THE UNIVERSITY OF MANITOBA

A COMPARISON OF THE EFFECTS OF INTERSPERSAL AND CONCURRENT TRAINING SEQUENCES ON ACQUISITION, RETENTION, AND GENERALIZATION OF PICTURE-NAMES WITH MENTALLY RETARDED CHILDREN

by

Vivienne C. Rowan

A Thesis

Submitted to the Faculty of Graduate Studies

In Partial Fulfillment of the Requirements for the Degree

of Master of Arts

Department of Psychology

Winnipeg, Manitoba

June, 1982

A COMPARISON OF THE EFFECTS OF INTERSPERSAL AND CONCURRENT TRAINING SEQUENCES ON ACQUISITION, RETENTION, AND GENERALIZATION OF PICTURE-NAMES WITH MENTALLY RETARDED CHILDREN

BY

VIVIENNE C. ROWAN

A thesis submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of

MASTER OF ARTS

Abstract

An interspersal training procedure, during which a picture being trained was alternated with previously "known" pictures, was compared to a concurrent training procedure, during which a picture being trained was alternated with other "unknown" pictures, to teach naming responses to three retarded children. An ABA design with counterbalancing (BAB) of training procedures across children was employed in this study. Results showed that the children learned picture-name responses more rapidly when trained by the interspersal procedure than by the concurrent procedure. In addition, casual observations revealed that emotional behaviors emitted during concurrent training were nonexistent during interspersal training.

Weekly retention tests conducted by the trainer on pictures that reached criterion during the previous week showed no consistent differences between the two training procedures. Response generalization assessments, conducted weekly in another setting by the trainer, and by a different individual, showed that picture-names that were retained also generalized. Generalization assessments conducted in another setting by the trainer, and by a different individual on objects whose corresponding matched pictures had been trained during the study showed that responses that generalized to objects when presented by the trainer also generalized to those objects when presented by a different individual.

ACKNOWLEDGEMENTS

I would like to express my sincere appreciation to:

Dr. Joseph J. Pear, my advisor, who "leadth me in the paths of radical behaviorism. Yea though he contingency shapeth and rule governth my behavior forever, I shall always be grateful for I know the course is true."

My committee members - Dr. Glen Lowther, Dr. Garry Martin, and Dr. Carl Stephens - whose comments were invaluable.

My colleagues - Don, Dickie, Valdine, Wendy, barb, and Vikki - who devoted their time and support which did so much to bring this research to a successful conclusion.

My children - Shannon, Sean, Stace, Robbie, and Chris - who have learned that there are three things sacred in our home; motherhood, apple pie, and a Master's degree.

To my husband, Terry - a very special person. Thank you for the spaces in our togetherness.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

The effectiveness of operant techniques for establishing verbal repertoires in retarded and autistic children are well documented (e.g., nonverbal imitation: Buddenhagen, 1971; Lovaas, Freitas, Nelson and Whalen, 1967; verbal imitation: Bricker and Bricker, 1972; Kogel and Rincover, 1974; Sloane, Johnston and Harris, 1968; functional speech: Goldstein and Lanyon, 1971; Wolf, Risley and Mees, 1964; and expressive and receptive language: Frisch and Schumaker, 1974; Wheeler and Sulzer, 1970). These studies, in addition to more extensive research on sound and word imitation and picture and object-naming, have led to the publication of several systematic training manuals (e.g., Bender, Valletutti and Bender, 1978; Bricker and Bricker, 1970; Bricker, 1972; Guess, Sailor and Baer, 1976; Hartung, 1970; Kent, 1974).

The procedures for verbal training with pictures or objects vary widely among researchers, but most have adopted either one or a combination of: (a) a serial procedure whereby a new stimulus to be trained is introduced only following acquisition of the previous target stimulus, so that items are trained serially until each attains the prescribed criterion (see Lutzker and Sherman, 1974, for a description of this procedure); (b) an interspersal procedure whereby previously mastered items are interspersed with the target stimulus until the latter is trained to criterion (e.g., Kent, 1974; Lovaas, Berberich, Perloff and Schaffer, 1966); and (c) a concurrent procedure in which two or more target stimuli are trained to criterion simultaneously by alternating between the items (e.g., Bender et al., 1978; Guess et al., 1976; Hewitt and Sherman, 1975; Martin, 1975; Ruder, Hermann and Schiefelbusch, 1977; Wheeler and Sulzer, 1970). A variation of the above is combined serial and concurrent procedure which involves initially training each target stimulus individually to a certain criterion, and then alternating two or more of the previously trained stimuli in a concurrent manner until they reach a second criterion simultaneously (Cuvo, Klevans, Borakove, Borakove, Landuyt and Lutzker, 1980; Firsch and Schumaker, 1974; Risley, Hart and Doke, 1972; Weeks and Gaylord-Ross, 1981).

To date only a few studies have been conducted to determine which of these procedures or combinations thereof is most efficient in terms of training time, retention of learned items, and generalization of learned items across different tasks and subject populations. It appears that most investigations involve comparisons of serial procedures with variations of either concurrent or interspersal procedures. For example, Cuvo et al. (1980) found that items trained by the concurrent method and by a combined serial and concurrent method required a few minutes longer to reach criterion than items trained by the serial method alone, but the former procedures resulted in better performance on retention tests.

In a number of other studies, comparisons of the effects of concurrent and serial training procedures have been investigated across a variety of tasks including picture-naming (Glidden, Pawelski, Mar, and Zigman, 1979), object-naming and comprehension training (McDonald, Note 1), and tracing and vocal imitation (Panyan and Hall, 1978; Schroeder and Baer, 1972). In terms of number of trials to criterion, Panyan and Hall (1978) and Schroeder and Baer (1972) found no differences between the two procedures; however, concurrent training resulted in better generalization to untrained items. McDonald (Note 1) extended her generalization measures to include testing by a different teacher in a different setting, and with different objects. Results indicated that concurrent training was superior to serial training for all generalization measures.

With respect to interspersal and serial training, the literature revealed two studies which compared these two procedures. Neef, Iwata, and Page (1977, 1980) investigated a spelling task, and found that more words were acquired and retained as a result of interspersal training than serial training. In addition, of the two modes of training, students said they preferred the interspersal procedure, which may have been related to the higher rate of acquisition during training.

Although the above studies appear to provide some empirical evidence in favor of either concurrent or interspersal training over serial training for facilitating retention and/or generalization, only one study could be found that directly compared concurrent and interspersal training. Reisin (Note 2) investigated the effects of these two procedures on acquisition, retention, and generalization of a picture-naming task with two mentally retarded children. The results suggest that a concurrent training procedure may produce better performance on all three measures. With respect to acquisition, Reisin's concurrent procedure involved alternating two "unknown" pictures for a number of trials until both reached criterion simultaneously whereas, during interspersal training, an "unknown" picture was alternated with a "known" picture until the "unknown" picture reached criterion. For one child, the former procedure produced more than twice as much learning than the latter procedure.

There are several possible advantages and limitations of serial, interspersal, and concurrent training in terms of acquisition, retention, and generalization. A serial procedure involves training each target stimulus for a number of trials until it reaches criterion. The next target stimulus is then introduced and trained in the same manner as the first. It is possible that this procedure produces a more rapid rate of acquisition because the subject is only required to attend to one stimulus and repeat the same response on consecutive trials within a session (Cuvo et al., 1980). Thus, serial training has the advantage of minimizing interference from other stimuli and responses. On the other hand, in this procedure it is perhaps less likely that a verbal response will come under the appropriate stimulus control. Differential reinforcement is required for a stimulus to acquire discriminative functions and this does not occur in serial procedures. In addition, correct responses are typically consequated with edibles on a continuous reinforcement schedule. Thus, a stimulus repeated many times in immediate succession, to which the child consistently responds correctly, may cause satiation and reduce the likelihood of the child attending to the target stimulus (Dunlap and Kogel, 1980).

Also, there are two potential problems associated with the testing procedures employed by previous researchers for assessing retention and/or generalization of serially trained items. First, due to repeated presentations of the same stimulus, appropriate stimulus control may not be established as a result of reaching criterion. Appropriate stimulus control, or lack of it, can be assessed during later testing when items are presented randomly requiring the child to make rapid discriminations from one trial to the next. Second, during serial training, the target stimuli reach criterion at different points in time; thus stimuli acquired at the beginning of the study may be weakening while those acquired near the end of the study may still be relatively well established. The passage of time between the termination of the study and later testing may introduce variables which reduce performance during testing.

In both interspersal and concurrent procedures differential reinforcement is more likely to occur, and therefore, it is more likely that the appropriate stimuli will acquire discriminative control over the particular responses. In the former, each training stimulus is alternated with other stimuli which have previously reached criterion (the other stimuli are considered to be "known" items) whereas in the latter, two or more training stimuli are alternated until they reach criterion simultaneously (all items are considered "unknown").

During interspersal training, criterion-trained stimuli are continually recycled throughout the study. Thus, stimuli reaching criterion during the study receive a variable number of review trials determined by the point at which they were learned. It is possible that the interspersal procedure may produce better retention because this procedure is more likely to establish appropriate stimulus control or because learned items are reinforced when they are interspersed with new items, and the strength of these responses is therefore maintained and stimulus control further refined.

Concurrent training procedures have the same stimulus control advantages as interspersal procedures. In addition, it would seem that more items could be trained per unit of time than during interspersal training, since many trials are not devoted to presenting learned items. A potential disadvantage however, is that one of the items may hamper the rate of acquisition for the other item(s) and introduce further problems into the training situation. For example, Weeks and Gaylord-Ross (1981) found that when a difficult task was compared to an easy task using the combined method (which, as pointed out, is similar to the concurrent method) self-injurious responses (i.e., finger biting) increased under the difficult task contingency.

STATEMENT OF THE PROBLEM

In an extensive review of the literature concerning the use of operant techniques for teaching verbal behavior to language-deficient children, Harris (1975) points out that the strategies have been vastly improved and repeatedly verified. She suggests, therefore, that further research should concentrate on developing novel procedures with an emphasis on appropriate controls during training and generalization to natural settings.

As previously stated, existing verbal training manuals vary their systematic training sequences between three modes of persentation (serial, interspersal, and concurrent). Since it seems reasonable to expect that more language training manuals will be available in the near future, it is important to evaluate the most efficient technique in terms of saving staff time and gains made by the child.

