1. COW 2. RUG 3. TIE 4. LOG 5. BOY 6. SAW 7. BUG 8. JAR	same as Step 1	same as Step 1	same as Step 1

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<u>Step 4 - same as Step 3</u> <div> Stimulus Change: Remove BUG, SAW Replace with BEE, PIE </div>	1. TIE 2. LOG 3. BEE 4. JAR 5. PIE 6. COW 7. RUG 8. BOY	same as Step 1	same as Step 1	same as Step 1
<u>Step 5 - same as Step 3</u> <div> Varied Order of Presentation of 8/10 Words From Now On </div>	1. COW 2. LOG 3. SAW 4. PIE 5. TIE 6. JAR 7. RUG 8. BEE	same as Step 1	same as Step 1	same as Step 1
<u>Step 6 - Input Sequence</u> <u>Auditory</u> - S-L-P names and spells word. <u>Visual</u> - <u>Card Function</u> Picture and key word presented. <u>CRT Function</u> Word appears, one letter at a time. Completed word removed from screen. First letter and two blanks appear. Three blanks appear. <u>Auditory</u> - S-L-P names and spells word a second time. <div>Omit One Letter on CRT</div>	1. BEE 2. JAR 3. COW 4. PIE 5. LOG 6. BOY 7. TIE 8. SAW	same as Step 1	same as Step 1	same as Step 1

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<p><u>Step 7 - Input Sequence</u></p> <p><u>Auditory</u> - S-L-P names and spells word.</p> <p><u>Visual</u> - <u>Card Function</u> Picture and key word presented.</p> <p><u>CRT Function</u> Word appears, one letter at a time. Completed word remains on screen four seconds. Completed word removed from screen. Three blanks appear.</p> <p><u>Auditory</u> - S-L-P names and spells word a second time.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;">One Less Blank Appears</div>	<p>1. BOY</p> <p>2. JAR</p> <p>3. SAW</p> <p>4. TIE</p> <p>5. LOG</p> <p>6. COW</p> <p>7. BEE</p> <p>8. RUG</p>	<p>same</p> <p>as</p> <p>Step 1</p>	<p>same</p> <p>as</p> <p>Step 1</p>	<p>same</p> <p>as</p> <p>Step 1</p>

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<p><u>Step 8 - Input Sequence</u></p> <p><u>Auditory</u> - S-L-P names and spells word.</p> <p><u>Visual</u> - <u>Card Function</u> Picture presented.</p> <p><u>CRT Function</u> Word appears, one letter at a time. Completed word remains on screen four seconds. Completed word removed. Three blanks appear.</p> <p><u>Auditory</u> - S-L-P names and spells word a second time.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Omit Key Word Presentation From This Point On</p> </div>	<p>1. BEE</p> <p>2. BOY</p> <p>3. TIE</p> <p>4. RUG</p> <p>5. SAW</p> <p>6. LOG</p> <p>7. PIE</p> <p>8. JAR</p>	<p>same</p> <p>as</p> <p>Step 1</p>	<p>same</p> <p>as</p> <p>Step 1</p>	<p>same</p> <p>as</p> <p>Step 1</p>
<p><u>Step 9 - same as Step 8</u></p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Varied Order of Presentation</p> </div>	<p>1. SAW</p> <p>2. TIE</p> <p>3. BEE</p> <p>4. LOG</p> <p>5. BUG</p> <p>6. JAR</p> <p>7. COW</p> <p>8. PIE</p>	<p>same</p> <p>as</p> <p>Step 1</p>	<p>same</p> <p>as</p> <p>Step 1</p>	<p>same</p> <p>as</p> <p>Step 1</p>

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<p><u>Step 10 - Input Sequence</u></p> <p><u>Auditory</u> - S-L-P names and spells word.</p> <p><u>Visual</u> - <u>Card Function</u> Picture presented.</p> <p><u>CRT Function</u> Word appears, one letter at a time. Completed word remains on screen four seconds. Completed word removed from screen. Three blanks appear.</p> <p><u>Auditory</u> - S-L-P names word.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <div style="border: 1px solid black; padding: 2px; display: inline-block;">Omit Second Spelling</div> </div>	<ol style="list-style-type: none"> 1. BEE 2. TIE 3. LOG 4. JAR 5. BOY 6. SAW 7. RUG 8. PIE 	<p>same as Step 1</p>	<p>same as Step 1</p>	<p>same as Step 1</p>
END OF TARGET IV				

TARGET V

VISUAL - MOTOR SPELLING
(CLOZE)

Stimuli

For Each Step: 8/10 Presentations of Stimulus Words
From Target IV

TIE, SAW, BUG, LOG, JAR, RUG, COW, BOY, BEE, PIE

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<u>Step 1</u> <u>Auditory</u> - S-L-P names and spells words <u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> First two letters and one blank appear on screen. Three blanks appear. <u>Auditory</u> - S-L-P names word.	1. JAR 2. LOG 3. TIE 4. RUG 5. SAW 6. COW 7. BEE 8. PIE	Gestural- Subject types whole word.	<u>If correct:</u> "YES" appears on CRT screen in con- junction with beep. Next stimulus word is presented. S-L-P says "Yes" <u>If error: *</u> "NO" appears on CRT screen.	7/8 Pica 10 or above
<div style="border: 1px solid black; padding: 5px; width: fit-content;"> Words No Longer Appear on CRT Screen </div>				

*See paper for special instances of program change contingent upon subject errors.

