THE EFFECT OF DELAYING CONSEQUENCES UPON THE LEARNING OF EMOTIONALLY DISTURBED ADOLESCENTS

By

ROBERT KEITH BROWN

A DISSERTATION PRESENTED TO THE
GRADUATE COUNCIL OF THE UNIVERSITY
OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE
DEGREE OF DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

JUNE, 1973

DEDICATION

To Barbara and Kelly

ACKNOWLEDGEMENTS

The writer wishes to express his thanks to the chairman and co-chairman of his committee, Dr. William Reid and Dr. Lyndal Bullock respectively. Sincere appreciation is also expressed to the other committee members, Dr. Henry Boudin and Dr. Hank Pennypacker.

The encouragement and guidance of three other individuals greatly contributed to my being at this point in my career. Dr. Wayne Richard, Dr. Robert Soar and Dr. Wilson Guertin deserve special thanks in appreciation for their influence on my professional growth from the beginning of my graduate program.

The study could not have occurred without the willing consent of Mrs. Julia Wickersham and Mr. Jack Barile. I thank them for allowing me the time to undertake the study. The cooperation of the teachers and students of the program for emotionally disturbed adolescents in Duval County is also greatly appreciated.

A very special thanks goes to Mr. William Geiger, Miss Catherine Baltzell and Dr. Charles Forgnone for their comments and suggestions on the initial drafts of the dissertation.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

FIGURE

Abstract of Dissertation Presented to the Graduate Council of the University of Florida in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

THE EFFECT OF DELAYING CONSEQUENCES UPON THE LEARNING OF EMOTIONALLY DISTURBED ADOLESCENTS

By

Robert Keith Brown

1973

Chairman: Dr. William R. Reid
Co-Chairman: Dr. Lyndal M. Bullock
Major Department: Special Education

This study investigated the effects of delayed consequences on the learning of emotionally disturbed adolescent students. The effects of three lengths of delays under two conditions of feedback were studied. The three delay lengths were: 1) a minimum delay of 15 to 45 seconds; 2) a 15 minute delay; and 3) a 3-hour delay of consequence. Each delay length was investigated under two types of feedback: 1) the stimulus and response produced cues (work sheets of the student) were returned when the consequence was delivered; and 2) the stimulus and response produced cues were not returned to the students (stimulus and response produced cues absent).

The study investigated the effects of the six conditions on the number of correct responses, response time, rate of correct responding and the celeration ratio. As the core of the learning task 48 nonsense geometric shapes were developed for this study. These 48 shapes were

paired so that each student received a different set of 24 pairs of these shapes. The 24 pairs were divided so that four pairs of shapes were presented in each of the six experimental conditions. The student's task was to learn the correct shape of each pair. The learning task was presented to each student a total of seven times.

The analysis of the results of the effects of the six conditions on the four dependent measures indicated that,

1) Delays of 15 minutes and 3 hours had a detrimental effect on the rate of correct responding when no response produced cues were present.

2) A delay of 15 minutes had a detrimental effect on the response time when no response produced cues were present.

3) Delays of 15 minutes or 3 hours had no detrimental effect on number of correct responses or celeration ratios.

4) Delays of 15 minutes or 3 hours had no detrimental effect on any of the four dependent measures when response produced cues were present. In fact performance was superior under the conditions of 3 hour delay as measured by number of correct responses.

It therefore appears that the detrimental effects of delays of reinforcement can be overcome by the presentation of stimulus and response produced cues at the time the consequence is delivered. This indicated that modification techniques used with emotionally disturbed students may employ techniques not centered around immediate delivery of consequences and expect some success. This should result in the design and adoption of techniques which are not as tedious as the present ones and which may be utilized more readily without tremendous outside support. These techniques however should be limited to behaviors in which stimulus and response produced cues can be presented during consequation.

CHAPTER I

INTRODUCTION

The effectiveness of behavior modification techniques with emotionally disturbed students has been demonstrated by numerous studies (Allen, Hart, Buell, Harris and Wolk, 1964; Quay, Werry, McQueen and Sprague, 1966; Graubard, 1969). However, little evidence of the effective application of such techniques is present in most nonexperimental public school programs serving disturbed students.

Many differences could be pointed out between the nonexperimental public school programs and the experimental or university supported settings in which the published studies have taken place with the more significant ones being, 1) the lack of professional support in public school programs as opposed to the university or experimental settings; and 2) teachers highly trained and experienced in behavior modification techniques have not systematically applied the techniques when the type of support supplied in a university or experimental setting is not present.