Recent studies have indicated superior performance for interspersal and concurrent procedures over serial procedures across a number of dependent variables. However, there appears to be a lack of research comparing the efficacy of interspersal and concurrent training on training time, and retention and generalization of learned items. This research was conducted to directly compare a concurrent procedure and an interspersal procedure for training picture-naming responses to determine which method (if either) best facilitates (a) rate of acquisition, (b) retention, and (c) generalization to another setting, to another experimenter, and to another modality (objects).

METHOD

Subjects

Three retarded children of the St. Amant Centre in Winnipeg were selected for participation in this study.

Shelley was born with Trisomy 21 Down's Syndrome and had been hospitalized at 10 months of age. She was seven years old at the time this research was initiated. Her vocal repertoire consisted of single-word responses, a few short phrases, and a number of picture-card names (e.g., "hi", "no", "come here", "ball", "car").

Mark was seven years old and diagnosed as mentally retarded (cause unknown) with moderate to severe autistic behaviors. Following a two-year training period in St. Amant's day care facility, he was formally hospitalized at age six. His vocal behavior was similar to Shelley's except that he could name only a few picture cards.

Laura, age 11, was diagnosed as severely retarded with an inactive seizure disorder and some indication of autism. She was hospitalized at four years of age. Except for a few single-word vocalized picture-name responses and one two-word response (peanut butter), her verbal repertoire consisted exclusively of babbling and a limited number of sign-language responses.

All three children were assessed by the Yale Development Schedule in October, 1980. The results showed the children's approximate level of functioning to be: 50% of normal for Shelley, 40% of normal for Mark, and 45% of normal for Laura.

Both Mark and Laura were experimentally naive whereas Shelley had served in a short extension of the study conducted by Welch and Pear (1980).

Setting, Apparatus, and Materials

Experimental sessions were conducted with each child individually in a small room located in the psychology department of the St. Amant Centre. The child and the experimenter sat at a small table facing each other. On the table were placed: (a) a trial-timing device, consisting of a small metal box with a red jewel lamp and a control button operated by the experimenter; (b) picture cards from the Peabody Articulation Kit; (c) data sheets; and (d) a container for holding the primary reinforcer(s). Laura and Mark were allowed access to a two-compartment choice box containing chocolate "Chipits" and small pieces of "Cheezies" as a primary reinforcer; one Chipit or piece of Cheezie per reinforcement. Shelley received one half of a teaspoon of ice cream per reinforcement. A large stop-clock was used to time the length of each session, and an audio tape recorder was used to record all responses emitted during the session. Video-tape recording equipment was used periodically to obtain tapes for procedural reliability assessment (described later).

A combination play area and conference room within the psychology department was used for conducting generalization tests. Materials used during retention and generalization tests were: (a) picture-cards which were trained to criterion during the experimental sessions, and (b) objects (three different objects per experimental phase) which were pre-selected on the basis that they were identical in color and form to the objects portrayed by the picture-cards used during training (see Welch and Pear, 1980, for a description of the selection and rating criteria).

Experimental Design

This study employed an ABA experimental design with counterbalancing (BAB) of picture-naming conditions across subjects. Laura and Shelley were

Table 1

A Summary of the Experimental Design

Subjects	Experimental Conditions (number of sessions are indicated in parentheses)		
Shelley	concurrent (33)	interspersal (35)	concurrent (27)
Mark	interspersal (36)	concurrent (49)	interspersal (31)
Laura	concurrent (60)	interspersal (19)	concurrent (12)

initially trained by the concurrent method, then the interspersal method, and then the concurrent method; whereas Mark was initially trained by the interspersal method, then the concurrent method, and then the interspersal method. A summary of the experimental design is presented in Table 1.

Preliminary Procedures

Prior to training, each child's picture-naming repertoire was assessed. Approximately 50 pictures were presented to a child in a randomized order, with each picture being presented on three occasions. Upon presentation of a picture, the child was asked "What's this?" and given eight seconds to respond. The trial was terminated when the child emitted a vocal response or after eight seconds had elapsed without a response. Following a five-second inter-trial interval, the next picture was presented in the same manner. This assessment was repeated as necessary during the study. That is, as the pool of pictures depleted as a result of training, another pool was selected and the child's picture-naming repertoire was assessed. Twenty preselected objects were also presented in accordance with the same procedure following the picture-name assessment.

During the picture and object-naming assessments, a variety of motor imitations (e.g., "clap your hands") were randomly interspersed on a one-to-two ratio among the presented pictures and objects (one motor imitation to two stimulus presentations) to maintain responding of picture-name responses. Several investigators have found that children will continue to emit responses to instructions which are never reinforced when these instructions are interspersed among other responses which produce reinforcement (Bucher, 1973; Martin, 1971; Welch and Pear, 1980; Whitman, Zakaras, and Chardos, 1971). The child was reinforced for correct motor imitation responses on a variable ratio-2 schedule (approximately every second response was reinforced), but was never reinforced for correct responses to pictures and objects.

After picture- and object-naming had been assessed, verbal imitation for both pictures and objects was assessed on the next day using the same procedure as described above. The child was prompted to imitate the name of each picture on three random presentations (e.g., "say bread"). If the child failed to respond or emitted an incorrect response to a word presentation, the corresponding picture and/or object was discarded. Approximations to perfect pronunciations (e.g., "brea" for "bread"), however, were accepted as correct pronunciations and specified as correct picture-name responses during training.

Each picture, and picture and corresponding object, which the child could not name during all three random presentations, but whose name the child could imitate was called a "subcriterion" item. Each picture to which the child could emit a correct response on all three random presentations was called a "criterion picture". The number of criterion pictures were: 18 for Shelley, eight for Mark, and five for Laura. All pictures that were not classified as subcriterion or criterion were discarded. The objects to which the child could emit a correct response on one or more of the three presentations were also discarded.

Ten pictures were selected from the subcriterion pool for each child and used as control pictures. These items were not trained but two of them were randomly selected and interspersed with trained pictures for presentation during weekly retention and generalization tests (to be described later). The rationale for testing control pictures with trained pictures was to assess the extent to which picture-name learning might have been occurring due to uncontrolled sources (e.g., home, school, wards).

Six objects were also selected from the subcriterion pool and used as control objects. Neither these objects nor their matched pictures were trained. Two of the six control objects were selected per experimental phase and were alternately interspersed and presented during generalization testing of those objects whose matched pictures were trained during the experimental sessions.

Nine objects were randomly selected from the subcriterion pool (three different objects for each condition) for generalization assessment. These objects were presented following the training and testing of corresponding pictures in order to determine the extent to which generalization may occur from the training stimuli to their untrained referents.

Picture-Name Training Procedures

Two 20-minute sessions, separated by a 10-minute break, were conducted with each individual child on each weekday. The procedure used for picture-name training was a modified version of a standardized procedure used by Kircher, Pear, and Martin (1971), Olenick and Pear (1980), Stephens, Pear, Wray, and Jackson (1975), and Welch and Pear (1980).

Trial initiation procedure. At the beginning of each session the experimenter depressed the button to start the clock to record session time. She then depressed the control button on the trial-timing device. This resulted in illumination of the red jewel lamp which initiated the eight-second trial. The experimenter then presented the picture at the child's eye-level and simultaneously said "What's this?" A correct or incorrect response resulted in the experimenter immediately terminating the trial by depressing the control button and extinguishing the red jewel lamp. Following the five-second inter-trial interval, the red lamp automatically illuminated again to signal the beginning of a new trial.

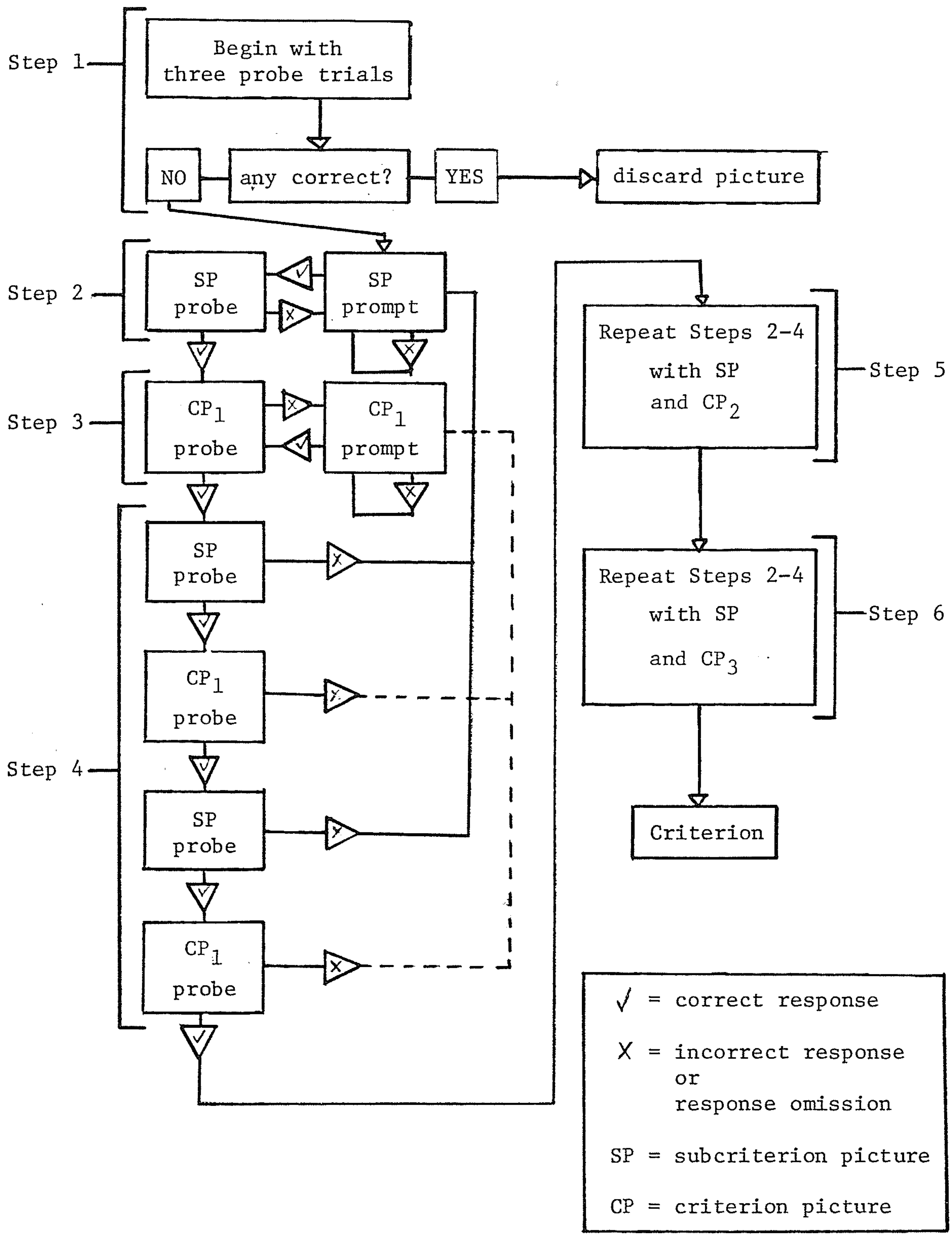
If the child failed to initiate a response within eight seconds (i.e., response omission), a buzzer sounded and the red lamp automatically extinguished signalling the termination of the trial and automatic progression into the five-second inter-trial interval.

