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Assessing some Side Effects of a Contingency Management Program

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ASSESSING SOME SIDE EFFECTS OF A CONTINGENCY
MANAGEMENT PROGRAM

A Thesis
Presented to
the Graduate Faculty
Central Washington State College

In Partial Fulfillment
of the Requirements for the Degree
Master of Education

by
Charles M. Atkinson

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APPROVED FOR THE GRADUATE FACULTY

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TABLE OF CONTENTS

	PAGE
LIST OF TABLES	vi
CHAPTER	
I. INTRODUCTION	1
Purpose	6
Hypotheses	6
II. METHOD	8
Subjects	8
Measurement Procedures	9
Baseline Phase	11
Reinforcement Phase	13
Posttest Phase	14
III. RESULTS	15
Addition Rate	15
Side Effects	15
IV. DISCUSSION	20
V. SUMMARY	23
REFERENCES	24

CHAPTER	PAGE
APPENDIX	
A. Addition Worksheet	26
B. Subtraction Worksheet	28
C. Individual Records of Addition Rates During Baseline, Reinforcement, and Posttest: Experimental Subjects . .	30
D. Individual Mean Rates and WPBIC Total Scores During Baseline Phase and Posttest Phase	35

LIST OF TABLES

TABLE	PAGE
1. Difference Between Gains in Addition Rate from Baseline to Posttest	16
2. Difference Between Gains in Subtraction Rate from Baseline to Posttest	16
3. Difference Between Gains in Reading Rate from Baseline to Posttest	17
4. Difference Between Gains in Reading Comprehension Score from Baseline to Posttest	18
5. Difference Between WPBIC Total Score from Baseline to Posttest	19

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This study applied a contingency management program to a single behavior while measuring multiple behaviors. Reinforcement was made contingent upon increased addition rate. The experimental group made significantly greater gains in addition rate. There was no significant difference in the gains made in subtraction rate, reading rate, reading comprehension, or classroom behavior. The study was limited by a small sample, six week time span, and the use of mentally retarded subjects to assess side effects of reinforcing an academic behavior.

CHAPTER I

INTRODUCTION

In recent years behavior modification principles and techniques have been applied to classrooms for exceptional children. At the Rainier School in Buckley, Washington, one of the earliest attempts was made to apply a token reinforcement system to a classroom for the mentally retarded (Birnbrauer and Lawler, 1964).

Birnbrauer, Wolf, Kidder, and Taque (1965) used knowledge of results, verbal approval, and tokens to reinforce correct responses in an experimental programmed instruction classroom for mentally retarded students. The tokens were exchanged at the end of each class period for inexpensive toys, school supplies, and an array of edible items. Later, the tokens were not dispensed for a short time to determine if they were essential for the high percentage of accuracy exhibited by the students. Five of the fifteen pupils showed no measurable change in performance. The remaining ten students stopped progressing in the programs, exhibited an increase in errors, and an increase in the amount of disruptive behavior. When the tokens were reinstated, all ten pupils recovered at least baseline performance.

Precise scheduling of consequences, systematic application of behavior modification techniques, and environmental manipulation were combined in one study to bring the behavior of an emotionally disturbed boy under better control (Whelan & Haring, 1966).

In another study (Becker, Madsen, Arnold, & Thomas, 1967), the contingent use of teacher praise and attention reduced the incidence of classroom behavior problems. Subjects were students in regular elementary classrooms with normal teacher-pupil ratios. The results of the study demonstrate different kinds of teachers can learn to apply behavior principles and modify the behavior of children within a regular elementary classroom.

Hewett (1968) used the systematic presentation of points and verbal praise to increase the task attention of educationally handicapped children. Developing an engineered classroom design, he applied a contingency management program to various behaviors of 45 children in six classrooms.

The effectiveness of behavior modification techniques has been demonstrated in other classroom settings as well as those mentioned above. Most studies are designed to apply contingencies to specific behaviors. But, some investigators have noted changes in behaviors other than those designated for modification.

Schwarz and Hawkins (1970) found that application of delayed reinforcement to the behavior of a young girl resulted in apparent

changes in a number of behaviors other than those specifically designated for modification. The apparent changes in other behaviors were reported by the experimenter, the subject's teacher, and others who had contact with the girl.

Risley (1968) found a side effect in what he described as a topographically dissimilar behavior. When shock was made contingent upon an autistic girl's persistent climbing on a bookcase, the number of eye contacts she made with the experimenter increased from 42 times per hour to a peak of 222 times per hour. When punishment was used to eliminate the girl's autistic rocking, she exhibited an increase in an existing imitative behavior (clapping hands) and established a new imitative behavior (pounding on table).

McKenzie, Egner, Knight, Perelman, Schneider, and Garvin (1970) described a program designed to impose a contingency on a boy's rate of accurately completing addition problems and his attending behavior during a social studies period. Coincident with the improved rate of accurately completing addition problems and better attending during the social studies period the boy's reading teacher noted a ". . . favorable change in his willingness to engage in appropriate academic work" [p. 141]. Additionally, the boy's mother reported that he ". . . had a more positive attitude toward school, and that he did his homework without reminders from her" [p. 141]. If measurement of behavior during reading period and attitude toward school had been

made prior to contingency application, the observation of the mother and reading teacher could have been verified or rejected by post contingency measurements.

In a study designed to ascertain the generalized effects of treating a specific behavior, Ward and Baker (1968) found no adverse changes in the subject children as a consequence of teachers' employing reinforcement techniques. Deviant behavior within the classroom was reduced by the contingent use of teacher attention. However, the use of reinforcement therapy to decrease deviant classroom behavior did not result in improved psychological test functioning found in another study (Baker, 1968). The authors conclude by suggesting ". . . future research should continue to look beyond the specific behaviors being treated, and consider the generalized effects of reinforcement therapy" [p. 328].

