A new approach for quantifying the effects of response elaboration training

Introduction

Response Elaboration Training (RET; Kearns, 1985, 1986) is a content-driven treatment for individuals with aphasia. Several studies by Kearns and colleagues indicate RET's unique "loose training" paradigm increases the amount of verbal information produced by individuals with non-fluent Broca's aphasia in response to picture stimuli (Gaddie, Kearns, & Yedor, 1991; Kearns, 1985, 1986; Kearns & Scher, 1989; Kearns & Yedor, 1991; Nessler, 2009), and that in some cases, RET effects generalize to other speaking partners, stimuli, and settings (Bennett, Wambaugh, & Nesslar, 2005; Gaddie et al., 1991; Kearns & Yedor, 1991). In most RET research, training effects are quantified by having the participant describe the same pictures used in RET. This provision of pictorial support limits conclusions that can be drawn about the effectiveness of RET and its generalizability. The present study examined the effectiveness and generalizability of RET on speaking performance of individuals with non-fluent Broca's aphasia with a sentence production task (SPT) that did not provide picture support.

Methods

Subjects

Three adults with chronic non-fluent Broca's aphasia participated in the study. All were Native speakers of English who incurred a left-hemisphere ischemic stroke with resulting right hemiparesis, aphasia, and apraxia of speech. Participant characteristics are provided in Table 1.

Treatment

Subjects received 12 sessions of RET following procedures described by Kearns (1986). Twenty treatment stimuli were randomly selected for each participant from 30 color action photographs depicting common activities (Webber, 2001). The remaining 10 photographs were not used in treatment, but the action verbs associated with these photographs were used to assess generalization. Participants were seen for treatment three times per week for four weeks. For each treatment session, RET was administered two to three times using the 20 picture stimuli.

Dependent Variable

Effects of RET and generalization were assessed with a sentence production task (SPT). For the SPT, the participant was instructed to use each of the 30 action verbs depicted in the photographs used for training or to measure generalization in a sentence (e.g., put the word cooking in a sentence). The SPT was administered on four occasions before treatment, four occasions during treatment, and one month after treatment. The 30 verbs of the SPT, shown in Table 2, were randomized for each of the nine administrations of the SPT and participants' responses were audio-recorded.

Measurement and Reliability

Responses to the SPT were transcribed verbatim. Each of the 30 responses was evaluated in terms of (a) type of syntactic structure produced, (b) grammatical completeness, and (c) semantic appropriateness based on criteria listed in Table 3. To calculate inter-observer reliability, twenty-five percent of the sentence productions were randomly selected and evaluated by two independent observers. Their percentage of agreements was compared on point-to-point bases. The average agreement between the examiners' and observers' judgment was 88%.

Results

Figures 1-6 display subjects' data for the nine SPT administrations. For each participant, SPT responses, based on verbs associated with the 20 trained photographs and 10 untrained photographs, are graphed separately, and data for type of syntactic structure, grammatical completeness, and semantic accuracy are shown in separate segments of the graph. Space limitations preclude full discussion of the performance of each participant. Figures 1, 3, and 5 indicate that all participants (1) decreased their production of non-sentences and increased their production of SV and SV+ sentences, (2) increased their use of grammatically complete sentences, and (3) increased their use of semantically appropriate responses from the "Before Tx" to the "Treatment" SPTs on verbs associated with treated photographs. Participants 1 and 2 reflected greater improvements on the SPT than participant 3, but participant 3 did markedly decrease his non-sentence productions. Figures 2, 4, and 6 indicate that all the participants improved their performance on the items of the SPT that required them to use a verb associated with a photograph not treated using RET.

To provide further information on the effects of RET on sentence production, four verbs associated with the trained photographs were randomly selected for each subject from the first, fifth, and either the seventh or eighth SPT. Verbatim transcriptions of these utterances for each participant are shown in Table 4**.** These data further support the benefits of RET on the SPT. From these transcriptions, it can be seen that subjects increased the length and complexity of their sentence productions, and decreased the number of false starts, interjections, and other disfluencies associated with their sentence productions across the repeated administrations of the SPT.

