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DIFFERENTIAL REINFORCEMENT AND TRIAL-INITIATION PROCEDURES IN PICTURE-NAME TRAINING WITH SEVERELY RETARDED CHILDREN

by

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Figure Page

ABSTRACT

A systematic sequence of prompt and probe trials was used to teach picture-names to three severely retarded children. On prompt trials the experimenter presented a picture and said the picture-name for the child to imitate; on probe trials the experimenter did not name the picture.

Experiment I compared continuous primary reinforcement (CRF; every correct response reinforced) with fixed-ratio primary reinforcement (FR; every nth correct response reinforced) for correct responses to probes. Three FR schedules were studied: FR 6, FR 8, and FR 10. Correct responses to prompts were not followed by primary reinforcement, but they were followed by conditioned reinforcement. For two children, probe accuracy, prompt accuracy, and the rate of learning picture-names did not change when the schedule of primary reinforcement for correct responses to probes was increased from CRF to FR 6. For one of these two children there was a decrease in probe accuracy, and for both children there was a decrease in the rate of learning picture-names at FRs above FR 6. There was no systematic variation in probe accuracy for one child and in prompt accuracy for both children at FRs above FR 6. For the third child, probe accuracy, prompt accuracy, and the rate of learning picture-names deteriorated at FR 6.

Experiment II compared experimenter-pacing, whereby the experimenter initiated trials at a fixed rate regardless of the child's behavior, with the child-pacing

procedure, whereby the child initiated picture-naming trials by emitting a specified "attending" response (i.e., a button press), which had been used in Experiment I. For all three children, probe and prompt accuracies were higher under child-pacing. Also, two of the children learned picture-names at higher rates under child-pacing.

In Experiment III, an FR 3 schedule of primary reinforcement for correct responses to probes was introduced. For one child, the FR 3 schedule was compared to the FR 6 schedule studied in Experiment I. There was no systematic variation in probe or prompt accuracies or in the rate of learning picture-names for this child. For the second child, whose performance had deteriorated at FR 6 in Experiment I, the FR 3 schedule was compared with the CRF schedule studied in Experiment I. Under the FR 3 schedule for this child, there was a decrease in probe and prompt accuracies, but no detectable change in the rate of learning picture-names.

Thus, of all the training procedures studied, continuous reinforcement for correct responses to probes, together with child-paced trial-initiation, was most reliably effective in picture-name training.

CHAPTER I

Introduction

The most prominent characteristic of the mentally retarded child is a deficiency in language production (Bricker, 1972; MacAubrey, 1971). For this reason, many investigators have been concerned with the development of effective verbal training procedures for mentally retarded children. One important aspect of language development is the acquisition of an extensive object- or picture-name repertoire (Harris, 1975).

Picture-name training procedures often involve at least two types of trials: prompt trials on which the experimenter presents a picture and says its name; and probe trials on which the experimenter presents a picture but does not name it. On prompt trials, the child is reinforced for imitating the prompt; on probe trials, he or she is reinforced for naming the picture (Biberdorf & Pear, 1977; Bricker, 1972; Buddenhagen, 1971; Goldstein & Lanyon, 1971; Hartung, 1970; Hewett, 1965; Hingten & Churchill, 1970; Kircher, Pear, & Martin, 1971; Lovaas, Freitas, Nelson, & Whalen, 1967; Lovaas, Schreibman, & Koegal, 1974; Risley, Hart, & Doke, 1972; Risley & Wolf, 1967; Stephens, Pear, Wray, & Jackson, 1975).

It is necessary to conduct intensive

investigations of the existing picture-name training procedures so that these procedures may be refined and improved. Each component of picture-name training should be systematically analyzed and evaluated in order to determine the combination of components that is maximally effective. Findings from both basic and applied laboratories suggest two important components of picture-name training that should be studied experimentally: the schedule of reinforcement and the procedure for trial-initiation.

Schedules of Reinforcement

Numerous studies have demonstrated the importance of reinforcement in shaping and maintaining such behaviors as: motor imitation (Baer, Peterson, & Sherman, 1967); vocal imitation (Lovaas, Berberich, Perloff, & Schaeffer, 1966; Risley & Wolf, 1967; Salzinger, Salzinger, Portnoy, Eckman, Bacon, Deutsch, & Zubin, 1962; Schell, Stark, & Giddan, 1967); picture-naming (Brawley, Harris, Allen, Fleming, & Peterson, 1969); mathematics performance (Kirby & Shields, 1972); co-operative play (Redd, 1969); smiling (Hopkins, 1968); appropriate meal-time behavior (Ayllon & Azrin, 1964); and attentive behavior (Hall, Lund, & Jackson, 1968; Walker & Buckley, 1968).

One decision that must be made when designing a program to teach picture-names to retarded children concerns the schedule for reinforcer delivery (Stephens et

al., 1975). Picture-name training procedures usually provide primary reinforcers for correct naming responses according to a continuous reinforcement (CRF) schedule, whereby each correct naming response is followed by a reinforcer (e.g., Brawley et al., 1969; Bricker & Bricker, 1972; Kent, Klein, Falk, & Guenther, 1972; Risley & Wolf, 1967). However, there has been an accumulation of evidence to suggest that intermittent reinforcement procedures may be preferable to continuous reinforcement for picture-name training.

The effects of two types of intermittent reinforcement schedules have been evaluated in the context of a picture-naming task: fixed-ratio schedules and differential schedules. The next two sections will describe some of the basic and applied research relating to these two types of schedules. Then, the possibility of their combination will be considered.

Fixed-Ratio Schedules

On a fixed-ratio (FR) schedule, reinforcement follows a specified number of occurrences of the target behavior (Ferster & Skinner, 1957; Martin & Pear, 1978). For example, on a FR 3 schedule, reinforcement follows every third occurrence of the target behavior. The effects of different FR reinforcement schedules have been studied extensively in basic research laboratories and, more recently, in applied settings. In this thesis, FR will be

used only to refer to FRs greater than 1 and CRF will indicate FR 1.

A direct relationship between FR size and response rate has been demonstrated with a variety of organisms performing a variety of tasks (e.g., rats pressing a lever: Boren, 1953; pigeons pecking a single key: Felton & Lyon, 1966; Ferster & Skinner, 1958; chimpanzees pressing buttons: Ferster, 1958; cats miaowing: Molliver, 1963; dogs barking: Salzinger & Waller, 1962; and humans pressing a lever: Ellis, Barnett, & Pryer, 1960; Green Saunders, & Squier, 1959; Hutchinson & Azrin, 1961; Long, Hammack, May, & Campbell, 1958; Orlando & Bijou, 1969).

Ferster (1960) studied the effects of FR size on the performance of pigeons in a matching-to-sample task. In this study, the pigeons received primary reinforcement (access to grain) contingent upon pecking a key whose color matched a "sample" key. As the FR schedule of reinforcement for correct matching was gradually increased from CRF to FR 30, both birds showed an increase not only in response rate, but also in matching accuracy (proportion of matching responses that were correct). Although further improvement in matching performance was not observed beyond FR 30, matching rate and accuracy were well sustained at FRs below FR 47 for Bird 1 and at FRs below FR 95 for Bird 2. While matching accuracy remained high, matching rate deteriorated at FR 47 (Bird 1) or FR 95 (Bird 2).

Like Ferster (1960), Nevin, Cumming, and Berryman

(1963) found an increase in pigeons' response rate on a matching-to-sample task as the FR schedule was gradually increased from CRF to FR 10. Unlike Ferster, Nevin et al. found this rate increase to be accompanied by a simultaneous decrease in matching accuracy. It may be relevant to note that Nevin et al. introduced FR reinforcement only after a matching accuracy of 96 to 98% was established under CRF, whereas Ferster introduced FR reinforcement when matching accuracy under CRF was much lower. Nevin et al. suggest that this procedural difference might, at least partially, account for the discrepancy between the effects of FR size on matching accuracy observed in their study and those observed in the Ferster study.

Studying the matching-to-sample performance of normal children, Davidson and Osborne (1974), like Nevin et al., introduced FR reinforcement only after high matching accuracies were established under CRF. As the FR schedule was increased, Davidson and Osborne found an increase in the children's response rates, but no systematic change in their matching accuracies.

Stephens et al. (1975) studied the effects of FR size on the picture-naming performance of retarded children. In this study, conditioned reinforcement (praise) for correct naming was delivered according to a CRF schedule; the schedule of primary reinforcement was systematically varied. Experiment I compared a CRF schedule of primary reinforcement with either an FR 5 or an FR 12 schedule.

For four of the five children, accuracy on the picture-naming task (i.e., proportion of naming responses that were correct) was unaffected by the schedule manipulations. For the fifth child, accuracy was higher under the FR condition. All five children emitted more naming responses, and thus more correct naming responses, and four of the children learned more picture-names when the FR schedule of primary reinforcement was in effect. Experiment II compared the effects of different values of FR schedules of primary reinforcement on the picture-naming performance of two retarded children. With one child, who was studied more extensively than the other, Stephens et al. found an increase in the number of naming responses and in the rate of learning picture-names as the reinforcement schedule was increased from FR 5, to FR 10, to FR 15. A further increase in the FR value to FR 20 generated no further improvement in performance. At FR 25, there was a marked decrease in the number of naming responses and in the rate of learning picture-names. Accuracy was unaffected by these schedule manipulations.

While the effects of FR size on the accuracy of task performance appear inconsistent from one study to another, the effect of FR size on response rate seems clear: increasing the FR schedule of reinforcement for task performance up to some maximal point produces an increase in response rate. Thus, FR reinforcement schedules whose values lie below the maximal point, generate higher response

rates than does a CRF schedule. Moreover, in the Stephens et al. study retarded children learned picture-names at higher rates under FR reinforcement than under CRF. It therefore appears that some degree of FR reinforcement is preferable to CRF for teaching picture-names to retarded children.

Differential Schedules

Under a differential schedule (as that term will be used here), correct responses to prompts and correct responses to probes are each reinforced according to separate and independent schedules of primary reinforcement. Conditioned reinforcement (praise) is presented on a CRF schedule for correct responses to both prompts and probes. Olenick and Pear (in press) compared four different primary reinforcement schedules: (1) nondifferential FR n (n=6 for two children and 8 for one child), whereby correct responses to prompts and probes advanced the same FR schedule; (2) differential FR n FR n, whereby every nth correct response to a prompt and every nth correct response to a probe were reinforced; (3) differential FR n CRF, whereby every nth correct response to a prompt and every correct response to a probe were reinforced; and (4) differential CRF FR n, whereby every correct response to a prompt and every nth correct response to a probe were reinforced. Of the four schedules studied, the differential FR n CRF schedule generated the best performance on the picture-

naming task. Under this schedule, the children emitted more correct responses to probes and prompts, had higher probe accuracies, and learned picture-names at a greater rate than under any of the other schedules. An extension of this research (Olenick & Pear, unpublished data) showed that the number of correct responses to probes and prompts, probe accuracy, and learning rate were further improved, or at least maintained, when primary reinforcement for correct responses to prompts was discontinued.

The findings of Olenick and Pear thus indicate that reinforcement schedules involving equal probabilities of primary reinforcement for correct responses on both prompt and probe trials may not be the most effective for picture-name training with retarded children. Indeed, it appears that a more effective reinforcement schedule for picture-name training is one which provides continuous primary reinforcement for correct responses to probes and no primary reinforcement for correct responses to prompts.

The Combination of FR and Differential Reinforcement Schedules in Picture-Name Training with Retarded Children

As previously mentioned, using nondifferential schedules Stephens et al. (1975) found that FR primary reinforcement schedules (below some upper limit) generated better performance in a picture-naming task for retarded children than did a CRF schedule. Comparing nondifferential

and differential schedules, Olenick & Pear (in press) found that a differential schedule (CRF for correct responses to probes and no primary reinforcement for correct responses to prompts) generated better performance in a picture-naming task than did a non-differential FR schedule. The data reported by Stephens et al. (1975) suggest that an FR schedule of primary reinforcement for correct responses to probes may produce even better performance on probes than the CRF schedule of reinforcement for correct responses to probes studied by Olenick and Pear. The present research was designed to investigate this possibility.

Trial-Initiation Procedures

In the verbal training of mentally retarded children, two general types of trial-initiation procedures have been used: an experimenter-paced procedure and a child-paced procedure.

According to the experimenter-paced trial-initiation procedure, the experimenter presents the training stimulus to the child at a pre-determined rate, so that the rate of trial-initiation is determined solely by the experimenter and is unaffected by the child. Experimenter-paced trial-initiation procedures have been used in: motor imitation training (e.g., Baer, Peterson, & Sherman, 1967); vocal imitation training (e.g., Kerr, Meyerson, & Michael, 1965; Lovaas, Berberich, Perloff, & Schaeffer, 1966);

picture-name training (e.g., Lutzker & Sherman, 1974; Twardosz & Baer, 1973); and sentence-usage training (e.g., Lutzker & Sherman, 1974).

According to the child-paced trial-initiation procedure, the child produces the training stimulus by emitting some specified "attending" response, so that the rate of trial-initiation is determined by the rate at which the child emits the "attending" response. In many cases, eye contact has been the specified "attending" response; that is, whenever the child glances at the experimenter's face, the experimenter presents the training stimulus (e.g., Brawley et al., 1969; Bricker & Bricker, 1972; Buddenhagen, 1971; Kent, Klein, Falk, & Guenther, 1972; Kircher, Pear, & Martin, 1971; Marshall & Hegrenes, 1970; Risley & Wolf, 1967; Schell, Stark, & Giddan, 1967). In other cases, a mechanical response such as a lever press (e.g., Biberdorf & Pear, 1977; Olenick & Pear, in press; Stephens et al., 1975) or a ball drop (e.g., Blake & Moss, 1967; Hewett, 1965) has been the specified "attending" response.

Budyk and Pear (unpublished manuscript) have recently conducted a study to compare the effects of experimenter-paced and child-paced trial-initiation procedures on the performance of retarded children in a verbal-training task. Under the experimenter-paced procedure, the experimenter presented the training stimuli (either sounds to be imitated or pictures to be named) to the

child whenever the child glanced at the experimenter's face. Budyk and Pear found that under the experimenter-paced procedure, the children learned to imitate more sounds or to name more pictures than under the child-paced procedure. These findings suggest that experimenter-paced trial-initiation is preferable to child-paced trial-initiation in the verbal training of retarded children.

For most of their study, Budyk and Pear delivered primary reinforcement for correct picture-naming responses according to a nondifferential schedule. In their study of differential schedules, Olenick and Pear (in press) used a child-paced trial-initiation procedure. There is little information concerning the effects of an experimenter-paced trial-initiation procedure on picture-naming performance maintained by a differential schedule. The findings of Budyk and Pear suggest, however, that experimenter-paced trial-initiation might further improve the already strong picture-naming performance maintained by an effective differential schedule. This research was designed also to investigate this possibility.

Statement of the Problem

In order to design an effective picture-name training procedure for mentally retarded children, it is necessary to analyze experimentally each of the procedural components. Both basic and applied research suggests two

important components that require intensive study: the schedule of reinforcement and the procedure for trial initiation. The three experiments presented in this thesis were designed to study these components of picture-name training procedures.