Several alternative solutions to this dilemma are posed. The teacher trainers could attempt to develop a schedule of support for the students while they are undergoing training which would more readily withstand extinction. That is they could give high levels of support during the first part of the teacher's training and gradually

fade into an intermittent schedule of support on a very infrequent basis. Thus the support during the last phases of training would approximate support in a public school system. This may result in the teacher's maintaining the effective use of the techniques.

A second alternative is that the public school system may attempt to increase the professional support. It is doubtful however that they could duplicate the quality or quantity of support present in the university or experimental setting.

A third alternative is to devise modified techniques which could more easily and practically be applied in the public school program. If effective variants in the usual procedures can be found which are less tedious and more practical these measures may be maintained with the present schedule of support. The focal point of this study is one aspect of the third alternative.

The variation in usual behavior modification procedures to be investigated in this study is the delay in delivery of consequences for specified behaviors. Most studies demonstrating effective modification of emotionally disturbed students' academic or social behavior have involved contingencies delivered during or immediately after completion of the behavior undergoing modification. In classroom situations where the teacher is attempting to modify the behavior of the disturbed student, it may be impractical to deliver consequences immediately, especially where large volumes of written academic work are produced.

Is the effectiveness of the modification techniques dependent on the immediate application of consequences. or are there ways of systematically applying effective consequences even when they may be

delayed minutes, hours, or even days? Research by Brackbill and Kappy (1962), and Goldstein and Seigel (1971) suggest that the retarding effect of delay of consequences may be overcome by presentation of the stimulus and response produced cues when the consequences are delivered.

Successful modification of behavior has been demonstrated in two recent studies (Schwartz and Hawkins, 1970; Sluyter and Hawkins, 1972) where the contingencies were delayed for several hours. These studies indicate that the usual procedure of immediate presentation of the consequence may, under certain circumstances, be replaced by systematically delaying consequences, and still maintain the effectiveness of the consequence in modifying behavior.

CHAPTER II

REVIEW OF LITERATURE

Public school education has steadily been increasing its role in the remediation of the social and academic behavior of emotionally disturbed students in recent years. A combination of factors has contributed to this increase: 1) the failure of the medical profession to solve all of these students' problems; 2) the shortage of clinically trained personnel; 3) the demands of parents of disturbed students for services; and 4) the availability of federal funds for teacher training, demonstration programs, research (PL 88-164) and support of local programs (Titles I and III of Elementary and Secondary Education Act PL 89-10).

The necessity of developing effective and practical techniques for the remediation of disturbed students' behavior has been brought to the forefront because of this increasing role. It has become of critical importance to determine the effect of variations in remediation techniques on the academic and social behavior of these students. This should enable the implementation of more practical and effective programs.

One of the most effective techniques has been the use of behavior modification procedures (Graubard, 1969; Hewitt, Taylor and Artuso, 1969; Hanley, 1970; Lovitt, 1970; Glavin, Quay, Annesley and Werry, 1971). There are a multitude of variations of such techniques

which have been employed with emotionally disturbed students. Most variations have one procedure in common. This is the immediate delivery of consequences of some form.

The type of reinforcers used have varied widely. Primary reinforcers such as food have found frequent use (Carlson, Arnold, Becker, and Madsen, 1968). Tokens which lead to a variety of back-up reinforcers have been employed in many projects (O'Leary and Becker, 1967; Glavin, Quay, Annesley, and Werry, 1971). Tokens are utilized due to the inconvenience of using primary reinforcers and the possible satiation if only one type of reinforcer is used. Social consequences such as praise contingent upon the occurrence of specified behaviors has also proved effective (Allen, Hart, Buell, Harris, and Wolk, 1964; Becker, Madsen, Arnold, and Thomas, 1967).

The immediate delivery of consequences such as those cited above may be inconvenient and impractical in many classroom situations for the teacher of the emotionally disturbed. This is especially true where a large amount of written academic work is produced which must be corrected by the teacher before she can distribute the consequences for correct responses. The delays under these circumstances may be measured by hours or even days.

Delay of consequence has been studied extensively in populations other than the emotionally disturbed. A review of these studies adds light to the major variables to be considered and the possible effects on learning. Historically, delay of reinforcement was first investigated with animals. These studies led to research with normal human subjects. Interest has also been present for the last decade and a half in the effects delays have on the learning of retarded students.