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<u>Step 2 - Input Sequence</u> <u>Auditory</u> - S-L-P names and spells word. <u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> First letter and two blanks appear on screen. Three blanks appear. <u>Auditory</u> - S-L-P names word. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;">Omit One Blank</div>	1. BUG 2. LOG 3. COW 4. BEE 5. JAR 6. SAW 7. BOY 8. TIE	same as Step 1	same as Step 1	same as Step 1
<u>Step 3 - Input Sequence</u> <u>Auditory</u> - S-L-P names and spells word. <u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> Three blanks appear. <u>Auditory</u> - S-L-P names word. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;">No Visual Graphemic Cues</div>	1. BEE 2. LOG 3. SAW 4. TIE 5. JAR 6. BOY 7. PIE 8. BUG	same as Step 1	same as Step 1	same as Step 1

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<u>Step 4 - Input Sequence</u> <u>Auditory</u> - S-L-P names word. <u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> Three blanks appear. <u>Auditory</u> - S-L-P names word. <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;">Omit S-L-P Spelling</div>	1. PIE 2. SAW 3. BUG 4. TIE 5. RUG 6. COW 7. LOG 8. BOY	same as Step 1	same as Step 1	same as Step 1
<u>Step 5 - Input Sequence</u> <u>Auditory</u> - None. <u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> Three blanks appear. <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;">Omit Auditory Cue</div>	1. LOG 2. BOY 3. COW 4. RUG 5. TIE 6. BUG 7. SAW 8. PIE	same as Step 1	same as Step 1	same as Step 1
END OF TARGET V				

TARGET VI - VISUAL - MOTOR MATCHING - CVCC WORDS
(COPYING)

Stimuli	CVCC Words (4 phonemes)
Steps 1, 2: HAND, GIRL, DESK, MILK	Picturable nouns from
SALT, CORN, BIRD, BOWL	Marshall Program
Steps 3, 4: Omit CORN, DESK	
Replace with NEST, LAMP	
Step 5: Random use of 8/10 per Step	

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<u>Step 1 - Input Sequence</u> <u>Auditory</u> - S-L-P names and spells word. <u>Visual</u> - <u>Card Function</u> Picture and key word presented. <u>CRT Function</u> Word appears on CRT screen one letter at a time. Completed word remains on CRT four seconds. Completed words removed. First three letters and one blank appear. <u>Auditory</u> - S-L-P names and spells word second time.	1. HAND 2. GIRL 3. DESK 4. MILK 5. BOWL 6. SALT 7. BIRD 8. CORN	Gestural- Subject types whole word.	same as Step 1	same as Step 1

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<u>Step 2 - same as Step 1</u> <div>Varied Order of Presentation</div>	1. BIRD 2. SALT 3. CORN 4. HAND 5. GIRL 6. DESK 7. BOWL 8. MILK	same as	same as	same as
<u>Step 3 - same as Step 1</u> <div> Stimulus Change Remove CORN, DESK Replace with NEST, LAMP. </div>	1. BOWL 2. NEST 3. SALT 4. MILK 5. BIRD 6. HAND 7. GIRL 8. CORN	same as Step 1	same as Step 1	same as Step 1
<u>Step 4 - same as Step 1</u> <div>Varied Presentation Order</div>	1. CORN 2. NEST 3. GIRL 4. SALT 5. BOWL 6. MILK 7. HAND 8. BIRD	same as Step 1	same as Step 1	same as Step 1

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<p><u>Step 5 - Input Sequence</u></p> <p><u>Auditory</u> - S-L-P names and spells word.</p> <p><u>Visual</u> - <u>Card Function</u> Picture and key word presented.</p> <p><u>CRT Function</u> Word appears, one letter at a time. Completed word remains on screen four seconds. Completed word removed from screen. First two letters and two blanks appear.</p> <p><u>Auditory</u> - S-L-P names and spells word a second time.</p> <div style="border: 1px solid black; padding: 10px; margin-top: 20px;"> <p>1. Omit One Letter Cue on CRT.</p> <p>2. Varied Order of Presentation of 8/10 Words From This Point On.</p> </div>	<p>1. CORN</p> <p>2. BIRD</p> <p>3. DESK</p> <p>4. HAND</p> <p>5. BOWL</p> <p>6. GIRL</p> <p>7. NEST</p> <p>8. MILK</p>	<p>same</p> <p>as</p> <p>Step 1</p>	<p>same</p> <p>as</p> <p>Step 1</p>	<p>same</p> <p>as</p> <p>Step 1</p>

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<p><u>Step 6 - Input Sequence</u></p> <p><u>Auditory</u> - S-L-P names and and spells word.</p> <p><u>Visual</u> - <u>Card Function</u> Picture and key word presented.</p> <p><u>CRT Function</u> - Word appears, one letter at a time. Completed word remains on screen four seconds. Completed word removed from screen. First letter and three blanks appear. Four blanks appear.</p> <p><u>Auditory</u> - S-L-P names and spells word a second time.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 20px;"> <div style="border: 1px solid black; padding: 2px; display: inline-block;">Omit One Letter Cue</div> </div>	<p>1. LAMP</p> <p>2. DESK</p> <p>3. HAND</p> <p>4. GIRL</p> <p>5. MILK</p> <p>6. CORN</p> <p>7. BIRD</p> <p>8. NEST</p>	<p>same</p> <p>as</p> <p>Step 1</p>	<p>same</p> <p>as</p> <p>Step 1</p>	<p>same</p> <p>as</p> <p>Step 1</p>