Interspersal training. During interspersal training, each picture to be taught proceeded through a systematic sequence in which a randomly selected subcriterion picture (SP) was first alternated with a randomly selected criterion picture (CP_1) for a number of trials, then with a second randomly selected criterion picture (CP_2) for a number of trials, and finally with a third randomly selected criterion picture (CP_3) for a number of trials. When the entire sequence was completed, the SP was said to have "reached criterion". If SP did not reach criterion within five sessions, it was discarded. The experimenter presented two types of trials: (1) a probe trial during which the experimenter asked the name of the picture ("What's this?"); and (2) a prompt trial during which the experimenter also named the picture ("What's this? Shoe.")

Figure 1 depicts the six-step training sequence for the interspersal procedure. As illustrated in the figure, training proceeded according to the following steps:

Before training began with a given subcriterion picture (SP), the experimenter presented three probe trials with the SP (Step 1 in Figure 1). This functioned as a pretest to ensure that the child did not know the picture just prior to training. If the child named the picture during any one of these trials, the picture was discarded and replaced with another subcriterion picture. The experimenter proceeded to Step 2 only if the child failed to respond correctly to the SP during the three probe trials.

Figure 1. An illustration of the interspersal picture-training procedure.


Step 1
Begin with three probe trials
NO
any correct?
YES
discard picture
Step 2
SP probe
SP prompt
Step 3
CP1 probe
CP1 prompt
Step 4
SP probe
CP1 probe
SP probe
CP1 probe
Repeat Steps 2-4 with SP and CP2
Step 5
Repeat Steps 2-4 with SP and CP3
Step 6
Criterion
√ = correct response
X = incorrect response or response omission
SP = subcriterion picture
CP = criterion picture

During Step 2, the experimenter presented a prompt trial to the child with the SP. If the child correctly imitated the experimenter, she then presented a probe trial with SP. If the child responded incorrectly during a prompt trial, the trial was simply repeated. If the child responded correctly during the probe trial, the experimenter proceeded to Step 3 on the next trial. If the child made an error (i.e., an incorrect response or a response omission) during the probe trial, the experimenter returned to the prompt trial and the sequence was repeated. However, if 10 successive errors occurred on the prompt trial, the picture was discarded and replaced with another picture from the subcriterion pool and the experimenter began on Step 1 again.

During Step 3, the experimenter presented a probe trial to the child with the first criterion picture (CP_1). If the child correctly named CP_1, the experimenter proceeded to Step 4. If the child made an error, the experimenter presented a prompt trial. A correct imitative response during the prompt trial resulted in another presentation of the probe trial. As in the previous step, a prompt trial was repeated if an error (defined as an incorrect response or response omission) occurred, up to a maximum of 10 successive errors. If 10 successive errors occurred, the CP was replaced. The experimenter advanced to Step 4 only if the child responded correctly to the probe trial.

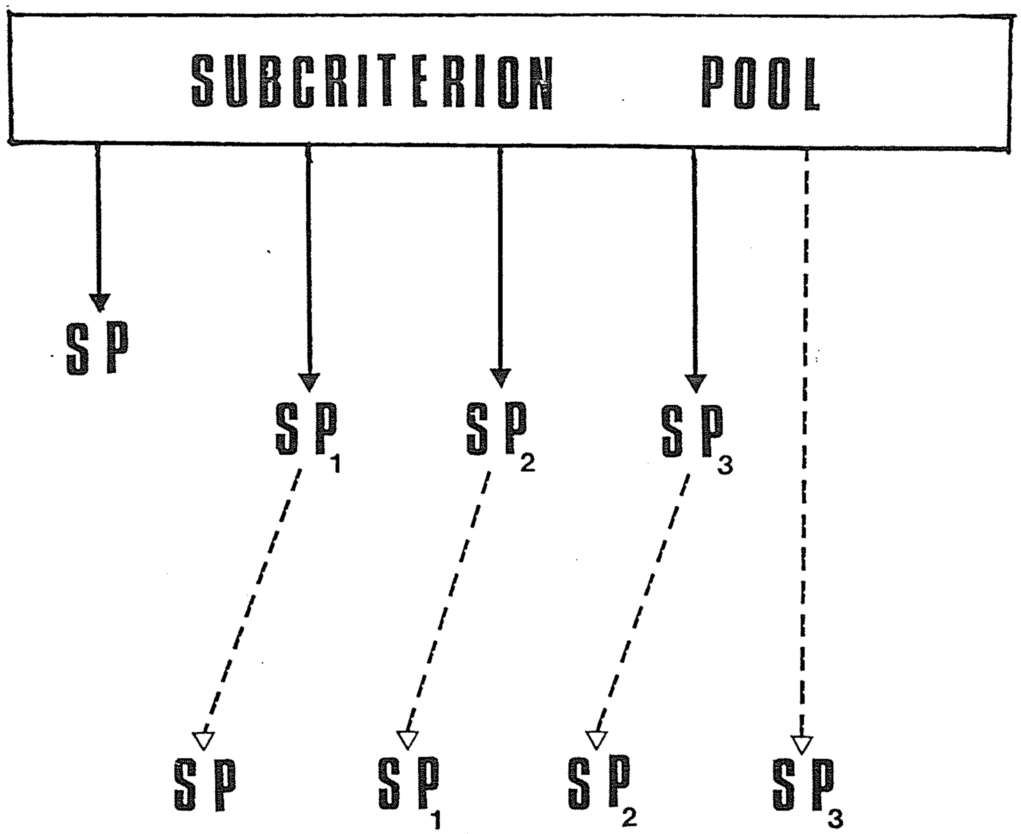
During Step 4, the experimenter presented a series of four probe trials to the child alternating between the SP and CP_1. If the child responded correctly on all four probe trials, the experimenter proceeded to Step 5. If the child made an error on a probe trial to SP, the experimenter returned to the prompt trial in Step 2 and continued as indicated in the figure. If an error occurred on a probe trial to CP_1, the experimenter returned to the prompt trial in Step 3, and continued as indicated in the figure.

Step 5 was essentially a repeat of Steps 2, 3, and 4, with a new criterion picture (CP_2). In addition, the experimenter began Step 2 by presenting a probe trial as opposed to a prompt trial. Step 6 was identical to Step 5 except CP_3 was substituted for CP_2. Upon successful completion of Step 6, SP was said to have "reached criterion". A new SP and three more CPs were then randomly selected and the entire training procedure was repeated.

Concurrent training. The concurrent training procedure was the same as the interspersal procedure as illustrated in Figure 1, but with the following exceptions: (1) the SP to be trained was alternated with three subcriterion pictures (SP_1, SP_2, SP_3) instead of CP_1, CP_2, and CP_3; and (2) when the SP reached criterion, SP_1 became the next SP to be trained, SP_2 became SP_1, SP_3 became SP_2, and a new randomly selected SP became SP_3. Figure 2 illustrates the manner in which subsequent SPs were relabelled and selected for training.

Reinforcement schedules. During picture-name training in both procedures, all correct responses to both prompts and probes were followed by social reinforcement (i.e., "good girl/boy"). However, the schedule of primary reinforcement differed for prompts and probes. For prompt trials, every fifth correct response was followed by primary reinforcement, whereas for probe trials every correct response was consequated with primary reinforcement. It has been found that verbal training is facilitated by employing this type of differential reinforcement schedule to prompts and probes (Olenick and Pear, 1980).

Figure 2. Schematic representation of relabelling and selecting subcriterion pictures for training with the concurrent procedure. The upper portion of the figure presents the SP being trained which was alternated with SP_1, SP_2, and SP_3. The lower portion of the figure shows that after the above SP had reached criterion, SP_1 became the next SP to be trained, SP_2 and SP_3 became SP_1 and SP_2, respectively, and a new SP selected from the pool, became SP_3.


SUBCRITERION POOL
SP
SP1
SP2
SP3
SP
SP1
SP2
SP3

Retention Tests

At the beginning of each week, every picture that had reached criterion (if any) during the previous week was tested for retention in the training setting prior to the experimental session. Two of the 10 control pictures were randomly selected and presented with the criterion-trained pictures in random order. The procedure employed for retention testing was identical to the picture presentation format used during the preliminary procedure conducted prior to picture-name training except that 25% of the criterion-trained pictures were randomly selected and designated as those pictures which would occasion primary and social reinforcement if the child responded correctly to the picture presentation.

Generalization Tests

Immediately following retention testing, the experimenter conducted a generalization test using objects that matched the criterion-trained pictures (if any). Two control objects were alternated with the generalization test object(s). Motor imitation trials were also interspersed as described above (see section entitled Preliminary Procedure).

On the day following retention testing of pictures and generalization testing of objects, an individual (hereafter referred to as tester) who was unaware of the experimental conditions repeated the assessments on all pictures and objects which were tested the previous day. These assessments proceeded in the same manner as retention testing and generalization testing of objects.

Dependent Variables

Nine dependent variables were examined in this research. They were:

1. cumulative number of picture-names reaching criterion over sessions;

2. probe accuracy per session for all pictures (i.e., the percentage of correct responses emitted to the total number of probe trials presented for all pictures during each session);
3. prompt accuracy per session for all pictures;
4. probe accuracy per session for each main picture (SP) only (i.e., the percentage of correct responses emitted to the total number of probe trials presented for each main picture [i.e., the SP being trained] during each session);
5. prompt accuracy per session for each main picture (SP);
6. total number of probe and prompt trials presented during each session;
7. total number of picture-names retained during each weekly test;
8. total number of picture-names generalized during each weekly test;
9. number of responses that generalized from pictures to objects during each test.

