Short-term syntax learning and generalization effects

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Abstract

Two language therapy procedures — a structured, repetitive drill approach, and a story-based question and answer approach — were used to teach is *and* are *to four language-impaired children aged 4;4 to 6;3, over a four-week period. Effectiveness was measured by three methods: within-therapy data, structured probe data, and at-home spontaneous probe data. While levels of correct productions were high in therapy, production on spontaneous probes remained low. Structured probe performance varied, but was generally substantially higher than spontaneous probe performance. Results indicate that syntax learning depends on how such learning is measured.*

Introduction

Language therapy with children who are delayed in acquisition of the syntactic aspects of language, may be described as having two phases: an ESTABLISHMENT phase and a GENERALIZATION phase. During the establishment or acquisition phase, the language structure enters the child's repertoire and can be produced, given abundant support. The generalization phase begins when the child starts to produce the structure within new linguistic contexts, in conversation with new listeners, or in new settings. When the structure has generalized across these contexts and situations, and is maintained across time, it can be viewed as automatized — it can be produced without self-monitoring whenever the speaker needs it to get across a message in the most efficient manner.

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Often therapy efforts are focussed on the initial phase, teaching the child to produce syntax target structures within practised sentence frames, first in imitation of a model, then in answer to questions, and finally within child-generated narrative or stories designed to provide numerous opportunities for producing the structure. If clinicians are employing a pragmatic approach to therapy, they will be choosing sentence frames frequently used in conversation, and providing meaningful linguistic and nonlinguistic context. Therapy will be accompanied by much modelling of appropriate dialogue containing the target structure. The line between establishment and generalization phases may blur, as the support needed for initial production of the structure is gradually withdrawn (Coggins and Olswang, 1987).

Many of the early studies of language intervention reported that generalization of a grammatical target to production in spontaneous language outside the treatment setting failed to occur automatically after the target was successfully established within a treatment setting (Costello, 1983; Leonard, 1981; Spradlin and Siegel, 1982; Warren, Rogers-Warren, Baer and Guess, 1980). Early studies usually employed behavioural training methods in unnatural clinic contexts, and targets often were not ecologically valid. Intervention with retarded and autistic individuals typically showed greater problems in achieving generalization to nontreatment contexts, although narrow measures of generalization have indicated limited success (Hughes, 1985).

The ease and speed with which generalization occurs varies with the therapy approach, as well as with client etiology. In an investigation of auxiliary and copular *is* training, two five-year-old language delayed boys studied by Hegde (1980) learned sentence responses within seven sessions of behavioural treatment. Correct production of *is* where obligatory in three conversational probes following training ranged from 89% to 93%. Thus, it is possible for syntax learning to occur rapidly, and to show generalization to conversational speech.

However, another study indicated that considerably more time was required before syntax targets were produced correctly in conversational speech. Using a strategy that focused on achieving generalization to spontaneous production, of forms ALREADY trained to 100% criterion in supportive contexts, Culatta and Horn (1982) demonstrated that high accuracy rates could be achieved. The strategy, which consisted of scripted play with gradually decreasing models and cued opportunities, was implemented for 19 to 28 sessions before 90% criterion was reached for the four children. Other research has also indicated that achievement of generalized and automatized production of forms lags well behind high and stable performances in supportive teaching contexts (Campbell and Stremel-Campbell, 1982).

It seems that language-impaired children need a period of time after a new grammatical structure is established in their repertoires, to master it completely (Fey, 1986). This should not be surprising, as grammatical learning in normal children also occurs over a lengthy time period.

As part of his rationale for a Cyclical Goal Attack Strategy, Fey (1986; 1987) proposed that rapid improvements in language structure should not be expected. Rather, intervention should target stable and meaningful gains, the acquisition of which may depend on the passage of time. It may be that focussing for a short period on particular structures triggers learning that does not show up until some later time.

Purpose of study

In an effort to examine short-term effects of two different types of therapy approaches on both establishment and generalization of a syntax target, the present research was designed. One of the treatments was a highly structured, repetitive drill procedure which included many features of small-step behavioural teaching programmes used in earlier studies (Gray and Ryan, 1973; Hegde, Noll and Pecora, 1979). The other was a more loosely structured adaptation of the Interactive Language Development Teaching (ILDT) procedure by Lee, Koenigsknecht and Mulhern (1975).

In addition to examining short-term effects of two treatment methods, differences between two ways of measuring the effects of treatment were also examined. Structured probes are often used to detect changes in a child's production of specific grammar targets under conditions slightly different from those of teaching (Hughes, 1985; Warren *et al.*, 1980). These probes can be designed systematically to vary antecedent events, or linguistic contexts, and thus allow the clinician to discover patterns of generalization or overgeneralization. Another way of measuring the effects of treatment is to collect spontaneous language samples from children in conversational speech outside the therapy setting, as they talk with others who are not associated with therapy. This is a global measure of linguistic communicative competence, a much more rigorous measure of the effects of language therapy.

