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EFFECTS OF RESPONSE ELABORATION TRAINING ON SENTENCE PRODUCTION OF PERSONS WITH CHRONIC AGRAMMATIC APHASIA

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THESIS

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Science in the
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By

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ABSTRACT OF THESIS

EFFECTS OF RESPONSE ELABORATION TRAINING ON SENTENCE PRODUCTION OF PERSONS WITH CHRONIC AGRAMMATIC APHASIA

Purpose: Response Elaboration Training (RET) is a treatment program for increasing the amount of information contained in the speech of individuals with aphasia. This study employed a sentence production task (SPT) to examine whether RET will (1) generalize to a task not worked on in treatment and (2) affect syntactic performance.

Methods and Procedures: Three adults with chronic non-fluent Broca's aphasia received RET in this prospective, repeated case study. The dependent variable was a SPT requiring the participant to put a verb in a sentence. Changes in the syntactic performance of the participant's sentence productions were classified across three parameters: (1) syntactic structure, (2) grammatical completeness, and (3) semantic appropriateness.

Results: Findings of this study indicate that RET improves the syntactic performance of individuals with chronic Broca's aphasia and generalizes to a task not worked on in treatment. Participant responses to the SPT showed increased complexity in syntactic structures, improved grammaticality, and improved topic relevancy. In addition, qualitative improvements were seen in 5 randomly selected verbs for each participant. These improvements included increased length of sentences and fewer false starts, interjections, and disfluencies. Finally, improvements on the *Western Aphasia Battery* and two picture description tasks were evinced for two participants.

KEYWORDS: Response Elaboration Training, sentence production task, Broca's aphasia, agrammatism, intervention

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This thesis is dedicated to my parents for their love, endless support, and encouragement

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Chapter One

Introduction

Aphasia is "an acquired selective impairment of language modalities and functions resulting from a focal brain lesion in the language-dominant hemisphere that affects the person's communicative and social functioning, quality of life, and the quality of life of his or her relatives and caregivers" (Papathanasiou, Coppens, & Potagas, 2011, p. xx). Two broad categories of aphasia, fluent and non-fluent, have been recognized in the literature (Damasio, 1981; Goodglass & Kaplan, 1983a). Patients with fluent aphasia have normal or near normal speech rates and use a variety of different grammatical constructions. Function words and grammatical inflections are present in the speech of these individuals and usually grammatically appropriate. Non-fluent aphasic patients, conversely, have slow, labored speech. The variety of grammatical constructions used by these patients is markedly restricted, and intonation may be reduced or absent; function words and grammatical morphemes may be omitted, and the patient's speech may largely consist of nouns (Howard & Hatfield, 1987). Much aphasia research has focused on recognizable syndromes of aphasia nested within the broader categories of fluent (Wernicke's, conduction, transcortical sensory, and anomic aphasia) and non-fluent (Broca's, global, and transcortical motor aphasia) aphasia (Benson, 1979; Damasio, 1981; Goodglass & Kaplan, 1983a). Largely, the focus of this research has been to identify patterns of language impairment associated with each syndrome and correlate these observations with areas of the brain that have been damaged and/or disconnected from one another by the causative lesions (Benson & Ardilla, 1996; Goodglass, Quadfasel, & Timberlake, 1964; Kertesz, Lesk, & McCabe, 1977).

This study focuses on the most commonly occurring syndrome of aphasia, Broca's aphasia (Benson, 1979). Broca's aphasia, also referred to as expressive aphasia, motor aphasia, anterior aphasia, and non-fluent Broca's aphasia (Brookshire, 2007; Thompson, 2008), usually results from large lesions affecting the lower part of the premotor cortex (Brodmann areas 44 and 45), adjacent areas of the motor cortex, insula, and sometimes portions of the basal ganglia (Damasio, 2008). Areas of the brain damaged in Broca's aphasia include portions of the pre-motor and adjacent motor cortex and are felt to be important for the planning, programming, and execution of speech movements. For this reason, two motor speech disorders, apraxia of speech (AOS) and unilateral upper motor neuron (UUMN) dysarthria may co-occur with Broca's aphasia. Duffy defines AOS as "a neurogenic speech disorder resulting from impairment of the capacity to program sensorimotor commands for the positioning and movement of muscles of the volitional production of speech (Duffy, 1995, p. 5). UUMN dysarthria also co-occurs with Broca's aphasia, but less frequently, and can impact speech intelligibility (Duffy, 1995; Kearns, 2005).

Controversy exists and will certainly continue to exist as to whether or not the speech characteristics of patients with Broca's aphasia reflect problems with language, motor programming/planning, speech execution, or a combination of these processes (Buckingham, 1979; Martin, 1974; McNeil, Robin, & Schmidt, 1997; Mohr et al., 1978). Nevertheless, this has not prevented researchers from studying the speech of patients with non-fluent Broca's aphasia in some detail. Generally, the utterances of the patient with Broca's aphasia are short, produced with effort, and impaired grammatically (Kearns, 2005). Many of the sounds, syllables, and words produced by the patient are

misarticulated and/or distorted, with these errors manifested on both consonants and vowels (Brookshire, 2007). In many cases the patient's speech may consist of an overproduction of content words, usually nouns, and a marked underproduction of function words and grammatical morphemes (Goodglass, 1973; Thompson, 2008). Patients with less-severe Broca's aphasia have been described as having "telegraphic" speech. Those with a more severe form of the aphasic syndrome have been described as having "agrammatic" speech (Thompson, 2008).

Agrammatism, according to Thompson (2008), refers to a pattern of faulty sentence production in which grammatical structure is reduced or absent. Agrammatic patients use strings of content words (e.g. beach, Sunday, Mary) and have more problems producing verbs as compared to nouns (Kohn, Lorch, & Pearson, 1989; Kim & Thompson, 2000, 2004; Thompson, Lange, Schneider, & Shapiro, 1997; Williams and Canter, 1987; Zingeser & Berndt, 1990). Research has shown that when patients with Broca's aphasia use verbs, the sentences in which they appear are usually simple, subject-verb-object constructions (e.g., Mary go beach; Saffran, Berndt, & Schwartz, 1989; Caplan & Hanna, 1998). Thompson (2008) indicates that when patients with Broca's aphasia use verbs in sentences, the arguments of the verb are often omitted or placed in the wrong order around the verb. Other studies have shown that verb inflections are often absent in the sentence production of patients with Broca's aphasia. Production of grammatical/functional morphology, including verb inflections (tense, agreement), complementizers (if, whether, that) and use of other free-standing morphemes is also a problem for the individual with agrammatic Broca's aphasia (Benedet, Christiansen, & Goodglass, 1998; Bird, Franklin, & Howard, 2002; Caramazza & Hillis, 1989; Druks &

Carroll, 2005; Faroqi-Shah & Thompson, 2007). Finally, there is some research to show that agrammatic Broca's aphasic patients are not totally without comprehension deficits. Thompson (2008) notes that these patients have difficulties understanding noncanonical and reversible sentences. It has also been noted that some patients have problems understanding relational words such as bigger or smaller (Hedge, 1998).

Treatment of non-fluent Broca's aphasia seeks to improve patients' production of spoken sentences and short narratives. This addresses the patient's biggest frustration, lack of speech, and the fact that most patients with Broca's aphasia comprehend well in contextual communication situations (Kearns, 2005). In addition, several studies have shown that grammatical knowledge is not lost in Broca's aphasia and that many patients can detect grammatical errors in spoken messages (Linebarger, Schwartz, & Saffran, 1983; Shankweiler, Crain, Gorrelli, & Tuller, 1989; Wulfeck, 1988; Wulfeck, Bates, & Capasso, 1991). Typically treatment of the patient with Broca's aphasia has been syntax-driven and addressed agrammatism. Thus, a clinician might work to increase utterance length, increase the variety and complexity of the patient's sentence constructions, improve the patient's ability to produce syntactically correct sentences, and/or increase the use of bound morphemes. A few selected examples of these syntactically-driven programs will be reviewed here.

The Helm Elicited Language Program for Syntax Stimulation (HELPSS; Helm-Estabrooks, 1981) focuses on increasing and improving the patient's production of sentences with increasing levels of complexity. The HELPSS uses a story-completion format to elicit target sentence structures that are then systematically trained at two levels of difficulty. Helm-Estabrooks and her colleagues (Helm-Estabrooks & Albert, 1991;

Helm-Estabrooks, Fitzpatrick, & Barresi, 1981; Helm-Estabrooks & Ramsberger, 1986) observed that individuals who received treatment with HELPSS demonstrated improved sentence productions on post-test studies. Other researchers (Doyle and Goldstein, 1985; Fink, et al., 1995; Salvatore, 1985) found that the benefits of HELPSS were restricted to items worked on in treatment and that generalization to other tasks was rare.

Loverso, Prescott, and Selinger (1988) developed a sentence production training program designated as Cueing Verb Treatment (CVT). CVT is based on the premise that verbs are pivotal in forming grammatical sentences and that verbs are often disrupted in Broca's aphasia. CVT is generally administered by presenting 'subject-verb' or 'subject-verb-object' picture stimuli (e.g., picture of a boy reading a book) and asking the patient wh-questions (what's the boy doing?; who is reading?; what's the boy reading?) to eventually lead to production of a short sentence (the boy is reading a book). As the patient improves his or her ability to respond to the wh-prompts the cues are gradually withdrawn. Patients with Broca's aphasia have been found to improve their sentence productions following CVT with some generalization to conversation and accompanying improvement on standardized tests (Loverso & Milione, 1992; Loverso, Prescott, and Selinger, 1988; Loverso, Selinger, and Prescott, 1979).

Mapping Therapy (MT) addresses both deficits in sentence production and comprehension and is based on the fact that grammatical knowledge is frequently retained or only moderately impaired in individuals with Broca's aphasia (Mitchum & Berndt, 2008). MT targets the relationship between sentence structures and thematic roles in canonical and noncanonical constructions. Stimuli are presented in written format and individuals are instructed to underline the agent and theme roles in response

to wh-questions concerning the logical subject and object of the sentence. Several studies have found that patients with Broca's aphasia improve their ability to produce trained sentences following MT (Byng, 1988; Marshall, 1995; Mitchum & Berndt, 2008; Mitchum, Greenwall, & Berndt, 2000; Rochen, Laid, Bose & Scofield, 2005; Schwartz, Saffran, Fink, Myers, & Martin, 1994), but Thompson (2008) in her review of studies of MT points out that generalization to untrained sentences was limited.

Thompson and her colleagues (Thompson, 2008; Thompson & McReynolds, 1986; Thompson & Shapiro, 1994) describe an approach for treating underlying linguistic representations of sentences. In the Treatment of Underlying Forms (TUF) program, sentences are presented in the active form and patients are taught to identify the verb, verb arguments, and thematic roles. Instructions are then provided on how to move the sentence constituents to form different surface forms of target sentences. Studies report that individuals who receive TUF demonstrate improved sentence productions and comprehension with limited generalization across sentences (Thompson, 2008).

Response Elaboration Training (RET; Kearns, 1985, 1986) has also had widespread appeal as a means of treating Broca's aphasia. Unlike HELPSS, CVT, MT, and TUF which target syntactic processes, RET is content-driven and seeks to increase the amount of verbal information contained in the patient's spoken utterances. One of the hallmarks of RET is a "loose training" and forward chaining technique that encourages the patient to elaborate on his or her spontaneously produced utterances instead of working to produce a response preselected by the clinician. In administering RET, the clinician presents the client with a situation or action picture and provides a general prompt such as "What's happening here?" The clinician then encourages the client to

elaborate upon his or her novel response using forward chaining and wh-questioning prompts. Thus, individuals receiving RET direct the content of their own therapy, and the clinician's role is to encourage and reinforce the spontaneous utterances produced by the patient (Kearns, 2005).