Interobserver Reliability

All training sessions were audio-taped and approximately one-sixth of the tapes were randomly selected for reliability checks on the child's correct and incorrect responses. An independent observer, who was familiar with the criteria for correct and incorrect responses, listened to the tapes and scored the child's imitative and picture-name responses prior to hearing the experimenter's decision. All retention and generalization tests were audio-taped and played to an independent observer for reliability checks in the same manner as described for training sessions.

Inter-observer reliability was calculated with the formula: $\frac{\text{agreements}}{\text{agreements + disagreements}}$. Omissions (i.e., trials during which no response was emitted) were not included in the calculations.

Table 2 shows the reliability coefficients for training, retention tests, generalization tests, and generalization to objects. As can be seen, the coefficients range from .87 to 1.00.

Procedural Reliability

Nine 20-minute video tapes were randomly selected and rated for procedural reliability by an independent observer on the following dimensions:

1. Did the experimenter present the correct picture during each trial?
2. Did the experimenter follow the probe and prompt sequence correctly?
3. Did the experimenter deliver primary and social reinforcements for probes and prompts according to the specified schedule?
4. Did the experimenter introduce a new training stimulus following 10 consecutive errors to prompts?

There were a total of 1177 trials presented (489 probe trials and 688 prompt trials) during the nine 20-minute periods. The number of errors observed on each dimension were as follows:

1. correct pictures presented - one error;
2. correct probe and prompt sequence - 3 errors;
3. delivery of primary and social reinforcements for probes - no errors; for prompts - 10 errors (of the 10 errors, six occurred during concurrent training and four

Table 2

Interobserver Reliability Coefficients

CHILD	Training				Retention Tests		Generalization Tests		Generalization To Objects			
	Probes		Prompts						Trainer		Testor	
	C.	E.	C.	E.	C.	E.	C.	E.	C.	E.	C.	E.
Shelley	.98	.99	.99	1.00	.98	.99	.98	.99	.96	.97	.88	.94
Mark	.99	.99	.98	.98	.87	.94	1.00	1.00	.87	.94	1.00	1.00
Laura	.94	.88	.99	1.00	.99	.99	.99	.99	.93	.95	1.00	1.00

C. Correct Responses scored by the experimenter

E. Errors (i.e., incorrect) responses scored by the experimenter occurred during interspersal training);

4. introduction of new training stimuli - no errors.

Thus, the procedures employed during this study were conducted with a high degree of precision.

RESULTS

Figure 3 presents the cumulative number of picture-names acquired (i.e., that reached criterion) over sessions by each child across conditions. Although the learning rates are different for all three children, the rates of acquisition are higher in the interspersal than in the concurrent conditions in all cases, with large differences for Shelley and Mark and smaller differences for Laura. In addition, fewer pictures were replaced during the interspersal than during the concurrent conditions (see procedure section for the replacement criterion). For Shelley, a total of four pictures were replaced during concurrent training, and one picture during interspersal training. For Mark, a total of five pictures were replaced during interspersal training, and 14 pictures during concurrent training. For Laura, a total of eight pictures were replaced during concurrent training, and none during interspersal training.

The probe accuracy over sessions for all pictures is presented in Figure 4 and the probe accuracy per session for main pictures only (i.e., subcriterion pictures being trained) is presented in Figure 5. When the total number of probe trials for all pictures is considered (Figure 4), the mean probe accuracy (indicated by the dashed line) is slightly higher during the interspersal condition for all three children. However, when the total number of probe trials presented for main pictures is considered (Figure 5), the mean probe accuracy is higher in the concurrent condition across all three children. Also note, in Figure 5, that when the mean probe accuracy for main pictures only is compared across both conditions, the mean is consistently higher during concurrent training. One may expect the means to be approximately equal across both conditions since trials devoted to alternate pictures are abstracted out of both conditions.

Figure 3. Cumulative number of picture-names reaching criterion during each session for Shelley, Mark, and Laura. The average number of picture-names reaching criterion per session are denoted below the horizontal axis for each condition. The arrowheads above the cumulative learning rates denote sessions during which a picture-card was replaced.

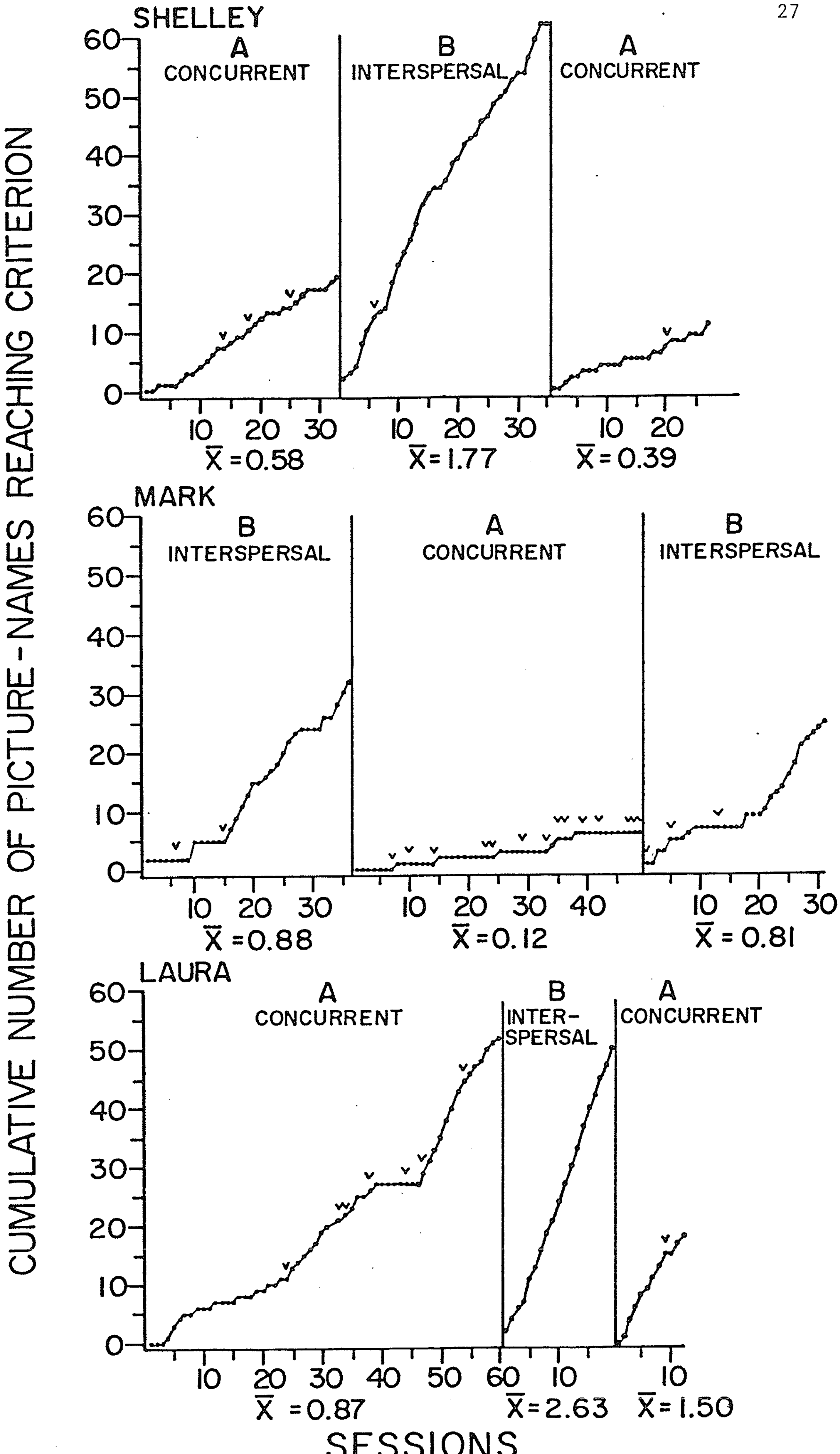

SHELLEY
A
CONCURRENT
B
INTERSPERSAL
A
CONCURRENT
X̄ = 0.58
X̄ = 1.77
X̄ = 0.39
MARK
B
INTERSPERSAL
A
CONCURRENT
B
INTERSPERSAL
X̄ = 0.88
X̄ = 0.12
X̄ = 0.81
LAURA
A
CONCURRENT
B
INTER-
SPERSAL
A
CONCURRENT
X̄ = 0.87
X̄ = 2.63
X̄ = 1.50
CUMULATIVE NUMBER OF PICTURE-NAMES REACHING CRITERION
SESSIONS

Figure 4. Probe accuracy expressed as percentage of correct responses emitted to the total number of probe trials for all pictures during each session. The dashed lines indicate the mean probe accuracy during each condition.

