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# Variables controlling generalized imitation in preschool children

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# VARIABLES CONTROLLING GENERALIZED IMITATION IN PRESCHOOL CHILDREN

by

EFFIE KYMISSIS

A dissertation submitted to the Graduate Faculty in Psychology in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.

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Abstract

VARIABLES CONTROLLING GENERALIZED IMITATION

IN PRESCHOOL CHILDREN

by

Effie Kymissis

Adviser: Professor Claire L. Poulson

The purpose of the present study was to determine the extent to which the generalized imitation paradigm applies to the vocal imitation of preschool children. Five normally developing male preschool children between 3 and 5 years of age served as subjects in a multiple-baseline across-subjects with an embedded repeated-reversal within-subjects experimental design. The multi-response apparatus used was a computer screen that displayed a five-paneled table top, with each panel containing a colored push button. The children's non-reinforced preference for Matching versus Non-Matching vocal responding, Listening, and Waiting during baseline conditions was compared to the children's non-reinforced preference for the same activities during the reinforced-imitation conditions. It was found that for three subjects the introduction of the reinforced vocal imitation condition in the middle panel resulted in a systematic increase of the side-panel matching choice, but

not of the other three choices. The results support the conditioned reinforcement hypothesis regarding generalized imitation. To the extent that generalized imitation has been demonstrated to be a functional response class, it is a robust concept in the account of the acquisition of language and social skills in children.

## Acknowledgements

This dissertation could not have been made possible without the continuous guidance and emotional support of my advisor Dr. Claire L. Poulson, whose dedication to quality research and never ending enthusiasm for hard work provided me with a model to imitate in my professional life. Her faith in my abilities and her continuous encouragement gave me the confidence to pursue my goals. Her sensitivity and understanding made it possible for me to complete my graduate studies while being a mother of three children.

When I entered the doctoral program my family life had to go through major changes. I would like to thank my beloved husband, Paul, for accepting our new way of life and for standing by me during the difficult times. I would like to thank each one of my wonderful children Anna, John, and Harry for becoming independent and responsible individuals while I was preoccupied with my work.

Finally, I would like to thank the students I have closely worked with during the past five years in Dr. Poulson's Infant Laboratory at Queens College. Their fellowship made the work a lot of fun and I will treasure their friendship forever.

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Most learning theorists have assumed that imitation plays some role in the linguistic and social development of children. Specifically, it has often been held that imitation can account for the rapidity with which children develop social and language skills (Bijou & Baer, 1965, 1978; Guess, Sailor & Baer, 1974; Schumaker & Sherman, 1978). In the history of learning theory, however, the processes underlying imitation have never been completely understood. Over the years, several diverse definitions of imitation have been proposed and different theories have been formulated to explain how imitation may account for the language-acquisition process (Kymissis & Poulson, 1990). Specifically, some theorists such as Thorndike (1911), Woodworth (1918) and Watson (1919) supported a nativistic view of imitation that retarded further study of the phenomenon as a learned process. Other investigators such as Humphrey (1921), Allport (1924), Dashiell (1928) and Holt (1931) thought that imitation involved conditioned reflexes. Imitation was explained according to the Pavlovian conditioning model, but this interpretation could not explain the selectivity of imitation nor how an activated imitative reflex ever stops. In contrast, Miller and Dollard (1947) relied upon the instrumental conditioning paradigm to analyze such submechanisms of imitation as matched-dependent behavior and copying. They were criticized, however, for studying discrimination rather than imitation. Mowrer (1960) used the phenomenon of secondary

reinforcement to offer his autistic theory of imitation and a new description of the first-language acquisition process. According to Mowrer, the human infant repeatedly hears the caregiver's voice paired with such reinforcers as warmth, food and comfort. Thus, the caregiver's vocal stimulus becomes a secondary reinforcer for the infant. According to Mowrer, when the infant produces a similar vocal stimulus it automatically reinforces itself, and consequently increases the use of the caregiver's sounds. "Imitation, as thus interpreted, becomes a sort of automatic trial-and-error process, one that is dependent upon reward from another organism, or `parent person,' only in an indirect, derived sense" (Mowrer, 1960, p.73).

Mowrer's theory was extended by Risley (1966, 1977) who followed an operant conditioning paradigm to further emphasize the role of environmental contingencies in imitation. According to Risley, the caregiver's vocal stimuli that are approximated by the infant may be only weak secondary reinforcers. Additional primary reinforcers applied by the caregiver for infant vocalizations may be needed to support a sufficiently high level of vocalization so that the weak secondary reinforcers of the infant's autistic imitation can shape more adult-like sounds by the infant.

Baer and Deguchi (1985) extended Risley's operant paradigm to provide an operant analysis of imitative responding that defines imitation as generalized imitation.

This definition describes imitation as a functional response class, maintained by a conditioned reinforcer. That conditioned reinforcer consists of the stimulus similarities between the model's response and the observer's matching of that response. Thus, in Baer and Deguchi's (1985) generalized imitation paradigm, just as in Mowrer's (1960) and Risley's (1966, 1977) imitation theories, it is hypothesised that similarity functions as a conditioned reinforcer. The difference between Baer and Deguchi (1985) on one hand and Mowrer (1960) and Risley (1966, 1977) on the other, is that by describing imitation as a response class, Baer and Deguchi's generalized imitation paradigm can account for the observer's imitation of new responses that have not been directly reinforced. Of course, those responses are reinforced indirectly, as long as some other responses are directly reinforced. This definition of imitation is powerful in that it can account for the learning of novel motor and vocal responding in the course of human development.

Empirical data that demonstrated the phenomenon of generalized imitation and led to its subsequent description as a response class came from a number of studies with normally developing children (Baer & Sherman, 1964; Brigham & Sherman, 1968; Steinman, 1970) as well as from a number of studies with developmentally delayed populations. Specifically, generalized imitation procedures were used to teach language and social skills to children with autism

(Metz, 1965), to children with schizophrenia (Lovaas, Berberich, Perloff, & Schaeffer, 1966; Lovaas, Freitas, Nelson & Whalen, 1967), and to children with retardation (Baer, Peterson & Sherman, 1967).

Baer and Sherman's (1964) experiment was one of first attempts to demonstrate generalized imitation. Baer and Sherman used a talking puppet as a social reinforcer to establish three imitative responses (nodding of the head, opening and closing of the mouth and nonsense verbalizations) in normal preschool children. Imitative responding of another response (bar pressing), which was never directly reinforced, was also established and maintained as long as imitative responding of the other three responses was maintained by social reinforcement. When extinction of imitation or non-modeling conditions were instituted for the three responses, imitative bar pressing also declined in rate. When the three imitative responses were once again reinforced, the bar pressing response increased in rate, even though it was never directly reinforced.