Table 5 shows the pre- and post-treatment *Western Aphasia Battery* (WAB; Kertesa, 2006) scores and picture description task data for subjects 1 and 3. Subject 2 was not available for post-treatment assessment or for his final SPT during treatment. Table 5 shows that participants 1 and 3 improved on the oral-language portion of the WAB and both improved on the three metrics of the picture description task: (1) time, (2) number of correct information units (CIU; Nicholas & Brookshire, 1993), and (3) mean length of utterance (MLU; Florance, 1981).

Discussion

Most studies of RET have employed multiple baseline single-subject designs and provided subjects with far more treatment than received by the subjects of this study. Geographical and other issues of subject availability restricted this study to use of a case series design and provision of treatment to 12 sessions. Nevertheless, results of this study were positive with some generalization to other tasks and stimuli and confirmed the viability of RET as a treatment that is beneficial for persons with non-fluent Broca's aphasia.

For this study, the effects of RET were quantified with a task that was not worked on in treatment, a sentence production task in which the subject had to put a specified verb in a sentence. Although the SPT was not worked on in treatment, subjects improved their performance on the SPT in three ways: (1) they produced successively fewer non-sentence productions and more sentences with an SV or SV+ construction, (2) their sentence productions reflected increased grammatical completeness, and (3) their sentence productions reflected increased semantic appropriateness. These results suggest RET has potential for indirectly affecting syntactic performance in spite of the fact that it is a content-driven approach. In addition, results of this study provide additional support for the generalizability of RET and its loose training procedure. Not only did the subjects improve the syntactic accuracy, grammatical completeness, and other aspects of performance on the SPT, but two of the three subjects improved their pre- and post-treatment performance on the WAB and two picture description tasks. Finally, as seen in Table 4, all subjects reflected improvements in sentence production as evinced by the transcriptions of the randomly selected sentence productions. These were largely qualitative and suggested that with treatment subject's sentences were longer, more complex, and more fluent.

In sum, the sentence production task seems to be a viable alternative to quantifying the benefits of RET and eliminates possible contaminants associated with visual support from pictures used in training. The SPT could, of course, be improved upon. One means of doing this might be that of balancing the verbs used for the task and/or controlling for verb argument structure.

References

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Table 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

Table 2
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

Table 3
Classifications of SPT Responses

Parameter	Classification	Definition	Example
Syntactic Structure	S-V	Response has a subject-noun and a verb (main or auxiliary)	Person is cooking
	S-V+	Response has a subject-noun, verb, plus additional information	Person is cooking vegetables
	NS	Response is non-sentential	Cooking
Grammatical Completeness	Grammatical (*credit is given for this parameter*)	Response is acceptable according to the grammar of Standard English	The person is cooking
	Ungrammatical (*no credit is given for this parameter*)	Response is *not* acceptable according to the grammar of Standard English	Person cooking is good
Semantic Appropriateness	Appropriate (*credit is given for this parameter*)	Response (a) contains target word or semantically related alternative, (b) is logically plausible, (c) is propositionally meaningful, and (d) has an SV or SV+ construction	Man is cooking on the grill
	Non-appropriate (*no credit is given for this parameter*)	Response does not meet the criteria for "appropriate"	The man is cooking the mouse

Participants' production errors (e.g., paraphasias, articulation errors), extraneous words (e.g., fillers, repetitions, unintelligible words, interjections), and disruptions in fluency (e.g., pauses, restarts) were ignored by the examiner when classifying the SPT responses for syntactic structure, grammatical completeness, and semantic appropriateness.

