Experimental Analysis of Acquisition and Generalization of Syntax in Broca's Aphasia

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Many procedures and treatment programs continue to be recommended as clinical tools based upon a limited body of empirical support. Helm's Elicited Language Program for Syntax Stimulation of "HELPSS" (Helm-Estabrooks, 1981) is such a program. Only a single article (Helm-Estabrooks, Fitzpatrick, and Baressi, 1981) includes data regarding its application and the results must be interpreted with caution because a nonexperimental case study design was employed. HELPSS is based on the position that agrammatism, as seen in Broca's aphasia, represents a retrieval disorder, and that systematic stimulation of certain syntactic constructions will facilitate production of these forms. The HELPSS protocol incorporates principles of programmed instruction and is comprised of eleven sentence types hierarchically arranged according to the level of difficulty identified by Gleason, Goodglass, Green, Ackerman, and Hyde (1975).

The purpose of the following investigation is to evaluate the efficacy and efficiency of HELPSS, employing an experimental design that will provide an analysis of individual learning, generalization, and maintenance patterns. Specifically, systematic evaluation of HELPSS will address the following research questions.

1. Does HELPSS facilitate verbal production of specific syntactic constructions in patients with agrammatism as seen in Broca's aphasia?
2. Does training of specific sentence types generalize to novel exemplars of the same form?
3. Does training certain sentence types generalize to different constructions?
4. Do trained sentence types generalize across tasks and to standard measures?

METHOD

Subjects. Two subjects were selected from the outpatient files of a metropolitan V.A. medical center. Each subject was classified as having Broca's aphasia according to their most recent Western Aphasia Battery. Both subjects had been enrolled in maintenance programs in the year prior to their participation in the study. Table 1 presents relevant subject characteristics.

Table 1. Subject characteristics.

S	AGE	GENDER	EDUCATION	HAND.	ETIOLOGY	TYPE	AQ	MPO
1	42	M	H.S.	R.	T-E CVA	Broca's	61	88
2	58	M	H.S.	R.	T-E CVA	Broca's	71	175

Setting and Materials. Both subjects were seen three times per week in a quiet room, free of distractions. HELPSS (1981) stimulus materials were presented according to the manual.

Experimental Design and Conditions

A multiple baseline design across responses using a multiple probe technique was employed. Sentence constructions from HELPSS comprised the repertoire of responses under investigation.

Baseline. Baseline measures were obtained using fifteen different exemplars for each of the eleven sentence types at levels A and B of the program. These 165 exemplars were divided into three sets, each containing five exemplars of each of the eleven sentence types. The 55 exemplars within each set were randomized and one set was administered alternately each successive baseline session to avoid practice effects.

Training. The first five sentence types on which each subject achieved stable and low levels of responding during the baseline condition were trained in succession. Twenty exemplars were selected for each sentence type and were divided into a training set of five items, and three generalization sets of five items each.

Training began with the level A delayed repetition condition on each subjects' previously determined sentence type, while the remaining four forms were intermittently assessed under nontreatment conditions. Five exemplars constituted a trial. Following three consecutive trials of 80% response accuracy for the level A delayed repetition condition, training was initiated on level B. Following three successive trials of 80% response accuracy for the level B self retrieval condition, generalization probes corresponding to the form undergoing treatment were administered. Criterion for progressing to the following sentence type was 80% response accuracy on the probe (generalization) exemplars for three consecutive sets of probes. In the event that a subject failed to meet criterion following nine sets of probe items after having met criterion on level B training exemplars, training was initiated on the next sentence type.

Scoring. All responses were scored correct or incorrect. A correct response was a semantically appropriate utterance that contained all grammatical elements of the target sentence type. Articulatory distortions and phoneme substitutions that did not effect the morphemic or syntactic integrity of the sentence were not penalized. Self corrected responses were not penalized.