Baer, Peterson, and Sherman (1967) offered another demonstration of generalized imitation with developmentally delayed children who lacked spontaneous imitative behavior. These researchers shaped imitation by first reinforcing approximations, and, later, exact matches of modeled responses. Interspersed among these training trials were models whose imitation was never reinforced. Never-

reinforced imitative responding occured as long as some other kind of reinforced imitative responding was continued. When a differential reinforcement of other-than-imitative responding (DRO) was implemented, both the previously-reinforced and never-reinforced imitative responding decreased. When reinforcement for imitative responding was re-introduced, both reinforced and never-reinforced imitative responding increased to former levels. Therefore, Baer, Peterson, and Sherman (1967) extended the generality of the generalized-imitation paradigm to include the acquisition of new responses not previously in the repertoire of the subjects. Consequently, Baer, Peterson and Sherman provided the following definition of generalized imitation:

> Any behavior may be considered imitative if it temporally follows behavior demonstrated by someone else, called a model, and if its topography is functionally controlled by the topography of the model's behavior...Such control could result, for example, if topographical similarity to a model's behavior were a reinforcing stimulus dimension for the imitator. (Baer, Peterson, & Sherman, 1967, p. 405)

Lovaas, Berberich, Perloff, and Schaeffer (1966) also used a generalized imitation training procedure to establish speech in two non-verbal, non-imitative, schizophrenic children. First, the experimenters reinforced increasingly more accurate imitations of English words to establish a

verbal repertoire in these children. Later, as they continued to reinforce only English-word imitations, the experimenters added presentations of Norwegian words, which the children were not able to reproduce accurately at first, and never reinforced any attempt of the children to imitate them. As the accuracy of the English-word imitations improved, the accuracy of the Norwegian-word imitations also improved for both children. The scoring of Norwegian-word accuracy was done by two analysts, who working independently played back tape-recorded sessions and marked each child's vocal response as correct or incorrect. Correct was each response that could be recognized by the analyst as an adult's utterance.

Brigham and Sherman (1968) replicated the Lovaas et al. (1966) study with three normally developing preschool children. In this study, reinforcement was delivered contingently upon the subjects' accurate imitation of English words. As accuracy of English-word imitation increased, accuracy of imitation of never-reinforced Russian words increased as well. When accuracy of English-word imitation decreased as a result of a DRO procedure, accuracy of the Russian-word imitation decreased as well. When accuracy of English-word imitation increased again as a result of reinforcement, accuracy of the never-reinforced Russian-word imitation increased as well. The accuracy of Russian-word imitation was measured by two independently working analysts who listened to tape recorded sessions and

gave one point to each correctly pronounced letter and three points to each correctly pronounced syllable. The total number of points given by the two observers was divided by the maximum number of points that the stimulus words could yield and a percentage score of accuracy was obtained.

Steinman (1970) examined the possibility that children may produce generalized imitation because they fail to discriminate the to-be-reinforced from the not-to-be-reinforced models presented to them. In his study, two different experimenters presented models to be imitated to six normally developing children. One experimenter presented models whose imitation was always followed by reinforcement. The other experimenter presented models whose imitation never led to reinforcement. It was found that imitation was maintained regardless of which experimenter presented the models. Steinman hypothesized that the children did not discriminate because of the social demand characteristics of the experimental situation. That is, because of previous social conditioning, the children felt that they had to obey the adult's implicit instruction to imitate. This hypothesis was further supported by the chidren's behavior when two modeled responses, to-be-reinforced and not to-be-reinforced, were presented on a given trial in a choice paradigm. Steinman found that the children chose the model that produced a reinforcer, clearly demonstrating that they discriminated between the two types of models. Thus, the hypothesis that the children fail to

discriminate the to-be-reinforced from the not-to-be-reinforced models in generalized imitation, was not supported by Steinman's (1970) data. In reviewing this and other related literature, Baer and Deguchi (1985) concluded that children continued to respond to non-reinforced models not because they failed to discriminate, but because imitation is a functional response class (Skinner, 1938). More recently, according to Catania, in defining a response class

> The experimenter must ask a fundamental behavioral question: can the consequences of responses modify the likelihood of responses in the class? If so, it may be called an operant class; ...An operant is a response class that can be modified by the consequences of the responses in it. This definition of a response class depends on behavioral properties of responding; it is independent of...physical or physiological properties...(Catania, 1984, p.110)

In generalized imitation, according to Baer, "response-changing contingencies applied to only some members of the class, produced similar results in all members of the class" (Baer, 1982, p. 232).

In summary, never-reinforced members of the class are maintained despite the continuous schedule of differential reinforcement (Steinman, 1970). In addition to the covariation in quantity (rate or frequency), there is covariation in the quality (gradually increasing accuracy)

of all the class members, never-reinforced and contingently-reinforced (Lovaas, Berberich, Perloff, & Schaeffer, 1966; Brigham & Sherman, 1968). In normal children, the origins of the class are not known. In non-verbal children the establishment of the class is due to the training program provided by the therapist or experimenter. In all cases, the response class of generalized imitation includes members that are not topographically similar to one another (Baer, 1982).

Nevertheless, according to Baer and Deguchi (1985), describing generalized imitation as a response class does not explain the phenomenon:

> Here, response class is not an explanation; it is only the observation that reinforcement of some members of the class controls the other members in a similar way. Thus, simply describing imitation as a response class does not contribute to understanding such complex cases. It is how the response class is molded and maintained that should be explained. (Baer & Deguchi, 1985, p. 185)

Baer and Deguchi (1985) in their analysis of generalized imitation propose a description of the formation of the response class of imitation as follows: When a response class of imitative responding is formed as a result of direct reinforcement, similarity between the stimuli produced by the model's response and the stimuli produced by the subject's matching of that response becomes a

conditioned reinforcer. Furthermore, the similarity between the stimuli produced by the new model and the stimuli produced by the new imitative behavior also becomes a conditioned reinforcer through primary generalization. Thus, newly established imitative responding is maintained as long as other imitative responding is directly reinforced.

Empirical research to demonstrate the reinforcing function of similarity in the imitative process is scarce. Similarity between modeling responses and imitative responses has been manipulated by the experimenter as a consequent stimulus in a paradigm in which the subject is imitated by the experimenter for choosing one response out of many (Gladstone & Cooley, 1975).

Baer and Deguchi (1985), however, conducted an experiment with preschool children to demonstrate the reinforcing function of "imitating" as opposed to "being imitated," thus providing empirical support for the conditioned-reinforcement explanation of imitation. In their experiment, the children's choice of four different motor responses was measured in a choice paradigm with a multi-response apparatus in a within-subjects repeated-reversal single-subject experimental design (Baer, Wolf & Risley, 1968). The apparatus had one middle panel, and four side panels. Each one of the four side panels had materials on it signaling responses to be made by the child in case the child chose that panel. The four responses were:

1. Observing the experimenter performing a motor activity.
2. Observing the experimenter performing a motor activity, and then matching that activity.
3. Performing a motor activity different from the experimenter's.
4. Waiting for the beginning of the next trial.

