*PRODUCING GENERATIVE SENTENCE USAGE BY
IMITATION AND REINFORCEMENT PROCEDURES¹*

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Three retarded subjects and two developmentally normal toddlers were trained using imitation and reinforcement procedures to use correct sentences. The experimental task was to use sentences with correct subject-verb agreement to describe pictures that were presented to the subjects. Two classes of sentences were taught: those involving a plural subject that required the use of the verb "are" (for example, "the boys are running") and those involving a singular subject that required the use of the verb "is" (for example, "the boy is running"). The basic design of the study involved multiple baselines for each class of sentences. Four of the subjects began to produce novel, untrained sentences of a particular type to generalization probe pictures when that particular class of sentence was currently being trained. Thus, the imitation and reinforcement procedures appeared to be functional in producing generative sentence usage for both types of sentences. One subject produced correct sentences to both singular and plural probe pictures when only "is" sentences had been taught. A reversal procedure and retraining phase indicated that for this subject, imitation and reinforcement procedures for training one class of sentence behavior seemed functional in producing generative responses of the other class of sentences.

There have been a number of theoretical accounts concerning the development of language in children, ranging from those by Lenneberg (1969) and McNeil (1966), which emphasize the innate and biological factors important for language development, to those of Sherman (1971) and Staats (1968), which emphasize the possible role of imitation and environmental consequences of language. One area of agreement in these accounts is the prevalence and importance of the development of generative language. Generative language simply

means the appearance of novel language responses within the language repertoire of the child that have not been modelled or directly trained, but that may be related to other language responses. For example, when Brown and Bellugi (1964) and Ervin (1964) observed the spontaneous speech of young children, they found that the children used plural labels such as "mans" and "foots" and past-tense forms such as "comed" and "buyed". Because these particular responses are ungrammatical, it seems unlikely that parents either modelled or directly trained them. Yet, these responses do appear to be closely related to other grammatical plural and past-tense forms.

In the past few years, several studies have been concerned with the production of generative language in children who had language deficits. Guess (1969), Guess, Sailor, Rutherford, and Baer (1968), and Sailor (*unpublished*), all used imitation and reinforcement procedures to develop generative language repertoires of plurality in retarded children. Similarly, Wheeler

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and Sulzer (1970) produced generative usage of complete sentences in a child who initially spoke in "telegraphic phrases"; Fygetakis and Gray (1970) increased the generative use of "is" in descriptive sentences of aphasic children; also, Bennett and Ling (1972) produced the generative use of "is" and the article "the" in the descriptions of pictures by a 3-yr-old hearing-impaired girl; and Schumaker and Sherman (1970) produce generative past- and present-tense verb production in retarded children. With children who displayed normal language repertoires, Bandura and Harris (1966) found that modelling, reinforcement, and instructions were more effective in increasing the number of generative passive constructions and prepositional phrases in sentences than was modelling alone, modelling and reinforcement, or none of these conditions. Again, with normal children, Whitehurst (1971) used imitation and reinforcement procedures to produce generative labels within the context of a simple artificial grammar.

Studies showing the functional role of imitation and reinforcement procedures in the development of generative language have both applied and theoretical significance. For applied purposes, these procedures can be used to produce extensive and novel language repertoires with subjects who have previously exhibited little or no appropriate language. Further, to the extent that imitation and reinforcement procedures have been functional in producing a wide range of different types of language repertoires with a variety of subjects, these studies suggest that similar variables *may* be functional in the normal acquisition of language.

The purpose of the present study was to explore the use of imitation and reinforcement procedures in the generative development of descriptive sentences, involving plural and singular subject-verb agreement, with retarded children who had language deficits and with normal young children who did not yet exhibit complete descriptive sentences with correct subject-verb agreement.

