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The Effects of a Multimodality Approach on Sentence Production using Response Elaboration Training with a Reading Component on Aphasic Patients.

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The Effects of a Multimodality Approach on Sentence Production Using Response Elaboration Training with a Reading Component on Aphasic Patients

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by

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ABSTRACT

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The effects of a multimodality treatment were investigated using a single subject experimental design across behaviors in two patients with different severity levels of Broca's aphasia. We hypothesized that Response Elaboration Training and an oral reading task would improve accuracy of sentence production, information content, and mean length of utterance. Results indicated that this treatment approach elicited significant improvement in the accuracy of sentence production and information content in the participant with very mild Broca's aphasia. Furthermore, the participant with severe Broca's aphasia demonstrated a very significant improvement in information content and mean length of utterance. The improvements support the idea that the same treatment may be used for individuals with various levels of ability as long as appropriate aspects of language are monitored for each client.

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CHAPTER 1

INTRODUCTION

Many treatments have been investigated that focus on the rehabilitation of language that is damaged when an individual acquires aphasia as a result of a cerebrovascular accident or other brain damage. Many of these treatments appeal to only one input modality, such as the auditory or visual senses. However, several studies have examined the benefits of using multimodality approaches to maximize benefits of therapy. In fact, several studies have proven the effects of using a multimodality approach. Schuell (1974) stated that, even though the auditory input modality is used most often in treatment, other modalities should be added in order to serve as reinforcements to one another. More specifically, Schuell hypothesized that combining auditory and visual stimuli might be maximally beneficial. North (1971) found that individuals with aphasia showed improved word recall when providing information through several input modalities. Moore (1996) studied brain activity during recall and recognition tasks of several single words using EEG technology. When comparing results using an auditory stimulus only, visual stimulus only, and a combination of the two, Moore discovered that multimodality stimulation is more effective in most cases than unisensory modalities.

Models of Language Production and Multimodality Approaches

Only one model has been developed and widely used that provides a theory for sentence production (Garrett, 1984). Figure 1 illustrates Garrett's model of sentence production. This model involves five different levels that, according to the theory, explain how sentences are formed. The Message Level representation includes the raw concept the speaker wants to convey (Garret, 1982). The Functional Level representation is where the raw content is encoded with grammatical structures. At the Positional Level representation, the grammatical structures are ordered into phrases, and prosody is added. Regular phonological processes are added in the Phonetic Level representation. Finally, motor coding processes occur at the Articulatory Level representation. Although this model was useful in determining which levels were impaired with the current study's participants, it was not helpful in explaining modalities involved in language. However, another model better illustrates the theory behind the development of the current study's treatment protocol.

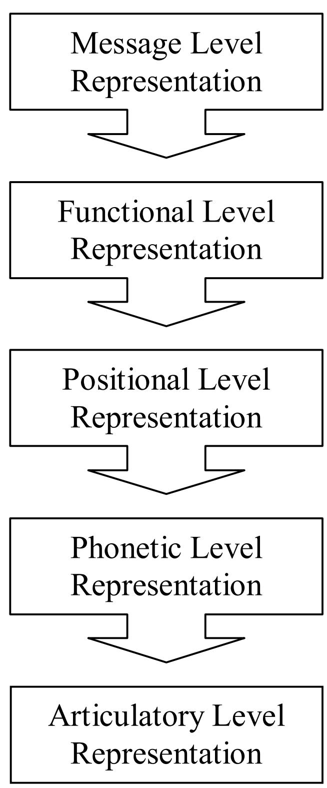

Figure 1. Garrett's Model of Normal Sentence Production. Adapted from Garrett, M.F. (1984). The organization of processing structure for language production: Applications to aphasic speech. In D. Caplan, A.R. Lecours, & A. Smith (eds.), *Biological perspectives on language* (p. 174). Cambridge, MA: MIT Press.

The Information Processing Model was developed to explain a theory of single word productions (Ellis & Young, 1988; Kay, Lesser, & Coltheart, 1996). However, the model was helpful in visualizing the theory behind sentence production as well. Figure 2 illustrates the portion on the Information Processing Model used to develop the current study. Three inputs were provided to the patient during treatment sessions: auditory comprehension, visual-picture, and visual-written word comprehension. Then, the information was processed by adding meaning to what was heard, read, or seen before the outputs of oral reading or sentence production occurred. The model below illustrates the theory of multimodality stimulation and how it affects sentence production.

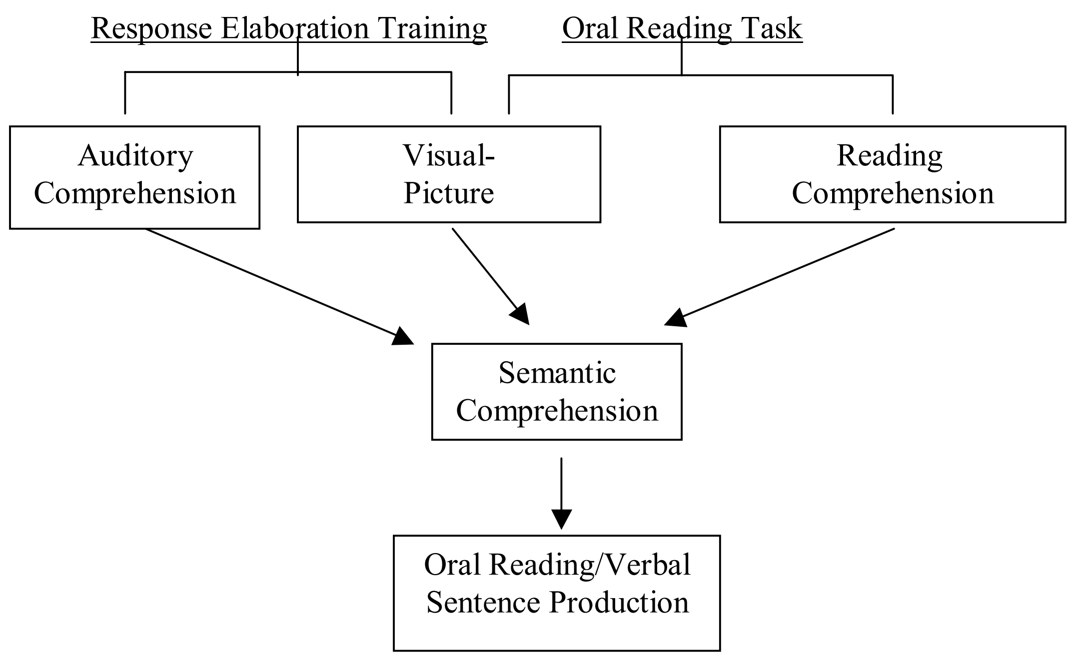

Figure 2: Information Processing Model, adapted. Adapted from Ellis, A. & Young, A. (1988). *Human cognitive neuropsychology.* Hillsdale, NJ: Erlbaum.

Most researchers and clinicians agree that using a multimodality approach is more efficacious in therapy than a unisensory approach. However, disagreements arise when determining what type of therapy is most appropriate for these patients: a highly structured clinician-directed approach (convergent) or a more flexible and individualized approach focused around the clients' responses (divergent). The research behind a specific treatment known as Response Elaboration Training (Kearns, 1985) has provided some insight into this debate.

Response Elaboration Training

Until 1985, there were no divergent or "loose training" approaches used in the treatment of aphasia. In that year, Kearns (1985) introduced a divergent approach called Response Elaboration Training (RET) as a possible alternative to previously established treatments for Broca's aphasia. The purpose of Kearns's study was to determine whether or not RET improved verbal sentence production through an increase in content words in each utterance and whether or not generalization to untrained stimuli would occur. RET involves the clinician elaborating on responses given by the client as a result of a picture stimulus. A series of steps is involved to give the client the most independence possible when producing a sentence. The results indicated a substantial increase in the production of content words (Kearns, 1985).

By placing the burden of communication on the patient, "loose" training approaches have the ability to empower the individual. Results were positive and occurred over a brief period of time. In the case of an individual with Broca's aphasia, who typically provides shorter, less complex sentences, it is even more imperative that clinicians find ways to facilitate more verbalization. RET clearly provides a framework for doing this type of facilitation, without requiring specific utterances. In addition, it is known that when a clinician is a facilitator of communication, rather than merely a stimulus presenter, there are more responses given by the patient (Shane & Kearns, 1994).

In order to prove that divergent training approaches, such as RET, are more effective at facilitating an increase in content words than convergent training approaches in some aphasic patients, Kearns and Yedor (1991) conducted a study comparing the two treatments. This study was the first attempt to compare RET with a structured treatment approach. In the study RET facilitated a greater total number and variety of content words than a convergent approach. In addition, patients' mean lengths of utterance (MLU) also improved as a result of increased information content. Thus, their findings further supported the effectiveness of RET, not only by reiterating previous successes, but also by revealing other positive changes in sentence production (i.e., MLU) not recognized before.

A follow-up to Kearns' (1985) study was conducted to further examine effects of RET in Broca's aphasia on trained and untrained stimuli (i.e., generalization). The results of this study also showed that RET could improve use of content words on trained stimuli and generalization of improvements to untrained stimuli (Kearns, 1986). Kearns still limited his subjects by using only individuals with nonfluent aphasias. However, the success of RET with nonfluent aphasic patients raises questions concerning the possible benefits of using RET with fluent aphasic patients. To determine the effectiveness of RET for patients with other classifications of aphasia, Kearns and Scher (1989) conducted a study using three different types of aphasia, including Broca's aphasia, conduction aphasia, and anomic aphasia. Thus, two patients had fluent aphasia (i.e., conduction and anomic), and one had nonfluent aphasia (i.e., Broca's). Again, the results showed that RET facilitated an increase in the total number of content words with moderate generalization to untrained stimuli (1989). In addition, this study provided evidence that some fluent aphasic patients could benefit from RET.

A more recent study by Wambaugh and Martinez (2000) examined treatment effects, generalization, and maintenance in three nonfluent, chronic, apraxic-aphasic patients. The researchers modified the treatment with photographs instead of line drawings and with modeling and practice during treatment. Once again, the results of the study found that a modified RET approach effectively increased the number of content words per utterance. Generalization to untrained stimuli was greater than in previous studies. Furthermore, the study showed that RET could be modified to better suit individual patients without compromising results. In the current study the participants verbally produced sentences based on RET's "loose" approach to treatment.

Because RET has been shown effective when modified, it raises questions about additional modifications that may make RET even more efficacious. RET focuses on auditory comprehension and visual-picture input modalities but excludes reading comprehension. Some aphasic patients may reach greater success and reach it more quickly if another input modality such as reading comprehension were added.

Oral Reading

Oral reading has been used frequently in therapy to facilitate improvements in many aspects of language. Researchers (Cherney, Merbitz, & Grip, 1986; Tuomainen & Laine, 1991) have found that reading comprehension, oral expression, auditory comprehension, and written expression abilities can significantly increase as a result of adding oral reading to treatment. Furthermore, they found that oral reading of sentences and paragraphs has been proven effective in fluent and nonfluent aphasic patients.