During each trial in all phases of the experiment each child made a choice among the four side panels by pressing one of four side-panel buttons and thereby signaling the choice of one of those four activities. No differential reinforcement was provided for choosing and engaging in any of the side-panel activities. During baseline and reversal conditions the children were reinforced for pressing the middle-panel button, but during treatment conditions the children were directly reinforced for pressing the middle-panel button and imitating other motor responses modeled by the experimenter.

The results indicated that the children's choice of engaging in non-reinforced side-panel motor imitative responding increased during treatment and was maintained at high levels as long as the children's motor imitative responding in the middle panel was directly reinforced. When direct reinforcement of this other motor imitative responding was discontinued, the children's choice of engaging in non-reinforced motor imitative responding decreased to baseline levels. Reintroduction of direct reinforcement conditions in the middle panel caused the children's choice of engaging in non-reinforced side-panel

motor imitations to increase to treatment levels. The Baer and Deguchi (1985) study supports the conditioned reinforcement hypothesis regarding generalized imitation by demonstrating that, as long as similarity of some motor responses is directly reinforced, similarity becomes a conditioned reinforcer for some other, never-reinforced motor responses. When direct reinforcement of motor responding is discontinued, then similarity loses its conditioned-reinforcement properties.

The purpose of the present study was to extend the generality of the Baer and Deguchi (1985) findings on the use of motor generalized imitation in preschool children, to determine whether vocal, as well as motor, responding falls under the generalized imitation paradigm. If stimuli produced by vocal imitative responding have a reinforcing function, then contingent presentation of non-reinforced opportunities to produce those vocal stimuli should be reinforcing for an arbitrary instrumental response such as button pressing. In the present study this hypothesis was assessed by comparing children's non-reinforced choice of Matching versus Non-Matching vocal responding, Listening, and Waiting during baseline conditions, to the children's non-reinforced choice of the same activities during reinforced-imitation conditions.

Two experimental designs were used to ask two slightly different questions about the effects of the reinforced imitation condition on choice responding of preschool

children. The first was a multiple-baseline across children design (Baer, Wolf, & Risley, 1968) to determine the extent to which the treatment procedure produced change in choice responding. The second was a single-subject repeated-reversal design (Baer, Wolf, & Risley, 1968) to determine the extent to which any effects of the treatment procedure would be resistant to extinction in a return to baseline procedure. This was followed by a final re-introduction of the reinforced-imitation procedure for some children.

# Method

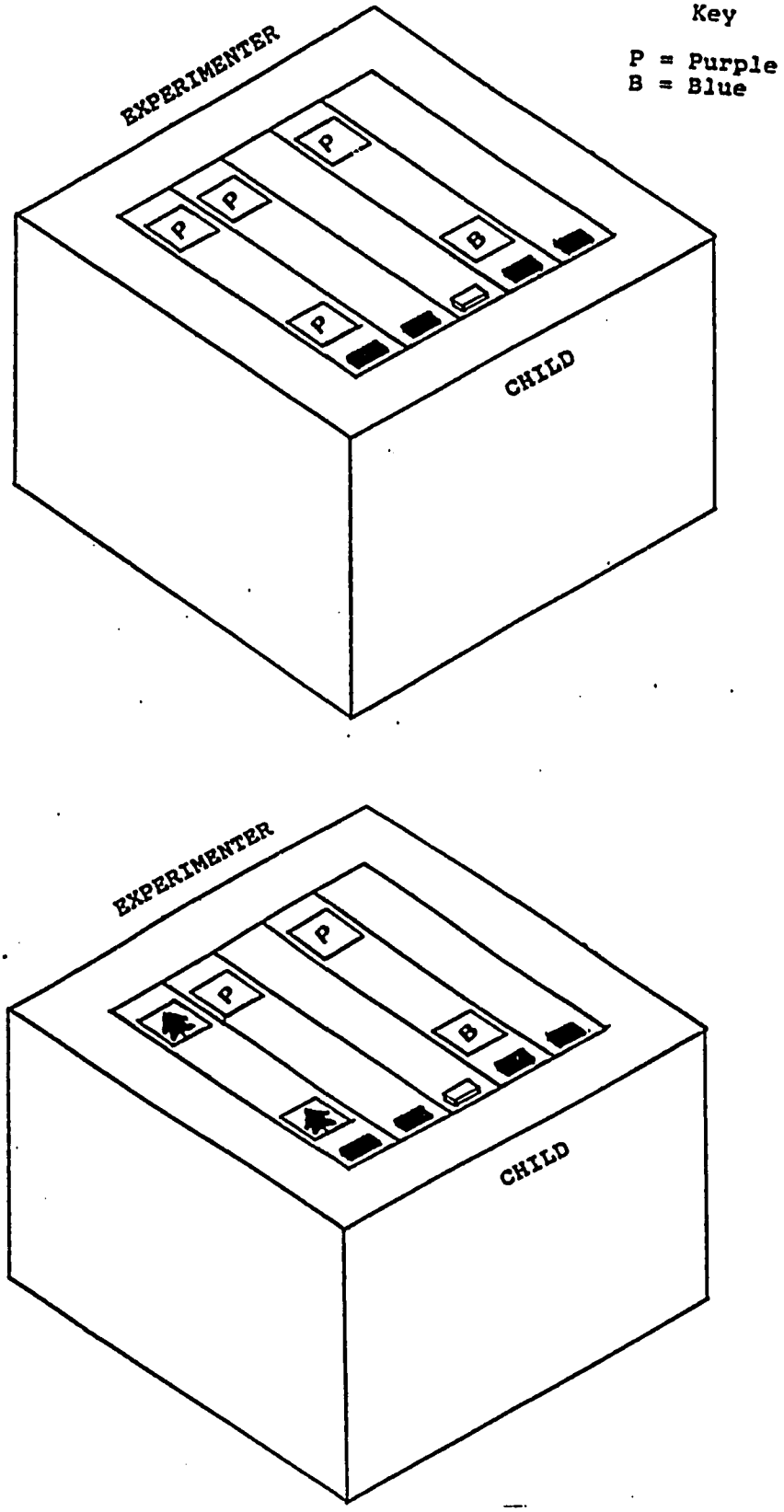
## Subjects and Setting

Five normally developing male preschool children served as subjects. Their ages at the beginning of the study were between 2 years and 11 months and 4 years and 11 months. The experiment was conducted in an experimental room containing a desk, a bookcase, three lamps, and a file cabinet. In the middle of the room was a low (17 inches above the floor) 18 x 18 inch table and three chairs. The three chairs were grouped around the table so that the child sat in one chair, the experimenter sat in another chair facing the child across the table, and an observer with her head down, sat in the third chair which was oriented toward the child and the table. A transparent cup which could contain earned tokens was placed on the table near the child.