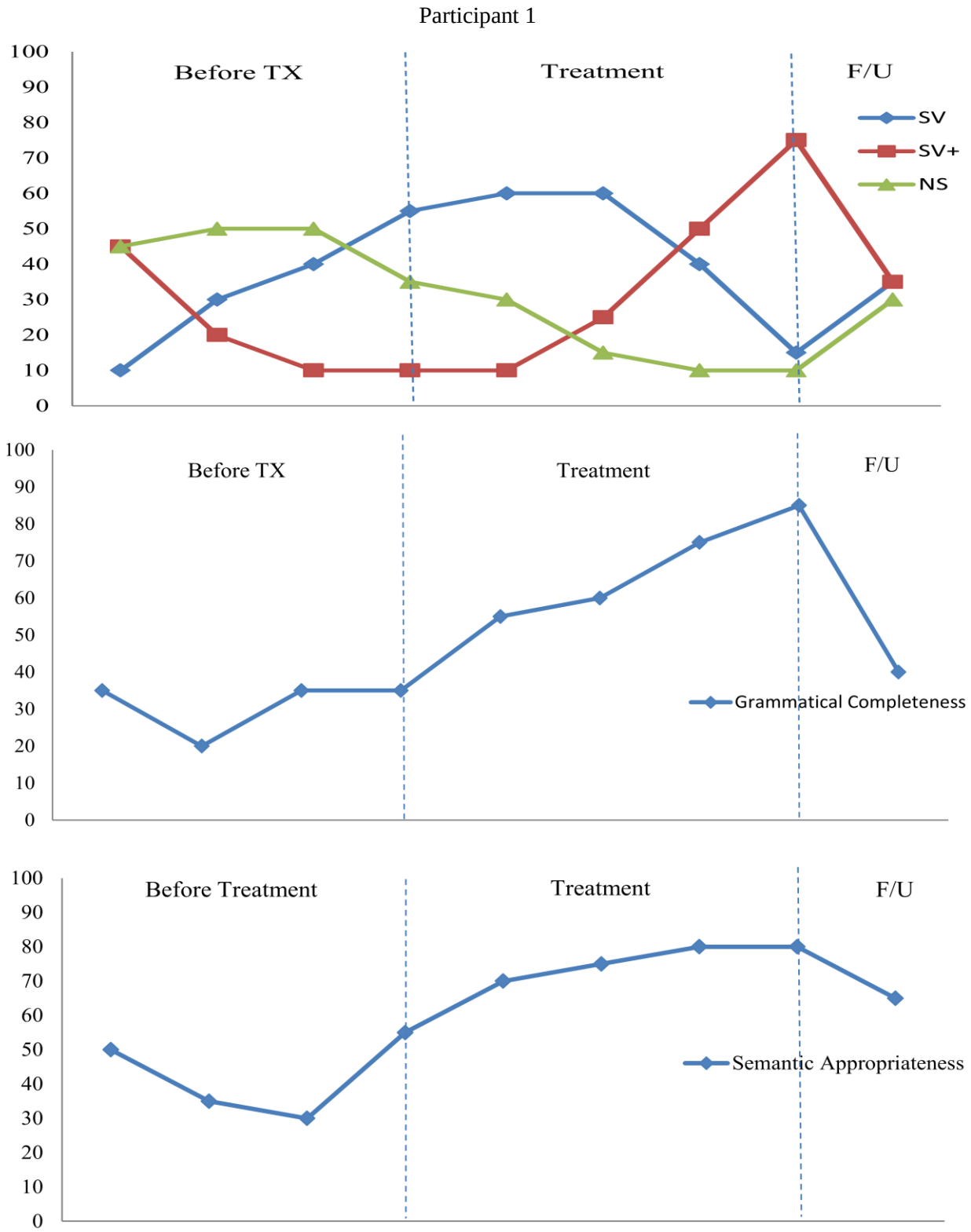

Figure 1 Percentage of NS, SV, and SV+ constructions (top), grammatically complete sentences (middle), and semantically appropriate sentences (bottom) for the 20 action words corresponding to activities depicted in the trained photographs.