In a recent study (Winett, Richards, Krasner, & Krasner, 1971), the investigators wanted to ascertain whether a contingency management program could increase the reading performance of students in a normal classroom setting. Additionally, the study was designed to test the feasibility of children monitoring their own token program. There was a positive increase in the reading rate of four of the five target children and other members of the class successfully monitored the token program. The investigators recommended ". . . other behaviors (such as noise and activity level) also should be recorded,

since it is apparent that a good deal of change occurs in behaviors that are not involved directly in the contingency program" [p. 262].

Lovitt (1970) has noted ". . . when an event is programmed to change one behavior, not only that behavior is affected, but so are related and even unrelated behaviors" [p. 163]. He suggests an alternate to the ordered approach of modifying only one or two of a child's behaviors at a time. According to Lovitt investigators should ". . . simultaneously measure a number of behaviors, using an environmental change with only one at a time" [p. 163]. In this manner, he contends, both the direct effects of environmental change on a specific behavior and side effects of the change in environment could be measured.

Investigations of the side effects of an environmental change are important to classroom teachers utilizing contingency programs. For instance, when reading speed is increased, can the teacher predict a positive change in the student's attitude toward school? Is addition speed increase sufficient to predict better playground behavior? Conversely, will a contingency arranged to improve playground behavior coincidentally increase addition speed?

Data collected from investigations which measure multiple behaviors while associating a contingency with a single behavior ". . . may reveal that skills previously considered unrelated do, in fact,

share certain commonalities--when one behavior is learned, other behaviors develop" [Lovitt, 1970, pp. 163-164].

Purpose

It was the purpose of this study to assess some of the side effects of increasing a child's rate of accuracy completing addition problems by the use of a contingency management program. The side effects assessed by this study were the student's rate of accurately completing subtraction problems, the student's reading comprehension skill, the student's reading rate, and the classroom teacher's rating of the student's behavior.

Hypotheses

It was hypothesized that, using points and money as reinforcement for increased rate of accurately completing addition problems:

1. the experimental group when compared with the control group would make significantly greater gains in rate of accurately completing addition problems.

It was further hypothesized that, coincident with greater gains in addition speed:

2. the experimental group would make significantly greater gains in rate of accurately completing subtraction problem.

3. the experimental group would make significantly greater gains in reading rate.

4. the experimental group would make significantly greater gains in reading comprehension scores.

5. the experimental group would make significantly greater improvement in behavior as rated by the classroom teacher.

CHAPTER II

METHOD

To determine some of the side effects of using a contingency management program to increase a child's rate of accurately completing addition problems, the baseline and posttest measurements of four behaviors for a control and experimental group were compared. The behaviors selected for assessment were rate of accurately completing subtraction problems, reading rate, reading comprehension, and the teacher's rating of each subject's behavior.

Subjects

Subjects were selected from a classroom for trainable mentally retarded (TMR) children in Ellensburg, Washington. The students had been placed in a TMR classroom according to the guidelines for definition and eligibility established by the Washington State Superintendent of Public Instruction (Bruno, 1970). The current definition classifies TMR students as those not eligible for educable mentally retarded programs because of retarded intellectual and social development. Although intelligence quotient (IQ) is not the primary consideration, TMR students will generally obtain an IQ below 51 on an individual test of intelligence administered by a qualified psychologist.

Each subject had previously been a resident of a Washington State Residential School for mentally retarded children. At the time of the study, the subjects resided at Kaskidian Group Home in Ellensburg, Washington. The group home was initiated to provide alternative residential care for institutionalized mentally retarded children.

The eight subjects were assigned a number and then placed in the control or experimental group by the occurrence of the assigned number in a table of random numbers (Roscoe, 1969). The control and experimental groups were not identified until after the baseline phase of the study, since treatment during baseline was identical for subjects in both groups. The control group consisted of two males ages 14 and 15 years old, and two females ages 14 and 16 years old. The experimental group consisted of one male age 16 and three females ages 14, 15, and 16 years old.

Measurement Procedures

The rate of accurately completing addition problems was obtained by the administration of an investigator made worksheet (Appendix A). The subject was handed the ditto and a pencil and instructed to complete as many of the problems as possible in two minutes. Number of correct problems was divided by two minutes to obtain a rate of accurately completing addition problems.

The rate of accurately completing subtraction problems was obtained by the administration of an investigator made worksheet

(Appendix B). The procedure followed was the same as that used for obtaining addition rate.

Reading rate was obtained by having each subject read orally one of the first three oral reading paragraphs provided in the Durrell Analysis of Reading Difficulty (DARD). The number of errors made and the total time taken to read the paragraph were recorded. The number of words read correctly was divided by time taken to read the paragraph to obtain a reading rate. While taking reading rate, five seconds were allowed on difficult words before the investigator assisted the subject.

Reading comprehension scores were based on questions for each paragraph provided in the Record Booklet of the DARD. After orally reading a paragraph, the subject was verbally asked the questions covering that paragraph. The comprehension score was the number of questions answered correctly.

Rating of the subjects' behavior was obtained by the classroom teacher completing a Walker Problem Behavior Identification Checklist (WPBIC) on each subject. Rationale for the WPBIC states that since teachers are concerned with achievement, they should be excellent judges of behavior disruptive of achievement (Walker, 1970).

Fifty descriptive items of classroom behavior problems are provided in the checklist. The teacher after observing the student for two months checks the items observed in the behavioral repertoire of the student. A total score was obtained for each student by summing

the five scale scores of Acting Out, Withdrawal, Distractibility, Disturbed Peer Relations, and Immaturity. The WPBIC Manual reports a split-half reliability coefficient of .98 for the checklist. Contrasted Groups, Criterion, and Factorial validity were estimated for the checklist.

In the contrasted groups validity study reported by Walker, behaviorally disturbed subjects received higher scores on the construct measured by the checklist than did nonbehaviorally disturbed subjects. The criterion study estimated a biserial correlation of the relationship between scores on the WPBIC and the construct of disturbance measured by three criteria. The criteria employed were: (1) because of his behavioral problems, specific educational provisions had been made for the subject within the school setting; (2) he had been examined by a psychologist and referred to a psychiatric or clinical facility; (3) he had received instruction at home because his behavioral problems precluded profiting from classroom instruction. The biserial correlation between checklist scores and criteria was .68. That correlation is significant at the .01 level of confidence. A factorial validity study indicated that the five scales are relatively independent of one another.