## Apparatus

The apparatus was an IBM compatible, miniature personal computer (CARRY I, model 8088) with an 8 x 10 inch color monitor (Goldstar, model B-14A) facing upward through the center of the table in the experimental room. The computer screen, enclosed in the table under a 1/4 inch transparent acrylic table top, displayed five panels, as seen at the top of Figure 1.

Figure 1. Top: The multi-response apparatus, before the beginning of a trial. Bottom: The multi-response apparatus after the child has pressed the push-button switch (Key) corresponding to the matching panel.


Key
P = Purple
B = Blue
EXPERIMENTER
P
P
P
B
CHILD
EXPERIMENTER
P
P
B
CHILD

Each panel contained a colored push-button switch that could be illuminated. The push button corresponding to the middle panel was white, and the push buttons corresponding to the side panels were green (shown as black in Figure 1). All push buttons were located on the child's side of the computer screen. During some trials only the push button corresponding to the middle panel was illuminated. On the remaining trials all the push buttons corresponding to the four side panels were lit and the center push button was not illuminated. The experimenter determined which push buttons were illuminated through a portable computer keyboard, kept on a low table on the experimenter's right, in sight of the subject.

Stimulus Materials

A software program was custom designed to select and present stimuli on the five panels displayed on the computer screen. An experimental trial began with a screen presentation. During each screen presentation five colored 1.5 x 1.5 inch squares appeared on the panels of the screen, four of them purple and one blue, as seen at the top of Figure 1. During the course of each trial, some of the squares were replaced by colored pictures of objects, as seen at the bottom of Figure 1. The distribution of colored squares and objects on the panels will be described below.

General Procedures

Two of the children were presented with either three or four blocks of trials per session, and the other three

children were presented with either two or three blocks of trials per session. Each block contained 14 trials, six middle-panel trials and eight side-panel trials. The two trial types were presented in a random order. Middle-panel trials were reinforced throughout the experiment, whereas side-panel trials were never reinforced. At the beginning of each trial the illumination of the middle panel and the corresponding white button signaled the beginning of a middle-panel trial, and the illumination of the four side panels and the corresponding green buttons signaled the beginning of a side-panel trial. Throughout the rest of this manuscript the term matching response is used to describe child behavior judged by the observers to be similar to that of the experimenter's during a given trial. The term imitation will refer to the inference that a generalized response class of behaving similarly to a model has emerged.

Experimental Conditions

Two experimental conditions were used: A baseline and a reinforced-imitation condition.

Baseline. During the baseline condition, no reinforcement occured for matching responses in the middle panel. During a middle-panel trial, the middle panel was illuminated and each child had an opportunity to receive a token by just pressing the illuminated white button.

Reinforced Imitation. During the reinforced imitation condition, reinforcement was given for matching a vocal

response in the middle panel. During a middle-panel trial, the middle panel was illuminated and each child had an opportunity to receive a token by pressing the illuminated white button and matching the experimenter's vocal model. The six vocal models used by the experimenter were the words: red, black, white, yellow, blue, and green. No visual stimuli in the form of colored squares or objects ever appeared in the middle panel during the experiment. Visual stimuli in the middle panel appeared only during pretraining as described below.

Therefore, the two conditions differed only in the middle-panel trials, but they had identical side-panel trials throughout the experiment.

During a side-panel trial, all four side panels were illuminated, colored squares were displayed on some of the panels, and the child had the opportunity to choose among four different tasks by pressing one of the four illuminated green buttons corresponding to the prefered task. When a child pressed the push-button of a panel containing squares, it resulted in replacement of each one of those squares by one colored picture of an object. The squares on the rest of the panels remained unchanged. The pictures of objects replacing the squares were: a house, a tree, a boat, a car, a fish, an umbrella, a chair or a duck. The order of appearance of those objects was random and could not be controlled by the experimenter.

The presence, absence, or nature of the colored squares on the side panels functioned as discriminative stimuli signaling the task to be performed if that panel was chosen by the child.

The four tasks to choose from during each side-panel trial were: Matching, Non-matching, Listening and Waiting.

1) Listening task: If the panel had a purple square on the experimenter's side only, then only one object would appear on the experimenter's side of the panel facing the child, and the experimenter named that object.
2) Matching task: If the panel had a purple square on the experimenter's side and a purple square on the child's side, then two identical objects, both facing the child, would appear on both sides of the panel. In that case, the experimenter named the object and then the child would name the same object, thus matching the experimenter's vocal model.
3) Non-matching task: If the panel had a purple square on the experimenter's side and a blue square on the child's side, then two different objects, both facing the child, would appear on the panel. In that case, the experimenter named the object on his side and the child would name the object on the child's side of the screen, which produced a vocal response different from the experimenter's.
4) Waiting task: If the panel had no colored squares on either side, both child and experimenter would wait for

the next trial to start. The inter-trial interval was 5 seconds.

If the child made a mistake either in pressing the appropriate button or by engaging in the appropriate vocal activity, the experimenter would instruct the child to try again, and would say to the child "that's correct" when the child responded appropriately.

Location of stimuli varied systematically across the four panels during the unreinforced side-panel trials, so that in a block of trials, each type of panel appeared twice in each position.

A basic assumption made was that the distribution of button pressing among the above visual discriminative stimuli displayed on the side panels would reflect a measure of preference for one or more of the verbal tasks to be performed.

Reinforcement System

During all experimental conditions, each child received one token (a plastic chip from a checkers game) in the transparent cup for each middle-panel response. The child could exchange tokens at the end of each block of trials for a number of objects or activities. Two tokens could be exchanged for a chance to play with the gum-ball machine and get a gum-ball, or they could be exchanged for a sticker, a baloon, or a chocolate bar. Four tokens could be exchanged for a big sticker or a small toy that the child could keep, or the chance to see a view-master story. Six tokens could

be exchanged for a children's book or the chance to play for five minutes with a number of toys: transformers, cars, trucks, legos, a toy castle and a toy car-wash service center.

Pretraining

All pretraining took place using the middle panel only. The purpose of the pretraining was to teach the children the format of the activities to be engaged in during the experiment. First, the child needed to learn the conditions under which to press the middle-panel and the side-panel buttons. Second, after the child made a choice during side-panel trials, he needed to learn to make the verbal response corresponding to that choice rather than to make a different verbal response. Finally, the child needed to learn to wait for his turn before naming a picture during side-panel trials and to wait for the experimenter's vocal model during middle-panel trials. To that effect two types of pretraining sessions were conducted.

In the first type of pretraining session the child was instructed to press the button corresponding to the white-light middle panel only when that light was on. To teach the child the consequences of pressing the middle-panel button, the six vocal responses that were directly reinforced during the reinforced-imitation phases of the experiment were modeled one at a time, and the child was instructed to match each. Each model was presented twice and the child received a token for matching it correctly.

No child made an error in the first type of pretraining sessions.

