*STIMULUS FACTORS IN THE TRAINING OF PREPOSITIONAL
USAGE IN THREE AUTISTIC CHILDREN*

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Language deficient, autistic children were trained to use the prepositions "in" and "on". Three subjects were exposed to conditions of training that differed in the method of employment of stimulus objects used to train prepositional usage. Two subjects were trained first with "ambiguous" stimuli, that is, the same stimulus objects were used for training both prepositions. The two subjects were then switched to a training condition with "non-ambiguous" stimulus objects, that is, objects used for training "in" were different than those used for training "on". The two subjects were then switched to the ambiguous stimulus condition and finally returned again to training with non-ambiguous stimuli (four conditions). A third subject began with training on non-ambiguous stimuli, was switched to an ambiguous condition and was then switched back to non-ambiguous stimuli (three conditions). The results for two of the three subjects indicated that accurate usage of the two prepositions was obtained only under training conditions with non-ambiguous stimuli. Results for the third subject suggested that initial training with non-ambiguous stimuli might enhance subsequent accurate responding with ambiguous stimuli.

The application of operant conditioning procedures to the study of language training with disadvantaged children has produced a growing body of research in recent years. Hewett (1965), Risley (1966), and Lovaas (1967) demonstrated procedures for training autistic and schizophrenic children in the basics of functional speech usage, relying on imitation as a catalyst for speech development. Evidence for an experimental acquisition of speech vocabulary and limited speech usage, using an imitation and differential reinforcement model, has accrued from these and other studies with various types of language-deficient children. The process by which children acquire accurate grammatical and syntactic usage is less well understood, but it is at least apparent that not all responses that are eventually learned need be directly trained.

Guess, Sailor, Rutherford, and Baer (1968), Guess (1969), and Sailor (1971) extended the reinforcement paradigm somewhat in experimentally analyzing grammatical speech usage by concentrating on aspects of pluralization as a linguistic class. Wheeler and Sulzer (1970) initiated an operant analysis of syntax by using imitation and reinforcement procedures to train a child to use complete sentences in responding to a set of pictures. Similarly, Schumaker and Sherman (1970) further extended the learning theory model in language development with an analysis of generative use of verb inflections (past and present tense) using reinforcement and imitation procedures with three retarded children.

Although prepositions as a linguistic class have yet to be analyzed experimentally, Bereiter and Englemann (1966) prescribed a program for teaching disadvantaged children prepositions both productively (expression) and receptively (comprehension). They supplied, however, no research evidence on the relative efficacy of their method. Lovaas (1966; 1967) discussed an operant procedure for training

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Fig. 1. Mary Lou's performance expressed as a percentage of correct responses during each experimental session over the four conditions. The solid line represents performance in training "in"; the broken line, performance in training "on". Conditions I and III show performance in training under ambiguous stimuli: Conditions II and IV show performance under non-ambiguous stimuli.

schizophrenic children in prepositional usage utilizing a spatial arrangement of objects on a table and requiring expression of the correct relationship (*e.g.*, "The book is on the table.") for reinforcement. The child is concurrently trained on comprehension (*e.g.*, "Put the book on the table.") and finally tested for generalization to novel objects.

The present study was designed to examine the acquisition of prepositional usage by speech-deficient, autistic children under two stimulus conditions. The choice of mode of stimulus presentation as a variable grew out of our observation that autistic children seemed to attach particular responses to discrete linguistic stimuli (pictured objects or spoken words) and could generalize only within the particular stimulus class used in their training. For example, a child could be trained to put objects under a table but could not generalize his training to put the

same objects under a chair *etc.*, yet he could accurately differentiate "chair" from "table" in different linguistic contexts. Whether or not this reflects a problem peculiar to the autism syndrome remains in doubt from experiments in perception and discrimination learning with this diagnostic group. The only conclusion that can be put forward with any certainty is that autistic children seem to differ from other disadvantaged groups and preschool children on an ability to integrate and process information from various sense modalities (Hermelin and O'Connor, 1970).