METHOD

Subjects

Three residents from Kansas Neurological Institute and two toddlers of normal development from the University of Kansas Department of Human Development Preschool Laboratory Classroom participated in this study. The three institutionalized residents were diagnosed as moderately retarded. At the beginning of the study, Jimmy, a male, was 32 yr old; Carol, a female, was 6; and Walter, a male, was 12. The toddlers, Barry, a male, and Sally, a female, were 2 yr, 5 months old when the study began.

Procedure

Stimulus materials. The trained language responses were descriptive sentences to pictures of one or two people, animals, or things engaged in a particular activity; for example, "Boat(s) is (are) sailing" or "Girl(s) is (are) riding". These were depicted on forty 8 by 11 in. (20 by 27.5 cm) pictures, 20 with one person, animal, or thing engaged in activity and 20 with two people, animals, or things engaged in an activity.

Pretest. The subjects were chosen for this study because they had relatively good articulation, yet showed deficits in the production of full sentences with correct subject-verb agreement. At the institution the experimenter asked ward personnel about each resident's use of full sentences. No resident who participated in this study was reported to have previously demonstrated proper subject-verb agreement in sentences. In order to ensure that the subjects did not use full sentences, the experimenter then individually tested each resident by showing him several pictures such as a boy or two boys fishing. The resident was asked: "What do you see?" Sometimes the correct noun was produced and sometimes it was not. If the resident failed to label the noun, the correct noun label was modelled by the experimenter. After the correct response was produced by the resident, he was asked: "Doing what?" None of the resi-

dents ever answered by producing the correct verb. Usually there was no verbal response or the noun was repeated. The experimenter then modelled the action verb, and the resident was asked: "What's happening?" This was an attempt to determine whether providing correct noun and verb labels for the pretest pictures would cause the residents to use full sentences. Further probes were used such as the experimenter saying, "Tell me more", or "Tell me *all* about the picture". No resident produced a sentence using "is" or "are" in response to the pretest pictures; in fact, they seldom combined the noun and verb together such as "boy fishing". Such deficits in the production of complete sentences in describing simple pictures met the criteria for a resident to participate in the study.

The same criteria and pretest were applied in the selection of the two toddlers who participated in the experiment. Also, before pretesting, the experimenter consulted with the Toddler Class teachers and observed language behavior in the classroom to ensure that the children did not exhibit complete sentences in their speech.

Preliminary training. The first step in training was to teach the correct labels for each noun subject (singular and plural) that would correctly describe the pictures and the label for each action depicted in the pictures. The purpose of the preliminary training was to ensure that the deficits in sentence production were not simply a result of a lack of "vocabulary" for either noun subjects or actions. The pictures used for preliminary training were different from the pictures used in the pretest.

Imitation and reinforcement procedures were used during preliminary training. The experimenter presented a series of pictures and asked about each picture: "What do you see?" If the noun subject was named correctly (e.g., "cow" or "cows", depending on whether there were one or two cows displayed in the picture) praise and a token were delivered. A cup of tokens was traded at the end of the session for candy, soda-pop, or a small toy. If the correct noun subject was not named, the experimenter waited a few

seconds, presented the card again, modelled the correct response, and again asked: "What do you see?" If the correct response was produced by the subject, he was given a token. When the correct response had been produced five times consecutively without a model, a new picture was presented. This procedure was repeated until all the singular and plural noun subjects were trained. In a similar manner, the experimenter trained labels for the action verbs depicted in the pictures by presenting the picture and asking: "What do you see?" When the correct noun label was produced, the experimenter asked: "Doing what?" Again, correct responses (e.g., "running") were reinforced with praise and a token. The same modelling procedure used for the nouns was used for the verbs. When the correct response was produced five times consecutively without a model, a new action verb was trained. This procedure was repeated until all the action labels were taught.

After the nouns and verbs were taught in this manner, the pictures were all shown once more to a subject. If he failed to produce a correct noun or verb label, it was taught again using the same modelling and reinforcement procedures. The procedure was repeated until no incorrect noun and verb labels were produced.