Baseline Phase

The group home mother and classroom teacher enlisted the subjects' cooperation by telling them they would be working with the investigator who was writing a "book" about school students.

The investigator met with each subject individually in a room separate from the classroom during all three phases of the study. The experimental room was a television viewing room not being utilized during the time of day the subjects and investigator were meeting.

The investigator met individually with each subject for fifteen minutes a day four times a week. The entire study lasted six weeks. The first week was used for assessing baseline skills.

During the four baseline phase meetings the same procedure was followed for subjects in the experimental and control groups. An addition rate, subtraction rate, reading rate, and reading comprehension score were obtained for each subject on four consecutive days. There was no feedback given to the subject concerning the results of his performance. Subjects were not reinforced for better performance, and the investigator was not aware of the subject's placement in the control or experimental group.

Addition and subtraction problems correctly completed during each of the four days were totaled and divided by eight minutes to obtain an overall rate for addition and subtraction. Total number of words correctly read for the four days was divided by total reading time to obtain a reading rate. The comprehension score was obtained by summing the number of questions correctly answered each day. The classroom teacher completed a WPBIC on each subject during the first day of the baseline phase.

Reinforcement Phase

During the reinforcement phase of the study the procedures differed for members of the control and experimental groups. Subjects in both groups were told that they were going to be paid for participation in the study. A Special Olympics for mentally retarded children was to be held in Seattle on the weekend following termination of the study. Experimental group subjects were told that increasing the number of correct addition problems they could complete in two minutes would earn points. The points could be exchanged at the end of the study for money to spend in Seattle while participating in the Special Olympics. The control group subjects were told they would receive the money at the end of the study for meeting with the investigator fifteen minutes a day four times a week.

Each subject in the experimental group was given a graph indicating his daily rate of addition during the baseline phase of the study. Subjects were told they would be assisted in increasing the number of problems they could do in two minutes. During each fifteen minute period individual subjects practiced addition facts by answering flash card addition problems and completing practice worksheets. Emphasis was placed on memorizing addition facts and fading of behaviors that precluded increased speed such as finger counting and the use of number-lines. The last five minutes of each session were used to obtain a daily addition rate. Individual graphs were used to record each student's

performance (see Appendix C). In this manner, the effect of reinforcement on addition rate was continually monitored. Points were awarded and recorded on a data sheet by the subject. Effort and performance were verbally praised and the subject was reminded of the final payoff.

Each subject in the control group met individually with the investigator for fifteen minutes a day four days a week. During that period the subject and investigator talked, played one of the games provided in the classroom, played basketball, or walked around the school campus. The activity for each period was selected by the subject. The subjects were told they would receive the spending money for engaging in these activities.

At the end of the reinforcement period each student received an envelope containing \$1.50 to be used for spending money while participating in the Special Olympics.

Posttest Phase

The final four days of the study were used to obtain data to be compared with baseline performances. Addition and subtraction rate, reading rate, and reading comprehension scores were obtained using the procedures of the baseline phase. Experimental subjects were returned to a condition of no reinforcement. Verbal praise, and student recording of rate and points earned were not allowed during this phase. The WPBIC was completed by the classroom teacher for each subject during the last day of the posttest phase.

CHAPTER III

RESULTS

On five behaviors, t tests were calculated to determine the significance of the difference between the gain in means by the control and experimental groups. Separate t tests were calculated for the difference between the control and experimental group gains in mean addition rate, mean subtraction rate, mean reading rate, mean reading comprehension score, and mean WPBIC total score.

Addition Rate

The experimental group when compared with the control group made significantly greater gains in rate of accurately completing addition problems. Therefore, hypothesis one was accepted. A one-tailed test was used since only an increase in rate was of interest. With 6 degrees of freedom, the calculated t of 4.031 was significant at the .005 level of confidence. (See Table 1.)

Side Effects

There was no significant difference between gains made by the control and experimental groups in subtraction rate mean. Table 2 summarizes the t test for the difference between gains made in

TABLE 1

DIFFERENCE BETWEEN GAINS IN ADDITION RATE
FROM BASELINE TO POSTTEST

Group	Mean Rate	Stand. Error	Mean Diff.	<u>t</u>
<u>Baseline Phase</u>				
Control	4.655			
Experimental	4.00			
<u>Posttest Phase</u>				
Control	5.475		.820	
Experimental	10.000	1.285	6.000	4.031*

*p<.005

TABLE 2

DIFFERENCE BETWEEN GAINS IN SUBTRACTION RATE
FROM BASELINE TO POSTTEST

Group	Mean Rate	Stand. Error	Mean Diff	<u>t</u>
<u>Baseline Phase</u>				
Control	4.625			
Experimental	4.093			
<u>Posttest Phase</u>				
Control	4.815		.190	
Experimental	5.500	.873	1.407	1.394

subtraction rate mean. The calculated t of 1.394 with 6 degrees of freedom was not significant. Therefore, hypothesis two was not accepted. The experimental group when compared with the control group did not make significantly greater gains in rate of accurately completing subtraction problems.

Hypothesis three was not accepted. Coincident with significantly greater gains in addition speed, the experimental group when compared with the control group did not make significantly greater gains in reading rate (see Table 3). The calculated t of 1.850 was not significant.

TABLE 3
DIFFERENCE BETWEEN GAINS IN READING RATE
FROM BASELINE TO POSTTEST

Group	Mean Rate	Stand. Error	Mean Diff.	t
<u>Baseline Phase</u>				
Control	37.950			
Experimental	40.050			
<u>Posttest Phase</u>				
Control	40.470		2.520	
Experimental	49.275	3.62	9.225	1.850

There was no significant difference between the gains made in comprehension score means obtained by the control group and the experimental group. Therefore, hypothesis four was not accepted. Table 4 summarizes the one-tailed t test for the difference between gains made in reading comprehension score means.