CHAPTER II

Experiment I

Fixed-Ratio Schedules of Reinforcement for Correct Responses to Probes in Picture-Name Training with Severely Retarded Children

Method

Subjects

Two severely retarded boys and one severely retarded girl participated in this study. The children were residents of the St. Amant Centre in Winnipeg, Manitoba.

Gilles was six years old with a diagnosis of Down's syndrome. In a previous study (Olenick & Pear, in press) he had learned to name about 20 pictures. His spontaneous vocal behavior consisted of babbling and a few words.

Peter was six years old with a diagnosis of phenylketonuria. He frequently exhibited bizarre, autistic mannerisms. At the beginning of the study, he imitated a number of vocal sounds but did not name any pictures. His spontaneous vocal behavior consisted of babbling and a few words.

Marda was six years old with a diagnosis of primary microcephaly. In a previous study (Olenick & Pear, in press) she had learned to name about 45 pictures. Her spontaneous vocal behavior consisted of some babbling, a

few words, and a small number of two- or three-word phrases (e.g., "come here", "sit down", "I go home").

Both Gilles and Marda were familiar with the picture-name training procedure used in this research (see Olenick & Pear, in press); Peter was initially unfamiliar with procedures used in this research.

Setting Apparatus, and Materials

Experimental sessions were conducted with each child individually in a small room. The child and the experimenter sat at a table facing each other. On the table, within easy reach of the child, was: (1) a small metal box whose functional parts were a button (operated by a force of 3.14N) and a small green jewel light; and (2) an empty M&M dispenser whose operation provided auditory feedback to the child and informed the experimenter when to deliver primary reinforcement. (The M&M dispenser was used only to give auditory feedback because M&M's were not suitable reinforcers for these children.) The operation of the M&M dispenser was controlled by digital logic programming equipment located in an adjacent room.

Near the experimenter was another metal box which contained several switches and counters for controlling the green jewel light on the child's box and for recording data.

A large stop-clock on a nearby shelf timed the length of each session. A tape recorder beside the stop-

clock recorded the verbal responses emitted during each session. Picture cards from a Peabody Articulation Kit were used as the stimuli for picture-name training. Each of these pictures vividly depicted an item that could be described with a single word. Ice cream was used as the primary reinforcer for Gilles (one teaspoonful per reinforcement) and for Marda (one-half teaspoonful per reinforcement); fruit jelly candy was used as the primary reinforcer for Peter.

Preliminary Procedures

Before beginning picture-name training, each child's picture-name repertoire was tested. Approximately fifty pictures were presented to the child three times each. When a picture was presented, the child was asked, "What's this?" and given five seconds to answer. If a correct response occurred on all three trials, the picture was called a criterion picture. If no response or an incorrect response occurred within the five-second time limit, the experimenter prompted the child by saying the correct word. If the child correctly imitated the experimenter's prompt within five seconds on all three trials, the picture was called a subcriterion picture. All pictures that were not classified as criterion or subcriterion were discarded.

Before being selected to participate in this study, Gilles and Marda had participated in a study conducted by Olenick and Pear (in press). During this prior

study, Gilles and Marda were trained to sit quietly, to respond on a picture-naming task, and to initiate training trials by pressing the button on their consoles. Also during this prior study, they were exposed to a highly effective differential schedule, whereby every sixth correct response to a prompt and every correct response to a probe were followed by a primary reinforcer.

Procedures similar to those reported previously (Martin, England, Kaprowy, Kilgour, & Pilek, 1968; Olenick & Pear, in press) were used to train Peter to sit quietly, to respond on a picture-naming task, and to initiate training trials by pressing the button on his console. During this preliminary training, primary reinforcement followed each correct response to a prompt and a probe (i.e., a nondifferential continuous reinforcement schedule was in effect).

Throughout the experiment, each primary reinforcement, although delivered by hand, was accompanied by the sound produced by the operation of the empty M&M dispenser. Praise ("good boy" or "good girl") occurred after every correct response.

Picture-Name Training Procedure

Two twenty-minute picture-name training sessions, separated by a ten-minute break, were conducted each week day with each child individually. The procedure for

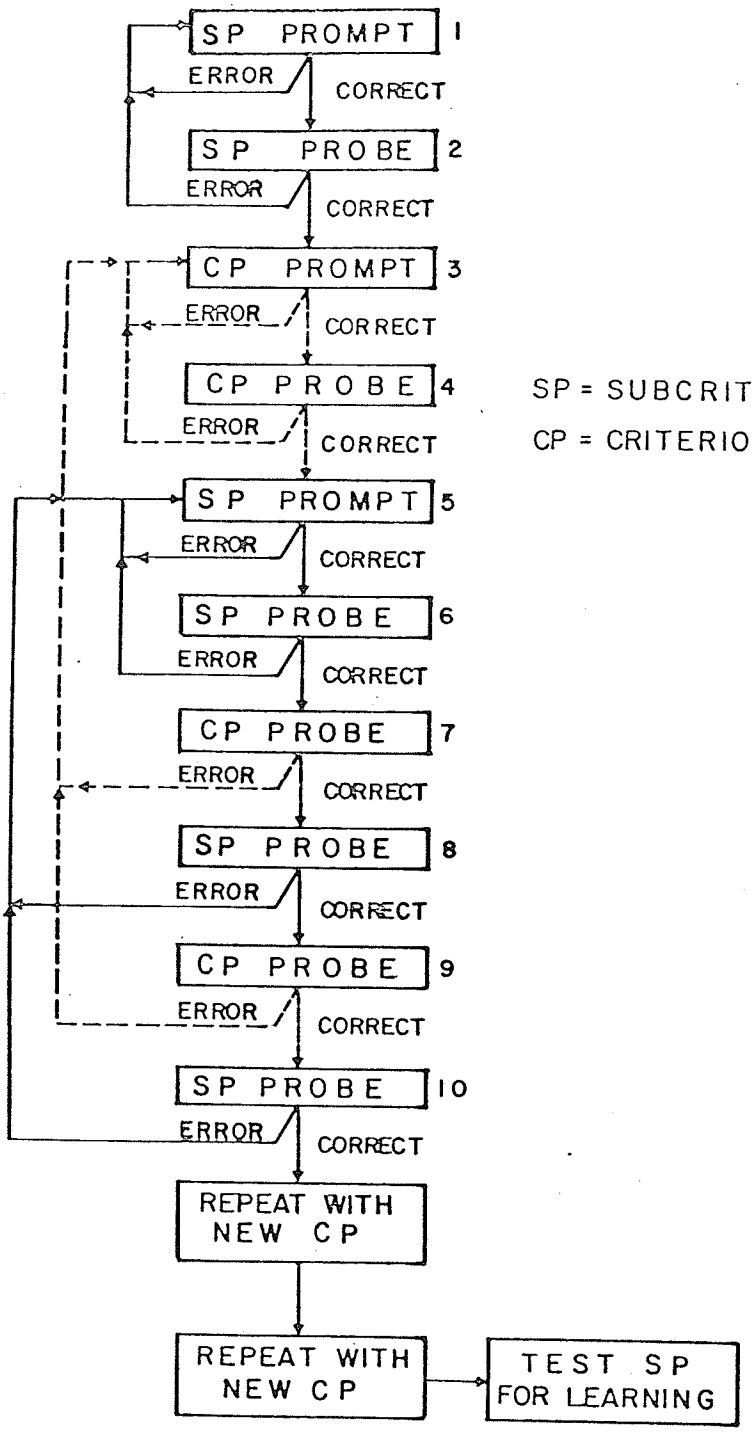
teaching the children to name pictures was similar to that used by Stephens et al. (1975). In general, each picture to be taught went through a systematic sequence. When it completed the sequence, it was said to have "reached criterion." During the sequence, pictures that had previously reached criterion were alternated with a subcriterion picture in the manner described below and diagrammed in Figure 1.

On each trial, the experimenter presented either a subcriterion or a criterion picture. Two types of trials were used: prompt trials, on which the experimenter named the picture (e.g., said "What's this? Apple.") and probe trials, on which the experimenter simply asked the name of the picture ("What's this?"). On Step 1 in the sequence, a randomly selected subcriterion picture was presented on a prompt trial. Step 1 was repeated on the next trial with the same subcriterion picture if the child made an error; i.e., an incorrect response or a response omission. A response omission occurred if the child did not respond within eight seconds after a picture presentation. If the child responded correctly on Step 1, Step 2 occurred on the next trial. On Step 3, a randomly selected picture that had reached criterion was presented, if one was available, and was alternated with the subcriterion picture in the manner diagrammed in Figure 1. The first ten steps of the sequence were repeated three times with, if possible, a different criterion picture each time. (In the early part

FIGURE 1

Figure 1. Diagram of the picture-name training procedure.

PICTURE—NAMING PROCEDURE



SP = SUBCRITERION PICTURE

CP = CRITERION PICTURE

of the study, when there were no criterion pictures for Peter, the subcriterion picture was presented to him on every step.)

When a subcriterion picture completed the ten steps three times within a single session, it was tested with a probe trial on each succeeding day until either an error was made on one of these trials or the picture was correctly named on three consecutive days. If the former occurred, the picture-naming procedure was started anew for that subcriterion picture; if the latter occurred, the picture was considered to have reached criterion and was eligible to be used as a criterion picture in subsequent applications of the picture-naming procedure. If a subcriterion picture did not complete the picture-name training sequence within six sessions, it was discarded from the experiment.

To evaluate the reliability of the experimenter's decisions regarding correct and incorrect verbal responses, tape recordings of approximately one-sixth of the experimental sessions were played to an independent observer after she had been familiarized with the experimenter's criteria for correct and incorrect verbal responses. (This familiarization was necessary because perfect pronunciation was not required; rather, specific close approximations were accepted.) The observer scored each response before hearing the experimenter's decision. The interobserver reliability measures used were the ratio of

agreements to agreements plus disagreements on responses the experimenter called correct and on responses the experimenter called incorrect. Percent agreement (calculated on the basis of data poooled from all three experiments) on correct and incorrect responses respectively, were 98% and 95% for Gilles, 99% and 96% for Peter, and 98% and 93% for Marda

Trial-Initiation Procedure

To begin a training session, the experimenter pressed a button on her console, thereby illuminating the green light on the child's console. A press by the child on the button on his/her console then turned the light off and initiated a picture-naming trial. Thus, a child-paced trial-initiation procedure was used. A trial terminated when a correct response or an error (i.e., an incorrect response or a response ommission) occurred. A five-second period (inter-trial interval) then elapsed prior to the next illumination of the green light.

Experimental Procedures

Experiment I was designed to study the effects of various fixed-ratio (FR) schedules of primary reinforcement for correct responses to probes on the picture-naming performance of three retarded children. Throughout the experiment, praise followed all correct responses on both prompt and probe trials. In each phase of the experiment, primary reinforcement was programmed according to a differential

schedule whereby correct responses to prompts were not followed by primary reinforcement (NPR; no primary reinforcement) and correct responses to probes were reinforced on an FR schedule. For each child, the value of the FR schedule was systematically increased from phase to phase, until there was a clear deterioration in the child's performance on probe and prompt trials. The reinforcement schedule that most effectively maintained the child's picture-naming performance was then re-introduced. Note that all three children were exposed to the same reinforcement schedule manipulations in Phases 1 and 2. However, because each child's picture-naming performance deteriorated at different values of the FR schedule of reinforcement for correct responses to probes, the schedule manipulations conducted after Phase 2 were slightly different for each child. The specific schedules of reinforcement studied for each child in each phase of this experiment are described below and summarized in Table 1.

Phase 1. DIFF (NPR, CRF). Olenick and Pear (unpublished data) have shown that a high level of picture-naming performance can be maintained by a differential schedule that provides no primary reinforcement for correct responses to prompts and continuous primary reinforcement for correct responses to probes (see Appendix A). Therefore this DIFF (NPR, CRF) schedule was in effect for each child during Phase 1 of this experiment.

TABLE 1

Schedules of Primary Reinforcement Studied in Experiments I and III

Correct responses to prompts were not followed by primary reinforcement. Correct responses to probes were reinforced according to the indicated schedules of primary reinforcement. The numbers in brackets represent the average obtained ratios of overall correct responses (i.e., correct responses to prompts and probes) to reinforcements for the indicated children over the last 5 days of the indicated phases.

	Phase	Gilles	Peter	Marda
Experiment I	1	CRF [1.7]	CRF [1.7]	CRF [1.7]
	2	FR 6 [9.8]	FR 6 [9.3]	FR 6 [11.8]
	3	FR 10 [18.6]	FR 8 [12.9]	CRF [1.7]
	4	FR 6 [9.4]	FR 10 [17.0]	---
	5	---	CRF [1.8]	---
Experiment III	1	FR 6 [9.8]	---	CRF [1.7]
	2	FR 3 [5.2]	---	FR 3 [5.4]

Phase 2. DIFF (NPR, FR 6). For each child, correct responses to prompts were not followed by primary reinforcement, as in Phase 1, and every sixth correct response to a probe was followed by primary reinforcement.

The primary reinforcement schedules used in succeeding phases of this experiment were determined on the basis of the picture-naming performance observed in Phases 1 and 2. Since the DIFF (NPR, FR 6) schedule of Phase 2 generated a different level of picture-naming performance for each child, the reinforcement schedules used after Phase 2 were different for each child. Therefore, the later phases of the experiment will be described for each child separately.

Gilles

Phase 3. DIFF (NPR, FR 10). As in Phases 1 and 2, correct responses to prompts were not followed by primary reinforcement. Correct responses to probes were reinforced according to an FR 10 primary reinforcement schedule.

Phase 4. DIFF (NPR, FR 6). Phase 4 for Gilles was a direct replication of Phase 2.

Peter

Phase 3. DIFF (NPR, FR 8). As in Phases 1 and 2, correct responses to prompts were not followed by primary reinforcement. Correct responses to probes were reinforced according to an FR 8 primary reinforcement schedule.

Phase 4. DIFF (NPR, FR 10). Correct responses to prompts were not followed by primary reinforcement, as in the preceding phases, and correct responses to probes were reinforced according to an FR 10 schedule.

Phase 5. DIFF (NPR, CRF). Phase 5 for Peter was a direct replication of Phase 1.

Marda

Phase 3. DIFF (NPR, CRF). Phase 3 for Marda was a direct replication of Phase 1.

Every phase continued until either there was stability in the data (as determined by visual inspection) or there was a clear deterioration in picture-naming performance.

Dependent Variables

Seven independent variables were studied in this research. They were:

1. daily number of correct responses to probes;
2. daily number of errors to probes (i.e., incorrect responses and response omissions to probes);
3. daily number of correct responses to prompts;
4. daily number of errors to prompts;
5. daily probe accuracy (i.e., the proportion of probe trials responded to correctly);
6. daily prompt accuracy;
7. daily number of picture-names reaching

criterion.

