TEACHING A COMPLEX VERBAL RESPONSE TO A HEARING-IMPAIRED GIRL

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A 3-yr-old hearing-impaired girl, who used neither the article "the" nor the auxiliary verb "is" was taught to use these words in describing a picture, initially through imitation and then in response to the command, "Tell me about this". As a result, she was able to use sentences in the present progressive form to describe a number of pictures on which she had received no training. This newly acquired behavior was subsequently extinguished and then reinstated.

Most attempts to teach hearing-impaired children sentence structures have been based on theory rather than experimental work, and many have required reading skills. Fitzgerald (1929) devised a Key, *i.e.*, a system of written symbols, for teaching language. The Key became widely used in schools and classes for the hearing-impaired in North America, and it remains widely used to this day. Elliott (1964) proposed the use of color charts to represent basic word classes that could be arranged into sentence patterns. Loren (1965) developed a series of multiple-choice language charts from which the child could build appropriate phrases and sentences. These charts were designed to demonstrate various uses of different word classes.

Syntactic structures have also been taught to hearing-impaired children through a "natural language" approach (Groht, 1958). In this approach, the teachers devise or exploit teaching situations that relate words or sentences to the child's interests and activities. The language patterns to be taught are initially used by the

teacher who encourages the child to reproduce these patterns through imitation and later, spontaneously, as the situation is repeated from day to day. D'Arc (1958) sought to structure the natural language approach by systematically developing interactive communication on the basis of commands and questions. She recommended an active approach in which verbs were used as the basic units to which other words were chained into phrases and sentences.

In the present study, operant conditioning was evaluated as a means of teaching a 3-yr-old hearing-impaired girl to use a present progressive sentence form in describing a picture. Training was specifically on the previously unused words "the" and "is".

METHOD

Subject and Setting

Diane was a 3-yr-old girl whose unaided hearing in the better ear averaged 85 dB (ISO, 1964) over the frequencies 250 to 4000 Hz. Her speech was intelligible but her language was telegraphic, consisting primarily of nouns and verbs. She did not use articles or auxiliary verbs. Diane had been enrolled in the McGill Project for Deaf Children for 16 months and had worn two body-type hearing aids over that period. Because of her severe hearing loss, Diane's ability to hear speech sounds was quite

¹The authors wish to thank Donald G. Doehring and Bonnie Bartholomeus for their constructive criticisms, and Carol Jacobson for transcribing the tape recordings. This study was supported by Canadian Federal Provincial Health Grant No. 604-7-725. Reprints may be obtained from Clinton W. Bennett, School of Human Communication Disorders, McGill University, 1266 Pine Avenue West, Montreal, Quebec, Canada.

limited but, with hearing aids, all vowel sounds were audible to her over a distance of at least 12 ft. Her hearing for consonants was more restricted, (s) being audible to her over a range of only 3 ft. Working within this distance and in a face-to-face situation, Diane was able both to hear and to see the sounds she was asked to imitate.

The study was conducted in a small, distraction-free room. Diane sat across a small table facing the experimenter. On the table were stimulus pictures, a small box for tokens, and a score sheet. On the floor next to the experimenter was a small box of assorted candy. Periodically, a Uher 4000 tape recorder was placed under the table with the microphone on the edge of the table so that recordings could be made and used to measure reliability.

Materials

The stimuli consisted of 17 pictures, 13 from the Peabody Language Development Kit (American Guidance Service, 1967) and four similar pictures drawn by an artist. Each item pictured words that Diane already used spontaneously. Sentences associated with the pictures were of the form "The (noun) is (verb) + ing" and as follows:

The girl is swimming.	The boy is running.
The boy is walking.	The girl is sewing.
The girl is sitting.	The girl is sleeping.
The girl is dancing.	The boy is jumping.
The boy is writing.	The boy is sitting.
The deer is running.	The fish is swimming.
The boy is sleeping.	The bear is eating.
The cat is climbing.	The man is walking.
The girl is running.	

The first picture (The girl is swimming) was used to train Diane. A second picture (The boy is running) was used as a retraining item. The remaining 15 pictures were used as probes to test generalization.

