Generative Use of Locatives in Multiword Utterances in Agrammatism: A Matrix-Training Approach

Cynthia K. Thompson, Leija V. McReynolds, Carol E. Vance
University of Kansas Medical Center, Kansas City, Kansas

Agrammatism has been described as a characteristic of Broca's aphasia by Jakobson (1956), Goodglass (1968), Bradley et al. (1979), and others. The disorder is typified by a breakdown at the syntactic level of language production in the presence of relatively well preserved auditory comprehension. Speech and language patterns associated with agrammatism are well documented in the literature. Descriptive studies by Goodglass and Hunt (1958), Goodglass and Berko (1960), Howes and Geschwind (1962), Wepman and Jones (1964), Goodglass (1968), Goodglass et al. (1972), DeVilliers (1974), Berko-Gleason et al. (1975) and others have shown that primary agents of reference are retained while sentence elements such as grammatical morphemes and functors are reduced. Thus, the agrammatic patient produces a variety of sentence types erroneously and incompletely in a "telegraphic" style (Berndt and Caramazza, 1981).

Approaches to treatment of agrammatism have been proposed and case studies have been reported by Holland and Levy (1971), Naeser (1975), Weigel-Crump (1976), Shewan (1976), Helm-Estabrooks et al. (1981) and others. However, few controlled investigations of acquisition and generalization of treatment for agrammatism are available in the aphasia literature. That is, the available data are problematic because they were derived from studies in which control groups were not employed and appropriate within-subject control measures were not established, and reliability data often were not reported. Furthermore, the results of available case studies are inconclusive. It has been shown that acquisition of targeted linguistic constructions occurs when various treatments are applied. However, equivocal findings with regard to generalization are reported. For example, Naeser (1975), Weigel-Crump (1976) and Helm-Estabrooks et al. (1981) reported generalized changes in subjects' ability to produce untrained examples of target constructions, while Holland and Levy (1971) and Shewan (1976) noted that performance improved only on trained items.

Children's comprehension and use of morphological structures and functors have been studied by Guess et al. (1968), Guess (1969), Shumaker and Sherman (1970), Baer and Guess (1971), Sailor and Taman (1972), Frisch and Schumaker (1974), Clark and Sherman (1975) and others. In addition, the production of complete sentences in both normal and language delayed children have been investigated by Wheeler and Sulzer (1970) and Lutzker and Sherman (1974). Review of these language training studies suggests that language behavior can be subject to generalized change even when only a few members of a response class are manipulated.

Other studies of language acquisition and generalization in both normal and language deficient populations have been reported by Esper (1925), Foss (1968), and Striefel et al. (1976) using matrix training procedures. In matrix training, stimuli from two different linguistic classes are presented and subjects are trained to produce labels from each linguistic class in combination. Results of matrix-training studies have suggested that, when a number of such combinations are trained, subjects begin to produce untrained stimulus sequences. When such generalization occurs it is then inferred that patients is unknown.

PURPOSE

The purpose of the present study was to investigate the effects of a matrix-training procedure on the acquisition and generalization of locatives in multiword utterances by agrammatic aphasic subjects; specifically, to investigate the effects of treatment on 1) the acquisition of the locatives "behind" and "beside" within the context of Noun Phrase + is + Prepositional Phrase (NP + is + PP) utterances, 2) generalization of the locatives "behind" and "beside" within the context of NP + is + PP utterances to items within trained and untrained matrices, and 3) generalization of the constructions of interest to spontaneous speech.

METHOD

Subjects. Two monolingual, English-speaking subjects with Broca's aphasia secondary to left CVA participated in the study. Subject 1, a 45-year-old male, was 19 months post onset of CVA and Subject 2, a 33-year-old female, was 27 months post onset of CVA. Both subjects exhibited residual right hemiparesis. Neither subject had a history of recurrent neurological involvement nor were they involved in concomitant speech or language treatment throughout the course of the study. Hearing was within normal limits as measured by pure-tone screening.

The diagnosis of aphasia was based on the Boston Diagnostic Aphasia Examination (BDAE)(Goodglass and Kaplan, 1972) and on the Rating Scale Profile of Speech Characteristics of the BDAE. Both Subjects exhibited behaviors consistent with Broca's aphasia on these measures. Analysis of individual subtest performances on the BDAE revealed relatively intact auditory comprehension, naming and repetition abilities (Table 1). On the 7-point rating scale profile both subjects scored between 1 and 2 on melodic line and phrase length, between 2 and 3 on articulatory agility and grammatical form and between 6 and 7 on paraphasias in running speech, word finding and auditory comprehension.

Table 1. BDAE Subtest scores for Subjects D.F. and L.B.