Generalization Across Tasks. Each sentence type was elicited under different stimulus conditions prior to, and immediately following training of that particular form. Five stimuli consisting of common objects, pictures, activities or situations were arranged to elicit each form. For example, to elicit the wh-interrogative form, an interview situation was created with an individual unfamiliar to the subject. The subject's task was to obtain certain information (e.g., name, address, phone number, occupation, and birthdate) by asking wh-questions. If the subject responded inappropriately, the investigator provided verbal prompting. If after prompting the subject failed to respond correctly, the next item was presented. Scoring was 2 points for a correct response without prompting, 1 point for a correct response with prompting and zero for failure to respond correctly.

Standard Measures. Each subject was evaluated prior to baseline and immediately following HELPSS training with The Western Aphasia Battery (WAB), and The Northwestern Syntax Screening Test (NSST).

Reliability. The investigator and another observer independently scored a random sample of trials from audiotape recordings. Percentage of inter-observer agreement was determined by the number of agreements divided by the number of agreements plus disagreements multiplied by 100. For subject #1,

33 of 105 trials were sampled with 97% point-to-point agreement. For subject #2, 22 of 100 trials were sampled with 96% point-to-point agreement.

RESULTS AND DISCUSSION

Subjects met criterion for each sentence type within 3-10 trials for level A and 7-18 trials for level B (Figures 1 and 2). No consistent trends in ease of acquisition were evident across sentence types. Nevertheless, HELPSS was sufficient for subjects to learn verbal production of five sentence types.

Performance on untrained generalization probes is shown in Figures 3 and 4. Stable and low levels of responding were evident for both subjects during the baseline condition. Following training, a significant increase in the level of correct responding is evident for both subjects on all sentence types through the maintenance phase. Thus, generalization to novel exemplars and maintenance was demonstrated consistently.

Figures 5 and 6 reflect performance of each subject on generalization of trained sentence types to elicitation tasks. Subjects showed limited improvement following treatment. Table 2 summarizes the performance of each subject on standard measures. Pre- and post- treatment comparisons show limited improvement. Thus, HELPSS training does not appear to be sufficient for subjects to generalize trained sentence types to novel stimulus conditions or standard measures.

Table 2. Subjects' performance on the Western Aphasia Battery (WAB) and the Northwestern Syntax Screening Test (NSST).

	PRE	POST
WAB		
S1		
Spontaneous Speech	13	13
Auditory Comprehension	7.65	7.75
Repetition	5.3	6.0
Naming	4.5	6.5
A.Q.	61.0	66.5
S2		
Spontaneous Speech	12	12
Auditory Comprehension	9.5	9.6
Repetition	6.5	7.2
Naming	7.5	8.1
A.Q.	71.0	73.8
NSST		
S1		
Expressive	1	6
Receptive	34	35
S2		
Expressive	1	3
Receptive	27	30