RET has a substantial amount of empirical support (Bennett, Wambaugh, Nessler, 2005; Gaddie, Kearns, Yedor, 1991; Kearns 1985, 1986; Kearns and Scher, 1989; Kearns and Yedor, 1991; Nessler, Wambaugh, & Wright, 2009). Studies have shown that RET results in an increase in the amount and variety of informational content produced in the picture descriptions of patients with Broca's aphasia with a moderate degree of generalization across speaking partners, stimuli, and settings (Bennett, Wambaugh, Nessler, 2005; Gaddie et al., 1991; Kearns, 1985, 1986; Kearns & Yedor, 1991). In addition, RET procedures have been combined successfully with other treatments such as semantic feature analysis (Conley & Coelho, 2003) and speech sound production treatment (Wambaugh & Martinez, 2000; Wambaugh, Martinez, & Alegre, 2001) with similar successful results.

The aphasia treatment literature has consistently shown that patients with Broca's aphasia benefit from RET. This literature, specific procedures, and the theoretical basis of RET will be presented in Chapter 2. The present study sought to add to the existing aphasia literature by addressing two important and unanswered questions about the use of RET. The first question has to do with how treatment effects of RET are assessed. To date, this has largely been done by having the subjects receiving RET describe the same situation/action pictures used in therapy without the wh-prompts and forward chaining cues. This limits conclusions about the effectiveness of RET because the patient has seen

these pictures on repeated occasions in therapy. To address this issue, RET effects need to be quantified with a task that does not provide the visual support of the pictures used in treatment and was different from the treatment task itself.

The second question of interest in this study relates to the influence of RET on syntax. Effects of RET have not been examined with regard to their influence on features of syntax. Syntax-driven therapies, as mentioned earlier, have resulted in limited generalization to untreated stimuli. The loose training component of RET, however, differs significantly from the clinician-selected target responses of syntactic-driven approaches such as HELPSS, CVT, MT, and TUF. Thompson (1989) has maintained that loose training is integral to implementing generalization in therapy because it more closely approximates naturalistic conversation. Thus, while the effects of RET on syntactic abilities have not been assessed, the loose training component of RET that has been shown to improve the content of spoken narratives of patients with Broca's aphasia, might also result in improvements in syntactic production. This would be predicted inasmuch as the loose training component of RET permits the clinician to train more exemplars, which should generalize to syntactic structures.

Purpose of Study

This treatment study sought to answer two questions concerning the effects of RET on the spoken sentence productions of three individuals with Broca's aphasia:

(1) Will the effects of RET be seen in the verbal performance of individuals with Broca's aphasia on a task that was not used in treatment?

(2) Does RET affect the syntactic performance of individuals with Broca's aphasia?

Chapter Two

Review of the Literature

The goals of this chapter are to (1) provide a description of Response Elaboration Training (RET), (2) overview the procedures in RET, (3) report the research findings from the clinical studies using RET, and (4) summarize the impact of RET on the communication of persons with aphasia.

RET

RET was developed by Kevin Kearns in the mid-1980s (1985) and continues to have widespread appeal in clinical settings. The purpose of RET is to increase the amount and variety of information contained in the spoken utterances of individuals with aphasia (Gaddie, Kearns, & Yedor, 1991; Kearns, 1985, 1986; Kearns & Yedor, 1991). RET has primarily been employed to treat individuals with nonfluent Broca's aphasia, but RET has also been used successfully with individuals with fluent aphasias (Kearns and Scher, 1989; Nessler, Wambaugh, & Wright, 2009; Yedor, Conlon, Kearns, 1993) and apraxia of speech (Wambaugh & Martinez, 2000; Wambaugh, Martinez, & Alegre, 2001).

A unique feature of RET is its "loose training" approach. Loose training is traditionally associated with child language therapies (Campbell & Campbell, 1982; Hart & Risely, 1982, 1974) and has been shown to be effective in promoting generalization of what is worked on in treatment to other communication partners and settings (Baer, 1981). Numerous researchers have reported that loosening and diversifying treatment parameters reduce the difference between treatment conditions and functionally relevant settings, thereby facilitating the transfer and carryover of skills developed in the clinic to

natural environments (Baer, 1981; Hughes, 1985; Stokes & Baer, 1977; Thompson and Byrne, 1984). As a treatment for patients with Broca's aphasia, RET differs from "clinician-directed" therapies, in which the clinician reinforces the patient for productions that conform to predetermine responses. RET loosens clinician's control over patient's responses by encouraging spontaneous utterances and reinforcing creative language use. By loosening the patient's response parameters, RET enables the patient to direct the content of his or her own therapy and facilitates generative responding.

RET is administered using a forward-chaining technique. Treatment stimuli usually consist of photographs or line drawings of a person or persons engaged in some form of activity. The clinician begins the treatment by showing the patient a stimulus item and eliciting a response with a general prompt such as "What do you see happening in this picture?" The patient's novel utterance is then expanded upon by asking wh-questions. The clinician uses the patient's elliptical utterances as building blocks to develop more elaborate responses. With each new patient-initiated response, the clinician adds the response to the chain, shapes it into a sentence, and models the sentence for the patient to repeat.

Steps of RET

The steps of RET for one stimulus item are presented in Table 2.1. Here it can be seen that RET is a 6-step procedure. The clinician begins by showing the patient a picture and prompts the patient to describe the activity depicted in the picture (Step 1). After the patient produces a response with at least one content word relevant to the initial prompt, the clinician provides reinforcement and expands and shapes the patient's utterance (Step 2). The clinician then asks a wh-question to stimulate additional

information (Step 3). After the patient produces a second response containing relevant content information, the clinician reinforces the patient and combines and shapes the two patient's responses into a sentence (Step 4). Next, the clinician models the sentence and requests that the patient repeat the model (Step 5). The clinician reinforces the patient and provides a second model of the sentence (Step 6).

Table 2.1 Steps of RET for a picture of a man cooking.

Step	Clinician	Patient
1	Verbal instruction and stimulus presentation e.g., "*Tell me about this picture*."	Spontaneous Description e.g., "*Cooking*"
2	Reinforcement, expansion, shaping e.g., "*Good. The man is cooking.*"	No Response
3	"Wh" Cue e.g., "*Why is he cooking*?"	Elaboration e.g., "*wife…hungry*"
4	Reinforce, combine patient responses, shape e.g., "*Great. The man is cooking because his wife is hungry*."	No Response
5	Request repetition, model e.g., "*Try to say the whole sentence after me. Say, the man is cooking because his wife is hungry.*"	Imitation e.g., "*Cooking because wife hungry*"
6	Reinforce, model e.g., "*Nice going! The man is cooking because his wife is hungry.*"	

Opportunities for the clinician to prompt, elaborate, and shape patient-initiated responses are provided throughout RET to help the patient effectively communicate more information. In this procedure, the emphasis is on scaffolding and reinforcing the patient's novel and varied utterances. The patient is required to assume the primary burden of communication insofar as his or her responses serve as the primary focus of treatment. The clinician merely guides the patient to ensure that the content of his or her responses and subsequent elaborations are informative.

Clinical Research

The usefulness of RET as a treatment for nonfluent agrammatic aphasia has substantial support from a series of single-subject experiments employing multiple baseline designs (Bennett, Wambaugh, Nessler, 2005; Gaddie, Kearns, & Yedor, 1991; Kearns 1985, 1986; Kearns and Scher, 1989; Kearns and Yedor, 1991; Nessler, Wambaugh, & Wright, 2009). Most of these studies have shown that RET increases the amount and variety of informational content produced in the picture descriptions of patients with aphasia with a moderate degree of generalization across speaking partners, stimuli, and settings (Bennett, Wambaugh, Nessler, 2005; Gaddie, Kearns, & Yedor 1991; Kearns, 1985, 1986; Kearns & Yedor, 1991). RET has also been combined successfully with other treatments such as semantic feature analysis (Conley & Coelho, 2003) and speech sound production treatments for apraxia of speech (Wambaugh & Martinez, 2000; Wambaugh, Martinez, & Alegre, 2001). Findings from nine published studies on RET will be summarized below.

Kearns (1985, 1986) investigated the effects of RET by measuring the amount of verbal information contained in responses to picture stimuli using baseline and clinical probe data for one subject with chronic Broca's aphasia. The researcher also sought to determine whether gains from RET would generalize to untrained picture stimuli and to improved scores on a standardized aphasia test. Thirty picture stimuli were divided into three sets of 10. Sets 1 and 2 were used for treatment and set 3 was used to assess generalization. Treatment was conducted in two phases. In phase 1, the participant received RET for the items in set 1 until reaching a production criterion level of 5 or more content words on 8 out of the 10 items on a single clinical probe. Phase 2 treatment

was identical to phase 1, except the items in set 2 were administered for treatment. The subject reached the criterion level for both phases after receiving a total of 21 treatment sessions with RET administered 3 times per session. A modest degree of generalization to untrained stimuli was also observed. During baseline testing, the subject produced one response with 5 content words on the generalization items. By the end of the treatment, he was consistently producing responses with at least 5 content words on half of the 10 items in the untrained, generalization set. Generalization was further evaluated by comparing pre- and post-treatment scores from the *Porch Index of Communicative Ability* (PICA; Porch, 1981). Following RET intervention, the subject revealed slight improvements on the four verbal subtests of the PICA: description, naming, sentence completion, and repetition. Results therefore suggest that RET is effective for increasing the amount of verbal information produced in response to pictures used in training with moderate generalization to untrained stimuli and improved performances on the verbal subtests of the PICA.

Kearns and Scher (1989) examined the effects of RET on responses to picture stimuli for three subjects with conduction, anomic, and Broca's aphasia. The researchers also sought to investigate whether RET improvements would be maintained after the cessation of treatment and generalize to (a) untrained stimuli, (b) different persons, (c) different settings, and (d) spontaneous discussions. The treatment methods in this study were administered in a similar manner as Kearns' original investigation (1985). Performance criterion levels for sets 1 and 2 items were individualized for each subject prior to treatment. The subject with conduction aphasia reached his production criterion for sets 1 and 2 items after approximately 26 RET sessions. Generalization to

spontaneous conversation and across settings and clinicians was observed. Improvements were maintained on three monthly follow-up probes. The subject with anomic aphasia met his individualized production criterion for set 1 after 7 sessions of RET and for set 2 after an additional 4 sessions. Moderate amounts of generalization to untrained stimuli, different clinicians, and spontaneous speech were observed. Gains made on the trained and untrained items were maintained on a 2-week follow-up probe. The subject with Broca's aphasia met his production criterion for set 1 after 34 RET sessions; he did not meet his production criterion for set 2 items and treatment was discontinued after 55 treatment sessions. Some generalization to untrained picture stimuli and spontaneous conversation was seen for this subject. Higher levels of generalization occurred across different people and settings. Performance gains were maintained 5 months after treatment was discontinued. Results from this study therefore provide additional support for the effectiveness of RET to increase the verbal output of people with aphasia in response to picture stimuli and to promote generalization to different people, stimuli, settings, and situations. Moreover, follow-up probes revealed that gains made secondary to RET may be maintained months after the cessation of treatment.

Gaddie, Kearns, and Yedor (1991) conducted a third RET study similar to Kearns' 1985 study. However, in addition to measuring the number of content words in response to picture stimuli, the researchers qualitatively analyzed the responses for efficiency and variety. Efficiency was analyzed using a ratio of content words per total words. Variety was measured by comparing the number of content words to the number of novel content words. The subjects in this study were three individuals with chronic

Broca's aphasia. All the subjects met their individualized criterion level for both sets of the treatment stimuli. The number of RET sessions needed to complete the two phases of treatment ranged from 13 to 150 sessions. A moderate degree of generalization to untrained picture stimuli was seen in each of the subjects. The descriptive analysis revealed that, as the subjects' utterances increased in length throughout the intervention period, the subjects maintained their levels of efficiency of relevant information and increased the variety of their responses. Results therefore support the effectiveness and generalizability of RET and indicate (a) that the observed increases in the subjects' responses corresponded to an increase in informational content and (b) that the increased length of their responses was not simply the result of adding additional content words to standard "rote" responses.