SUBTEST	SCORE	
	D.F.	L.B.
Auditory Comprehension		
Word Discrimination	+1	+1
Body Part Identification	+1	+1
Commands	+1	+1
Naming		
Responsive Naming	+1	+1
Confrontation Naming	0	+.5
Animal Naming	+1	+1
Body Part Naming	0	+.5
Repetition		
Words	0	+.5
High Probability	0	+.5
Low Probability	-1	+0

Additional pretesting revealed that both subjects comprehended the locatives "behind" and "beside" individually and within NP + is + PP contexts. However, neither subject demonstrated the ability to produce target locatives individually or in NP + is + PP constructions upon presentation of picture stimuli such as those used in the study. Neither subject produced NP + is + PP constructions during spontaneous language samples. However, both subjects labeled all nouns used as subjects or objects of the preposition in sentence stimuli such as those used in the study. In addition, both subjects had the ability to produce the verb form "to be" in the third person singular (i.e., NP + is + NP: "That is a coat.").

Stimuli. Thirty-six 5" X 7" black and white line drawings depicting the locative relations of interest were divided into four groups of nine items each and used to elicit NP + is + PP responses (Figure 1). Each group of nine items made up a 3 X 3 language matrix. Matrices #1 and #2 contained the locative "behind" and Matrices #3 and #4 contained the locative "beside." Items on Matrices #1 and #3 were selected for training, while items on Matrices #2 and #4 were used for probing generalization.

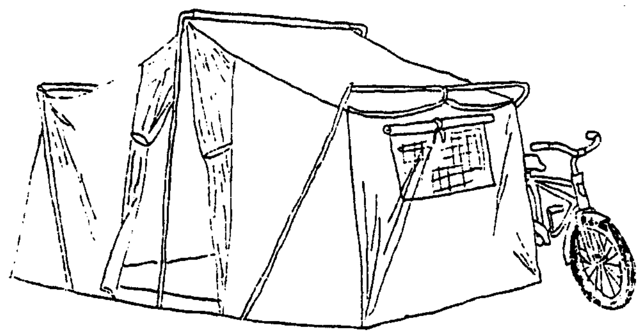

Figure 1. Stimulus used to elicit "The bike is behind the tent."

Each language matrix contained 3 nouns and 3 prepositional phrases. As can be seen in Figure 2, nine sentences can be formed by combination of the constituents of the matrix. For example, NP1 (the bike) can be combined with PP1 (behind tent), PP2 (behind house), or PP3 (behind fence).

	NP1 BIKE	NP2 TREE	NP3 RAKE
PP1 BEHIND TENT			
PP2 BEHIND HOUSE			
PP3 BEHIND FENCE			

Figure 2. Matrix #1 used for training "behind" within NP + is + PP utterances. (NP = Noun phrase. PP = Prepositional phrase.)

Design. A multiple baseline design across behaviors was used (Baer et al., 1968; Hersen and Barlow, 1976). In a design of this nature a number of behaviors are chosen and measured in the baseline phase, and in the treatment phase the independent variable is sequentially applied to each behavior. Experimental control is assumed when behavioral change is noted only when treatment is applied. In the present study, two independent behaviors were studied: 1) production of the locative "behind" within the context of NP + is + PP constructions and 2) production of the locative "beside" within the context of NP + is + PP constructions.

During the Baseline (A) phase, subjects' ability to produce target locatives within the sentence constructions of interest was examined on four separate occasions. The thirty-six visual stimuli were randomly presented and subjects were given instructions to "tell me what you see in the picture." (Prior to testing, practice trials were administered to ensure that subjects understood the task.) The first response to occur within 30 seconds was scored plus or minus. A response was considered to be correct only when a complete NP + is + PP utterance containing the target locative was produced by the subject.

In the Treatment (B) condition, subjects were trained to produce sentences from Matrices #1 and #3 (these matrices were designated for training purposes). S1 was first trained on Matrix #1. When 8 of 9 sentences within that matrix were accurately produced for 2 consecutive days on daily probes, treatment was applied to Matrix #3. To control for order effects, S2 was first trained to criterion on Matrix #3, at which time training on Matrix #1 was initiated.

One sentence per session was trained using modeling, forward chaining and response contingent verbal feedback. A maximum of 50 trials per session (5 sets of 10 trials each) were presented. Training on a specific sentence continued until performance was at 80% (8 of 10) correct for 2 consecutive training sets within a session.

Sentences were trained in a diagonal sequence as suggested by Foss (1968). (Figure 3) That is, NP1 PP1 was first trained to criterion. Then NP2 PP2 was trained, and so on. In this manner, all lexical information (nouns, prepositions and objects of the preposition) contained within a matrix was exposed by training only 3 sentence combinations. Foss (1968) suggested that exposure to a subset of stimuli within a matrix might facilitate greater generalization to untrained combinations of the constituents of the matrix.