Results

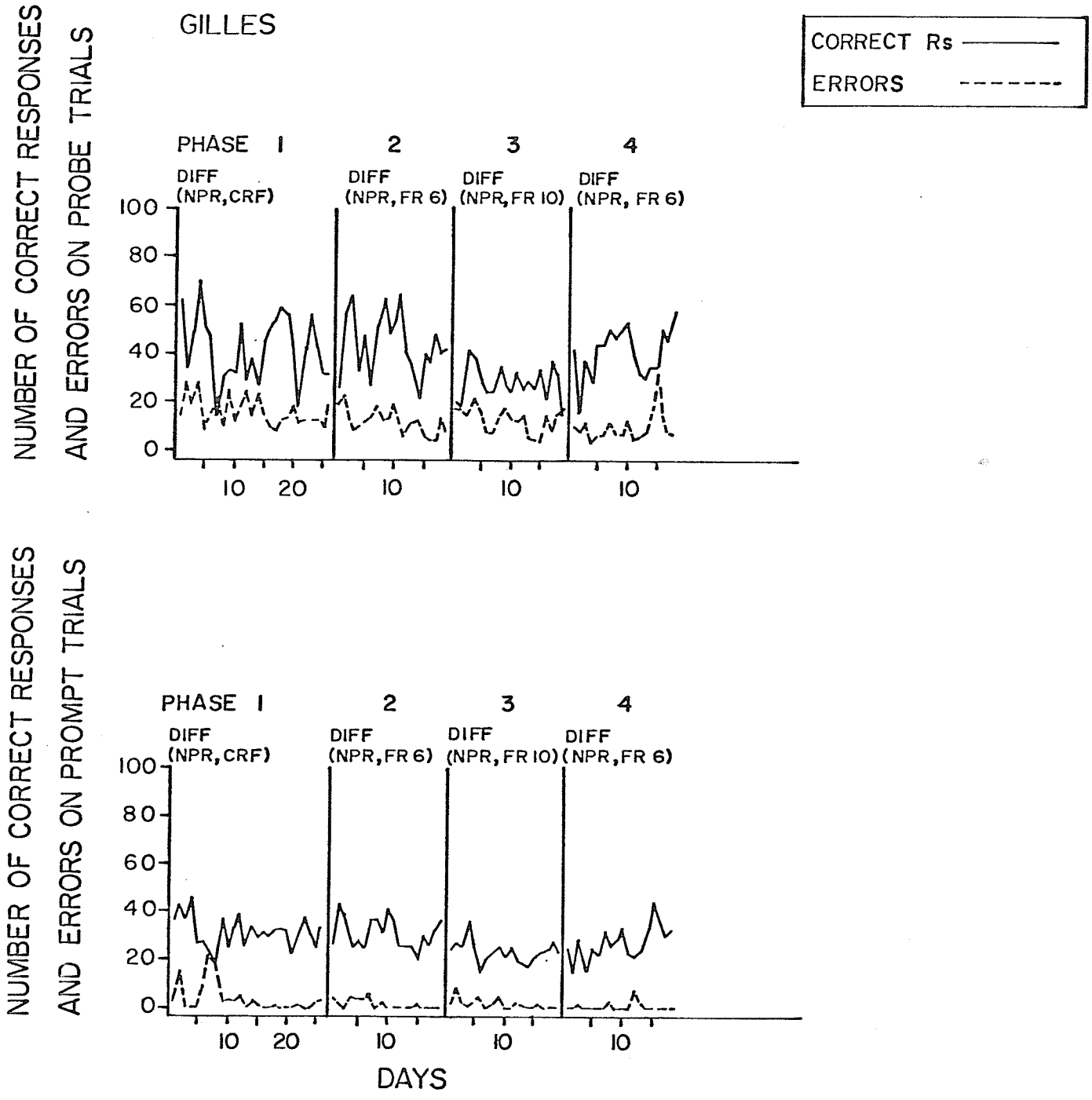
Because each child was exposed to slightly different experimental manipulations in Experiment I, the results are reported for each child separately. A summary of the results appears at the conclusion of this section.

Gilles

Figure 2 presents the daily number of correct responses and errors (the latter being defined as incorrect responses plus response omissions) to probes and prompts for Gilles. There was no systematic variation in any of these variables when the schedule of primary reinforcement for correct responses to probes was increased from CRF in Phase 1 to FR 6 in Phase 2. That is, the high level of probe and prompt performance observed under the DIFF (NPR, CRF) condition of Phase 1 was maintained under the DIFF (NPR, FR 6) condition of Phase 2. When the schedule of reinforcement for correct responses to probes was further increased from FR 6 under the DIFF (NPR, FR 6) condition of Phase 2 to FR 10 under the DIFF (NPR, FR 10) condition of Phase 3, there was a pronounced decrease in the number of correct responses to probes and a less pronounced decrease in the number of correct responses to prompts. When the DIFF (NPR, FR 6) condition of Phase 2 was reinstated in Phase 4, the number of correct responses to probes and prompts increased to the levels previously

FIGURE 2

Figure 2. Daily number of correct responses and errors on probe and prompt trials for Gilles during Experiment I. Schedule abbreviations are explained under Experimental Procedures (Experiment I).


GILLES
CORRECT Rs
ERRORS
NUMBER OF CORRECT RESPONSES AND ERRORS ON PROBE TRIALS
PHASE 1
2
3
4
DIFF (NPR,CRF)
DIFF (NPR,FR 6)
DIFF (NPR,FR 10)
DIFF (NPR, FR 6)
100
80
60
40
20
0
10
20
10
10
10
NUMBER OF CORRECT RESPONSES AND ERRORS ON PROMPT TRIALS
PHASE 1
2
3
4
DIFF (NPR,CRF)
DIFF (NPR,FR 6)
DIFF (NPR,FR 10)
DIFF (NPR,FR 6)
100
80
60
40
20
0
10
20
10
10
10
DAYS

observed in Phase 2. The number of errors to probes and prompts were unaffected by these schedule manipulations.

Figure 3 presents Gilles' daily probe and prompt accuracies. Probe accuracy was defined as the proportion of probe trials responded to correctly; prompt accuracy was defined as the proportion of prompt trials responded to correctly. There was no systematic variation in probe accuracy from Phase 1, when the DIFF (NPR, CRF) condition was in effect, to Phase 2, when the DIFF (NPR, FR 6) condition was in effect. That is, a high level of probe accuracy was maintained when the schedule of reinforcement for correct responses to probes was increased from CRF (Phase 1) to FR 6 (Phase 2). When the DIFF (NPR, FR 10) condition was introduced in Phase 3, there was a drop in probe accuracy. When the DIFF (NPR, FR 6) condition of Phase 2 was reinstated in Phase 4, probe accuracy increased to the level previously observed in Phase 2. Prompt accuracy remained near the 1.00 level throughout Experiment I and was thus little affected by the schedule manipulations in this study.

Figure 4 presents the cumulative number of picture-names that reached criterion across days for Gilles. From Phase 1, when the DIFF (NPR, CRF) condition was in effect, to Phase 2, when the DIFF (NPR, FR 6) condition was in effect, there appeared to be a slight increase in the rate at which picture-names reached criterion. Under the DIFF (NPR, FR 10)

FIGURE 3

Figure 3. Daily accuracies on probe and prompt trials for Gilles during Experiment I. Schedule abbreviations are explained under Experimental Procedures (Experiment I).

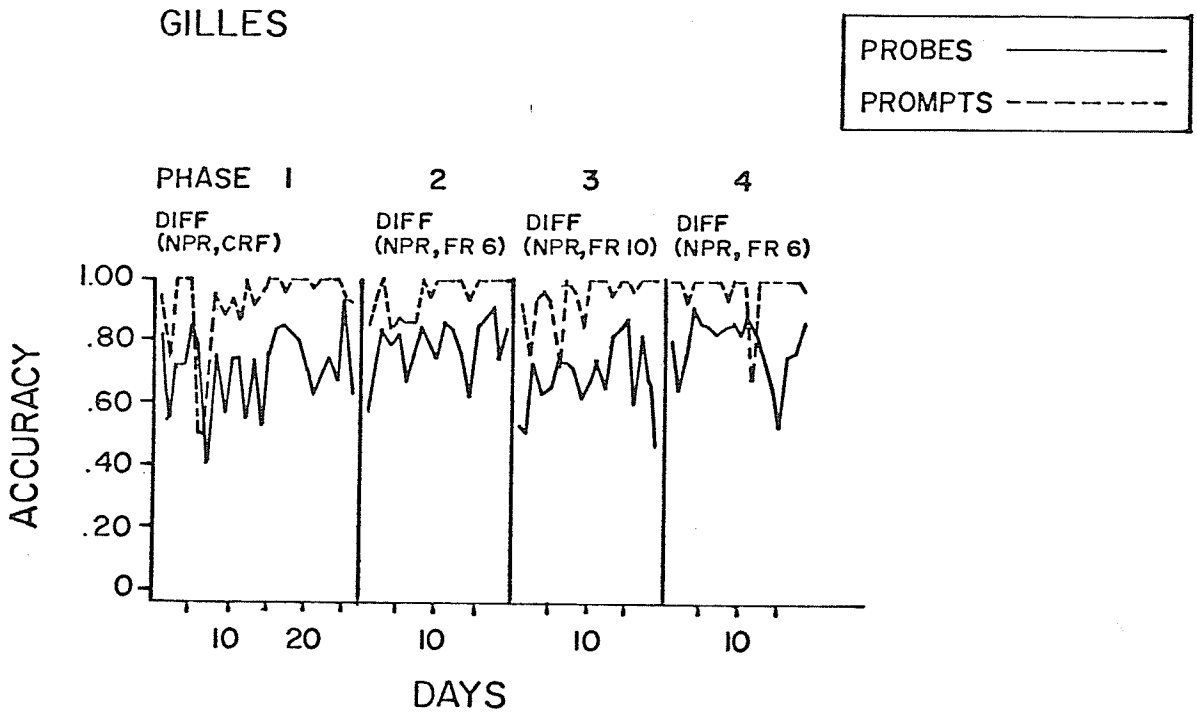
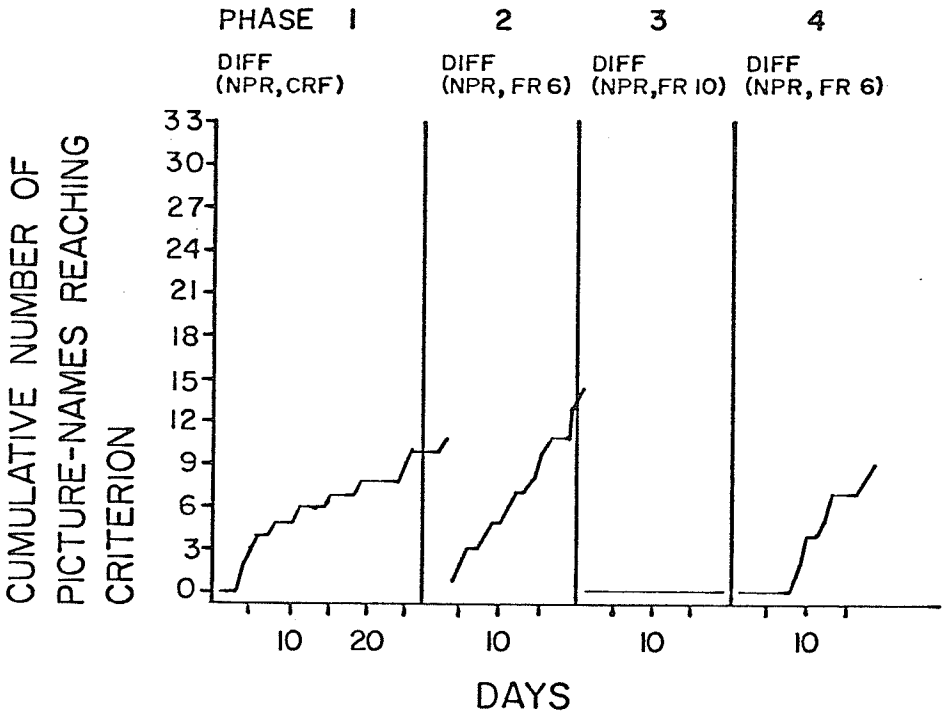

GILLES
PROBES
PROMPTS
PHASE 1
2
3
4
DIFF (NPR,CRF)
DIFF (NPR,FR 6)
DIFF (NPR,FR 10)
DIFF (NPR, FR 6)
1.00
.80
.60
.40
.20
0
ACCURACY
10
20
10
10
10
DAYS

FIGURE 4

Figure 4. Daily cumulative number of picture-names reaching criterion for Gilles during Experiment I. The line does not reset after the end of a phase until that point at which all the pictures trained during that phase had been tested. Schedules abbreviations are explained under Experimental Procedures (Experiment I).

GILLES


PHASE 1
2
3
4
DIFF (NPR, CRF)
DIFF (NPR, FR 6)
DIFF (NPR, FR 10)
DIFF (NPR, FR 6)
CUMULATIVE NUMBER OF PICTURE-NAMES REACHING CRITERION
33
30
27
24
21
18
15
12
9
6
3
0
10
20
10
10
10
DAYS

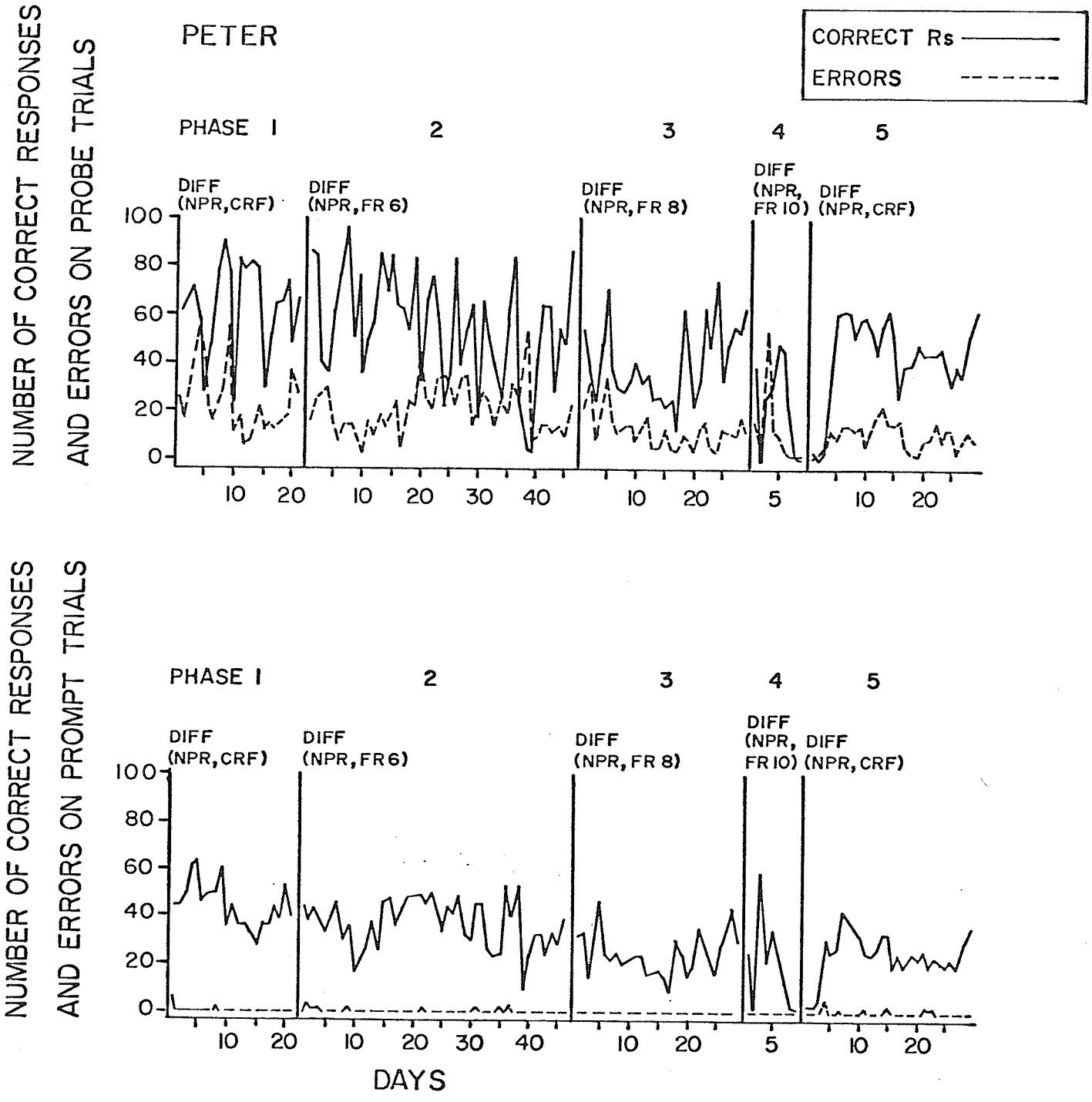
condition of Phase 3, this rate was zero. It should be noted that picture-names that reached criterion at the beginning of Phase 3 were trained at the end of Phase 2; the test probes for these pictures were conducted over the first three days of Phase 3 (see Picture-Name Training Procedure) and therefore these picture-names were recorded as reaching criterion in Phase 3. Thus, the rate at which picture-names reached criterion at the beginning of Phase 3 reflects the effects of the DIFF (NPR, FR 6) condition of Phase 2. (This is indicated in the cumulative record by not resetting the line to zero at the beginning of a phase until testing had been completed on the picture-names that were completely trained in the previous phase.) When the DIFF (NPR, FR 6) condition was reinstated in Phase 4, the rate at which picture-names reached criterion returned to the high level observed under the same condition in Phase 2.