A common reading comprehension task used in these studies was scrambling sentences and requiring patients to place the words in the correct order. Arranging words in the correct order focuses treatment on reducing the effects of agrammatism and improving reading comprehension, organization, and self-monitoring. In the current study, unscrambling of written-word cue cards addressed reading comprehension of a sentence and was followed by oral reading of the sentence. The oral reading task comprises the convergent component of the treatment as compared to the divergent oral expression component in the earlier phase.

Qualitative Analysis

Qualitative measures are often overlooked in clinical settings (Kearns, 1999), and qualitative improvements are more recognizable to the patient and their family than quantitative improvements shown in therapy. In order for a treatment approach to be truly successful, the effects must be evidenced by improvements outside of the treatment setting. It is important to measure the generalization of communication skills of the patient in their social or work environments. The family and friends of the patient can provide feedback that the clinician cannot measure. Therefore, a survey was administered to the patients' families before and after treatment during the current study in order to measure the improvements observed outside treatment.

Purpose

The intent of this study is to examine the effects of sentence production in aphasic patients participating in a multimodality treatment approach using divergent RET training with a structured convergent reading task. The following questions will be addressed: (1) Will Response Elaboration Training with a reading component improve sentence production by increasing the information content of adult patients with aphasia? (2) Will increased information content generalize to untrained stimuli? (3) Will Response Elaboration Training with a reading component improve sentence production in aphasic patients by bringing the mean length of utterance to a more acceptable level? (4) Will this treatment cause an increase in aphasic patients' communication skills outside the treatment setting? (5) Will accuracy of complete sentence production improve as a result of RET with an additional reading task?

Hypotheses

We believed this multimodality treatment approach would help increase the number of content words in verbal communication. Also, we hypothesized that this experiment would provide evidence that using RET with a reading component can not only increase a nonfluent aphasic patient's mean length of utterance, but it can also decrease MLU in a high-level Broca's patient with numerous circumlocutions. Furthermore, we believed that this training would generalize to untrained stimuli by increasing the number of content words in therapy and in the home or work environment. We also hypothesized that accuracy of sentence production should improve in an aphasic patient that communicates at a sentence level.

CHAPTER 2

METHODS

Participants

Two individuals who were at least 18 years of age or greater and who were a minimum of three months postonset of a left cerebrovascular accident (CVA) resulting in aphasia were recruited for this study. The participants were monolingual English speakers with at least a fifth grade education and had normal cognition for their age as determined by informal or formal assessment or by medical history. Participants were recruited from the Tri-Cities region, including the East Tennessee State University (ETSU) Aphasia Research Center, Veterans Affairs (VA) Mountain Home Medical Center, and local speech-language pathologists.

Subject exclusion criteria included the following: a) other neurological or chronic medical conditions that would interfere with therapy, b) auditory comprehension inadequate to understand the experimental stimuli (i.e., score of 25 or less on the Yes-No Comprehension Subtest of the Western Aphasia Battery), c) concurrent participation in other speech-language therapy, and d) severe sensory deficits in hearing or vision (i.e., hearing of at least 45 dB or better in the 2-4000 Hz range in at least one ear with or without hearing aids and vision adequate to see the picture and written-word stimuli).

Participant CV

Participant CV, an 80-year-old right-handed married white male, was referred to the ETSU Aphasia Research Center by a local speech-language pathologist involved in his initial rehabilitation. CV suffered a left cerebrovascular accident (CVA) due to an acute left middle cerebral artery embolism in May 2003. Upon arrival at the hospital, doctors discovered that he was a candidate for a tissue plasminogen activator (TPA) injection, which was reportedly successful in the cessation of further neurological damage. CV was hospitalized for seven days in acute care and then transferred to a rehabilitative hospital for one month. Following discharge from the rehabilitation hospital, CV continued attending outpatient rehabilitation services for two-to-three months, including speech and language therapy. Thus, participant CV attended approximately 6 months of rehabilitation from May until October 2003 prior to his enrollment in speech therapy at the ETSU Aphasia Research Center as a participant in the current study.

Initial testing at the ETSU Aphasia Research Center resulted in the following diagnoses: mild aphasia (most consistent with Broca's), mild-to-moderate apraxia of speech (AOS), and mild unilateral upper motor neuron dysarthria. Participant CV met all of the admittance criteria for the study.

In addition to the CVA, participant CV had several medical issues that raised concern regarding his ability to participate in the study. Concomitant medical diagnoses included the following: coronary artery disease (status post angioplasty), cardiac arrhythmia, status post defibrillator placement, diabetes, hypertension, rheumatoid arthritis, obstructive sleep apnea secondary to Addison's disease, asthma, and gastroesophageal reflux disease. CV smoked for several years but quit several years earlier. Although CV presented with multiple medical problems in addition to his recent CVA, his level of functioning and independence were still sufficient for activities of daily living. Because of these skills, he was selected to participate in the current study.

Due to scheduling difficulties and a break in the university calendar over Christmas holiday, baseline measures for CV were interrupted with two baseline measures conducted in November 2003 and the remaining two baseline measures conducted in February 2004, a gap of 3 months.

Participant LH

Participant LH was a 58-year-old right-handed married white female and former patient at the ETSU Aphasia Research Center who had been previously enrolled in speech therapy for three years (i.e., since October 2001). She suffered a left CVA in May 2000 secondary to severe stenosis of the middle cerebral artery. A left cerebral artery bypass was performed in January 2001. Post-operative complications included a basal ganglia hematoma with a midline shift, large left retroperitoneal hematoma, respiratory failure requiring a tracheostomy, and temporary placement of a percutaneous endoscopic gastrotomy (PEG) tube.

Following discharge from acute care, participant LH attended speech therapy at a rehabilitative hospital during the summer of 2000 and the spring and summer of 2001. In October 2001, LH began attending the ETSU Aphasia Research Center and subsequently participated in a word retrieval study for 9 months through July 2002. After the word-retrieval study ended, the focus of her treatment shifted to apraxia of speech from the fall of 2002 through the spring of 2003.

Testing conducted in June 2003 resulted in the following diagnoses: severe Broca's aphasia, severe verbal apraxia of speech and limb apraxia, and moderate spastic dysarthria. LH met all criteria for participation in the study.

Materials

Treatment materials included fifty 4 x 6 inch color photographs of individuals performing a single action, such as riding a bike, fixing a tire, and driving a car. In addition, 3 x 5-inch unlined index cards were used to print each word in the target sentence and each nonword for the supplemental control task in block letters with a black permanent marker. Treatment took place in a quiet treatment room isolated from extraneous noise. The room required a table long enough to complete the oral reading task (approximately four feet long) and two chairs: one for the client and one for the clinician. A third chair was placed in the room when an observer was present. A Panasonic AG-188 VHS movie camera for recording, Smith-Victor Corporation Gemini 2600 tripod, and T-120 VHS videotapes were used to record each session. A Panasonic Double Feature VCR and Sony Trinitron television monitor were used after each session by the reliability judge and sometimes the examiner to review and score the probes. Two data sheets were completed during each session: one for information content and MLU, the other for the supplemental control task (Appendices A & B). Finally, the Western Aphasia Battery (Kertesz, 1979) was administered before the study began and after the study ended as an additional measure of communicative progress.

Design

The study used a multiple baseline experimental design across behaviors. In this design, the treatment was administered twice to each participant: in phase 1 treatment was applied to Set 1 stimuli, then replicated in phase 2 treatment with Set 2 stimuli. Baselines were extended across participants (i.e., three baseline sessions for participant LH and four baseline sessions for participant CV). Experimental control was observed through baseline trends in both Sets 1 and 2 stimuli, extended baselines, and an additional control task with nonword oral reading task.

During the treatment phases, all stimuli (picture stimuli and nonword oral-reading stimuli) were presented in random order for assessment. Verbal performance was measured across three phases of the study: 1) baseline, 2) treatment, and 3) maintenance. Subjects were trained on Set 1 stimuli for 15 sessions or until the patient produced a grammatically correct sentence on 8 of 10 trained stimuli over three of four consecutive sessions. Meanwhile, Set 2 stimuli was monitored and held in reserve for training until after treatment for Set 1 was completed. Then, Set 2 stimuli were trained in the same manner as Set 1. After treatment was withdrawn, progress was monitored for maintenance of skills for a period of least two weeks. Generalization data were obtained on the untrained Set 2 stimuli during training of Set 1 stimuli. Ten nonwords were presented for oral reading as a supplemental control (see Appendix C). Participants were seen for two one-hour sessions, weekly, in a quiet therapy room at the ETSU Aphasia Research Center.

Each participant presented with different areas of difficulty during baseline sessions. Thus, both CV and LH were assigned separate sets of 20 stimulus picture cards. Furthermore, an additional set of 10 pictures (i.e., 30 total picture stimuli) was used with CV for an additional generalization task. The stimuli were also chosen for each participant based on their individual interests and personally relevant information. Of the 20 picture stimuli for LH and 30 for CV, 10 were used as trained stimuli (i.e., Set 1), while the other 10 (i.e., Set 2) were used as untrained stimuli to assess generalization. Then, Set 2 stimuli were trained in phase 2 as replication of the treatment. The additional set of 10 picture cards (i.e., Set 3) used in CV's treatment was used to assess a more complex level of generalization because of his advanced communicative abilities (see Appendix C).

A pre- and posttreatment survey was completed by LH's spouse. Because CV withdrew early from treatment, only a pretreatment survey was completed for him. The survey reported the spouse's view of the progress by participant LH in treatment (see Appendix D).

Procedures

Baseline

At the beginning of each session, the participant was shown a picture and asked to produce a sentence: "Tell me a sentence about this picture." Participants' performances were assessed without treatment until a stable baseline was established on the sentence production task. Accuracy of sentence production, performance on MLU, and information content for each response were measured. Information content was measured based on the number of correct nouns, pronouns, verbs, adjectives, adverbs, and prepositions (Kearns, 1985). The words had to also be intelligible, accurate, relevant, and informative about the content of the picture (Nicholas & Brookshire, 1993).

As an additional measure of experimental control, an extended baseline phase was implemented for the second participant: While the first participant (LH) had 3 baselines sessions, baseline for participant CV was extended to 4 sessions. Four consecutive baseline sessions showing a stable baseline in accuracy of sentence production took place before the treatment phase commenced for participant CV.

Treatment

During the treatment phase, each session began in the same manner as the baseline phase with an assessment of probe to determine sentence accuracy, number of content words, and MLU. After the probe measures were completed at the beginning of each session, then treatment began. Treatment was conducted for 15 sessions or until criterion was met. During phase 1 of treatment, the first set of 10 trained stimuli was presented in a random order for treatment. The same verbal instruction, "Tell me one complete sentence about this picture," was used to elicit an initial response from the client. At that time the clinician elaborated on the participant's response by using any appropriate content words to model an appropriate and correct sentence. If the patient produced an acceptable response, treatment proceeded to the oral reading task.

Correct responses were based on normative data collected from five nonaphasic adults. Therefore, if the number of content words produced and the MLU were in the same range as in the normative sample, the response would be deemed acceptable. The prompts given by the clinician would follow the treatment protocol shown in Appendix E. In accordance with the "loose" nature of this treatment approach, each response by the client was spontaneous and was immediately and effectively built upon in order to construct an appropriate, informative sentence.