TABLE 4

DIFFERENCE BETWEEN GAINS IN READING COMPREHENSION
SCORE FROM BASELINE TO POSTTEST

Group	Mean Score	Stand. Error	Mean Diff.	t
<u>Baseline Phase</u>				
Control	12.75			
Experimental	16.00			
<u>Posttest Phase</u>				
Control	13.00		.25	
Experimental	18.25	1.554	2.25	1.287

Coincident with significantly greater gains in addition rate, the experimental group when compared with the control group did not show significantly greater improvement in behavior. The calculated t of .9556 was not significant. Therefore, hypothesis five was not accepted. Table 5 summarizes the t test for the difference between the

improvement in total score means obtained by the control group and the experimental group.

TABLE 5
DIFFERENCE BETWEEN WPBIC TOTAL SCORE
FROM BASELINE TO POSTTEST

Group	Mean Score	Stand. Error	Mean Diff.	<u>t</u>
<u>Baseline Phase</u>				
Control	9.50			
Experimental	3.00			
<u>Posttest Phase</u>				
Control	3.75		5.75	
Experimental	2.75	5.755	.25	.9557

CHAPTER IV

DISCUSSION

The purpose of the present study was to assess some of the side effects of increasing a child's rate of accurately completing addition problems by the use of a contingency management program. It was hypothesized that coincident with greater gains in addition rate the experimental group would make greater gains in subtraction rate, reading rate, reading comprehension, and greater improvement in behavior as rated by the classroom teacher. A statistically significant difference at the .005 level in addition rate gain is consistent with results of other studies reporting reinforced behavior tends to increase in rate. There were no significant differences in the gains made by the control and experimental group in the four behaviors not specified for change by the contingent application of reinforcement.

With the exception of improvement of WPBIC total score means, the experimental group made greater gains than the control group in the behaviors not specified for reinforcement. Although not statistically significant, gains in reading rate were made by all experimental group subjects while two control group subjects exhibited a slight decrease in reading rate (see Appendix D).

The teacher's rating of the subjects' classroom behavior reflected very little change from the baseline to the posttest phase of the study. There was a measurable change in the teacher's rating of three subjects. Two experimental group subjects' ratings improved by one point between measurements. One control group subject's WPBIC total score improved by twenty-three points. All other control group subjects' WPBIC total scores were unchanged from baseline to posttest measurement. The improved control group subject was excluded from school for one day near the end of the study because of unacceptable classroom behavior. On return to school the subject's behavior was noticeably improved.

A delay in beginning the investigation limited the study to six weeks. Although that was sufficient time for the experimental group to make statistically significant gains in the reinforced behavior, a longer study might provide more complete assessment of those behaviors not specified for change by the contingency management program.

In a recent study by Winett, et al., a contingency management program was instituted within a normal classroom setting, and the authors reported changes in behaviors not involved directly to the contingency program. The subjects in the present study were removed from the classroom while meeting with the investigator. The study by Winett, et al. indicates that the side effects of reinforcing an academic behavior might more appropriately be measured within the classroom setting.

As may be noted from the original data, some of the subjects exhibited barely measurable baseline performances on the five behaviors (see Appendix D). This suggests that the side effects of reinforcing an academic behavior could be better assessed by using subjects functioning within the average range of intelligence.

The study was further limited by an N of only eight subjects. A contingency management program within a classroom of normal size would allow the investigator to obtain a broader sample on which to base conclusions.

CHAPTER V

SUMMARY

This study attempted to apply a contingency management program to a single behavior while measuring multiple behaviors. Presentation of reinforcers (points and money) was made contingent upon increased rate of accurately completing addition problems. It was hypothesized that coincident with increased addition rate there would be an increase in subtraction rate, reading rate, reading comprehension, and improved classroom behavior. Although the experimental group when compared with the control group made significantly greater gains in addition rate, there was no significant difference in the gains made in the other behaviors. The experimental group made greater (but statistically insignificant) gains in subtraction rate, reading rate, and reading comprehension. The control group made greater (but statistically insignificant) gains in improved classroom behavior.

It was concluded that the study was limited by a small sample, a six week time span, and the use of mentally retarded subjects to assess the side effects of reinforcing an academic behavior.