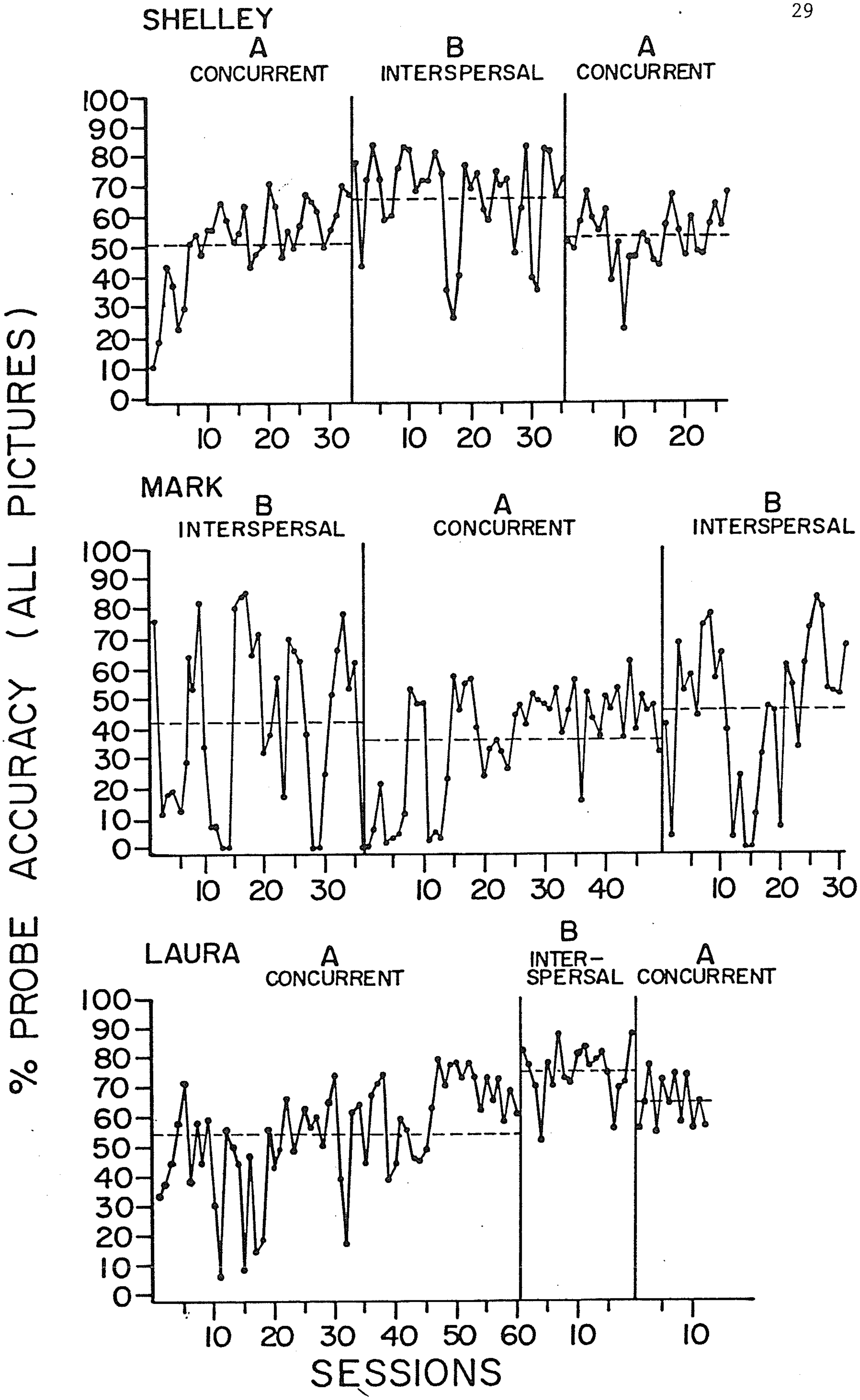
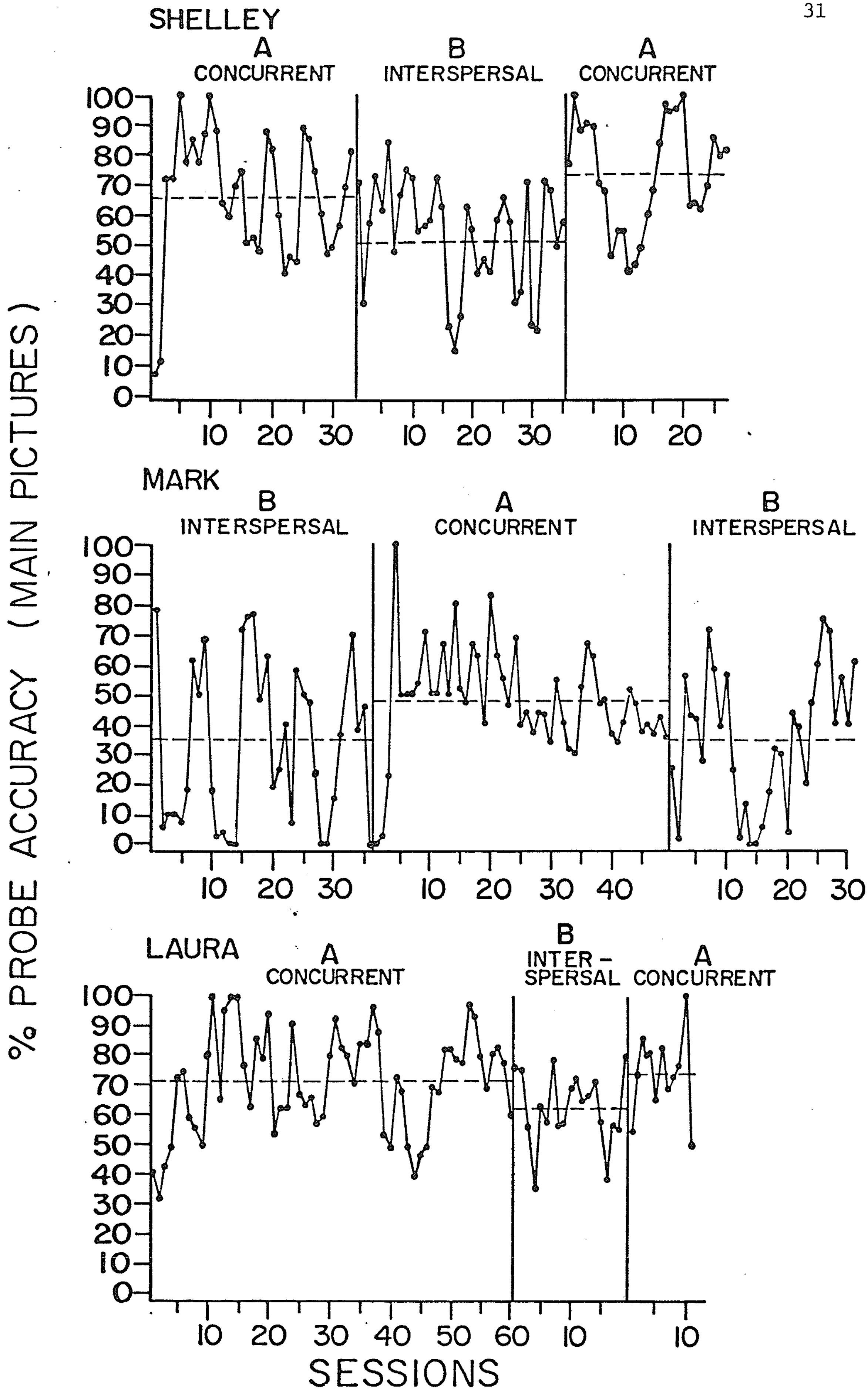

SHELLEY
A
CONCURRENT
B
INTERSPERSAL
A
CONCURRENT
MARK
B
INTERSPERSAL
A
CONCURRENT
B
INTERSPERSAL
LAURA
A
CONCURRENT
B
INTER-
SPERSAL
A
CONCURRENT
% PROBE ACCURACY (ALL PICTURES)
SESSIONS

Figure 5. Probe accuracy expressed as percentage of correct responses emitted to the total number of probe trials presented for each main picture only (i.e., SP being trained) during each session. The dashed lines indicate the mean probe accuracy during each condition.


SHELLEY
A
CONCURRENT
B
INTERSPERSAL
A
CONCURRENT
100
90
80
70
60
50
40
30
20
10
0
10 20 30 10 20 30 10 20
MARK
B
INTERSPERSAL
A
CONCURRENT
B
INTERSPERSAL
10 20 30 10 20 30 40 10 20 30
LAURA
A
CONCURRENT
B
INTER-
SPERSAL
A
CONCURRENT
10 20 30 40 50 60 10 10
SESSIONS
% PROBE ACCURACY (MAIN PICTURES)

However, the higher mean probe accuracy for concurrent training may be due to the fact that prior to becoming main pictures, the child received exposure to these pictures as alternate pictures (i.e., SP_1, SP_2, and SP_3) as a result of the recycling process. On the other hand, main pictures trained with the interspersal method were novel in each case.

Figures 6 and 7 present prompt accuracy per session for all pictures, and for main pictures only, respectively. Overall, there is no clear difference between the interspersal and concurrent training conditions in prompt accuracy for all pictures (Figure 6) as well as prompt accuracy for main pictures only (Figure 7). In Figure 6, the mean prompt accuracy for all pictures shows a slight upward trend for Shelley but a slight downward trend for Laura across conditions. On the other hand, the mean prompt accuracy for Mark shows no difference across all conditions. In Figure 7, Shelley also showed a slight upward trend in mean prompt accuracy across conditions, but Mark and Laura showed a slight difference in mean prompt accuracy favoring the concurrent condition.

Table 3 depicts the average number of primary reinforcers delivered over sessions in each condition. The average number of reinforcers delivered for probes was slightly higher during interspersal training for all children, while the average number of reinforcers delivered for prompts was slightly higher during concurrent training. In total, there were more reinforcers delivered during interspersal than during concurrent training (except for Mark who averaged the same number of reinforcers during the first and second phases and slightly more reinforcers during the third phase).

Table 4 presents the average number of trials to criterion for each picture (SP) for each child during each condition. The first column shows

Figure 6. Prompt accuracy expressed as percentage of correct responses emitted to the total number of prompt trials presented for all pictures during each session. The dashed lines indicate the mean prompt accuracy during each condition.