The oral reading phase of treatment was administered next. After the patient produced his best sentence at the conclusion of the RET phase, the clinician wrote that sentence on 3 X 5-inch unlined index cards (one word per card) with a black marker in lower case print (except for the first word in the sentence, which was capitalized). The examiner scrambled the word order of the written cue cards on the table in front of the patient. Then, the patient unscrambled the words to form the correct word order for each sentence with cueing from the clinician as needed (see Appendix E for treatment protocol). After the words were arranged in the correct order, the participant orally read the sentence with cueing as needed. Then the written cue card was removed, and the picture stimulus was presented again. The patient was asked to produce a single sentence in response to the picture stimuli, and then the patient proceeded to the next picture stimulus. The patient was trained on all pictures in a set at least once per session, and, if time permited, more than once. After Set 1 was trained in treatment phase 1 (for 15 sessions or until criterion is met), then Set 2 was trained in the same manner as Set 1. During phase 2 treatment for Set 2, Set 1 continued to be monitored but was no longer trained.

Generalization

Data were collected to examine each participant's ability to generalize skills learned in the treatment phase to the untrained stimuli in Set 2. Thus, during treatment phase 1 on Set 1 stimuli, Set 2 stimuli were untrained but observed for generalization. In addition to observations of generalization to Set 2 stimuli, a third set of ten stimuli was monitored during phase 1 treatment for participant CV. On Set 3 stimuli, participant CV was asked to produce two complete sentences for each picture stimulus. Set 3 stimuli for CV was never trained.

Maintenance

Maintenance is the measure of the effects of treatment after the treatment is withdrawn (i.e., How well does the patient remember the treatment techniques after treatment has ended?) Maintenance, or follow-up, was measured two weeks after treatment concluded. However, there was an additional opportunity to observe a form of maintenance during phase 2 treatment on the previously trained Set 1 stimuli.

Treatment effects observed on previously trained Set 1 stimuli during phase 2 of treatment were likely the results of a combination of effects from the previous training as well as possible generalization while Set 2 were being trained. Gains made on Set 1 stimuli that exceeded previous performance during treatment phase 1 may be interpreted as generalization effects during treatment phase 2.

Scoring

Accuracy of sentence production was scored using a plus or minus sign. Both the length of utterance and the number of content words were scored using tick marks or slashes on data sheets; each tick mark counted one point (see Appendix A). The number of content words and utterance length were totaled for each set of stimuli. Mean length of utterance was calculated by taking the total of utterance length and dividing by ten (i.e., 10 picture stimuli per set). For example, if participant CV produced 30 content words and 40 total words in Set 1, information content would be scored as 30 content words, and MLU would be scored as 4.0. The patients' productions during the nonword oral reading control task were individually marked correct (+) or incorrect (-), and any correct response counted as one point (see Appendix B).

Reliability

Both interjudge and procedural reliability were evaluated. A reliability judge (i.e., another graduate student in speech-language pathology) scored at least 30% of the sessions from videotape recordings. Interjudge reliability was scored using the same data collection sheets included in Appendices A and B. Procedural reliability was scored using a data sheet that listed each step in the treatment protocol. For each stimulus picture trained in treatment, the reliability judge scored the clinician's performance of each step (e.g., a plus sign if the step was performed and a minus sign if it was not).

Additional reliability measures of this study were based on length of time postonset of CVA, a stable baseline, an extended baseline for each subsequent participant, and a supplemental control task.

Data Analysis

Single subject experimental designs are analyzed from visual inspection of the data for slope and trend (McReynolds & Kearns, 1983). Thus, the clinician calculated the total amount of content words and the MLU for all stimuli at the beginning of each session during probe measures. Improvement was measured by determining the percentage increase of content words. Depending on the participants of the study, one of the treatment goals was either to increase MLU (i.e., LH) or decrease MLU (i.e., CV). Improvement was analyzed based on percentage change (increased or decreased depending on treatment goal).

Table 1 shows the categories of improvement used to analyze progress during the present study. There are no published norms to use for this analysis; therefore, degree of improvement was designated based on clinical experience. Improved accuracy of sentence production, use of content words, and more appropriate MLU was evaluated separately. For example, a participant might have shown significant improvement in the use of content words but moderate improvement of MLU.

Table 1

Criterion for Measurements of Improvement

Classification of Improvement	Percent Change
Mild improvement	10-24%
Moderate improvement	25-45%
Significant improvement	>45%

CHAPTER 3

RESULTS

The first two available aphasic individuals participated in this study. Results are compared across participants for production of grammatically correct sentences only. Individual results for production of number of content words and mean length of utterance, as well as a supplemental control task, are reported. However, a comparison of results on these measures across participants was uninformative because of the vast difference in their responses. It was anticipated that CV would improve at the sentence level and that LH would improve at the word level.

Sentence Production

Participant CV

Data were collected measuring CV's production of complete sentences in response to presented picture stimuli on Set 1 and Set 2 stimuli. Because CV's severity level of Broca's aphasia was mild, a more challenging task was added to monitor his progress and generalization ability on untrained Set 3 stimuli by asking him to produce two complete sentences about each picture. CV's performance on the three sets of picture stimuli is reported in Figure 3.

Results of Treatment. Baseline performance of sentence production for Set 1 remained stable across four sessions at 0% accuracy. After treatment began, performance improved to a range of 75-90% accuracy across the last three sessions. Criterion was achieved prior to the designated 15 sessions originally scheduled.

Due to health issues of the patient, only two treatment sessions were applied to Set 2. However, CV's performance improved by 40% from a baseline high score of 50% to a score of 90% during treatment.

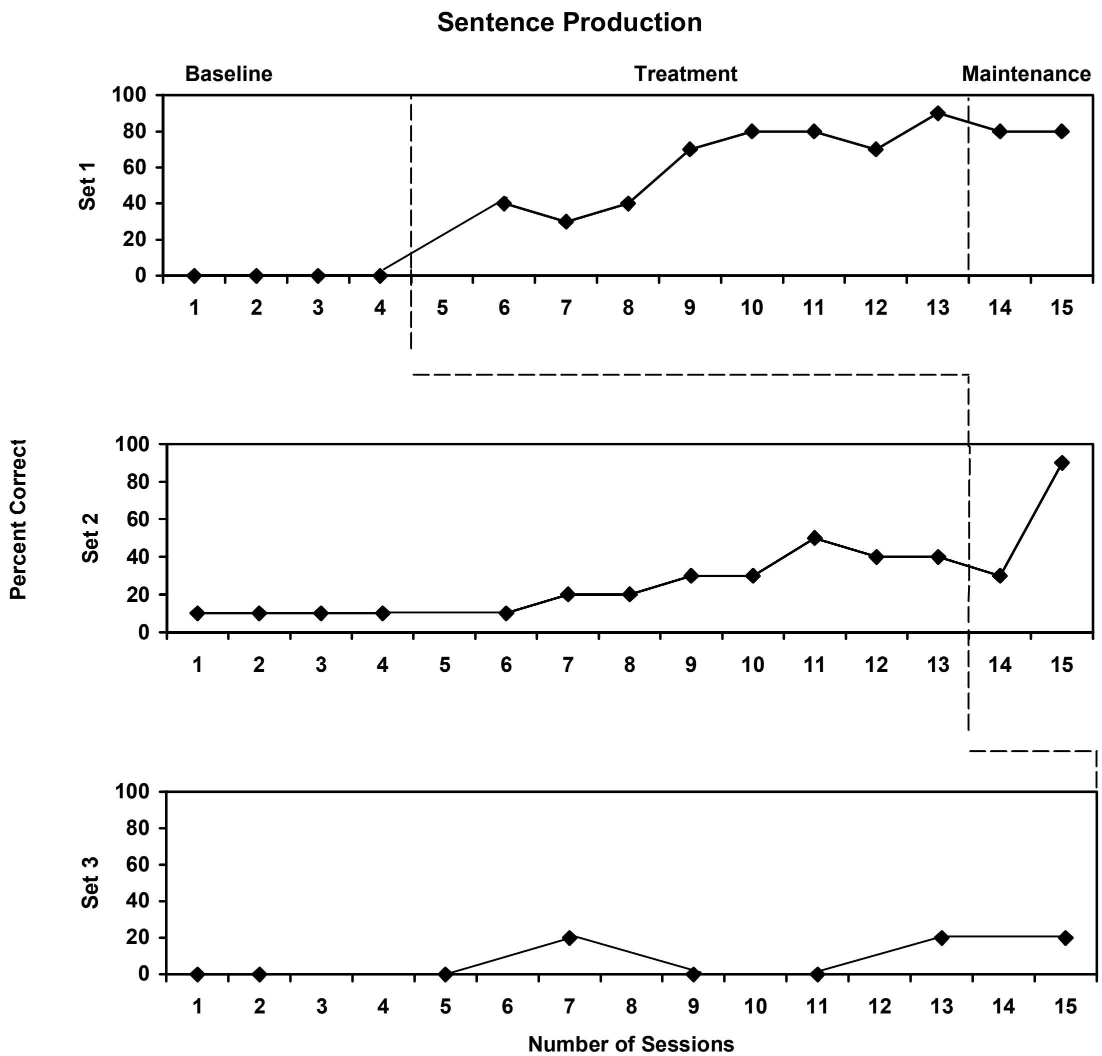

Figure 3. CV'S results of treatment for sentence production.

Generalization. Production of sentences of the untrained Set 2 improved while Set 1 was trained from as low as 10% to as much as 50% accuracy, an improvement of 40%. Performance on Set 3 stimuli (two sentence productions) improved from 0% accuracy in the first two sessions to 20% accuracy in the last two sessions.

Maintenance. During the two sessions of phase 2 treatment when Set 2 was trained, accuracy of sentence production for the previously trained Set 1 remained consistently at 80%. Only two sessions of Set 1 maintenance could be monitored and no follow-up data were obtained due to premature termination of therapy.

Participant LH

LH was unable to form complete sentences before treatment was initiated. Therefore, improvement on sentence production was not expected. Data from LH's sentence production are reported in Figure 4.

Results of Treatment. LH demonstrated no improvement in production of grammatically correct sentences. Her performance began and ended at 0% accuracy.

Generalization. No generalization was shown to untrained Set 2 stimuli, and performance remained at 0% accuracy.

Maintenance. Her performance continued at 0% accuracy during the maintenance and follow-up phases.