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APPENDIX A

ADDITION WORKSHEET

APPENDIX A
ADDITION WORKSHEET

$\begin{array}{r} 4 \\ +1 \\ \hline \end{array}$	$\begin{array}{r} 5 \\ +2 \\ \hline \end{array}$	$\begin{array}{r} 3 \\ +6 \\ \hline \end{array}$	$\begin{array}{r} 1 \\ +1 \\ \hline \end{array}$	$\begin{array}{r} 1 \\ +6 \\ \hline \end{array}$	$\begin{array}{r} 3 \\ +2 \\ \hline \end{array}$	$\begin{array}{r} 9 \\ +9 \\ \hline \end{array}$	$\begin{array}{r} 1 \\ +5 \\ \hline \end{array}$	$\begin{array}{r} 5 \\ +9 \\ \hline \end{array}$	$\begin{array}{r} 8 \\ +7 \\ \hline \end{array}$
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$\begin{array}{r} 6 \\ +3 \\ \hline \end{array}$	$\begin{array}{r} 5 \\ +9 \\ \hline \end{array}$	$\begin{array}{r} 6 \\ +2 \\ \hline \end{array}$	$\begin{array}{r} 0 \\ +6 \\ \hline \end{array}$	$\begin{array}{r} 5 \\ +0 \\ \hline \end{array}$	$\begin{array}{r} 5 \\ +8 \\ \hline \end{array}$	$\begin{array}{r} 6 \\ +2 \\ \hline \end{array}$	$\begin{array}{r} 9 \\ +6 \\ \hline \end{array}$	$\begin{array}{r} 7 \\ +6 \\ \hline \end{array}$	$\begin{array}{r} 6 \\ +9 \\ \hline \end{array}$
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$\begin{array}{r} 8 \\ +9 \\ \hline \end{array}$	$\begin{array}{r} 3 \\ +2 \\ \hline \end{array}$	$\begin{array}{r} 4 \\ +7 \\ \hline \end{array}$	$\begin{array}{r} 4 \\ +6 \\ \hline \end{array}$	$\begin{array}{r} 4 \\ +7 \\ \hline \end{array}$	$\begin{array}{r} 3 \\ +1 \\ \hline \end{array}$	$\begin{array}{r} 2 \\ +8 \\ \hline \end{array}$	$\begin{array}{r} 0 \\ +0 \\ \hline \end{array}$	$\begin{array}{r} 1 \\ +8 \\ \hline \end{array}$	$\begin{array}{r} 0 \\ +9 \\ \hline \end{array}$
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$\begin{array}{r} 0 \\ +9 \\ \hline \end{array}$	$\begin{array}{r} 6 \\ +9 \\ \hline \end{array}$	$\begin{array}{r} 0 \\ +4 \\ \hline \end{array}$	$\begin{array}{r} 6 \\ +4 \\ \hline \end{array}$	$\begin{array}{r} 2 \\ +3 \\ \hline \end{array}$	$\begin{array}{r} 1 \\ +7 \\ \hline \end{array}$	$\begin{array}{r} 8 \\ +1 \\ \hline \end{array}$	$\begin{array}{r} 8 \\ +2 \\ \hline \end{array}$	$\begin{array}{r} 3 \\ +4 \\ \hline \end{array}$	$\begin{array}{r} 0 \\ +4 \\ \hline \end{array}$
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$\begin{array}{r} 0 \\ +7 \\ \hline \end{array}$	$\begin{array}{r} 1 \\ +8 \\ \hline \end{array}$	$\begin{array}{r} 0 \\ +8 \\ \hline \end{array}$	$\begin{array}{r} 2 \\ +6 \\ \hline \end{array}$	$\begin{array}{r} 2 \\ +5 \\ \hline \end{array}$	$\begin{array}{r} 8 \\ +4 \\ \hline \end{array}$	$\begin{array}{r} 2 \\ +7 \\ \hline \end{array}$	$\begin{array}{r} 6 \\ +3 \\ \hline \end{array}$	$\begin{array}{r} 1 \\ +6 \\ \hline \end{array}$	$\begin{array}{r} 7 \\ +3 \\ \hline \end{array}$
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APPENDIX B

SUBTRACTION WORKSHEET

APPENDIX B
SUBTRACTION WORKSHEET

$$\begin{array}{r} 4 \\ -1 \\ \hline \end{array} \quad \begin{array}{r} 5 \\ -2 \\ \hline \end{array} \quad \begin{array}{r} 1 \\ -1 \\ \hline \end{array} \quad \begin{array}{r} 3 \\ -2 \\ \hline \end{array} \quad \begin{array}{r} 9 \\ -9 \\ \hline \end{array} \quad \begin{array}{r} 8 \\ -7 \\ \hline \end{array} \quad \begin{array}{r} 6 \\ -3 \\ \hline \end{array} \quad \begin{array}{r} 6 \\ -2 \\ \hline \end{array} \quad \begin{array}{r} 5 \\ -0 \\ \hline \end{array} \quad \begin{array}{r} 6 \\ -2 \\ \hline \end{array}$$

$$\begin{array}{r} 9 \\ -6 \\ \hline \end{array} \quad \begin{array}{r} 7 \\ -6 \\ \hline \end{array} \quad \begin{array}{r} 8 \\ -8 \\ \hline \end{array} \quad \begin{array}{r} 3 \\ -2 \\ \hline \end{array} \quad \begin{array}{r} 3 \\ -1 \\ \hline \end{array} \quad \begin{array}{r} 0 \\ -0 \\ \hline \end{array} \quad \begin{array}{r} 6 \\ -4 \\ \hline \end{array} \quad \begin{array}{r} 8 \\ -1 \\ \hline \end{array} \quad \begin{array}{r} 4 \\ -3 \\ \hline \end{array} \quad \begin{array}{r} 8 \\ -3 \\ \hline \end{array}$$

$$\begin{array}{r} 2 \\ -1 \\ \hline \end{array} \quad \begin{array}{r} 4 \\ -3 \\ \hline \end{array} \quad \begin{array}{r} 7 \\ -4 \\ \hline \end{array} \quad \begin{array}{r} 9 \\ -5 \\ \hline \end{array} \quad \begin{array}{r} 8 \\ -3 \\ \hline \end{array} \quad \begin{array}{r} 8 \\ -2 \\ \hline \end{array} \quad \begin{array}{r} 9 \\ -7 \\ \hline \end{array} \quad \begin{array}{r} 6 \\ -3 \\ \hline \end{array} \quad \begin{array}{r} 4 \\ -2 \\ \hline \end{array} \quad \begin{array}{r} 6 \\ -6 \\ \hline \end{array}$$

$$\begin{array}{r} 6 \\ -2 \\ \hline \end{array} \quad \begin{array}{r} 3 \\ -1 \\ \hline \end{array} \quad \begin{array}{r} 6 \\ -1 \\ \hline \end{array} \quad \begin{array}{r} 9 \\ -1 \\ \hline \end{array} \quad \begin{array}{r} 5 \\ -2 \\ \hline \end{array} \quad \begin{array}{r} 4 \\ -1 \\ \hline \end{array} \quad \begin{array}{r} 9 \\ -4 \\ \hline \end{array} \quad \begin{array}{r} 8 \\ -0 \\ \hline \end{array} \quad \begin{array}{r} 7 \\ -4 \\ \hline \end{array} \quad \begin{array}{r} 3 \\ -1 \\ \hline \end{array}$$

$$\begin{array}{r} 9 \\ -8 \\ \hline \end{array} \quad \begin{array}{r} 8 \\ -0 \\ \hline \end{array} \quad \begin{array}{r} 5 \\ -1 \\ \hline \end{array} \quad \begin{array}{r} 8 \\ -5 \\ \hline \end{array} \quad \begin{array}{r} 9 \\ -7 \\ \hline \end{array} \quad \begin{array}{r} 5 \\ -1 \\ \hline \end{array} \quad \begin{array}{r} 8 \\ -5 \\ \hline \end{array} \quad \begin{array}{r} 9 \\ -8 \\ \hline \end{array} \quad \begin{array}{r} 9 \\ -2 \\ \hline \end{array} \quad \begin{array}{r} 2 \\ -0 \\ \hline \end{array}$$