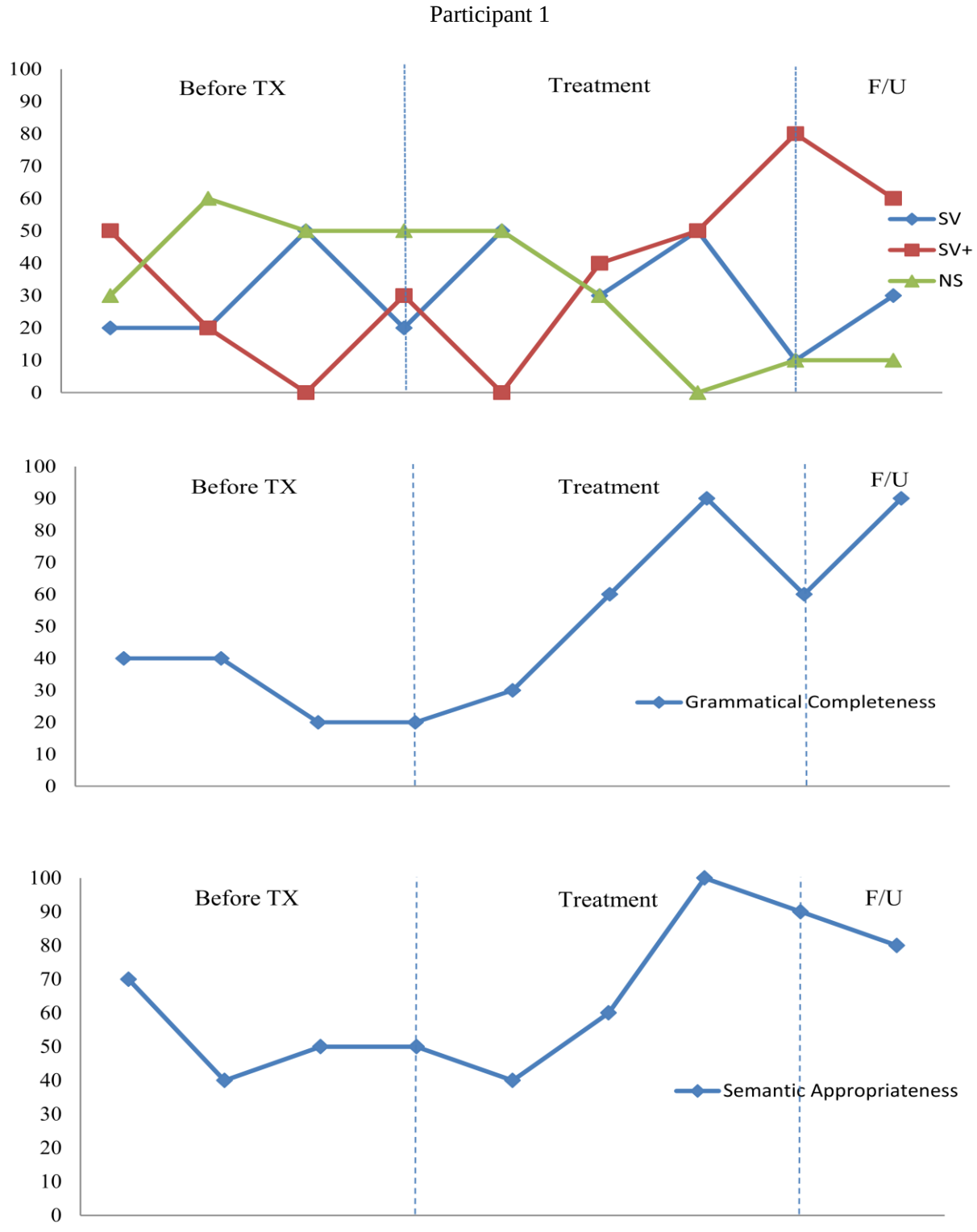

Figure 2 Percentage of NS, SV, and SV+ constructions (top), grammatically complete sentences (middle), and semantically appropriate sentences (bottom) for the 10 action words corresponding to activities depicted in the untrained photographs.