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<u>Step 7 - Input Sequence</u>				
<u>Auditory</u> - S-L-P names and spells word.	1. MILK 2. CORN 3. DESK 4. BOWL 5. NEST	same as Step 1	same as Step 1	same as Step 1
<u>Visual</u> - <u>Card Function</u> Picture and key word presented.	6. GIRL 7. SALT 8. BIRD			
<u>CRT Function</u> Word appears, one letter at a time. Completed word remains on screen for four seconds. Completed word removed. Four blanks appear.				
<u>Auditory</u> - S-L-P names and spells word a second time.				
<div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <div style="border: 1px solid black; padding: 2px 10px; display: inline-block;">Omit One Letter Cue</div> </div>				

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<p><u>Step 8 - Input Sequence</u></p> <p><u>Auditory</u> - S-L-P names and spells word.</p> <p><u>Visual</u> - <u>Card Function</u> Picture presented.</p> <p><u>CRT Function</u> Word appears, one letter at a time. Completed word remains on screen four seconds. Completed word removed. Four blanks appear.</p> <p><u>Auditory</u> - S-L-P names and spells word a second time.</p> <div style="border: 1px solid black; padding: 10px; margin-top: 20px;"> <p>Omit Key Word Presentation With Picture</p> </div>	<p>1. CORN</p> <p>2. NEST</p> <p>3. GIRL</p> <p>4. HAND</p> <p>5. BOWL</p> <p>6. LAMP</p> <p>7. MILK</p> <p>8. SALT</p>	<p>same as Step 1</p>	<p>same as Step 1</p>	<p>same as Step 1</p>
END OF TARGET VI				

TARGET VII - VISUAL - MOTOR SPELLING - CVCC WORDS
(CLOZE)

Stimuli

For each Step: 8/10 Presentations of Stimulus Words
From Target VI
HAND, GIRL, DESK, MILK, NEST
SALT, CORN, BOWL, LAMP, MILK

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<u>Step 1 - Input Sequence</u> <u>Auditory</u> - S-L-P names and spells word. <u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> Four blanks appear. <u>Auditory</u> - S-L-P names word.	1. MILK 2. NEST 3. HAND 4. LAMP 5. BOWL 6. BIRD 7. SALT 8. GIRL	Same	Same	Same
<div style="border: 1px solid black; padding: 5px; width: fit-content;"> Word No Longer Appears on CRT Screen </div>				

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<u>Step 2 - Input Sequence</u> <u>Auditory</u> - S-L-P names word. <u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> Four blanks appear. <u>Auditory</u> - S-L-P names word. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;">Omit S-L-P Spelling</div>	1. SALT 2. GIRL 3. LAMP 4. BOWL 5. NEST 6. MILK 7. DESK 8. BIRD	same as Step 1	same as Step 1	same as Step 1
<u>Step 3 - Input Sequence</u> <u>Auditory</u> - None <u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> Four blanks appear. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;">Omit Auditory Cue</div>	1. NEST 2. HAND 3. GIRL 4. SALT 5. CORN 6. BOWL 7. LAMP 8. DESK	same as Step 1	same as Step 1	same as Step 1
END OF TARGET VII				

TARGET VIII - VISUAL - MOTOR MATCHING - SILENT "E"
 (COPYING) FOUR-LETTER WORDS

Stimuli:

All Steps: NOSE, LAKE, GATE, PIPE
 CAKE, DIME, VASE, RAKE

Varied Order

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<u>Step 1 - Input Sequence</u>				
<u>Auditory</u> - S-L-P names and spells word.	1. CAKE 2. VASE 3. RAKE 4. PIPE 5. GATE 6. LAKE 7. NOSE 8. Dine	Gestural- Subject types word.	same as Step 1	same as Step 1
<u>Visual</u> - Card Function Picture and key word presented.				
<u>CRT Function</u> Word appears, one letter at a time. Completed word remains on CRT screen four seconds. Completed word removed. First three letters and one blank appear. Four blanks presented.				
<u>Auditory</u> - S-L-P names and spells word a second time.				

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<p>Step 2 - same as Step 1</p> <div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> <p>Varied Order of of Presentation</p> </div>	1. NOSE 2. DIME 3. GATE 4. PIPE 5. CAKE 7. VASE 8. RAKE	same as Step 1	same as Step 1	same as Step 1
<p>Step 3 - Input Sequence</p> <p><u>Auditory</u> - S-L-P names and spells word.</p> <p><u>Visual</u> - <u>Card Function</u> Picture and key word presented.</p> <p><u>CRT Function</u> Word appears, one letter at a time. Completed word remains on screen four seconds. Completed word removed from screen. First two letters and two blanks appear. Four blanks appear.</p> <p><u>Auditory</u> - S-L-P names and spells word a second time.</p> <div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> <p>Omit One Letter Cue</p> </div>	1. RAKE 2. GATE 3. NOSE 4. DIME 5. LAKE 6. PIPE 7. CAKE 8. VASE	same as Step 1	same as Step 1	same as Step 1