The studies with animals are important not only because of their historical value, but because much more control of the significant variables surrounding the behavior to be acquired and the reinforcement is possible. This allows for a more precise investigation of the effect of the delays.

Renner (1964) has complied an excellent review (Watson, 1917; Mischel and Metzner, 1962) of the effects of delay of reinforcement. The results of the studies with animals suggest the following concerning the effects on the acquisition of a response:

1) A constant delay of consequence will retard acquisition.

2) The detrimental effects become more so as indirect rewards (such as are present in the goal box) are removed.

When shifting focus from animal studies to studies with human subjects two important differences should be noted: 1) the comparability of the animal data to human data is only rough since many human studies used delay of feedback of knowledge as opposed to the primary reinforcement used in animal studies; and 2) there is much evidence (Brackbill and Kappy, 1962; Erickson and Lipsitt, 1960) that verbal cues may play an important role in human studies, creating differential effects above and beyond that of the delay (Renner, 1964).

Renner concluded in his review that the data on humans agreed essentially with the animal data. In his review, however, two factors come into more prominent view when consideration is given to the human studies: 1) the noticable effect of response produced cues (corresponding to the indirect rewards in animal studies) in reducing the detrimental effect of the delay; and 2) the effect of the intertrial interval in retarding acquisition.

Brackbill and Kappy (1962) investigated the effect of response produced cues, finding that they reduce the detrimental effect of delays of reinforcement and may even enhance resistance to extinction of a response. This reduction of the detrimental effects has also been produced by using goal orientation instructions (Erickson and Lipsitt, 1960), a motor response (Biloudeau and Biloudeau, 1958), and stimulus exposure during delay (Goldstein and Siegel, 1971). Brackbill and Kappy (1962) theorized that when a subject links the consequence to the response through the use of mediating cues the delay of reinforcement has no detrimental effect.

The possibility that the major retarding variable in delay of reinforcement was the intertrial interval rather than response-consequence interval was suggested by studies by Biloudeau and Biloudeau (1958) and Denny, Allard, Hall, and Rokeach (1960). These studies demonstrated that when long intertrial intervals are used acquisition is retarded. Thus it seems evident from studies with animals and normal human subjects that there are variables surrounding delays of consequence which may be manipulated to decrease the negative effects.

Several studies have been undertaken to investigate the effects of delays of consequences with retarded children. Ross, Hetherington, and Wray (1964) found the effects of delay of reinforcement to be similar for both retarded and normals. Delays of six seconds or more retarded learning for both populations. Various delay lengths (3,5,6,12, and 18 seconds) were found to differentially affect speed of acquisition of a response by retarded students (Schoelkopf and Orlando, 1965, 1966). Presentation of the stimulus during the delay has also been proved to

be an important variable with retarded students (Ward and Baumeister, 1971).

Most of the aforementioned studies with animals and humans have been done in laboratory conditions with delays measured in seconds. In a recent study with retarded students in the classroom Piper (1971) found that a delay of 15 minutes in the delivery of consequence had a detrimental effect on learning only when response produced cues were absent. Thus the studies with animals, normal human subjects and retarded subjects point to the reduction of the detrimental effects of delay of reinforcement when response produced cues are present during the delay or when the consequence is delivered.

Mower and Ullman (1945) made a speculation regarding emotional disturbance and delay of reinforcement. They note that neurotics frequently persist in responding in ways that lead to punishment. They contend that the particular behavior may result in some immediate reinforcer before the delayed punishment. An interrelationship between ineffectiveness of delayed consequences on behavior, delay of gratification and abnormal behavior has also been postulated through the work of Mischel (1958, 1961). These studies point to the possibility that emotionally disturbed students may acquire responses less readily under delay consequence conditions than normals.

However other research raises questions about the correctness of this conclusion. Morris (1969) found that a 10-second delay of reward had no effect on the number of trials emotionally disturbed students took to reach the criterion of correct responses. In applying the techniques of delayed consequences to the modification of a maladjusted

student's behavior, Schwartz and Hawkins (1970) found that the desired behavior could be modified. The behaviors undergoing modification were presented on videotape several hours after their occurrence and the consequences were systematically applied resulting in modification of the behavior in a short period of time. Sluyter and Hawkins (1972) demonstrated the modification of classroom behavior by the application of specific consequence by parents based upon a note dispensed after school. The last two studies demonstrate the possibility of effective modification of disturbed students' behavior even when consequences are applied several hours after the behavior occurs.