Procedure

To obtain a baseline of Diane's spontaneous use of the words "the" and "is", the experimenter presented each of the pictures three times and

on each presentation instructed Diane: "Tell me about this". To obtain a baseline of Diane's ability to imitate, the same pictures were presented once again, but this time Diane was asked to repeat complete sentences in the form "The (noun) is (verb) + ing". Her response to each presentation was written down and tape recorded.

Before we began to teach Diane the use of the article and the auxiliary verb, she was taught about tokens by introducing her to a picture-naming task. She was shown pictures of common animals and asked to name them. For each correct name she was given a token and told "good" or "that's right". When she amassed 10 tokens she exchanged them for candy. Training began after Diane earned a total of 30 tokens. Diane was seen four days a week. One training session, consisting of 100 trials and lasting approximately 20 min, was completed each day.

The training procedures consisted of five phases: (I) inclusion of the article "the"; (II) inclusion of the auxiliary verb "is"; (III) reversal; (IV) reinstatement of "is"; and (V) reinstatement of "the". In each phase, Diane was first trained to imitate the required pattern, then to produce it on command. Table 1 outlines the sequence of the training program, the response patterns required, the response modes used, and the position of the generalization probes.

To train Diane to imitate, the experimenter presented the picture and provided her with the required model (e.g., "the girl swimming"). Diane's responses were reinforced with a token and she was told "good" or "right" if they included all words in correct order on her first attempt. Twenty five tokens were exchanged for candy. Mispronunciations were accepted providing the responses were intelligible to the experimenter. After each incorrect response, Diane was told "no" and the next trial presented.

To train Diane to give responses on command, the experimenter showed her the same picture (The girl swimming) and said: "Tell me about this". To be judged correct, such responses had to include all words in the required

Table 1

Sequence of training procedures, generalization probes, and response patterns required.

<i>Sequence of Training Procedures</i>	<i>Generalization Probes</i>	<i>Response Patterns Required</i>	<i>Types of Responses</i>
Phase I: Inclusion of "the"			
Step 1		the girl swimming	Imitated
Step 2		the girl swimming	On Demand
	Probe 1		
Step 3		the boy running	On Demand
		the girl swimming	On Demand
	Probe 2		
Phase II: Inclusion of "is"			
Step 4		the girl is swimming	Imitated
Step 5		the girl is swimming	On Demand
	Probe 3		
Step 6		the girl is swimming	On Demand
		the boy is running	On Demand
	Probe 4		
Step 7		the girl is swimming	On Demand
		the boy is running	On Demand
	Probe 5		
Phase III: Reversal			
Step 8		girl swimming	Imitated
Step 9		girl swimming	On Demand
	Probe 6		
Step 10		girl swimming	On Demand
		boy running	On Demand
	Probe 7		
Phase IV: Reinstatement of "is"			
Step 11		girl is swimming	Imitated
Step 12		girl is swimming	On Demand
	Probe 8		
Phase V: Reinstatement of "the"			
Step 13		the girl is swimming	Imitated
Step 14		the girl is swimming	On Demand
	Probe 9		

order. Each correct response was reinforced as described above. When Diane made an incorrect response she was told "no" and given the correct pattern. If the pattern provided was imitated correctly, she was told "good", but a token was not awarded.

Each training step consisted of at least two sets of 50 trials that were scored by the experimenter as the training proceeded. If Diane scored 80% or more correct on the first two sets of 50 trials, she was moved on to the next step. If not, further sets of 50 trials were presented until she scored 80% or more correct on two consecutive sets. When Diane reached 80% criterion for any training step requiring responses

on demand, a generalization probe was administered. Probes were presented immediately after criterion was achieved. For these probes, during which responses were not reinforced, the 15 pictures on which Diane had received no training were each presented once and the number of correct sentences she produced was recorded. If, in Phases I, II, IV, and V, Diane generalized the target pattern taught in the preceding step to at least eight of the 15 probe pictures, she was considered to have reached criterion and moved to the next phase of training. If she failed to generalize, she was retrained to criterion on the given target pattern with both training pictures ("The girl is swimming" and "The boy is run-

ning”), which were presented an equal number of times in a quasi-random order. The generalization probe was then administered again. The criterion for reversal (Phase III) was more stringent. Use of “the” and “is” was considered to have been extinguished only when both words were used less than twice.