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<u>Step 4 - Input Sequence</u>				
<u>Auditory</u> - S-L-P names and spells word.	1. DIME 2. VASE 3. LAKE 4. GATE 5. RAKE	same as Step 1	same as Step 1	same as Step 1
<u>Visual</u> - <u>Card Function</u> Picture and key word presented.	6. NOSE 7. PIPE 8. CAKE			
<u>CRT Function</u> Word appears, one letter at a time. Completed word remains on screen four seconds. Completed word removed. First letter and and three blanks appear. Four blanks appear.				
<u>Auditory</u> - S-L-P names and spells word a second time.				
<div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> <div style="border: 1px solid black; padding: 5px; display: inline-block;">Omit One Letter Cue</div> </div>				

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<u>Step 5 - Input Sequence</u>				
<u>Auditory</u> - S-L-P names and spells word.	1. PIPE 2. CAKE 3. LAKE 4. VASE 5. DIME	same as Step 1	same as Step 1	same as Step 1
<u>Visual</u> - <u>Card Function</u> Picture and key word presented.	6. GATE 7. NOSE 8. RAKE			
<u>CRT Function</u> Word appears, one letter at a time. Completed word remains four seconds. Completed word removed. Four blanks appear.				
<u>Auditory</u> - S-L-P names and spells word a second time.				
<div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <div style="border: 1px solid black; padding: 2px 10px; display: inline-block;">Omit One Letter Cue</div> </div>				

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<p><u>Step 6 - Input Sequence</u></p> <p><u>Auditory</u> - S-L-P names and spells word.</p> <p><u>Visual</u> - <u>Card Function</u> Picture presented.</p> <p><u>CRT Function</u> Word appears, one letter at a time. Completed word remains on screen four seconds. Completed word removed. Four blanks appear.</p> <p><u>Auditory</u> - S-L-P names and spells word a second time.</p> <div style="border: 1px solid black; padding: 10px; margin: 10px 0;"> <div style="border: 1px solid black; padding: 5px; display: inline-block;"> Omit Key Word Presentation </div> </div>	1. VASE 2. CAKE 3. NOSE 4. RAKE 5. LAKE 6. DIME 7. GATE 8. PIPE	same as Step 1	same as Step 1	same as Step 1
END OF TARGET VIII				

TARGET IX - VISUAL - MOTOR SPELLING - "SILENT E"

(Cloze)

FOUR LETTERS

Stimuli:

For each Step: Same Word List as Target VIII
 NOSE, LAKE, GATE, PIPE,
 CAKE, DIME, VASE, RAKE

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<u>Step 1 - Input Sequence</u> <u>Auditory</u> - S-L-P names and spells word. <u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> Four blanks appear. <u>Auditory</u> - S-L-P names word.	1. LAKE 2. VASE 3. DIME 4. CAKE 5. NOSE 6. PIPE 7. RAKE 8. GATE			
<div style="border: 1px solid black; padding: 5px; width: fit-content;"> Words No Longer Appear on CRT Screen </div>				

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<u>Step 2 - Input Sequence</u> <u>Auditory</u> - S-L-P names word. <u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> Four blanks appear. <u>Auditory</u> - S-L-P names word. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <div style="border: 1px solid black; padding: 2px; display: inline-block;">Omit S-L-P Spelling</div> </div>	1. PIPE 2. VASE 3. NOSE 4. CAKE 5. DIME 6. GATE 7. RAKE 8. LAKE	same as Step 1	same as Step 1	same as Step 1
<u>Step 3 - Input Sequence</u> <u>Auditory</u> - None <u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> Four blanks appear. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <div style="border: 1px solid black; padding: 2px; display: inline-block;">Omit Auditory Cue</div> </div>	1. LAKE 2. VASE 3. DIME 4. CAKE 5. NOSE 6. PIPE 7. RAKE 8. GATE	same as Step 1	same as Step 1	same as Step 1
END OF TARGET IX				

TARGET X - VISUAL - MOTOR MATCHING - CVCC
(COPYING)

Stimuli:

- Step 1: HEAD, BOAT, RAIN, BEAR, SOAP, COAT, SOUP, PAIL
 Step 2: Remove BOAT, RAIN
 Replace with LEAF, NAIL
 Step 3: Varied Presentation of 8/10 Words.

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<u>Step 1 - Input Sequence</u> <u>Auditory</u> - S-L-P names and spells word. <u>Visual</u> - <u>Card Function</u> Picture and key word presented. <u>CRT Function</u> Word appears, one letter at a time. Completed word remains on CRT four seconds. Completed word removed. First three letters and one blank appear. Four blanks appear. <u>Auditory</u> - S-L-P names and spells Word A second time.	1. HEAD 2. BOAT 3. RAIN 4. BEAR 5. SOAP 6. COAT 7. SOUP 8. PAIL	same as Step 1	same as Step 1	same as Step 1

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<u>Step 2 - same as Step 1</u> <div> Stimulus Change: Omit BOAT, RAIN. Replace with LEAF, NAIL. </div>	1. PAIL 2. SOAP 3. COAT 4. HEAD 5. NAIL 6. SOUP 7. LEAF 8. BEAR	same as Step 1	same as Step 1	same as Step 1
<u>Step 3 - same as Step 1</u> <div> Varied Presentation Order of 8/10 Words </div>	1. BOAT 2. HEAD 3. RAIN 4. LEAF 5. PAIL 6. SOAP 7. BEAR 8. COAT	same as Step 1	same as Step 1	same as Step 1
<u>Step 4 - Input Sequence</u> <u>Auditory</u> - S-L-P names and spells word. <u>Visual</u> - <u>Card Function</u> Picture and word presented. <u>CRT Function</u> Word appears, one letter at a time. Completed word remains four seconds. Completed word removed. First two letters and two blanks appear. Four blanks appear. <u>Auditory</u> - S-L-P names and spells word a second time. <div>Omit One Letter Cue</div>	1. BEAR 2. SOAP 3. RAIN 4. HEAD 5. COAT 6. BOAT 7. NAIL 8. PAIL	same as Step 1	same as Step 1	same as Step 1