It may be hypothesized that children whose language learning is still in the establishment phase will show progress after a period of treatment on structured probes designed to measure generalization of syntax targets to untrained linguistic contexts. At the same time however, spontaneous conversational language samples from those same children may fail to show any effects of treatment.

Method

Treatment programmes

The two programmes were designed to differ across several variables which might be expected to influence syntax learning, i.e. the degree of structure and repetitiveness of the child–clinician dialogue, and the diversity of linguistic stimuli and target responses. To establish experimental control, other possible influences were held constant between the two programmes. These included the presence of visual stimuli, the approximate number of opportunities to produce the target responses during each session (i.e. 32–35), the syntactic structure of the target sentences (i.e. all were simple sentences with forms of copular *be*), the verbal antecedents (i.e. all were requests to imitate, 'tell me about', or *Wh*-questions), and the consequent events for correct responses (i.e. verbal and token reinforcement). The consequent events for incorrect responses differed somewhat. The more structured programme supplied 'No' and a model for the child to imitate, while the less structured programme supplied prompts of varying levels.

The highly structured programme (HS), consisted of three steps, which varied in verbal, but not picture antecedents. The same set of five picture stimuli was used at each step, which resulted in repetitive practice on the same sentences. Step 1 required a direct imitation of each modelled target response; Step 2 required each target response as an answer to a *Wh*-question; Step 3 required each target response in reply to a 'Tell me about X' request. Table 1 contains therapy dialogue sequences illustrating antecedent events, correct and incorrect child responses, and consequent events for programme HS. During each session, 35 trials (seven repetitions of the set of five randomly ordered target responses) were provided. When criterion of three sets of five

Table 1 Programme HS dialogue sample. Examples are drawn from all three complement sets

Antecedent events (visual stimuli present)	*Child response*	*Consequent events*
Step 1: Immediate imitation		
Tell me 'He is a pilot'.	[1] He is a pilot.	Good, you said *is*. (*token*)
Tell me 'They are funny'.	[2] Them funny.	No, They *are* funny.
	Them *are* funny.	Good, you said *are*. (*no token*)
Step 2: Wh-questions (*place pictures of a mommy and a pilot on table*)		
Who is a pilot?	He is a pilot.	Good, you said *is*. (*token*)
(*place pictures of a full basket and an empty basket on table*)		
Which is empty?	That one empty.	No, That *is* empty.
	That *is* empty.	Good, you said *is*. (*no token*)
Where are they?	[3] Them in canoe.	No, They *are* in a canoe.
	Them *are* in canoe.	Good, you said *are*. (*no token*)
Step 3: Tell-me-about . . .		
Tell me about (her/him/that).	She is strong.	Good you said *is*. (*token*)
Tell me about (them/these).	They are in the bag.	(*same*)

[1] Example of noun phrase complement set
[2] Example of adjective complement set
[3] Example of prepositional phrase complement set

consecutive correct responses within each step was met, the next step was begun. When criterion was met for step 3, a new set of five stimuli was used.

Target responses in the first set of stimuli consisted of five simple copular *be* sentences with noun phrases as complements (e.g. *He is a pilot*). Adjectives were used as complements for the second set (e.g. *They are afraid*), and prepositional phrases for the third (e.g. *It is in the bag*).

The more loosely structured procedure (programme LS) was an adaptation of the ILDT therapy procedure (Lee *et al.*, 1975) involving sequences of conversational interchanges during story-telling. Stories were written which contained 32 target sentences. These were elicited by *Wh*-questions asked by the clinician after the child had heard several models of the sentence. Each story was accompanied by either felt-board figures which were moved as the story unfolded, or by sequences of pictures which revealed the story (Johnson and Smith, 1980). Different stories were used for each session, and this resulted in a diverse set of target responses. There was no repetitive practice on the same sentence.

Correct child responses, i.e. those which contained the target, were consequated with verbal praise and a token. Incorrect child responses, i.e. those in which the target was obligated but was not produced, were consequated with a verbal prompt designed to assist the child in producing a correct response. The choice of prompt depended upon past error performance, with direct models provided initially, when errors were frequent. As errors decreased in frequency, indirect prompts to self-correct, e.g. 'Tell me the whole thing' or 'Was that right?', were provided. Any spontaneous productions which contained opportunities for the target response, whether correct or incorrect, were consequated in a similar manner. When this occurred, more than 32 target opportunities occurred in a session. Table 2 contains a therapy dialogue sequence illustrating antecedent events, correct and incorrect child responses, and consequent events for programme LS.