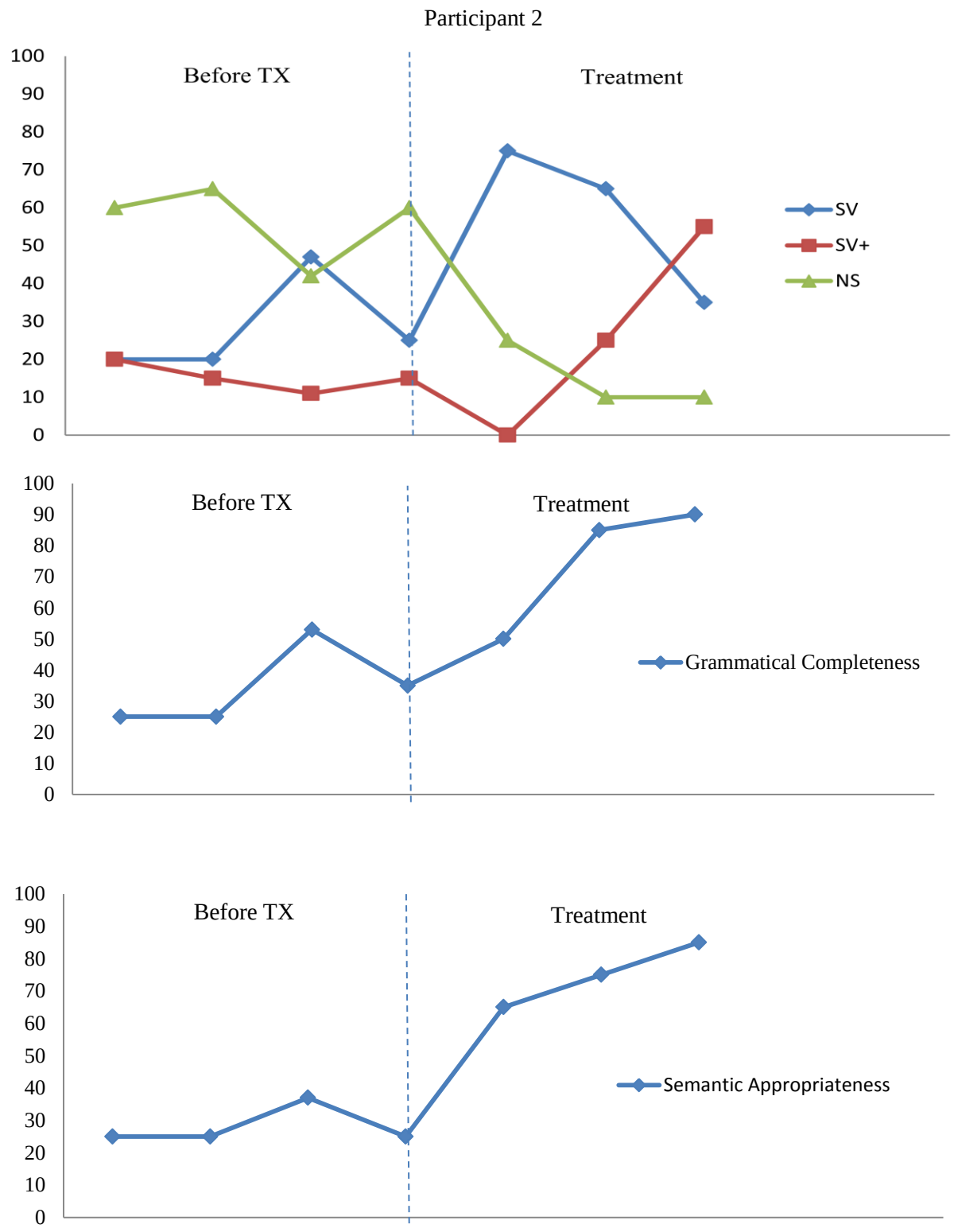

Figure 3 Percentage of NS, SV, and SV+ constructions (top), grammatically complete sentences (middle), and semantically appropriate sentences (bottom) for the 20 action words corresponding to activities depicted in the trained photographs.