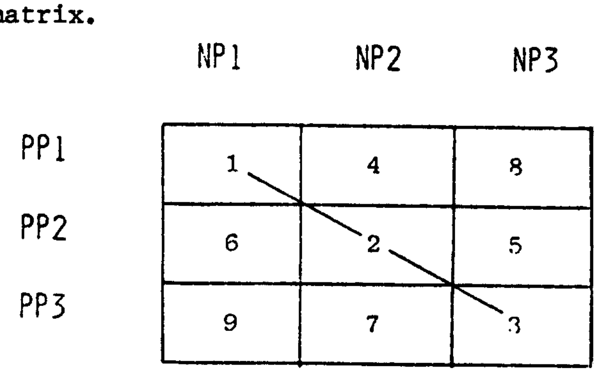

Figure 3. Order of sentences trained within training matrices.

Probes. Generalization probes were administered daily following treatment, using procedures identical to baseline. Performance on these probes served as the dependent variable throughout the study. Followup probes were administered weekly for four weeks following treatment to assess maintenance. In addition, followup probes were administered at 4 and 6 month intervals. Language samples were obtained once weekly throughout baseline and treatment phases to assess changes in spontaneous output.

Reliability. All sessions were recorded on audiotape. Interobserver and intraobserver reliability was obtained on the dependent variable for each session of the study. There was 96% interobserver agreement and 98% intraobserver agreement across all samples.

RESULTS

The results of treatment for D.F. are presented in Figure 4. The number of correct sentences produced within trained and untrained matrices during baseline, treatment and followup phases of the study are depicted. As can be seen by analysis of the baseline phase (phase A) in the figure, the subject's ability to produce the constructions of interest ranged from zero to three correct responses on Matrices #1 and #2 and zero or one correct response on Matrices #3 and #4 prior to treatment. Upon initiation of treatment (phase B), behavioral change was evident. D.F. reached criterion on Matrix #1 after four treatment sessions, during which time no change in baserate performance was seen on Matrices #3 and #4. However, when treatment was applied to Matrix #3, acquisition of the behavior of interest was noted and criterion was reached in five sessions.

The generalization effects of treatment can be seen by analysis of the B phase in Figure 4. As can be seen, generalization to items within trained matrices (Matrices #1 and #3) occurred rapidly with initiation of treatment. Similarly, generalized change in the ability to produce items contained within untrained matrices was seen secondary to treatment. That is, when treatment was applied to Matrix #1, behavioral change was noted on Matrix #2. Further, when treatment was applied to Matrix #3, an increase in correct responding was noted on Matrix #4. Further effects of treatment are evident from the maintenance phase in Figure 4. Responding on all matrices, both trained and untrained, was maintained at a high level for six months following treatment.

The data for L.B. are presented in Figure 5. Examination of the figure shows responding similar to that of D.F. During the baseline phase (A) there was a low rate of correct responding on all language matrices. However, when items from Matrix #3 were trained, changes in baserate performance was maintained for Matrices #1 and #2. Similarly, when items from Matrix #1 were trained, behavioral change was noted on Matrices #1 and #2. These data indicate that generalization to untrained items within trained matrices occurred after training four exemplars from Matrix #3 and six exemplars from Matrix #1. In addition, these data show that generalization to untrained matrices occurred. Finally, L.B.'s responding on all language matrices was maintained at a high level for 6 months subsequent to treatment.

Analysis of language samples taken throughout the course of the study revealed notable changes in spontaneous output for D.F. However, no appreciable changes in spontaneous output were noted for L.B. D.F. produced more prepositional phrases in samples taken during and following treatment than in those taken during baseline.

In summary, results of this investigation suggest that: 1) Treatment was effective in facilitating verbal production of target locatives within the context of NP + is + PP utterances for both subjects. 2) Generalization to untrained items within trained and untrained language matrices occurred when a limited number of exemplars were trained. 3) Production of locative

