

*OPERANT TRAINING AND GENERALIZATION OF A
VERBAL RESPONSE FORM IN A
SPEECH-DEFICIENT CHILD*

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A subject who spoke essentially in "telegraphic" English, leaving out most articles and auxiliary verbs, was trained to use a particular sentence form that included the articles and verbs to describe a set of standardized pictures. The subject used the trained sentence form to describe the trained pictures, and in addition, use of the sentence form generalized to sets of untrained and novel stimuli. When the trained sentence form was changed, the subject used the new form to describe both training and generalization stimuli. When the original correct form of response was retrained, the subject once again used the trained sentence form to respond to both training and generalization trials.

The problem of training complex language in speech-deficient children is a long-standing one. Recent literature contains many examples of training of relatively simple verbal responses: use of descriptive adjectives (Hart and Risley, 1968); use of the plural morpheme (Guess, Sailor, Rutherford, and Baer, 1968); correct use of personal pronouns and prepositions (Lovaas, 1969); increased frequency of continuous speech (Salzinger, Salzinger, Portnoy, Eckman, Bacon, Deutsch, and Zubin, 1962); imitation, labelling, and simple answers to questions (Risley and Wolf, 1964), and many studies cited by Peterson (1968) on imitative verbal behavior. Little work has been done, however, on developing complex forms of verbal responding, such as the development of syntax or sentence structure, including the correct use of articles, appropriate verb endings, and word order. A possible reason for the paucity of experimental studies on complex language is the difficulties encountered when trying to observe and reliably measure such responses. The present study attempts to demonstrate a procedure for the training of complex language, to show the generalizability of the acquired complex response, and to present a reliable measuring system for the use of a particular sentence form.

Although linguistic development has been an area of concern for some time, according to Guess *et al.* (1968), most recent efforts have focused primarily on theory with few attempts to analyze language development functionally. Linguists have made use of the concept of "generative" language to account for the fact that an organism exhibits ". . . more behavior exemplifying the dimensions of his experience than that experience has taught directly to him." (Guess *et al.*, 1968, p. 297). To the behavioral psychologist, the linguist's use of generative language is probably analogous to the terms generalized or functional response classes. A generalized response class exists when all responses in the class show an effect of a manipulation (*e.g.* extinction or differential reinforcement) which is made in relation to only a few members of the class. If this is indeed the case, then environmental intervention could have a great effect upon the development of generative language. By analyzing generative language in terms of functional response classes, the growing body of knowledge and techniques available to behavioral psychologists can be brought to bear on the analysis of the development of normal language as well as upon the modification of problem language behavior (Salzinger, 1968).

Several studies have appeared in the recent literature in which imitative responses seem to form functional response classes (Baer, Peterson, and Sherman, 1967; Metz, 1965; Lovaas, Berberich, Perloff, and Schaeffer, 1966; Peterson, 1968; Brigham and Sherman, 1968). In these studies, several responses were rein-

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forced while, typically, a few never-reinforced responses were interspersed. The general findings seemed to be that the non-reinforced responses improved along with the reinforced ones. When a manipulation, such as extinction or differential reinforcement of other responses (DRO) was made on the previously reinforced responses, a decrement in responding was seen with all responses, thus apparently demonstrating a functional response class.

Much of language other than imitative responses can be at least theoretically analyzed in terms of the response class model. In addition to attacking some of the applied problems mentioned above, the present study was very similar to the Guess *et al.* (1968) analysis of morphology, but with the analysis applied instead to syntax. In the present study, a subject who spoke essentially in "telegraphic" English, leaving out most articles and auxiliary verbs, was trained to use a particular sentence from that included the articles and verbs to describe a set of standardized pictures. The basic training consisted of combining labels that had already been present in his repertoire, in order to teach him the use of grammatically correct sentences, all of which included subjects, predicates, and objects. The training procedure used was a chaining paradigm similar to that used by Risley and Wolf (1967). An attempt was also made to demonstrate the generalization of this form of response to a set of pictures that were never trained or reinforced, demonstrating the development of a functional response class or generative language.