Peter

Figure 5 presents the daily number of correct responses and errors to probes and prompts for Peter. Like Gilles, Peter showed little change in any of these variables from the DIFF (NPR, CRF) condition of Phase 1 to the DIFF (NPR, FR 6) condition of Phase 2, except, perhaps, for a very slight decline in his number of correct responses to probes in Phase 2. When the schedule of reinforcement for correct responses to probes was increased from FR 6 in

FIGURE 5

Figure 5. Daily number of correct responses and errors on probe and prompt trials for Peter during Experiment I. Schedule abbreviations are explained under Experimental Procedures (Experiment I).


PETER
CORRECT Rs
ERRORS
NUMBER OF CORRECT RESPONSES AND ERRORS ON PROBE TRIALS
PHASE 1
2
3
4
5
DIFF (NPR,CRF)
DIFF (NPR,FR 6)
DIFF (NPR,FR 8)
DIFF (NPR, FR 10)
DIFF (NPR,CRF)
100
80
60
40
20
0
10 20 10 20 30 40 10 20 5 10 20
NUMBER OF CORRECT RESPONSES AND ERRORS ON PROMPT TRIALS
PHASE 1
2
3
4
5
DIFF (NPR,CRF)
DIFF (NPR,FR6)
DIFF (NPR,FR 8)
DIFF (NPR, FR 10)
DIFF (NPR,CRF)
100
80
60
40
20
0
10 20 10 20 30 40 10 20 5 10 20
DAYS

Phase 2 to FR 8 in Phase 3, the decline in the number of correct responses to probes became slightly more pronounced and was accompanied by a small decrease in the number of correct responses to prompts. There was little systematic variation in the number of errors to probes and prompts from Phase 2 to Phase 3. Under the DIFF (NPR, FR 10) condition of Phase 4, there was a significant decrease in the number of correct responses to probes and prompts. The number of errors to probes also declined while the number of errors to prompts did not vary systematically. When the DIFF (NPR, CRF) condition of Phase 1 was reinstated in Phase 5, the number of correct responses to probes and prompts increased to levels slightly below those observed in Phase 1. The number of errors to probes returned to the Phase 1 level, while there was no systematic variation in the number of errors to prompts.

Figure 6 presents Peter's daily probe and prompt accuracies. There was a high degree of variability and little systematic change in Peter's probe accuracy throughout Experiment I. Prompt accuracy remained at or near the 1.00 level throughout the study.

Figure 7 presents the cumulative number of picture-names that reached criterion across days for Peter. From Phase 1, when the DIFF (NPR, CRF) condition was in effect, to Phase 2 when the DIFF (NPR, FR 6)

FIGURE 6

Figure 6. Daily accuracies on probe and prompt trials for Peter during Experiment I. Schedule abbreviations are explained under Experimental Procedures (Experiment I).

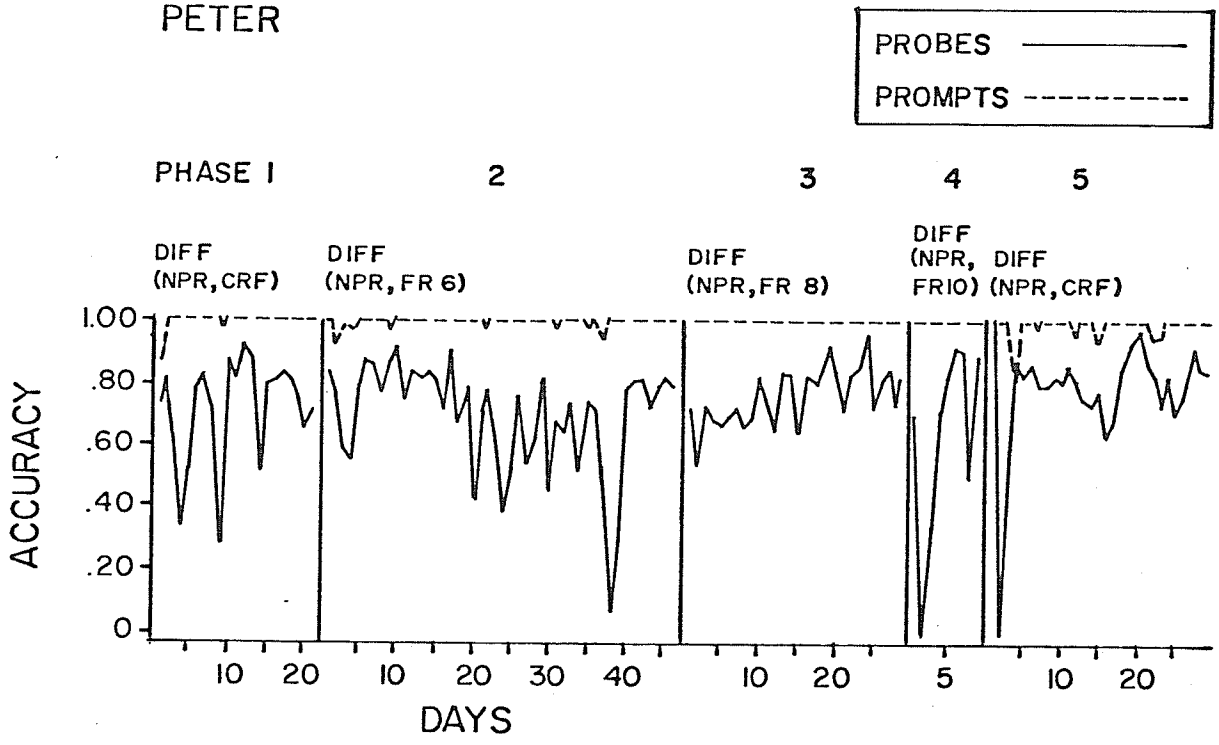
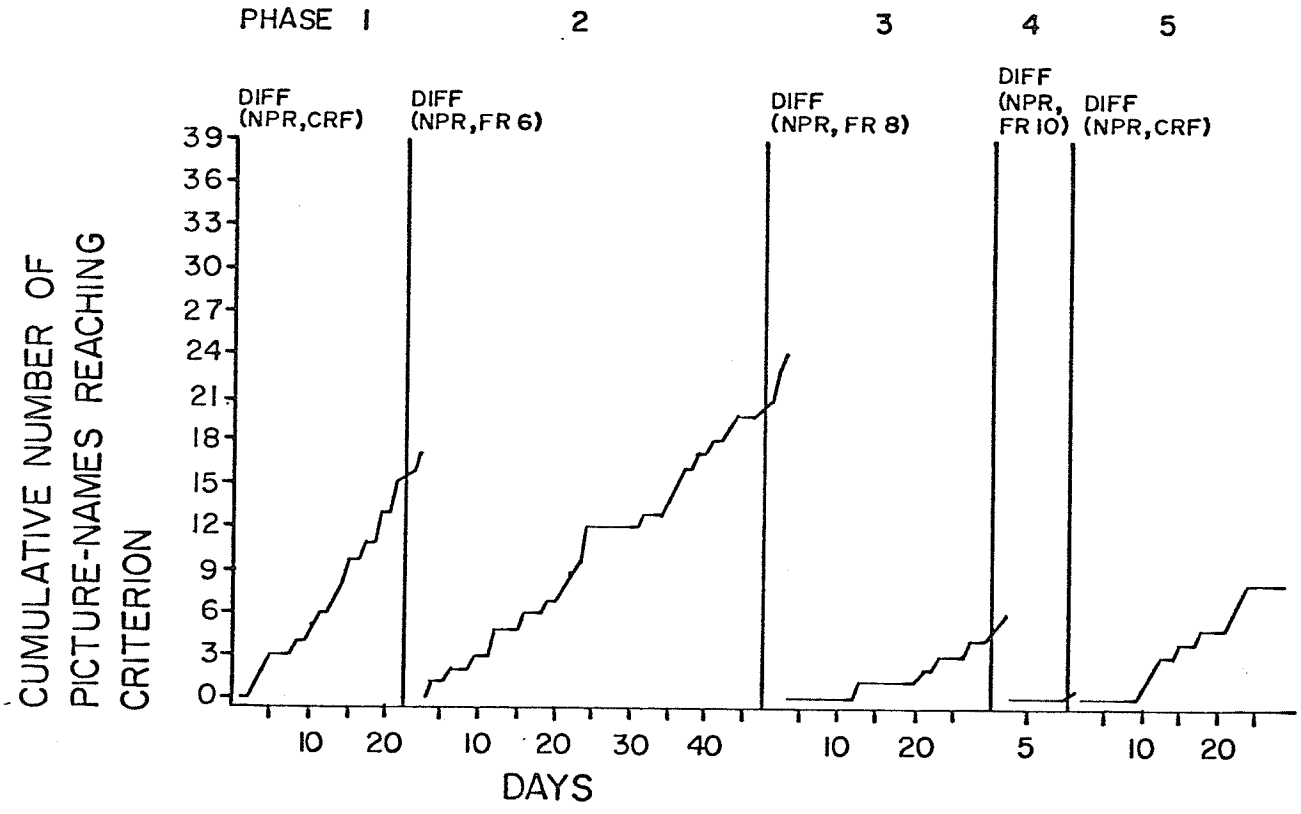

PETER
PROBES
PROMPTS
PHASE 1
2
3
4
5
DIFF (NPR, CRF)
DIFF (NPR, FR 6)
DIFF (NPR, FR 8)
DIFF (NPR, FR10)
DIFF (NPR, CRF)
ACCURACY
1.00
.80
.60
.40
.20
0
10
20
10
20
30
40
10
20
5
10
20
DAYS

FIGURE 7

Figure 7. Daily cumulative number of picture-names reaching criterion for Peter during Experiment I. The line does not reset after the end of a phase until that point at which all the pictures trained during that phase had been tested. Schedule abbreviations are explained under Experimental Procedures (Experiment I).

PETER


PHASE 1
2
3
4
5
DIFF (NPR,CRF)
DIFF (NPR,FR 6)
DIFF (NPR, FR 8)
DIFF (NPR, FR 10)
DIFF (NPR,CRF)
CUMULATIVE NUMBER OF PICTURE-NAMES REACHING CRITERION
0
3
6
9
12
15
18
21
24
27
30
33
36
39
10
20
10
20
30
40
10
20
5
10
20
DAYS

condition was in effect, there was a slight drop in the rate at which picture-names reached criterion. This drop became more pronounced under the DIFF (NPR, FR 8) condition of Phase 3 and the DIFF (NPR, FR 10) condition of Phase 4. (As previously explained, the line on the cumulative record was not reset to zero at the beginning of a phase until testing had been completed on the picture-names that were completely trained in the previous phase.) When the DIFF (NPR, CRF) condition of Phase 1 was reinstated in Phase 5, the rate at which picture-names reached criterion increased, but not to the levels originally observed in Phase 1. Thus, Peter learned picture-names at the highest rate under the DIFF (NPR, CRF) condition of Phase 1.

Marda

Figure 8 presents the daily number of correct responses and errors to probes and prompts for Marda. Unlike the other two children, Marda showed a marked decline in the number of correct responses to probes and prompts when the schedule of reinforcement for correct responses to probes was increased from CRF in Phase 1 to FR 6 in Phase 2. When the DIFF (NPR, CRF) condition of Phase 1 was reinstated in Phase 3, there was an increase in the number of correct responses to probes and prompts, but not to the levels previously observed in Phase 1. The number of errors to probes and prompts were unaffected by these schedule manipulations.

FIGURE 8

Figure 8. Daily number of correct responses and errors on probe and prompt trials for Marda during Experiment I. Schedule abbreviations are explained under Experimental Procedures (Experiment I).

