

Introduction

Agrammatism is characterized by difficulty comprehending and producing grammatical structures (Berndt, 1987). Of specific difficulty is the utilization of complex, non-canonical sentence structures (e.g., wh-questions, passives, object cleft, & subject-raising) (Saffran, Berndt, & Schwartz, 1989).

Systematic research by Thompson and colleagues (1996, 1997, 1998, 1999, 2000, & 2003) has documented positive effects of Linguistic Specific Treatment (LST) in terms of increasing correct production of targeted complex sentence structures. Thompson and colleagues also reported generalization to related sentence structures (i.e., sentences requiring similar movement of the underlying structure), with some variance in generalization patterns noted across individuals.

Although Thompson and colleagues have provided substantial documentation of the effects of LST, their findings have not been replicated by an independent team of investigators. Such replication is considered to be an important component of the process of determining that a treatment is efficacious (Chambless & Hollon, 1998).

The purpose of this investigation was to examine the effects of Linguistic Specific Treatment (LST) by systematically replicating the study conducted by Thompson, Shapiro, Ballard, Jacobs, Schneider, & Tait (1997). More specifically, the study was designed to determine if response generalization results would be similar to those predicted by the findings of Thompson and colleagues. A secondary purpose of the investigation was to extend the work of Thompson et al. by evaluating the effects of treatment on discourse production.

Specific experimental questions to be addressed are:

1. Will application of LST to object clefts result in a) improved production of trained exemplars of those structures, and b) improved production of untrained who questions? (like object clefts, who questions rely on wh- movement)
2. Will application of LST to subject-raising structures result in a) improved production of trained exemplars of those structures and b) improved production of passives? (passives also rely on NP-movement)
3. Will application of LST result in changes in informativeness and production of grammatical forms in narratives elicited through a story re-tell procedure?

Method

Participant

One male with moderate-severe Broca's aphasia, agrammatism, and apraxia of speech (AOS) resulting from a left-hemisphere CVA participated in this study. Descriptive data and pre and post treatment assessment results are shown in Tables 1 and 2. The participant's productive verbal language was typified by utterances consisting of one to three words that were grammatically simple and was consistent with a diagnosis of agrammatism (Saffron et al., 1989).

Experimental Stimuli

Following the methods outlined by Thompson et al. (1997), a set of 15 semantically reversible active sentences of the form NP-VP-NP were selected (See Appendix A). Each sentence had two cognate picture pairs with corresponding nouns and verb printed on them, one depicting the action taking place (target picture) and one representing the semantically-reversible

counterpart of the sentence (foil picture) for a total of 30 pictures. These pictures were used in probes to elicit 15 of each of the four following sentence types; object-cleft, subject raising, passive and wh-question. During the treatment phase, these pictures were used in conjunction with another set of stimuli cards, each typed with individual sentence constituents that were manipulated to form the target sentences.

Experimental Design

A multiple baseline design across behaviors was implemented to evaluate the acquisition effects of treatment as well as response and stimulus generalization effects.

Baseline. Baseline probes were conducted for each sentence type under investigation prior to beginning any phase of treatment. An 8 point scoring scale developed by Thompson et al. (1997) was used to characterize the accuracy of participant responses. The baseline procedures, sentence production priming task (in accordance with the Thompson et al., 1997, protocol), are outlined in Appendix B. Specifically, four types of sentences with 15 exemplars each were elicited for a total of 60 sentences produced for each baseline session.

Treatment. Following initial testing and baseline procedures, treatment of object cleft sentences was initiated. During the initial training phase, probes of all sentence types continued to be conducted. Following treatment of object cleft sentences, treatment was then applied to subject-raising sentences. Treatment procedures are shown in Appendix C.

The subject received treatment twice per week, with each of the training sentences practiced one to two times each, for a maximum of 30 trials per session. Treatment for each sentence type was provided for a maximum of twenty sessions or until the subject demonstrated at least 60% correct responding to trained items in probes in three consecutive probe sessions (after Thompson et al., 1997).