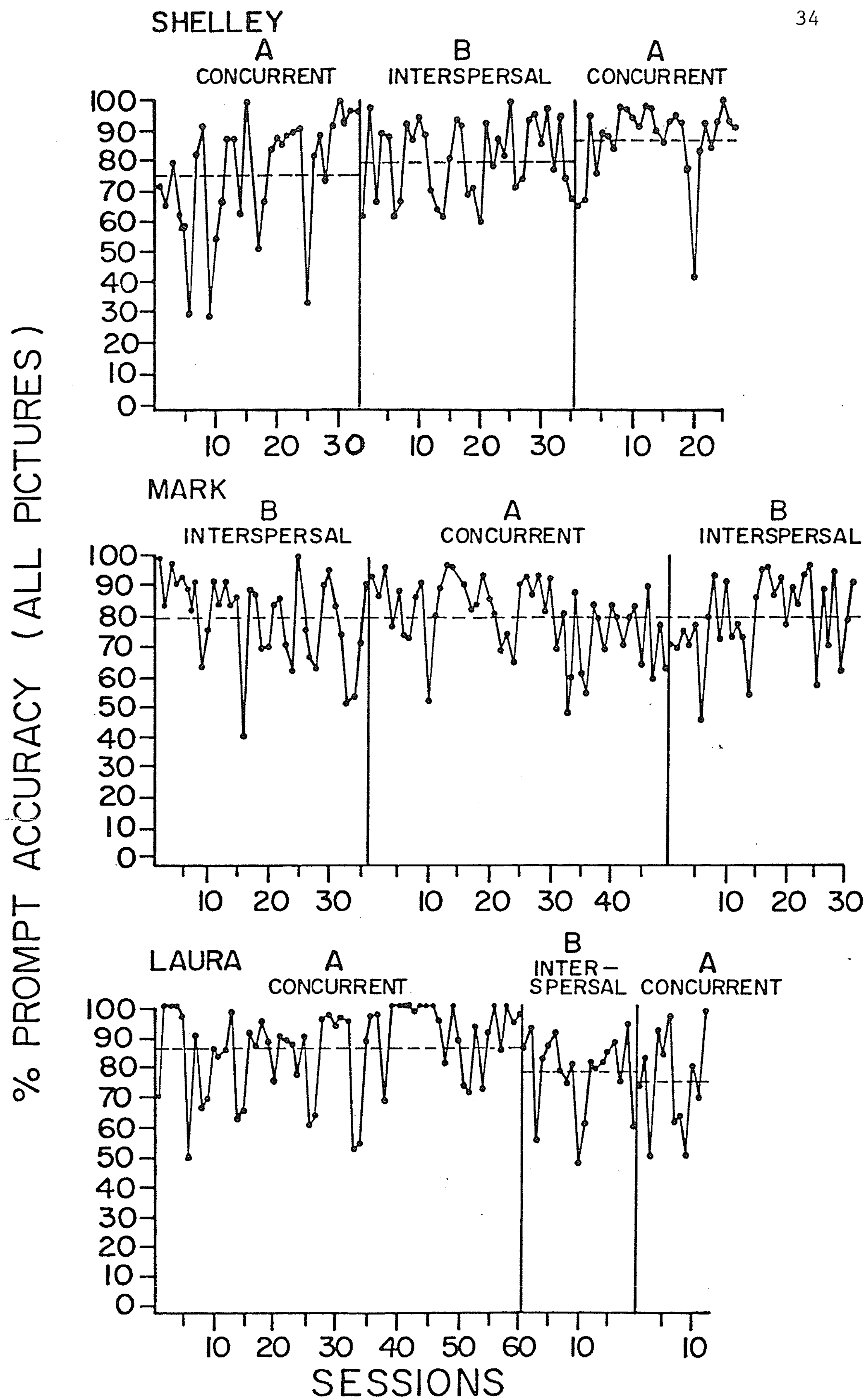

SHELLEY
A
CONCURRENT
B
INTERSPERSAL
A
CONCURRENT
MARK
B
INTERSPERSAL
A
CONCURRENT
B
INTERSPERSAL
LAURA
A
CONCURRENT
B
INTER-
SPERSAL
A
CONCURRENT
% PROMPT ACCURACY (ALL PICTURES)
SESSIONS

Figure 7. Prompt accuracy expressed as percentage of correct responses emitted to the total number of prompt trials presented for each main picture only (i.e., SP being trained) during each session. The dashed lines indicate the mean prompt accuracy during each condition.

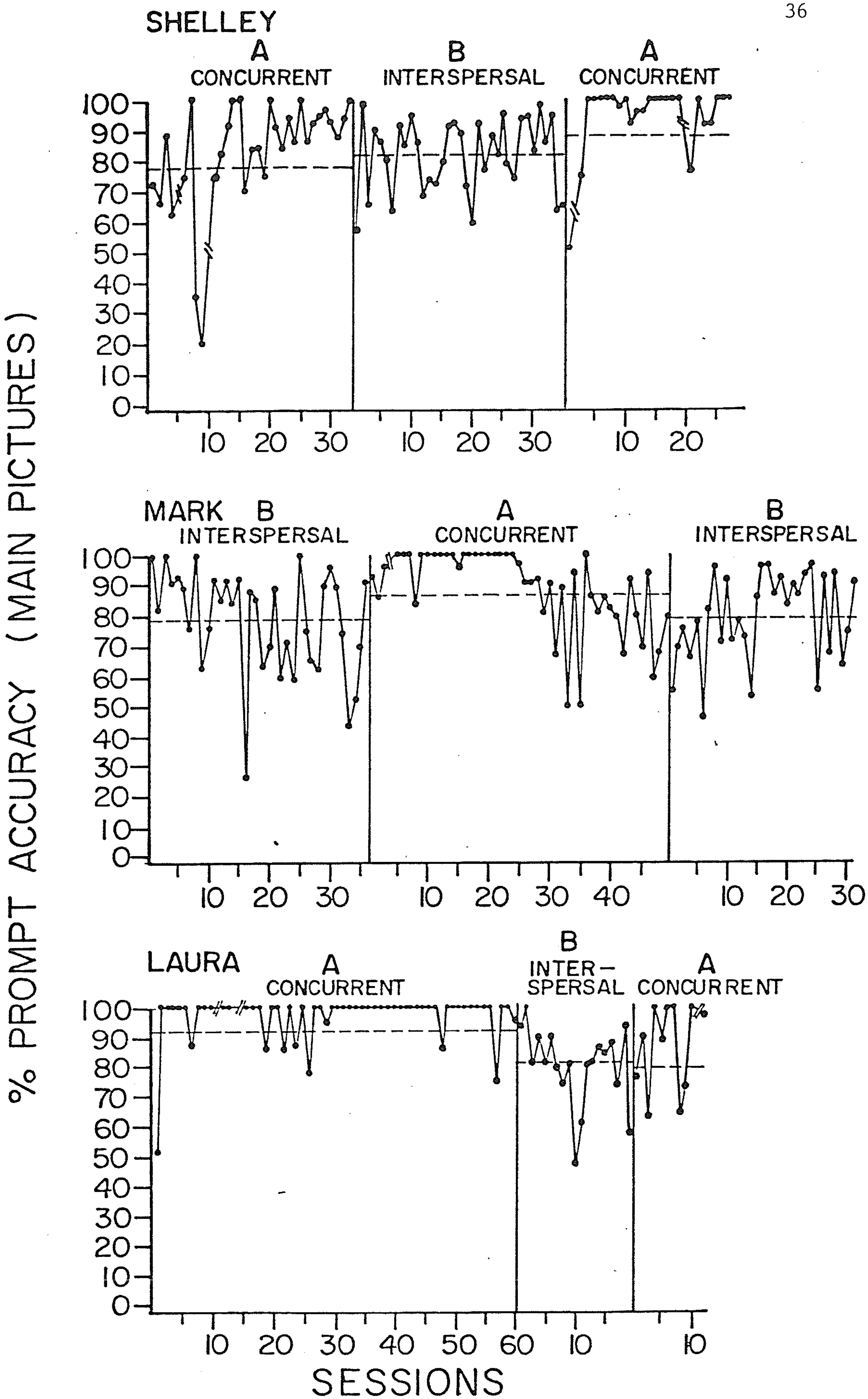

SHELLEY
A
CONCURRENT
B
INTERSPERSAL
A
CONCURRENT
MARK
B
INTERSPERSAL
A
CONCURRENT
B
INTERSPERSAL
LAURA
A
CONCURRENT
B
INTER-
SPERSAL
A
CONCURRENT
% PROMPT ACCURACY (MAIN PICTURES)
SESSIONS
0
10
20
30
40
50
60
70
80
90
100
10 20 30
10 20 30 40
10 20 30 40 50 60

Table 3

Average Number of Primary Reinforcers Delivered

Per Session for Each Condition

Child	Condition	Number of Sessions Conducted	Average Number of Reinforcers per Session		
			Probes	Prompts	Total
Shelley	Concurrent	33	44	8	52
	Interspersal	35	57	6	62
	Concurrent	27	40	7	47
Mark	Interspersal	36	30	7	38
	Concurrent	49	29	9	38
	Interspersal	31	37	7	44
Laura	Concurrent	60	46	7	53
	Interspersal	19	67	4	71
	Concurrent	12	52	6	57

Table 4

Average Number of Training Trials to Criterion per Picture for Each Child in Each Condition

Child	Condition	Average Number of Trials to Criterion Per Picture	Average Number of Trials to Criterion for Main Pictures	Average Number of Trials to Criterion for Alternate Pictures
Shelley	Concurrent	240	95	145
	Interspersal	66	47	18
	Concurrent	264	93	171
Mark	Interspersal	88	67	21
	Concurrent	725	246	479
	Interspersal	117	92	26
Laura	Concurrent	143	50	93
	Interspersal	46	30	16
	Concurrent	80	31	49

the average total number of trials to criterion for each picture (SP). This included the trials presented for the main pictures and the alternate pictures (i.e., CP_1, CP_2, and CP_3 during the interspersal condition, and SP_1, SP_2, and SP_3 during the concurrent condition). The second and third columns show trials presented for main pictures only and trials presented for alternate pictures only, respectively. Pictures trained during the concurrent condition always required a higher total number of trials to criterion (first column in Table 4). However, a comparison of the second and third columns in Table 4 shows that the majority of trials in the concurrent condition were spent on the alternate pictures rather than on the main pictures. The reverse is true for the interspersal procedure.

Figure 8 shows the total number of trials presented per session for each condition. The fact that, on the average, more trials tended to be presented during concurrent training than during interspersal training was surprising because trial and inter-trial interval times within each session were automatically controlled.

Table 5 presents the total number of picture-names tested during the weekly retention and generalization assessments for each training condition and the number of picture-names that the child both retained and generalized on at least one of the three picture presentations. Table 5 also shows: (1) the total number of pictures not denoted for reinforcement (75% of the picture pool) which were tested, retained, generalized, and both retained and generalized, and (2) the total number of pictures denoted for reinforcement (25% of the picture pool) which were tested, retained, generalized, and retained and generalized. In general, retention was poor across all children. The results suggest that percent retention may have been somewhat better for pictures trained by the concurrent method across both

Figure 8. The total number of trials presented during each session.