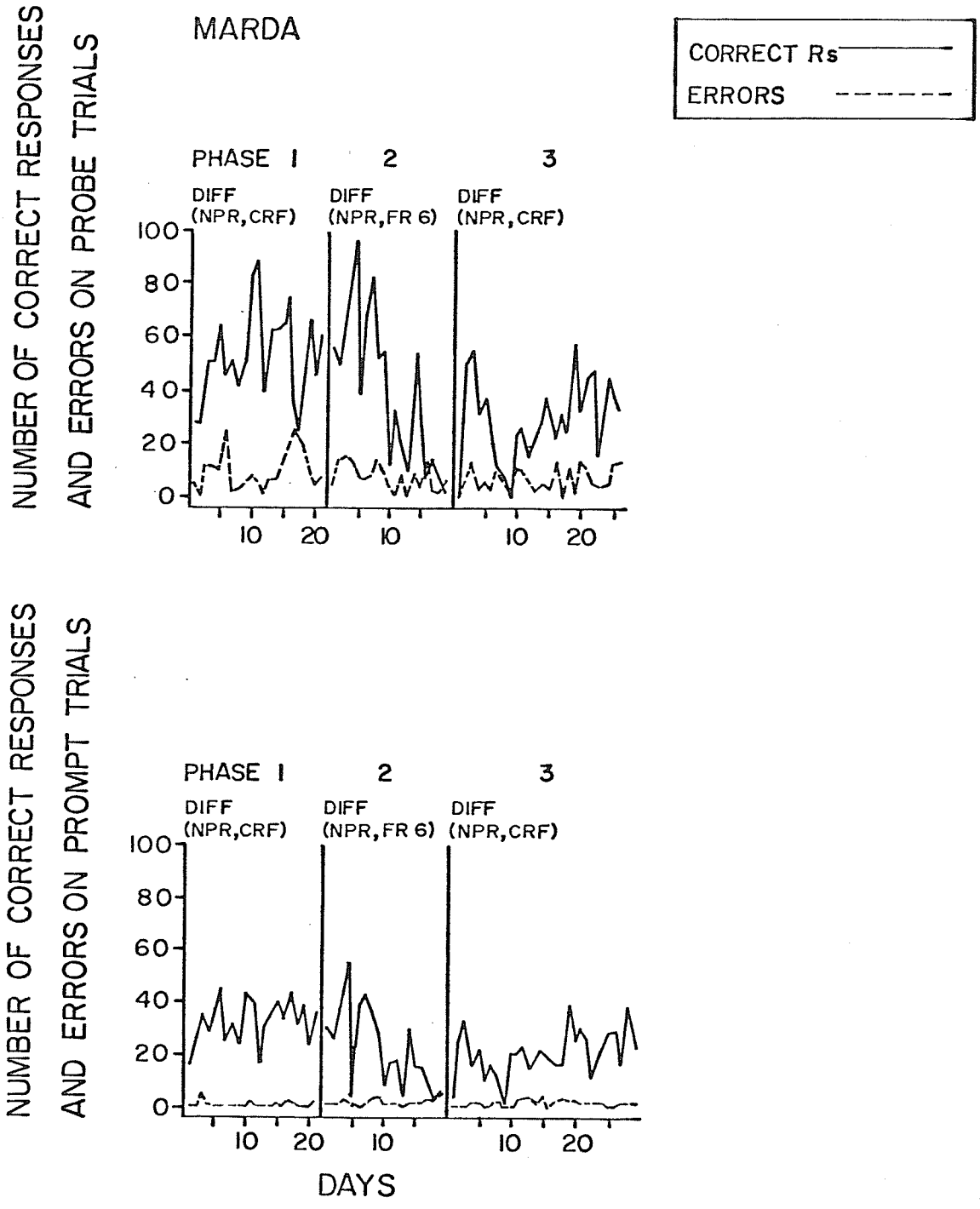

MARDA
CORRECT Rs
ERRORS
NUMBER OF CORRECT RESPONSES AND ERRORS ON PROBE TRIALS
PHASE 1
2
3
DIFF (NPR,CRF)
DIFF (NPR,FR 6)
DIFF (NPR,CRF)
100
80
60
40
20
0
10
20
10
10
20
NUMBER OF CORRECT RESPONSES AND ERRORS ON PROMPT TRIALS
PHASE 1
2
3
DIFF (NPR,CRF)
DIFF (NPR,FR 6)
DIFF (NPR,CRF)
100
80
60
40
20
0
10
20
10
10
20
DAYS

Figure 9 presents Marda's daily probe and prompt accuracies. There was a slight decrease in probe accuracy and a more pronounced decrease in prompt accuracy from Phase 1, when the DIFF (NPR, CRF) condition was in effect, to Phase 2, when the DIFF (NPR, FR 6) condition was in effect. When the DIFF (NPR, CRF) condition of Phase 1 was reinstated in Phase 3, there was little systematic variation in probe accuracy and marked improvement in prompt accuracy.

Figure 10 presents the cumulative number of picture-names that reached criterion across days for Marda. When the schedule of reinforcement for correct responses to probes was increased from CRF in Phase 1 to FR 6 in Phase 2, there was a slight drop in the rate at which picture-names reached criterion. When the DIFF (NPR, CRF) condition was reinstated, in Phase 3, there was a further decrease in the rate at which picture-names reached criterion. Thus, like Peter, Marda learned picture-names at the highest rate under the DIFF (NPR, CRF) condition of Phase 1.

Summary of Results

When the schedule of reinforcement for correct responses to probes was increased from CRF (Phase 1) to FR 6 (Phase 2), there was little systematic variation in any of the dependent variables for Gilles and Peter, except for a slight increase in the rate at which picture-names

FIGURE 9

Figure 9. Daily accuracies on probe and prompt trials for Marda during Experiment I. Schedule abbreviations are explained under Experimental Procedures (Experiment I).

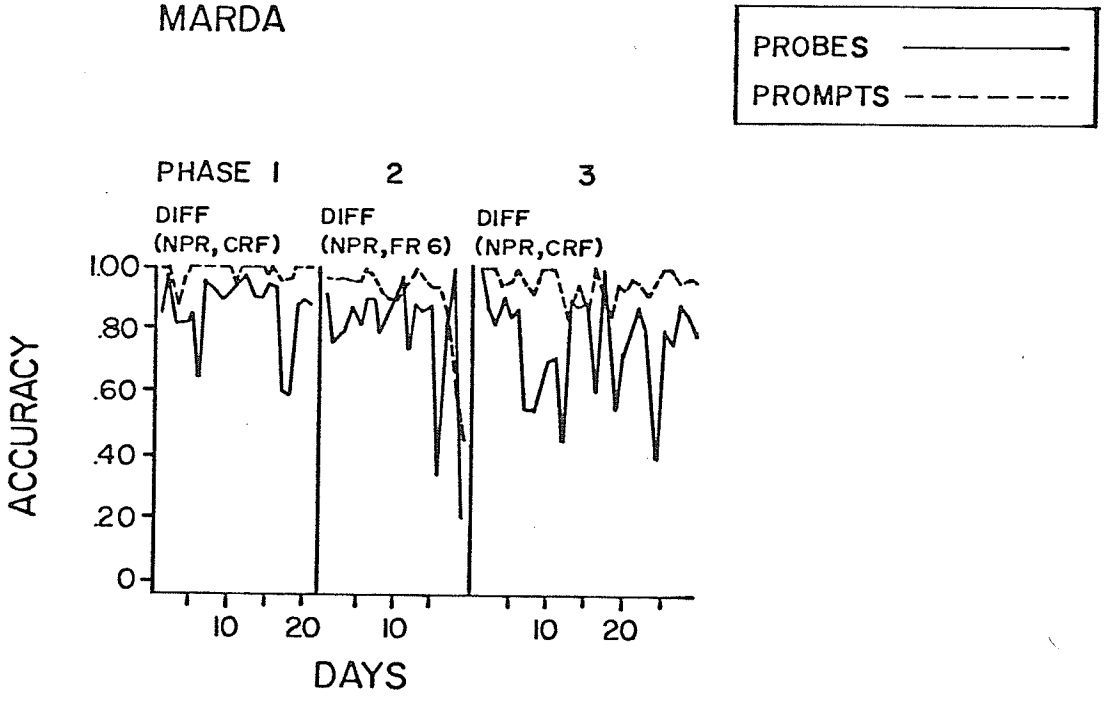
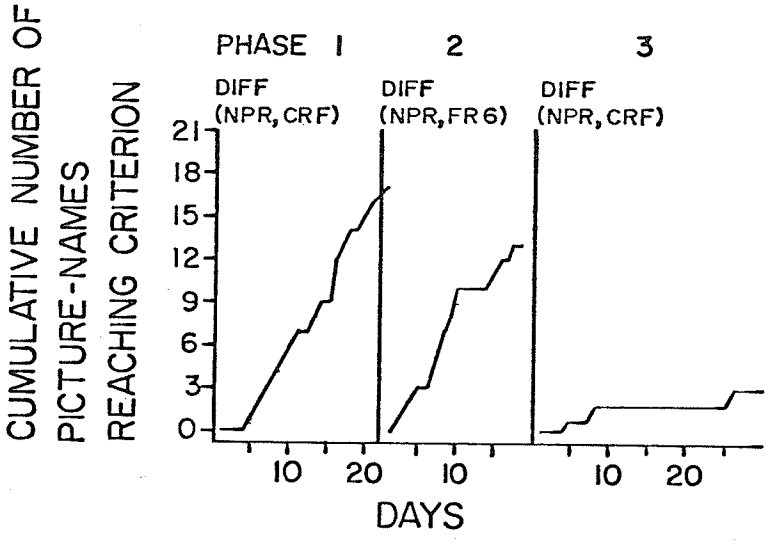

MARDA
PROBES
PROMPTS
PHASE 1
2
3
DIFF (NPR, CRF)
DIFF (NPR, FR 6)
DIFF (NPR, CRF)
ACCURACY
1.00
.80
.60
.40
.20
0
10
20
10
10
20
DAYS

FIGURE 10

Figure 10. Daily cumulative number of picture-names reaching criterion for Marda during Experiment I. The line does not reset after the end of a phase until that point at which all the pictures trained during that phase had been tested. Schedule abbreviations are explained under Experimental Procedures (Experiment 3).

MARDA


CUMULATIVE NUMBER OF PICTURE-NAMES REACHING CRITERION
PHASE 1
2
3
DIFF (NPR, CRF)
DIFF (NPR, FR 6)
DIFF (NPR, CRF)
21
18
15
12
9
6
3
0
10
20
10
10
20
DAYS

reached criterion for Gilles and a very slight decrease in the number of correct responses to probes and in the rate at which picture-names reached criterion for Peter. When the schedule of reinforcement for correct responses to probes was increased above FR 6, for both children, there was a decrease in the number of correct responses to probes and prompts and in the rate at which picture-names reached criterion. Also, for Gilles there was a decrease in probe accuracy. (Probe accuracy for Peter and prompt accuracy for Gilles and Peter were not appreciably affected by the schedule manipulations in this study.) Thus, for both Gilles and Peter, picture-naming performance deteriorated when the FR schedule of reinforcement for correct responses to probes was increased above FR 6.

When the schedule of reinforcement for correct responses to probes was increased from CRF (Phase 1) to FR 6 (Phase 2) for Marda, there was a marked decrease in the number of correct responses to probes and prompts, a marked decrease in probe and prompt accuracies, and a slight decrease in the rate at which picture-names reached criterion. That is, unlike the other two children, Marda showed a deterioration in picture-naming performance when the schedule of reinforcement for correct responses to probes was increased from CRF to FR 6.

Discussion

The results of Experiment I indicate that increases in the FR schedule of reinforcement for correct responses to probes produced either no change or a decrease in probe and prompt accuracies, and in the number of correct naming responses (on both prompt and probe trials). Also, there was a decrease in the rate of learning picture-names as the FR schedule of reinforcement for correct responses to probes was increased above CRF for two children and above FR 6 for the third child. The level of picture-naming performance maintained by the DIFF (NPR, FR) schedule was about equivalent to that maintained by the DIFF (NPR, CRF) schedule for two children, and DIFF (NPR, FR) was much less effective than DIFF (NPR, CRF) for one child.

The present results seem somewhat inconsistent with those of Stephens et al. (1975), who found that increases in nondifferential FR size up to FR 20 produced an increase in the number of correct naming responses and in the rate of learning picture-names. In the present study, picture-naming performance did not improve as the size of the FR schedule of reinforcement for correct responses to probes was increased.

It may be relevant to note that the increase in the overall number of correct responses per reinforcement from DIFF (NPR, CRF) to DIFF (NPR, FR 6) in the present study (see bracketed numbers in the top part of Table 1, p. 25) was substantially larger than that from CRF to FR 5 in the

Stephens et al. study where the increase was 4. Perhaps a more gradual increase in the overall number of correct responses per reinforcement would establish a relationship between the size of the FR schedule of reinforcement for correct responses to probes and picture-naming performance that is similar to the relationship between nondifferential FR size and picture-naming performance found by Stephens et al. Prior to investigating this possibility, Experiment II was conducted to compare the effects of child-paced and experimenter-paced trial-initiation on picture-naming performance maintained by the leanest differential reinforcement schedule found to be effective for each child in Experiment I.

CHAPTER III

Experiment II

The Effects of Child-Paced vs. Experimenter-Paced Trial Initiation on Picture-Naming Performance Maintained by an Effective Differential Schedule

Throughout Experiment I, training trials were initiated according to a child-paced procedure. Experiment II was designed to compare this child-paced procedure with an experimenter-paced procedure, using the leanest differential schedule found to be most effective for each child in Experiment I.

Method

Subjects

The three children who participated in Experiment I also participated in Experiment II.

Setting, Apparatus, and Materials

Experiment II was conducted in the same setting, using the same apparatus and materials, as Experiment I.

Picture-Name Training Procedure

The children were taught to name pictures according to the procedure described under Experiment I.

Experimental Procedures

As mentioned, the leanest differential schedule

found to be most effective for each child in Experiment I was used throughout Experiment II: DIFF (NPR, FR 6) for Gilles, and DIFF (NPR, CRF) for Peter and Marda. As in Experiment I, praise followed all correct responses to prompts and probes. The trial-initiation procedure was systematically varied according to a three-phase reversal design.

Phase 1. Child-Pacing. Phase 1 of Experiment II was a continuation of the last phase of Experiment I. Thus, for Gilles, primary reinforcement was delivered according to a DIFF (NPR, FR 6) schedule; for Peter and Marda, primary reinforcement was delivered according to a DIFF (NPR, CRF) schedule. Trials were initiated according to the child-paced procedure described earlier. To begin a training session, the experimenter pressed a button on her console, thereby illuminating the green light on the child's console. A button press by the child turned the light off and initiated a picture-naming trial. At the conclusion of a trial, a five-second inter-trial interval elapsed prior to the next illumination of the green light. Thus, according to this child-paced procedure, the child initiated trials by pressing the button on his/her console.

Phase 2. Experimenter-Pacing. Primary reinforcement was delivered according to the schedules used in Phase 1. Trials were initiated according to an experimenter-paced procedure. The child's button press was not required

to initiate a training trial. The experimenter simply initiated a trial by presenting a picture at the end of each inter-trial interval.

Phase 3. Child-Pacing. Phase 3 was a direct replication of Phase 1.

Each phase continued until the data became stable (as determined by visual inspection).

Dependent Variables

The seven dependent variables that were studied in Experiment I were also studied in Experiment II.

Results

Figure 11 presents the daily number of correct responses and errors (the latter being defined as incorrect responses plus response omissions) to probes for the three children. When experimenter-pacing was introduced in Phase 2, all three children emitted more correct responses to probes than in Phase 1 when child-pacing was in effect. For Gilles and Marda, however, this increase was transitory. Under the experimenter-pacing condition there was a marked increase in the number of errors to probes for all three children. When the child-pacing condition was reinstated in Phase 3, the number of correct responses to probes remained at the level observed in Phase 1 for Gilles, while there was a decline in this variable to slightly above the level observed in Phase 1 for Peter and to slightly below that level for Marda. The number of errors to probes returned to slightly above the level observed in Phase 1 for Gilles and to the levels observed in Phase 1 for Peter and Marda.

FIGURE 11

Figure 11. Daily number of correct responses and errors on probe trials for each child during Experiment II.