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<u>Step 5 - Input Sequence</u>				
Auditory - S-L-P names and spells word.	1. COAT	same as Step 1	same as Step 1	same as Step 1
	2. RAIN			
Visual - <u>Card Function</u> Picture and word presented. <u>CRT Function</u> Word appears, one letter at a time. Completed word remains on screen four seconds. Completed word removed. First letter and three blanks appear. Four blanks presented.	3. SOAP			
	4. HEAD			
	5. LEAF			
	6. BOAT			
	7. PAIL			
	8. SOUP			
Auditory - S-L-P names and spells word a second time.				
<div style="border: 1px solid black; padding: 5px; display: inline-block;"> <div style="border: 1px solid black; padding: 2px; display: inline-block;">Omit One Letter Cue</div> </div>				

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<u>Step 6 - Input Sequence</u>				
<u>Auditory</u> - S-L-P names and spells word.	1. BOAT 2. SOAP 3. COAT 4. LEAF 5. NAIL 6. SOUP 7. PAIL 8. BEAR	same as Step 1	same as Step 1	same as Step 1
<u>Visual</u> - <u>Card Function</u> Picture and key word presented. <u>CRT Function</u> Word appears, one letter at a time. Completed word remains on screen four seconds. Completed word removed. First letter and three blanks appear. Four blanks presented.				
<u>Auditory</u> - S-L-P names and spells word a second time.				
<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> <div style="border: 1px solid black; padding: 2px 10px;">Omit One Letter Cue</div> </div>				

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<u>Step 7 - Input Sequence</u>				
<u>Auditory</u> - S-L-P names and spells word.	1. RAIN 2. SOUP 3. LEAF 4. BOAT 5. NAIL 6. SOAP 7. BEAR 8. PAIL	same as Step 1	same as Step 1	same as Step 1
<u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> Word appears, one letter at a time. Completed word remains four seconds. Completed word removed. Four blanks appear.				
<u>Auditory</u> - S-L-P names and spells word a second time.				
<div style="border: 1px solid black; padding: 5px; display: inline-block;">Omit Key Word Presentation</div>				
END OF TARGET X				

TARGET XI

VISUAL - MOTOR SPELLING

(CLOZE)

Stimuli:

For each Presentation, 8/10 Words From Target X.

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<u>Step 1 - Input Sequence</u>				
<u>Auditory</u> - S-L-P names	1. SOUP 2. LEAF 3. PAIL 4. COAT 5. HEAD 6. RAIN 7. BOAT 8. BEAR 9. NAIL	same as Step 1	same as Step 1	same as Step 1
<u>Visual</u> - <u>Card Function</u> Picture presented.				
<u>CRT Function</u> Four blanks appear.				
<u>Auditory</u> - S-L-P names word.				
<div>Word No Longer Appears on CRT Screen</div>				

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<u>Step 2 - Input Sequence</u>				
<u>Auditory</u> - S-L-P names word.	1. COAT 2. LEAF 3. PAIL 4. SOAP	same as Step 1	same as Step 1	same as Step 1
<u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> Four blanks appear.	5. BOAT 6. BEAR 7. RAIN 8. HEAD			
<u>Auditory</u> - S-L-P names word.				
Omit S-L-P Spelling				
<u>Step 3 - Input Sequence</u>				
<u>Auditory</u> - None	1. SOAP 2. HEAD 3. BOAT 4. BEAR	same as Step 1	same as Step 1	same as Step 1
<u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> Four blanks appear.	5. SOUP 6. RAIN 7. NAIL 8. LEAF			
Omit Auditory Cue				
END OF TARGET XI				

TARGET XII - VISUAL - MOTOR MATCHING - FIVE-LETTER
(COPYING)

Stimuli:

- Step 1: TRAIN, CHAIR, CHAIN, SHEET
SHOES, CLOUD, SHEEP, STOVE
- Step 2: Remove CHAIN, SHEET
Replace with STEAK, SPOON
- Step 3: Remove CLOUD, TRAIN
Replace with SHIRT, BROOM
- Step 4-7: Varied Order of Presentation of 8/12 Words.

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<u>Step 1 - Input Sequence</u>	1. TRAIN	same	same	same
<u>Auditory</u> - S-L-P names and spells word.	2. SHEET	as	as	as
	3. STOVE	Step 1	Step 1	Step 1
	4. SHOES			
	5. CLOUD			
<u>Visual</u> - <u>Card Function</u>	6. CHAIR			
Picture and key word presented.	7. SHEEP			
<u>CRT Function</u>	8. CHAIN			
Word appears, one letter at a time.				
Completed word remains four seconds.				
First four letters and one blank presented.				
Five blanks appear.				
<u>Auditory</u> - S-L-P names and spells word a second time.				