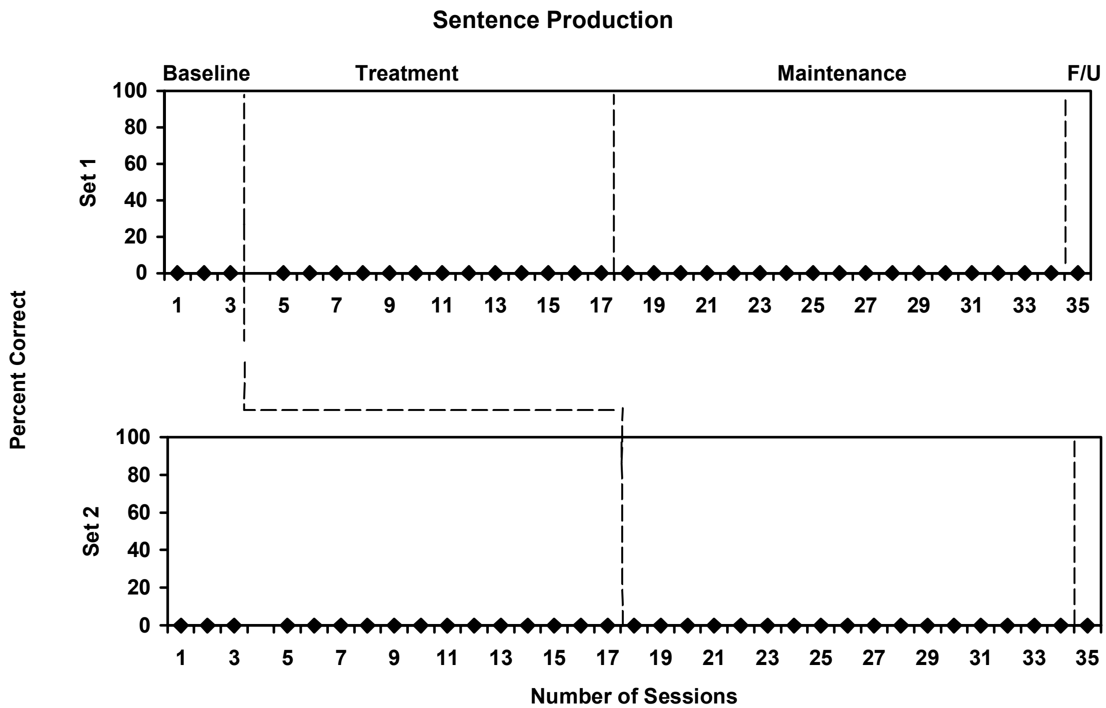

Figure 4. LH'S results of treatment for sentence production.

Additional Results of Treatment for Participant CV

In addition to sentence production, participant CV was measured on his production of content words (information content) and mean length of utterance (MLU). Also, a nonword reading task was conducted in order to provide additional experimental control for the study.

Information Content

The number of content words, such as nouns, verbs, and adjectives, was measured per sentence and reported in Figure 5.

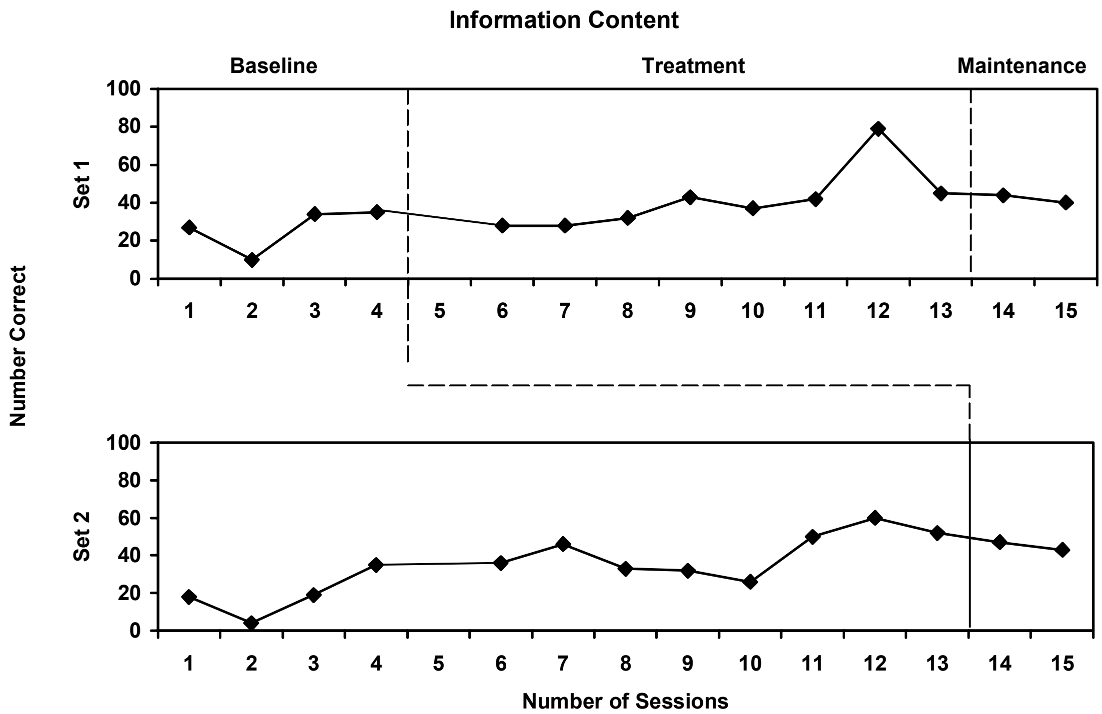

Figure 5. CV'S results of treatment for information content.

Results of Treatment. Baseline performance for number of content words showed a rising trend, ranging from 27 to 35 words with an average of 26.5 content words during the first four sessions. With the exception of one session during treatment, CV's performance on content words remained relatively stable across treatment with a range of 28 to 45 words. At the beginning of session 12, CV stated that he wanted to make his sentences longer and more complex, and his performance jumped to 79 content words for Set 1.

Treatment of trained Set 2 stimuli was interrupted due to CV's failing health, and thus his performance could not be fully assessed. Only two sessions of treatment for content words were completed on Set 2 stimuli with performance ranging from 43 to 47 correct.

Generalization. Generalization of content words to the untrained Set 2 stimuli was measured while Set 1 stimuli were trained. Performance on these untrained stimuli demonstrated an improvement of 25 words with a range of 35 to as many as 60 content words. CV averaged 19 content words across the first four sessions and averaged 54 content words across the last three sessions.

Maintenance. Maintenance on previously trained Set 1 stimuli was observed while Set 2 stimuli were trained. A slight downward trend was noted over these two sessions for Set 1 stimuli. However, due to the premature end to treatment of Set 2, maintenance of Set 1 could not be fully analyzed. Likewise, no maintenance data is available for Set 2 stimuli.

Mean Length of Utterance

The mean length of utterance (MLU), the average number of words per utterance as a response to presented stimuli, was also measured and reported in Figure 6.

Results of Treatment. Production of utterances increased from an average of 6.75 across the four baseline sessions to an average of 8.7 across the last four treatment sessions of trained Set 1 stimuli. Performance during session 12 was atypical, resulting in an inflated score.

Only two sessions of treatment were completed on trained Set 2 stimuli. During these two sessions, CV's MLU decreased from 9.6 to 7 words per utterance.

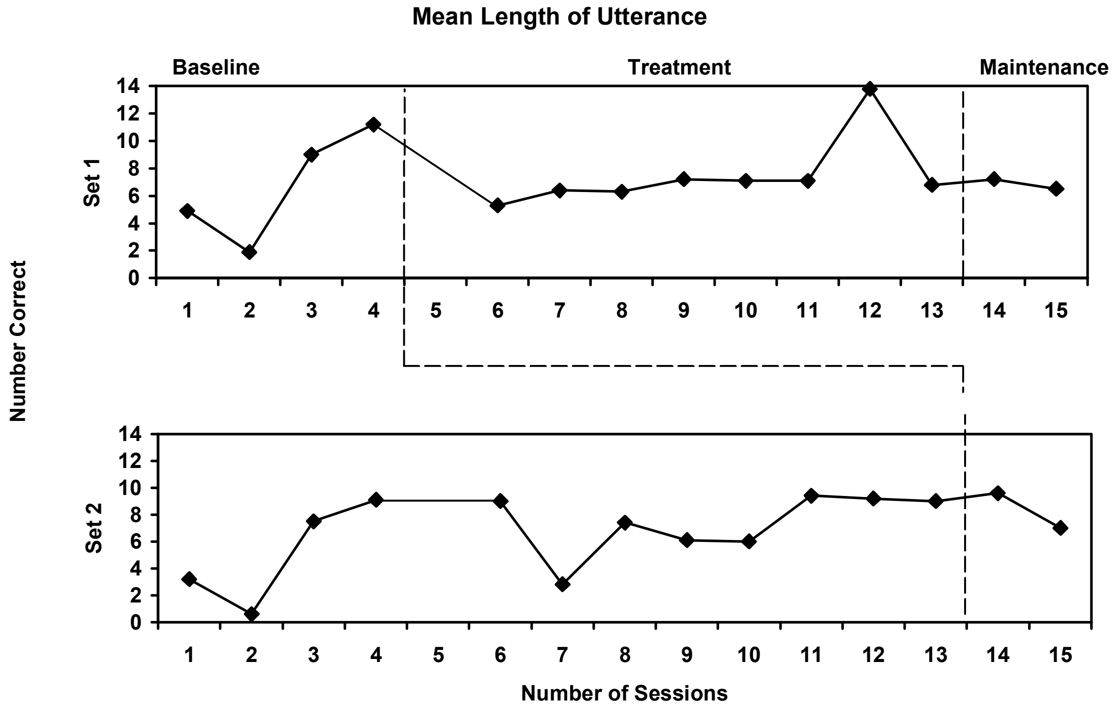

Figure 6. CV'S results of treatment for mean length of utterance.

Generalization. Generalization of MLU to the untrained Set 2 stimuli was measured while Set 1 was trained. The MLU of the untrained Set 2 remained approximately the same with a slight decrease from an average of 7.6 across the first four sessions to 7.05 across the last four sessions.

Maintenance. Maintenance (i.e., follow-up session) was scheduled to be measured two weeks after treatment ended for Set 1 and Set 2 stimuli. Due to the premature end of the second treatment phase, maintenance of performance two weeks after the conclusion of both treatments could not be analyzed for Set 1 and Set 2.

Maintenance of previously trained Set 1 was monitored while Set 2 was trained. Data show a slight downward trend from 7.2 to 6.5 across the two final sessions.

Western Aphasia Battery

Because CV unexpectedly withdrew from treatment, posttreatment scores from the Western Aphasia Battery were unavailable. Therefore, a comparison of pre- and posttreatment measures could not be made with this participant. However, results of the Western Aphasia Battery prior to treatment are reported in Table 2.

Table 2

Results of Pretreatment Testing for CV

Subtests	Pretreatment (October 2003)	Total AQ	Posttreatment	Total AQ
Spontaneous Speech				
Information Content (of 10)	9.0		N/A	
Fluency (of 10)	9.0		N/A	
Total (of 20)	18.0	18	N/A	N/A
Auditory Comprehension				
Yes/No Reliability (of 60)	60.0		N/A	
Auditory Word Recognition (of 60)	59.0		N/A	
Sequential Commands (of 80)	64.0		N/A	
Total (of 200)	183.0	9.15	N/A	N/A
Repetition (of 100)	82.5	8.25	N/A	N/A
Naming				
Oral Naming (of 60)	40.0		N/A	
Word Fluency (of 20)	20.0		N/A	
Sentence Completion (of 10)	9.0		N/A	
Responsive Speech (of 10)	9.0		N/A	
Total (of 100)	69	6.9	N/A	N/A
TOTAL	42.3 x 2=	84.6	N/A	N/A
Reading (of 100)	62.0		N/A	
Praxis (of 60)	38.0		N/A	

Qualitative Data

Posttreatment scores from a communication survey administered to CV's wife were unavailable. Therefore, a comparison of pre- and posttreatment measures could not be made with this participant. However, results prior to treatment are reported in Table 3.