APPENDIX C

INDIVIDUAL RECORDS OF ADDITION RATES DURING BASELINE,
REINFORCEMENT, AND POSTTEST:
EXPERIMENTAL SUBJECTS

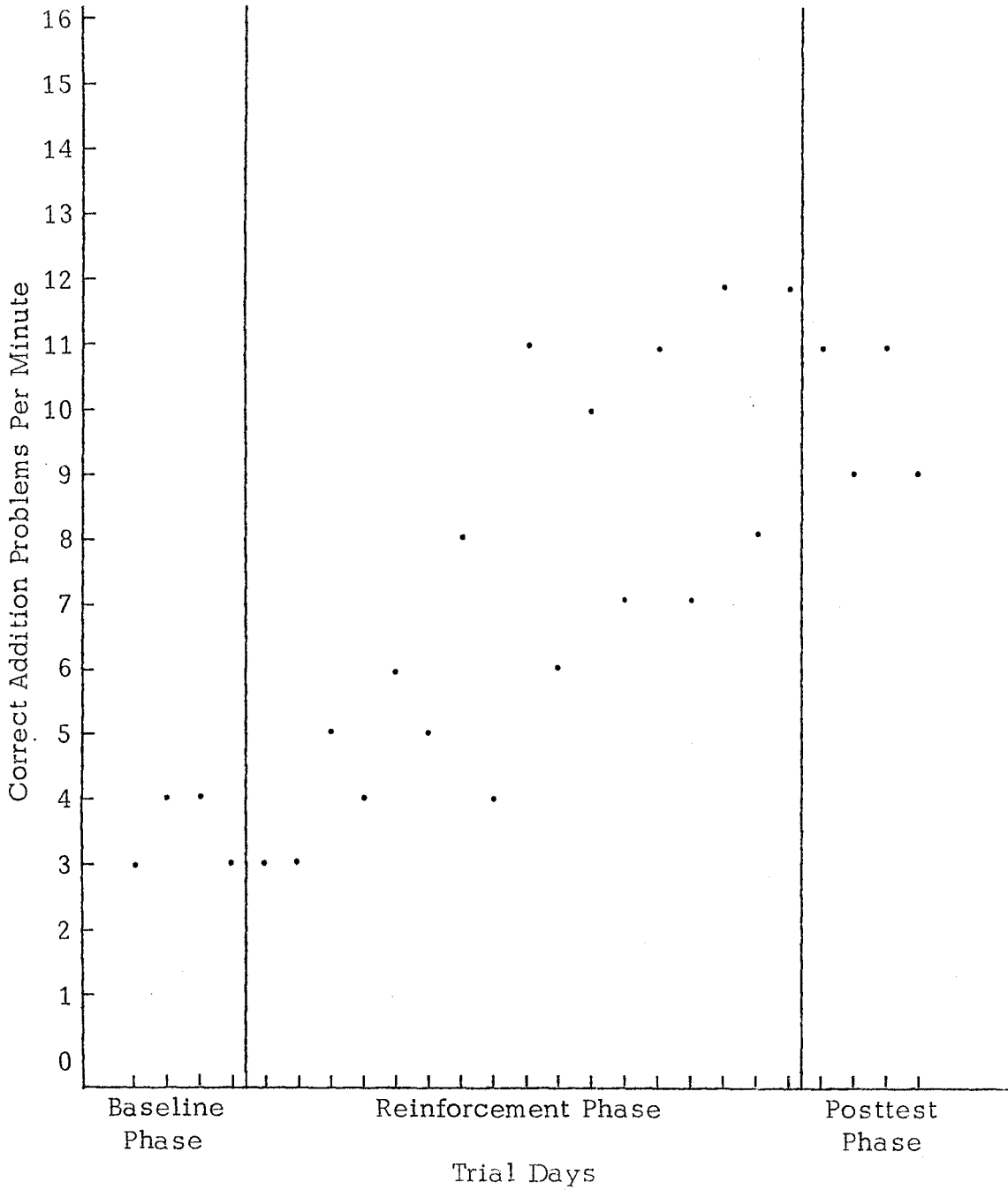


Fig. 1. Individual record of addition rate during baseline, reinforcement, and posttest: Subject 1.

