THE ACQUISITION OF SIMPLE AND COMPOUND SENTENCE STRUCTURE IN AN AUTISTIC CHILD¹

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Contingent reinforcement and imitative prompts were used to teach an autistic child to use simple and compound sentences to describe a set of standard pictures. When imitative prompts and reinforcement were discontinued, correct use of simple sentences declined, but increased again when imitative prompts and reinforcement were re-instated. When imitative prompts and reinforcements were used to teach compound sentence structure, correct use of simple sentences declined and correct use of compound structure increased. At the end of training, the child also used novel compound sentences to describe a set of pictures on which he had received no direct training.

Recent evidence suggests that it may be possible to teach speech-deficient children the verbal skills involved in the productive use of language; that is, to use language in ways not directly trained and reinforced. Lovaas (1969) provided an informal illustration. The autistic children in his film appeared to produce novel sentences when talking about their immediate environment and events of the recent past. However, Lovaas presented no experimental analysis of the more complex language behavior of his subjects.

More systematic analyses have appeared, beginning with fairly simple behaviors, such as the acquisition of the plural morpheme (Guess, Sailor, Rutherford, and Baer, 1968; Sailor, 1971). Subsequent research has investigated increasingly complex behavioral targets. Wheeler and Sulzer (1970), using imitative prompts and differential reinforcement, attempted to elaborate a complete sentence format out of the telegraphic form characterizing the speech of their

subject before training. After training, the subject used the form to describe a set of untrained stimuli. Schumaker and Sherman (1970) took the research further by developing generative use of verbal inflections in response to verbal stimuli signalling past and present. Baer and Guess (1971) also examined relatively complex behavior. They demonstrated that it is possible to train correct identification of comparative and superlative adjectives.

The theoretical assumptions outlined by Guess *et al.* (1968) provide a framework for the method used in the present study. These authors attempted to account for the skill with which most human beings generate grammatically correct utterances that they have never been directly trained to use. Essentially, it is assumed that generative language may be conceptualized within an operant framework as a set of functional response classes. The specification of a response class is accomplished when an intervention is applied to some responses and is shown to affect other responses as well; the class is defined as all such affected responses.

The present study attempted to demonstrate a procedure by which compound sentence form, as well as simple sentence form, may be trained, and to test the assumption that the compound form may be considered a response class. The first phase of the study consisted of training the

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subject to use four types of simple sentences to describe a set of standard pictures. The simultaneous training of various sentence forms was performed to analyze the possibility of designing an efficient training procedure for use in the applied setting; that is, a procedure that produces a wide variety of responses after a relatively small number of training sessions. The subject was required to produce two of these several forms in response to each of the training stimuli.

In the second phase of the study, the subject was taught to chain the two simple sentences he had learned in Phase 1, using the conjunction "and" to produce compound sentences. The training method in both phases included the use of imitative prompts, differential reinforcement, and timeout for errors. The method is similar to that used in several of the studies cited above, and particularly to that of Lovaas (1969) and of Wheeler and Sulzer (1970).

METHOD

Subject

Brian was an 8-yr-old boy who had been previously diagnosed autistic. He was enrolled in a special classroom for autistic children at California State University, Los Angeles. Brian was echolalic at times. His verbal repertoire consisted mainly of one- or two-word responses. While he occasionally produced a complete sentence, he was selected for this study because neither the experimenter nor Brian's teacher had ever observed Brian using sentences of the forms trained in this study, nor had Brian ever been observed or reported to have used a compound sentence.

Setting

Training was conducted in a small classroom within the school complex. Brian and the experimenter sat facing one another next to a desk on which reinforcers and stimulus materials were placed. An observer was sometimes pres-

ent, seated in a chair 4 to 5 ft behind the experimenter.

Materials

The stimulus materials consisted of 17 pictures approximately 11 by 14 in. (28 by 35.5 cm) from the *Teaching Pictures* series published by David C. Cook (1966) for use in nursery school and kindergarten classrooms. Each card selected for this study pictured at least two actors, each engaged in different and readily discriminable activities. Most of the pictures illustrated a number of actors and activities.