After preliminary training, each subject's ability to produce correct sentences containing noun subject-verb agreement was again evaluated. This was accomplished by showing all the pictures to the subject, one at a time, and saying: "Tell me what is happening." If the subject labelled the noun and verb correctly, but did not use the auxiliary verb, the experimenter said: "Tell me more, is there another way you can tell me?"

No correct responses (full sentences containing subject-verb agreement) were produced by any of the subjects after they had completed preliminary training.

Experimental training. Some subjects were first taught to produce "is" sentences involving singular noun subject-verb agreement. Other subjects were first taught to use "are" sentences

involving plural noun subject-verb agreement. Both forms were eventually trained.

Singular noun sentence ("is") training. Ten singular noun pictures were randomly selected as training items. Correct sentence responses, consisting of the appropriate singular noun, the auxiliary verb "is", and the appropriate action verb were taught separately to each training picture, one per training session in the following way. The experimenter showed a picture to a subject that contained a singular noun subject and said: "What's happening?" If a correct sentence (e.g., "The cow is running") was produced, praise (e.g., "Good boy, Jimmy") and a token were delivered. If the correct sentence was not produced, the experimenter placed the picture face down, turned his face away for 5 sec, then presented the picture, modelled the correct response, and again asked: "What's happening?" Praise and tokens were delivered for correct responses following a model. Each time a child produced a correct sentence, whether it was modelled or not, no model was provided on the next presentation of the picture.

A training session was terminated when a subject produced five consecutive correct sentences without a model. A subject then traded his or her tokens for candy, cereal, or a small toy, and a probe session immediately followed. If the subject did not meet the criterion of five consecutive correct responses without a model within one-half hour, the training session was terminated, but if a retarded subject had earned 40 tokens, or a normal toddler subject 20, he or she was allowed to trade them and training was resumed in the next session. After five consecutive correct sentences were produced without a model, a probe session was conducted. (Probe sessions are described later.) After each probe session, the next training session occurred (the following day) in which a new noun picture was trained. Training sessions were followed by probe sessions, and so on, until all 10 training pictures had been trained. Thus, training sessions occurred before the first 10 probe sessions of each experimental condition.

Plural noun sentence ("are") training. Ten randomly selected plural noun pictures were used as training items and correct sentences consisting of the appropriate plural noun, the auxiliary verb "are", and the appropriate action verb were taught. This was done in the same way as singular noun sentences were taught.

Probe sessions. After subjects were taught to respond to each training picture to a criterion of five correct sentence responses without a model, a probe session immediately followed. The probe sessions consisted of randomly presenting the picture to which a correct sentence response had just been trained, together with a number of pictures (some with singular noun subjects and some with plural noun subjects) to which correct sentence responses had not been trained (probe items). During all probe sessions, the number of trials on which trained pictures were presented was almost always equal to the number of trials on which probe pictures were presented. (The only exceptions to equal numbers of trained and probe pictures occurred when a picture was inadvertently placed in the wrong pile.) Responses to the probe pictures were never modelled or reinforced and constituted the measure of the generative repertoire developed by the subjects. After a subject's response to a probe picture (or no response within 10 sec), the experimenter paused for a few seconds and presented the next item. The training items were treated in the same manner as described for training sessions.

If a subject was initially being taught correct usage of "is" sentences to some items, the probe items consisted of 10 new pictures involving singular noun subjects and 20 new pictures involving plural noun subjects. If a subject was initially being taught correct usage of "are" sentences to some pictures, the probe items consisted of 20 pictures involving singular noun subjects and 10 pictures involving plural noun subjects. If one form of a sentence had already been taught (either "is" or "are" sentences) and the second form was currently being trained, probe items consisted of 10 new, untrained pictures

involving singular noun subjects and 10 new pictures involving plural noun subjects.