Table 3

Results of Pretreatment Survey for CV

Areas of Interest	Pretreatment	Posttreatment
CV's Ability to Communicate (on a scale of 1-10)	8	N/A
% of CV's Utterances Spouse Understands	71-85%	N/A
% of CV's Utterances Other People Understands	71-85%	N/A
Words per Utterance Spouse Understands	5-8	N/A
Number of Words CV Can Understand	6-10	N/A
CV's Number of Initiations per Day	>10	N/A
Number of Times CV Shows Communication Frustration per Day	2-5	N/A

Because the survey could not be completed, two language samples were taken from conversations that were recorded during treatment sessions. One sample was taken from a baseline session; the other was taken from the final treatment session CV attended. Both samples are about reading the nonwords presented to him during the supplemental control task. A transcript of these samples is reported in Table 4.

In the baseline-session language sample, CV's MLU was 30.0, but his information content was very low in comparison with content words comprising no more than one third of the total words in the sample. In contrast, CV's MLU during the final treatment session was 9.67, and content words comprised at least 75% of the total words in the sample.

Table 4

Comparison of CV's language samples

Baseline sample	Total words (TW) and number of content words (CW)	Final treatment session sample	Total words (TW) and number of content words (CW)
I don't know . . . but that . . . I think it's about it but I don't believe them words is in the Bible I tell you what	TW: 27 CW: 4	Give me some words that I . . . and I'll bled 'em for you	TW: 13 CW: 10
I don't . . . see 'em and all . . . I read 'em and the paper and I got the governors and all the uh, well . . . I know what and I looked at the paper today	TW: 35 CW: 11	I'll get them really good.	TW: 6 CW: 6
No siree I do not but I read 'em and I pick 'em and I got to get 'em in the right order maybe but he says five minutes	TW: 28 CW: 5	Well I can read better and I'm getting better	TW: 10 CW: 8

Supplemental Control Task

For additional experimental control, CV was asked to orally read 10 irregular nonwords that were never treated but instead were monitored throughout the study. These measures are reported in Figure 7. Performance on irregular nonword oral reading remained essentially unchanged at 0% accuracy in all but one session at 10% accuracy.

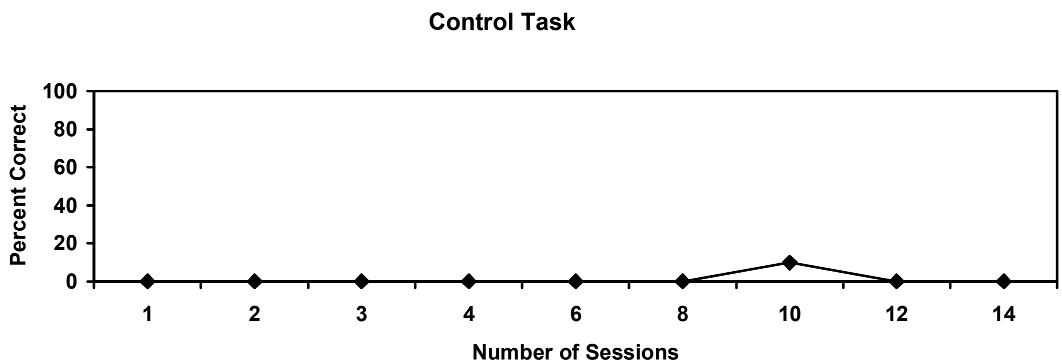

Figure 7. CV'S results for untreated nonword oral reading

Additional Results of Treatment for Participant LH

LH's performance was also analyzed with measures of content words and mean length of utterance. In addition, a supplemental control task was monitored throughout treatment. Finally, the Western Aphasia Battery and a subjective survey completed by LH's spouse were analyzed before and after treatment to monitor any other changes in her communication ability.

Information Content

LH's production of content words were analyzed and reported in Figure 8. Information content was measured with content words that included every noun, verb, adjective, adverb, and preposition that was meaningful to the picture stimulus presented.

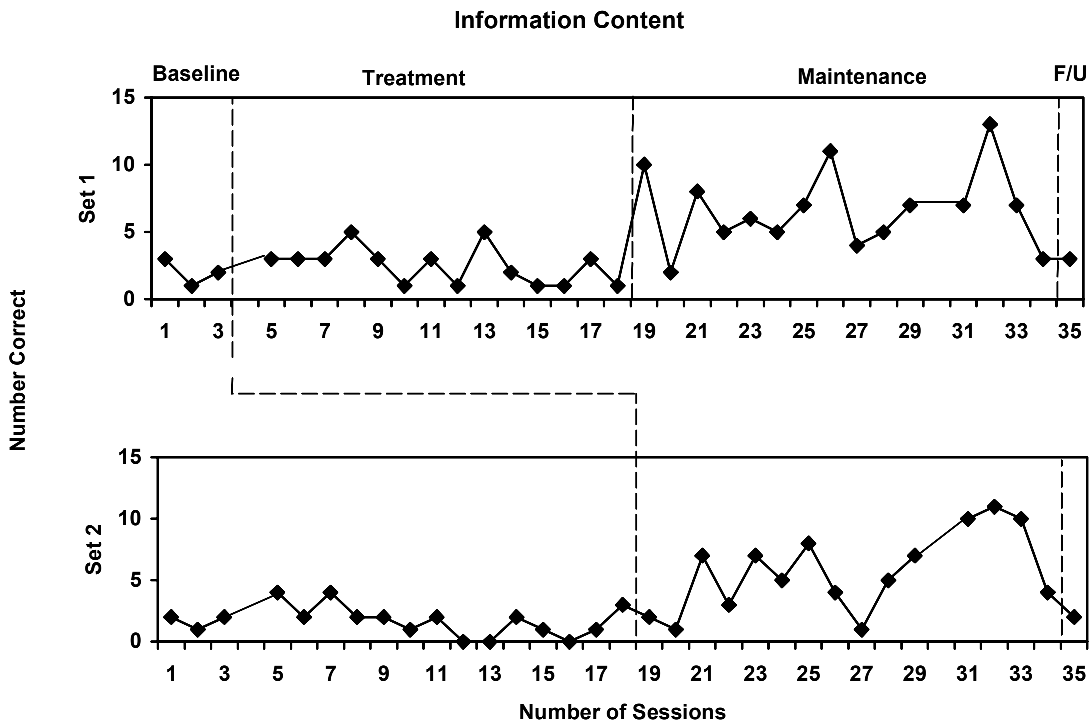

Figure 8. LH'S results of treatment for information content.

Results of Treatment. The number of content words was reported as the total number of correct content words produced over ten sentences in one set and not the average number of words per sentence. Baseline performance on content words for Set 1 stimuli remained stable across three sessions with a range from a total of 1 to 3 words correct. After treatment began, performance on trained Set 1 stimuli improved during two sessions to as many as a total of five correct content words. No appreciable trend in improvement was observed during treatment of Set 1 stimuli.

However, with additional sessions of treatment during phase 2, a significant improvement was observed. On Set 2 trained stimuli, a change in production from four correct content words during baseline to as many as 11 content words during treatment occurred, an improvement of 175%.

Generalization. While Set 1 stimuli were trained, generalization for production of content words to untrained Set 2 stimuli varied with a range in performance from a baseline score of a total of two words to an improvement of as many as four content words, an improvement of 100%.

Maintenance. A noticeable improvement in performance was observed during maintenance on previously trained Set 1 stimuli while Set 2 was being trained. Production of content words improved from a previously trained high score of five content words during the treatment phase to as many as 13 content words during the maintenance phase, an improvement of 160%.

A follow-up session was conducted to measure maintenance of treatment effects. This maintenance was measured for Set 1 and Set 2 stimuli two weeks after treatment ended. LH's performance remained essentially the same for Set 1 stimuli and decreased by 50% for Set 2 stimuli.

Mean Length of Utterance

LH's responses to presented stimuli were assessed and the MLU was determined for each set. The results are reported in Figure 9.

Results of Treatment. Mean length of utterance (MLU) performance in Set 1 stimuli was stable across three baseline sessions with a range of 0.3 to 1.3 words per utterance. Results of treatment showed an upward trend, with performance ranging from 2.8 to 3.3 words per utterance over the last three sessions of treatment, an improvement of 18%.

Performance on Set 2 trained stimuli increased from an average of 2.2 words correct over the last three untrained sessions to an average score of 5.67 over the last 3 trained sessions, an improvement of 157%.

Generalization. While Set 1 stimuli were trained, generalization for MLU to untrained Set 2 stimuli increased from an average of 0.8 words correct over the first 3 sessions to an average of 3.2 correct words per utterance over the last 3 sessions, an improvement of 300%.

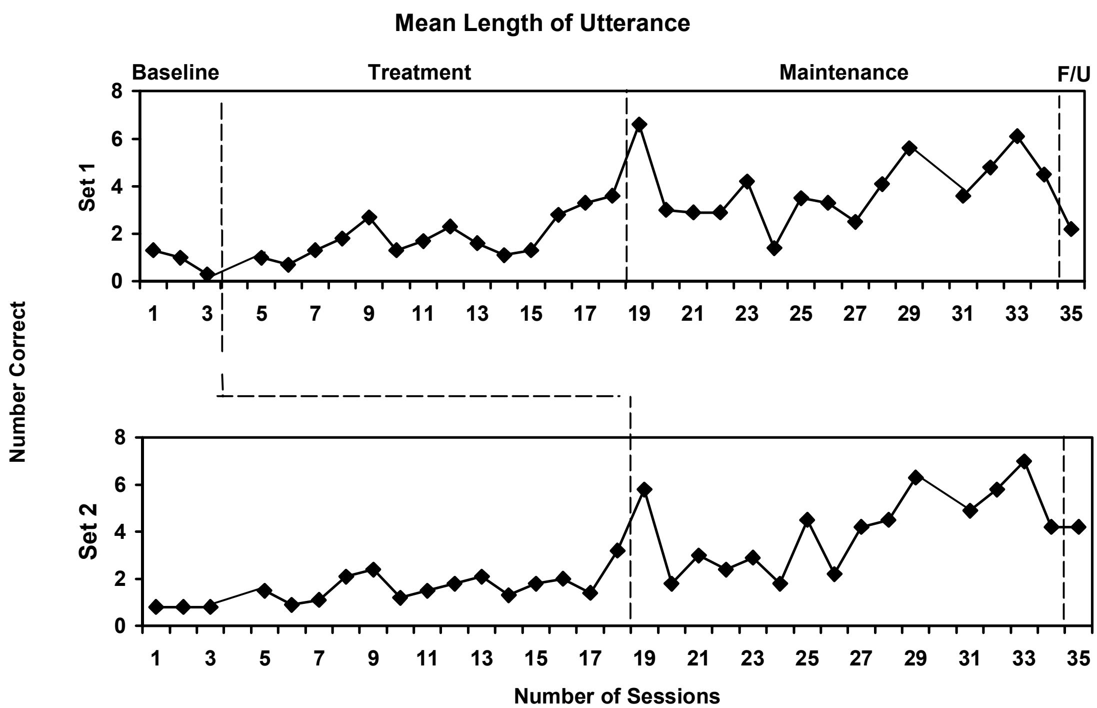

Figure 9. LH'S results of treatment for mean length of utterance.