Table 2 Programme LS dialogue sample

Story portion (visual stimuli present)	*Child response*	*Consequent events*
(1) Mom says 'Here are the vegetables. What kinds shall we buy?' Tom says 'Carrots are good. Let's get some carrots. Carrots are good.'		
What does Tom say?	Carrots are good.	Good, you said *are*. (*token*)
(2) 'What is it?' yells Dad from the barn. 'What did Mom bring?' 'It is iced tea', says Nancy. 'It is iced tea'.		
What is it?	It iced tea.	* Did you say that right?
	It iced tea.	* Tell me the whole thing
	It iced tea.	* Tell me 'It is iced tea'.
	It is iced tea.	Good, you said *is*. (*no token*)
(3) Look. Stars are in that little pocket. The teacher has some stars to put on good papers. Stars are in the little pocket.		
Where are the stars?	In little pocket.	Tell me the whole thing.
	Stars are in the little pocket.	Good, you said the whole thing.

* The level of prompt chosen depended on the child's past errors. These are prompts described by Lee, Koenigsknecht and Mulhern (1976).

Language target

The syntax target chosen for this research was simple sentence structures with copular *be*, specifically its two present tense forms, *is* and *are*. This target was selected for several reasons. Errors on copular *be* are frequent in the spontaneous language of children whose syntax acquisition is delayed, and it is therefore a frequent therapy target (Ingram, 1974; Lee, 1974). Obligatory contexts occur relatively frequently (i.e. 18–27% of utterances) in children's speech (Ingram, 1974; Shields, 1974); therefore spontaneous language samples should include sufficient opportunities to observe possible generalization of the target. Copular *be* includes two morphological forms, *is* and *are*, which may be viewed as independent, in that treatment on one is not expected to affect the other (Hegde, Noll and Pecora, 1979; Hegde and McConn, 1981). Therefore, these two forms of the same target can be used to keep separate the effects of two treatment programmes for purposes of measuring generalization.

It should also be noted that *is* and *are* rarely contribute non-redundant semantic information in utterances. Therefore, therapy approaches which employ functional communication strategies may not be particularly effective in teaching these forms, since messages can be understood, even with *is* or *are* omitted.

Experimental design

An alternating treatments design (Olswang, Bain, Dunn, and Cooper, 1983) was used to investigate the effects of programme LS and programme HS on the production of target responses both within therapy and in conversational language in the children's homes. For subjects 1 and 3, HS was applied to *are*, and LS to *is*. For replication, subjects 2 and 4 were taught *are* using LS and *is* using HS. For all subjects, the order of treatments was alternated between HS first, followed by LS on odd-numbered treatment days, and vice versa for even-numbered treatment days. Thus, treatment order was counter-balanced across treatment sessions, and target forms (*is* and *are*) were counterbalanced across treatments and subjects.

Over a four-week period, each child received the programmes three times per week for approximately 30 minutes. Three of the four children received 12 treatment sessions within four weeks. Due to a family illness, however, subject 2 went for 19 days without therapy, between his seventh and eighth sessions.

Subjects

Four language-delayed children, three boys and one girl, were selected as subjects for this research. Ages ranged from 4;4 to 6;3. In their spontaneous language, the children typically omitted copular *is* and *are* in obligatory contexts. Hearing, general development, and receptive language as assessed by the *Test for Auditory Comprehension of Language* (Carrow, 1973) were normal for chronological age. Intelligibility was judged adequate for determining whether *is* and *are* were present in sentences, although articulation errors were present.

Measures

Baseline and treatment measures of *is* and *are* were collected by spontaneous and structured probes. A minimum of three spontaneous language samples were collected as baseline, and the percentage correct for the two target forms was calculated for each sample. For these samples of 100 utterances or more, target production varied between 0% and 26% correct. Collection of spontaneous samples continued twice weekly during treatment, using an FM transmitter and tape recorder in each child's home. Opportunities for both copular and auxiliary forms of *is* and *are* were counted in order to increase usable data, and because research has indicated that copular and auxiliary forms belong to a single response class (Hegde, 1980; Hegde and McConn, 1981).

A structured probe consisting of 34 massed opportunities to produce target responses was also used to collect data before and during the therapy period. Appendix A shows examples of this probe, which allowed measurement of generalization across linguistic contexts. (Figure 2 includes baseline measures for both spontaneous and structured probes.)

Transcript reliability

Half of the baseline and treatment spontaneous samples for each subject were used to compute intraobserver and interobserver reliability, using the number of agreements divided by the total number of agreements plus disagreements. Intraobserver agreement after a minimum of four weeks between first and second transcription averaged 95%; interobserver agreement averaged across the four subjects was 88%.