Kearns and Yedor (1991) measured the amount and variety of information produced in response to picture stimuli and in elicited speech samples to compare the effects of RET and convergent treatment (CT) tasks on two females with chronic Broca's aphasia. Unlike the "loose training" approach used in RET, CT tasks facilitate language use by eliciting high-probability target responses from the patient (Chapey, 1981, 2008). Procedurally, RET and CT were administered in the same way in this study, except that the researchers used open-ended wh-prompts to expand the participants' utterances when administering RET, whereas graphic- and wh-cues were used to elicit specific content words during the CT tasks. Treatment stimuli consisted of 30 pictures separated into 6 sets of 5 pictures. Four of the sets were used for training (2 sets for RET and 2 sets for CT) and the remaining 2 sets were used, separately, to assess generalization effects of RET and CT. Both RET and CT were administered twice per treatment session to the

subjects. A multiple-baseline design across behaviors with an alternating treatment component was used for experimental control (Barlow & Hayes, 1979). Data from the study showed that RET facilitated greater increases in the length and variety of responses than the training effects of CT. Generalization and maintenance were also noted to be greater in response to RET. For instance, performance criterion was achieved on every RET-trained set for both of the subjects, but criterion for the trained CT items was met on only one set by one of the subjects. Moreover, in every condition in which generalization occurred, the subjects' utterances contained more information in response to RET than CT. Results from this study suggest that the "loose training" approach of RET may be more effective at facilitating elaborate utterances in response to picture stimuli than a clinician-directed approach such as CT.

Bennett, Wambaugh, and Nessler (2005) examined the stimulus generalization effects of RET across three discourse conditions ((1) trained and untrained picture descriptions, (2) 5 minute personal recounts, and (3) home conversations with spouse) for an individual with chronic Broca's aphasia and apraxia of speech. The subject demonstrated large increases in the production of correct information units (CIUs; Nicholas & Brookshire, 1993) on the 2 sets of trained picture stimuli items, the generalization set of pictures, and personal recounts. A slightly smaller amount of generalization to the home-conversation context was observed in this study. Results therefore continue to support the effectiveness and generalizability of RET on the production of content for individuals with Broca's aphasia.

Nessler, Wambaugh, and Wright (2009) investigated the treatment and generalization effects of RET on the productions of CIUs (number of CIUs and

efficiency) on trained and untrained pictures and on unrehearsed personal narratives for two persons with chronic fluent aphasia (subjects' aphasia classifications were transcortical sensory aphasia and Wernicke's aphasia). Changes in the subjects' functional communication skills were reported from pre- to post-treatment on the *Communication Activities of Daily Living-Second Edition* (CADL-2; Holland, Fratalli, & Fromm, 1999) and *Communication Effectiveness Index* (*CETI*; Lomas, et al., 1989). Pre- and post-treatment performances on the PICA and *Western Aphasia Battery* (WAB; Kertesz, 1982) were also provided. Clinical probe data on the number of CIUs and efficiency of communication produced by the subjects in response to picture stimuli and in their personal recounts were analyzed using a dual criteria method to determine whether positive treatment effects could be concluded from the study. Neither of the subjects demonstrated positive treatment effects for the number of CIUs produced in any of the three treatment conditions; however, positive findings were seen in efficiency of CIU productions for the trained items in set 1 by both subjects. Generalization to the untrained picture set was not observed for either subject. Post-testing revealed improved scores on the functional communication assessments and on the standardized aphasia tests. Results from this study suggest that RET may be an effective treatment procedure for increasing the efficiency of communication on picture descriptions and may lead to improved performances on standardized aphasia assessments for individuals with chronic fluent aphasia.

Several investigations have examined the effects of combining RET with other treatment procedures. Wambaugh and her colleagues (Wambaugh & Martinez, 2000; Wambaugh, Martinez, & Alegre, 2001) modified RET for use of individuals with Broca's

aphasia and moderate-to-severe apraxia of speech (AOS). Specifically, their version of RET incorporated additional modeling, repeated practice, and integral stimulation. The treatment and generalization effects of the modified RET were assessed by measuring the number of CIUs produced in response to trained and untrained picture stimuli and in personal recounts by 3 subjects with chronic Broca's aphasia and AOS (Wambaugh & Martinez, 2000). Positive findings were reported for the subjects' productions of CIUs on the trained items, the untrained items, and the personal recount in this study. Two of the three subjects (speakers 1 and 3) met their performance criteria for the trained items following 13 to 30 RET sessions per set. Generalization to untrained stimuli was observed for speakers 1 and 3, and their treatment gains were maintained four weeks later on a follow-up probe. Speaker 2 did not meet the performance criteria for set 1 items after receiving 50 RET sessions; however, her performance criteria was reached on the next set of items following approximately 8 RET sessions. Sixty RET sessions were extended to the trained items to try to promote additional improvements. Speaker 2's performance on the generalization items was comparable to her performance on the trained items, and the gains she made in response to treatment were maintained above baseline levels on the one-month follow-up probe. Results from this study indicate that modifying RET to make treatment more amendable for application of people with AOS can be effective.

In a subsequent study, Wambaugh and her colleagues (2001) qualitatively analyzed the verbal productions exhibited in the picture descriptions and personal recounts of two subjects from the researchers' previous RET investigation (Wambaugh & Martinez, 2000). Specifically, the researchers sought to describe the changes in the

lexical type (e.g., nouns, verbs, adjectives, articles) of the content words the subjects produced resulting from treatment. Baseline and clinical probe data were also analyzed for the production of noun phrases, verb phrases, well-formed sentences, the number of different nouns and different verbs, and the mean length of utterance. Findings indicated that increases in the number of nouns produced accounted for the majority of verbal improvements for both subjects, but subject 2 produced markedly more variation in lexical type following RET intervention. Both subjects also evinced increases in the number of noun phrases and verb phrases in response to treatment. Results from this study therefore suggested that lexical changes may occur with increased word productions following the application of the modified RET procedure for individuals with Broca's aphasia and AOS.

Conley and Coelho (2003) combined semantic cues from semantic feature analysis (SFA) with the forward-chaining procedure of RET to treat object naming in an individual with chronic Broca's aphasia. These researchers measured the effects of SFA-RET on naming accuracy using pictures of nouns. Thirty color photographs depicting a single object, e.g., telephone, were divided into 3 sets of 10 items. Sets 1 and 2 were used for treatment and set 3 was used to assess generalization. Fifteen of the pictures were "high familiarity objects," i.e., objects that the subject encountered daily, and 15 were "low familiarity objects," i.e., objects that she rarely encountered. Pictures of the high and low familiarity objects were balanced evenly among the 3 sets. RET was administered three times weekly for approximately 1 hour for a total of 6 weeks. The subject's naming accuracy for the trained and untrained items increased following the application of treatment. During baseline, her accuracy in naming objects in the

treatment and generalization pictures ranged from 10-30% and from 10-20%, respectively. Naming accuracy of the treated items improved to 80% after 3 weeks of intervention and remained at or above that level throughout the rest of the study with the exception of one probe measure. Greater variability was seen for the generalization items than the treatment items; however, steady increases in naming accuracy were observed throughout the study with a maximum of 80% being reached on the sixth week of treatment. The subject also demonstrated better performance on naming the high frequency objects than the low frequency ones. Approximately 6 weeks after the completion of the SFA-RET treatment, the subject was seen for 3 follow-up sessions. For these sessions, naming accuracy remained well above pre-treatment levels for the trained and untrained items. Results therefore suggest that the combined SFA-RET approach can lead to improved object naming in response to picture stimuli for a person with Broca's aphasia.

Summary

Together the above studies provide a strong foundation for the use of RET as a treatment for individuals with Broca's aphasia. First, most studies have shown that RET usually results in increases in the amount and variety of information contained in the speech of individuals with aphasia with some generalization across different stimuli, settings, communication partners, and conversational contexts (Bennett, Wambaugh, Nessler, 2005; Gaddie et al., 1991; Kearns, 1985, 1986; Kearns & Yedor, 1991). Second, the effects of RET are reasonably durable as some of the subjects who received RET showed improved verbal performances several weeks and months after treatment was discontinued (Bennett, Wambaugh, Nessler, 2005; Conley & Coelho, 2003; Gaddie,

Kearns, Yedor, 1991; Kearns 1985, 1986; Kearns and Scher, 1989; Kearns and Yedor, 1991; Nessler, Wambaugh, & Wright, 2009; Wambaugh & Martinez, 2000). Third, some subjects receiving RET have reflected improved scores on a standardized aphasia test following completion of RET (Kearns, 1985, 1986; Nessler, Wambaugh, & Wright, 2009). Fourth, while RET was developed as a treatment for individuals with non-fluent Broca's aphasia, improvements in verbal performance following RET have been reported for individuals with other aphasia classifications as well (Kearns and Scher, 1989; Nessler, Wambaugh, & Wright 2009; Yedor, Conlon, Kearns, 1993). Finally, RET appears to be a flexible treatment that can be adapted to changing clinical situations. Some studies show that the loose-training and forward-chaining procedure of RET is amendable to combining with other treatment approaches (Conley & Coelho, 2003; Wambaugh & Martinez, 2000; Wambaugh, Martinez, & Alegre, 2001).

Chapter Three

Methods

Research Design

The present study was approved by the University of Kentucky Institutional Review Board (IRB). This investigation was a prospective, repeated case study that examined the effects of RET on the performance of individuals with non-fluent Broca's aphasia on a sentence production task (SPT). Changes in the participants' responses on the SPT were examined in terms of (1) syntactical structure, (2) grammatical completeness, and (3) semantic appropriateness.

Participants

Three adults with chronic aphasia gave informed consent to participate in this study. All were Native English speakers who incurred a left-hemisphere stroke with resulting right hemiparesis, aphasia, and apraxia of speech. Participants were recruited from the University of Kentucky Aphasia Program (UKAP), where they had received individual and group speech and language therapy, but were not enrolled in treatment at the time of the study. Participant characteristics are provided in Table 3.1.

Table 3.1. Participant characteristics.

Characteristics	Participant 1	Participant 2	Participant 3
Age	63	66	64
Gender	Female	Male	Male
Race	Caucasian	African American	Caucasian
Months of post-onset	95	73	36
Years of education	12	12	14
Former occupation	Office Manager	Material Handler	Robotics Technician
Pre-morbid handedness	Right	Right	Left

Participants' speech was characteristic of individuals with non-fluent Broca's aphasia as described by Thompson (2008) and others (e.g., Goodglass & Kaplan, 1983a; Kearns, 2005; Saffran, Berndt, and Schwartz, 1989). Participants 1 and 2 communicated primarily using verbal communication. Participant 3 used some verbal communication, but needed to supplement his lack of speech with writing of single words, drawing, and hint-and-guess strategies.

Pre-study Testing

The *Western Aphasia Battery-Revised* (WAB-R; Kertesz, 2006) was administered to each participant. Aphasia Quotient (AQ) scores from the WAB-R were used to determine the severity of aphasia. Participants also described two pictures, the "Cookie Theft" picture from the *Boston Diagnostic Aphasia Examination* (BDAE; Goodglass & Kaplan, 1983b) and the "Picnic Scene" picture from the WAB-R (Kertesz, 2006). These narratives were transcribed and participants' performance on the picture description tasks were quantified by (1) determining the time (in minutes and seconds) it took the participant to describe each picture, (2) counting the number of Correct Information Units (CIUs) in the description using guidelines provided by Nicholas and Brookshire (1993), and calculating the Mean Length of Utterance (MLU) for each description using procedures of Florance (1981).

Table 3.2 summarizes results from the WAB-R and the participants' picture descriptions. Results show that participants 2 and 3 had moderately-severe aphasia, and participant 1 had moderate aphasia based on calculated AQ scores from the WAB-R. Results from the picture descriptions show that participants deviated widely in the

number of CIUs produced per picture, but the MLU of each participant was usually short, confirming speech output characteristic of Broca's aphasia.