Nine of these pictures were selected for training. The series and picture numbers, as well as the training sentences used during Phases 1 and 2 of training, are presented in Table 1. The remaining eight pictures were used as a test for generalization. Series and picture numbers of these eight appear in Table 1, but no sentences are given, as any one of several descriptions would be accurate.

Initially, Brian was required to give both sentences listed in Table 1 in response to the presentation of a particular card. Each training sentence may be described as falling in one of four form categories. Differences between the forms are described in Table 1 and the form category into which each training sentence falls is also listed.

Generalization test cards were selected on the basis of vocabulary present in Brian's repertoire or vocabulary that would be trained in Phase 1. Many of the same verbs, nouns, prepositions, and adverbs could be used to describe the test and training pictures, but new combinations of these elements would be required to do so. For example, "The girl is riding the bike and the boy is pushing the wagon" adequately describes picture A1531-4 of the generalization test cards and requires a recombination of elements from training sentences that describe cards A1591-5, A1536-11, and A1531-2.

For several generalization test cards, nouns not found in the training sentences were re-

Table 1
Form Elements, Picture Numbers, and Descriptive Training Sentences

<i>Form Numbers</i>	<i>Elements</i>	
1	Article, noun, auxilliary verb, present participle.	
2	Article, noun, auxilliary verb, present participle, article, noun.	
3	Article, noun, auxilliary verb, present participle, article, noun, adverb.	
4	Article, noun, auxilliary verb, present participle, article, noun, preposition, article, noun.	

<i>Picture Numbers</i>	<i>Training Sentences</i>	<i>Form Numbers</i>
A1591-5	The boy is pulling the wagon. The man is putting the box away.	2,3
A1591-7	The teacher is holding the book. The boy is reaching for the book.	2,4
A1531-2	The lady is pushing the cart. The girl is putting the box away.	2,3
A1531-1	The boy is pouring the water. The girl is digging a hole.	2,2
A1531-5	The boy is reading. The teacher is putting the books away.	1,3
A1536-11	The boy is pulling the bike. The girl is riding the bike.	2,2
A1536-5	The man is feeding the tiger. The children are watching.	2,1
A1536-10	The car is coming down the street. The children are walking.	4,1
A1536-7	The girls are swinging. The boys are playing ball.	1,1

Note.—Series and picture numbers for the generalization test cards were A1533-9, A1533-1, A1533-12, A1531-4, A1536-3, A1536-9, A1536-6, and A1533-4.

quired. For example, "The girl is feeding the rat" is required to describe picture A1533-12, but "rat" is not found in the training sentences. If the subject could label the object, the picture was included in the generalization test cards.

Procedure

Training sessions of 30 min each were held twice a week. The number of trials depended on how cooperative Brian was. Tantrums and refusal to sit quietly sometimes resulted in fewer trials per session. The average number of trials was 34. In Phase 1, every trial on which two correct sentences occurred was immediately reinforced with a bite of food. In Phase 2, every trial on which one correct compound sentence occurred was immediately reinforced. In both phases, if no response or an incorrect response occurred, the experimenter offered an imitative prompt. If the subject did not respond to the prompt, the experimenter turned away from the subject for approximately 10 sec and then be-

gan a new trial. Sessions were held immediately before lunch.

Baseline

During the first two sessions, all 17 cards were presented once during each session. The subject was asked: "What do you see?". No prompts were given and any response produced praise from the experimenter (*e.g.*, "good boy", a pat on the head, *etc.*). In addition, the experimenter made two further checks of the subject's comprehension and production of various sentence forms. For 5 min, the experimenter attempted to initiate a conversation with the subject by asking a number of simple questions such as "What did you do today?", "where is your teacher?", *etc.* This procedure served as a brief check on the subject's ability to produce complete sentences in response to simple verbal stimuli. The experimenter also verbally presented a list of 10 commands phrased in compound sentence form; *e.g.*, "Touch the door and

touch the window", "walk to the desk and pull out the chair", "go to the shelf and point to the crayons", etc. This informal procedure was used to help to assess the subject's comprehension.