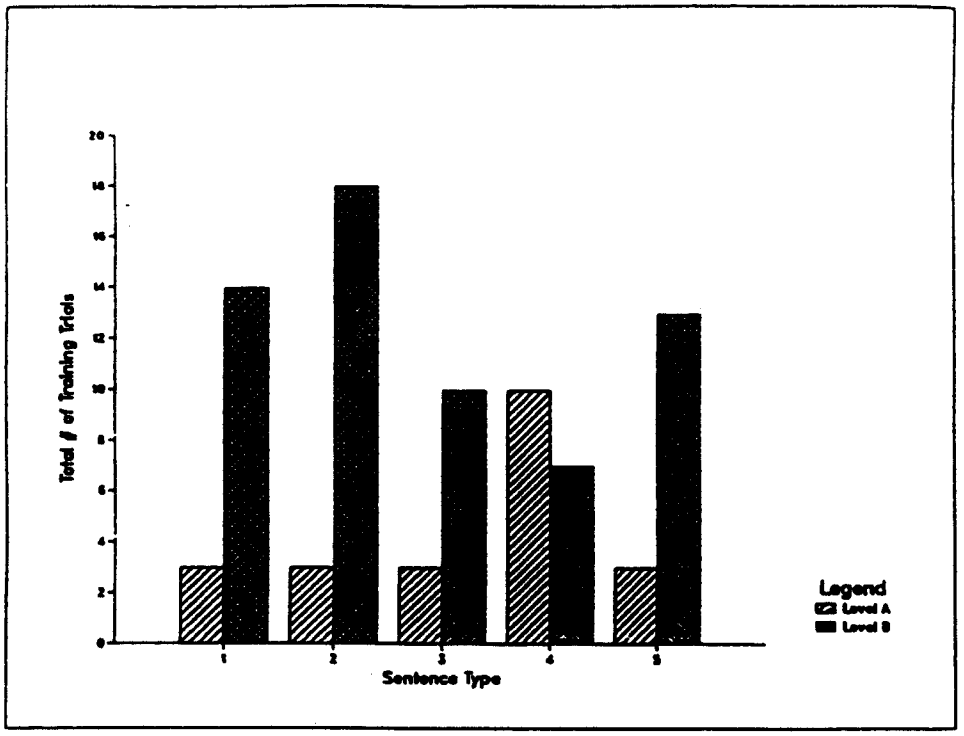

Figure 1. Training data for Subject 1.

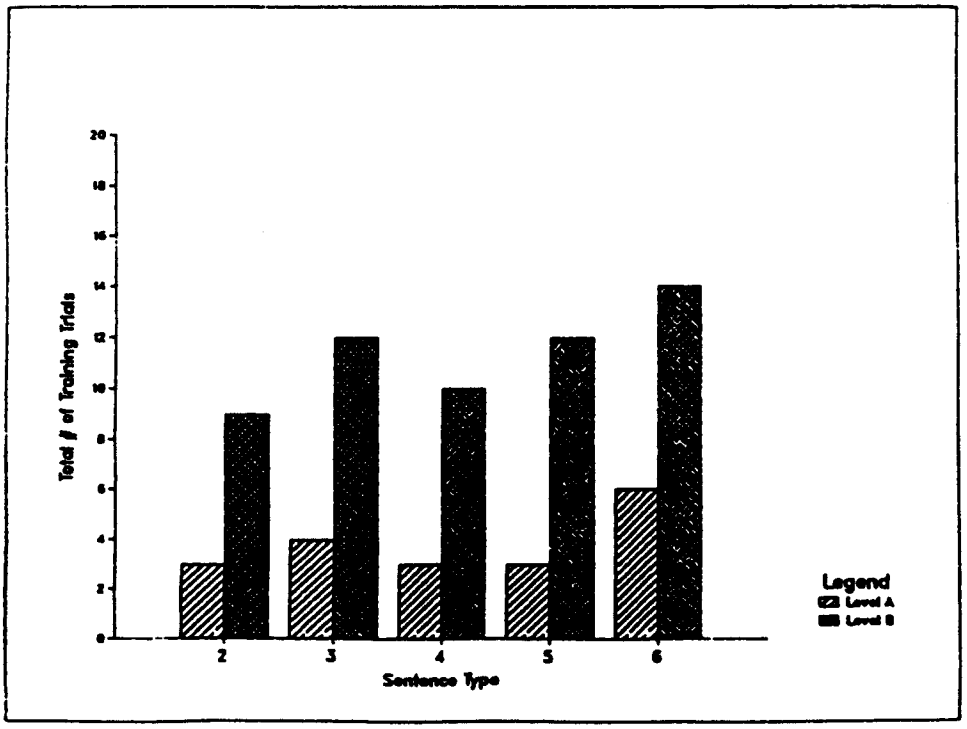

Figure 2. Training data for Subject 2.