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<u>Step 2 - same as Step 1</u> <div> Stimulus Change: 1. Omit CHAIN, SHEET 2. Replace with STEAK, SPOON </div>	1. CLOUD 2. SHOES 3. TRAIN 4. SPOON 5. STEAK 6. STOVE 7. SHEEP 8. CHAIR	same as Step 1	same as Step 1	same as Step 1
<u>Step 3 - same as Step 1</u> <div> Stimulus Change: 1. Omit CLOUD, CHAIN 2. Replace with SHIRT, BROOM </div>	1. STEAK 2. SHIRT 3. STOVE 4. SHEEP 5. BROOM 6. CHAIR 7. TRAIN 8. SHOES	same as Step 1	same as Step 1	same as Step 1
<u>Step 4 - same as Step 1</u> <div> Varied Presentation Order of 8/12 Words </div>	1. CHAIR 2. SPOON 3. CLOUD 4. SHEET 5. TRAIN 6. STEAK 7. CHAIN 8. SHOES	same as Step 1	same as Step 1	same as Step 1

Method of Presentation	Stimulus Order	Response	Contin-gency	Cri-terion
<p><u>Step 5 - Input Sequence</u></p> <p><u>Auditory</u> - S-L-P names and spells word.</p> <p><u>Visual</u> - <u>Card Function</u> Picture and key word presented.</p> <p><u>CRT Function</u> Word appears, one letter at a time. Completed word remains on screen four seconds. Completed word removed. Five blanks presented.</p> <p><u>Auditory</u> - S-L-P names and spells word a second time.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <div style="border: 1px solid black; padding: 2px; display: inline-block;">Omit Letter Cues</div> </div>	<ol style="list-style-type: none"> 1. STOVE 2. CHAIR 3. STEAK 4. SHEET 5. CHAIN 6. SPOON 7. CLOUD 8. SHEEP 	<p>same as Step 1</p>	<p>same as Step 1</p>	<p>same as Step 1</p>
<p><u>Step 6 - same as Step 5</u></p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <div style="border: 1px solid black; padding: 2px; display: inline-block;">Varied Presentation</div> </div>	<ol style="list-style-type: none"> 1. CLOUD 2. TRAIN 3. SPOON 4. CHAIN 5. SHEEP 6. STEAK 7. CHAIR 8. SHOES 	<p>same as Step 1</p>	<p>same as Step 1</p>	<p>same as Step 1</p>

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<u>Step 7 - Input Sequence</u>				
<u>Auditory</u> - S-L-P names and spells word.	1. STEAK 2. SHOES 3. CHAIN 4. STOVE 5. CHAIR	same as Step 1	same as Step 1	same as Step 1
<u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> Word appears, one letter at a time. Completed word remains on screen four seconds. Completed word removed. Five blanks appear.	6. TRAIN 7. CLOUD 8. SPOON			
<u>Auditory</u> - S-L-P names and spells word a second time.				
<div style="border: 1px solid black; padding: 10px; width: fit-content; margin: 10px auto;"> Omit Key Word Presentation </div>				
END OF TARGET XII				

TARGET XIII

VISUAL - MOTOR SPELLING

(CLOZE)

Stimuli:

For each Presentation, 8/12 Words from Preceding Target

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
Step 1 - Input Sequence	1. STOVE	same	same	same
<u>Auditory</u> - S-L-P names and spells word.	2. SPOON	as	as	as
	3. SHEET	Step 1	Step 1	Step 1
	4. STEAK			
	5. CHAIR			
<u>Visual</u> - <u>Card Function</u> Picture presented.	6. SHOES			
	7. CHAIN			
	8. TRAIN			
- <u>CRT Function</u> Five blanks appear.				
<u>Auditory</u> - S-L-P names word.				
<div>Word No Longer Appears on CRT Screen</div>				

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<u>Step 2 - Input Sequence</u> <u>Auditory</u> - S-L-P names and spells word. <u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> Five blanks appear. <u>Auditory</u> - S-L-P names word. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;">Omit S-L-P Spelling</div>	1. STEAK 2. STOVE 3. TRAIN 4. SHEET 5. SHOES 6. CHAIR 7. TRAIN 8. SHEEP	same as Step 1	same as Step 1	same as Step 1
<u>Step 3 - Input Sequence</u> <u>Auditory</u> - None <u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> Five blanks appear. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;">Omit Auditory Cue</div>	1. SPOON 2. CHAIR 3. TRAIN 4. STEAK 5. STOVE 6. SHEEP 7. CLOUD 8. TRAIN	same as Step 1	same as Step 1	same as Step 1
END OF TARGET XIII				

TARGET XIV - VISUAL - MOTOR MATCHING - FIVE-LETTER WORDS
(COPYING) "SILENT E"

Stimuli:

Steps 1-3: Varied Presentation Order
HOUSE, HORSE, PLANE, FENCE, SLIDE,
PURSE, NURSE, WHALE

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<u>Step 1 - Input Sequence</u>	1. HOUSE	same	same	same
<u>Auditory</u> - S-L-P names and spells word.	2. SLIDE	as	as	as
	3. WHALE	Step 1	Step 1	Step 1
<u>Visual</u> <u>Card Function</u> Picture and key word presented.	4. PURSE			
<u>CRT Function</u> Word appears, one letter at a time. Completed word remains four seconds. Completed word removed. Five blanks appear.	5. HORSE			
	6. FENCE			
	7. PLANE			
	8. NURSE			
<u>Auditory</u> - S-L-P names and spells word a second time.				