METHOD

Subject

Tod was an 8-yr-old boy who had previously been echolalic, and had carried various diagnostic labels: brain damage, autism, and retardation. After 2 yr of speech training, Tod was no longer echolalic, and he had gained a verbal repertoire consisting mostly of a large number of one-word tacts, simple mands, and some fragmentary answers to questions. He had never been observed to use a complete sentence of the type trained in this study and had very little spontaneous speech. While he was no longer echolalic, imitative responses could easily be occasioned with the appropriate discriminative stimuli (S^Ds). Such S^Ds,

for example, might have consisted of the experimenter instructing Tod to repeat or the experimenter assuming a particular tone of voice. Simultaneous with the study, Tod was attending a special education class where activities included training in academic skills and social skills, and some informal language training.

Setting

The study was conducted in a large therapy room connected via one-way mirror and intercom to an observation area. Tod and the experimenter sat facing each other, next to a large table on which were kept some of the reinforcers and objects to be used in the study. Other reinforcers were scattered about the room within Tod's sight but out of his reach.

Materials

The stimuli consisted of thirteen 7 by 9-in. (17.8 by 22.8 cm) picture cards from Levels #P and #3 of the Peabody Language Development Kit (American Guidance Service Inc., 1967). Appropriate descriptions of the 13 pictures used, along with their numbers, are shown on the sample data sheet in Table 1. Seven of the cards, which could be adequately described by a particular form of sentence, Form I, were selected for use throughout all experimental phases. A Form I sentence was defined as including the article "the" followed by a noun subject, followed by a verb phrase consisting of the auxiliary verb "is", followed by a present participle, followed by an object phrase consisting of the article "the" and a noun object. Each sentence was thus divided into three components. The subject phrase ("the man") was the initial component, the verb phrase ("is smoking") was the middle component, and the object phrase ("the pipe") was the terminal component.

A second sentence form, Form II, was also defined. Form II consisted of the same key words presented in the same order as in Form I, but omitting the article "the" and the verb "is". Thus, an example of a perfect Form I response is, "The man is smoking the pipe". For the same stimulus card, a perfect Form II response is, "Man smoking pipe".

Of the seven cards selected, five (P-4, P-6, A-3, A-6, and A-7) were used for training. The training cards were selected on the basis that a Form I sentence would be an appropriate

Table 1
Sample Data Sheet

Card #	Response		
	Initial	Middle	Terminal
P-1	The baby	is taking	a (the) bath
P-2	The boy	is putting on	his (the) shirt
P-4	The man	is smoking/is sitting	a (the) pipe/in the chair
P-5	The lady (woman)	is talking	on the telephone
P-6	The lady (woman)	is washing	the dish
P-7	The girl	is combing	her (the) hair
P-11	The man	is riding	on the tractor
P-18	The teacher (lady)	is writing	on the chalkboard
A-3	The boy	is emptying	the garbage (can)/the trash
A-6	The boy	is painting	a (the) picture
A-7	The girl	is opening	the window
A-19	The girl	is swimming	in the water
A-21	The boy	is washing	the car

description of each. Two cards (P-7 and A-21) were selected for generalization trials on the same basis, but with an additional criterion. The additional criterion was that without any training Tod had emitted the key words in response to the presentation of the cards. Key words for these two cards were: boy, girl, combing, washing, hair, and car. The reason for this additional criterion was that there was never to be any prompting or reinforcement given for responses to these two cards, and if the form of response was to generalize, the necessary vocabulary would have to be already present in Tod's repertoire. The remaining six cards, the test cards, were to be presented only during the first baseline phase of the experiment and during the last part of the final phase. This was done in order to test for generalization to stimuli to which Tod had relatively little exposure. Four of these cards were of a slightly different form than the others. They ended in a prepositional phrase rather than in a direct object.