After all 10 sentences of a particular form had been taught to the 10 training pictures and randomly presented during training sessions, these 10 pictures were presented during probe sessions, randomly mixed in with probe pictures. Otherwise, only the last item trained was randomly mixed in with probe items. During probe sessions, only the current training items were presented. For example, if "is" sentences had previously been trained and "are" sentences were currently being trained, only "are" training items were presented in probe sessions. The "is" training items were no longer presented. A probe session lasted until a retarded subject received 40 tokens or a toddler subject 20 tokens for correct sentence responses to the training item(s).

Variations in procedure. Different results were obtained with both Walter and Jimmy than with the other subjects, which required somewhat different procedures for both. Walter exhibited generative "is" sentence behavior during "is" training and then began to exhibit generative "are" sentences once "are" sentences were taught to the training pictures. However, unlike other subjects, when a new form was trained ("are"), Walter no longer responded appropriately to "is" sentence probes. To attempt to produce generative sentences of both types, the 10 "is" training items were again presented randomly in probe sessions along with singular and plural probes and the 10 "are" training items. The results with Jimmy necessitated a change in the procedures and experimental design. During "is" training, Jimmy began to produce generative "is" sentences to the singular probe items. Jimmy also began to use "are" sentences correctly in response to probe pictures that required the plural form, even though "are" sentences had not been trained, and he had not used "are" in response to pictures that required the plural form in the pretests, nor had he ever been heard by ward personnel to use correct noun subject-verb agreement in his speech. To evaluate

whether or not the training of "is" sentences facilitated the correct production of the plural "are" sentences, a reversal procedure was used whereby an incorrect response to singular training items was taught. Training of the incorrect form was accomplished in an identical manner as the training of the correct form. The response taught was the use of the noun and action verb without "is" to the singular noun picture training items. If Jimmy used "is", it was treated as an incorrect response: the experimenter put the picture down and looked away for 5 sec, and the new "(in)correct" form was modelled (e.g., "boy fishing"). Jimmy's production of the noun and the action verb without "is" was reinforced whether or not it was modelled to him on a trial. In the last condition for Jimmy, correct "is" sentences were retrained in the same way as during the first condition.

Response Definitions, Scoring Responses, and Reliability

During each session, each response produced by the subject to the pictures was written down by the experimenter. Three different observers were used throughout the study to provide an independent record of responses for several sessions in each experimental condition for each subject. The observers sometimes recorded responses from tape recordings and sometimes while being present at the session. When responses were scored from tape recordings, the tapes were scored in a different sequence than in which sessions actually occurred. When an observer was present during a session, he sat in a position that prevented him from seeing the pictures that were presented to the subject. The reliability scores from tapes and "live" observation sessions were virtually identical. A sentence was scored correct if it contained the correct singular or plural noun subject, the correct "is" or "are" auxiliary verb, and the correct action verb all in proper sequence. If the subject started a sentence response with an article or followed the action verb with a prepositional phrase (which occurred only once for one sub-

ject), it was not written down or scored. "Eh" in place of "is" was not acceptable, nor was "ah" acceptable in place of "are". If any part of the sentence was wrong, it was scored as an incorrect response. Reliability scores were calculated for the probe trials only, because they represented the dependent variables under study. The responses that the observers recorded for each probe trial of a session were compared to those recorded by the experimenter. Agreement was counted when each word and word order were the same for that particular trial. That is, if any disagreement occurred on any part of the sentence, the whole sentence was scored as a disagreement.

For Carol, agreement was 91% (637 agreements in 701 responses). For Jimmy, agreement was 82% (670 agreements in 815 responses). For Walter, agreement was 94% (267/286). For the toddlers, agreement was 89% for Barry (254/286) and 88% for Sally (125/141). Reliability calculated over probe trials early in training did not differ substantially from reliability calculated on probe trials later in training. Across all subjects, reliability calculated on probe trials occurring during the first half of training was 87, and was 89 for probe trials occurring during the second half of training.