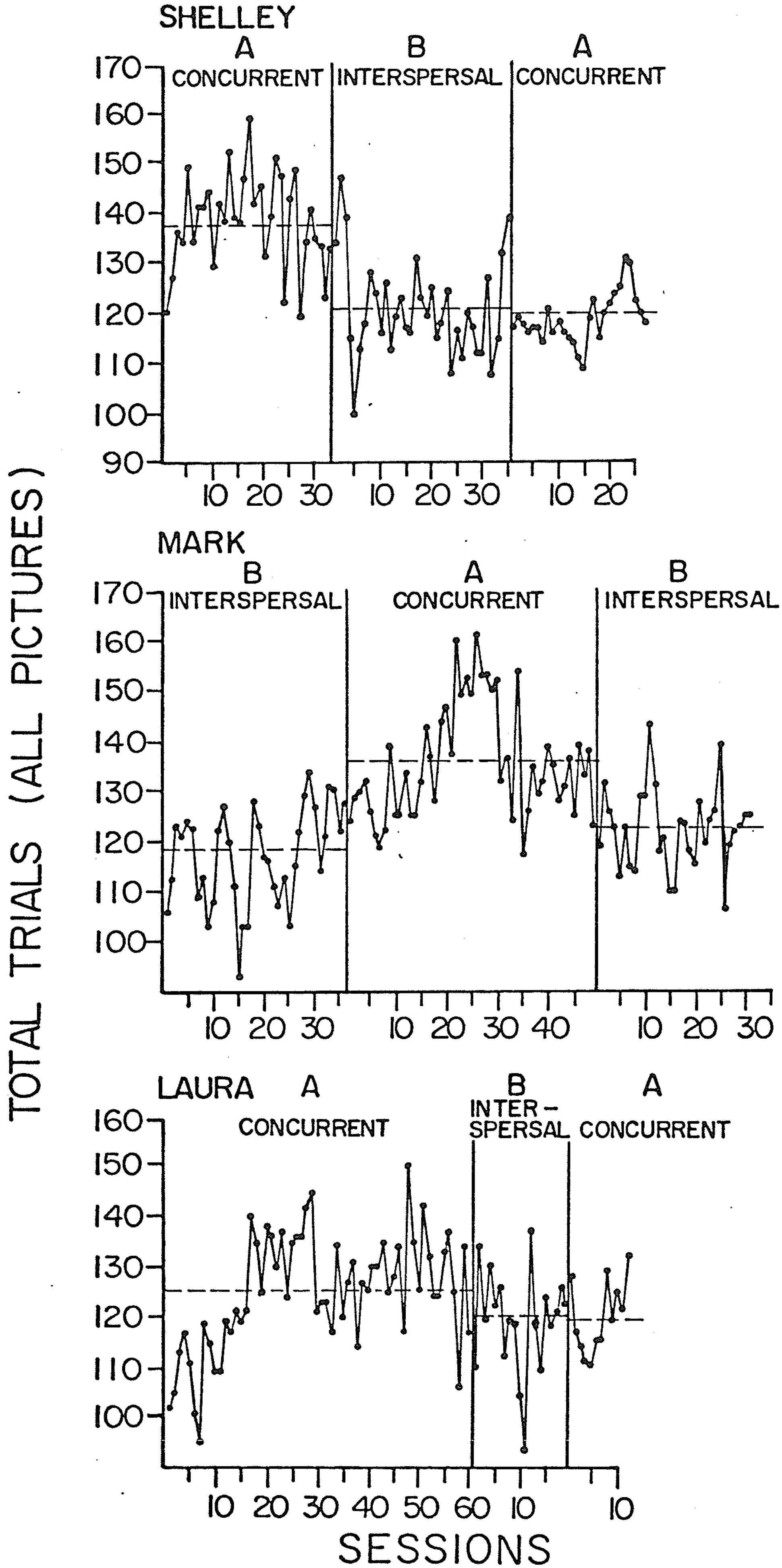

SHELLEY
A
CONCURRENT
B
INTERSPERSAL
A
CONCURRENT
MARK
B
INTERSPERSAL
A
CONCURRENT
B
INTERSPERSAL
LAURA
A
CONCURRENT
B
INTER-
SPERSAL
A
CONCURRENT
TOTAL TRIALS (ALL PICTURES)
SESSIONS

Table 5

A Summary of Retention and Generalization of Picture-Naming Responses

Child	Condition	Total Number of Pictures				Total Number of Pictures Not Denoted for Reinforcement				Total Number of Pictures Denoted for Reinforcement			
		Tested	Retained	Generalized	Retained and Generalized	Tested	Retained	Generalized	Retained and Generalized	Tested	Retained	Generalized	Retained and Generalized
Shelley	Concurrent	19	12(63%)	13(68%)	11(92%)*	14	7(50%)	8(57%)	6(86%)*	5	5(100%)	5(100%)	5(100%)
	Interspersal	62	32(52%)	25(40%)	21(66%)	46	20(43%)	16(35%)	12(60%)	16	12(75%)	9(56%)	9(75%)
	Concurrent	11	9(82%)	8(73%)	6(67%)	8	6(75%)	6(75%)	4(67%)	3	3(100%)	2(67%)	2(67%)
Mark	Interspersal	32	9(28%)	6(19%)	5(56%)	26	5(19%)	5(19%)	4(80%)	8	4(50%)	1(13%)	1(25%)
	Concurrent	6	6(100%)	6(100%)	5(83%)	4	4(100%)	4(100%)	3(75%)	2	2(100%)	2(100%)	2(100%)
	Interspersal	30	1(03%)	1(03%)	1(100%)	22	1(05%)	1(05%)	1(100%)	8	0	0	0
Laura	Concurrent	52	24(46%)	25(48%)	21(88%)	39	18(46%)	18(46%)	15(83%)	13	6(46%)	7(54%)	6(100%)
	Interspersal	50	1(02%)	3(06%)	1(100%)	37	1(03%)	3(08%)	1(100%)	13	0	0	0
	Concurrent	18	0	0	0	13	0	0	0	5	0	0	0

*Indicates percent of retained responses that generalized.

non-reinforced and reinforced picture pools whereas the opposite is shown for absolute retention. The findings of the generalization tests appear to be consistent with the results on retention. However, due to the lower rate of learning during the concurrent condition, fewer pictures were trained to criterion in that condition and tested during weekly assessments. In addition, both Mark and Laura began to omit dramatically to picture presentations following the 13th week of testing. These two factors made this data difficult to compare across conditions.

An interesting result of the analysis showed that, picture-names that were retained also tended to generalize (e.g., if a child emitted a correct response to the picture-card boat on the retention test he/she also tended to respond correctly to that particular picture on the generalization test). This finding appeared to be consistent for both nonreinforced and reinforced pictures across both conditions for all three children. This suggests that being able to retain learned items is a critical variable in facilitating generalization. Perhaps better performance on retention tests would have also produced similar results on generalization tests.

Table 6 shows the number of correct responses emitted to objects presented by the experimenter (trainer) and the tester. The results were similar to those found during the picture-name retention and generalization tests. That is, although performance was generally poor across all children, objects that the children responded to correctly when presented by the trainer also tended to be responded to correctly when presented by the tester.

Table 6

A Summary of Generalization Tests to Objects

Child	Condition	Number of Objects Tested	Total Number of Objects Generalized		
			Presented by the Trainer	Presented by the Tester	Presented by the Tester and Trainer
Shelley	Concurrent	3	2 (67%)	2 (67%)	2 (100%)
	Interspersal	3	3 (100%)	2 (67%)	2 (67%)
	Concurrent	3	1 (100%)	1 (100%)	1 (100%)
Mark	Interspersal	3	0	0	0
	Concurrent	2*	0	0	0
	Interspersal	3	1 (33%)	1 (33%)	1 (100%)
Laura	Concurrent	3	3 (100%)	2 (67%)	2 (67%)
	Interspersal	3	0	0	0
	Concurrent	3	0	0	0

*Only two of the three pictures for the corresponding objects reached criterion during training.

DISCUSSION

The interspersal procedure used in this study was clearly superior to the concurrent procedure with respect to acquisition of picture-name responses. More pictures were acquired per session during interspersal training across all three children. This finding was particularly evident in Shelley's and Mark's rates of responding, and to some extent, in Laura's rate. As previously noted, Laura's verbal repertoire was limited, almost exclusively, to sign language at the beginning of this study. After approximately four weeks of training, her school teacher and the cottage staff informed this investigator that her sign language behaviors were decreasing and her spontaneous vocal behavior was increasing. These uncontrolled sources of reinforcement for spontaneous verbalizations may have contributed to Laura's increased rate of learning at approximately session 50 (see Figure 3) and also possibly influenced her rate of responding during the remainder of the study.

There are a number of factors which may have contributed to the effectiveness of the interspersal procedure. Poor performance during concurrent training may be partially accounted for by the greater number of trials spent on alternate pictures. It was originally presumed that by providing training for the alternate unknown pictures, acquisition of the unknown pictures would be facilitated when each became the main picture to be trained. However, learning, if any, as a result of this prior exposure, did not appear to be enough to offset the greater amount of trials (time) spent. As shown in Table 4, the majority of trials were spent on alternate pictures in the concurrent condition across all of the children whereas the opposite was true for the interspersal condition. Perhaps this was due to the fact that in the interspersal condition, alternate pictures were already "known" and thus the probability of correct responding was increased to these alternate pictures which produced a faster progression of the main picture through the training sequence. On the other hand, alternate pictures in the concurrent condition were "unknown" and errors on these pictures resulted in a recycling process within the training sequence causing a delay in acquisition of the main picture.

A second contributing factor may have been the higher frequency of reinforcement in the interspersal condition which resulted from the higher probe accuracy in that condition. Whereas, for concurrent training, overall probe accuracy was lower and hence reinforcement frequency was lower. The higher frequency of reinforcement in the interspersal condition may have also reinforced better overall attending behavior during training which led to faster acquisition of the main pictures. The average number of primary reinforcers delivered per session to both Shelley and Laura as well as to Mark during the third phase were in fact somewhat greater during interspersal training.

It is of interest to note that the total number of trials presented per session was generally greater for concurrent training than for interspersal training. Considering that the presentation of trials was controlled by an automatic trial-timing device and was held relatively constant, the total number of trials presented per session is primarily affected by the child's response latency following presentation of the picture-card. That is, if the child did not respond, the trial would last for eight seconds. If the child did respond quickly to the presentation of the picture-card, the trial terminated before the maximum eight-second interval, and the inter-trial interval was initiated (see trial initiation procedure). Therefore, it would appear that the children responded more rapidly during the concurrent condition (as reflected by the greater number of trials presented), but emitted more incorrect responses (as reflected by the lower acquisition rate).