Scoring

Scoring of responses was done on the data sheet shown in Table 1. The sentence was divided into three components with a score of one point possible in each component, giving a possible total of three points per sentence. The correct Form I responses are shown on the data sheet. As Tod responded to each presentation of a card, each component was marked as correct if his response conformed to the Form I response shown. In order to receive a point for any component, all articles and endings had to be present and

key words correct. Any omission (e.g., "The man/smoking/the pipe") or error in key word resulted in the loss of a point for that component only (the middle one in this case). Per cent correct for either form of response per session was tabulated by dividing the number of points earned by the number of points possible during that session. Since cards were presented twice per session, the per cent correct for each session was based on a total of 30 possible points for the training cards and 12 possible points for the generalization cards. The six test cards, when used, were presented only once per session, and thus per cents for these cards are based on 18 possible points each session. Per cent correct Form I responses were tabulated throughout the experiment. On the five cards ending in a prepositional phrase, scoring was the same as for the other cards, except that a point was given for the terminal component only if Tod said the prepositional phrase the way it appears on the sample data sheet.

All scoring of responses was done directly on the data sheets by the experimenter. Seven reliability checks were made during the first and second baseline phases, during the first and third Train Form I phases, and during the Train Form II phase. Three of the checks were taken by an observer scoring simultaneously with the experimenter from behind the one-way mirror. The other four checks were made from an audio tape of the session by a third observer. Reliabilities were calculated by dividing the number of agreements by the total number of components scored. There were 60 components when the test cards were

being used, and 42 components when these cards were not used. The three live checks yielded agreements of 88, 94, and 90%. The tape checks yielded agreements of 97, 95, 98, and 100%.

Procedure

The experimental manipulations took place during the first 10 min of each 30-min speech training session. Sessions were held four days a week. Other tasks taking place during the sessions included training in the use of pronouns and prepositions, and teaching answers to personal identity and social amenities questions, and recall of morning activities and events. Reinforcement during all types of training consisted of the immediate presentation of tokens (poker chips). When four tokens were accumulated, Tod was allowed to count them out into the experimenter's hand in order to gain access to one of several toys in the room, have something to eat, or be tickled or rocked by the experimenter. Each back-up reinforcement period lasted for 30 sec, after which work was resumed.

Baseline. During the first four sessions, all 13 cards shown in Table 1 were presented in the order shown. The experimenter presented each card by holding it up and saying only, "What do you see?" No other instructions were given and no reinforcement was available.

Train Form I. During these five sessions, Tod was trained to use the Form I response on the five training cards. The Form I response was treated as a three-component chain. The correct completion of each component was the S^D for the beginning of the next, and completion of the terminal component resulted in the delivery of reinforcement. Thus, following the S^D , "What do you see?" if Tod failed to use Form I in any component of his response, he was stopped and given an imitative prompt for the missed component. He was then required to emit the Form I response before he was allowed to go on to the next component or to receive reinforcement. Reinforcement always occurred after the terminal component was completed, whether prompts had been used or not. However, each component of the response was scored correct only if it occurred without prompting. Thus, an example of a typical training sequence might have proceeded as follows: The experimenter: "What do you see?" Tod: "The man/smok-

ing." The experimenter: "Is smoking," Tod: "Is smoking/the pipe." The experimenter: "Good" (delivers token). Such a sequence would have received a score of two points, one each for the initial and terminal components. No shaping by successive approximations was ever used in the training. Imitative control over Tod's verbal responses was good enough that an imitative prompt delivered after a wrong response, as in the above example, reliably occasioned the correct response. Because this imitative control was so good, it was also never necessary to move the delivery of reinforcement forward in the chain of responses. From the beginning of training, reinforcement was always delivered after completion of the entire chain immediately following the terminal component. In the early stages of training, of course, extensive prompting was necessary, but the scoring system allows for reflection of the prompting in the data. As the procedure was set up, every time a card was presented, a full correct response occurred, sometimes prompted and sometimes not prompted.