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<p><u>Step 2 - same as Step 1</u></p> <div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> <p>Varied Presentation Order</p> </div>	<ol style="list-style-type: none"> 1. SLIDE 2. NURSE 3. FENCE 4. PLANE 5. HORSE 6. PURSE 7. HOUSE 8. WHALE 	<p>same as Step 1</p>	<p>same as Step 1</p>	<p>same as Step 1</p>
<p><u>Step 3 - Input Sequence</u></p> <p><u>Auditory</u> - S-L-P names and spells word.</p> <p><u>Visual</u> - <u>Card Function</u> Picture presented.</p> <p><u>CRT Function</u> Word appears, one letter at a time. Completed word remains on screen four seconds. Completed word removed. Five blanks appear.</p> <p><u>Auditory</u> - S-L-P names and spells word a second time.</p> <div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> <p>Omit Key Word Presentation</p> </div>	<ol style="list-style-type: none"> 1. PLANE 2. HORSE 3. WHALE 4. SLIDE 5. FENCE 6. PURSE 7. HOUSE 8. NURSE 	<p>same as Step 1</p>	<p>same as Step 1</p>	<p>same as Step 1</p>
END OF TARGET XIV				

TARGET XV

VISUAL - MOTOR SPELLING

(Cloze)

Stimuli:

All Steps

Varied Presentation Order of Stimulus Words from Target XIV

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<u>Step 1 - Input Sequence</u> <u>Auditory</u> - S-L-P names and spells word. <u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> Five blanks presented. <u>Auditory</u> - S-L-P names word.	1. HORSE 2. PLANE 3. NURSE 4. WHALE 5. PURSE 6. SLIDE 7. HOUSE 8. FENCE	same as Step 1	same as Step 1	same as Step 1
<div>Word No Longer Appears on CRT Screen</div>				

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<u>Step 2 - same as Step 1</u> <div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> <div style="border: 1px solid black; padding: 5px; text-align: center;"> Varied Presentation Order </div> </div>	1. NURSE 2. HOUSE 3. FENCE 4. PURSE 5. PLANE 6. HORSE 7. WHALE 8. SLIDE	same as Step 1	same as Step 1	same as Step 1
<u>Step 3 - Input Sequence</u> <div style="margin-bottom: 10px;"> <u>Auditory</u> - S-L-P names and spells word. </div> <div style="margin-bottom: 10px;"> <u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> Five blanks appear. </div> <div> <u>Auditory</u> - S-L-P names and spells word a second time. </div> <div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> <div style="border: 1px solid black; padding: 5px; text-align: center;"> Omit Key Word Presentation </div> </div>	1. WHALE 2. SLIDE 3. PLANE 4. HORSE 5. PURSE 6. HOUSE 7. FENCE 8. NURSE	same as Step 1	same as Step 1	same as Step 1

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<u>Step 4 - Input Sequence</u> <u>Auditory</u> - None <u>Visual</u> - <u>Card Function</u> Picture presented. <u>CRT Function</u> Five blanks appear. <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> Omit Auditory Cue </div>	1. WHALE 2. FENCE 3. HOUSE 4. PLANE 5. PURSE 6. HORSE 7. NURSE 8. SLIDE	same as Step 1	same as Step 1	same as Step 1
END TARGET XV				

TARGET XVI - VISUAL - MOTOR MATCHING - FIVE LETTERS
(COPYING) TWO SYLLABLES
THREE SYLLABLES

Stimuli:

- Step 1, 2: WOMAN, TABLE, RADIO, WAGON
OCEAN, PENNY, LEMON, TOWEL
Step 3: Remove TABLE, PENNY
Replace with TIGER, APPLE
Step 4: Varied Order of 8/10 Words

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<p><u>Step 1 - Input Sequence</u></p> <p><u>Auditory</u> - S-L-P names and spells word.</p> <p><u>Visual</u> - Card Function Picture and key word presented.</p> <p><u>CRT Function</u> Word appears, one letter at a time. Completed word remains four seconds. Completed word removed. Five blanks appear.</p> <p><u>Auditory</u> - S-L-P names and spells word a second time.</p>	<p>1. WOMAN 2. TABLE 3. PENNY 4. RADIO 5. WAGON 6. OCEAN 7. LEMON 8. TOWEL</p>	<p>same as Step 1</p>	<p>same as Step 1</p>	<p>same as Step 1</p>

Method of Presentation	Stimulus Order	Response	Contingency	Criterion
<u>Step 2 - same as Step 1</u> <div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> Varied Order of Presentation </div>	1. LEMON 2. OCEAN 3. TABLE 4. WOMAN 5. TOWEL 6. PENNY 7. RADIO 8. WAGON	same as Step 1	same as Step 1	same as Step 1
<u>Step 3 - same as Step 1</u> <div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> Stimulus Change: Remove TABLE, PENNY. REPLACE WITH TIGER, APPLE. </div>	1. RADIO 2. TIGER 3. WAGON 4. APPLE 5. TOWEL 6. LEMON 7. WOMAN 8. OCEAN	same as Step 1	same as Step 1	same as Step 1
<u>Step 4 - same as Step 1</u> <div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> Varied Order of Presentation of 8/10 Words </div>	1. APPLE 2. WOMAN 3. PENNY 4. TABLE 5. TIGER 6. OCEAN 7. WAGON 8. RADIO	same as Step 1	same as Step 1	same as Step 1