Based on the observation that stimulus specificity seemed to determine generalization within a linguistic response class, it was hypothesized that the acquisition of prepositions would in part be determined by stimulus specificity. Thus, under "ambiguous" stimulus conditions (same stimuli for two different prepositional responses)

Fig. 2. Jim's performance during the four experimental conditions as shown for Mary Lou in Figure 1.

autistic children should require more trials (or fail to learn) when trained on prepositional usage than would be reflected in their performance under "non-ambiguous" stimulus conditions (different stimuli for two different prepositional responses).

METHOD

Subjects

Three children were selected from a group of 12 who had been diagnosed autistic and referred to a day care treatment program for autistic children. The criteria for diagnosis were the same as summarized by Ward (1970), and included failure to develop communicable speech, presence of bizarre or ritualistic behavior, and failure to form responsive relationships with other human beings. All three subjects were untestable by any psychological methods at the time of admission.

Mary Lou was a 7-yr-old girl who had developed some echolalic speech at the time the experiment was begun, but could not form complete sentences; she had a very restricted vocabulary. Jim was a 5-yr-old boy who had been admitted a year prior to the experiment without any language sounds in his repertoire. Through his participation in a language development program (Sailor, 1970), he had been brought to a level of speech proficiency sufficient to begin the experiment.

Don was a 5-yr-old boy who also had no speech at the time of his admission and who had also acquired sufficient linguistic skills (*e.g.*, labelling, sentence imitation), over an eight-month training period, to enable his participation in the experiment. Briefly, this language training program consisted of an imitation-reinforcement procedure that began with reinforcement of imitative vocal responses. The procedure then continued word shaping with imitation and reinforcement, through imitation of short sentences, and finally, non-imitative labelling of objects and pictures. Thus, all three subjects at the time of the experiment had limited vocabularies of responsive speech, sel-

dom initiated speech, demonstrated no correct usage of any grammatical rule, and were not conversational. Although all three subjects demonstrated compliance with simple instructions such as "Sit down" and "Turn around" at the beginning of the experiment, none were capable of expressing correct prepositional usage, of complying with any prepositional instruction such as "Put the book on the table", or of using prepositions accurately in response to questions such as "Where are you?" or "Is the book on the table?"

Procedure

All three subjects began the experimental procedure with reinforcement training to establish use of the prepositions "in" and "on". The subjects participated individually in sessions that lasted about 15 min each and occurred twice daily, once in the morning and once in the afternoon. Each subject sat at a table opposite his experimenter in a soundproof room, connected by a one-way mirror and intercom system to an adjoining observation room. Various reinforcers (bits of food that had demonstrated reinforcing value for the particular child in previous language training work) were placed behind a partition near the experimenter but out of the subject's sight. Reinforcement consisted of a bit of food coupled with verbal praise from the experimenter.

Stimulus objects for training consisted of a red felt circle 2 in. (5 cm) in diameter, an empty tin can, a toy hat, a small pail, a plate, a chair and a 4-in. (10-cm) square box. All three subjects were pretrained to point reliably to and label hat, can, box, plate, pail, and chair using a training procedure described by Sailor, 1970. To train usage of the preposition "in", the experimenter placed the circle either in the hat, can, box, or pail and said, "Where is the circle?". A reply of "*in* the hat" (or "*in* the box," *etc.*), produced reinforcement and a shift to the next trial. An incorrect response (either wrong preposition, no response or wrong object named) produced a "no" from the experimenter and a

15-sec timeout followed by the experimenter stating the correct relationship (not reinforced if imitated by the subject) and moving to the next trial. The procedure for training "on" was exactly the same using plate, chair, hat, or can, depending upon which condition of the experiment the subject was undergoing. Throughout the experiment, each correct response was reinforced.

The subjects' training occurred under a series of experimental conditions that were defined in terms of stimulus ambiguity. Thus, in the ambiguous stimulus condition, the subject was trained to use both "on" and "in" with the same stimulus objects for both prepositions. Hat and can served as the ambiguous stimulus objects. For "on", the hat and can were turned upside down on the table and the circle was placed on top. For "in", the objects were positioned normally and the circle placed inside in full view of the subject. An effort was made to ensure that the subject's attention was focused on the objects at all times before responding, by noting direction of gaze, eye contact, *etc.* In the non-ambiguous condition, the subject was trained to use the two prepositions with pail and box in the normal upright position for "in", with the plate and chair serving as stimulus objects for "on". Two of the subjects began training with the ambiguous condition; the third began training with the non-ambiguous condition

to control for effects or order of exposure. The procedure was reversed after performance had stabilized to assess the effect of the two types of stimulus employment. Thus, Mary Lou and Jim began with ambiguous stimuli in Condition I, switched to non-ambiguous stimuli in Condition II, reverted to ambiguous stimuli in Condition III, and reverted to non-ambiguous stimuli in Condition IV. Don began with Condition II and proceeded through Conditions III and IV.