Maintenance. A noticeable improvement was shown during the maintenance phase of the previously trained Set 1 while Set 2 was trained. MLU increased from an average of 3.6 words correct at the end of treatment for Set 1 stimuli to an average score of 5.1 correct words per utterance over the last 3 sessions (32-34), an improvement of 42%.

Maintenance in the follow-up session was also measured for Set 1 and Set 2 stimuli two weeks after treatment ended. LH's performance decreased by 50% on Set 1 stimuli and remained the same for Set 2 stimuli at 4.2.

Western Aphasia Battery

The Western Aphasia Battery (WAB) was administered before treatment and five months later after treatment ended. The results are compared in Table 5.

Results of Treatment. LH's performance on the Western Aphasia Battery after treatment ended showed a significant improvement in spontaneous speech, auditory comprehension, repetition, word fluency, and reading. These changes resulted in an improved Aphasia Quotient (AQ) from a pretest score of 39.4 to a posttest score of 51.5, an improvement of 14.1 quotient points. According to testing, both information content and fluency increased, improving the AQ for the spontaneous speech subtest from 4 to 9, an increase of 125%. Yes/no reliability, auditory word recognition, and sentence completion also all increased, improving the auditory comprehension subtest AQ from 5.4 to 6.25. The repetition subtest also showed an improvement from an AQ of 6.9 to 8. Finally, the reading subtest improved from 42 to 49.82. All of these subtests that showed improvement included language tasks that were incorporated during treatment. The results from the naming and praxis subtests show a slight decrease from pre-to post-therapy testing. However, these two subtests included areas of communication not targeted during treatment.

Table 5

Results of Pre- and Posttreatment Testing for LH

Subtests	Pretreatment June 2003	Total AQ	Posttreatment October 2003	Total AQ
Spontaneous Speech				
Information Content (of 10)	3.0		5.0	
Fluency (of 10)	1.0		4.0	
Total (of 20)	4.0	4	9.0	9
Auditory Comprehension				
Yes/No Reliability (of 60)	48.0		51.0	
Auditory Word Recognition (of 60)	40.0		46.0	
Sequential Commands (of 80)	20.0		28.0	
Total (of 200)	108.0	5.4	125.0	6.25
Repetition (of 100)	69.0	6.9	80.0	8
Naming				
Oral Naming (of 60)	21.0		16.0	
Word Fluency (of 20)	1.0		2.0	
Sentence Completion (of 10)	8.0		7.0	
Responsive Speech (of 10)	3.0		0.0	
Total (of 100)	33.0	3.3	25.0	2.5
TOTAL	19.6 x 2=	39.4	25.75 x 2=	51.5
Reading (of 100)	42.0		49.82.0	
Praxis (of 60)	11.0		7.0	

Qualitative Data

A communication survey was administered before and after treatment to the patient's spouse. The results are reported in Table 6, and the questionnaire is listed in Appendix D.

Table 6

Results of Pre- and Posttreatment Survey for LH

Areas of Interest	Pretreatment	Posttreatment
LH's Ability to Communicate (on a scale of 1-10)	5	9
% of LH's Utterances Spouse Understands	41-70%	71-85%
% of LH's Utterances Other People Understands	26-40%	56-70%
Words per Utterance Spouse Understands	3-4	3-4
Number of Words LH Can Understand	6-10	6-10
LH's Number of Initiations per Day	6-10	6-10
Number of Times LH Shows Communication Frustration per Day	2-5	2-5

According to this survey, LH's communication at home improved over the course of this treatment. More specifically, LH's ability to communicate increased from 5 to 9 (on a scale of 1-10 with 10 being the highest score), the percentage of LH's utterances her husband could understand increased from 41-55% to 71-85%, and the percentage of utterances her husband thought that other people (unfamiliar listeners) could understand increased from 26-40% to 56-70%. The number of LH's communication attempts and the amount of words per utterance (MLU) did not increase according to her husband. However, based on his report and feedback from LH's adult children, the content of those utterances did improve at home.

A language sample taken from the videotape of the first baseline session and another from the final treatment session were compared and are reported in Table 7. In the baseline session, LH produced no content words and very few total words. In contrast, during the final treatment session language sample, her total words were limited but every word was a content word.

Table 7

Comparison of LH's language samples

Baseline sample	Total words (TW) and number of content words (CW)	Final treatment session sample	Total words (TW) and number of content words (CW)
I don't know	TW: 4 CW: 0	Yes I know	TW: 3 CW: 3
Uh huh	TW: 0 CW: 0	Yes sad	TW: 2 CW: 2
Okay	TW: 1 CW: 0	Michelle	TW: 1 CW: 1
I don't know	TW: 4 CW: 0	But sad	TW: 2 CW: 2
Ruanz (neologism)	TW: 0 CW: 0	Michelle	TW: 1 CW: 1

Supplemental Control Task

Like other measures, the nonword oral reading task was assessed at the beginning of each session. The nonword oral reading task provided an additional measure of experimental control, such that, if the dependent variable (e.g., content words or MLU) improved and the nonword oral reading variable did not, then the improvement in the dependent variable was thought to be the result of the treatment and not due to extraneous influences in the environment. The results are reported in Figure 10.

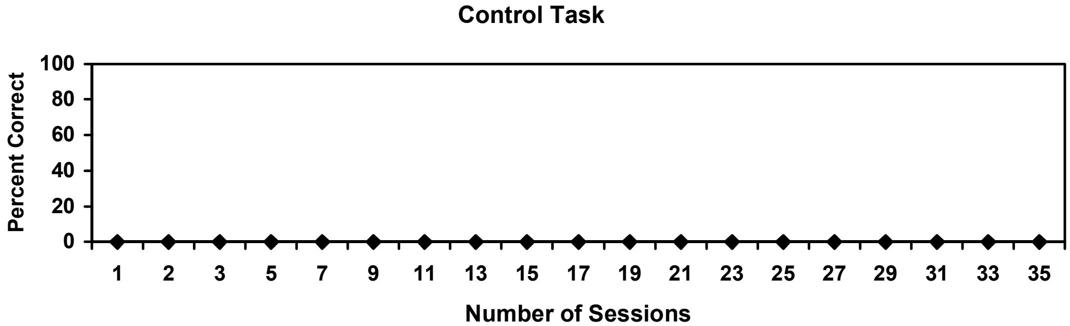

Figure 10. LH'S results for untreated nonword oral reading

Performance on the supplemental control task remained consistently at 0%.

Reliability

Interjudge reliability and procedural reliability were evaluated to assess the reliability of data collection and procedures for treatment by two examiners on one-third of randomly selected sessions. The subjects' utterances were videotaped and assessed independently by two graduate clinicians in speech-language pathology on the following factors: number of content words, MLU, percentage of correct sentences, and steps in the treatment protocol. The interjudge scoring reliability for LH's data was 94%, and the reliability of CV's data was 97%.

Procedural reliability was also calculated to determine if the clinicians performed the same steps in treatment consistently. Reliability of treatment with LH was calculated to be 97%; reliability of treatment with CV was 92%. Both of these reliability scores demonstrated a high degree of interjudge reliability.

CHAPTER 4

DISCUSSION

This study investigated the effects of Response Elaboration Training plus reading on two adult aphasic patients. Only a few previous studies have investigated these individual treatments (Cherney, Merbitz, & Grip, 1986; Kearns, 1985; Kearns & Scher, 1989; Tuomainen & Laine, 1991; & Wambaugh & Martinez, 2000). However, a review of the literature suggested that each of the two treatments, Response Elaboration Training and reading, were individually effective in increasing speech production of some aphasic patients, but no study has combined these two approaches. In addition, no study has examined the effects of these combined treatments in two patients with widely diverse severity levels of aphasia.

Two individuals with Broca's aphasia and co-occurring apraxia of speech (AOS) participated in this study. A multiple baseline designed was used. The experimental procedure consisted of the participant viewing an action picture and producing a complete sentence. If the participant was unable to produce a sentence, then the participant underwent a series of treatment tasks to facilitate sentence production: answering a question about the picture, repeating an appropriate sentence, placing the words of the sentence in the correct order, and reading an appropriate sentence.

We have compared performance on these tasks, to the extent possible, within and across participants and have interpreted these data as they related to the research questions posed in the Introduction. However, because of the vast differences in their response to treatment, most of the analysis of the data collected during the study had to be compared independently rather than across participants. Each participant's results show significant improvement in several areas measured throughout the study, and implications for length of treatment in relation to severity levels are suggested. In this chapter we will discuss our results and conclusions. Questions and implications for further research will also be discussed.

Information Content

The first experimental question asked if information content would improve as a result of the treatment. The results of this study indicate that the answer to this question is yes. Both participants LH and CV showed an improvement in number of content words per sentences but to varying degrees and on different stimuli. First, participant CV showed improvement on the trained stimuli in treatment phase 1; however, greater gains were demonstrated in generalization to untrained stimuli during this time period. An explanation for CV's greater response to untrained rather than trained stimuli is unclear. One explanation would suggest a difference in picture stimuli between Set 1 and Set 2, such as actions that were more familiar or more frequently used by the patient. However, the picture stimuli were randomly assigned to each set. Second, participant LH, who was more impaired, showed greater gains than participant CV in information content. Two possible explanations for their varied improvements might include pretreatment speech production levels and word class effects. Prior to treatment, participant CV was already using content words at the sentence level, whereas participant LH rarely used content words spontaneously. Thus, fewer content words were needed to complete an adequately specified sentence for participant CV. Word class effects may have also contributed to their response to treatment in that nouns are most typically first re-acquired after a stroke, then verbs, then other word classes (e.g., prepositions, adjectives, and adverbs) (Berndt, Mitchum, & Wayland, 1997). CV's sentences consisted primarily of nouns but also some verbs; prepositions were incorrectly used (e.g., substituted one preposition for another) or omitted.

Likewise, LH's few spontaneous utterances were primarily nouns. Through the course of treatment, LH increased information content by increasing her production of nouns and adding production of verbs and prepositions; whereas, CV, who already demonstrated a noun repertoire, gained in some verbs, prepositions, and adjectives. CV's advanced word classes are more difficult to acquire and use than nouns after stroke, and they occur less frequently in sentences than nouns. Third, participant LH demonstrated only small gains during treatment phase 1 but demonstrated large gains during treatment phase 2 to both previously trained Set 1 stimuli as well as to newly trained Set 2 stimuli.

In general, participant LH was slow to respond initially. This pattern of performance is consistent with the idea that providing additional sessions of treatment for severely impaired aphasic patients can be beneficial (Pederson, Jorgensen, Nakayama, Raaschou, & Olsen, 1995). Based on her slow response to treatment in phase 1, participant LH would likely have been prematurely terminated from treatment in a clinical setting. However, with additional sessions of treatment, in this study she was able to demonstrate a significant improvement on both sets of stimuli.