Method of Presentation	Stimulus Order	Response	Contin- gency	Cri- terion
<p><u>Step 5 - Input Sequence</u></p> <p><u>Auditory</u> - S-L-P names and spells word.</p> <p><u>Visual</u> - <u>Card Function</u> Picture presented.</p> <p><u>CRT Function</u> Word appears, one letter at a time. Completed word remains on screen four seconds. Completed word removed. Five blanks presented.</p> <p><u>Auditory</u> - S-L-P names and spells word a second time.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Omit Key Word Presentation</p> </div>	<p>1. TOWEL 2. APPLE 3. WAGON 4. PENNY 5. OCEAN 6. LEMON 7. RADIO 8. WOMAN</p>	<p>same as Step 1</p>	<p>same as Step 1</p>	<p>same as Step 1</p>
END OF TARGET XVI				

REFERENCES

- Bollinger, R. L., & Stout, C. Response-contingent small step treatment: Performance-based communication intervention. Journal of Speech and Hearing Disorders, 1976, 41, 40-51.
- Boone, D. R., & Friedman, H. M. Writing in aphasia rehabilitation: Cursive vs manuscript. Journal of Speech and Hearing Disorders, 1976, 41, 523-529.
- Bricker, A. L., Schuell, H., & Jenkins, J. J. Effect of word frequency and word length on aphasic spelling errors. Journal of Speech and Hearing Research, 1964, 7, 183-192.
- Broida, H. Communication breakdown of brain injured adults. Houston: College Hill Press, 1979.
- Brookshire, R. H. An introduction to aphasia. Minneapolis: B.R.K. Publishers, 1978.
- Buckingham, H. W., Jr. Lexical and semantic aspects of aphasia. In M. T. Sarno (Ed.) Acquired aphasia. New York: Academic Press, 1981.
- Culton, G. L. Spontaneous recovery from aphasia. Journal of Speech and Hearing Research, 1969, 12, 825-832.
- Duffy, R. J., & Ulrich, S. R. A comparison of impairments in verbal comprehension, speech, reading, and writing in adult aphasics. Journal of Speech and Hearing Disorders, 1976, 41, 110-119.
- Friederici, A. D., Schoenle, P. W., & Goodglass, H. Mechanisms underlying writing and speech in aphasia. Brain and Language, 1981, 13, 212-22.
- Hagen, C. Communication abilities in Hemiplegia: Effects of speech therapy. Archives of Physical Medicine and Rehabilitation, 1974, 54, 454-563.
- Jasack, J. Wide Range Achievement Spelling Test. Wilmington, DE.: C. L. Story Company, 1945.

- Keenan, J. S., & Brassell, E. G. Aphasia Language Performance Scales. Murfreesboro, Tenn.: Pinnacle Press, 1975.
- Leske, M. C. Prevalence estimates of communicative disorders in the United States. ASHA, 1981, 23, 217-237.
- Lesser, R. Linguistic investigations of aphasia. New York: Elsevier, 1978.
- Locke, J. L., & Deck, J. W. The processing of printed language by aphasic adults: Some phonological and syntactic effects. Journal of Speech and Hearing Research, 1982, 25, 314-319.
- Marshall, R. Clinician controlled auditory stimulation for aphasic adults. Tigard, OR.: C. C. Publications, 1975.
- Mercer, C. D. Children and adolescents with learning disabilities. Cleveland: Charles E. Merrill, 1979.
- Noll, J. D., & Hoops, H. R. Aphasic grammatical involvement as indicated by spelling ability. Cortex, 1967, 3, 419-431.
- Pizzamiglio, L., & Black, J. W. Phonic trends in the writing of aphasic patients. Journal of Speech and Hearing Research, 1970, 13, 606-623.
- Pizzamiglio, L., & Roberts, M. Writing in aphasia: A learning study. Cortex, 1967, 3, 250-257.
- Porch, B. E. Porch Index of Communication Ability Administration, Scoring, and Interpretation. Los Angeles: Consulting Psychologists Press, 1981.
- Sarno, M. T. The Functional Communication Profile: Manual of directions. New York: New York University Medical Center - The Institute of Rehabilitation Medicine, 1969.
- Sarno, M. T., Silverman, M., & Sands, E. Speech therapy and language recovery in severe aphasia. Journal of Speech and Hearing Research, 1970, 13, 606-623.
- Schuell, H., Carroll, V., & Street, B. S. Clinical treatment of aphasia, Brain, 1969, 84, 243-264.
- Schuell, H., Minnesota Test for Differential Diagnosis of Aphasia, Brain, 1961, 84, 263-264.
- Schuell, H., & Jenkins, J. J. Reduction of vocabulary in aphasia. Brain, 1961, 84, 243-264.

- Schwartz, L., Nemeroff, S., & Reiss, M. An investigation of writing therapy for the aphasic adult: The word level. Cortex, 1964, 1, 344-367.
- Seron, X., Deloche, G., Moulard, G., & Rousselle, M. A computer-based therapy for the treatment of aphasic subjects with writing disorders. Journal of Speech and Hearing Disorders, 1980, 45, 45-58.
- Sies, Luther F. Aphasia theory and therapy: Lectures and papers of Hildred Schuell. Baltimore: University Park Press, 1974.
- Smith, A. Diagnosis, intelligence, and rehabilitation of chronic aphasics. Kalamazoo: University of Michigan Department of Physical Medicine and Rehabilitation, 1972.
- Vignolo, L. A. Evolution of aphasia and language rehabilitation: A retrospective study. Cortex, 1, 344-367.