In the second type of pretraining session, which was designed to teach the child the consequences of pressing each one of the side-panel buttons, the child was taught the four different types of non-reinforced activities associated with the four side-panel discriminanda (S- stimuli). During the second type of pretraining sessions, the four S- stimuli appeared one by one in the middle panel, four times each, and each time in a different sequence to each other. The child received instructions before each trial depending upon the type of trial, as follows:

For S-1 (Listening): "In this game, there is something for me to name and nothing for you. I name this; you just listen."

For S-2 (Matching): "In this game, there is something for me to name and something for you. The two things are the same. I name this; now it's your turn."

For S-3 (Non-Matching): "In this game, there is something for me to name and something for you. But the two things are different. I name this, you name that."

For S-4 (Waiting): "In this game, there is nothing for us to name. We just wait."

Correction was provided by the experimenter each time the child made a procedural mistake and verbal praise was given for the procedurally correct answer. In this type of pretraining session the child received tokens after the

session was over for his participation only. That is, the child was never given reinforcement based on task performance.

After the two types of pretraining sessions were conducted a criterion session was successfully completed by all children before the first baseline session. Two pretraining sessions of the second type were sufficient for the four children to pass the criterion session. The fifth child, who was 2 years and 11 months old at the beginning of the study, needed ten pretraining sessions of the second type, and a special pretraining session in order to pass the criterion session.

Dependent Variables

Throughout the experiment and during all trials the experimenter and one observer recorded the following:

1. The child's button-pressing choice: M (matching), N (non-matching), L (listening), W (waiting) or C (middle panel) button pressing.
2. Whether the child pressed buttons correctly or incorrectly: They would record whether the child pressed the middle-panel button during middle-panel trials and one of the side-panel buttons during side-panel trials.
3. The child's vocal response. The experimenter and the observer would write down what the child said after the experimenter produced the vocal model. During some trials the child would name the picture on the child's side of the screen. During some trials the child would

say nothing, in which case a dash was recorded, and during some other trials the child would repeat the color-naming response produced by the experimenter, in which case experimenter and observer would write down that response.

Independent Variables

Throughout the experiment, the experimenter and the observer also recorded the following:

1. What the experimenter said immediately following the child's button pressing, which during some trials was naming the picture on the experimenter's side of the screen. During other trials the experimenter said nothing, in which case they would record a dash. During some other trials it was color naming, in which case the observers would write down the particular color named.
2. Whether the child's vocal response was corrected: Correction was provided for two reasons. Whenever the child named the wrong picture and whenever the child produced a vocal response before the experimenter. Correction was provided and recorded for both types of mistakes.
3. Whether a token was given at the end of the trial.

Inter-observer agreement on all of the categories recorded was obtained for all of the experimental blocks. The experimenter was always the primary observer and was paired with seven different secondary observers. The inter-observer agreement data were calculated by the point-by-

point method, so that the number of agreements between the two data sets was divided by the number of agreements plus disagreements, and it was found to be 100% for all the categories recorded.

Discrimination test

After the completion of the first reinforced-imitation condition, all children were given a discrimination test. This test, which consisted of ten trials, was administered to determine whether each child would correctly state that the color-words were associated with reinforcement and the objects revealed by the colored squares were not. During each trial two models were presented to the child: one reinforced and one not reinforced. The child was asked to identify only the model associated with reinforcement. The instructions were: "When did you get a token? When you said `red' or when you said `house'?". No feedback or token was given after each response.

## Results

First, the results of the multiple-baseline part of the experiment will be reported, followed by the results of the reversal part. With respect to the multiple-baseline part of the experiment, for three of the five children the introduction of the first reinforced-imitation condition was associated with a systematic increase over baseline levels of the number of responses emitted on the matching panel button (matching key). This is represented by closed circles in Figure 2.

Figure 3 shows three graphs each representing the rest of the side-panel choices made by the three children. These data are presented on a separate figure so that the data on Figure 2 can be seen clearly. The open triangles represent the number of responses emitted on the non-matching panel button (non-matching key), the open squares represent the number of responses emitted on the listening panel button (listening key), and the open circles represent the number of responses emitted on the waiting panel button (waiting key). A comparison of Figures 2 and 3 shows that the only choice that systematically increased with the introduction of the first reinforced-imitation condition was the choice of the matching key by all three children. The choice of the other three keys either decreased during the first reinforced-imitation condition over first baseline levels, or remained at low levels during both phases of the experiment.

Figure 2. The number of responses emitted on the matching key (closed circles) and the number of verbal matching responses (open circles) emitted by Paul, Nicholas, and Philip during baseline and reinforced-imitation conditions. Paul and Nicholas experienced first baseline, first reinforced-imitation condition, second baseline, and a second reinforced-imitation condition. Philip experienced first baseline, first reinforced-imitation condition, and second baseline.