RESULTS

Figure 1 shows the percentage of Diane’s responses at baseline, on training sets within each step, and on probes. On the baseline measures, Diane’s responses elicited by the command, “Tell me about this”, consisted only of nouns and verbs; she used neither “the” nor “is”. The same was true for the baseline measure (not shown) in which Diane was required to imitate.

Only initially did Diane have difficulty learning to imitate the required response and on Step

1, the purpose of which was to teach the use of the word “the”, she required four sets of 50 trials in order to reach criterion. In Step 2, the same responses were elicited by saying to Diane: “Tell me about this”. A minimum number of trials (*i.e.*, two sets) was required to reach criterion. Not once did Diane use the word “the” in response to any of the 15 pictures in Probe 1. In Step 3, she was therefore given further training on the same pattern (the girl swimming) and a second training picture (the boy running) was also introduced. After 200 trials, Diane reached criterion. On Probe 2, she used “the” in response to eight of the 15 probe pictures. The word “is”, on which she had received no training, was not used.

The purpose of Phase II was to maintain the use of “the” and teach the use of “is”. Step 4, imitation of “the girl is swimming”, was completed with a minimum number of trials. Step

Fig. 1. Per cent of responses correct at baseline, for the 14 training steps and nine probes. Each set of 50 items administered is represented by a data point. Thus, a total of 200 trials was presented in Step 1, 100 in Step 2, and so on.

5, in which the same pattern was elicited in the manner described above, was similarly completed with a minimum number of trials. However, Probe 3 showed that, while the use of "the" was maintained, the word "is" was employed in response to only one of the 15 pictures. She was therefore given retraining (Step 6) on the sentences "the girl is swimming" and "the boy is running". This step proved to be the most difficult for Diane and she succeeded in reaching criterion only after five sets (250 trials) had been presented. Probe 4 showed that Diane both maintained the use of "the" and reached the generalization criterion for the use of "is". However, only four of the 15 responses included both the article and the auxiliary verb; therefore, retraining was repeated (Step 7). After 100 trials, Diane reached criterion and Probe 5 was presented. Diane generalized the use of "the" in response to 14 of the 15 pictures and used "is" on 13 of the 15. Twelve of the 15 responses included both the article and the auxiliary verb.

In Phase III, reversal was introduced as a control procedure. In Steps 8 and 9, Diane was reinforced only if she omitted both words. Criterion was reached in two sets. However, Probe 6 showed that training had not eliminated the previously learned responses because Diane responded with "the" on seven occasions and with "is" on two. Retraining on the impoverished patterns "girl swimming" and "boy running" was therefore introduced as Step 10. During Probe 7, Diane used "is" in response to only one picture and did not employ "the" at all.

The purposes of Phases IV and V were to reinstate the use of the words "is" and "the" respectively. Criterion was reached in both phases after presentation of only two sets in each step. Probe 8 showed that "the" remained extinguished while "is" was used in response to 12 of the 15 probe pictures. The final probe showed that Diane used "the" in response to 13 of the 15 pictures and "is" to 14. On Probe 9, the complete target pattern was used 13 times.

An independent judge's transcription of tape

recordings were compared with the experimenter's scoring sheets in order to estimate reliability. Responses in Steps 1, 7, and 14 and in Probes 1 and 9 were selected for this purpose. Reliability was calculated by dividing the number of agreed responses by the total number of responses obtained. The level of agreement thus derived was better than 0.93 for each of the five measures.

DISCUSSION

Results of this study showed that operant procedures can be used effectively to increase the complexity of a hearing-impaired child's verbal responses. Similar results with a normally hearing, speech-deficient child were reported by Wheeler and Sulzer (1970).

In Phase I, the objective was to teach Diane to include the word "the" in a verbal response describing pictures. Results showed that when training was limited to only one pattern (the girl swimming), generalization failed to occur. It was only after retraining, in which a second item (the boy running) was introduced, that Diane began to use "the" in response to pictures on which she had received no training. Similar results were obtained for Phase II in which Diane was trained to include both "the" and "is" in her responses. It is not clear whether subsequent generalization occurred simply as a result of the additional practice, as a result of introducing a second training item, or both. Nevertheless, since generalization did occur, results demonstrated that Diane was thus enabled to begin to generate new sentences of the present progressive form.