The two generalization cards were presented throughout this phase, but without any prompting or reinforcement. Thus, baseline conditions were maintained with these two cards throughout the phase. During each session, the five training cards were presented in the order shown in Table 1. This was followed by the presentation of the two generalization cards. Then, the whole sequence was repeated for a second set of trials.

Baseline repeated. For the next six sessions the original baseline conditions were reinstated for all seven cards.

Train Form I repeated. For the next seven sessions there was a return to the original Train Form I conditions for the five training cards, with no change in conditions for the two generalization cards.

Train Form II. The next five sessions consisted of training the Form II response to the five training cards. Here Tod was prompted, and reinforcement was delivered, for leaving out all articles and auxiliary verbs. Except for the form of response, the training procedure was the same as during Train Form I. There was no change in conditions during this phase for the generalization cards.

Train Form I repeated. The final phase of the experiment, lasting 11 sessions, was a re-

turn to the original Train Form I conditions for the training cards with no change for the generalization cards. In addition, during Sessions 35, 36, and 37, the six cards that had not been presented since the original baseline were presented as a post-test without any prompting or reinforcement.

RESULTS

Figure 1 shows the per cent correct for the Form I response to both training and generalization stimuli through all phases of the experiment. With both training and generalization cards, correct Form I responses progressed from a range of 7% to 33% during baseline to 83% and 100% respectively by the fifth session of Train Form I. The next two manipulations, however, produced little effect. The Train Form II manipulation produced a large and rapid drop in the use of the Form I response, but recovery of the use of Form I on both training and generalization cards was rapid upon return to the Train Form I condition. From the end of the second baseline onwards, Form I responding on the generalization cards was consistently lower

than that on the training trials, although it had originally been higher during the first baseline. For the six test cards, performance improved substantially as evidenced by the mean of 21% Form I responses during baseline and the mean of 67% Form I responses at the end of the experiment. Table 2 shows

Table 2

Mean per cent correct in each component for test cards during Baseline and last train from I Condition.

Component	Baseline	Train Form I
Initial	0	72
Middle	0	89
Terminal	58	39

the mean per cent correct for the individual components of these test cards during the two conditions. As can be seen from the table, Tod never made a correct response for the first two components during baseline, but at the end of the experiment most of the correct responding occurred in these two components, while errors increased somewhat in the terminal component.