Maintenance and Follow-Up. To assess maintenance, probes were conducted biweekly for previously treated sentence types using the sentence production priming task. Two follow-up probes were conducted at 2 and 4 weeks post-treatment.

Dependent Measures

Production of four sentence types; object cleft, who questions, subject-raising, & passive structures, each with fifteen exemplars served as the dependent measures. The sentences were elicited during probes to assess acquisition and generalization effects of treatment.

In addition, changes in production of content in discourse were repeatedly measured using a story re-tell procedure developed by Doyle, McNeil, Spencer, Goda, Cottrell, & Lustig (1998). During the baseline phase, each parallel form of the stories (i.e., a group of three stories) was administered. Then, during the treatment phase, one form was administered after approximately every six treatment sessions and at the completion of each phase of treatment. Production of information units was calculated according to procedures specified by Doyle et al. (1998).

Reliability

Twenty-five percent of all recorded baseline and treatment probes were randomly selected for re-scoring by an individual other than the original scorer. Point to point agreement was calculated and was greater than 95% for baseline and treatment probes.

Ten percent of all recorded treatment sessions were randomly selected to determine accuracy of administration of the independent variable. Point to point agreement was calculated at 100% across scorers.

Results

Results of LST are represented in Figure 1. The top graph indicates that during the initial phase of treatment, the subject's production of object clefts improved from 0% to 60% accuracy after 10 treatment sessions as measured during sentence production probes.

The treatment of object clefts did not appear to impact production of related who questions or of NP- movement structures (i.e., subject-raising or passives).

Improved performance on object cleft items was not maintained following discontinuation of treatment. The participant's performance rapidly returned to baseline levels, with only two probes during the maintenance phase exceeding baseline.

During the second phase of treatment, subject-raising structures were treated. Only two of the eleven probes collected during this treatment phase showed any evidence of structure acquisition. No significant differences were noted for passive structures or for wh- movement structures during subject raising sentence treatment.

Discourse results are shown in Table 3.

Discussion

The application of LST to object clefts resulted in improved production of those structures during the treatment phase. However, the application of LST to subject raising structures did not result in consistent, improved production of trained exemplars of those structures. Response generalization to untrained exemplars was not evident. Discussion will include possible explanations for decline of acquired object cleft structure and the variation in results compared to previous studies.

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Appendix A
Sentence Stimuli

1. The man kissed the child.
2. The cow followed the horse.
3. The woman pushed the child.
4. The cow kicked the horse.
5. The child washed the woman.
6. The mother pulled the child.
7. The man saved the woman.
8. The woman painted the man.
9. The man filmed the woman.
10. The man carried the woman.
11. The woman pinched the man.
12. The boy followed the girl.
13. The dog followed the cat.
14. The woman kissed the man.
15. The man pushed the woman.

Semantic Reversible Foil Example:

The man kissed the child. (target)
The child kissed the man. (foil)

Target Non-Canonical Sentences:

Wh- Question: Who has the man kissed?
Object Cleft: It was the child who the man kissed.
Passive: The child was kissed by the man.
Subject Raising: The man seems to have kissed the child.

Appendix B
Baseline and Probe Procedures

- 15 pairs of pictures presented in random order
- Randomly elicit production of 4 sentence types using the sentence production priming task (total 60 target sentences) identified in the following four steps:
 1. Present the foil picture and read the two nouns and verb printed on the picture
 2. Produce a primer sentence while pointing at the foil picture (e.g., to elicit wh-? “In this picture, you want to know the person being kissed, so you say, ‘who has the child kissed?’”)
 3. Remove primer picture
 4. Present the second picture that depicts target sentence with the elicitation cue (e.g., “In this picture, you want to know the person being kissed, so you say” _____.)
- Provide the participant with 10 seconds to respond before the next item is introduced
- No corrective feedback is given
- May provide non specific feedback as necessary (e.g., “You’re trying hard.”)
- Orthographically transcribe all sentences online