CHAPTER III

PROCEDURES

Statement of the Problem

This study investigated the effects of delayed consequences on the learning of emotionally disturbed adolescent students. The effects of three lengths of delays under two conditions of feedback were studied.

The three delay lengths were, 1) a minimum delay of 15 to 45 seconds; 2) a 15-minute delay; and 3) a 3-hour delay of consequence. Each delay length was investigated under two types of feedback, 1) the stimulus and response produced cues (work sheets of the student) were returned when the consequence was delivered; and 2) the stimulus and response produced cues were not returned to the students (stimulus and response produced cues absent).

The study investigated the effects of the six conditions on the number of correct responses, response time, rate of correct responding and the celeration pair. The following are the six conditions investigated,

A) Minimum delay of consequence, stimulus and response produced cues absent.

B) 15-minute delay of consequence, stimulus and response produced cues absent.

C) 3-hour delay of consequence, stimulus and response produced cues absent.

D) Minimum delay of consequence, stimulus and response produced cues present.

E) 15-minute delay of consequence, stimulus and response produced cues present.

F) 3-hour delay of consequence, stimulus and response produced cues absent.

The following questions were investigated:

1) Do delays in the delivery of consequence of 15 minutes or 3 hours have detrimental effects on the learning of emotionally disturbed adolescents when no stimulus or response produced cues are present?

2) Do delays in the delivery of consequences of 15 minutes or 3 hours have detrimental effects on the learning of emotionally disturbed adolescents when stimulus and response produced cues are present?

Hypothesis

Specifically the following null hypotheses were tested.

1) There are no significant differences among the number of correct responses in the three delay conditions (minimum, 15 minutes, 3 hours).

2) There are no significant differences among the response times under the three delay conditions.

3) There are no significant differences among the rate of correct responding under the three delay conditions.

4) There are no significant differences among the celeration ratios under the three delay conditions.

5) There are no significant differences between the number of correct responses in the two types of consequence presentations (stimulus and response produced cues absent, or stimulus and response produced cues present).

6) There are no significant differences between the response times in the two types of consequence presentations.

7) There are no significant differences between the rate of correct responding in the two types of consequence presentations.

8) There are no significant differences between the celeration ratios under the two types of consequence presentations.

9) There are no significant interactions among the delay conditions and consequence types on the number of correct responses.

10) There are no significant interactions among the delay conditions and consequence types on the response time.

11) There are no significant interactions among the delay conditions and consequence types on the rate of correct responding.

12) There are no significant interactions among the delay conditions and consequence types on the celeration ratios.

Delimitations

The population of concern was restricted to emotionally disturbed adolescent students enrolled in the Duval County Exceptional Child Program. Caution should be taken against generalizing these results to other populations.

This study investigated the effect of delays of consequences only under the conditions specified. This study did not investigate behavioral characteristics of the students other than in the learning task.

Definitions

Emotionally disturbed students: refers to students identified by a school psychologist as emotionally disturbed and enrolled in a program for emotionally disturbed students.

Celeration Coefficient: refers to how much one must multiply the predicted rate of responding on day n to obtain the predicted rate or responding on day n + 7.

Celeration Ratio: refers to how much one must multiply the celeration coefficient of rate of incorrect responding to obtain the celeration coefficient of rate of correct responding.

Subjects

Ten adolescent emotionally disturbed children enrolled in the Duval County Exceptional Child Program during May of 1972 constituted the sample for this study. All of these students had been identified by a school psychologist as emotionally disturbed prior to enrollment in the Exceptional Child Program.

The students ranged in age from 12 to 16 years. There were nine boys and one girl included in the sample. The students were selected on the basis of low absenteeism from a total of 16 students assigned to the program at that time.

Learning Task

As the core of the learning task 48 nonsense geometric shapes were developed for this study (see Appendix A for examples). These 48 shapes were paired so that each student received a different set of 24 pairs of these shapes. The 24 pairs were divided so that four pairs of shapes were presented in each of the six experimental conditions.

One shape from each of the pairs was designated as correct by the experimenter before the start of the study. The selection of the correct shape was made using a random number table.

The student's task was to learn the correct shape of each pair under conditions of:

(A) minimum delay of consequence-stimulus and response produced cues absent.