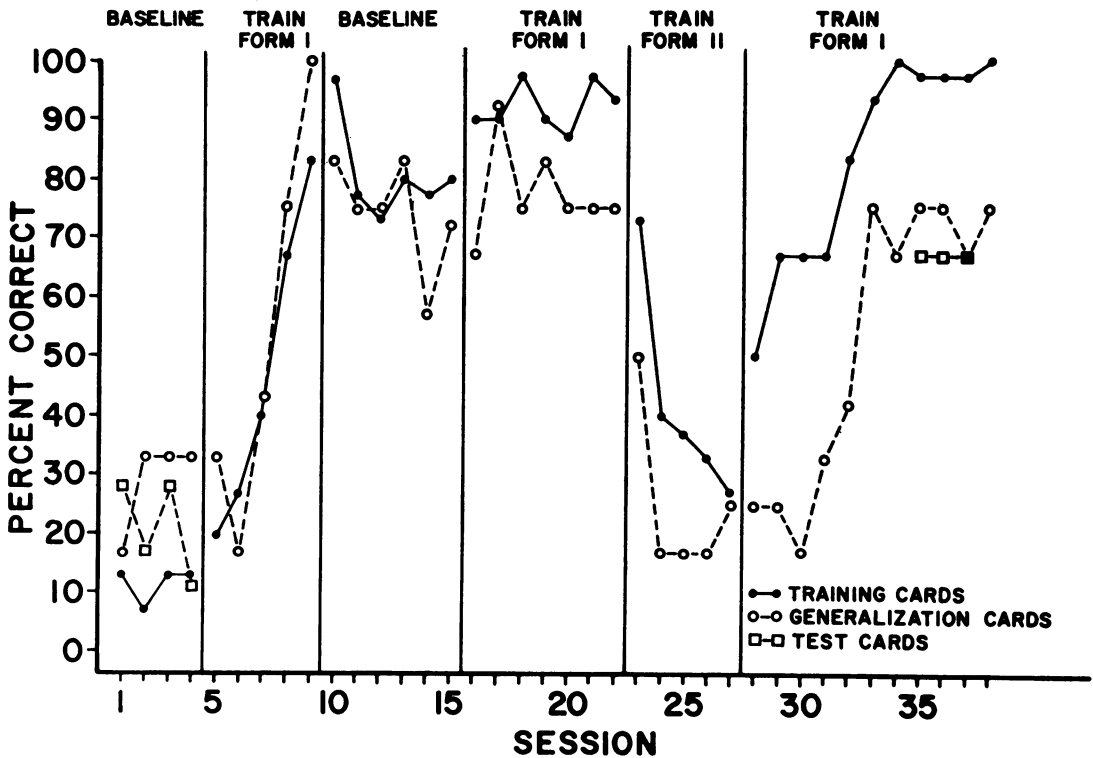


Fig. 1. Per cent correct Form I responding for six experimental conditions. Form I is the long form of response, e.g., "The man is smoking the pipe."

Figure 2 shows the acquisition of the Form II response during Train Form II, while Figure 1 showed the decrease in Form I responding. Although Forms I and II are mutually exclusive, these two response forms are not exhaustive. Other errors, such as incorrect verb forms, would lower the per cent correct for both forms of response. For instance, if Tod said for card #P-4, "Man/smoke/pipe," the middle component would have been incorrect for Form II as well as for Form I. Thus, the acquisition of Form II responding could not be inferred from Figure 1. Per cent Form I responses emitted during the last session of the second Train Form I manipulation was 93% and 75% respectively for training and generalization cards. Therefore, per cent use of Form II during that session could have been no greater than 7% and 25% respectively, given mutually exclusive forms of response. The 25% and 50% respective levels of Form II responding on training and generalization cards in the first session of Train Form II represent a considerable rise in the use of this form over what had obtained in the previous session. During the five sessions of Train Form II, correct Form II training card responses increased steadily, but the generalization cards showed a rise and subsequent decrease in the use of the Form II response. As was noted above, however, the level of Form II responding on the generalization cards, despite its variability, was considerably higher than it had been under the previous experimental condition.

In Figure 1, the components of the sentence are averaged, thereby in some cases cancelling out the effects of changes in individual components. Figure 3 breaks these down and shows per cent correct Form I responding by component. The data show large variations from component to component during any given manipulation. In the generalization trials, the use of Form I in the middle component is consistently higher than in the initial component. The initial component in turn is consistently higher than the terminal component. In the training trials there is no obvious ordering of components by per cent correct Form I responding. The terminal component shows the least variability from manipulation to manipulation, maintaining a high stable level of correct Form I responding regardless of experimental phase. It was in the