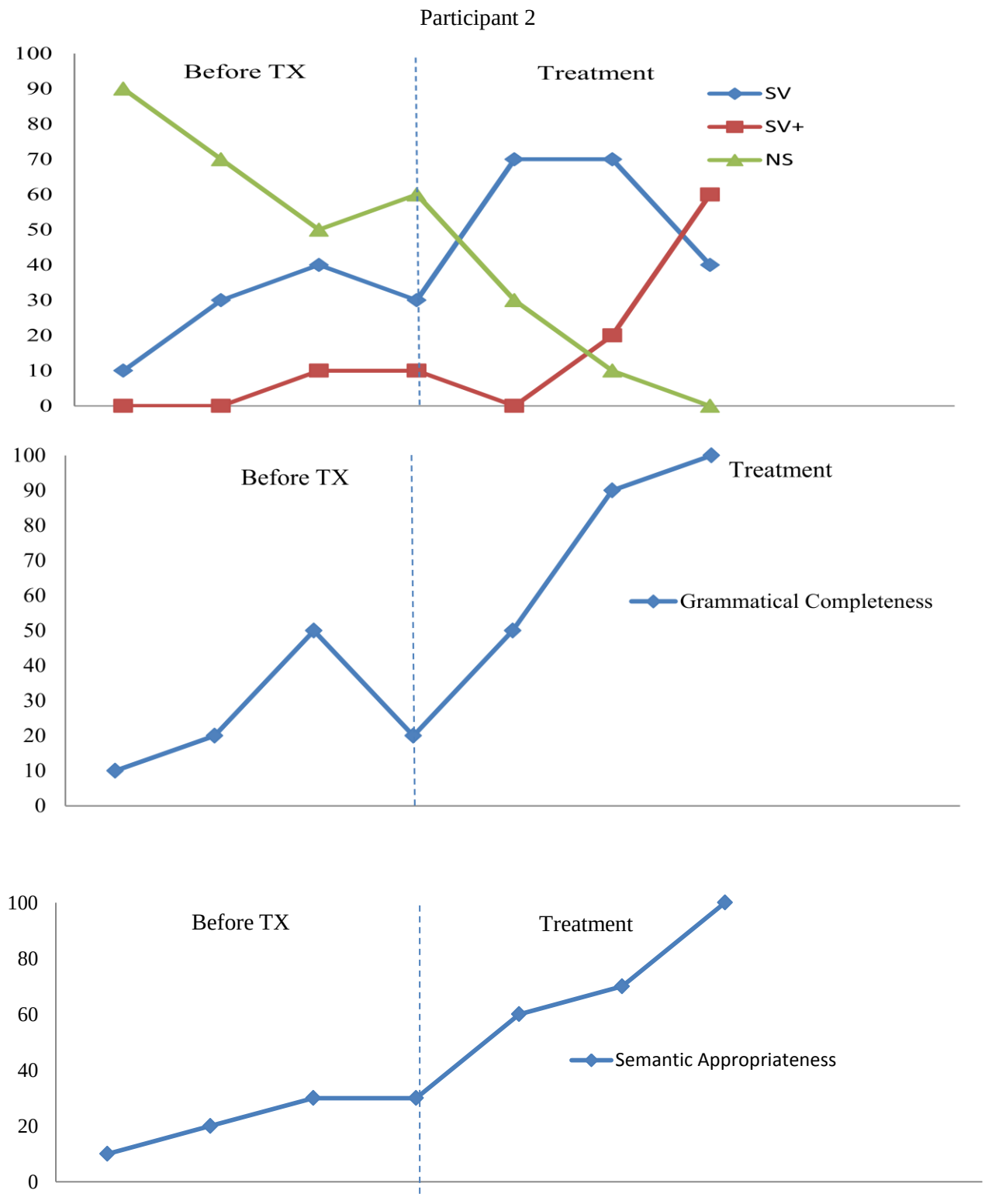

Figure 4 Percentage of NS, SV, and SV+ constructions (top), grammatically complete sentences (middle), and semantically appropriate sentences (bottom) for the 10 action words corresponding to activities depicted in the untrained photographs.