Data analysis

Learning rates for within-therapy performance over the four-week period were determined by computing the percentage of correct responses on the 32–35 trials per session for each method. To detect any transfer of learning to spontaneous language at home, percentage correct in obligatory contexts for each of the spontaneous probes was computed. Percentage correct for each structured probe was also computed.

Graphic displays described changes in the performance measures over time. Graphic data allowed comparison of the effects of the two treatment procedures on each measure.

Results

Target production on the within-therapy measure and the spontaneous probes (i.e. the more rigorous measure of generalization to conversational language at home) is shown in Figure 1. A comparison of performance on the structured probes and the spontaneous probes is shown in Figure 2, which also includes the fractions from which the percentage correct was calculated for each spontaneous probe. For all graphs, the data points for programme HS are filled symbols, and for programme LS are open symbols. Squares represent *is* and triangles represent *are*. For all subjects, performance in therapy was either generally high throughout the four weeks, or began moderately and increased.

Pair One: For Subject 1, within-therapy performance was similar for both programmes, with performance on LS slightly below that for HS. Performance on spontaneous probes remained low, never reaching 50%, and thus revealed little effect for either treatment. The best performance was 33% correct for *are* on the last probe. This final data point for HS appears spuriously high, as only three obligatory contexts for *are* occurred in the sample. For subject 2, within-therapy performance started high and fell slightly for the HS target, and started lower and rose for the LS target. No obligatory contexts for *are* were found in the seventh spontaneous probe, and thus no data point was plotted. Little change was observed in the spontaneous probes until the last week of therapy, when the HS target reached 56% correct. However, recall that subject 2 received no treatment for over two weeks, between therapy sessions seven and eight. Thus, the duration of treatment for subject 2 was greater than for other subjects.

Pair Two: Results for subjects 3 and 4 are also shown in Figure 1. For subject 3, within-therapy performance was similar for both programmes, with performance on LS slightly below that for HS. Performance on spontaneous probes remained below 50%, and thus again revealed little effect for either treatment. The best performance was 44% correct for *is* during Week 3, after which performance fell. For Subject 4, within-therapy performance was highly variable, although performance on LS was substantially lower than for HS. Performance on spontaneous probes remained below 50%, again revealing little effect for either treatment. Subject 4's best performance occurred on the first probe (i.e. 33% for *is*), and declined thereafter.

Structured probe performance

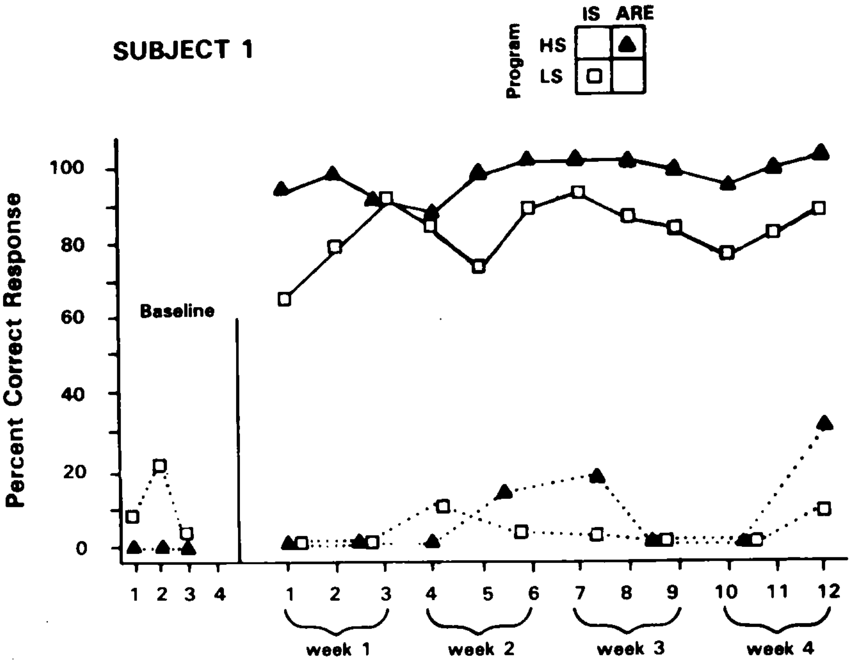
Performance on structured probes differed from performance on spontaneous probes, even for baseline measures, as shown in Figure 2. Stimulus items on this structured probe were never used in therapy; thus, performance on probe items could reflect generalization to untrained linguistic contexts. For both pairs, performance on structured probes was nearly always higher than on spontaneous probes. For subject 2, perfect scores were obtained by the second baseline probe, and were maintained throughout the treatment period, yielding a ceiling effect. For the remaining subjects, it appears that therapy resulted in some increases on structured probe performance, but there was no differential effect for LS or HS targets. For subject 4, therapy seemed to have no effect on structured probe performance for the LS target, since *are* production remained low throughout baseline and treatment periods.