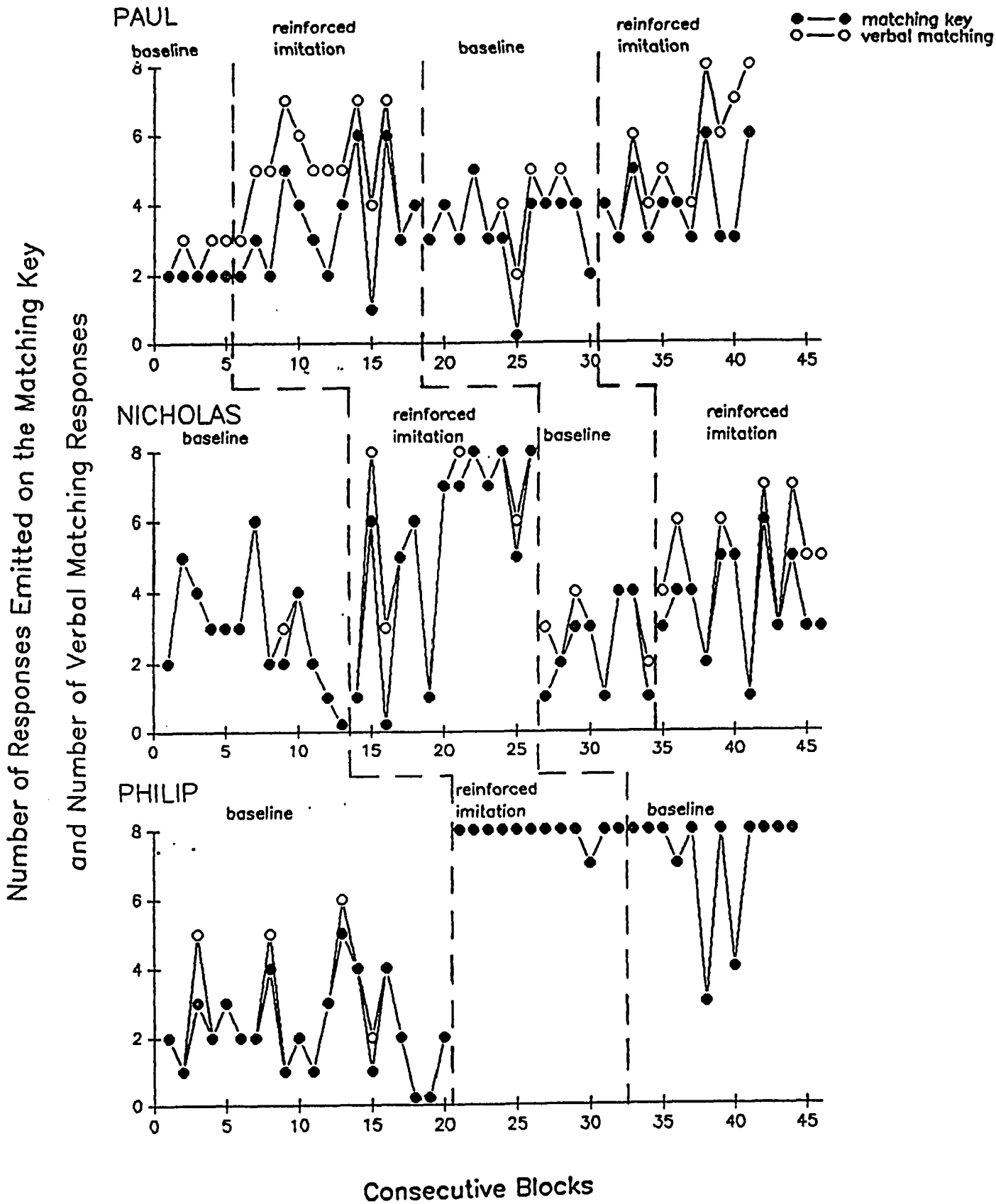
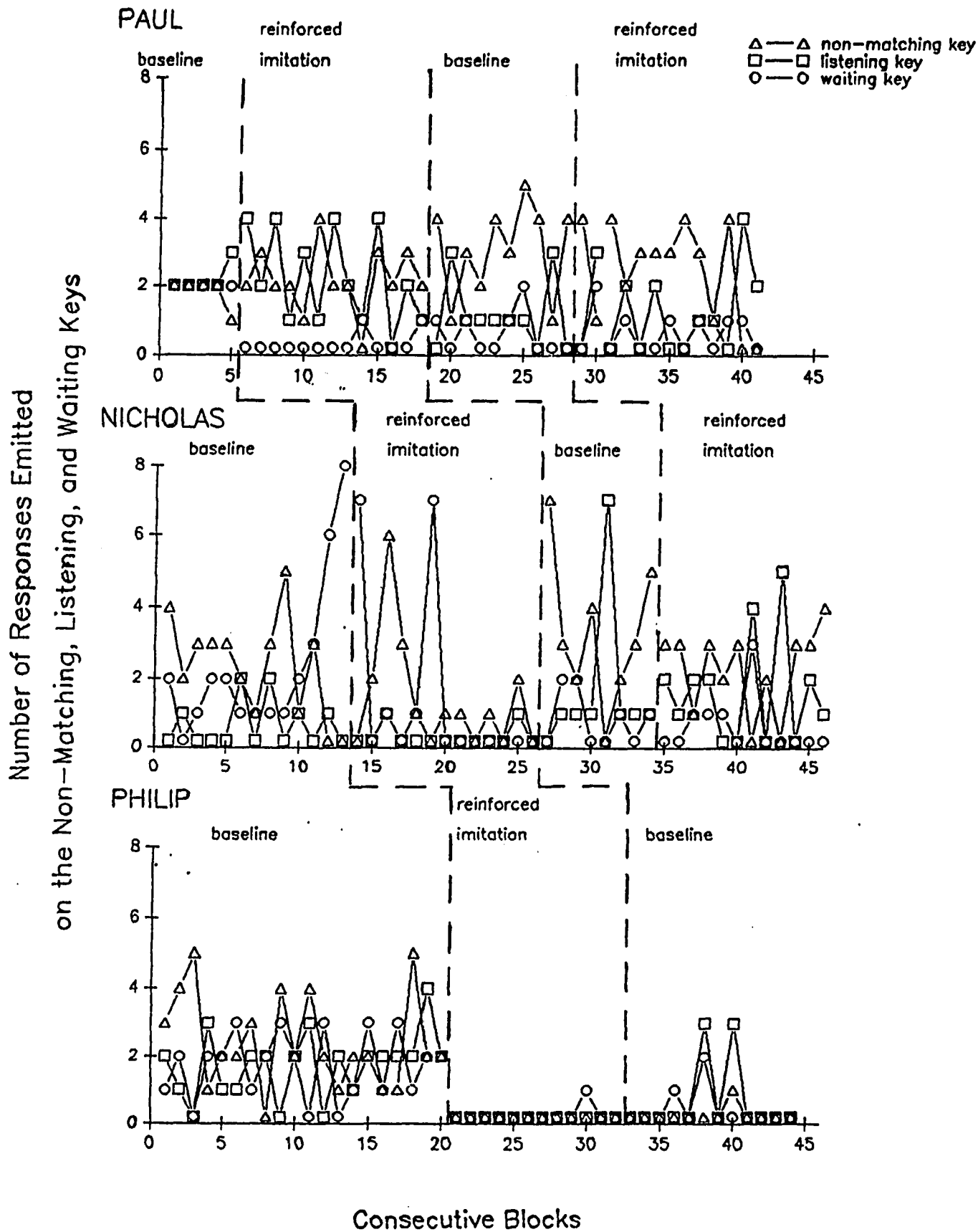

PAUL
baseline
reinforced imitation
baseline
reinforced imitation
matching key
verbal matching
NICHOLAS
baseline
reinforced imitation
baseline
reinforced imitation
PHILIP
baseline
reinforced imitation
baseline
Number of Responses Emitted on the Matching Key and Number of Verbal Matching Responses
Consecutive Blocks

Figure 3. The number of responses emitted on the non-matching (open triangles), listening (open squares), and waiting (open circles) keys by Paul, Nicholas, and Philip during baseline and reinforced-imitation conditions. Paul and Nicholas experienced first baseline, first reinforced-imitation condition, second baseline, and a second reinforced-imitation condition. Philip experienced first baseline, first reinforced-imitation condition, and second baseline.


PAUL
baseline
reinforced imitation
baseline
reinforced imitation
non-matching key
listening key
waiting key
NICHOLAS
baseline
reinforced imitation
baseline
reinforced imitation
PHILIP
baseline
reinforced imitation
baseline
Number of Responses Emitted on the Non-Matching, Listening, and Waiting Keys
Consecutive Blocks

The open circles in Figure 2 represent the number of trials in which each child verbally matched the experimenter's verbal model regardless of key choice during side-panel trials. It is worth noting that the differences between the number of responses emitted on the matching key and the number of verbal matching responses are mistakes, meaning that the children did not perform the side-panel task according to the choice that they made on the side keys. These mistakes were always made during trials in which the children chose the non-matching or the listening key but verbally matched the experimenter anyway. None of the children made mistakes in the opposite direction, that is, there was no occasion on which any child chose the matching key on the side panel and did not match the experimenter's verbal model. For Paul and Nicholas, many fewer mistakes were made during the first baseline condition compared to mistakes made during the first reinforced-imitation condition. Philip's verbal matching did not increase after the introduction of the first reinforced-imitation condition, because there was a ceiling effect. The children's mistakes continued to be made in the face of correction. The experimenter corrected each child's mistake and required the child to repeat the correct verbal model for that trial.