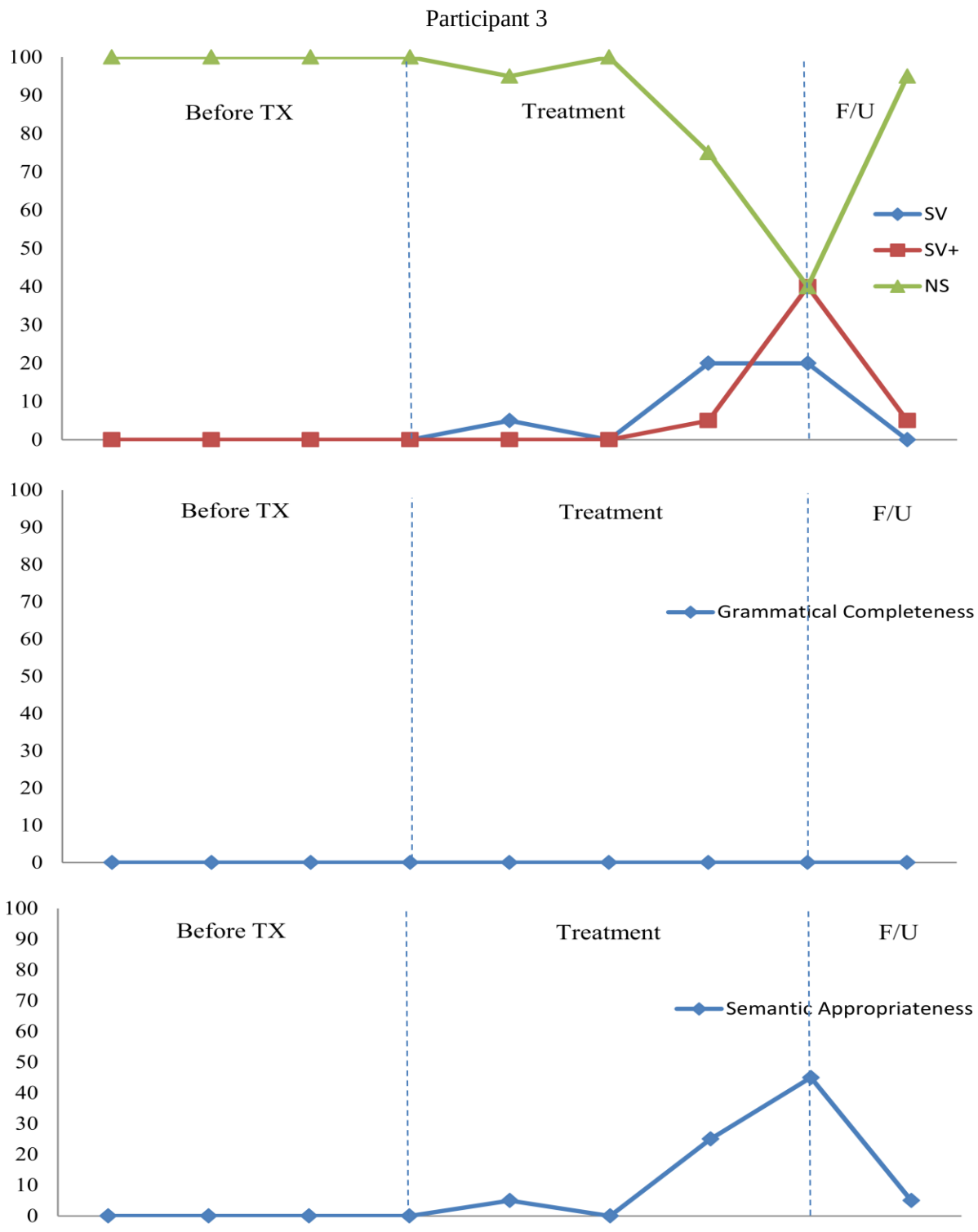

Figure 5 Percentage of NS, SV, and SV+ constructions (top), grammatically complete sentences (middle), and semantically appropriate sentences (bottom) for the 20 action words corresponding to activities depicted in the trained photographs.