Discussion

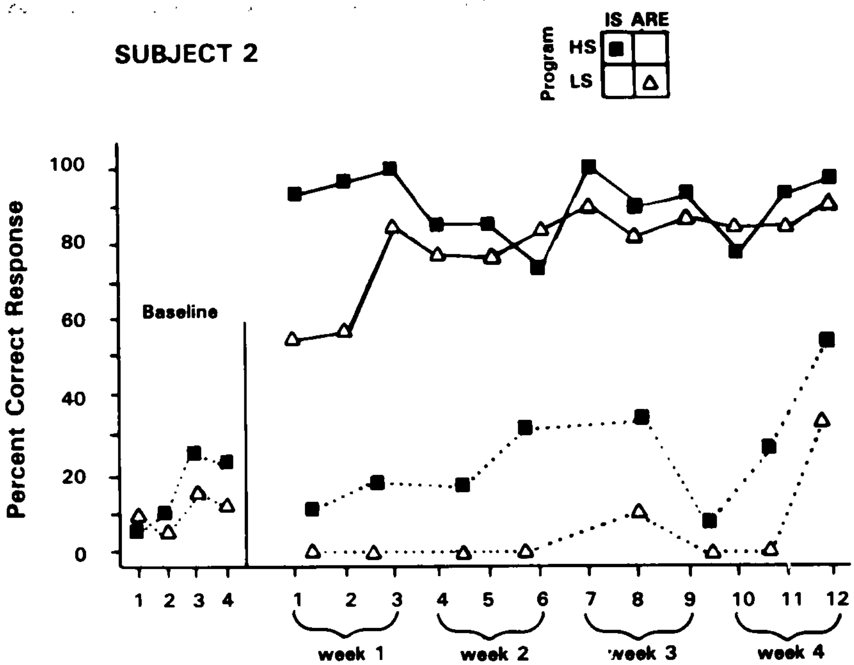
For both pairs of subjects, short-term effects of therapy were demonstrated by the within-therapy measures of *is* and *are* within practised therapy contexts. By the eighth session, production for seven of the eight targets (i.e. two each for four subjects) was at 80% correct or higher. During this treatment period, programme HS (filled symbols) resulted in marginally higher rates of correct responses for three of the four subjects than did programme LS, and in substantially