(B) 15 minutes delay of consequence-stimulus and response produced cues absent.

(C) 3 hours delay of consequence-stimulus and response produced cues absent.

(D) minimum delay of consequence-stimulus and response produced cues present.

(E) 15 minutes delay of consequence-stimulus and response and produced cues present.

(F) 3 hours delay of consequence-stimulus and response produced cues present.

Utilization of this two-choice discrimination task allows for comparison with similar studies and controls for differential exposure to the task, which would have been present if material from the academic program were utilized. Each of the 24 unique, nonsense geometric pairs was presented on a separate 8½ by 11 sheet. Each of the student's sheets were numbered for identification purposes, 1 to 24. There were two sheets for each unique, nonsense geometric pair; one sheet with the correct geometric shape on the right and one with the correct geometric shape on the left.

The correct shape for each pair was randomly assigned by the experimenter before the first trial. During the first trial the students had no information on which shape of each pair was correct but had to guess. After the first trial the students had information on the correctness or incorrectness of his first guess. The specific condition under which each pair was presented determined the types of feedback and the length of time the feedback was delayed.

The student indicated his selection of the correct shape of each pair by circling that shape. The dependent variables were the number of correct choices of the four pairs under each condition, the response time, the rate of correct responding, and the celeration ratio (the celeration of rate correct compared to the celeration of rate incorrect).

Administration Procedures

On the Friday previous to the beginning of the week of data collection, the students were oriented to the study and the learning task. The study was described as an attempt to discover how the students learn under various conditions. It was explained that the experimenter needed the cooperation of the students by their regular attendance and appropriate behavior during the learning situations. In return the students were told that they would earn five cents for each correct choice they made.

The experimenter then told them that, as an example of what they would be doing the next week, he would like to have each of them do a sample of the type of problems they would be working with. The experimenter then showed the students four pairs of nonsense geometric shapes (not used in the actual trials) saying,

> These are four pairs of oddly shaped figures like the ones you will be dealing with next week. One of the figures from each of these pairs has been decided upon as being correct by a friend of mine. When I hand out your sheet it's each of your jobs to guess (without help from anyone else) which is the correct shape of each figure. Do you have any questions?

After answering all questions, most of which dealt with how they would be paid, the experimenter continued.

> OK, when I hand you your papers leave them turned over until I give you your instructions to start. Indicate which figure is correct on your sheet by circling the shape you think is correct, when you finish your paper please raise your hand until I come over to your desk. I'll take up your papers and hand them back to you, telling you which ones you got correct and give you a nickle for each one you get correct.

After all the papers had been corrected and the money was given out the experimenter said,

> OK, you all did very well. Next week each of you will have 24 pairs of the odd shapes like the ones today. Each of you however will have pairs that are different from anyone elses.
>
> I will give you 4 papers at a time exactly like I did today except next week I won't always return your papers or tell you which papers were correct right away. Sometimes I'll tell you right away and sometimes I won't be able to tell you until in the afternoon. Are there any questions?

After answering all questions, again most of which concerned the amount of money, the experimenter continued.

> Each day next week you will be working with the same pairs, and you will have a chance to improve the number you get correct by remembering which shapes you get correct from day to day.
>
> Now remember we will do this learning game every day next week and you will be earning the money we discussed. So be sure and be here all next week.

Week of Testing

The students were administered the learning task during art class in small groups of 2 to 5. Before the beginning of the session the experimenter reminded them of the task by saying,

> Today we're going to get into the learning for real. Remember, I said last week that each of you would be presented pairs of odd shapes. Your job is to learn which shape of each pair is the correct shape. Indicate which pair is correct by circling it like we did last week. Remember each of you has 24 pairs of shapes made up just for you which you will be working with each day this week, your pairs are different than anyone else's. Again I want to remind you that the most important thing is how many of the pairs you get correct. Your art teacher will, however, be timing how long it takes you, take as much time as you need but raise your hand as soon as you are finished with each four pairs.
>
> Sometimes I will give your paper back right away and tell you right away which ones you got correct (by telling you the identification number of the ones you got correct) and give you your reward, and sometimes I'll tell you and won't give you back your paper, and sometimes I won't tell you or return your paper until later.

As some will still be working when you finish I would like no talking while you are in this room during the learning games.

Are there any questions?

After all questions were answered the experimenter continued.

"OK, don't turn the paper over until I tell you to begin."