Table 3.2. Pre-study testing results.

Measure	Participant 1	Participant 2	Participant 3
Western Aphasia Battery-Revised			
Aphasia Quotient (AQ)	60.2	43.3	44.8
Subtests (AQ totals)			
Informational content	8	3	8
Fluency	4	2	2
Auditory verbal comprehension	6.9	7.35	7
Repetition	5.8	4.6	1.4
Naming	5.4	4.7	4
Aphasia type	Broca's	Broca's	Broca's
Picture description			
"Cookie Theft" picture			
Time	2:41	2:06	1:51
Number of CIUs	16	2	5
MLU	2.4	1.5	1.4
"Picnic Scene" picture			
Time	4:31	2:55	3:54
Number of CIUs	19	7	10
MLU	2.04	1.6	1.5

Table 3.3 provides verbatim transcriptions of the Cookie Theft and Picnic Scene pictures for each participant.

Treatment Materials

Thirty commercially available 3 x 5 inch color photographs (Webber, 2001) were selected by the researcher. Each photograph depicted a person or persons involved in an everyday activity such as cleaning or cooking. For each participant, 20 of the photographs were randomly selected for use in treatment; the remaining 10 photographs were not used in treatment.

Table 3.3. Verbatim transcriptions of the pre-study picture descriptions for each participant. ("..." indicate noticeable silent pauses)

	Cookie Theft	Picnic Scene
Participant 1	*Uh...uh, jar, a cookie jar, and uh… um…right there…bump… uh…uh… uh, sink filling…uh… plates…uh… tree and, uh, shrub, grass, uh…uh …boys, uh…uh… jars, a cookie jar, uh, right there …uh, right there, washing the dishes and, uh…uh… playing around, uh, right there, uh, uh, boys playing around and, uh… um…ga, garage…he's just, right there, and, uh, cookie jar*	*Uh…uh, sand and, uh…dog…uh, boys flying kite, um,…mother and dad, um …uh…bottle and… uh…uh …sand and, uh… um… sand, uh, castle, and… uh …uh, uh boats and, uh…fisherman… kite, um, kite, um…um …um, um, um, flag …uh, reading, uh, uh… dog, uh, uh… oh…mother and dad…I don't know …uh, uh, uh, wand, and, uh, um…uh …a car… comb, home…tree…uh, uh, I don't know why, um…oh, I don't know…it's running…flying, uh, kites, walking…a spring…uh, uh, uh, girl …pales or…uh, pales or…uh*
Participant 2	*O.K., this is uh…you know…uh, this, this…um…uh…the, this, this…O.K….and…falling…um… water…um…I don't know…that …hum…that…hum …uh, water*	*Tree…reading…kite…uh…chhh …bbb…wait a minute…uh…well shit…that…dog…nothing…uh… beer or something…um*
Participant 3	*Uh…fall…fall, and uh water…uh …I don't know…boy…O.K…. uh…wipe…uh, boy…uh, ya…uh, cookies… and here, nothing, here, but, hand… I don't know, no*	*Uh…dog…uh…drink…uh… paper…shoes…uh…radio…car …um…fishing… um…p, um…I don't know, here… uh, tail, pail …I don't know…uh…I don't know…I don't know, I…house… uh…car...a fl, flag …uh…I can't … here, I don't know, but…don't know, here*

Dependent Variable

The dependent variable for the study was a 30-item sentence production task (SPT). The SPT required the participant to use an action verb in a sentence (e.g. "Put the word *cooking* in a sentence"). Twenty of the action verbs of the SPT corresponded to the

verbs in the photographs used in RET; 10 action verbs of the SPT were not associated with any of the training stimuli. These items were used to assess generalization on the SPT. The 30 action verbs of the SPT, shown in Table 3.4, were randomized for each administration. Instructions for the SPT were repeated by the examiner when requested by the participant. Participants were provided general encouragement, but were not provided any feedback on their performance. All participant responses were audio recorded.

Table 3.4. Action verbs used in the SPT.

Eating	Skiing	Selling
Smelling	Running	Reading
Blowing	Throwing	Raking
Mopping	Vacuuming	Swimming
Swinging	Walking	Drinking
Rinsing	Mowing	Shouting
Hugging	Cooking	Exercising
Crying	Feeding	Teaching
Talking	Hanging	Sleeping
Painting	Jumping	Shaving

The SPT was administered four times before starting treatment to establish a baseline performance level. Once treatment began, the SPT was administered four additional times during treatment. These administrations occurred two days after the third, sixth, ninth, and twelfth treatment sessions. A follow-up SPT was administered one month after the final treatment session. Thus, each participant was scheduled for a total of nine SPT administrations.

Treatment Procedures

During the first six treatment sessions (sessions 1-6), RET was conducted as described by Kearns (1985) and as summarized in detail in Chapter 2. Treatment over these sessions largely involved the researcher (1) prompting the participant to describe

what he or she saw happening in a picture, (2) reinforcing, shaping, and expanding the participant's response, (3) asking the participant wh-questions to elicit additional information, (4) chaining and shaping the participant's responses into a sentence, and (5) requesting the participant to repeat the sentence. During this phase of treatment, participants tended to respond by describing the action (e.g., "cooking") or naming the objects depicted in the photographs (e.g., "pots," "eggs," "knife"). These responses limited the constructions that could be elicited and shaped by the researcher's ensuing wh-questions to basic sentence constructions such as subject-verb constructions. The researcher therefore made a decision to modify the RET protocol by (1) altering the initial RET prompt and (2) providing the participant with visual support.

For treatment sessions 7-12, the researcher changed the initial prompt of RET from "tell me what's happening in this picture" to "start with the person and tell me what you see happening in the picture." This was done to encourage the participant to initiate a sentence with a person or persons in the subject position. The visual support provided to the participant consisted of a piece of paper with "S - V - +" written on it. The visual cue was employed to facilitate the production of sentences with a grammatically acceptable word order by cueing the participant, first, to use a person-noun in the initial position (subject), then, to describe the activity (verb), and finally, to provide additional information (plus more). By altering the initial prompt and using the visual cues, the researcher sought to reduce the need to shape the participant's initial responses. This allowed the researcher to use the expanding and shaping techniques of RET to attempt to facilitate longer and grammatically more complex sentence productions.

Schedule

Participants were seen for treatment three times per week. A cycle of RET included presentation of the 20 photographs used for training and movement through the steps of RET for each photograph, one by one. Each RET treatment session consisted of two or three cycles, depending on whether the SPT was administered on the day of that session. On treatment sessions which the SPT was administered, the participants received only two cycles of RET with the SPT always being administered at the beginning of the session. The 20 photographs were randomized for each cycle of RET. Participants were permitted to take breaks during the treatment sessions any time they wished, and asked by the examiner if they wanted a break between each cycle of RET. Participants 1 and 3 completed all nine administrations of the SPT and the twelve sessions of RET. Participant 2 completed all the treatment sessions, but he was not available for either the eighth or the follow-up administration of the SPT.

Post-treatment Testing

The WAB-R and picture description tasks were re-administered to two of the three participants two days after the final RET treatment session. Participant 2 was unable to attend this session and therefore did not receive any follow-up testing.

Data Management

Participants' responses to the SPT were transcribed verbatim by the examiner. All responses were examined in terms of three parameters: syntactic structure, grammatical completeness, and semantic appropriateness.

(1) *Syntactic structure.* In terms of syntactic structure, SPT responses were classified in one of three ways: (i) having a subject and a verb (SV), (ii) having a subject and a verb plus added information (SV+), or (iii) having a non-sentential structure (NS).

(2) *Grammatical completeness.* Utterances were classified as "grammatically complete" if they were judged acceptable according to the grammar of Standard English (Huddleston & Pullum, 2006). Otherwise, the utterances were judged "grammatically incomplete."

(3) *Semantic appropriateness*. Responses were classified as "semantically appropriate" if they (i) contained the target word or a semantically related alternative, (ii) were logically plausible, (iii) were propositionally meaningful, and (iv) had an SV or SV+ construction. Responses that did not meet the criteria were judged "semantically inappropriate."

Classifications of SPT responses were carried out for all SPT administrations based on the examiner's transcriptions of the participants' responses. Participants' production errors (e.g., paraphasias, articulation errors), extraneous words (e.g., fillers, repetitions, unintelligible words, interjections), and disruptions in fluency (pauses, restarts, etc.) were included in the transcriptions, but ignored in classifying utterances for syntactic structure, grammatical completeness, and semantic appropriateness.

Reliability of Classification

To calculate interobserver reliability, 25% of all the transcribed SPT responses were randomly selected. Two independent observers utilized copies of the transcriptions to determine the syntactic structure, grammatical completeness, and semantic appropriateness of the selected items. The independent observers were graduate students

in communication sciences and disorders at the University of Kentucky and were trained in classifying the responses. Their classification agreements were compared on a point-to-point base with those of the examiner using the following formula: [(total number of agreements/ total number of possible agreements) x 100]. The average agreement between the examiner and the independent observers was 88%.

Chapter Four

Results

Results of this study are presented separately for each of the three participants. First, quantitative data with respect to each participant's performance on the SPT before, during, and after treatment with RET will be presented. These data reflect the percentage of sentences determined to represent (1) NS, SV, or SV+ constructions, (2) grammatically complete sentences, and (3) semantically appropriate sentences. Participants' sentence productions that used the verbs depicted in the 20 photographs used in training will be presented separately from the sentence productions that used the 10 verbs not worked on in treatment. Second, qualitative information on each participant's SPT performance will be presented. These data include verbatim transcriptions of SPT responses for five randomly selected verbs associated with the trained photographs from the first, fifth, and seventh or eighth SPT. Finally, pre- and post-treatment changes on the WAB-R and two picture description tasks will be presented for two of the three participants.

Participant 1

Participant 1 (P1) was a 63 year-old, right-handed, Caucasian woman with moderate Broca's aphasia, apraxia of speech, and right hemiparesis resulting from a left-hemisphere ischemic stroke approximately 8 years prior to the study. P1 communicated primarily via verbal communication, but her utterances were laboriously produced, short, grammatically inaccurate, and characterized by numerous pauses, re-starts, and self-corrections.

The top portion of Figure 4.1 shows that before treatment began approximately half of her responses were non-sentences, and that across the before treatment SPTs, her use of SV constructions slightly increased, and her use of SV+ constructions slightly decreased. During the initial phase of treatment, she reflected a slight decrease in NS constructions, an increase in SV constructions, and little change in her use of SV+ constructions. As treatment progressed, she evinced a further decrease in NS constructions, a sharp decrease in SV constructions, and a sharp increase in SV+ constructions. On the SPT administered on month after cessation of treatment, P1 showed a slight increase in NS constructions, a slight increase in SV productions, and a decrease in SV+ productions. The middle portion of figure 4.1 shows that the grammatical completeness of P1's sentences increased steadily from the before treatment measures through the treatment period and decreased slightly in the follow-up SPT. Similarly, the lower portion of figure 4.1 reflects comparable findings with respect to the semantic appropriateness of P1's sentence production responses.