- Probes were conducted at the beginning of each session prior to any treatment
- Audio and video record all probes sessions for verification of online transcription, accurate scoring, and reliability purposes

Appendix C Treatment Procedures

- Participant trained to identify the relevant syntactic properties of each structure using the simple active counterpart of the target sentence with the following steps by the investigator:
 1. Point to the verb of each sentence and identify the argument structure/thematic role of the verb
 2. Move the sentence constituents to form the target sentence structure
 3. Produce the surface form of the targeted sentence type
- The picture pairs were presented and the subject was given the opportunity, following the Sentence Production Priming protocol, to produce the target sentence structure.
- Incorrect responses required the target picture and the sentential constituents representing the active sentence form, on individual cards, to be presented. (Any additional grammatical elements needed to complete the correct Surface Structure of the sentence were also presented.)
- The roles of both the subject and object NP's were described, and the card with the word written on it *who* (for object clefts, for instance) was placed next to the object NP while explaining the reason for such placement (ie., "The man is the person doing the kissing and the child is the person being kissed. *Who* is added next to the child because he is the one being kissed.")
- Then, the subject was instructed to move the object NP and the *who* card to the beginning of the sentence, while the examiner explained that a new sentence was being made.
- The subject was then asked to read the sentence, and asked if anything seems to be missing, while the examiner was pointing to the extra grammatical constituents provided on individual index cards.
- If the subject did not respond to this indirect cue, the investigator took the correct card (*it was*) and said, "To make the new sentence complete, we need to add this card (*it was*) to the beginning of the sentence."
- The subject was asked to read the complete sentence. Sentential constituents were then rearranged in their original order and the subject was asked to arrange the cards to make the target sentence.
- Assistance and feedback was provided when required.
- Finally, the sentence production priming task was repeated with presentation of the foil stimulus picture followed by the target picture.

Table 1
Subject's Descriptive Data

Characteristics	Subject
Age	53
Gender	male
Months Post-Onset	38
Years of Education	12
Former Occupation	Cook
Pre-Morbid Handedness	Right
Paralysis	Partial Right-side

Table 2
Results of Pre and Post Treatment Testing

Porch Index of Communicative Ability (PICA; Porch, 1981)

<u>Subtest</u>	<u>Pre</u>	<u>Post</u>
Verbal	52%	51%
Auditory	74-99%	74-99%
Overall Score	51%	52%

Western Aphasia Battery (WAB; Kertesz, 1982)

<u>Subtest</u>	<u>Pre</u>
Fluency	10
Comprehension	146
Naming	79
Repetition	54
Aphasia Quotient	61.2

Philadelphia Comprehension Battery for Adults (PCBA; unpublished)

<u>Subtest</u>	<u>Pre</u>	<u>Post</u>
Lexical Comprehension	100%	100%
Sentence Comprehension		
Reversible	61%	70%
Lexical	91%	100%
Synonymy Triplets	83%	77%
Grammaticality Judgements	84%	82%

Raven's Colored Progressive Matrices (RCPM, Raven et al., 1965)

Non-verbal Intelligence Score	25%ile
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Assessment of Intelligibility of Dysarthric Speech (AIDS; Yorkston & Beukelman, 1981): (word level)

70%

Table 3
Production of Discourse Content (IUs) and Word Types in Story Retells

Session #	4	10	15	20	25	31	39
Phase of Study	Baseline	Tx. 1	Tx. 1	Tx. 2	Tx.2	Tx. 2	End of Tx.
IUs	39	24	28	30	25	25	53
IUs possible	448	473	473	448	476	422	448
Story %	8.7%	5.1%	5.9%	6.7%	5.2%	6%	12%
Nouns	22	13	20	22	18	15	29
Verbs	11	8	6	5	5	7	51
Adjectives	4	0	0	0	1	0	1
Prepositions	2	3	2	3	1	3	2

Figure 1. Percent correct production of wh- and NP- movement structures during probes