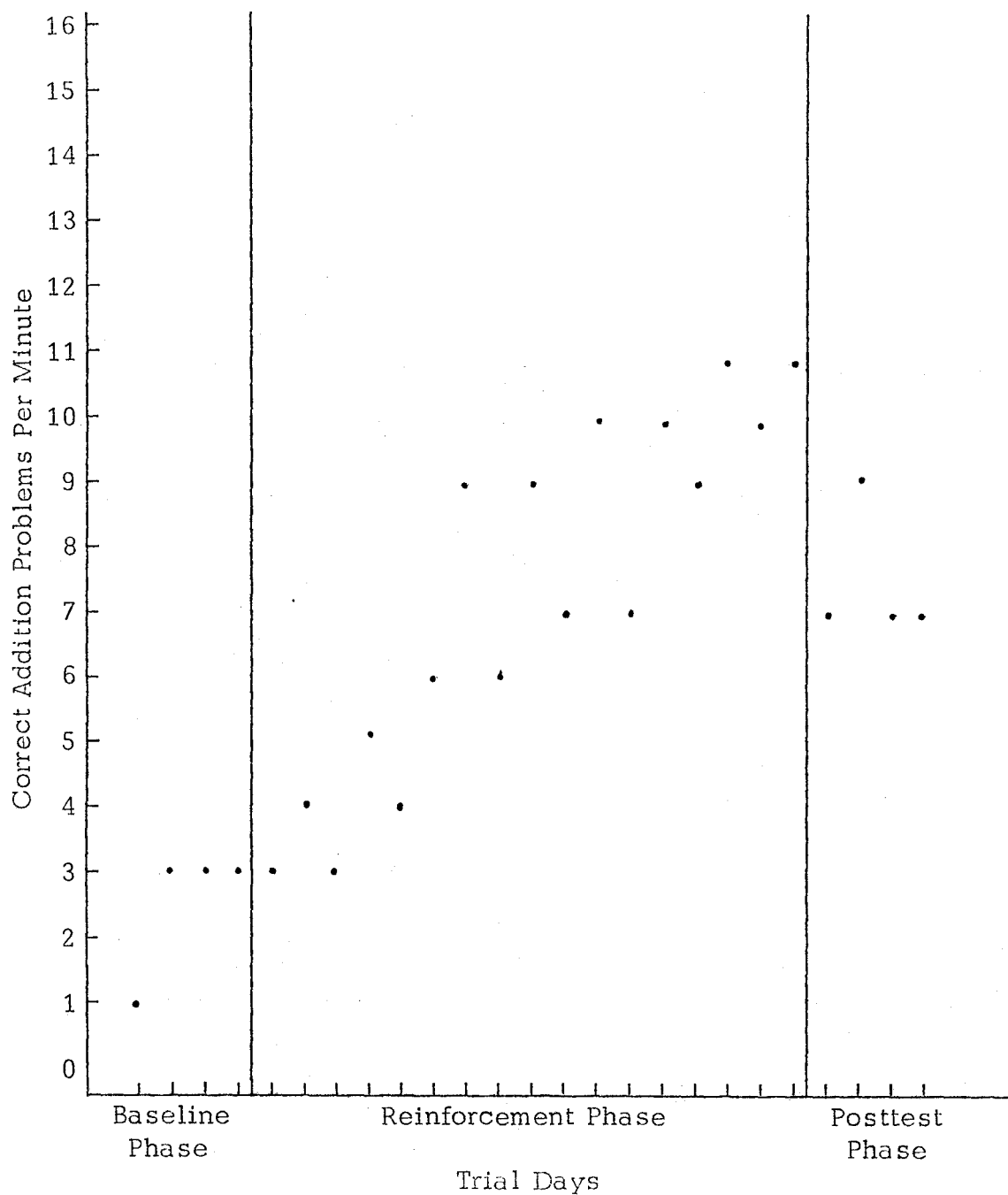


Fig. 2. Individual record of addition rate during baseline, reinforcement, and posttest: Subject 2.

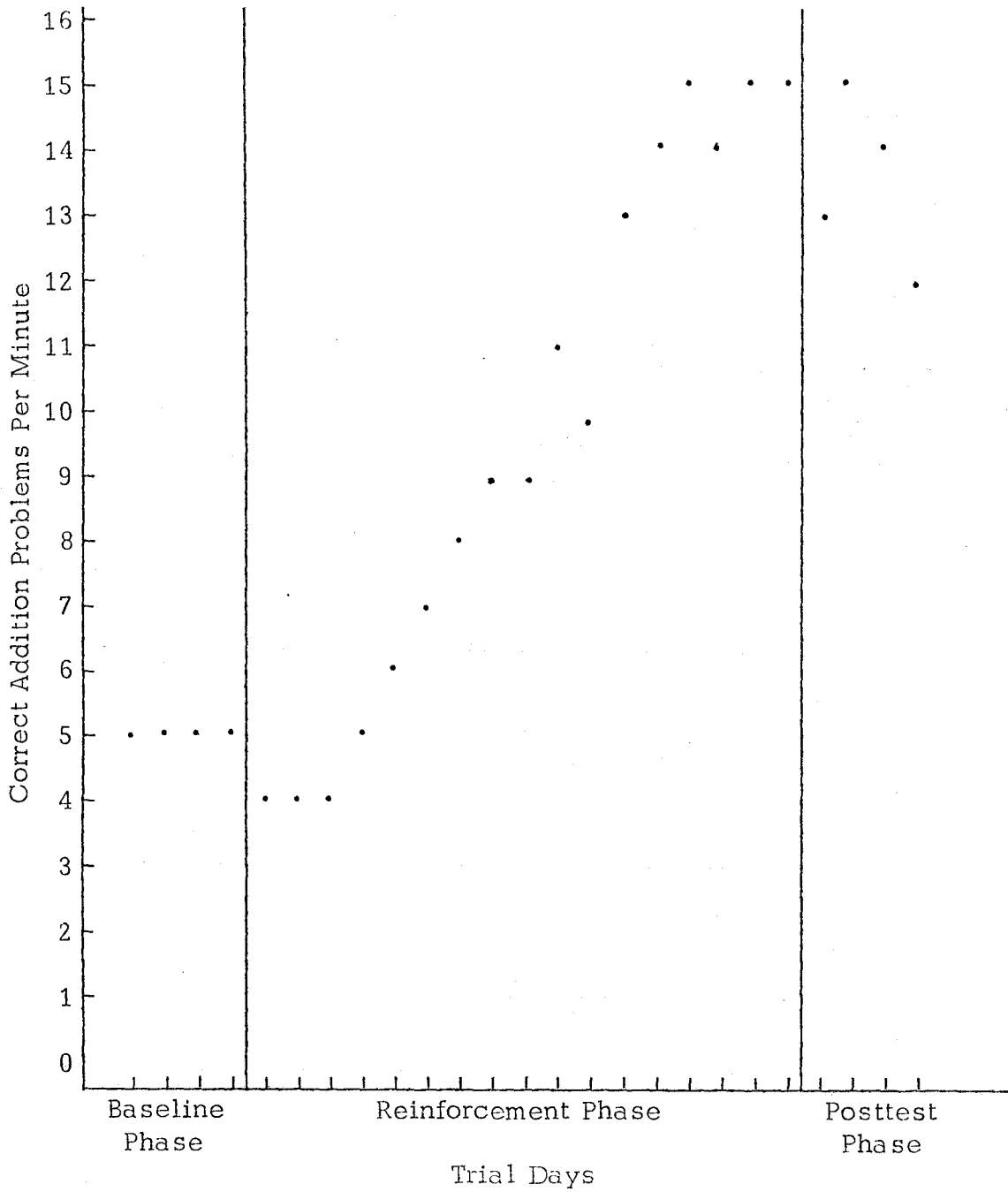


Fig. 3. Individual record of addition rate during baseline, reinforcement, and posttest: Subject 3.