Phase 1. During Sessions 3 to 11, the nine training cards were presented in an unsystematic order. The subject was asked: "What do you see?". If no response or an incorrect response occurred, the experimenter modelled the correct response. If the subject did not imitate the prompt, the experimenter turned away from the subject for approximately 10 sec and then began a new trial. Two sentences were required on each trial before reinforcement. The experimenter continued working on one card until the subject produced two correct sentences before going on to the next card.

A sample trial might proceed as follows: Experimenter: (presents card A1536-7) "What do you see?" Subject: "The girls is . . ." Experimenter: "The girls are. . . ." Subject: "The girls are swinging. The boy is playing ball." Experimenter: "Good" (gives the subject a bite of food).

Baseline repeated. For the next nine sessions, baseline conditions were re-instated for the nine training cards. The cards were presented twice a week and the subject received praise for any response, whether correct or not.

Phase 1 repeated. During the next four sessions, the training method was reintroduced and carried out exactly as in Phase 1.

Phase 2 training. During the next eight sessions, the procedure was similar to Phase 1, except that Brian was now prompted to chain the two sentences for each card by inserting the conjunction "and" between them. This prompt was gradually faded. The change in procedure was designed to teach the subject to produce one compound sentence in response to each card. No reinforcement was given unless Brian included "and" in the appropriate position in the sentence; that is, one correct compound sentence was the condition for reinforcement. Two unchained correct simple sentences were no longer reinforced.

Generalization test. The last session in Phase 2, Session 32, consisted of a generalization test and presentation of training stimuli. All nine training cards were presented, Brian was prompted if necessary, and responses were reinforced as usual. The eight generalization test cards were presented as well. Each generalization test card was presented once. The two sets were interspersed in an unsystematic order. The subject had seen the test cards only during the original Baseline condition. Baseline conditions were maintained during test card presentation. In other words, prompts were not given and praise was given for any response to the generalization test cards, whether the response was correct or not.

Scoring

In Phase 1, the subject was required to produce two complete sentences in response to each card; therefore, two responses were scored on each trial. A correct response was recorded if the subject produced a complete sentence of the required form as listed in Table 1 without prompting. All nouns, articles, verbs, adverbs, and prepositions had to be present and correct, with one exception. Confusion of the words "boy" and "girl" was not scored as incorrect. Brian was unable to make appropriate gender discriminations between boys and girls as illustrated on the cards. Often, the only distinction was hair length. Subject-verb agreement (*i.e.*, *is-are*) was also required.

The production of compound forms was also scored in Phase 1. If any compound form was produced, no correct unchained simple sentences were scored on that trial and the compound form was scored according to the criteria for compound forms used in Phase 2 scoring.

In Phase 2, compound sentence form was trained. If the experimenter gave a prompt for the conjunction "and" on a given trial, no correct compound sentence form was scored on that trial. Both sentences were scored as simple sentences according to the criteria used for Phase 1 scoring. If the subject produced a compound

form, the sentence was scored as a compound. The same criteria for correctness were applied to the component sentences as for Phase 1; that is, all nouns, verbs, adverbs, articles, and prepositions, plus the conjunction "and", had to be present and correct in order to score a correct compound sentence.

Reliability checks were made during Sessions 9 and 32 by the experimenter and the observer recording simultaneously. The experimenter and observer could not see the scores being recorded by one another.

Reliabilities were calculated by dividing the number of agreements by the total number of sentences scored. Reliability during Session 9 was 85% for correct, unprompted responses. Reliability during Session 32 was 100% for these responses. During Session 32, reliability for generalization trials was 100%.

RESULTS

Figure 1 presents per cent of correct, unprompted simple and compound sentences. Per cent of correct responses was calculated by dividing the number of complete, correct responses given by the subject during a given session by the total number of possible responses. Throughout, there were twice as many possible correct, unchained simple sentences as there were possible correct compounds.

During the first Baseline period, Brian never produced any complete sentences either in response to the training and generalization test cards or to the experimenter's attempts to initiate conversation. Moreover, Brian never responded correctly to any of the 10 commands. Although he usually was cooperative and completed the first direction given, he never re-

Fig. 1. Per cent correct, unprompted responses for both simple and compound sentences over the five experimental conditions. Slashed lines indicate the loss of data from Baseline period 2.

sponded to the second sentence in the compound command.