The experimenter handed out the papers and told the students to begin. The art teacher began the stop watch when the experimenter told the students to begin and recorded the time each student took to complete the described task. The order of presentation of the conditions was counter balanced to prevent any condition from occurring predominately in any presentation position. The order is presented in Table 1.

The experimenter responded to each student in the following way dependent upon the condition.

Condition A

Experimenter collected each student's papers and within 15 to 45 seconds told the student which number he correctly circled (i.e. number 1 and 3 were correct), and gave the student the appropriate amount of money.

Condition B

Experimenter collected each student's papers and in 15 minutes (during which time the student was working on other tasks) told the student which numbers he circled correctly and gave the student the appropriate amount of money.

Condition C

Experimenter collected each student's papers and in 3 hours told the student the numbers he circled correctly and gave the student the appropriate amount of money.

TABLE 1

ORDER OF PRESENTATION OF
DELAY/CUE CONDITIONS

ORDER / DAY	FIRST	SECOND	THIRD	FOURTH	FIFTH	SIXTH
	CONDITIONS					
One	B	C	F	D	E	A
Two	F	B	C	E	A	D
Three	C	F	A	B	D	E
Four	E	A	D	F	C	B
Five	A	D	E	C	B	F
Six	D	E	F	B	A	C
Seven	B	F	D	A	C	E

Condition D

Experimenter collected each student's papers and within 15 to 45 seconds gave the student the paper back saying "Look at the pairs you circled number _____, _____ and _____ correctly. Here is your money _____ cents." The experimenter then collected the student's papers again.

Condition E

Experimenter collected each student's papers and in 15 minutes gave the student the paper back saying "Look at the pairs, you circled number _____ and _____ correctly. Here is your money _____cents." The experimenter then collected the student's papers again.

Condition F

Experimenter collected each student's papers and in three hours gave the student the paper back saying "Look at the pairs, you circled number _____ and _____ correctly. Here is your money _____ cents." The experimenter then collected the student's papers again.

Second, third, fourth, and fifth day

Experimenter said,

> Today we are going to do the same things as yesterday. You each will have the same pairs and the same shape of each pair will be correct as it was yesterday. OK?
>
> Now remember don't turn your paper over until I say begin and remember to raise your hand when you have completed each set of four pairs.

The experimenter then handed out the papers and said,

"Now we're ready to begin."

The experimenter response was the same as during the first day depending on the conditions.

Eighth and ninth day

The experimenter told the students before they began the eighth day that they would now be able to earn $.25 for three correct responses on a set and $.50 for four correct responses a set. No money would be earned for one or two correct responses. The experimenter response was similar to the previous week but the amount of money earned was changed. After the final consequence was delivered on the ninth day the purpose of the study was discussed with the students.

CHAPTER IV

RESULTS

Three measures of the students' behavior were collected as raw data to be used in the analyses to determine the effects of the six conditions on the learning of the emotionally disturbed adolescents. These variables were the number of correct responses, the number of incorrect responses, and the time (in seconds) required for all responses in each condition. From these measures the rate of correct responding and the rate of incorrect responding were calculated. These new variables were then plotted on six-cycle semilog paper (Lindsley, Behavior Research Co.) which provides a display of relative rather than absolute change.

The log of correct and incorrect responding provided the data for the calculation of the celeration coefficients for rate of correct and incorrect responding. The coefficients provide a measure of change of behavior over a week's period of time. A ratio of the celeration coefficients of the log of the rate of correct responding to the log of the rate of incorrect responding was then calculated. This ratio provides a measure of the rate of diversion of the two rates and is referred to as the celeration ratio (for a detailed description of celeration coefficients and ratios see Geneviene Skypek's dissertation, 1971 pages 24-27).

To provide answers to the two major questions and the nine null hypotheses (see page 11) the following analyses of the data were performed:

1) a four way analysis of variance - repeated measures design on the number of correct responses;

2) a four way analysis of variance - repeated measures design on the response time;

3) a four way analysis of variance - repeated measures design on the log of the rate of correct responding;

4) a three way analysis of variance - repeated measures design on the celeration ratios.

The analyses are presented in the above order. A summary comparison of the results of the various analyses is presented at the end of the chapter.