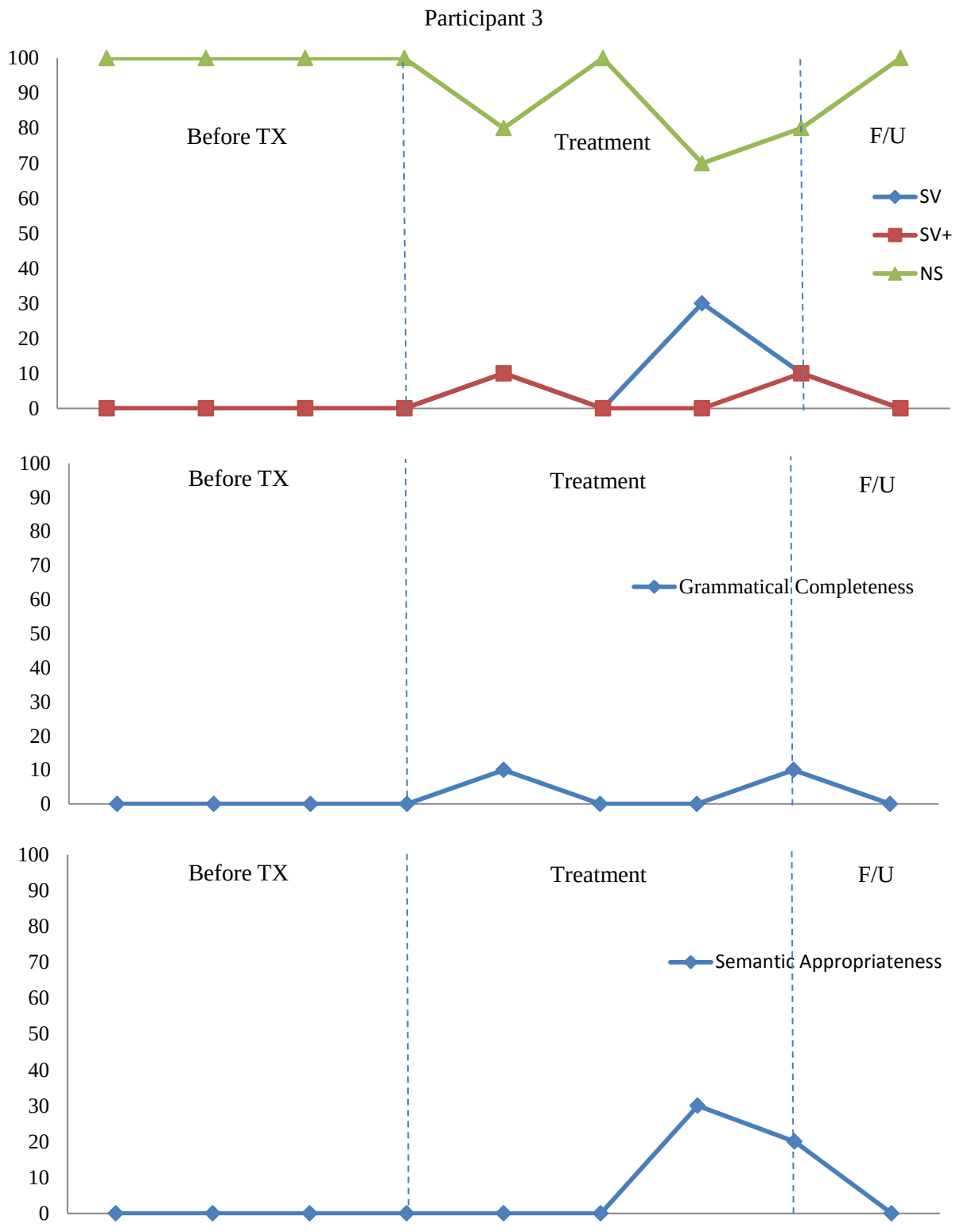

Figure 6 Percentage of NS, SV, and SV+ constructions (top), grammatically complete sentences (middle), and semantically appropriate sentences (bottom) for the 10 action words corresponding to activities depicted in the untrained photographs.

Table 4
Examples of responses to the SPT provided by participant 1 (top), participant 2 (middle), and participant 3 (bottom).

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: *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

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: *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*

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 5
Results from Pre-study and Post-study Testing for Participant 1 and Participant 3

Measure	Participant 1		Participant 3	
	Pre-study	Post-study	Pre-study	Post-study
Western Aphasia Battery-Revised				
Aphasia Quotient (AQ)	60.2	65.4	44.8	54.4
Subtests				
Informational content	8	8	8	8
Fluency	4	4	2	4
Auditory verbal comprehension	6.9	7.8	7	6.9
Repetition	5.8	6.1	1.4	2.4
Naming	5.4	6.8	4	5.9
Picture description				
"Cookie Theft" picture (Goodglass &Kaplan, 1983)				
Time	2:41	2:30	1:51	2:09
Number of CIUs	16	20	5	6
MLU	2.4	2.5	1.4	2.6
"Picnic Scene" picture (Kertesa, 2006)				
Time	4:31	4:19	3:54	3:59
Number of CIUs	19	24	10	24
MLU	2.04	3.0	1.5	3.2