In Steps 4, 5, and 6 Diane learned to use "is" but she received reinforcement only when she responded with the complete sentence, which included the previously taught word "the". Results for Probes 3 and 4 show that the frequency with which "the" was used did not improve substantially. Diane's failure to use "the" more frequently in these probes suggests that our criterion for passing from one phase to the next

may have been too low. Thus, the word "is" may have been introduced before the word "the" was adequately learned. However, had we set the criterion higher, we might have experienced more difficulty in extinguishing the words in Phase III. Further study of the relationship between criterion level selected and the extent of generalization found for verbal material is required, particularly if similar procedures are to be used as part of a clinical training program.

Results for Phase III showed that the use of "the" was more difficult to extinguish than the use of "is". But "the" was used in both of the preceding phases, whereas "is" was used only in Phase II. Thus, this difficulty may possibly be explained in terms of the extent of prior training. Alternatively, the difference may have been due to the relative salience of the two words, since the word "the" is more audible to a hearing-impaired child than "is".

In the present study, neither "the" nor "is" was stressed when the required pattern was provided for Diane to imitate. Work by Blasdell and Jensen (1970) and by Risley and Reynolds (1970) suggests that had these words been emphasized to give them perceptual salience, acquisition may have been more rapid.

In Phases IV and V, the use of the words "is" and "the" was rapidly reinstated. A minimum number of trials on the one picture was required in order for Diane to reach criterion and to generalize. These results suggest that while Diane's use of the two words was extinguished in the previous phase, her knowledge of the words and her ability to use them was not substantially affected by the reversal procedure. Indeed, she was heard to use both words outside the experimental setting during this phase. Had her newly acquired competence been destroyed by the reversal procedure, reinstatement would have involved as many trials as the initial training. This was not the case. As pointed out by Baer, Wolf, and Risley (1968), social considerations may often dictate against the use of reversal as a control procedure. In a clinical program concerned with teaching language to young hearing-

impaired children, evaluation through the use of a multiple baseline procedure might be more generally acceptable.

Imitation is widely used as a technique in teaching hearing-impaired children. This is probably because it provides a means whereby parents and teachers can check rapidly and reliably on whether the child is able to hear or see the words presented. It is, however, not known how far imitation, in itself, facilitates language acquisition in hearing-impaired children. Ervin (1964) and Ling and Ling (*unpublished*) found relatively little use of imitation by normally hearing children; so little in fact, that they questioned whether it could possibly play a significant role in normal language acquisition. Frazer, Brown, and Bellugi (1963) and Kirk, McCarthy, and Kirk (1968) believe that imitation may require only an automatic sequential level of response, involving mainly short-term memory processes. However, this view is not supported by the work of Schumaker and Sherman (1970) or Garcia, Baer, and Firestone (1971). Both show that imitation can facilitate generalization of vocal and verbal behaviors. The problem has not been studied in relation to deaf or hearing-impaired children.

In this study, imitation was used as the first step to introduce the required response and Diane had no difficulty in subsequently producing the same responses on demand. However, imitation did not appear to play a substantial role in helping Diane to generalize. Had it done so, generalization might have been expected to occur on the initial probe in each phase.

Perfect pronunciation was not demanded from Diane, but in further studies similar procedures could be used to increase the accuracy of her speech at a phonemic level. An adequate criterion of correctness in pronunciation would, however, be more difficult to establish than a criterion of correctness in sentence usage, because the experimenter would have to make finer judgements relating to responses during the course of training. That an experimenter may tend to accept other than auditory cues is

suggested by the discrepancy between his and the judge's interpretation of Diane's responses. While the experimenter wrote down what he thought Diane said in a "live" situation, one in which he could see as well as hear the subject, the judge had to rely on audition alone in transcribing the tape recordings. In view of the differences between these conditions, it is surprising that agreement was so good ($> 93\%$).

Further experimental work is required to determine whether generalization would occur more readily if a greater number of training pictures were used. It would have been possible to include a wider range of both nouns and verbs, though in different contexts, in both training and generalization procedures.

The present technique was effective and results suggest that the approach reported might be employed in teaching other hearing-impaired children. Other syntactic structures could possibly be taught through the use of similar procedures. Development of programs that include this type of work might allow hearing-impaired children to acquire a wider variety of syntactic structures at an earlier age than programs based entirely on traditional procedures.

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Received 30 August 1971.

(Revised 21 February 1972.)