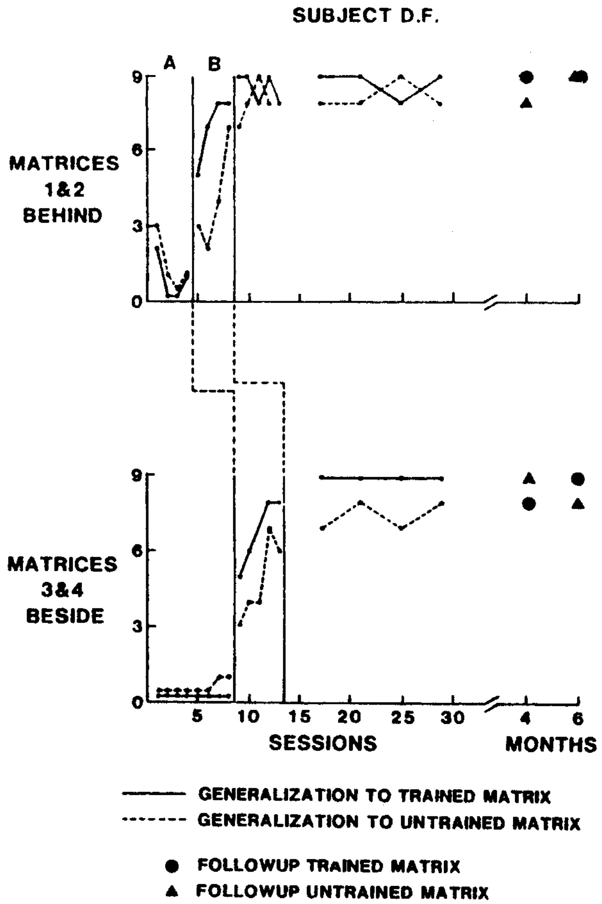

Figure 4. Number of correct NP + is + PP constructions produced within trained and untrained matrices by Subject 1 (D.F.) during baseline (A), treatment (B), and follow-up phases.

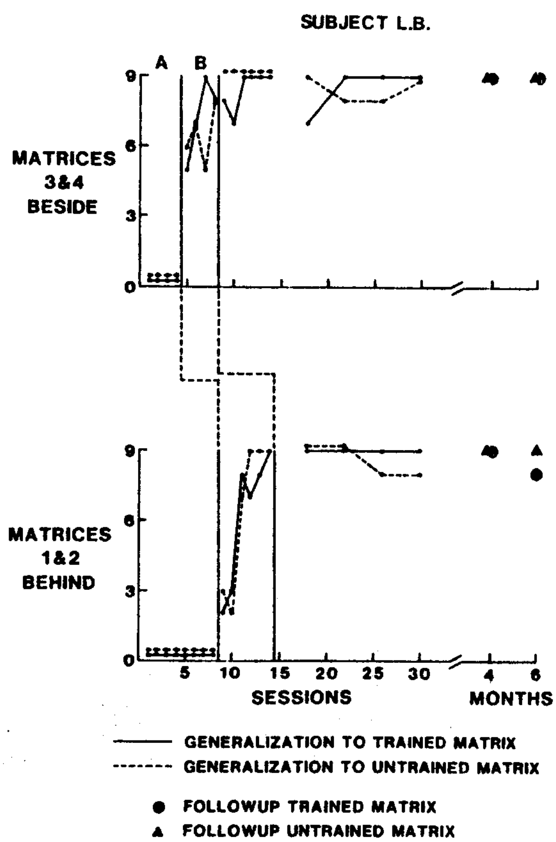

Figure 5. Number of correct NP + is + PP constructions produced within trained and untrained matrices by Subject 2 (L.B.) during baseline (A), treatment (B), and follow-up phases.

responses within NP + is + PP contexts was maintained for several months following treatment. 4) An increase in the use of NP + is + PP utterances occurred during spontaneous speech for D.F. while no appreciable change in spontaneous speech was noted for L.B.

These data show the acquisition, generalization and maintenance effects of matrix-training procedures on production of targeted locatives within the context of NP + is + PP constructions in agrammatic aphasic subjects. These findings agree with those reported in the applied behavioral literature and are consistent with previous work concerned with generalization of word sequencing phenomena using miniature linguistic systems. The present subjects performed much like language delayed children in that they demonstrated a general change in their production of targeted locative when a minimal number of examples of each locative were trained. Such generalization occurred only when treatment was directly applied to specific structures. In addition, the agrammatic aphasic subjects' performance was similar to that of normal adults (Esper, 1925) and of language delayed children (Striefel _et al._, 1976) in their ability to sequence stimuli from two dimensions or classes following training of only a few members of each class combined with those from the second class.

An issue related to generalization from these data is that of response classes. Response classes have been defined in terms of functional relationships between the environment and behavior (Johnston and Pennypacker, 1980). Phenomena can be considered to belong to a response class only when they covary contingent upon common events. The present data suggest that locatives may not constitute a response class even though they belong to the same linguistic class, because changes in production of untrained locatives did not occur after application of treatment to other locatives. Therefore, these findings suggest that generalization cannot be expected to occur even to topographically similar responses. It is suggested, then, that treatment be systematically applied to specific linguistic structures at the level of the agrammatic aphasic patient's residual language ability and that a mechanism for assessing the generalization effects of treatment, such as a matrix training procedure, be incorporated into treatment.

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