With respect to the reversal part of the experiment, of the three children who showed an increase in the number of responses emitted on the matching key during the first

reinforced-imitation condition, only Nicholas subsequently showed a reversal of responding with the re-introduction of the baseline condition. Nicholas did not show a clear increase of responding to the re-introduction of the second reinforced-imitation condition. Figure 3 shows that for Nicholas there was no other decrease in the number of responses emitted on the non-matching, waiting or listening keys with the re-introduction of the baseline condition.

The number of verbal matching responses across all conditions in Figure 2 shows that for Paul and Nicholas many fewer mistakes were made during both baseline conditions compared to mistakes during both reinforced-imitation conditions. Also, the trend of verbal matching responses followed the trend of the choice of the matching key closely for both children. For example, Paul's verbal matching remained flat during both baseline conditions and showed an upward trend during both reinforced-imitation conditions, reaching a much higher level than the choice of the matching key. A similar pattern is observed in Nicholas' data.

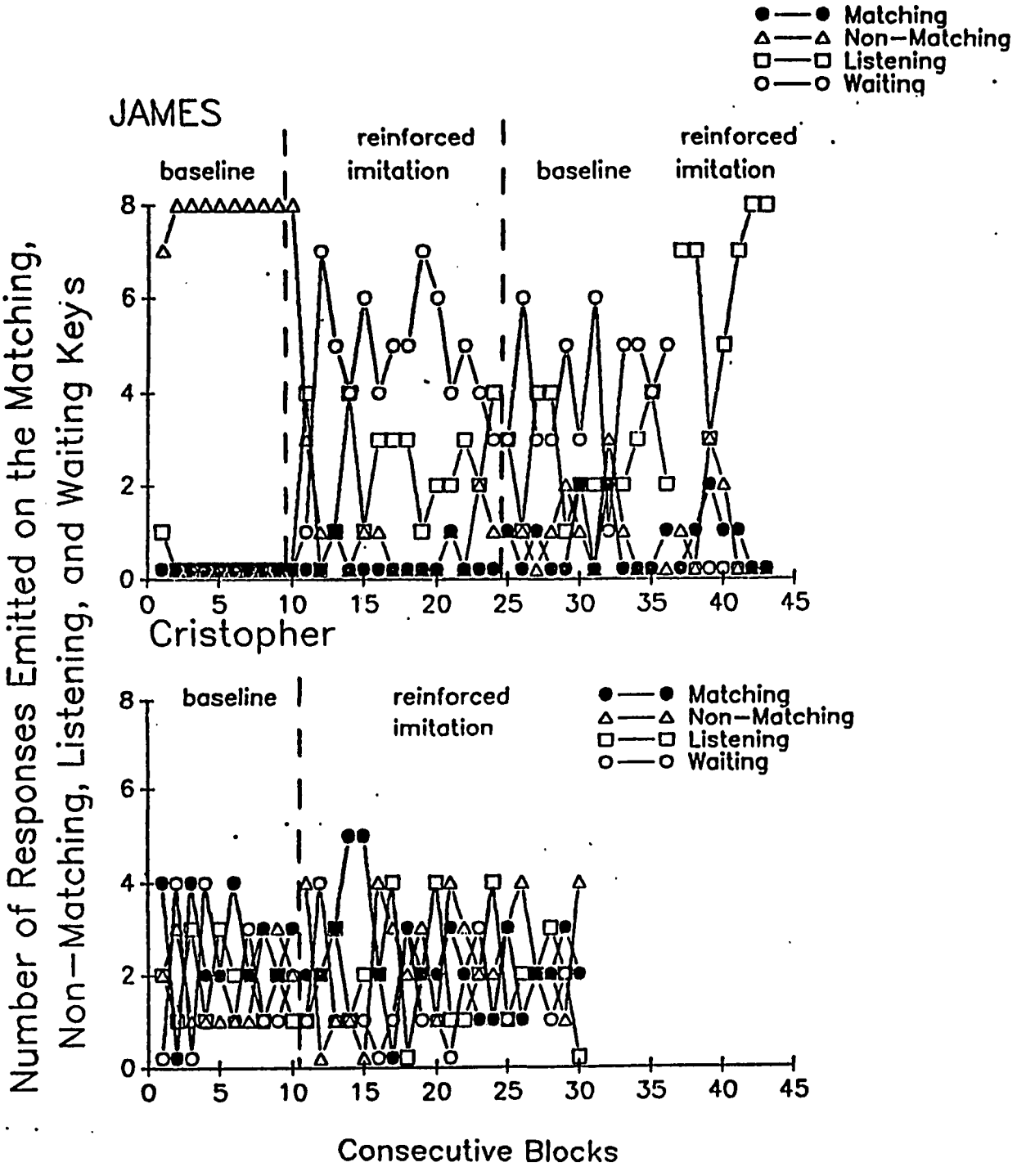
In the discrimination test both Paul and Philip were able to identify the color words as associated with reinforcement during 100% of the ten trials presented to them. Nicholas was able to identify the color words as associated with reinforcement during 90% of the ten trials presented to him.

During the course of the experiment the children were corrected by the experimenter for pressing a side-panel

button during middle-panel trials only in .25% of 780 trials. They were corrected by the experimenter for pressing the middle-panel button during side-panel trials only in .19% of 1048 trials. During the side-panel trials the children were corrected for naming the object on the their side of the screen before the experimenter named hers during .38% of 1048 trials. In addition to the mistakes in verbal responding, which occured during 6.87% of the 1048 side-panel trials and described in Figure 2, the children were corrected by the experimenter for producing an incorrect vocal response during only .95% of 1048 side-panel trials. During reinforced-imitation condition, the children never made a mistake in verbally matching the color words during middle-panel trials. Finally, the experimenter never dispensed a token for side-panel trial responding. The experimenter never failed to dispense a token for middle-panel responding.

Figure 4 represents data of two children, James and Christopher that did not change their choices of the matching key with the introduction of the reinforced-imitation condition. Neither James nor Christopher increased in the number of responses made on the matching key during the reinforced-imitation condition over baseline levels. James' number of responses made on the non-matching key decreased with the introduction of the reinforced-imitation condition, but did not increase again during second baseline.