Analysis of Number of Correct Responses

The number of correct responses has been utilized as the major dependent variable in several studies on the effects of delayed consequences. The analysis of variance of the number of correct responses (Table 2) reveals several significant effects. There was a significantly higher ($P<.01$) number of correct responses when the response produced cues were returned as the consequence was delivered than when the response produced cues were not returned. The mean number of responses when the cues were present was 2.433 as opposed to a mean of 2.152 when the cues were absent. This difference is complicated by two significant interactions. The first is an interaction between the trials and the presence or absence of response produced cues ($P<.05$). The utilization of a Duncan's New Multiple Range Test (Li,

TABLE 2

ANALYSIS OF VARIANCE OF NUMBER OF CORRECT RESPONSES

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F RATIO
Trials	6	8.362	1.394	1.722
Cues	1	8.288	8.288	10.240**
Delay	2	2.871	1.436	1.774
Subjects	9	33.002	3.667	
Trials X Cues	6	13.229	2.205	2.724*
Trials X Delay	12	7.295	0.608	.751
Trials X Subjects	54	46.448	0.860	
Cues X Delay	2	8.233	4.117	5.087**
Cues X Subjects	9	33.689	3.743	
Delay X Subjects	18	40.748	2.264	
Trials X Cues X Delay	12	12.200	1.017	1.256
Trials X Cues X Subjects	54	51.295	0.950	
Trials X Delay X Subjects	108	97.752	0.905	
Cues X Delay X Subjects	18	24.147	1.342	
Residual	108	87.405	0.809	
TOTAL	419	474.964		

*Significant at .05
**Significant at .01

1964, pages 270-273) presented in Table 3 indicated the following: 1) That the number of correct responses on trial six when cues were present was significantly different from trial one when cues were present and trials three and four when cues were absent; and 2) That the number of correct responses on trial seven with cues present was significantly higher than on either trials three or four when cues were absent.

A plot (Figure 1) of the mean number of correct responses on each trial under the two-cue conditions further illustrates the interaction. Under conditions in which the response produced cues were present a steady increase in the number of correct responses was made. However in conditions where response produced cues were absent no steady increase in number of correct responses is shown.

The second interaction which complicates the interpretation and the effect due to cue presentation is between cues and delay conditions ($P < .01$). A Duncan's New Multiple Range Test (Table 4) of the six conditions reveals the source of the interaction. The three-hour delay of consequence in which response produced cues were present along with the consequence differed significantly from every other condition except immediate presentation of consequence with response produced cues absent.

The mean number of correct responses are plotted (Figure 2) to illustrate the interaction. From this it can be seen that the mean number of correct responses was very similar in both cues present and cues absent conditions when the consequence was delivered immediately. As the length of the delay was increased to three hours, the presentation of the response produced cues when the consequence was delivered

TABLE 3

DUNCAN'S NEW MULTIPLE RANGE TEST ON NUMBER OF CORRECT RESPONSES IN EACH TRIAL/ RESPONSE PRODUCED CUE CONDITION

LABEL	TRIAL /	RESPONSE PRODUCED CUES	MEANS	STANDARD DEVIATIONS
1NC	1	No Cues	2.4000	1.102
1C	1	Cues	2.000	1.174
2NC	2	No Cues	2.267	0.827
2C	2	Cues	2.167	0.950
3NC	3	No Cues	1.833	0.950
3C	3	Cues	2.400	1.102
4NC	4	No Cues	1.900	0.950
4C	4	Cues	2.433	1.006
5NC	5	No Cues	2.267	1.172
5C	5	Cues	2.567	1.040
6NC	6	No Cues	2.233	1.006
6C	6	Cues	2.767	0.935
7NC	7	No Cues	2.167	1.085
7C	7	Cues	2.7000	1.208

LABEL	3NC	4NC	1C	7NC	2C	6NC	5NC	2NC	3C	1NC	4C	5C	7C	6C
ORDERED MEANS	1.8	1.9	2.0	2.2	2.2	2.2	2.3	2.3	2.4	2.4	2.4	2.6	2.7	2.8
SUBSETS														