Generalization of Information Content

The second experimental question asked if the treatment to improve information content would generalize to untrained stimuli. Performance on generalization varied by participant. During phase 1 treatment, Participant CV showed a significant amount of generalization to the untrained stimuli, but LH did not. In both participants, their response to generalization on untrained stimuli was consistent with the degree of impairment in aphasia and apraxia of speech such that the milder impaired patient demonstrated more generalization and the severely impaired patient demonstrated no appreciable generalization. However, with additional sessions during phase 2 treatment, LH began to show generalization of information content in the previously trained Set 1 stimuli. Generalization to previously trained Set 1 stimuli was defined as those gains acquired during treatment phase 2 that were beyond previous maximum scores obtained during treatment phase 1 on Set 1 stimuli. Thus, in performance on both trained and untrained stimuli, participant LH showed a trend of slowness to respond and required more sessions to benefit from treatment; this response pattern is consistent with a severely impaired aphasic patient with a co-occurring apraxia of speech. In contrast, participant CV's gains in generalization are consistent with a patient with mild aphasia and co-occurring mild apraxia of speech.

Improving Mean Length of Utterance

The third question posed in this study focused on whether the treatment could facilitate bringing each participant's mean length of utterance (MLU) to a more acceptable level. An acceptable level could be an increase or decrease in MLU. Again, performance varied by participant. MLU improved with participant LH but not with CV. Prior to treatment, participant LH produced too few words per sentence, and participant CV produced an excessive number of words in conversation. Participant LH showed a strong response to treatment and demonstrated gains in MLU both on trained and untrained stimuli, indicating the benefits of a combination treatment with Response Elaboration Training plus reading in a severely aphasic patient. In contrast, based on conversational speech prior to treatment, it was anticipated the MLU for participant CV would decrease with treatment as he eliminated unnecessary and imprecise words from his sentences. However, at the single-sentence level in this experimental task, his performance appeared average in most sessions with approximately 8 words per sentence. One explanation for this level of performance is that the picture constrained the participant to limit the number of words per sentence as compared to spontaneous conversation in which the number of words may be greater than 8 words per sentence. In addition, participant CV was premorbidly verbose. It is unclear whether the increased MLU in baseline sessions 3 and 4 were due to his belief that a longer sentence was better, which was also seen in the unusually high performance during session 12 or to some other explanation, such as the degree of difficulty of the task was too easy for him or due to some degree of spontaneous improvement between semester breaks.

Generalization of Skills Outside the Therapy Setting

The fourth experimental question asked if improvements of communication skills would be evident outside the treatment session. This assessment was measured in two ways: a survey completed by a spouse to evaluate general communication skills and pretreatment and posttreatment performances on the Western Aphasia Battery.

Communication Survey Results

The pretreatment and posttreatment survey was completed for one participant but not the other. Results of the survey for participant LH showed an improvement in 3 areas of communication skills at home. LH's husband reported that he and his adult children noticed a general improvement in her ability to convey her ideas and be understood at home, and he discovered that outsiders (strangers while shopping) could understand more of what she was trying to say. Also, the content of what LH said showed an improvement, according to her husband. Finally, LH's attempts to initiate speech involved mostly gestures and facial expressions before the study, but after the study her attempts to communicate typically included a word as well as a gesture.

Because of his early and unexpected termination from treatment due to health reasons, the posttreatment survey for participant CV could not be completed. Although CV did not complete the full course of treatment, a baseline and final treatment session conversational sample was taken from videotapes of treatment sessions and analyzed to determine improvement at the conversational level. In the conversational samples taken from one baseline session and the final treatment session, a significant decrease in MLU was shown. In addition, content words increased, and total words consisted of a significantly larger percentage of those content words in the sample. Although the sentences from the final sample still contained some errors, the main point CV tried to make was more concise and easier to determine.

A similar language sample was collected from LH's first baseline and final treatment sessions. The results of the sample further show that LH improved her communication skills at the word level by increasing the content of her utterances. However, LH produced no complete sentences during the samples, which supports the data collected during the treatment sessions.

Western Aphasia Battery Results

Pretreatment and posttreatment performances on the Western Aphasia Battery (WAB) were also used to indicate changes in general communication skills. Results are available for participant LH but not for participant CV. Participant LH demonstrated improvement in numerous subtests, including spontaneous speech, auditory comprehension, and reading. These specific areas of improvement correlated to areas targeted in treatment, as well as improvements reported by her spouse and children. For example, the current study's treatment protocol included tasks that focused on auditory comprehension and oral reading as a means to boost verbal output (spontaneous and elicited speech).

In summary, because of LH's improvement in the experimental tasks, pretreatment and posttreatment WAB scores, and observations of her family and unfamiliar listeners, the combination treatment with Response Elaboration Training plus reading was an effective tool for improving communication in a severely impaired aphasic patient with a co-occurring severe apraxia of speech.

Accuracy of Sentence Production

The fifth experimental question investigated the effects of the treatment on verbal production of a correct and complete sentence. This experimental question was added after participant CV was admitted to the current study because his level of speech production (i.e., sentence production) was much higher than the first participant (i.e., a few spontaneous single words). Performance varied by participant: Participant CV demonstrated an improvement in sentence production but participant LH did not. The most plausible explanation for this difference in response to treatment is again due to severity levels of impairment.

In the current study the primary measure for improvement for participant CV was sentence production. Not only did he demonstrate a strong response to treatment on the trained stimuli, he also demonstrated generalization to untrained one-sentence stimuli and even a small degree of generalization to a harder treatment task for untrained two-sentence production tasks. Thus, Response Elaboration Training plus Reading proved to be a very effective combination treatment for participant CV on both trained and untrained stimuli for sentence production.

Although the improvements in information content showed a positive correlation with accuracy of sentence production during most sessions, the increase in content words in session 12 correlates negatively with a slight decrease in sentence production accuracy. This negative correlation shows that one measure does not consistently correspond with the other. As CV produced more words in attempt to make his sentences more complex, his accuracy was not as precise. Therefore, each measure should be monitored individually.

Contrasting Participants in Severity Levels and Response to Treatment, Co-occurring Disorders, Time Postonset, and Complexity of Treatment Tasks

As has been previously described in the literature (Pederson et al., 1995; Mazzoni, Vista, Pardossi, Avila, Bianchi, & Moretti, 1992), each participant's response to treatment was consistent with expectations in accordance with severity levels of disorders. Participant LH was diagnosed with severe aphasia while participant CV was diagnosed with a mild aphasia. Accordingly, participant LH demonstrated improvement at the word level, and participant CV demonstrated improvement at the sentence level. In addition, the length of time to obtain a noticeable improvement varied by severity of impairment: Participant LH, who was severely impaired, required twice as long to respond to treatment as participant CV, who was mildly impaired.

Co-occurring disorders also appeared to play a role in speech performance for both participants but perhaps to a different degree. Participant LH demonstrated a severe apraxia of speech, which markedly interfered with her initiation and motor programming of the initial phoneme of words, thus limiting her speech productions for single-word or longer responses. Participant CV also had a mild-to-moderate apraxia of speech. However, his motor programming difficulties resulted in sound- or word-substitutions that were easily corrected in sentences. Thus, CV's communicative content was slowed and less precise but not nearly as significantly altered by his apraxia of speech, as was LH's performance. Finally, although both participants demonstrated a mild or moderate dysarthria, neither's speech production study was significantly impacted by this disorder.

Length of time postonset of the language disorder has potential to impact speech performance (Basso, 1992; Benson & Ardilla, 1996; Pederson et al., 1995). Participant LH was more than three years postonset when treatment for the present study began, whereas, participant CV's was less than seven months postonset. While participant LH was well past the period of spontaneous recovery, participant CV's performance may have been influenced to some degree by spontaneous recovery as indicated by rising baselines on some of the easier treatment tasks.

As a result of the milder speech impairment of the second participant (CV), complexity of the treatment tasks was adapted by using more complex picture stimuli and adding a more complex sentence-level treatment task. The results of the sentence-production treatment task provided the only data common to both participants. Anticipated performance of these two participants was expected to vary in part based upon complexity of the treatment tasks. Improvement for each participant occurred at the expected level with severely impaired participant LH demonstrating improvement on the easier tasks at the word and phrase levels and mildly impaired participant CV demonstrating improvement at the more complex sentence level. Prior to treatment, LH's produced a few single words spontaneously but the majority of her utterances were word- or phrase repetitions of what others said to her. After treatment, participant LH produced more spontaneous utterances, consisting of words from various word classes. In contrast, prior to treatment participant CV produced sentences that were imprecise and confused. Thus, his sentences did not convey specificity of content, often resulting in unnecessarily long sentences. After treatment, CV produced more precise sentences with fewer redundancies and errors.

The differences between the participants were addressed in treatment through the selection of picture stimuli used during the study. Separate stimuli were used with both LH and CV based on their areas of difficulty and general interests and daily activities. For example, LH's stimuli mainly included pictures of her family's daily activities (e.g., eating breakfast and pouring coffee). Stimuli used with CV were more complex and also included his interests (e.g., playing guitar). The stimuli selection could have contributed greatly to each participant's significant improvements in treatment.

Early Termination of Treatment for CV

Participant CV completed all of treatment phase one and two sessions of phase two before an untimely withdrawal from the current study due to medical problems. Because of his high level of speech production at the sentence level, his primary measurement for improvement in this study was on the sentence production task. Participant CV showed a dramatic improvement during treatment phase one. In addition, as phase two treatment began, participant CV demonstrated a marked response to the new trained stimuli in only two sessions of treatment from 30% to 90% in sessions 14 and 15. Thus, it is possible that participant CV could have reached criterion in only two additional sessions (sessions 16 & 17) in phase two. Thus, although he was unable to complete the second phase of treatment, it was anticipated that his response to treatment was so strong that an early termination would have been indicated regardless of his early withdrawal due to his health.

Based on CV's improvement in the areas of sentence production and information content, the results of the pretreatment and posttreatment administration of the Western Aphasia Battery would have likely shown an improvement in the aphasia quotient. In particular, improvements could have occurred in the spontaneous speech, auditory comprehension, and naming subtests. Also, CV's spouse would have probably reported qualitative improvements in similar areas on the posttreatment survey.

Experimental Controls

The primary measure of experimental control in this study are the baseline phases in which data were collected on each patient's performance before treatment was initiated. The baseline phase occurred during the first three sessions of LH's data and the first four sessions of CV's. For each task monitored for participant LH, baselines were stable, indicating that without treatment each task would likely not have improved on its own. With participant CV, the baseline for the sentence production task was stable, but the baselines for easier tasks such as information content and MLU showed an improvement. Performance on the sentence production task was used as the primary indication of improvement for participant CV because it was the only experimental task with a sufficient degree of difficulty to match his high level of performance prior to treatment. The other experimental tasks were much easier in scope and were more appropriate for the more impaired participant LH. However, because there was another measure of experimental control in this study besides baseline performance and the task most closely monitored to determine CV's improvement was sentence production, the rising baselines for participant CV were thought to be associated with these 2 tasks being too easy for him.

A second means of experimental control implemented in the study was an extended baseline for the participant CV. A fourth baseline session was added, and data were collected to further ensure that performance did not improve over time without treatment.

A third control task implemented for this study was a nonword oral reading task. Each participant's ability to orally read nonwords was monitored throughout each phase of the study. Both participants showed a stable baseline for this task that was never treated. LH showed a consistent performance on this task: at 0% accuracy, and CV's performance remained at 0% accuracy for every session except one, which was 10% correct. Overall, this task provided the study with further control, proving that the treatment was the reason for improvement in targeted areas, not spontaneous recovery of the participants.