PAIR ONE

SUBJECT 1



SUBJECT 2



PAIR TWO

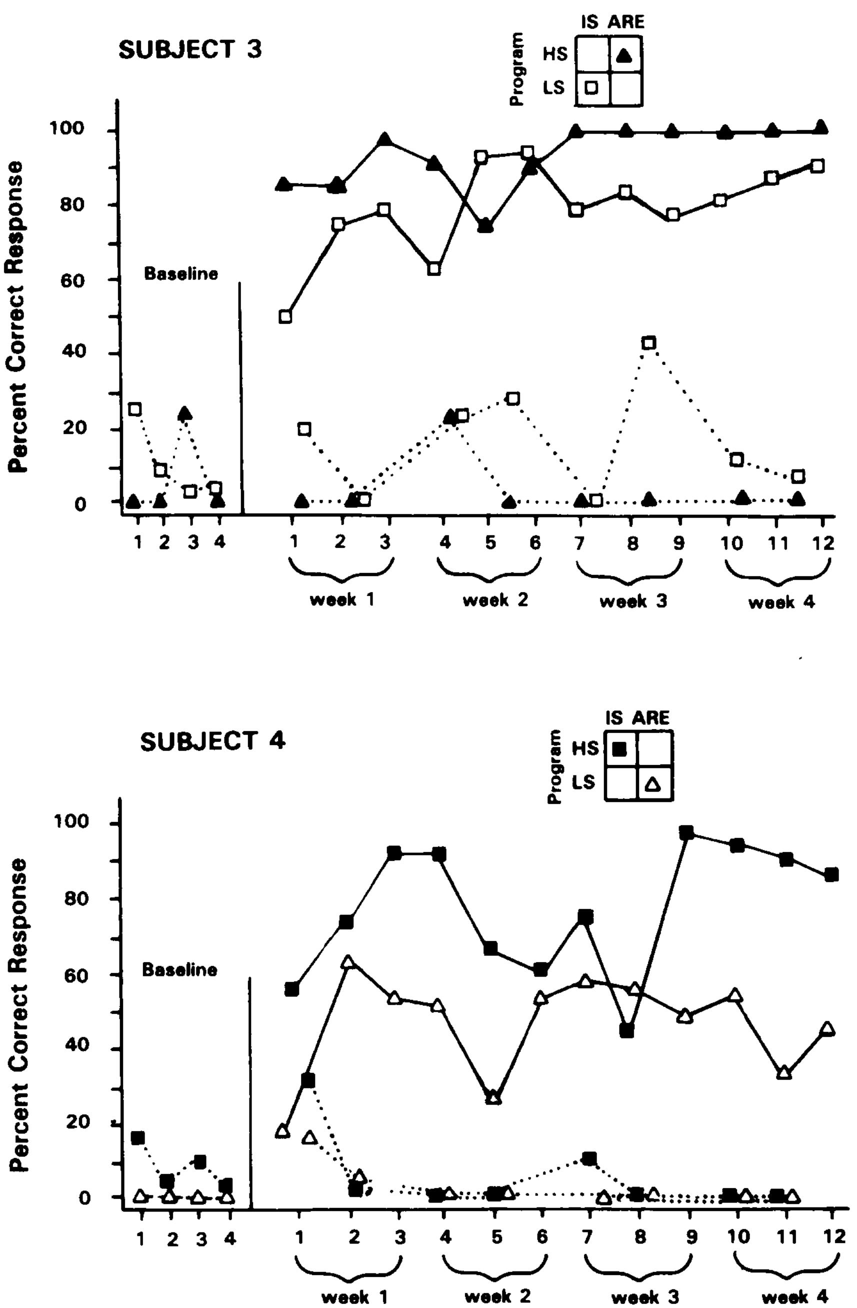
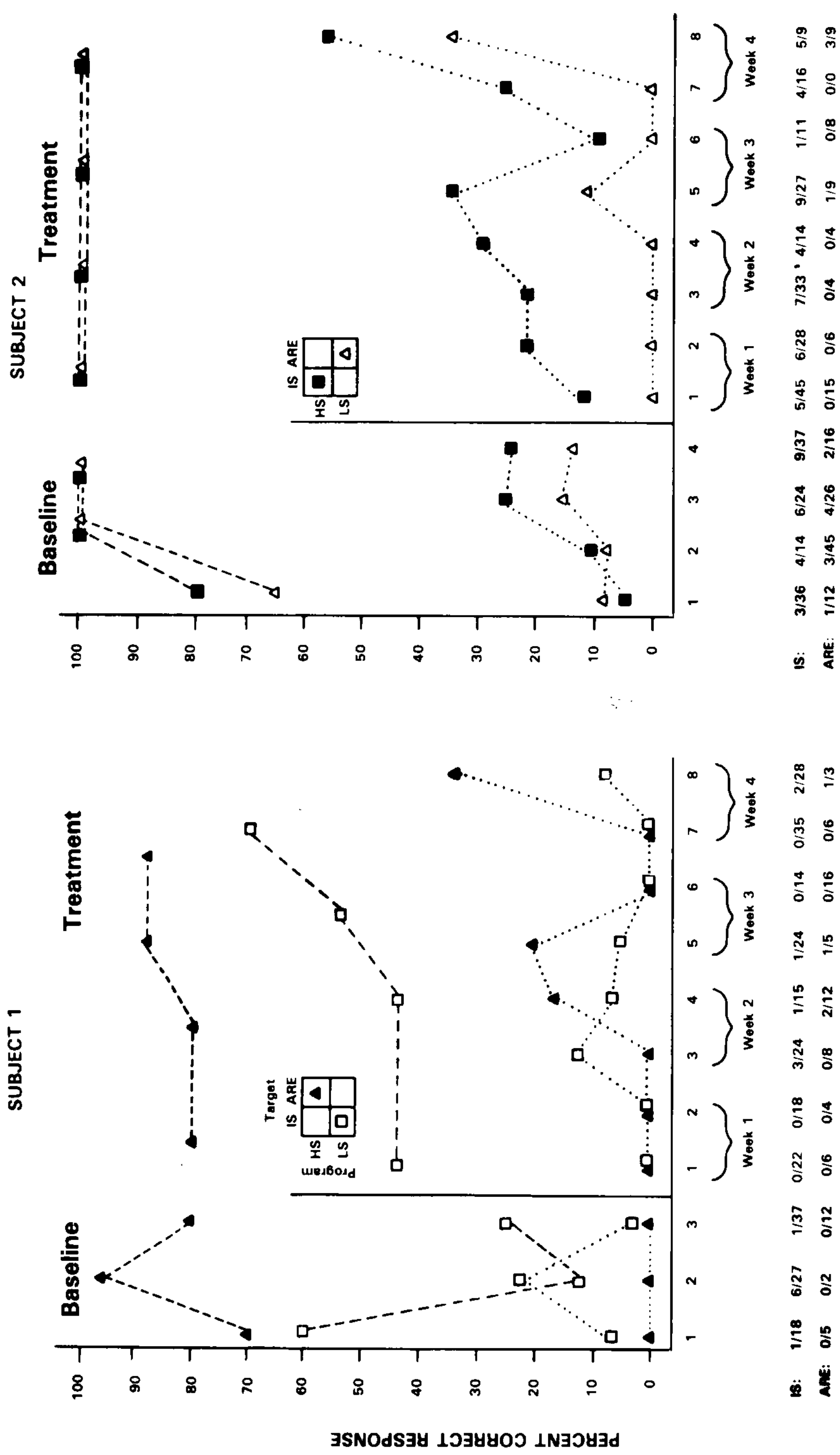