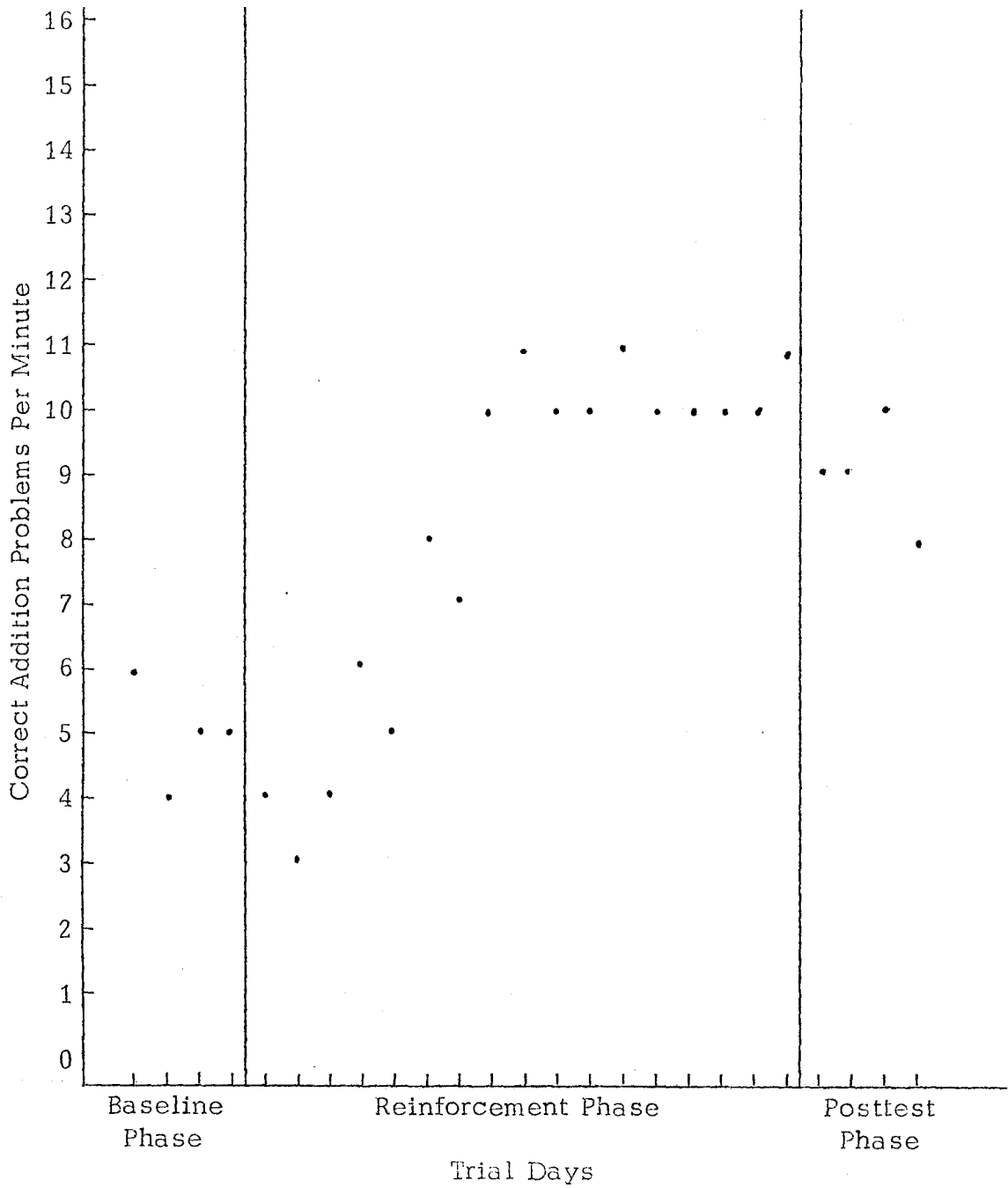


Fig. 4. Individual record of addition rate during baseline, reinforcement, and posttest: Subject 4.

APPENDIX D

INDIVIDUAL MEAN RATES AND WPBIC TOTAL SCORES DURING
BASELINE PHASE AND POSTTEST PHASE

APPENDIX D

INDIVIDUAL MEAN RATES AND WPBIC TOTAL SCORES DURING
BASELINE PHASE AND POSTTEST PHASE

Subject	Control			Experimental		
	Baseline	Posttest	Differ.	Baseline	Posttest	Differ.
<u>Mean Addition Rates</u>						
1	2.00	4.37	2.37	3.50	10.00	6.50
2	1.75	2.00	.25	2.50	7.50	5.00
3	5.87	5.00	-.87	5.00	13.50	8.50
4	9.00	10.50	1.50	5.00	9.00	4.00
<u>Mean Subtraction Rates</u>						
1	2.00	2.00	.00	1.87	7.00	5.13
2	1.50	2.13	.63	1.25	4.00	2.75
3	2.63	2.00	-.63	4.75	4.00	-.75
4	12.37	13.13	.76	8.50	7.00	-1.50
<u>Mean Reading Rates</u>						
1	13.20	12.60	-.60	69.00	82.20	13.20
2	1.80	3.00	1.20	10.80	20.70	9.90
3	22.80	22.20	-.60	17.40	19.20	1.80
4	114.00	124.08	10.08	63.00	75.00	12.00
<u>Reading Comprehension Scores</u>						
1	16	14	-2	14	17	3
2	2	4	2	14	16	2
3	14	14	0	16	16	0
4	19	20	1	20	24	4
<u>WPBIC Total Scores</u>						
1	33	10	23	0	0	0
2	4	4	0	5	5	0
3	1	1	0	5	4	1
4	0	0	0	2	2	0