Figure 4.2 shows that P1's performance on the SPT with respect to the verbs not worked on in treatment was grossly similar to her performance based on the trained photographs shown in figure 4.1. The top portion of figure 4.2 shows that she reduced the number of her NS constructions from the before treatment SPTs and continued to produce few NS constructions in the follow-up SPT. Similar to her performance on the SPT for the verbs depicted in the photographs used in training, she reflected an increase in her use of both SV and SV+ constructions throughout the treatment period, and actually produced a higher percentage of SV and SV+ constructions on the follow-up SPT for the verbs that were not worked on in training than the verbs that corresponded to

Participant 1

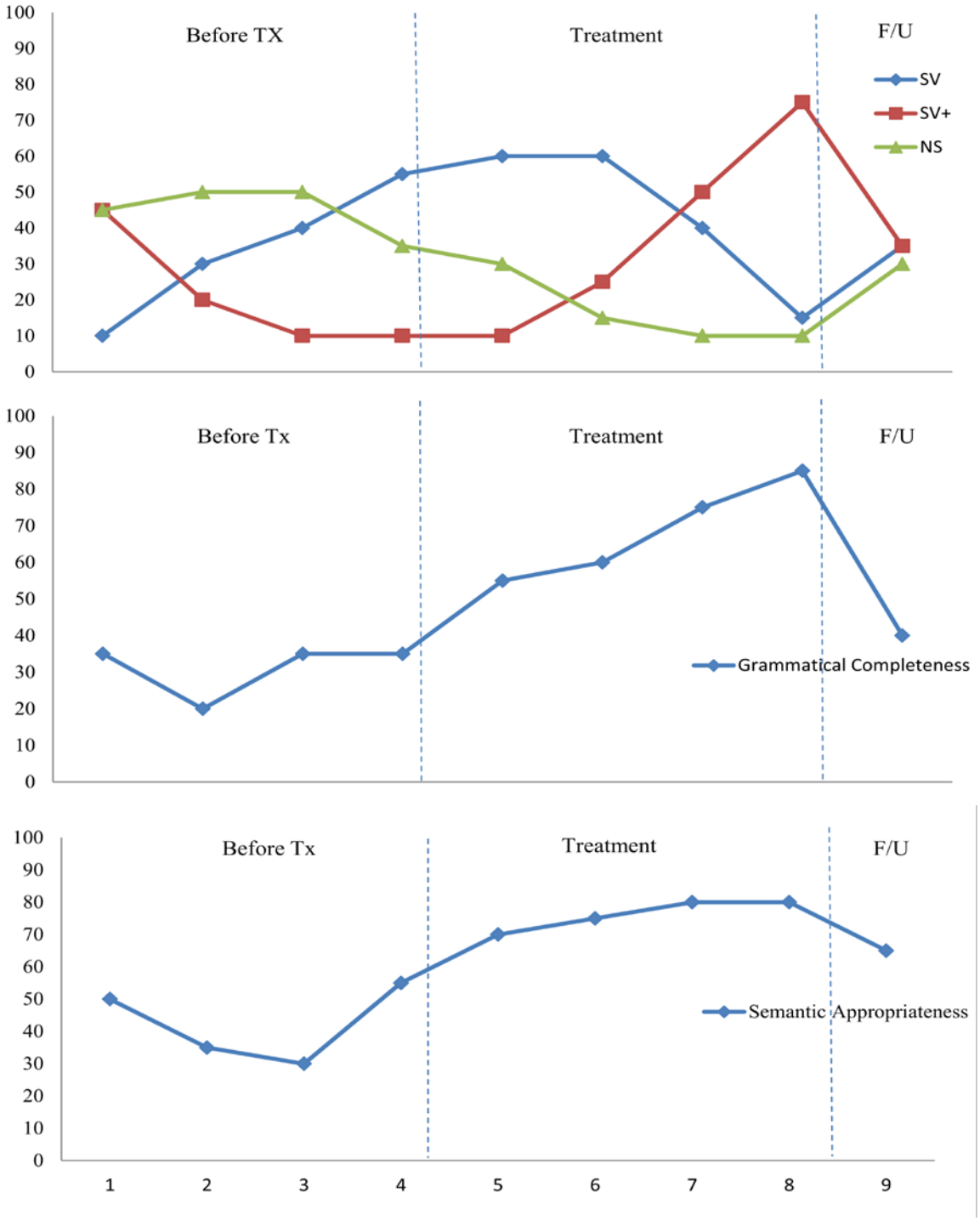

Figure 4.1. Percentage of NS, SV, and SV+ constructions (top), grammatically complete sentences (middle), and semantically appropriate sentences (bottom) for the 20 action words depicted in the photographs used in training by participant 1.

Participant 1

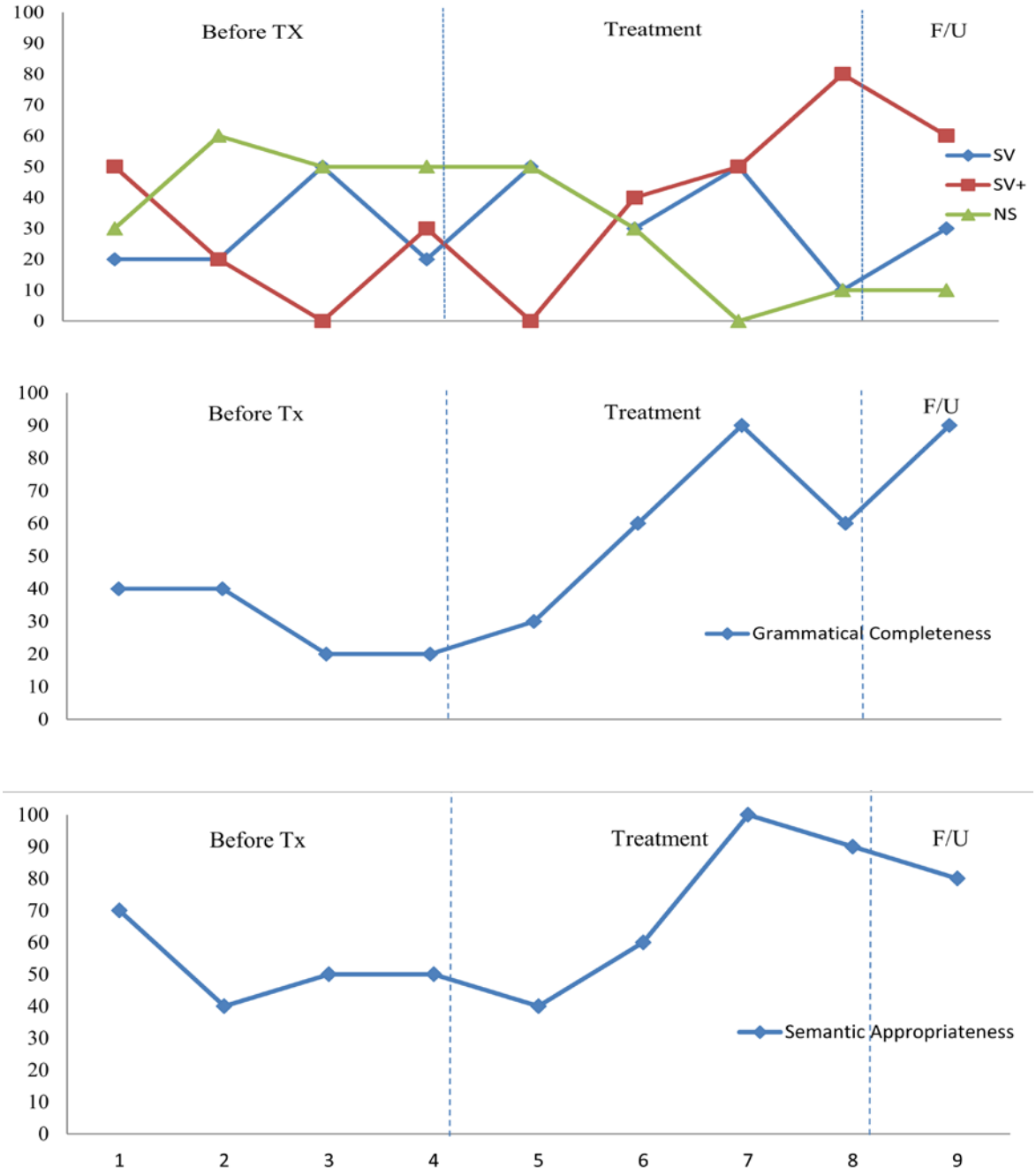

Figure 4.2. Percentage of NS, SV, and SV+ constructions (top), grammatically complete sentences (middle), and semantically appropriate sentences (bottom) for the 10 action words not depicted in the photographs used in training by participant 1.

the activities depicted in the photographs used in treatment. The middle and bottom portions of figure 4.2 demonstrate that P1 also increased the grammatical completeness and semantic appropriateness of her sentence constructions throughout treatment for the verbs that were not depicted in the photographs treated with RET.

Table 4.1 provides verbatim transcriptions of P1's sentences from the SPT before (first), during (fifth), and at the end (eighth) of treatment. The table shows that at the start of treatment, P1 tended to "nominalize" the target verbs by using them as the subjects of her sentences. As treatment progressed, she produced more sentences with a person or persons in the subject position, the target verb in the present progressive form, and additional grammatical elements.

These transcriptions reflect that P1's ability to construct sentences using the target verb improved qualitatively as well as quantitatively. Table 4.1 indicates that as treatment progressed, P1 reduced the number of pauses, re-starts, and self-corrections in her sentence productions, and increased the length of her responses. Although she continued to correct and revise her utterances, the sentences she ultimately came up with were increasingly more complex and novel. For example, note the changes in the responses to the target verb "swinging." In the first SPT, prior to treatment, P1 produced an incomplete sentence; for the fifth SPT, she produced a simple SV construction; and by the eighth SPT, she produced a far more complex sentence. Similar changes in the SPT for the other four verbs can be observed as well.

Table 4.1. Verbatim transcriptions of randomly selected SPT responses for participant 1. ("…" indicate noticeable silent pauses in the participant's utterance.)

Target: *Jumping*	
First SPT:	*Jumping is nice*
Fifth SPT:	*Oh man, uh, jumping, uh, the like to jump*
Eighth SPT:	*Man is jumping the rope*
Target: *Swinging*	
First SPT:	*Swinging…um…up there…and exercise*
Fifth SPT:	*A swinging, uh, the girls swinging*
Eighth SPT:	*Uh, alright, the man is swinging the baby in the garage, uh, the, uh, garden*
Target: *Hanging*	
First SPT:	*Hanging on the hook*
Fifth SPT:	*Um…uh….hanging, the man is hanging*
Eighth SPT:	*Uh, alright, uh, the man is hanging around*
Target: *Sleeping*	
First SPT:	*A sleeping is nice…I got to do it. Thank you.*
Fifth SPT:	*The, um, the persons, slll, sleep, sleeping, the ers, the person is sleeping*
Eighth SPT:	*Alright, the mmm, uh, alright, the mmm…sss, alright, the man is sleeping, the, the man is sleeping*
Target: *Reading*	
First SPT:	*I like the reading, but I can't do it*
Fifth SPT:	*Reading is, uh…uh, reading is…understand the…I like to read*
Eighth SPT:	*O.k., the, uh…um…alright, the man is reading the library book*

Table 4.2 indicates that P1 improved her AQ score on the WAB-R from 60.2 to 65.4 from pre- to post-treatment. Improvement on the WAB-R was accompanied by a concomitant improvement in her picture description performance. Table 4.2 shows that she improved on all three metrics of the task: time, number of CIUs, and MLU.

Table 4.2. Results from pre-study and post-study testing for participant 1.

Measure	Participant 1	
	Pre-study	Post-study
Western Aphasia Battery-Revised		
Aphasia Quotient (AQ)	60.2	65.4
Subtests		
Informational content	8	8
Fluency	4	4
Auditory verbal comprehension	6.9	7.8
Repetition	5.8	6.1
Naming	5.4	6.8
Picture description		
"Cookie Theft" picture		
Time	2:41	2:30
Number of CIUs	16	20
MLU	2.4	2.5
"Picnic Scene" picture		
Time	4:31	4:19
Number of CIUs	19	24
MLU	2.04	3.0

Participant 2

Participant 2 (P2) was a 66 year-old, right-handed, African American man with moderately-severe Broca's aphasia, apraxia of speech, and right hemiparesis, requiring him to use a motorized wheelchair for mobility. At the time of study, he was approximately 6 years post-onset of aphasia secondary to a left-hemispheric stroke. He was primarily a verbal communicator. His verbal productions were usually short, effortful, grammatically impaired, and characterized by marked word retrieval deficits.