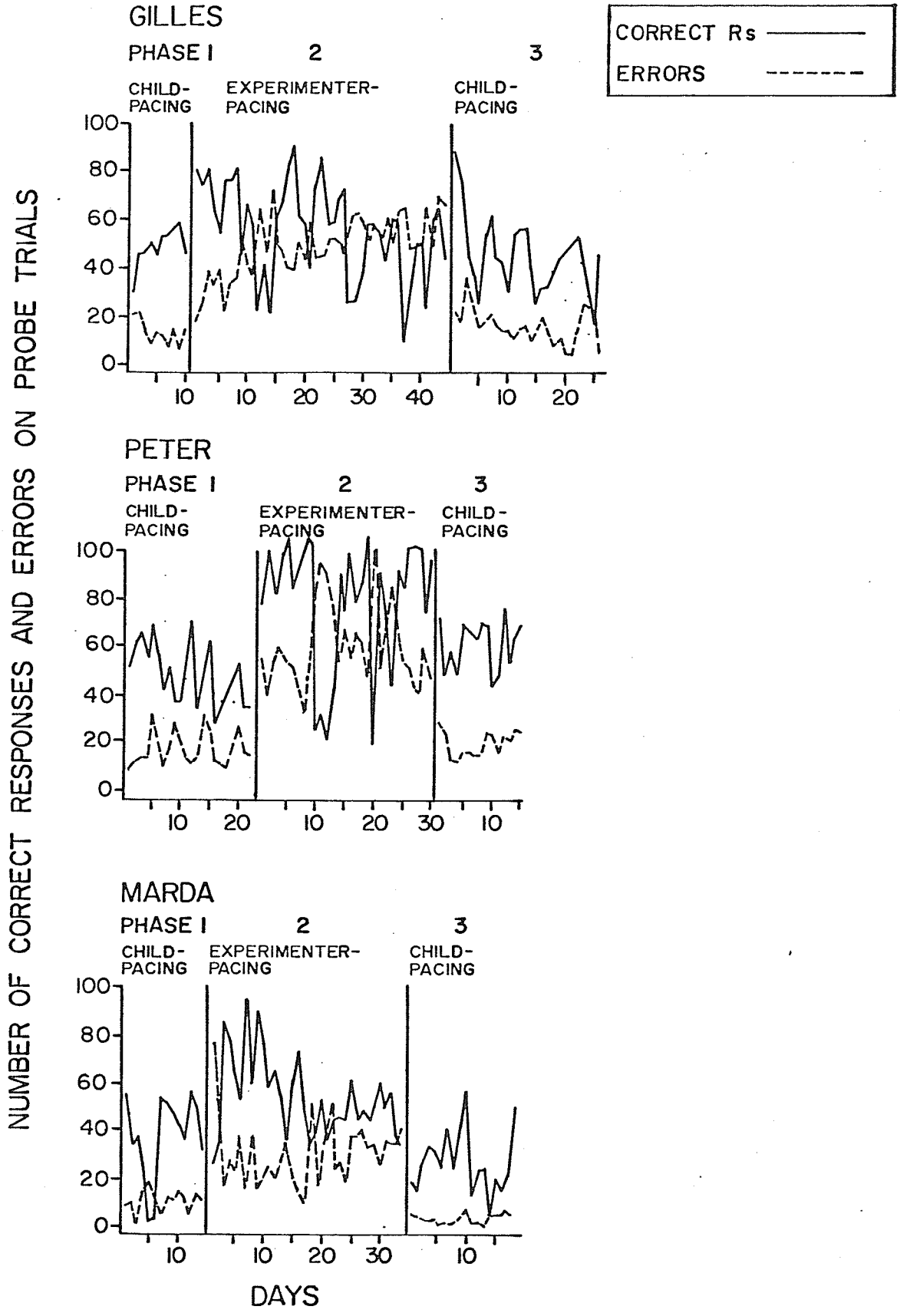

GILLES
PHASE 1
2
3
CHILD-PACING
EXPERIMENTER-PACING
CHILD-PACING
CORRECT Rs
ERRORS
NUMBER OF CORRECT RESPONSES AND ERRORS ON PROBE TRIALS
100
80
60
40
20
0
10
10
20
30
40
10
20
PETER
PHASE 1
2
3
CHILD-PACING
EXPERIMENTER-PACING
CHILD-PACING
10
20
10
20
30
10
MARDA
PHASE 1
2
3
CHILD-PACING
EXPERIMENTER-PACING
CHILD-PACING
DAYS

Figure 12 presents the daily number of correct responses and errors to prompts for the three children. For each child there was a sizeable increase in the number of correct responses to prompts from the child-pacing condition of Phase 1 to the experimenter-pacing condition of Phase 2. At the same time, there was a slight increase in the number of errors to prompts from Gilles and Peter and a marked increase in this variable for Marda. When the child-pacing condition of Phase 1 was reinstated in Phase 3, the number of correct responses to prompts declined to the level observed in Phase 1 for Gilles, to slightly above that level for Peter, and to slightly below that level for Marda. The number of errors to prompts declined to the levels observed in Phase 1 for the three children.

Figure 13 presents the daily probe and prompt accuracies for the three children. For each child there was a decline in probe accuracy from the child-pacing condition of Phase 1 to the experimenter-pacing condition of Phase 2. At the same time, there was a slight decrease in prompt accuracy for Gilles and Peter, and a marked decrease in prompt accuracy for Marda. When the child-pacing condition of Phase 1 was reinstated in Phase 3, probe and prompt accuracies returned to the levels previously observed in Phase 1 for all three children.

Figure 14 presents the cumulative number of picture-names that reached criterion across days for each child. For Gilles, the rate at which picture-names reached

FIGURE 12

Figure 12. Daily number of correct responses and errors on prompt trials for each child during Experiment II.

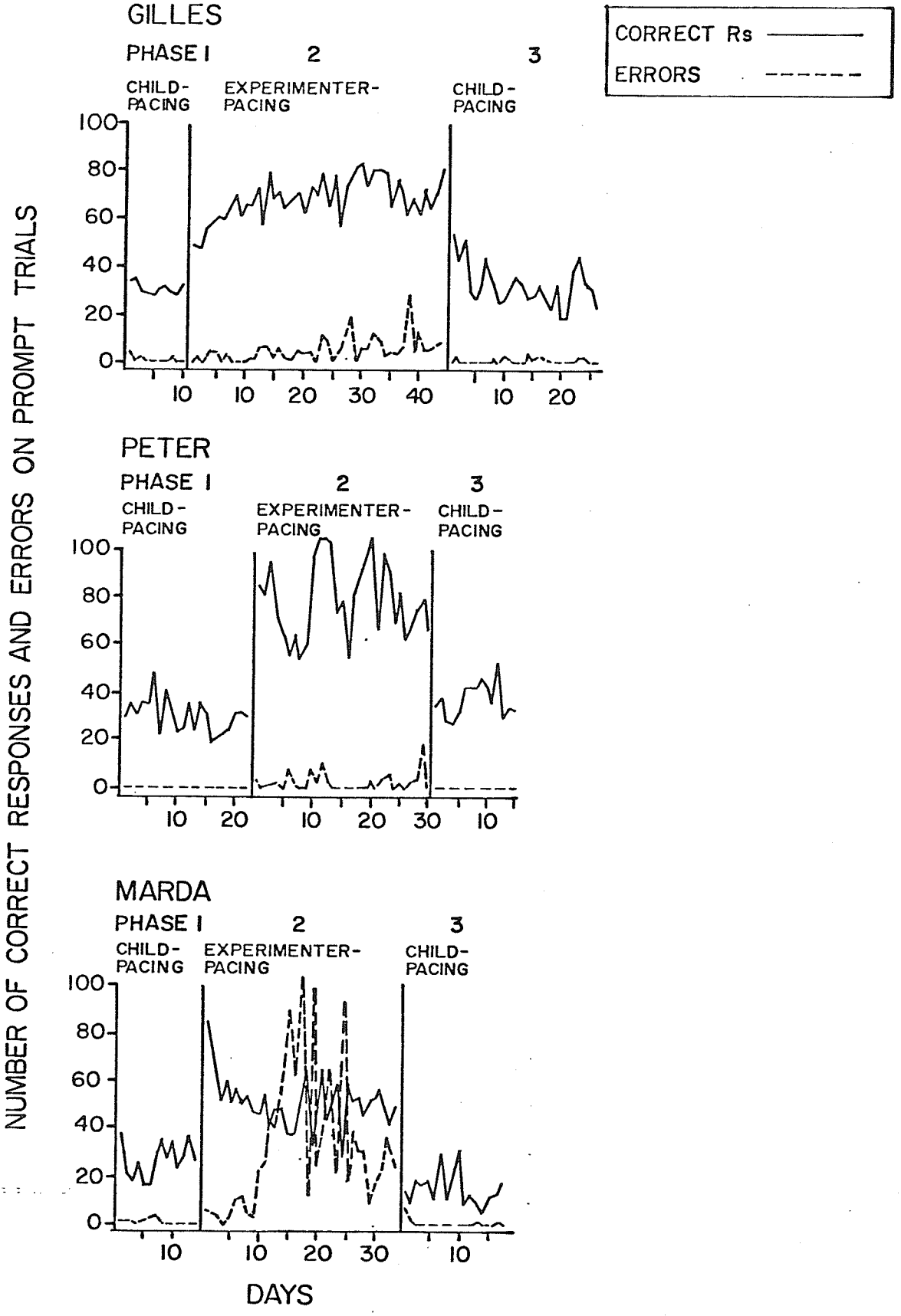

GILLES
PHASE 1
2
3
CHILD-PACING
EXPERIMENTER-PACING
CHILD-PACING
CORRECT Rs
ERRORS
NUMBER OF CORRECT RESPONSES AND ERRORS ON PROMPT TRIALS
100
80
60
40
20
0
10
10
20
30
40
10
20
PETER
PHASE 1
2
3
CHILD-PACING
EXPERIMENTER-PACING
CHILD-PACING
100
80
60
40
20
0
10
20
10
20
30
10
MARDA
PHASE 1
2
3
CHILD-PACING
EXPERIMENTER-PACING
CHILD-PACING
100
80
60
40
20
0
10
10
20
30
10
DAYS

FIGURE 13

Figure 13. Daily accuracies on probe and prompt trials for each child during Experiment II.

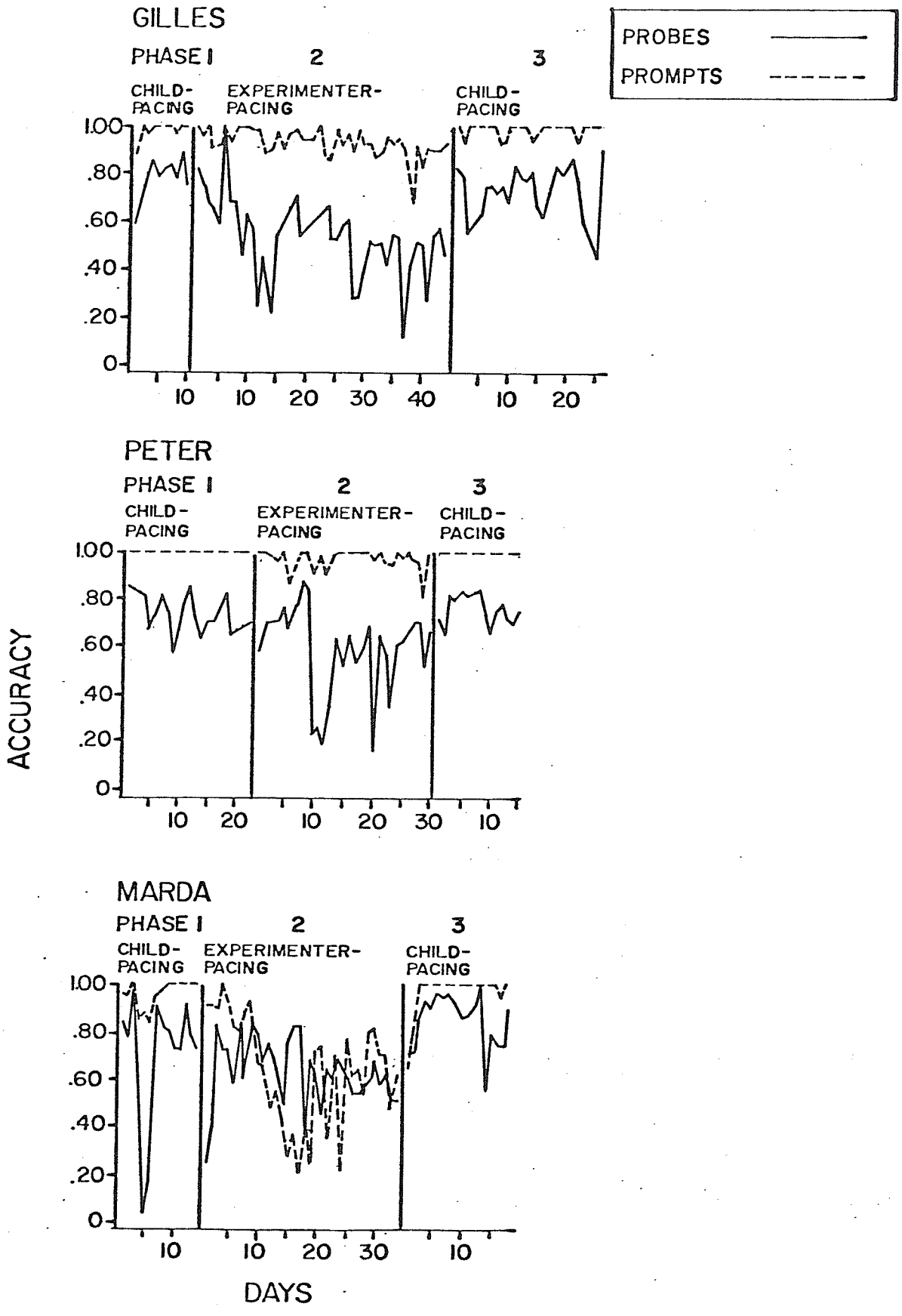
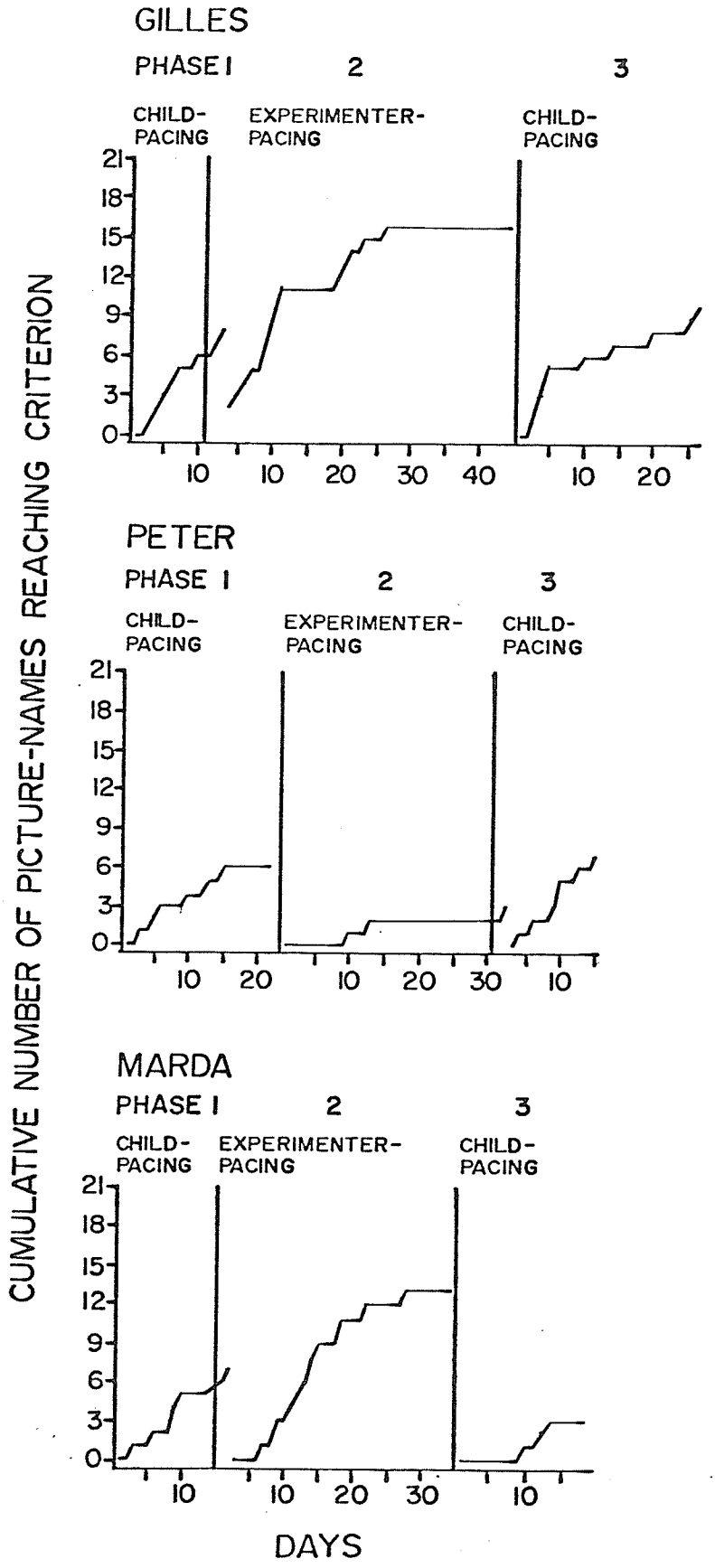

GILLES
PHASE 1
2
3
CHILD-PACING
EXPERIMENTER-PACING
CHILD-PACING
PROBES
PROMPTS
1.00
.80
.60
.40
.20
0
10
10
20
30
40
10
20
PETER
PHASE 1
2
3
CHILD-PACING
EXPERIMENTER-PACING
CHILD-PACING
ACCURACY
1.00
.80
.60
.40
.20
0
10
20
10
20
30
10
MARDA
PHASE 1
2
3
CHILD-PACING
EXPERIMENTER-PACING
CHILD-PACING
1.00
.80
.60
.40
.20
0
10
10
20
30
10
DAYS

FIGURE 14

Figure 14. Daily cumulative number of picture-names reaching criterion for each child during Experiment II. The line does not reset after the end of a phase until that point at which all the pictures trained in that phase had been tested.