Figure 1 Comparison of data collected in treatment (shown at top, connected by solid lines) with data collected at home by spontaneous probes (shown at bottom, connected by dotted lines)


SUBJECT 1
SUBJECT 2
Baseline
Treatment
PERCENT CORRECT RESPONSE
Program
Target
IS ARE
HS
LS
Week 1
Week 2
Week 3
Week 4
IS: 1/18 6/27 1/37 0/22 0/18 3/24 1/15 1/24 0/14 0/35 2/28
ARE: 0/5 0/2 0/12 0/6 0/4 0/8 2/12 1/5 0/16 0/6 1/3
IS: 3/36 4/14 6/24 9/37 5/45 6/28 7/33 4/14 9/27 1/11 4/16 5/9
ARE: 1/12 3/45 4/26 2/16 0/15 0/6 0/4 0/4 1/9 0/8 0/0 3/9

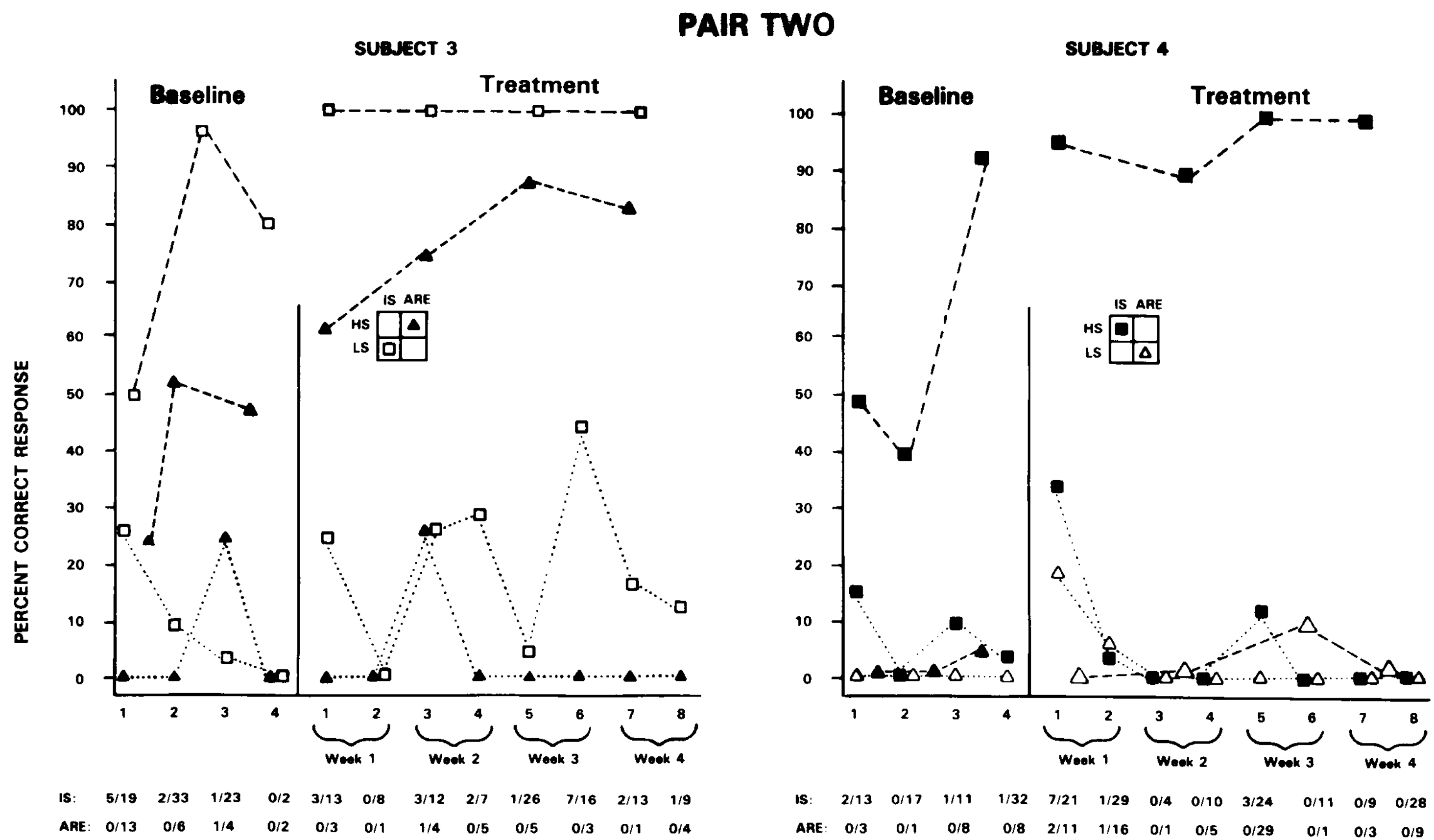


Figure 2 Comparison of data collected in treatment setting by structured probes containing nontreatment stimuli (shown at top, connected by dashed lines) with data collected at home by spontaneous probes (shown at bottom, connected by dotted lines. Fractions below baseline and treatment probes show number correct (numerator) and number of obligatory contexts (denominator) for spontaneous probes

higher performance for subject 4. The repetitive drill procedure (HS) was successful in establishing the targets within each subject's repertoire of responses. LS (open symbols) was likewise effective in establishing high rates of correct target responses by the fourth week for all except subject 4. Performance during LS treatment generally started out lower than did HS performance.

It would be tempting to say that both programmes ESTABLISHED the targets, and if ESTABLISHMENT means production at rates of 80% or better, given initial rates much lower, this would be so. However, if ESTABLISHMENT implies that the target response was initially not produced at all, then all four subjects showed establishment at some level before treatment, albeit at quite low rates. Examination of baseline data show that *is* was observed at least once for all subjects BEFORE treatment began, and *are* was observed for subjects 2 and 3. Nevertheless, the change in correct production rates in therapy over baseline rates would be deemed clinically significant by most clinicians.

However, when the rigorous measure of production of *is* and *are* within spontaneous conversational language at home is considered, neither programme's results were impressive. Data from the spontaneous probes indicated little or no generalization clearly attributable to either programme. Neither the highly structured programme characterized by massed practice and repetitive stimuli, nor the more loosely structured programme characterized by diversity in antecedent, behaviour, and consequent events was effective in achieving high rates of production in spontaneous language outside therapy by the end of the short four-week therapy period. These results support the notion that something more than 12 sessions over four weeks is probably needed to achieve both establishment of a grammatical target, and generalization to spontaneous language outside therapy. Recall the Culatta and Horn (1982) research cited earlier, which suggested that as many as 19 to 28 sessions were necessary before a 90% criterion was achieved.