This participant completed the 12 sessions of RET, but did not return to the clinic for the eighth and the follow-up SPTs and did not undergo any post-treatment testing.

The top portion of Figure 4.3 reveals that P2 produced mostly NS constructions and few SV+ constructions prior to treatment. His productions of SV constructions varied during this time. After treatment began, he sharply reduced his use of NS constructions, markedly increased his use of SV constructions, and decreased his use of SV+ constructions. As treatment progressed, he evinced a sharp increase in his productions of SV+ constructions and a decrease in SV constructions, while continuing to produce few NS constructions. The middle and bottom portions of figure 4.3 demonstrate that he consistently increased the grammatical completeness and semantic appropriateness of his sentence productions throughout treatment.

Figure 4.4 shows that the changes in P2's SPT responses with respect to the verbs not worked on in treatment. These changes paralleled the changes observed for the items presented in figure 4.3. The top portion of figure 4.4 shows a steady decrease in NS constructions before and during treatment, which eventually reached 0% on his last SPT. A slight increase in his productions of SV and SV+ constructions was observed before treatment. At the beginning of treatment, he sharply increased his productions of SV constructions and slightly decreased his use of SV+ constructions. As treatment continued, he decreased his use of SV constructions and markedly increased his use of SV+ constructions. The middle and bottom portions of figure 4.4 show dramatic changes in his production of grammatically complete and semantically appropriate sentences. A steady increase was observed throughout the treatment period for both parameters. On his final SPT, he achieved 100% accuracy for grammatical completeness and semantic appropriateness.

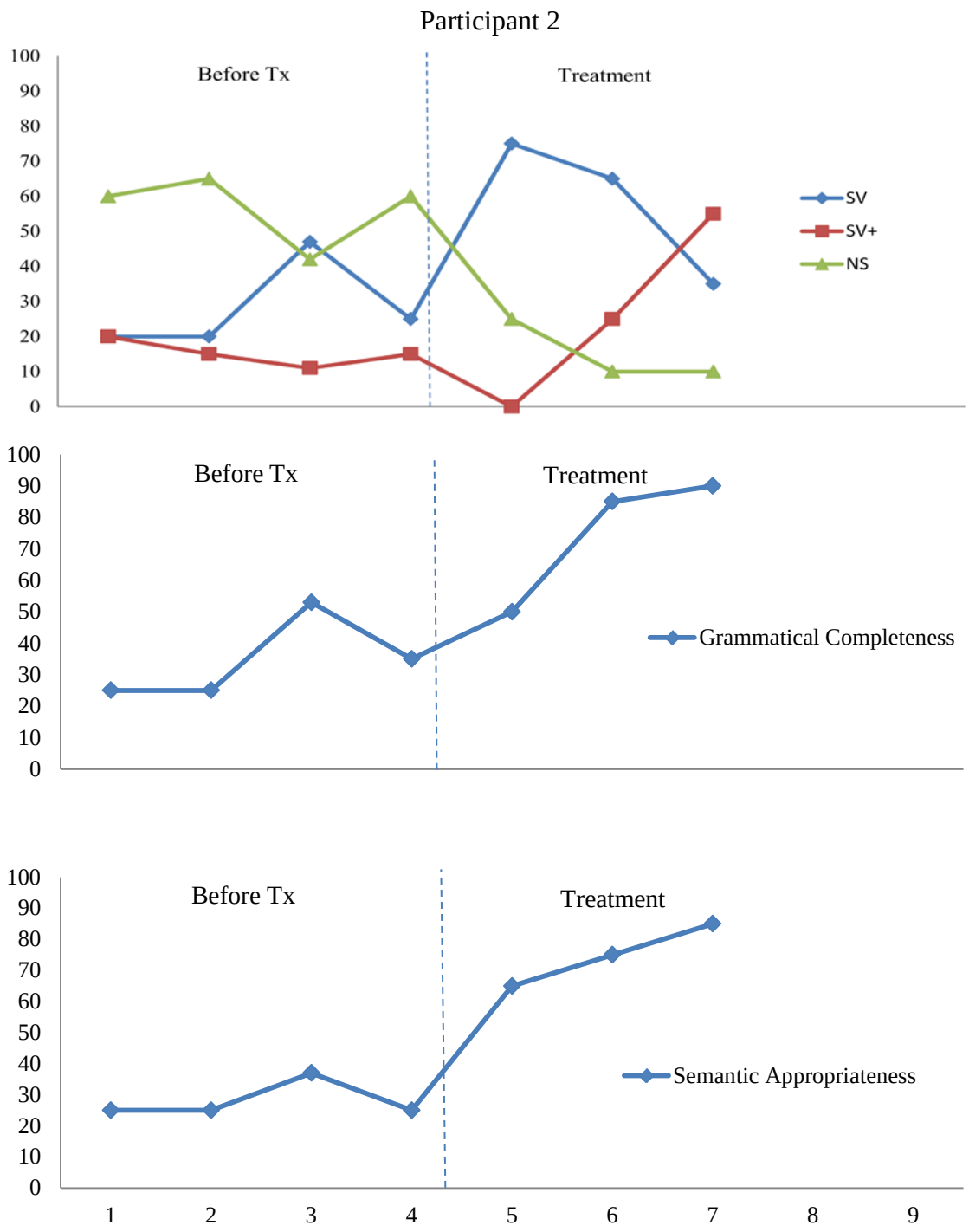

Figure 4.3. Percentage of NS, SV, and SV+ constructions (top), grammatically complete sentences (middle), and semantically appropriate sentences (bottom) for the 20 action words depicted in the photographs used in training by participant 2.

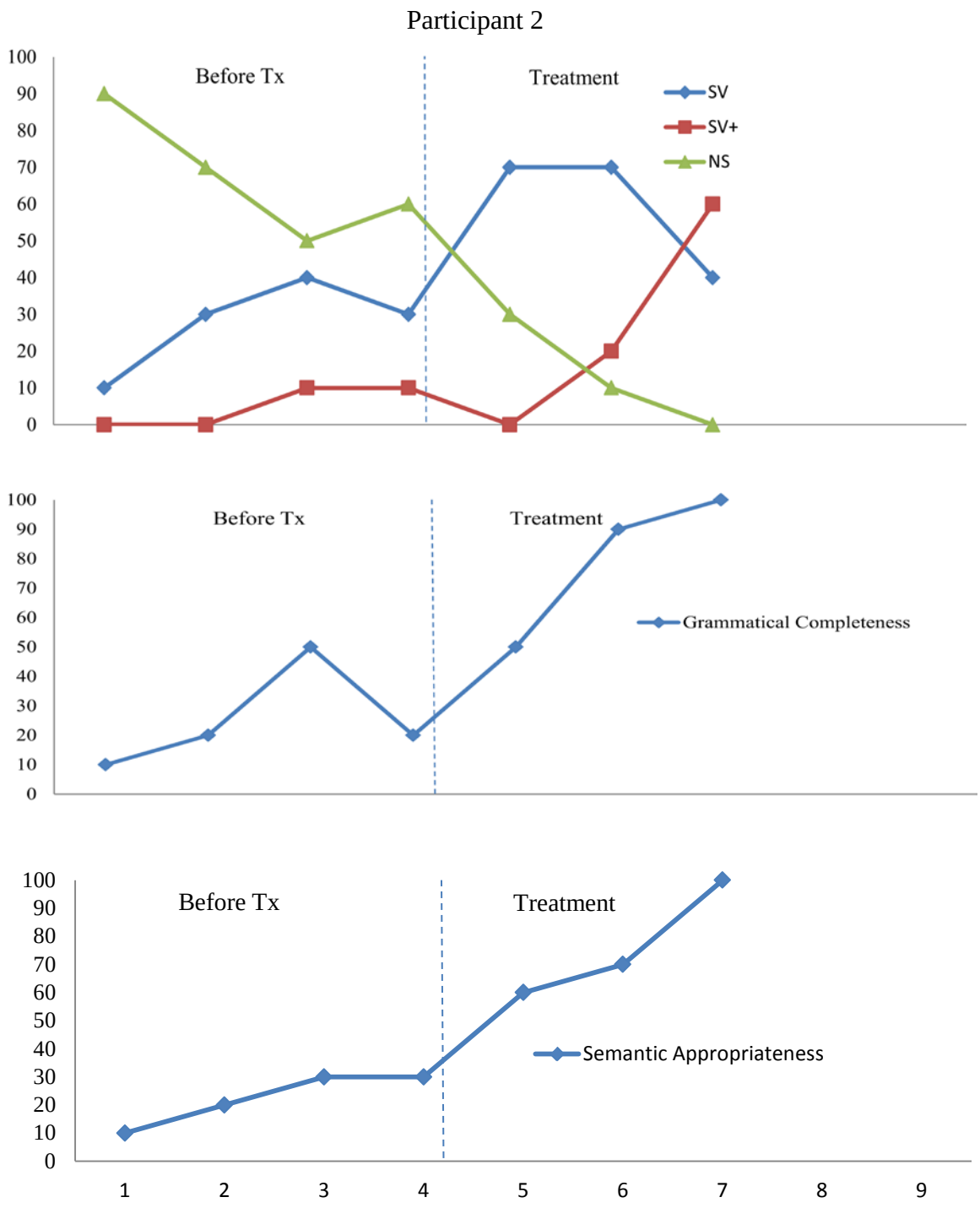

Figure 4.4. Percentage of NS, SV, and SV+ constructions (top), grammatically complete sentences (middle), and semantically appropriate sentences (bottom) for the 10 action words not depicted in the photographs used in training by participant 2.

Table 4.3 provides verbatim transcriptions of P2's sentences for the first, fifth, and seventh SPT. Here is can be seen that his sentence productions increased in length, complexity, and grammaticality throughout the study. The transcriptions further reveal that he decreased the number of false starts, interjections, and other disfluencies associated with his sentence productions on his final SPT.

Table 4.3. Verbatim transcriptions of randomly selected SPT responses for participant 2. ("…" indicate noticeable silent pauses in the participant's utterance.)

Target: *Reading*	
First SPT:	*Reading. I want to read*
Fifth SPT:	*I want to, let's see, I want to throw*
Seventh SPT:	*Reading, I was reading the book*
Target: *Selling*	
First SPT:	*I…um…nope*
Fifth SPT:	*Selling…uhm*
Seventh SPT:	*Selling, I was selling ba, ba, (unintelligible word, then laughter)*
Target: *Blowing*	
First SPT:	*Blowing…blowing…blowing… I want a*
Fifth SPT:	*Blowing…blow, blow, I…hum, hum, hum, um*
Seventh SPT:	*I was blowing…I was blowing*
Target: *Raking*	
First SPT:	*Raking. Rake leaves. I want the rake leaves*
Fifth SPT:	*Raking, I want, I want, well, huh*
Seventh SPT:	*I was raking leaves*
Target: *Mowing*	
First SPT:	*Mowing, huh, I want. I want. I want. I want to mow*
Fifth SPT:	*Mowing…bow, bowing, I want to mow*
Seventh SPT:	*Mowing, I was mowing*

Participant 3

Participant 3 (P3) was a 64 year-old, left-handed, Caucasian man at the time of the study. He had moderately-severe Broca's aphasia, apraxia of speech, and residual right-sided hemiparesis. He was 3 years post-onset of aphasia secondary to a left-hemispheric ischemic stroke. He was primarily a multimodal communicator, who supplemented his speech with gesture, drawing, and writing of single words. His speech

was characterized by short, telegraphic utterances with frequent omissions of function words and grammatical endings. His spontaneous utterances and answers to open-ended questions typically consisted of only one-to-two content words. He would often say "I don't know" when asked to provide additional information or elaborate on a point of conversation.