GILLES
PHASE 1
2
3
CHILD-PACING
EXPERIMENTER-PACING
CHILD-PACING
21
18
15
12
9
6
3
0
10
10
20
30
40
10
20
PETER
PHASE 1
2
3
CHILD-PACING
EXPERIMENTER-PACING
CHILD-PACING
21
18
15
12
9
6
3
0
10
20
10
20
30
10
MARDA
PHASE 1
2
3
CHILD-PACING
EXPERIMENTER-PACING
CHILD-PACING
21
18
15
12
9
6
3
0
10
10
20
30
10
CUMULATIVE NUMBER OF PICTURE-NAMES REACHING CRITERION
DAYS

criterion was zero between the tenth and twentieth days of experimenter-pacing in Phase 2. Then, there was an apparent recovery in the rate at which picture-names reached criterion for Gilles until Day 25 of Phase 2, when the rate dropped to zero for the remainder of the phase. (As mentioned previously, the line on the cumulative record was not reset to zero at the beginning of a phase until testing had been completed on the picture-names that were completely trained in the previous phase.) For Peter, there was a decrease in the rate at which picture-names reached criterion as soon as experimenter-pacing was introduced in Phase 2. When the child-pacing condition of Phase 1 was reinstated in Phase 3 for these two children, the rate at which picture-names reached criterion increased to just below the level previously observed in Phase 1 for Gilles, and to the level observed in Phase 1 for Peter. For Marda, there appeared to be no systematic change in this variable as a function of the trial-initiation procedure.

Discussion

The results of Experiment II suggest that when an effective differential schedule is used, child-paced trial-initiation might be preferable to experimenter-paced trial-initiation for teaching picture-names to retarded children. Although for one of the children in this study the number of correct responses to probes was higher under experimenter-pacing, there was no appreciable change

in this variable for the other two children. All three children emitted many more errors to probes under experimenter-pacing. Although experimenter-pacing produced an increase in correct responses to prompts, there was a simultaneous increase in errors to prompts for the three children. Thus, for each child, both probe and prompt accuracies were higher under child-pacing. Also, two of the three children appeared to learn picture-names at higher rates under the child-paced procedure.

The present results seem somewhat inconsistent with those of Budyk and Pear (unpublished manuscript). Comparing child-paced and experimenter-paced trial-initiation in verbal training with three retarded children, Budyk and Pear found that the child-paced procedure produced no systematic variation in accuracy (not an increase, as in the present study) and a decrease in learning rate (not an increase, as in the present study). Five procedural differences between the present study and that of Budyk and Pear might account for the discrepant findings.

First, in the present study picture-naming performance was maintained by a differential schedule; in the Budyk and Pear study performance was maintained by a non-differential schedule. Second, throughout the present study the children were taught to name pictures; throughout the majority of the Budyk and Pear study the children were taught to imitate vocal sounds. Third, the present study used a reversal design; the Budyk and Pear study used a

multi-element design. That is, in the present study each child was exposed to a single trial-initiation procedure over a period of several weeks, whereas in the Budyk and Pear study each child was exposed to both the child-paced and the experimenter-paced trial-initiation procedures on the same day. Fourth, in the child-paced condition of the present study, the children initiated trials by pressing a button on their consoles; in the child-paced condition of the Budyk and Pear study, the children initiated trials by looking at the experimenter's face. Fifth, the children in the present study had been taught to name pictures using child-paced trial-initiation for a period of one to three years before experimenter-paced trial-initiation was introduced in Experimenter II; the children in Budyk and Pear study had been given little or no prior verbal training.

The role played by each of these five procedural differences in producing the discrepancy between the present results and those of Budyk and Pear has yet to be determined. Further research is thus necessary to identify the conditions under which child-paced and experimenter-paced trial-initiation should be used in verbal training with retarded children.

CHAPTER IV

Experiment III

A Low Fixed-Ratio Schedule of Reinforcement for Correct Responses to Probes in Picture-Name Training with Severely Retarded Children

In Experiment I, no schedule between DIFF (NPR, FR 6) and DIFF (NPR, FR 10) was found which would reliably increase the children's picture-naming performance above that maintained by DIFF (NPR, CRF). This appears inconsistent with that of Stephens et al. (1975) who found that picture-naming performance improved as the nondifferential schedule was increased from CRF to FR 20. As previously explained, a possible reason for this discrepancy is that the FR schedules of reinforcement for correct responses to probes in Experiment I were too high. Experiment III therefore investigated a DIFF (NPR, FR 3) schedule.

Method

Subjects

Gilles and Marda, who participated in Experiments I and II, also participated in Experiment III. (Peter was unavailable for Experiment III.)

Setting, Apparatus, and Materials

Experiment III was conducted in the same setting using the same apparatus and materials, as Experiments I and II.

Picture-Name Training Procedure

The children were taught to name pictures according to the procedure described under Experiment I.

Experimental Procedures

In Experiment III picture-naming trials were initiated according to the child-paced procedure used throughout Experiment I. Praise followed all correct responses on both prompt and probe trials. In Phase 1 of Experiment III correct responses were reinforced according to the leanest differential schedule found to be most effective in Experiment I: DIFF (NPR, FR 6) for Gilles and DIFF (NPR, CRF) for Marda. In Phase 2 for both children, correct responses were reinforced according to a DIFF (NPR, FR 3) primary reinforcement schedule, whereby correct responses to prompts were not followed by primary reinforcement and every third correct response to probe was followed by primary reinforcement.

Dependent Variables

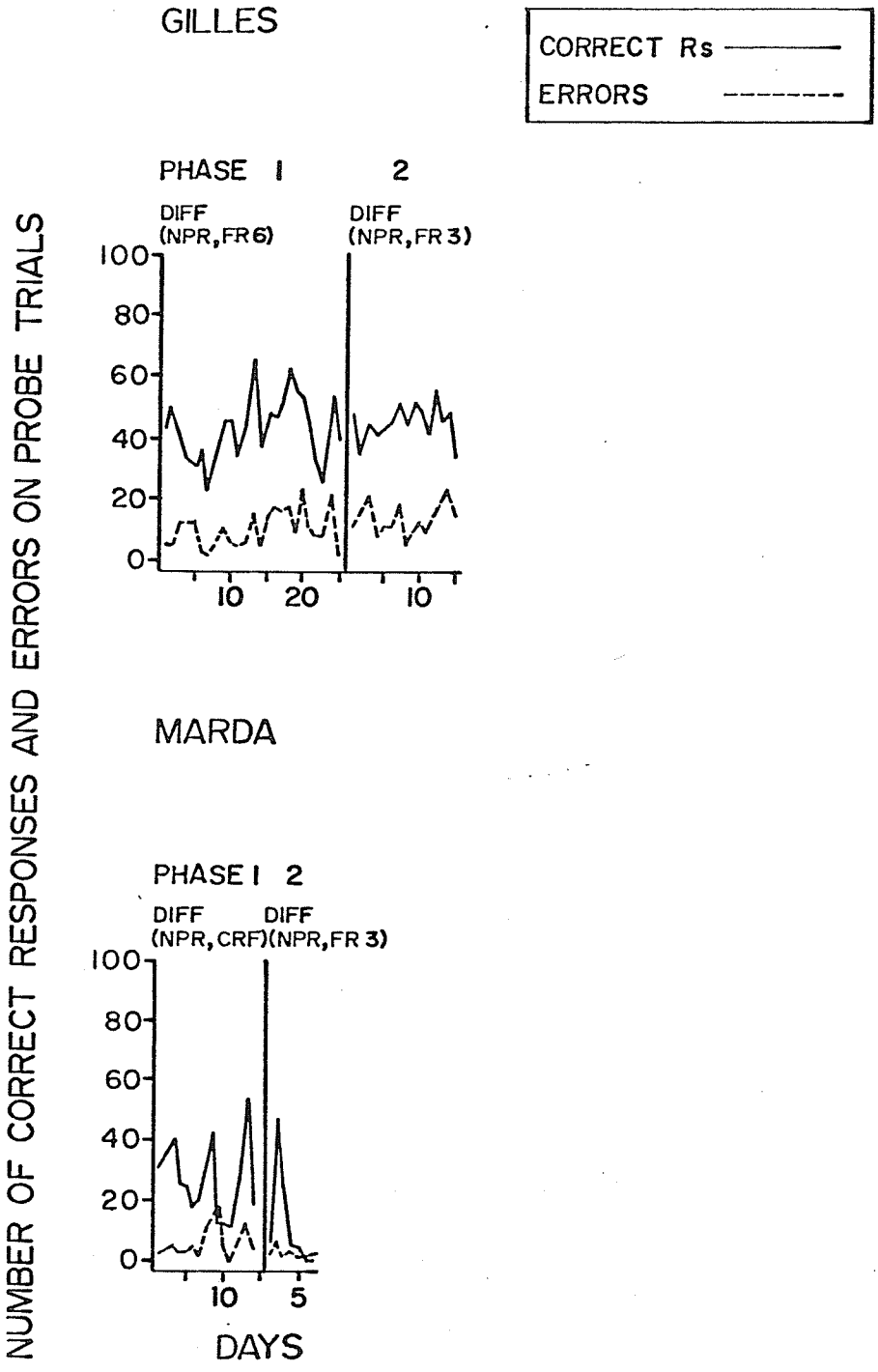
The seven dependent variables that were studied in Experiments I and II were also studied in Experiment III.

Results

Figure 15 presents the daily number of correct

FIGURE 15

Figure 15. Daily number of correct responses and errors on probe trials for each child during Experiment III. Schedule abbreviations are explained under Experimental Procedures (Experiment III).


GILLES
CORRECT Rs
ERRORS
PHASE 1 2
DIFF (NPR, FR6)
DIFF (NPR, FR3)
100
80
60
40
20
0
10 20 10
MARDA
PHASE 1 2
DIFF (NPR, CRF)
DIFF (NPR, FR3)
100
80
60
40
20
0
10 5
DAYS
NUMBER OF CORRECT RESPONSES AND ERRORS ON PROBE TRIALS

responses and errors (the latter being defined as incorrect responses plus response omissions) to probes for both children. For Gilles there was no systematic change in either of these variables from the DIFF (NPR, FR 6) condition of Phase 1 to the DIFF (NPR, FR 3) condition of Phase 2. From the DIFF (NPR, CRF) condition of Phase 1 to the DIFF (NPR, FR 3) condition of Phase 2 for Marda, there was a marked decrease in the number of correct responses to probes and a slight decrease in the number of errors to probes.

Figure 16 presents the daily number of correct responses and errors to prompts for both children. There was no appreciable change in either of these variables for Gilles. Under the DIFF (NPR, FR 3) condition for Marda (Phase 2), there was a marked decrease in the number of correct responses to prompts and little variation in the number of errors to prompts.

Figure 17 presents the daily probe and prompt accuracies for both children. When the DIFF (NPR, FR 3) condition was introduced in Phase 2, there was no systematic variation in either probe or prompt accuracy for Gilles, while there was a sizeable decrease in both types of accuracy for Marda.

Figure 18 presents the cumulative number of picture-names that reached criterion across days for each

FIGURE 16

Figure 16. Daily number of correct responses and errors on prompt trials for each child during Experiment III. Schedule abbreviations are explained under Experimental Procedures (Experiment III).