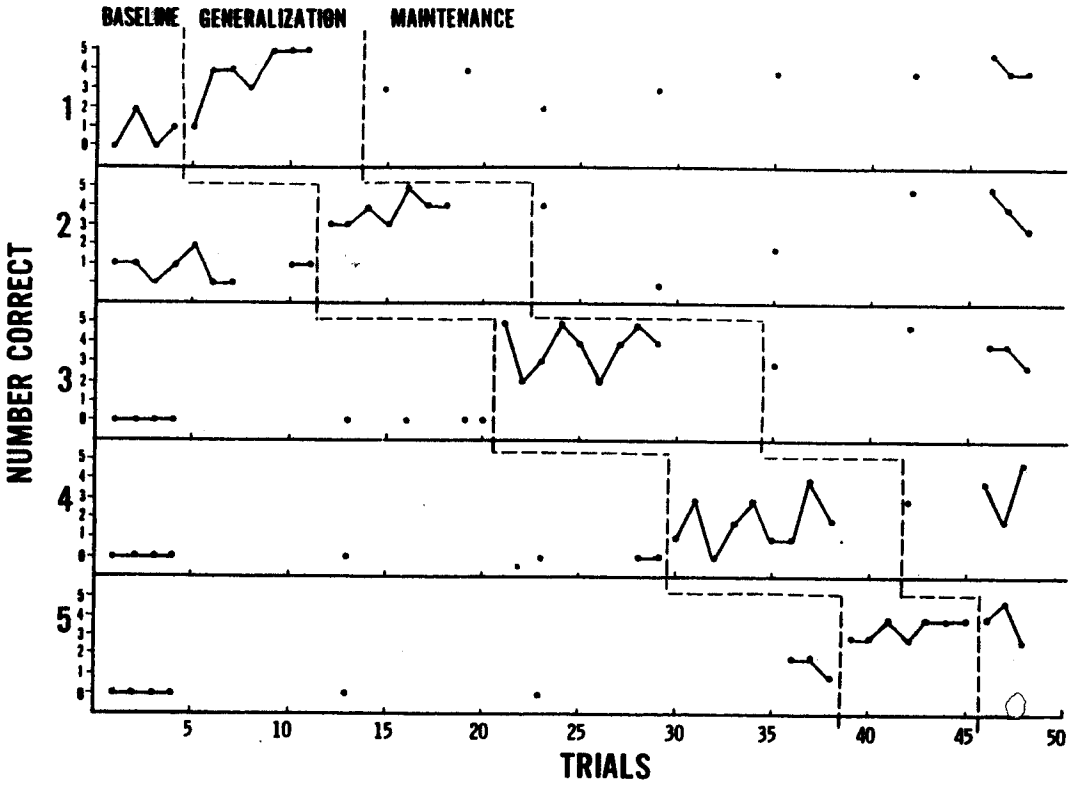

Figure 3. Performance over trials for Subject 1.