The top portion of Figure 4.5 shows that P3 made no changes in the percentage of NS, SV, and SV+ constructions produced on the SPT before treatment for the verbs associated with the photographs worked on in treatment. During the first half of treatment, he produced a minor change in his productions of NS and SV constructions on one of the SPTs. As treatment progressed, however, he evinced a sharp decrease in his use of NS constructions, an increase in SV productions, and a sharp increase in his use of SV+ constructions. The follow-up SPT reveals a slight decrease in NS constructions and a slight increase in SV+ productions from pretreatment levels. The middle portion of figure 4.5 indicates that participant 3 did not produce a grammatically complete sentence on any of the SPT items using the verbs associated with the photographs employed in treatment. The bottom portion of the figure shows that he produced few semantically appropriate sentences before and during the first half of treatment. However, in the second half of treatment, he sharply increased his production of semantically appropriate sentences. A decrease in the percentage of semantically appropriate sentences was seen in the follow-up SPT.

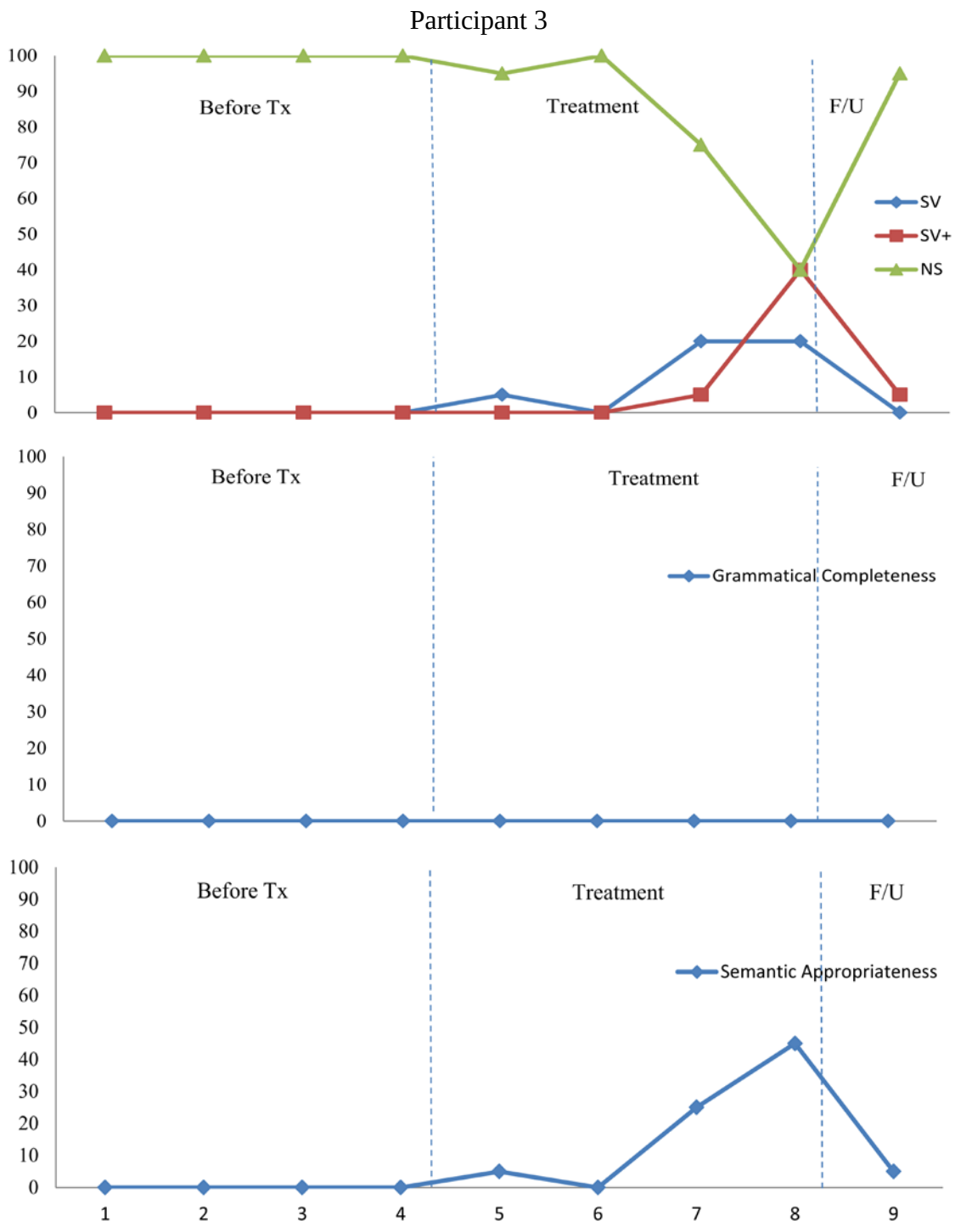

Figure 4.5. Percentage of NS, SV, and SV+ constructions (top), grammatically complete sentences (middle), and semantically appropriate sentences (bottom) for the 20 action words depicted in the photographs used in training by participant 3.

The top portion of Figure 4.6 reveals P3 made no changes in the percentage of NS, SV, and SV+ constructions produced on the four pretreatment administrations of the SPTs for the verbs not associated with the actions depicted in the treatment stimuli. A slight decrease in P3's use of NS constructions and a slight increase in his use of SV constructions were observed at the onset of treatment. As treatment continued, he decreased his use of NS constructions and increased his use of SV productions across two SPTs; he also evinced a slight increase in SV+ productions on one of the SPTs. On the follow-up SPT, his percentage of NS, SV, and SV+ constructions returned to pretreatment levels. The middle portion of the figure reveals a slight increase in the number of grammatically complete sentences produced on two SPTs during the treatment period. As shown in the bottom portion of the figure, participant 3 did not produce a semantically appropriate sentence before treatment. However, approximately midway through the treatment period, he markedly increased his productions of semantically appropriate sentences until the cessation of treatment. On the follow-up SPT, his productions of semantically appropriate sentences returned to levels observed prior to treatment.

Table 4.4 presents verbatim transcriptions of sentences produced by P3 on the first, fifth, and eighth SPT. Here it can be seen that he demonstrated longer and more complex utterances and produced more content words as treatment progressed. The table further reveals an apparent increase in his effort to initiate sentence productions throughout the study. Notice that on the first SPT he made little effort to produce a sentence. Instead, he said "I don't know" on four out of five of his responses. Gradually, he demonstrated a greater effort to produce sentences across the repeated

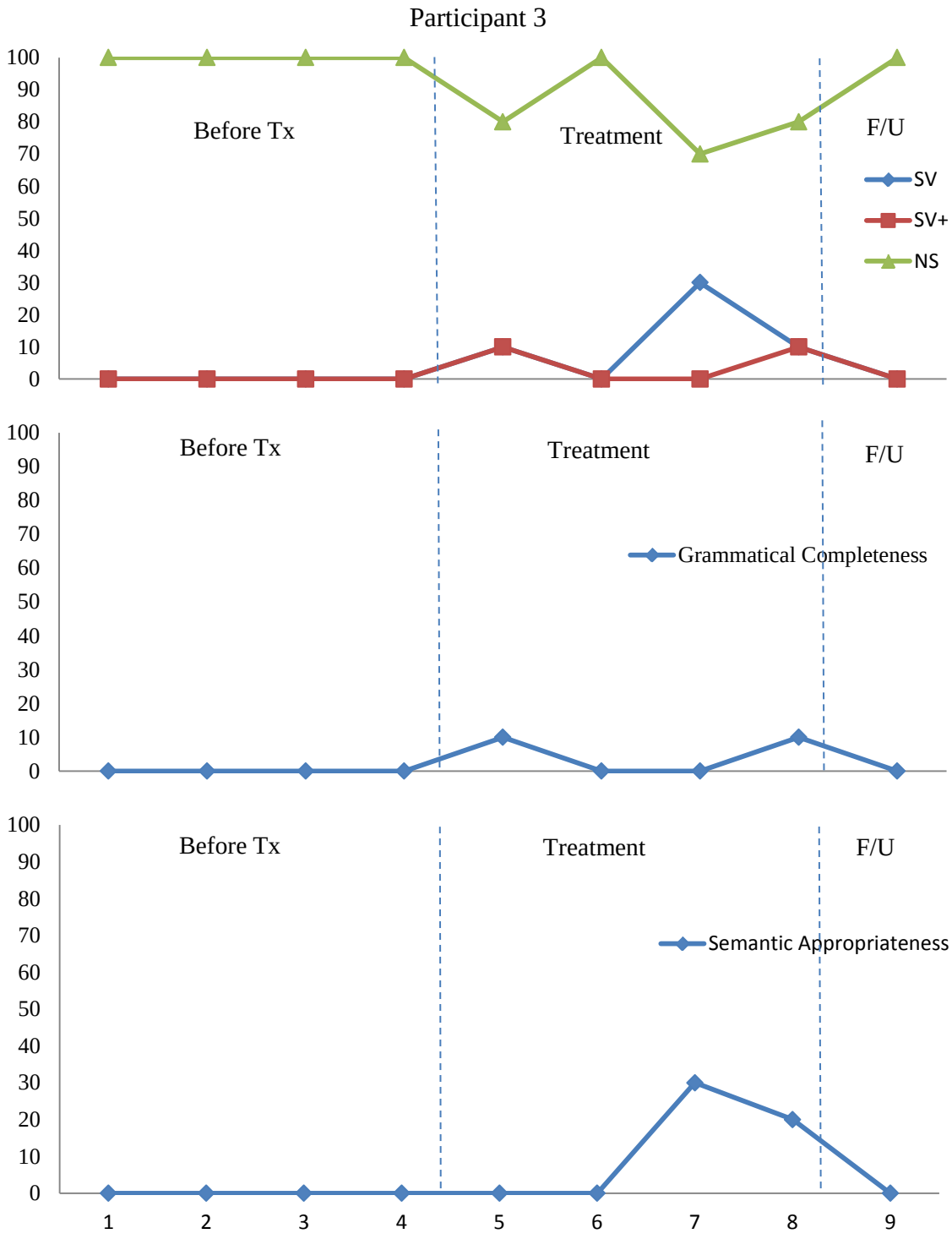

Figure 4.6. Percentage of NS, SV, and SV+ constructions (top), grammatically complete sentences (middle), and semantically appropriate sentences (bottom) for the 10 action words not depicted in the photographs used in training by participant 3.

administrations of the SPT. By the eight SPT, he was attempting to construct sentences by inserting a person in the subject position on all five of the SPT responses.

Table 4.4. Verbatim transcriptions of randomly selected SPT responses for participant 3. ("…" indicate noticeable silent pauses in the participant's utterance.)

Target: *Sleeping*	
First SPT:	*I don't know*
Fifth SPT:	*Uh…oh…uh…yard, (snoring sound)…uh…porch*
Eighth SPT:	*Uh, I don't know, sleeping, uh, boy is…bed, uh*
Target: *Eating*	
First SPT:	*I don't know*
Fifth SPT:	*Eat…oh, uh…I…can't, here too good*
Eighth SPT:	*Uh…man is…I don't know, I, I can't*
Target: *Rinsing*	
First SPT:	*Wash hair*
Fifth SPT:	*Uh…uh…hair…blow, uh…uh…I don't know, I*
Eighth SPT:	*Uh…uh, man is sss shave, no, shampoo*
Target: *Mowing*	
First SPT:	*I don't know*
Fifth SPT:	*Uh…uh…uh…I don't, I can't*
Eighth SPT:	*Uh…man is…uh, I don't know, it's, uh, I don't know*
Target: *Raking*	
First SPT:	*I don't know*
Fifth SPT:	*Rrr…I don't know*
Eighth SPT:	*Uh, man is…rake, raking, uh, leaves*

Table 4.5 indicates that P3 improved his performance on the WAB-R and on the two picture description tasks from pre- to post-treatment. His AQ score for the WAB-R increased by 9.6 points from 44.8 to 54.4. This change is reflected by an improved performance on the fluency, repetition, and naming subtests of the WAB-R. Table 4.1 also shows that he increased the number of CIUs and the average length of his sentences for both picture descriptions.

Table 4.5. Results from pre-study and post-study testing for participant 3.