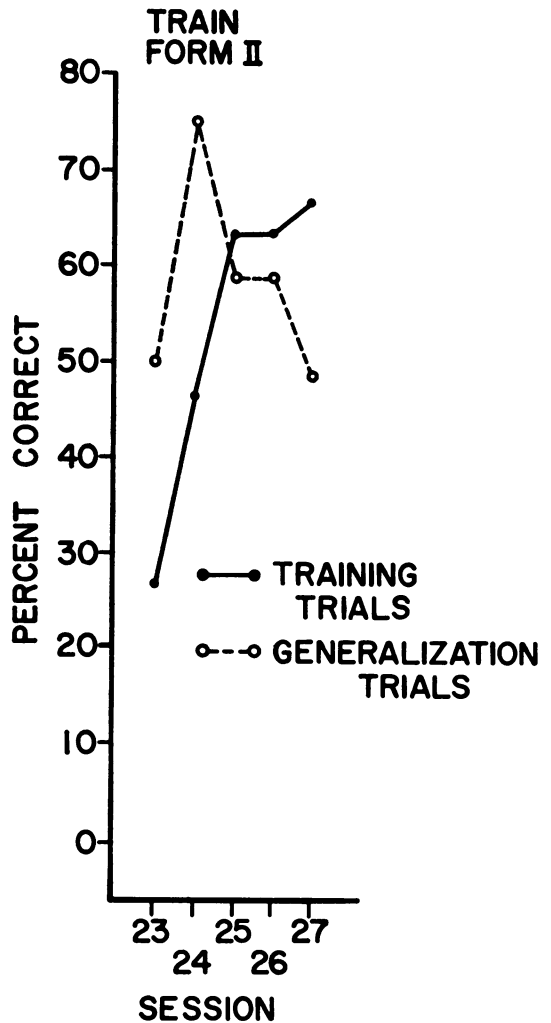


Fig. 2. Per cent correct Form II responding in Train Form II. Form II is the short form of response, e.g., "Man smoking pipe."

terminal component also that the generalization trials showed the least effect of the manipulations. From the middle of the second baseline to the end of the experiment, Form I responding in the generalization trials seldom varied from 50% in the terminal component. The other two components show much clearer effects of the manipulations in both training and generalization trials. The middle and initial components accounted for most of the effects seen in Fig. 1. While Fig. 1 showed little change in Form I responding in generalization trials from second baseline to second Train Form I, some change is evident on these trials in the middle and initial components in Fig. 3.