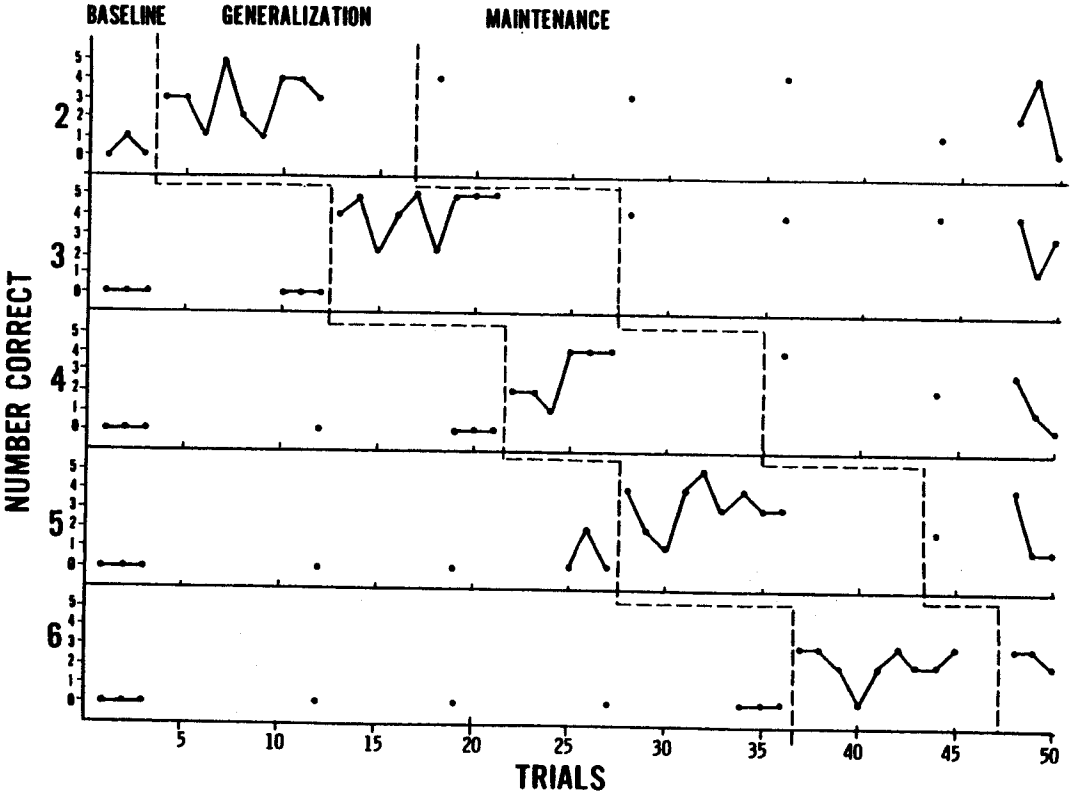

Figure 4. Performance over trials for Subject 2.

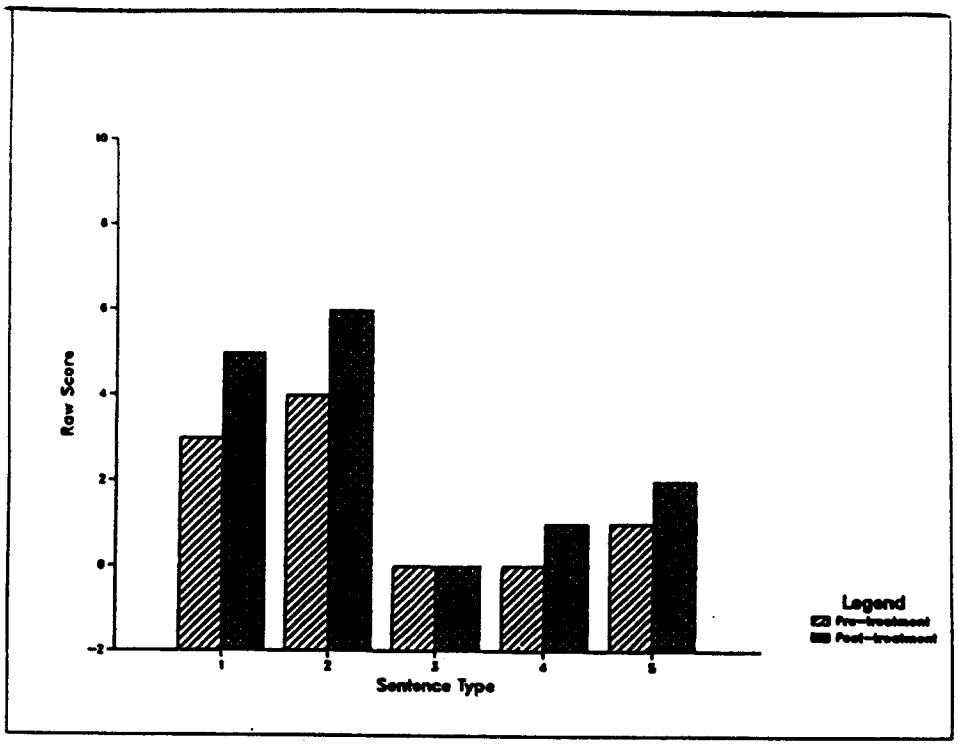

Figure 5. Generalization across tasks for Subject 1.