Measure	Participant 3	
	Pre-study	Post-study
Western Aphasia Battery-Revised		
Aphasia Quotient (AQ)	44.8	54.4
Subtests		
Informational content	8	8
Fluency	2	4
Auditory verbal comprehension	7	6.9
Repetition	1.4	2.4
Naming	4	5.9
Picture description		
"Cookie Theft" picture		
Time	1:51	2:09
Number of CIUs	5	6
MLU	1.4	2.6
"Picnic Scene" picture		
Time	3:54	3:59
Number of CIUs	10	24
MLU	1.5	3.2

Chapter Five

Discussion

This was a prospective, clinical study in which three individuals with chronic Broca's aphasia were provided 12 one-hour sessions of Response Elaboration Training (RET; Kearns, 1985). Rather than assess the effects of RET by having the participants describe the same action pictures used in RET, a sentence production task (SPT) was used as the dependent variable. For the SPT, the subject was required to construct 30 sentences one-at-a-time. For each sentence the subject was provided a present progressive tense verb form as a "root" word (e.g., "Use the word *cooking* in a sentence"). Twenty SPT items used verbs depicted in the action pictures used for RET; 10 sentences used verbs not used in training. The SPT served two functions important to the research questions. First, it permitted the researcher to assess the effects of RET on (1) syntactic structure, (2) grammatical completeness, and (3) semantic appropriateness of the subjects' spoken sentences. This was considered to be important inasmuch as the effects of RET on syntax have not been examined. Secondly, the SPT allowed the researcher to assess the effects of RET on a task that is different from the picture description task used in most studies on RET. This was considered important because conclusions about RET effects could be questioned when the person describes the same pictures repeatedly.

Discussion of Results

Results of this study indicated that RET impacted positively the syntactic performance of three subjects with Broca's aphasia. After RET was initiated, all participants improved their performance on the SPT. Quantitatively, these improvements

were seen in three ways: (1) decreases in the percentages of non-sentences and increases in the percentages of sentences with an SV and SV+ construction; (2) increases in the percentage of grammatically well-formed sentences; and (3) increases in the percentage of semantically appropriate sentences. All three subjects also demonstrated qualitative improvements on the SPT. Verbatim transcriptions of subjects' sentences produced before, during, and after treatment indicate that subjects' sentences increased in length and complexity as treatment progressed and that the number of false starts, dysfluencies, and processing delays in their spoken sentences decreased. Changes on the SPT appeared to be related to severity of aphasia and differences in subjects' communication styles. For example, participant 1 responded robustly to RET and had the highest score on the WAB-R (AQ = 60.2). While participants 1 and 2 communicated verbally most of the time, participant 3 had limited speech and often supplemented his verbalizations by writing single words, drawing, and using hint-and-guess strategies. In addition, participant 3 appeared to have greater difficulty accessing verbs than participants 1 and 2. These factors may have limited the ability of participant 3 on the SPT as it is a verbal task that required constructing sentences with verbs provided to him by the researcher.

Results of this study provide further support that the loose training paradigm used in RET promotes generalization. First of all, each subject improved his or her performance on the SPT, even though this task was not specifically addressed in treatment. For the treatment, the researcher adhered to traditional RET steps for the first six treatment sessions. The researcher then introduced a different initial prompt to focus participants' attention on the positioning of the subject in the action pictures used in treatment and provided a visual cue to facilitate sentence productions with a

grammatically acceptable word order. The SPT, administered nine times during the course of the study, consisted of 30 verbs and the participant had to use each verb in a sentence. Twenty of the verbs corresponded with verbs in the photographs used in training and 10 other verbs were items not used in training. The percentage of SPT responses based on the 10 verbs not used in training reflected similar patterns for syntactic structure, grammatical completeness, and semantic appropriateness as the 20 sentences constructed from the verbs associated with the photographs used in treatment. Finally, participants 1 and 3 reflected noticeable improvements on the pre- and post-treatment WAB-R administrations and two picture description tasks. Unfortunately, these data were not available for participant 2.

Clinical Implications

The participants in this study received substantially less RET than in any prior study using this paradigm with patients with Broca's aphasia. Numbers of treatment sessions in prior RET studies using single-subject multiple baseline designs range from a low of 21 (Kearns, 1985) to more than one-hundred treatment sessions (Gaddie, Kearns, & Yedor, 1991). In some studies, subjects were trained to criterion levels of performance. In this study, subjects received only 12 RET treatments which is commensurate with standard clinical practice. This study demonstrated that RET can affect change in speaking performance in a fairly brief period of time. These gains were realized after a few weeks of treatment in subjects with moderately-severe and severe chronic Broca's aphasia. This suggests that RET may be an appropriate therapy for patients with only a limited number of treatments funded by the insurance company.

Single-subject design research uses rigorous methodology and seeks to establish experimental control of as many variables as possible to measure treatment effects (McReynolds & Kearns, 1983). Clinicians reviewing research in RET and considering this treatment for use with their patients could see RET as rigid and inflexible. The present study demonstrated that RET's loose training procedures can be modified and used in a naturalistic clinical environment. For example, the study employed a repeated case study design out of consideration of the subjects' time, availability and other scheduling considerations. While this reduced experimental control and conclusions that can be drawn about the results of the study, it provided the researcher with greater degrees of freedom. For example, it was observed that subjects, at times, became frustrated and/or bored with the repetitiveness of RET. This prompted the researcher to modify the initial RET instructions from "What's happening here?" to "Start with the person and tell me what's happening here" and to provide visual clues to facilitate grammatically correct word order of subjects' picture descriptions. This procedural adjustment is similar to those incorporated into studies that have combined RET with other treatment procedures (Conley & Coelho, 2003; Wambaugh & Martinez, 2000; Wambaugh, Martinez, & Alegre, 2001). More importantly, it suggests that RET is a sufficiently flexible treatment to allow clinicians to modify its procedures to better address a client's communicative deficits.

Some researchers have developed systems for scoring the sentence productions of patients with non-fluent agrammatic aphasia (Saffran, Berndt, & Schwartz, 1989), but in many cases these tools are time consuming and difficult for a busy clinician to use. The sentence production task (SPT) proved to be a relatively straight-forward approach for

capturing changes in subjects' sentence productions. Specifically, this involved classifying the subjects' SPT responses in terms of syntactic structure, grammatical completeness, and semantic appropriateness using explicit definitions for this purpose (See Chapter 3). Reasonable scoring reliability was reflected for this task. It is possible that this task could be used to measure the effects of treatments other than RET. It may be possible to further simplify the scoring of the SPT by using a multidimensional scoring system similar to that used with the scoring of subtest I (describing the use of objects) of the PICA (Porch, 1981).

One of the more interesting clinical implications arising from this study has to do with the relationship of language form (as reflected by grammatical completeness) and content (as reflected in semantic appropriateness). It appeared that as subjects improved their ability to produce the more complex SV+ sentences and reduced the number of non-sentence productions, grammatical completeness and semantic appropriateness of spoken sentences improved concomitantly. This trend was far more noticeable for participants1 and 2 than for participant 3 who did not reflect any noticeable changes on the SPT until the end of the treatment period. While it might be assumed that as spoken utterances of individuals with non-fluent Broca's aphasia become more complex, then grammaticality or semantic appropriateness would be diminished, the performance of participants 1 and 2 suggest otherwise. These participants actually increased their percentage of grammatically complete and semantically appropriate sentences as they produced more complex sentences.

Limitations

This clinical study was conducted under less than ideal conditions. It is acknowledged that, from a researcher's point of view, repeated case study designs are far less strong than single-subject designs which permeate aphasia treatment research. However, clinicians function under constraints that researchers do not face and vice versa. The design of this study was largely dictated by participants' availability, travel considerations, the researcher's class schedule, the clinic schedule, and other factors. It has a number of limitations that will be addressed here.

This study limited the number of RET treatments to 12. It is unreasonable to expect that all patients with aphasia require the same amount of treatment. How much treatment a patient requires to achieve a certain goal depends on a number of factors not considered in planning this study. While 12 sessions of RET appeared sufficient to result in positive changes for participants 1 and 2, participant 3 truly did not respond positively to RET until the last few treatment sessions. It appears he might have profited from more treatment and that he was just starting to "catch on" as treatment ended. While this patient did not improve as much on the SPT as the other participants, it is certainly noteworthy that his pre- and post-treatment AQ on the WAB-R (Kertesz, 2006) improved from 44.8 to 54.4 after just one-month of RET.

Several studies have found that individuals with non-fluent Broca's aphasia reflect marked differences in their ability to access and name verbs (Berndt, Mitchum, Haendiges, & Sandson, 1997; Berndt, Haendiges, Mitchum, & Sandson, 1997; Davis, 2000; Miceli, Silveri, Romani, & Caramazza, 1989; Zingeser & Berndt, 1990). Participant 3 seemed to have more difficulties with verbs than participants 1 and 2. This,

however, is an observation based on speculation since there was no pre-study assessment of participants' ability to name or recognize verbs and various verb forms. Thus, failure to obtain this information about each subject is a weakness that would definitely need to be rectified in a future study.

The sentence production task used as a dependent variable for this study was useful, but there are many ways in which this measurement tool could be modified and/or improved upon in future studies of RET and treatment of non-fluent Broca's aphasia in general. First of all, the participants were only provided present progressive tense verbs (e.g., cooking) as "root" verbs for the SPT. Retrospectively, it may have been better to require the participants to construct sentences using different verb tenses and verbs having different verb argument structures (Thompson, Shapiro, & Schendel, 1995).

Another limitation of this study is that repeated use of the SPT could have produced some practice effects. The SPT was administered nine times to participants 1 and 3 and seven times to participant 2. The SPT was composed of the same 30 verbs, presented in different orders for each administration. Improvement on the SPT by all participants has been explained as evidence that RET results in improvement in syntactic performance. However, it could be argued that improvement on the SPT occur from administering the same task repeatedly, and that these are "practice effects" rather than RET effects. That participants produced slightly different sentences each time on the SPT, as shown in Tables 4.1, 4.3, and 4.4, argues against this. Nevertheless, to show that the SPT changes are not task practice effects, it would be necessary to repeatedly administer an SPT to subjects with Broca's aphasia in the absence of any RET training.

The spouses of participants 1 and 3 reported some increases in language use by the participants during the four week period in which they received RET. However, the study has no objective measure to socially validate treatment effects. Like many aphasia treatment studies, measurement in this study was confined to the clinic and did not extend outside it. Changes in the picture descriptions of participants 1 and 3 from pre- to post-treatment suggest these individuals were producing more speech and more efficient communications following treatment, but social validation remains a need in this study as well as most aphasia treatment research.

Finally, another obvious limitation of this study is the fact that treatment data were not examined. Over the course of the investigation, each participant received 12 one-hour sessions of therapy. In these sessions he or she produced many responses to the 20 photographs used in training. Time and manpower precluded analysis of the treatment data. In addition, examination of the responses from the subjects in treatment was confounded by prompts, questions, and variations in how treatment was conducted for each subject. However, the researcher observed that the subjects markedly improved their sentence productions in treatment. Their responses to the initial RET prompt increasingly became longer, more complex, and more grammatically well-formed throughout the treatment period.

Directions for Future Research

RET is a well established treatment approach to management of individuals with non-fluent Broca's aphasia. Commensurate with the success of RET, many studies have shown that verbs play a critical role in improving the spoken narratives of people with aphasia (Fink, Martin, Schwartz, Saffron, & Myers, 1992; Marshall, Pring, & Chiat,

1998). RET is a loose training approach and seeks to elaborate and expand on the patient's novel, spontaneous spoken utterances. It differs markedly from convergent therapies where the clinician dictates the patient's response. The SPT is a relatively easy means to measure the effects of RET, but it may not be necessary to limit the verbs of the SPT to present progressive tense items. Additionally, it may not be necessary to include verbs in the SPT that coincide with those used in photographs used in training. It might be a better test of the effects of RET to simply use verbs of different tenses and with different argument structures.

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