On the basis of casual observations, there is some indication that concurrent training was somewhat aversive for all three children. During this condition, the children often emitted "emotional" behaviors which were characterized by crying, tantruming, or hitting the presented stimulus. Mark and Laura appeared to be the most affected as they would sometimes strike themselves on the chest and throw themselves backwards in their chairs. When two alternating stimuli had been presented for a number of trials with very few correct responses, these two children would eventually ignore the stimuli by turning away. This resulted in a large number of errors which subsequently led to the replacement of the picture-cards (see procedure section regarding the criteria for replacing pictures). As shown in Figure 3, the replacement rate of new stimuli during concurrent training was greater for both Mark and Laura than for Shelley. These anecdotal observations appear to be consistent with the findings that aberrant behavior increases as the difficulty of varied verbal task increases (Weeks and Gaylord-Ross, 1981).

Retention and generalization of pictures was poor for all three children. The fact that 25% of the criterion trained picture-pool was reinforced during testing did not seem to consistently affect performance. Perhaps the children did not have an opportunity to come into contact with the reinforcement contingency because the percentage of reinforced picture-name responses was small and/or the frequency of errors was relatively high on each test.

Another explanation could be that the ratio of motor imitation trials may have been too low (one motor imitation to every two pictures, with approximately every second motor response receiving reinforcement), as well as too different a response class to maintain responding to test stimuli. Contrary to this study, Welch and Pear (1980) maintained performance by employing a two-to-one ratio of continuously reinforced motor instructions to generalization test probes, and Whitman et al. (1971) maintained performance by only using one response class (instruction following). The children in this study consistently responded correctly on motor imitation trials on all tests. Therefore, if the above interpretation is valid, it may be that the subset of motor instructions produced a discrimination between motor and vocal responding.

In general, picture-names that were retained also generalized. The finding appeared to be consistent across both conditions for all three children. This suggests that retention of learned items is a critical variable in facilitating generalization. A further analysis was conducted to determine if there were any differences in correct responding on tests to pictures that reached criterion at the beginning of the week versus those that reached criterion at the end of the week. The results showed no consistent differences in either retention or generalization. This suggests that once a picture-name was acquired through training, the passage of time alone, at least within the limits set in this study, did not consistently affect performance.

Although only three objects were tested in each condition (except for Mark who learned only two picture-names which had corresponding objects during one condition), objects to which the children responded correctly when presented by the experimenter (trainer) were also responded to correctly when presented by the tester. As with picture-name responses, this may have reflected the child's failure to retain the picture-name responses rather than an inability to generalize from the pictures to the corresponding untrained referents (objects).

In conclusion, the present research suggests that interspersing known stimuli with an unknown stimulus produces a more rapid rate of picture-name acquisition than training several unknown stimuli concurrently. This difference seems to be largely accounted for by the number of trials spent on training the alternate pictures. The interspersal procedure appears to have the advantage of capitalizing on the learner's past history with the "known" alternate pictures. Moreover, this procedure does not appear to produce the emotional side-effects observed in the concurrent procedure. Perhaps if given a choice, these children would have indicated a preference for interspersal training as did the subjects in the Neef et al. (1980) study. Further comparisons of these procedures should incorporate a preference testing component to empirically evaluate the acceptability of these procedures from the learner's standpoint.

Future research is also needed to further examine the relationships between acquisition, retention, and generalization. The present study highlights the fact that retention is critical for generalization. The relevant variables for maximizing retention of picture-naming responses need to be identified and controlled. Frequent reviews of items learned during training, as is typically presented in interspersal procedures (but not in this study), undoubtedly are important. In this study, however, review of learned items was deliberately omitted in order to test retention and generalization apart from such reviews. Future studies should be directed toward determining optimum amounts and types of reviews.

Reference Notes

1. McDonald, L.M.O. A validation of three instructional procedures for early language. Unpublished Doctoral dissertation, University of Alberta, Edmonton, Alberta, 1980.

2. Reisin, I. Effects of interspersal versus concurrent training of picture-names on acquisition maintenance and generalization. Unpublished Master's thesis, The University of Manitoba, Winnipeg, Manitoba, 1980.

REFERENCES

Bender, M., Valletutti, P.J., & Bender, R. Teaching the moderately and severely handicapped: Curriculum objectives, strategies, and activities, volume II. Baltimore: University Park Press, 1978.

Bricker, W.A. A systematic approach to language training. In R.L. Schiefelbusch (Ed.), Language of the mentally retarded. Baltimore: University Park Press, 1972.

Bricker, W.A., & Bricker, D.D. A program of language training for the severely handicapped child. Exceptional Children, 1970, 37, 101-111.

Bricker, W.A, & Bricker, D.D. Assessment and modification of verbal imitation with low-functioning retarded children. Journal of Speech and Hearing Research, 1972, 15, 690-698.

Bucher, B. Some variables affecting children's compliance with instructions. Journal of Experimental Child Psychology, 1973, 15, 10-21.

Buddenhagen, R. Establishing vocalizations in mute Mongoloid children. Champaig, Ill.: Research Press, 1971.

Cuvo, A.J., Klevans, L., Borakove, S., Borakove, L.S., Landuyt, J.V., & Lutzker, J.R. A comparison of three strategies for teaching object names. Journal of Applied Behavior Analysis, 1980, 13, 249-257.

Dunlap, G., & Kogel, R.L. Motivating autistic children through stimulus variation. Journal of Applied Behavior Analysis, 1980, 13, 619-627.

Frisch, S.A., & Schumaker, J.B. Training generalized receptive prepositions in retarded children. Journal of Applied Behavior Analysis, 1974, 7, 611-621.

Glidden, L.M., Pawelski, C., Mar, H., & Zigman, W. Extended recency effect extended: Blocking, presentation mode, and retention interval. American Journal of Mental Deficiency, 1979, 84, 74-81.

Goldstein, S.B., & Lanyon, R.I. Parent-clinicians in the language training of an autistic child. Journal of Speech and Hearing Disorders, 1971, 36, 522-560.

Guess, D., Sailor, W., & Baer, D.M. Functional speech and language training for the severely handicapped. Part 1. Kansas: H & H Enterprises, Inc., 1976.

Harris, S.L. Teaching language to nonverbal children with emphasis on problems of generalization. Psychological Bulletin, 1975, 82, 565-580.

Hartung, J.R. A review of procedures to increase verbal imitation skills and increase functional speech in autistic children. Journal of Speech and Hearing Disorders, 1970, 35, 203-217.

Hewitt, B.C., & Sherman, J.A. Teaching generative use of sentence answers to three forms of questions. Journal of Applied Behavior Analysis, 1975, 8, 321-330.

Kent, L.R. Language acquisition program for the retarded or multiply impaired. Champaign, Ill.: Research Press, 1974.

Kircher, A.S., Pear, J.J., & Martin, G.L. Shock as punishment in a picture-naming task with retarded children. Journal of Applied Behavior Analysis, 1971, 4, 227-233.

Kogel, R.L., & Rincover, A. Treatment of psychotic children in a classroom environment: I. Learning in a large group. Journal of Applied Behavior Analysis, 1974, 7, 45-60.

Lovaas, O.I., Berberich, J.P., Perloff, B.F., & Schaeffer, B. Acquisition of imitative speech by schizophrenic children. Science, 1966, 151, 705-707.

Lovaas, O.I., Freitas, L., Nelson, K., & Whalen, C. The establishment of imitation and its use for the development of complex behavior in schizophrenic children. Behavior Research and Therapy, 1967, 5, 171-182.

Lutzker, J.R., & Sherman, J.A. Producing generative sentence usage by imitation and reinforcement. Journal of Applied Behavior Analysis, 1974, 7, 447-460.

Martin, G. Brief time-outs as consequences for errors during training programs with autistic and retarded children: A questionable procedure. The Psychological Record, 1975, 25, 71-89.

Martin, J.A. The control of imitative and nonimitative behaviors in severely retarded children through "generalized-instruction following". Journal of Experimental Child Psychology, 1971, 11, 390-400.

Neef, N.A., Iwata, B.A., & Page, T.J. The effects of known-item interspersal on acquisition and retention of spelling and sight reading words. Journal of Applied Behavior Analysis, 1977, 10, 738.

Neef, N.A., Iwata, B.A., & Page, T.J. The effects of interspersal training versus high-density reinforcement on spelling acquisition and retention. Journal of Applied Behavior Analysis, 1980, 13, 153-158.

Olenick, D.L., & Pear, J.J. Differential reinforcement of correct responses to prompts and probes in picture-name training with retarded children. Journal of Applied Behavior Analysis, 1980, 13, 77-89.

Panyan, M.C., & Hall, R.V. Effects of serial versus concurrent task sequencing on acquisition, maintenance, and generalization. Journal of Applied Behavior Analysis, 1978, 11, 67-74.

Risley, T., Hart, B., & Doke, L. Operant language development: The outline of a therapeutic technology. In R.L. Schiefelbusch (Ed.), Language of the mentally retarded. Baltimore: University Park Press, 1972.

Ruder, K.F., Hermann, P., & Schiefelbusch, R.L. Effects of verbal comprehension training on verbal production. Journal of Psycholinguistic Research, 1977, 6, 59-72.

Schroeder, G.L., & Baer, D.M. Effects of concurrent and serial training on generalized vocal imitation in retarded children. Developmental Psychology, 1972, 6, 293-301.

Sloane, H.N., Johnston, M.K., & Harris, F.R. Remedial procedures for teaching verbal behavior to speech deficient or defective young children. In H.N. Sloane & B.D. MacAuley (Eds.), Operant procedures in remedial speech and language training. Boston: Houghton Mifflin, 1968.

Stephens, C.E., Pear, J.J., Wray, L.D., & Jackson, G.S. Some effects of reinforcement schedules in teaching picture names to retarded children. Journal of Applied Behavior Analysis, 1975, 8, 435-447.

Weeks, M., & Gaylord-Ross, R. Task difficulty and aberrant behavior in severely handicapped students. Journal of Applied Behavior Analysis, 1981, 14, 449-463.

Welch, S.J., & Pear, J.J. Generalization of naming responses to objects in the natural environment as a function of training stimuli modality with retarded children. Journal of Applied Behavior Analysis, 1980, 13, 629-643.

Wheeler, A.J., & Sulzer, B. Operant training and generalization of a verbal response form in a speech deficient child. Journal of Applied Behavior Analysis, 1970, 3, 139-147.

Whitman, T.L., Zakaras, M., & Chardos, S. Effects of reinforcement and guidance procedures on instruction following behavior of severely retarded children. Journal of Applied Behavior Analysis, 1971, 4, 283-290.

Wolf, M.M., Risley, T.R., & Mees, H. Application of operant condition procedures to the behavior problems of an autistic child. Behavior Research and Therapy, 1964, 1, 305-312.