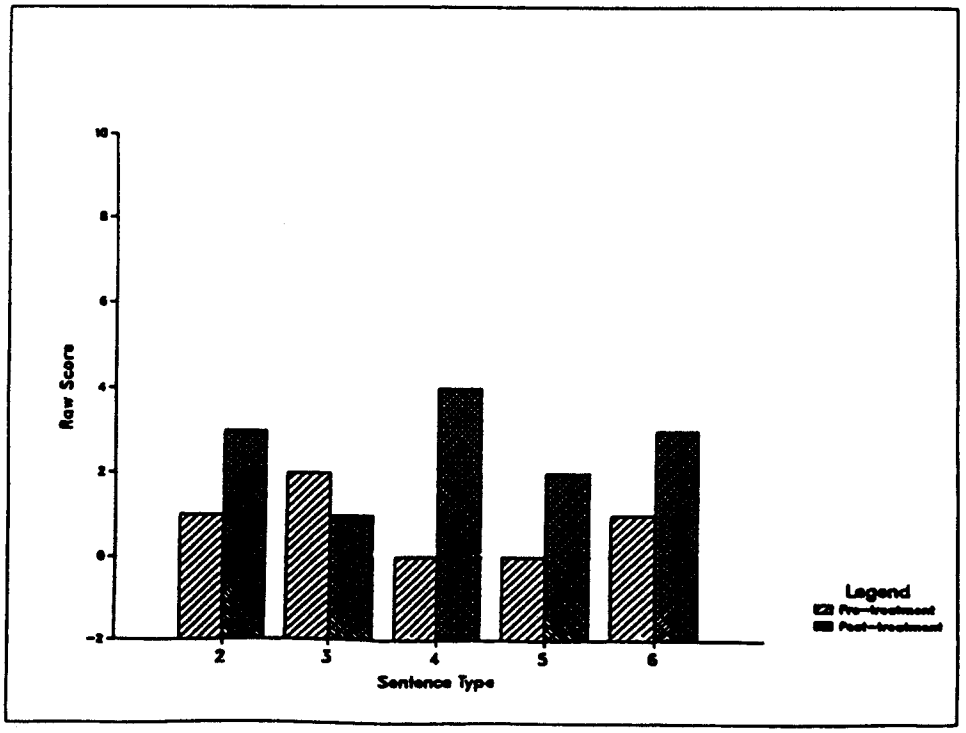

Figure 6. Generalization across tasks for Subject 2.

DISCUSSION

The results of this study provide information concerning the effects of a specific treatment protocol (Helm-Estabrooks, 1981) on the speech production skills of two Broca's aphasic patients with agrammatism. The findings of rapid acquisition, generalization to novel exemplars and strong maintenance effects, with limited generalization to nontrained stimulus conditions has been reported previously for auxiliary and copula verb training (Kearns and Salmon, 1984), and WH-interrogative training (Thompson and McReynolds, in press). In each case, a well defined intervention program produced excellent effects under treatment conditions, but failed to result in similar behavioral changes under more naturalistic conditions.