The data for subject 2, whose spontaneous probe data appear to be rising by the final week, are particularly interesting in view of this notion. The unplanned hiatus in therapy between his seventh and eighth session may have provided an opportunity for the practice on the target forms during the first seven sessions to have an effect. Two weeks of therapy may have triggered a process of syntax learning, which needed a period of 'incubation' before the effect would be seen in sentences produced during spontaneous language.

Structured probe performance

The structured probe items were clearly measuring a different level of language production than were the spontaneous probes. Structured probe responses were neither imitative nor practised, and thus required more than the lowest, or easiest level of production. However, the verbal antecedent, a negative statement matching one picture, provided linguistic support for producing its opposing affirmative statement to match the second picture (see Appendix A). Children whose grasp of syntax rules governing copular *is* and *are* is incomplete, or whose productions have not become automatic, seem to be assisted in producing these structures, given the contextual support provided by the structured probe. Indeed, subject 2 appeared to 'learn' the rule after going through the probe once. However, his spontaneous probe production of the targets remained low until the last week of the study, when it rose to a high of 56% for *is*.

All subjects learned to include the target in some language produced during therapy activities and on structured probes, showing they could produce the target in some physical and linguistic contexts. Therapy and structured probes elicited context-dependent performance (Coggins and Olswang, 1987), where children's language was highly constrained. Target production during spontaneous probes, however, required context-independent performance. Few contextual cues to produce *is* and *are* were present in conversations with parents and siblings at home. The target forms did not contribute meaning to messages, and the children's utterances were usually understood WITHOUT the forms present. Thus, there was no functional reason for children to produce the targets, nor were there cues from therapy (e.g. person, pictures, verbal antecedents) to remind them to produce the targets. Although the forms were in their repertoires, learning had not reached the automatization level (Johnston, 1988).

It appears that research on the process of establishment, generalization, and automatization of syntax targets to conversational speech will require lengthy longitudinal study. Researchers as well as clinicians should plan to monitor target production well past the point where the target is well-established in supportive contexts. It may be that direct treatment on the target may be discontinued or reduced after an initial period of therapy. Perhaps teaching a parent, teacher, or sibling to detect errors and provide a prompt to self-correct whenever the error occurs in spontaneous language, would be sufficient to achieve automatization. How long this might take remains to be determined and is likely to be affected by many factors. Much additional research is needed before clinicians can predict the course of syntax learning in language-delayed children.

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