The procedures of Phase 1 produced a marked increase in the percentage of correct unprompted simple sentences in response to the training cards, while the repetition of Baseline conditions produced a large decrement in Brian's performance. Unfortunately, circumstances beyond the experimenter's control made it impossible to collect data for all nine sessions during the repetition of Baseline. However, the limited data from Baseline repetition is buttressed by the orderly re-acquisition of simple sentences in Phase 1 and the decline of correct simple sentences in Phase 2.

Brian's performance on the generalization test cards nearly matched his best performance on the training cards during Phase 2—75% correct, unprompted responses. He had never produced any correct simple or compound forms in response to these cards during the original Baseline period. Table 2 presents the six compound sentences Brian produced during the generalization test in response to the generalization test cards. Six of the simple "and" chained sentences Brian produced were sentences that had not been specifically trained. These six sentences are identified by an asterisk in Table 2. None of the specific combinations of simple sentences Brian produced in response to the generalization test cards had been trained. The sentences presented in Table 2 also evidence the fact that Brian was able to use all four training sentence forms in response to the generalization test cards.

DISCUSSION

The combination of multiple baseline and reversal designs used in this study indicates that training procedures involving modelling, differential reinforcement, and timeout for errors were effective in teaching Brian to use simple and compound sentences. The results of the generalization test showed that Brian correctly used new compound sentences to describe test pictures after he had been trained to produce compound sentences in describing other pictures. This suggests that the training effectively produced a generative language repertoire. Unfortunately, the generalization data are not as conclusive as they might have been. If generalization tests had been given after each phase of training and if, for example, Brian produced new simple sentences to the test cards after Phase 1 and then new compound sentences to the test cards after Phase 2, the generalization results would more clearly indicate that the training was responsible for Brian's production of new, generative sentences.

The present results do indicate that the procedure appears to be an efficient way to teach the use of a variety of sentence forms. Available experimental data often concentrate on training one very circumscribed response at a time. Such experimental procedures allow maximum control and ease of data analysis, but may be relatively inefficient when translated into procedures for use in an applied environment. The procedures presented here produced a large amount of verbal behavior in a short time. The

Table 2
Brian's Responses to the Generalization Test Cards During Session 32

Picture number	Sentence
A1533-9	The boy is reaching* and the boy is pouring water.
A1533-1	The girls are swinging and the boy is walking.*
A1533-12	The boy is feeding the rat* and the boy is watching.*
A1531-4	The boy is pushing the wagon* and the girl is riding the bike.
A1536-3	The boy is holding the candy* and the man is putting the box away.
A1536-6	The girl is riding the bike and the car is coming down the street.
Note—Asterisks indicate simple sentence structures within the compounds that were never specifically trained.	

substantial decrement in Brian's performance at the end of the second Baseline period and the decline of correct simple sentences during Phase 2 suggest that the training procedures were central to the development of the behavior.

In the present study, a relatively low level of performance was used as criterion for changing experimental conditions. Overtraining of simple sentences may have made it more difficult to teach compound structure in Phase 2. The effect of criterion levels on performance has not been systematically studied. It seems reasonable to assume for the time being that optimum criterion levels may best be determined by the behavior of the individual child. Brian appeared to become bored and restless when his performance reached about 75% correct, unprompted responses.

The present results are an addition to work previously cited. Other researchers have trained the productive use of morphemes, such as the plural (Guess *et al.*, 1968; Sailor, 1971). Wheeler and Sulzer (1970) trained a single complete sentence format. Schumaker and Sherman (1970) demanded discrimination among available forms in training the productive use of verbal inflections. The present study demonstrated that these procedures are applicable to the training of several sentence forms simultaneously and that they may produce longer, compound sentences simply by training a child to chain simple sentences using the conjunction "and". Moreover, although not conclusive, the data suggest that the same procedures will result in the productive or generative use of the compound form.

Whether or not differential reinforcement and imitation are important in "normal" development remains an unanswered question. Sherman (1971) offered a good review of the argu-

ments surrounding the issue. As he pointed out, the research cited keeps alive the theoretical possibility that reinforcement and imitation are central to normal development, but it cannot prove the point. Detailed observational and short-term experimental projects of many kinds must be conducted with normal populations before such a position can be argued with certainty.

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