Finally, a fourth indicator of experimental control was demonstrated on some of the experimental measures during the baseline phase with Set 2 stimuli. Participant LH's performance on the untrained Set 2 with the information content and sentence production tasks remained stable while Set 1 was trained.

Implications for Further Research

Limitations of the Study

Response elaboration training (RET) is a multimodality treatment approach, targeting both seen pictures or objects and auditory comprehension to increase verbal output. The addition of an oral reading task increases the amount of input, therefore, in theory increasing verbal output. The current study proved to be very successful. However, because the current study only used one treatment, its effectiveness compared to RET alone or any other treatment could not be reported. Future studies that compare this combination treatment to RET only or to a reading treatment only could be beneficial to the advancement and understanding of aphasia treatments. In addition, further study of a comparison of response to treatment by level of severity of impairment would also be helpful in future selections of appropriate treatments.

External Variables

Another interesting concept associated with severely impaired aphasic patients is their vulnerability to influences external to treatment. LH's performance was strongly related to her home or therapy environment, such as changes in clinicians present in the room or significant events happening at home. In addition, her anticipation of treatment ending, knowing that a new clinician would be in the room, or short breaks in treatment were consistently correlated to temporary declines in performance.

Error Patterns

With a severely impaired aphasic patient, it may be more valuable to initially monitor a decrease in errors (e.g., paraphasias and perseverations) rather than an increase in desirable behaviors. Although LH did not show improvement on some of the experimental tasks, this method of recording responses was insufficient to demonstrate other areas of improvement. Specifically, for participant LH one area of improvement was a noticeable decrease in perseverative responses that then allowed her to produce more and a greater variety of single word responses. Because of this decrease in error patterns, future studies that also track a decrease in negative speech production may be a more accurate reflection of progress in severely impaired patients. Thus, an important factor to determine may not be what treatment to use as much as what outcomes of the treatment to measure in many cases.

Determining Treatment Based on Severity and/or Prognosis

Another interesting topic for future research would examine the selection of a treatment that matches the degree of severity level of aphasia. In this study, the more impaired patient and her family demonstrated more satisfaction with her treatment outcome and appeared to more easily observe the progress she had made by their voluntary expressions of improvement during the treatment. Whereas, the milder impaired patient appeared to see less progress with his treatment outcome, and neither the patient nor his wife voluntarily comments on any changes in speech production during the treatment. This study showed that the same treatment could produce different results in patients with very different levels of ability.

Conclusions

As a result of the treatment in the current study, both participants showed significant improvements in verbal communication. Furthermore, each participant made progress in the areas and at the level at which their communication was impaired. For example, LH, who spoke primarily in single or two-word utterances, increased her production of information content words and overall lengths of utterance. CV, who was already a high-functioning aphasic patient and was impaired at the sentence level, improved on the accuracy of complete sentences. The treatment used in the present study was effective with both patients. More importantly, the protocol was tolerated well by both a high and limited functioning participant. The flexibility of the treatment shows that it could be an effective and easy way to tailor the same treatment to patients with a wide range of abilities and areas of difficulty.

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APPENDICES

Appendix A
Data Collection Sheet

#	Utterance	(+/-)	Delay	Errors	CW	TW
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

Appendix B
Control Word Task Data Collection Sheet

Date:_____	**(+)/(-)**	**Production**		**Date:_____**	**(+)/(-)**	**Production**
1. Floy				1. Floy		
2. Pridge				2. Pridge		
3. Smirt				3. Smirt		
4. Crint				4. Crint		
5. Brap				5. Brap		
6. Phane				6. Phane		
7. Jice				7. Jice		
8. Pough				8. Pough		
9. Dack				9. Dack		
10. Hudge				10. Hudge		
Date:_____	**(+)/(-)**	**Production**		**Date:_____**	**(+)/(-)**	**Production**
1. Floy				1. Floy		
2. Pridge				2. Pridge		
3. Smirt				3. Smirt		
4. Crint				4. Crint		
5. Brap				5. Brap		
6. Phane				6. Phane		
7. Jice				7. Jice		
8. Pough				8. Pough		
9. Dack				9. Dack		
10. Hudge				10. Hudge		
Date:_____	**(+)/(-)**	**Production**		**Date:_____**	**(+)/(-)**	**Production**
1. Floy				1. Floy		
2. Pridge				2. Pridge		
3. Smirt				3. Smirt		
4. Crint				4. Crint		
5. Brap				5. Brap		
6. Phane				6. Phane		
7. Jice				7. Jice		
8. Pough				8. Pough		
9. Dack				9. Dack		
10. Hudge				10. Hudge		

Appendix C
Picture Stimuli and Control Task Stimuli

Picture Stimuli
Normative data from five adults, who ranged in age from 45-66, is provided below for each picture stimulus and for oral reading of nonwords. These adults, who do not have aphasia and no known neurological impairments, produced a sentence in response to each picture stimulus. Their responses were adapted from a present progressive verb (e.g., is shaving) to a simple progressive verb (e.g., shaves) to provide the easiest sentence construction for the patient when he/she is unable to produce a target sentence.

LH

1. The man shaves his face.
2. The boy hangs from a tree.
3. The man starts a fire.
4. The man buys a newspaper.
5. The man eats a piece of toast.
6. The woman writes a letter.
7. The boy rides a bike.
8. The man drives a car.
9. The woman talks on the phone.
10. The man drinks a glass of water.
11. The woman mails a letter.
12. The woman reads a book.
13. The woman pours a cup of coffee.
14. The man vacuums the carpet.
15. The man looks at a map.
16. The woman cuts a cake.
17. The man fixes his tie.
18. The woman cooks an egg.
19. The boy watches television.
20. The man fixes her bike.

CV

1. The woman is vacuuming under the woman's feet.
2. The woman is making the bed.
3. The man and girl are looking at the flowers.
4. The man and boy are fishing in the lake.
5. The lifeguard is watching the swimmers in the pool.
6. The waitress is waiting to take an order.
7. The woman is looking at a video in the video store.
8. The girl is icing the cake.
9. The man is hitting the tennis ball.
10. The woman is picking up a prescription.
11. The woman is changing a flat tire.
12. The man is playing a guitar.
13. The man is cracking an egg in the skillet.

14. The man and woman are laughing.
15. The woman and girl are taking pictures.
16. The veterinarian is listening to the dog's heart.
17. The woman is getting money out of an ATM.
18. The man is playing solitaire.
19. The woman is sewing a button on a shirt.
20. The man is looking at a blueprint of a building.

Set 3 Stimuli for CV

1. The man surprises the woman. / The woman is drinking coffee.
2. The man burned a hole in the shirt. / The man was ironing a shirt.
3. The man is buying luggage. / The man is at a flea market.
4. The man and woman are at a zoo. / They are looking at two elephants.
5. The girl is tying a bow on the flower basket. / She is making a bouquet.
6. People are waiting for the bus. / They are sitting in a bus stop.
7. The man is swimming in the pool. / The water is blue.
8. The dentist is fixing the patient's tooth. / She has her mouth open.
9. The woman is shopping in the grocery store. / She is buying vegetables.
10. The children are waiting to get on the bus. / The bus door is open.

Control Task Words

1. bloud
2. pridge
3. stune
4. crint
5. trupt
6. phane
7. jice
8. pough
9. poldier
10. mool

Appendix D
Pre- and Posttreatment Survey

Name:______________________________ **Date:_________**

Relationship to Patient:___________________________________

---

1. On a scale of 1-10 (1 = not able; 10 = extremely able), how would you rate your family member's ability to communicate? _________________

2. What percentage of your family member's utterances are you able to understand? (Circle One)

   <25% 26-40% 41-55% 56-70% 71-85% >85%

3. What percentage of your family member's utterances do you think other people understand (i.e., strangers, unfamiliar individuals)? (Circle One)

   <25% 26-40% 41-55% 56-70% 71-85% >85%

4. On average, how many words per utterance do you understand? (Circle One)

   1-2 3-4 >5

5. On average, how many words per utterance does your family member understand? (Circle One)

   one word 2-5 5-10 >10 words

6. On average, how many conversations does your family member initiate with you per day? (Circle One)

   1 2-5 6-10 >10

7. On average, how many times per day does your family member exhibit COMMUNICATION frustration? (Circle One)

   1 2-5 6-10 >10

Appendix E
Training Protocol

Response Elaboration Training (RET)

STEP 1
The clinician will show the patient a picture and say, “Tell me one sentence about this picture.”

a) If the patient produces a correct response, the clinician will reinforce by repeating the sentence. Then, the treatment will proceed to the oral reading phase.
b) If the patient produces at least one content word, but the response is still incorrect, the clinician will say, “Good,” then use the correct content words given by the patient to form a more appropriate sentence.
c) If the patient produces no content words, the clinician will model the appropriate sentence as determined by the normative data.

STEP 2
The clinician will ask a question, such as, “What is going on in this picture?”

a) If the patient produces a correct response, the clinician will reinforce by repeating the sentence. Then, the treatment will proceed to the oral reading phase.
b) If the patient produces at least one content word, but the response is still incorrect, the clinician will say, “Good,” then use the correct content words given by the patient to form a more appropriate sentence. These words may be different than those produced during the first step. However, the clinician will use the content words just produced.
c) If the patient produces no content words, the clinician will model an appropriate sentence as determined by the normative data.

STEP 3
The clinician will say “Now you try and say the whole thing,” then model an appropriate sentence by using the final sentence from Step 2.

a) If the patient correctly repeats the modeled sentence, fully or partially, the clinician will say, “Good,” then repeat the sentence again and proceed to the oral reading phase.
b) If the patient uses appropriate words that were not just modeled, the clinician will use the new words to form another appropriate sentence and proceed to the oral reading phase.
c) If the patient fails to produce any content words, the clinician will model the appropriate sentence again, then proceed to the oral reading phase.

Oral Reading Phase

STEP 1
The picture stimulus will remain on the table in front of the patient. Then, from the last appropriate sentence in the preceding RET phase, the clinician will write each word (one word per card) in lower case letters; however, the first word will be written with a capital letter. As the clinician writes each word, she will orally read it and show it to the patient before the patient places it on the table in front of him/her.

STEP 2
Then, the clinician will orally read the entire sentence - slowly and with pauses – while pointing to each written-word cue card.

STEP 3
The clinician will scramble the written-word cue cards and ask the patient to arrange the words in the right order for the sentence: "Arrange these words in the right order."

a) If correct, the clinician will reinforce, then proceed to Step 4.
b) If incorrect, the clinician will orally read the sentence the patient has constructed, while pointing to each word individually.
    1) If the patient recognizes his/her own error(s), he/she will be given up to 15 seconds to self-correct. If correct, reinforce, and proceed to Step 4.
    2) If the patient does not recognize his/her own error(s), the clinician will arrange the written words in the correct order, orally read the sentence, and proceed to Step 4.

STEP 4
The clinician will instruct the patient to orally read the sentence: "Read this sentence out loud."

a) If correct, reinforce, and proceed to Step 5.
b) If incorrect, the clinician will orally read the sentence, again ask the patient to orally read the sentence, then proceed to Step 5.

STEP 5
The clinician will remove the written-word cue cards from the table, present the picture stimulus only, and ask the patient to verbally produce one sentence about the picture: "Tell me one sentence about this picture."

STEP 6
Proceed to the next picture stimulus for RET phase treatment.

VITA

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