RESULTS

Table 1 shows the number of trials each training item was presented to each subject before the criterion of five consecutive correct responses without a model was reached. The five correct responses are included in the number presented. For example, Carol was presented with the first "are" training item 23 times before criterion was met. The last five of those 23 were without a model. With the exception of Barry during the first training condition, all subjects generally required more training trials to meet criterion for the first few one or two pictures in a training condition than they did on subsequent pictures in that condition.

Figures 1 to 5 show the generative produc-

tion of correct "is" and "are" sentences to the probe items for the subjects in the study. A correct sentence contained the appropriate singular or plural noun, the appropriate auxiliary verb ("is" or "are"), and the appropriate action verb. Throughout the study, the great majority of errors by subjects involved producing "is" and "are" appropriately. Subjects rarely used an incorrect action verb and only occasionally labelled a noun incorrectly (when this occurred it was usually a singular noun label to a plural item).

Figure 1 shows the results for Carol, a retarded resident. During the pretest session no correct sentences of either type were produced. When Carol was taught to produce correct "are" sentences to the training pictures during the first condition of probe sessions, she also gradually began to produce correct "are" sentences to the untrained probe pictures. Eventually, she reached 100% correct generative performance on four of the last five probe sessions of that training condition. During this first condition, Carol still did not produce any correct "is" sentences. However, once she had been trained to produce correct "is" sentences to some of the training pictures, she gradually began to produce correct "is" sentences to the probe items, eventually reaching 100% level on six of the last seven probes. Further, a decrement in generative production of "are" sentences was observed when the training of "is" sentences began, but gradually a high level of correct production of "are" sentences was recovered without additional training on that type of sentence.

The results for the two toddlers, Sally and Barry, were very similar to those obtained with Carol, as shown in Figures 2 and 3. For Sally, training began with "is" sentences, and for Barry, training began with "are" sentences. With both subjects, the development of correct generative performance of "is" and "are" sentences was correlated with teaching these sentences to the training pictures.

Figure 4 shows that Walter exhibited generative "is" sentence behavior during "is" training

Table 1
Number of Trials Each Training Item was Presented Before Criterion was Met

[illegible]

Fig. 1. Carol's correct sentence responses in probe sessions to plural and singular probe items during "are" and "is" sentence training.

at a high percentage after 20 sessions. He also produced a high percentage of generative "are" sentences during "are" training, but the percentage of correct "is" sentences decreased during this condition. When both "is" and "are" sentences were trained in the third condition, Walter exhibited a high percentage of generative production of both forms.

Figure 5 shows that Jimmy exhibited a high percentage of generative "is" sentences after the fourth "is" training session. He also exhibited "are" sentences to plural probes after the eighteenth training session. The reversal condition produced a decrease in the generative production of both forms, while the re-introduction of "is" sentence training was again accompanied

Fig. 2. Sally's correct sentence responses in probe sessions to singular and plural probe items during "is" and "are" sentence training.

by a high percentage of correct generative sentences of both forms.

During the initial training conditions, "overgeneralization" of the sentence form being trained was observed to varying degrees for all subjects except Barry. For example, when Carol began to produce correct "are" sentences to the plural probe items, she also began to use "are" sentences incorrectly to describe the singular probe items. These incorrect "overgeneraliza-

tions" typically involved the correct singular noun with "are" in the sentence (*e.g.*, "Boy are fishing."). Sometimes the incorrect response to a singular probe item involved both the use of "are" and the incorrect use of the plural noun (*e.g.*, "Boys are fishing."). For Carol, during the last two probe sessions in the first training conditions, such "overgeneralizations" occurred on 90 to 100% of the singular probe trials. However, once correct "is" sentences were

BARRY

Fig. 3. Barry's correct sentence responses in probe sessions to plural and singular probe items during "are" and "is" sentence training.

taught to Carol during the "is" training condition, "overgeneralization" of the "are" sentences gradually dropped out.