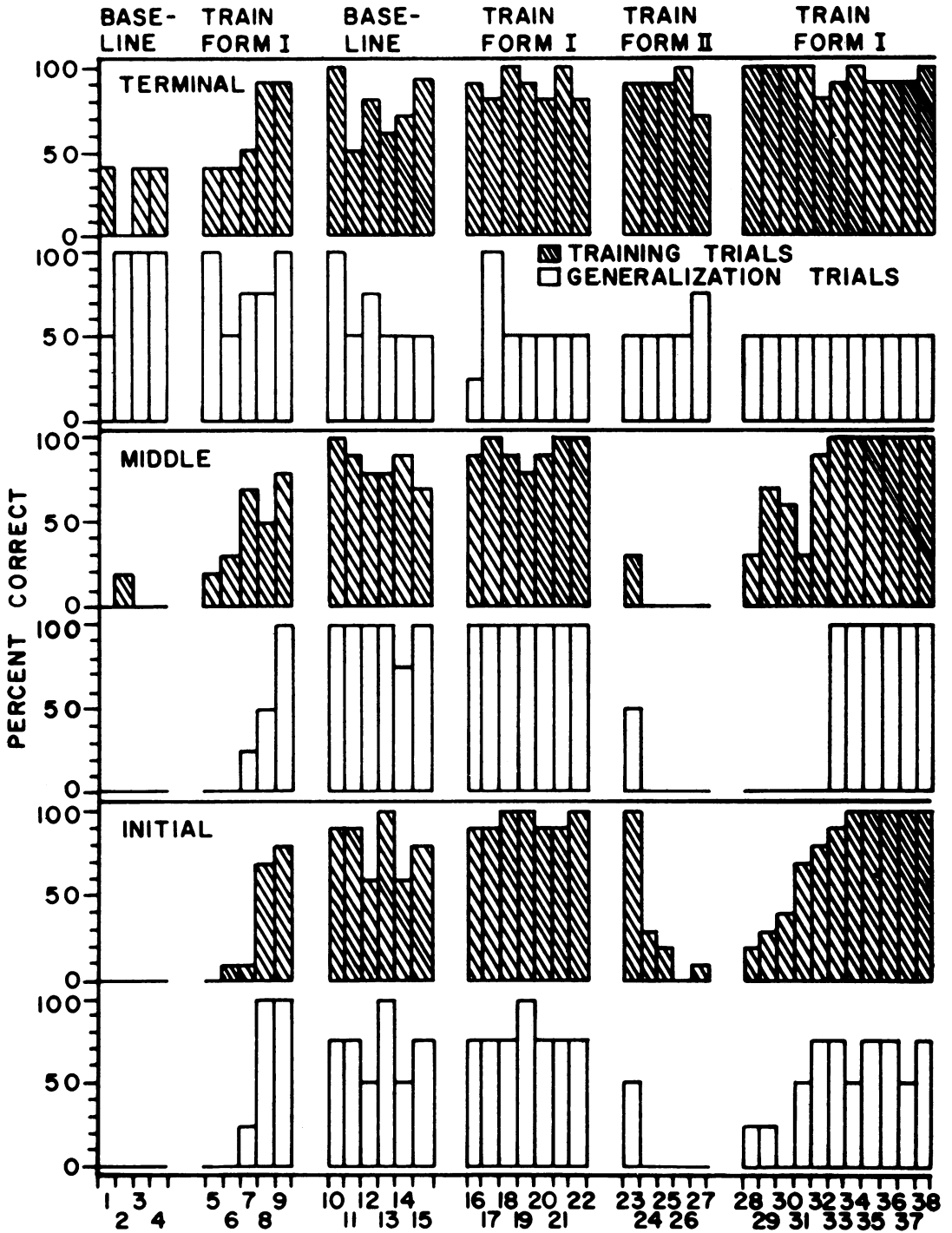


Fig. 3. Per cent correct Form I responding by component for six experimental conditions.

DISCUSSION

The results of this study demonstrated that a complex verbal response could be trained in

a speech-deficient child. The response was measured with an acceptable level of reliability, and the response generalized to untrained and novel stimuli. The large reversal

and concurrent acquisition of Form II during Train Form II demonstrated that the training procedures, a combination of chaining, imitative prompting, and differential reinforcement, were the crucial factors in the development of the response. The generalization responses showed many of the same variations as the training responses, but generalization responding was consistently at a lower level of accuracy than training responding for most of the experiment. One reason for the comparatively lower level of generalization responding was that some consistent error patterns that were never corrected developed in these trials. For instance, on card #P-7, Tod almost always said, "The girl is combing *my* hair." This response caused a point to be lost in the terminal component, the primary reason for the low level of accuracy in this component shown in Fig. 3. Another possibility is that Tod formed a discrimination between reinforced and unreinforced stimuli, since the cards were always presented in the same order and the same cards were always reinforced. This possibility, however, would have worked against the results obtained, and thus would not seem to detract from the significance of these results.

Changes in training and generalization card responses corresponded throughout the manipulations made in the study. The data on the test cards offered further evidence that the response did generalize to stimuli to which Tod had had relatively little exposure. Since some of the test cards ended in prepositional phrases, one could argue that earlier preposition training had contributed to the improvement shown in Fig. 1. However, examination of the individual component data demonstrated that all of the improvement occurred in the first two components. The terminal component, the one containing the prepositional phrase, actually showed a decrement in performance. Thus, the improvement on the test cards could in no way be attributed to preposition training.

Since the response was rapidly developed to stimuli with which training had been given and to stimuli with which no training had been given, it can be said that a functional response class or generative language had developed. The training involved no new vocabulary for Tod, only the way in which the words already in the repertoire were com-

bined. Thus, it was the form of the response, or syntax, that was trained, and the response class that developed was not a new set of labels for the stimuli but a new combination of old labels. As can be seen from Fig. 3, during baseline Tod never had emitted an entire Form I sentence. During the last phase of the experiment, he emitted several Form I sentences in response to training, generalization, and test cards.

Whereas Guess *et al.* (1968) demonstrated the role of imitation and differential reinforcement in the development of a morphological response, the present study extended the analysis to a syntactic response. As Guess *et al.* point out, such a demonstration does not show that all generative language develops in the manner that it developed in the present experiment. Such an experiment is of primary value in demonstrating the feasibility of producing generative language with the techniques presented. Perhaps the most significant point to be gained from the present study, and from earlier studies analyzing language in terms of functional response classes, is that every response that is eventually learned does not have to be directly trained.

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