Such findings challenge the clinical aphasiologist to develop treatment programs or to modify existing ones, such that functional use of learned language behaviors is facilitated. A necessary step in this process is identification of the crucial variables that are necessary for generalization to occur. Horner, Bellamy, and Colvin (in press) have suggested that the analysis of generalization error patterns from a stimulus control perspective has direct implications for the development of a technology to enhance generalized responding. Indeed, our finding of limited generalization across tasks may be explained from this perspective. We were able to trace generalization error responses of our subjects to characteristics of the HELPSS training stimuli. For example, following successful acquisition of the declarative transitive and intransitive forms (e.g., "He plays baseball" and "He sings"), both subjects consistently used the masculine personal pronoun "He" when presented with novel stimulus conditions requiring the feminine personal pronoun "She." The syntactic form of their response was correct, however, because all teaching examples employed only the masculine pronoun, restricting response variation (Horner et al., in press). In this case, it resulted in a semantically inappropriate response. Another example of restricted response variation was subject #1's error response "What are your name?", for the target response "What is your name?". Again, HELPSS training examples only employ the auxilary "are" with the 2nd person pronoun "you" and present progressive form of the verb within the WH-interrogative teaching examples. When novel stimulus conditions required a target response comprised of the copula and possessive pronoun "your," the subject responded in a restricted manner. Because the finding of limited generalization to nontrained stimuli has been frequently reported in the aphasia rehabilitation literature (Holland and Levy, 1971; Holland and Sonderman, 1974; Kearns, Simmons, and Sisterhen, 1982; Thompson and McReynolds, in press; West, 1973) the objective in developing a technology for generalized responding should be

> "...to select a logistically feasible set of teaching examples that sample the relevant stimulus variation in situations the individual will encounter after training" (Horner, McDonnell, and Bellamy, in press).

That is, there are many ways to form an interrogative or declarative sentence. Our findings revealed that training with five exemplars was sufficient for acquisition, maintenance, and generalization to nontrained members of the response class. What is needed, then, is not fifteen more teaching examples whose stimulus characteristics require the same form of response, but rather, examples whose stimulus characteristics require relevant variations of the response.

In keeping with the general tactic of analyzing error responses from a stimulus control perspective, an alternative explanation for the lack of

generalization across tasks may be that target responses were under the control of irrelevant stimuli (Horner, Bellamy and Colvin, in press). In other words, the pairing of a verbal cue with the presentation of a line drawing may have become a discriminative stimulus for occasioning correct responding. Although there are many naturally occurring stimulus conditions under which the formulation of a WH-interrogative or declarative sentence is appropriate, they may not be sufficient to elicit such responses if correct responding is under the control of irrelevant stimuli that are not present in these situations. Thompson and Byrne (1984) demonstrated experimentally that generalization across settings of social conventions and self-disclosures in Broca's aphasic subjects was facilitated by systematically altering their teaching examples such that the training conditions more closely approximated naturalistic conditions. This strategy is consistent with "loose training" (Stokes and Baer, 1977) and "general case instruction" (Horner, McDonnell and Bellamy, in press). Perhaps HELPSS training would be more effective with the addition of a "Level C" in which pictorial cues are faded, and a "Level D" in which target responses are evoked in role-play situations.

Finally, we offer yet another explanation for our findings. Perhaps the lack of generalized responding was due not simply to shortcomings of the HELPSS protocol, but rather, to the multidimensional nature of the deficits that define Broca's aphasia. In other words, can we expect a program whose purpose is to "improve the grammatical skills of adults with acquired aphasia" (Helm, 1981) to have an effect on the phonologic-prosodic and word finding deficits that are common symptoms of Broca's aphasia? Error responses may, in fact, reflect the interdependence of syntactic processing with phonological and lexical-semantic components of the linguistic system--components that are compromised in Broca's aphasia. To ignore these aspects of Broca's aphasia is to address only part of the problem. In this regard, HELPSS may best be employed as one component of a total treatment program for Broca's aphasia.

ACKNOWLEDGMENT

The authors wish to acknowledge the Audiology and Speech Pathology Service, University Drive VA Medical Center for their cooperation in identifying potential subjects for this study and for the use of their clinic space.

This work was supported by the Veterans Administration Department of Rehabilitation Research and Development Merit Review Project # 330.

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