DISCUSSION

The results obtained with the three retarded and two normal children indicate that generative descriptive sentences can be produced by

imitation and reinforcement procedures. As each subject in the study was taught more and more sentences of a particular type, he or she increasingly produced correct untrained sentences of that type. Thus, these results systematically replicate and extend the results of previous studies that have used imitation and reinforcement procedures to produce other generative language forms (Bennett and Ling, 1972; Fygetakis and

Fig. 4. Walter's correct sentence responses in probe sessions to singular and plural probe items during "is", "are", and combined "is" and "are" sentence training.

Gray, 1970; Guess, 1969; Guess *et al.*, 1968; Sailor, *unpublished*; Schumaker and Sherman, 1970; Wheeler and Sulzer, 1970).

The present results are also similar to those of previous studies in that all of the present subjects except Barry showed "overgeneralization" of the response form initially trained. The production of currently trained forms in other classes was also discussed by Guess (1969) and

Schumaker and Sherman (1970). The "overgeneralization" effects would seem to strengthen the possibility that the reinforcement and imitation training procedures are critical components in the production of generative language forms. Another similarity of the present results to previous ones was that the present subjects generally required fewer training trials to reach criterion during a training condition on

Fig. 5. Jimmy's correct sentence responses in probe sessions to singular and plural probe items during "is", incorrect without "is", and the second "is" sentence training.

pictures later in the training than on the first one or two pictures in the condition. Several previous studies (Guess, 1969; Guess *et al.*, 1968; Schumaker and Sherman, 1970) found that as training progressed, the training items were learned more rapidly.

One finding of the present study was somewhat different than results of previous work. Several previous studies (Sailor, *unpublished*; Schumaker and Sherman, 1970) found that current training conditions produced generalized responses of that class, which appeared to override past training conditions. In the present study, only Walter produced the current train-

ing form in response to probe items of the previously trained form. That is, after he produced generative singular sentence forms during singular form training, he no longer consistently produced the generative singular form when the plural subject-noun sentence form was taught. A third condition, in which both training forms were presented, was required for Walter. The two normal subjects and one retarded subject maintained the generative production of a prior trained form when a new form was being taught.

The results for one of the subjects, Jimmy, deserve special discussion. Jimmy generatively

produced both sentence forms when only the singular noun sentence form was taught. Jimmy was 32 yr old and thus had many more years of exposure to language than the other subjects in the study. It is possible that Jimmy had appropriate usage of "is" and "are" sentences in his repertoire, but simply did not display it in the pretest. Perhaps the systematic exposure to the imitation and reinforcement procedures for one of the sentence forms (singular) was sufficient to cause production of both sentence forms (singular and plural). That Jimmy's generative repertoire was affected by the training procedures, at least in part, was indicated by the results of the reversal condition for him. In the reversal condition, when incorrect singular forms were trained, correct generative performance on both singular and plural sentences declined. When correct singular sentences were again trained, correct generative performance of both sentence forms recovered. Therefore, there is some evidence that the training affected the extent to which Jimmy displayed correct generative performance, but not which type of sentence he produced.

In general, the performance of the retarded subjects and the normal subjects was similar in that both types of subjects generatively produced new sentences of a particular type after being trained to use examples of that type. But, as might be expected, the normal children displayed the generative forms after less training than the retarded subjects.

With the exception of studies by Bandura and Harris (1966) and Whitehurst (1971), previous research on the experimental development of generative language has been with children who had speech deficits, relative to their chronological age mates. The similarity of the results between the retarded and the normal children in the present study suggests that teaching programs based on imitation and reinforcement procedures might not only be useful in remediating language deficits but also in accelerating normal language development. Whether or not imitation and reinforcement are functional in

the usual development of language is not answered by this study. The results, however, indicate that these variables can have powerful effects and that they deserve serious consideration in accounts of how language acquisition may occur normally.

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