Throughout the experiment, the three subjects were given sessions (twice daily) with 20 trials per session presented in random order, 10 trials for each preposition. The criterion for shifting from one condition to the next was based on stability of performance. Thus, either a minimum of at least five sessions with 90% accuracy or a stable low percentage correct, indicating a minimum likelihood of accelerated performance, produced a shift.

Table 1 presents the order of conditions for the three subjects with type of stimulus presented during each condition.

RESULTS AND DISCUSSION

Reliability of measurement was ascertained by having the experimenter, a child-care worker, spot checked by another child-care worker (in the observation room) for agreement on the

Table 1
Order of conditions for the three subjects with stimulus objects used for training the two prepositions in each condition.

<i>Subjects</i>	<i>Condition</i>	<i>Procedure</i>	<i>Stimulus Objects</i>
Mary Lou Jim	I	Training with ambiguous stimuli	IN-Hat, Can ON-Hat, Can
Mary Lou Jim, Don	II	Training with non- ambiguous stimuli	IN-Pail, Box ON-Plate, Chair
Mary Lou Jim, Don	III	Training with ambiguous stimuli (reversal)	IN-Hat, Can ON-Hat, Can
Mary Lou Jim, Don	IV	Training with non- ambiguous stimuli (reversal)	IN-Pail, Box ON-Plate, Chair

Fig. 3. Don's performance during the three experimental conditions to which he was exposed as shown for Mary Lou in Figure 1. Don did not receive Condition I.

prepositional responses and on object labels. With all three subjects, spot checks on reliability of scoring "in" and "on" showed no disagreements. Reliability measurements were taken on 20% of the sessions for each child. All three subjects had learned by imitation carefully to articulate "in" and "on" from the outset of the experiment and provided no problem for observer-experimenter discrimination.

Figure 1 displays Mary Lou's performance during the four conditions in terms of accuracy of prepositional responses. Her performance in response to ambiguous stimuli of Condition I (hat and can) stabilized at about chance discrimination level. Under the two separate pairs (non-ambiguous) of stimuli in Condition II, she achieved a 100% discrimination on both prepositions in seven sessions. Upon return to the ambiguous stimuli of Condition III, her performance reflected a strategy of focusing upon "in", with "on" falling to a low rate. A return to non-ambiguous stimuli in Condition IV produced an immediate return to 100% accuracy of discrimination.

Figure 2 presents Jim's data for the four conditions. His performance was essentially equivalent to that of Mary Lou except that Jim required more trials to stabilize under each of the conditions.

Figure 3 presents Don's data for the three conditions to which he was exposed. Don began the experiment with training on the non-ambiguous stimulus objects (Condition II) and underwent two reversals. His performance showed the characteristic rapid discrimination under Condition II but failed to show a significant breakdown of the discrimination under Condition III.

There were no omissions of nouns or errors of labelling nouns for any of the three subjects. The data from Mary Lou and Jim suggest that learning occurs more rapidly when separate stimulus objects are used in training differential usage of several prepositions. Don's data, however, suggest that initial training with non-ambiguous stimuli may facilitate later differen-

tiation when ambiguous stimulus objects are presented. There can, however, be no certainty as to whether Don's data were a result of the order of his training conditions, or if his performance simply characterized him as a unique subject.

Any statement as to whether these results are characteristic only of autistic children or pertain to all language deficient children must await replication with other subjects. In any event, the data point to the hypothesis that accurate usage of a linguistic class may be trained rapidly when separate stimuli are initially employed in training separate elements within the class. This hypothesis has a particular relevance for the training and education of exceptional children.

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