Figure 4. The number of responses emitted on the matching (closed circles), non-matching (open triangles), listening (open squares), and waiting (open circles) keys by James and Christopher during baseline and reinforced-imitation conditions. James experienced first baseline, first reinforced-imitation condition, second baseline, and second reinforced-imitation condition. Christopher experienced first baseline and first reinforced-imitation condition.


Matching
Non-Matching
Listening
Waiting
JAMES
baseline
reinforced imitation
baseline
reinforced imitation
Cristopher
baseline
reinforced imitation
Number of Responses Emitted on the Matching, Non-Matching, Listening, and Waiting Keys
Consecutive Blocks

## Discussion

In the multiple-baseline part of the experiment, introduction of the first reinforced-imitation condition resulted in a systematic increase over baseline in the number of responses emitted on the matching key relative to other choices for the three of the five children. Thus, the reinforced-imitation procedure produced a preference for access to vocal imitation in the absence of direct reinforcement. The present findings are consistent with findings of other researchers of generalized motor imitation who also found that only a portion of subjects showed generalized motor imitation. Specifically, in the Baer and Sherman (1964) experiment only seven of eleven children studied demonstrated generalization of motor imitative responding. In the initial experiment by Baer and Deguchi (1985) four out of six children studied demonstrated generalized imitation with motor responses. Thus, the generality found in the present study is similar to that of other generalized imitation studies. Nevertheless, this limited generality does not detract from the validity of the results obtained from the children who did show generalized imitation.

The fact that only three of the five subjects in this study demonstrated generalization of imitative responding may be explained by the relatively weak control exerted by conditioned reinforcement. The failure to demonstrate conditioned reinforcement effects with all children simply

means that further analysis of the controlling variables is needed. These experimental findings confirm real life anecdotal observations regarding the selectivity and fragility of imitative behavior that makes the generalized imitation paradigm a plausible paradigm for language and social learning by children. Consider the problems that ensue when a child is not selective on his or her use of imitation of speech. Such a child is labeled "echolalic" and is often found to have no meaningful use of language. This observation suggests that the Baer and Sherman (1964), the Baer and Deguchi (1985) and the present studies on generalized imitation show "just the right amount of experimental control" (Baer, 1991).

Of the children who did show generalized imitation when direct reinforcement of verbal matching was discontinued, for one of them, the choice of the matching key decreased to baseline levels. For the other two children, non-reinforced imitation proved to be more durable, as there was no decrease in preference for generalized imitation when baseline conditions were re-introduced. The failure of two subjects to show reversal suggests that for these subjects generalized imitation was a response class maintained by reinforcers other than those directly provided by this experiment, just as it is supposed that instruction following in the rule-governance literature is maintained by extra-experimental reinforcers (Catania, Lowe & Horne, 1990).

One possible explanation for having obtained experimental control over responding on the matching key by the three children may be that the children failed to discriminate between matching that resulted in reinforcement and matching that did not. This hypothesis was ruled out by the discrimination test, and this finding is consistent with similar findings of Steinman (1970) and Baer and Deguchi (1985).

A more viable explanation is the conditioned reinforcement hypothesis of generalized imitation (Mowrer, 1960; Risley, 1966, 1977; Baer & Deguchi, 1985). According to this account, direct reinforcement of some imitative responding results in the formation of the response class of imitation. Similarity between the modeled responses and the imitative responses of the child acquires conditioned reinforcement properties and becomes the conditioned reinforcer maintaining new imitative responding that has never been directly reinforced. As argued in the introduction of this paper, the formation of the response class of imitation provides a familiar experimental paradigm for the observation that reinforced and non-reinforced imitative responses covary in quality (gradually increasing accuracy) and quantity (rate or frequency), despite a differential schedule of reinforcement, as demonstrated in studies done with normally developing children (Baer & Sherman, 1964; Brigham & Sherman, 1968; Steinman, 1970; Baer & Deguchi, 1985), as well as with children with

developmental delays (Metz, 1965; Lovaas et al., 1966; Lovaas et al., 1967; Baer et al., 1967).

Also as argued in the introduction, the conditioned-reinforcement explanation of generalized imitation can account for the acquisition of new imitative responding (Lovaas et al., 1966; Brigham & Sherman, 1968). As long as caregivers provide direct reinforcement for some level of vocalization, the weak conditioned reinforcement of similarity between the child's and the adult's vocalizations automatically shapes more adult like sounds by the child. Thus, the conditioned-reinforcement explanation accounts for the emergence of novel sounds in child's phonology. Just so novel linguistic forms may be shaped by the conditioned-reinforcement effects of similarity between adult and child verbalizations. The present study extends the findings of Baer and Deguchi (1985) concerning conditioned reinforcement of generalized motor imitation, to generalized vocal imitation, which has more direct implications for an account of language acquisition.

Emission of new verbal responses is one of the main subjects of interest of psycholinguistics (Bloom, Hood, & Lightbown, 1974; Clark & Clark, 1977; Dale, 1976; Chomsky, 1986). Expression of novel linguistic forms throughout the psycholinguistic literature has been interpreted as evidence of grammatical, generative production of language. Although the acquisition of novel responding shown in generalized imitation is perfectly generative and productive, most

traditional psycholinguists seem to be unaware of that fact. Thus, the operant paradigm has been dismissed too quickly by most traditional psycholinguists.

More specifically, traditional psycholinguists argue that in the process of language development, children often emit novel grammatical forms that have no direct conditioning history. Therefore, they conclude that language development occurs as a result of internal rather than learning processes. Apparently such psycholinguists have not understood the full implications of the operant analysis of language (Skinner, 1957; Baer, Guess, & Sherman, 1972). It is precisely the definition of imitation as generalized imitation and its subsequent description as a functional response class that allows us to account for the emission of novel linguistic forms in children (Kymissis & Poulson, 1990).

Furthermore, the generalized imitation paradigm can support an operant account of first-language acquisition in children without having to demonstrate that the caregivers shape every infant vocalization. As long as the caregivers deliver reinforcement for some vocalizations, the infant will increasingly emit more adult like vocalizations.

The conditioned-reinforcement hypothesis of generalized imitation appears to provide a sound analysis of language and social development in children. Generalized imitation, however, is highly selective in real life. That is, behavior may be under the concurrent control of many

competing activities. The reinforcing value of the activities available in the subject's environment at any given moment determine the subject's preference or non-preference to imitate (Baer & Deguchi, 1985).

The selectivity of imitation itself can also be accounted for by the conditioned reinforcement hypothesis. That is, primary reinforcers are more powerful than conditioned reinforcers, and so, one could expect that imitation would exercise relatively weak control over behavior. This relative weakness of control of behavior by conditioned reinforcers may be accounted for by the competition between primary and conditioned reinforcers. This point can be illustrated by the data obtained in the present study, showing that generalized imitative behavior emerged in only three of the five subjects. The conditions under which experimental control of generalized imitation is exerted by such variables as conditioned reinforcers await further experimental analysis.

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