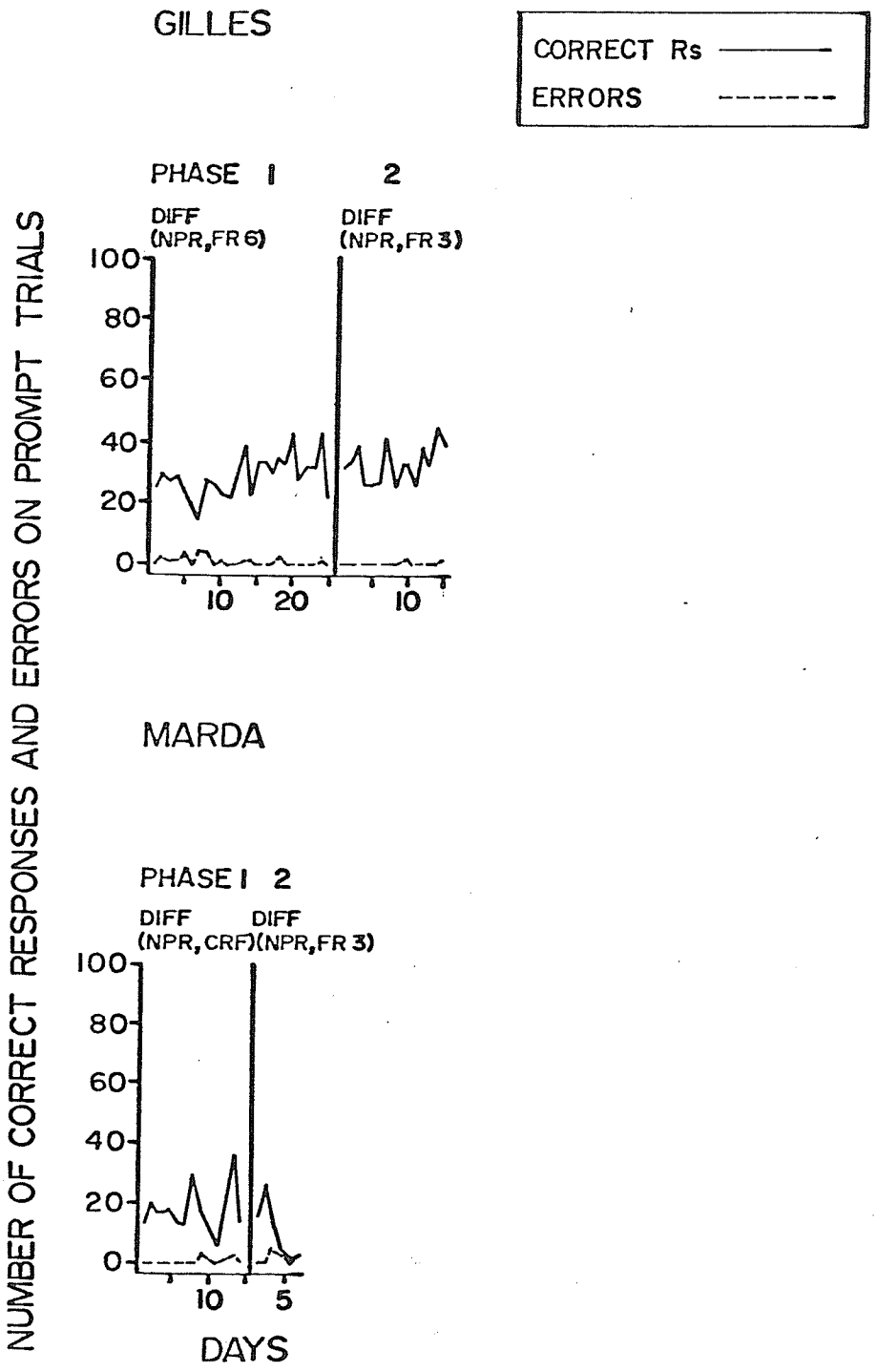

GILLES
CORRECT Rs
ERRORS
PHASE 1 2
DIFF (NPR,FR 6)
DIFF (NPR,FR 3)
100
80
60
40
20
0
10 20 10
MARDA
PHASE 1 2
DIFF (NPR,CRF)
DIFF (NPR,FR 3)
100
80
60
40
20
0
10 5
DAYS
NUMBER OF CORRECT RESPONSES AND ERRORS ON PROMPT TRIALS

FIGURE 17

Figure 17. Daily accuracies on probe and prompt trials for each child during Experiment III. Schedule abbreviations are explained under Experimental Procedures (Experiment III).

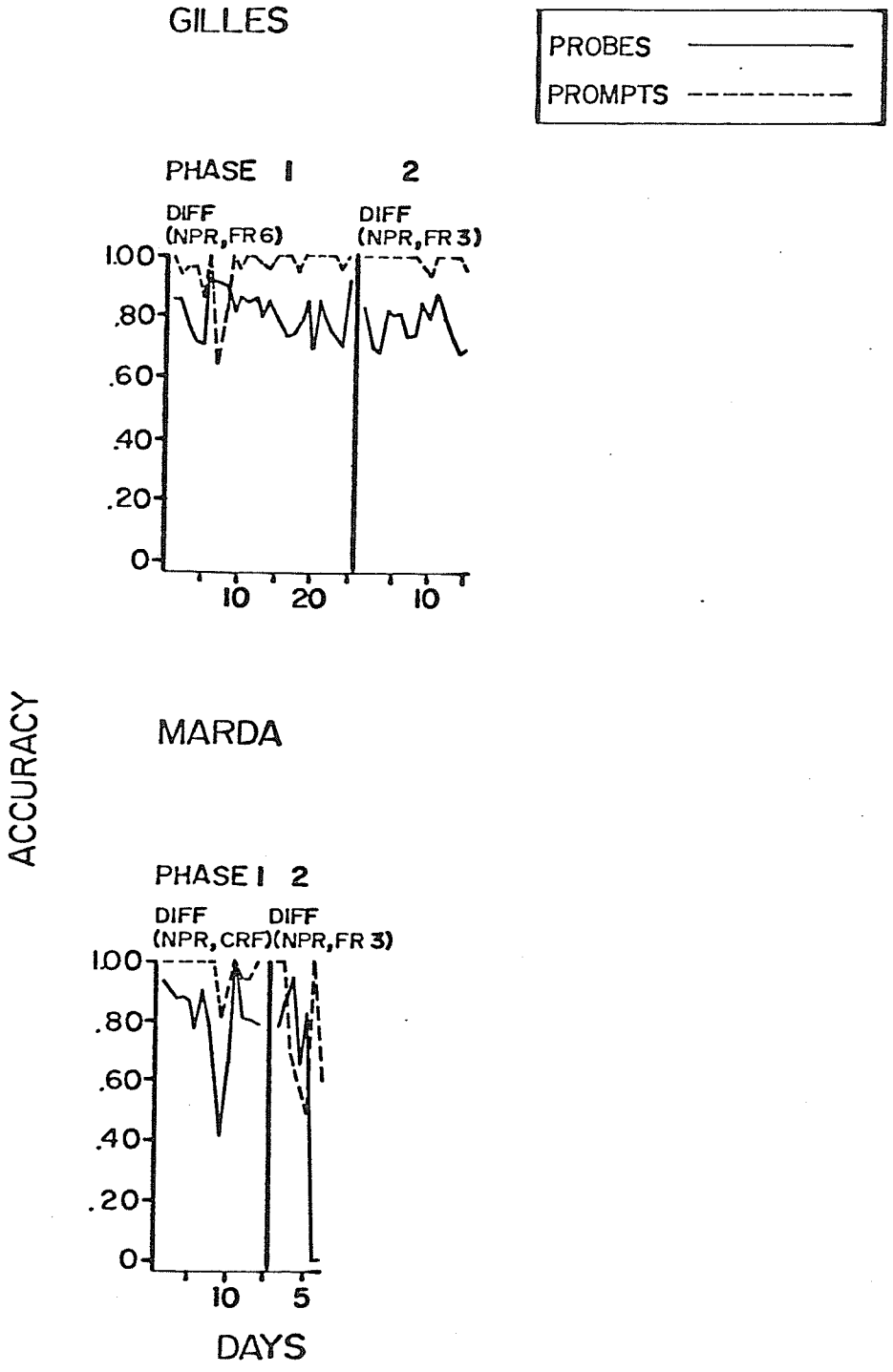
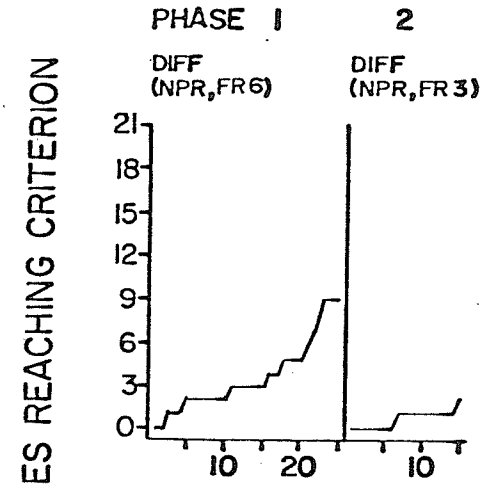

GILLES
PROBES
PROMPTS
PHASE 1 2
DIFF (NPR, FR6)
DIFF (NPR, FR3)
1.00
.80
.60
.40
.20
0
10
20
10
ACCURACY
MARDA
PHASE 1 2
DIFF (NPR, CRF)
DIFF (NPR, FR3)
1.00
.80
.60
.40
.20
0
10
5
DAYS

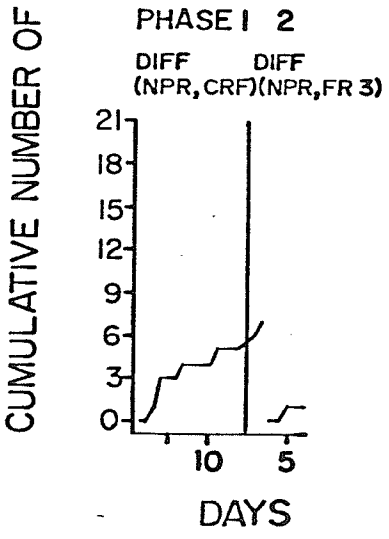
FIGURE 18

Figure 18. Daily cumulative number of picture-names reaching criterion for each child during Experiment III. The line does not reset after the end of a phase until that point at which all the pictures trained during that phase had been tested. Schedule abbreviations are explained under Experimental Procedures (Experiment III).

GILLES



MARDA



CUMULATIVE NUMBER OF PICTURE-NAMES REACHING CRITERION

child. For Gilles, there appeared to be no appreciable change in the rate at which picture-names reached criterion from the DIFF (NPR, FR 6) condition (Phase 1) to the DIFF (NPR, FR 3) condition (Phase 2). Because Marda's performance on probe and prompt trials was greatly disrupted by the DIFF (NPR, FR 3) reinforcement schedule (Phase 2), Phase 2 was terminated before this schedule had a detectable effect on the rate at which picture-names reached criterion for Marda.

Discussion

Just as DIFF (NPR, FR 6) produced no improvement in picture-naming performance compared to DIFF (NPR, CRF) in Experiment I, DIFF (NPR, FR 3) produced no improvement in Experiment III. Gilles emitted the same number of correct responses, had the same accuracies, and learned picture-names at approximately the same rate under all three conditions. As under DIFF (NPR, FR 6), under DIFF (NPR, FR 3) Marda emitted fewer correct responses and had lower accuracies than under DIFF (NPR, CRF). There was no clear effect of DIFF (NPR, FR 3) on Marda's rate of learning picture-names.

The results of Experiment III, together with those of Experiment I, indicate that picture-naming performance does not improve as the FR schedule of reinforcement for correct responses to probes is increased. Note that the increase in the overall number of correct responses

per reinforcement from DIFF (NPR, CRF) to DIFF (NPR, FR 3) in the present study (see the bracketed numbers in the bottom part of Table 1, p. 25) was approximately four, which was the increase from nondifferential CRF to nondifferential FR 5 in the Stephens et al. (1975) study. Although the present results were inconsistent with those of Stephens et al., this inconsistency is thus not attributable to changes in the overall number of correct responses per reinforcement.

It should be noted that Gilles, Peter, and Marda emitted more correct responses, had higher accuracies, and learned picture-names at higher rates under CRF for correct responses to probes than did the children under nondifferential CRF in the Stephens et al. study. Perhaps the effect of FR size on picture-naming performance is related to performance level at the time FR reinforcement is introduced. Research designed to investigate this relationship might elucidate the conditions under which increasing the FR schedule of reinforcement improves the performance of retarded children on a picture-naming task.

CHAPTER V

Summary and Conclusions

This research comprised a systematic analysis of two components of picture-name training procedures for retarded children: the schedule of primary reinforcement and the procedure for trial initiation. Although the cause of retardation was diagnosed differently for each of the three children participating in this research (Gilles had Down's syndrome; Peter had phenylketonuria and autistic mannerisms; Marda had primary microcephaly), the findings of the research were generally consistent across the three children.

The results of Experiments I and III indicate that when correct responses to prompts are not followed by primary reinforcement, increasing the FR schedule of primary reinforcement for correct responses to probes produces no improvement in picture-naming performance. Rather, the level of picture-naming performance maintained by a DIFF (NPR, FR) schedule appears to be either equivalent or inferior to that maintained by a DIFF (NPR, CRF) schedule.

The results of Experiment II suggest that when an effective differential schedule is used, child-paced trial-initiation is preferable to experimenter-paced trial-initiation in picture-name training. For all three

children probe accuracy, prompt accuracy, and for two of the three children, learning picture-names were generally higher under the child-paced procedure.

Thus, of the reinforcement and trial-initiation procedures evaluated in this research, the DIFF (NPR, CRF) schedule of primary reinforcement combined with child-paced trial-initiation was found to be most reliably effective for teaching picture-names to retarded children.

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APPENDIX A

A Comparison of Fixed-Ratio Primary Reinforcement and No Primary Reinforcement for Correct Responses to Prompts

Method

Subjects

Gilles and Marda participated in this experiment just prior to participating in Experiment I.

Setting, Apparatus, and Materials

This experiment was conducted in the same setting using the same apparatus and materials described under Experiment I.

Picture-Name Training Procedure

The children were taught to name pictures according to the procedure described under Experiment I.

Experimental Procedures

This experiment was designed to study the effects of a differential schedule that provided no primary reinforcement for correct responses to prompts on the picture-naming performance of two retarded children. Throughout the experiment, praise followed all correct responses on both prompt and probe trials. The primary reinforcement schedules are described below.

Phase 1. DIFF (FR 6, CRF). Every sixth correct

response to a prompt and every correct response to a probe were followed by primary reinforcement. Olenick and Pear (in press) found this differential schedule to be highly effective in picture-name training.

Phase 2. DIFF (NPR, CRF). Correct responses to prompts were not followed by primary reinforcement (NPR; no primary reinforcement) and, as in Phase 1, every correct response to a probe was followed by primary reinforcement.

Each phase continued until the data became stable, as determined by visual inspection.

Dependent Variables

Seven dependent variables were studied. They were:

1. daily number of correct responses to probes;
2. daily number of errors to probes (i.e., incorrect responses and response omissions to probes);
3. daily number of correct responses to prompts;
4. daily number of errors to prompts;
5. daily probe accuracy (i.e., the proportion of probe trials responded to correctly);
6. daily prompt accuracy;
7. daily number of picture-names reaching criterion.

Results and Conclusions

Table 2 presents the results of this study. From the DIFF (FR 6, CRF) condition to the DIFF (NPR, CRF) condition, there was little change in the number of correct responses to probes and prompts for Gilles and an increase in these variables for Marda. At the same time, there was a decrease in the number of errors to probes for Gilles and a slight increase in this variable for Marda. There was no appreciable change in the number of errors to prompts for either child. Gilles showed an increase in probe accuracy from the DIFF (FR 6, CRF) condition to the DIFF (NPR, CRF) condition, while probe accuracy for Marda and prompt accuracy for both children did not change appreciably. Both children learned picture-names at a greater rate under the DIFF (NPR, CRF) condition.

These results indicated that a differential schedule providing no primary reinforcement for correct responses to prompts and continuous reinforcement for correct responses to probes is highly effective in picture-name training with retarded children.

TABLE 2

Results of the DIFF (FR 6, CRF) and DIFF (NPR, CRF) Comparison

For each dependent variable the data were averaged over the last 5 days of the indicated phases.

Dependent Variable	Gilles		Marda	
	Phase 1: DIFF (FR 6, CRF)	Phase 2: DIFF (NPR, CRF)	Phase 1: DIFF (FR 6, CRF)	Phase 2: DIFF (NPR, CFR)
Correct responses to probes	46.0	41.0	36.2	49.0
Errors to probes	24.6	14.0	7.0	13.0
Correct responses to prompts	31.6	27.0	23.8	34.2
Errors to prompts	.8	1.4	.8	1.0
Probe Accuracy	.66	.78	.77	.76
Prompt Accuracy	.98	.99	.97	.98
Cumulative Number of Picture-Names Reaching Criterion	.2	.4	.4	.6