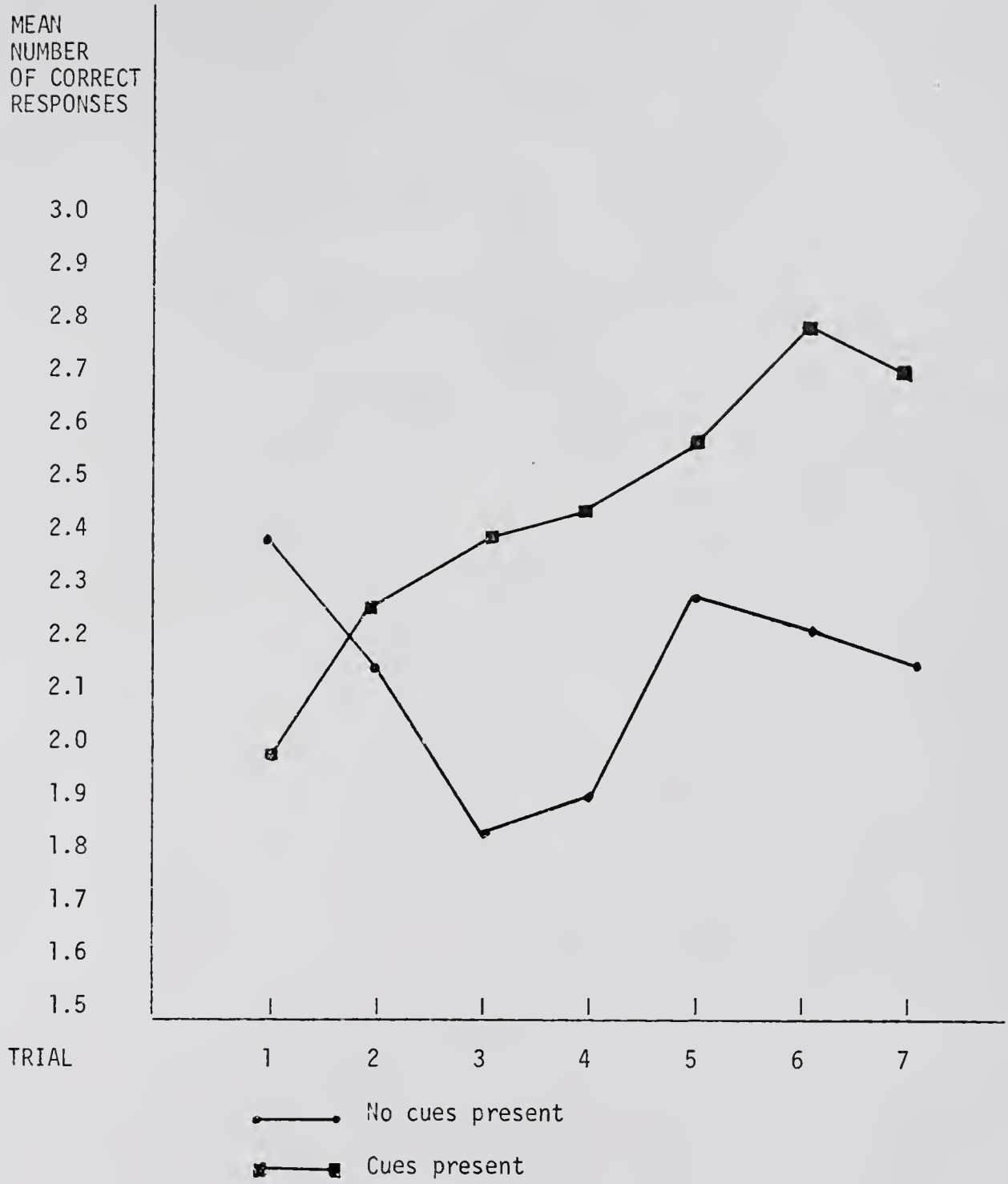


FIGURE 1

MEAN NUMBER OF CORRECT RESPONSES IN
EACH TRIAL/RESPONSE PRODUCED
CUE CONDITION

TABLE 4

DUNCAN'S NEW MULTIPLE RANGE TEST ON NUMBER OF CORRECT RESPONSES IN EACH DELAY/RESPONSE PRODUCED CUES CONDITION

	DELAY	/	CUES	MEANS	STANDARD DEVIATIONS
A	Minimum	/	No Cues	2.357	.964
B	15 Minutes	/	No Cues	2.043	1.056
C	3 Hours	/	No Cues	2.057	1.062
D	Minimum	/	Cues	2.300	1.095
E	15 Minutes	/	Cues	2.314	1.001
F	3 Hours	/	Cues	2.686	1.110

LABEL	B	C	D	E	A	F
ORDERED MEANS	2.043	2.057	2.300	2.314	2.357	2.686
SUBSETS	———	———	———	———	———	
					———	———

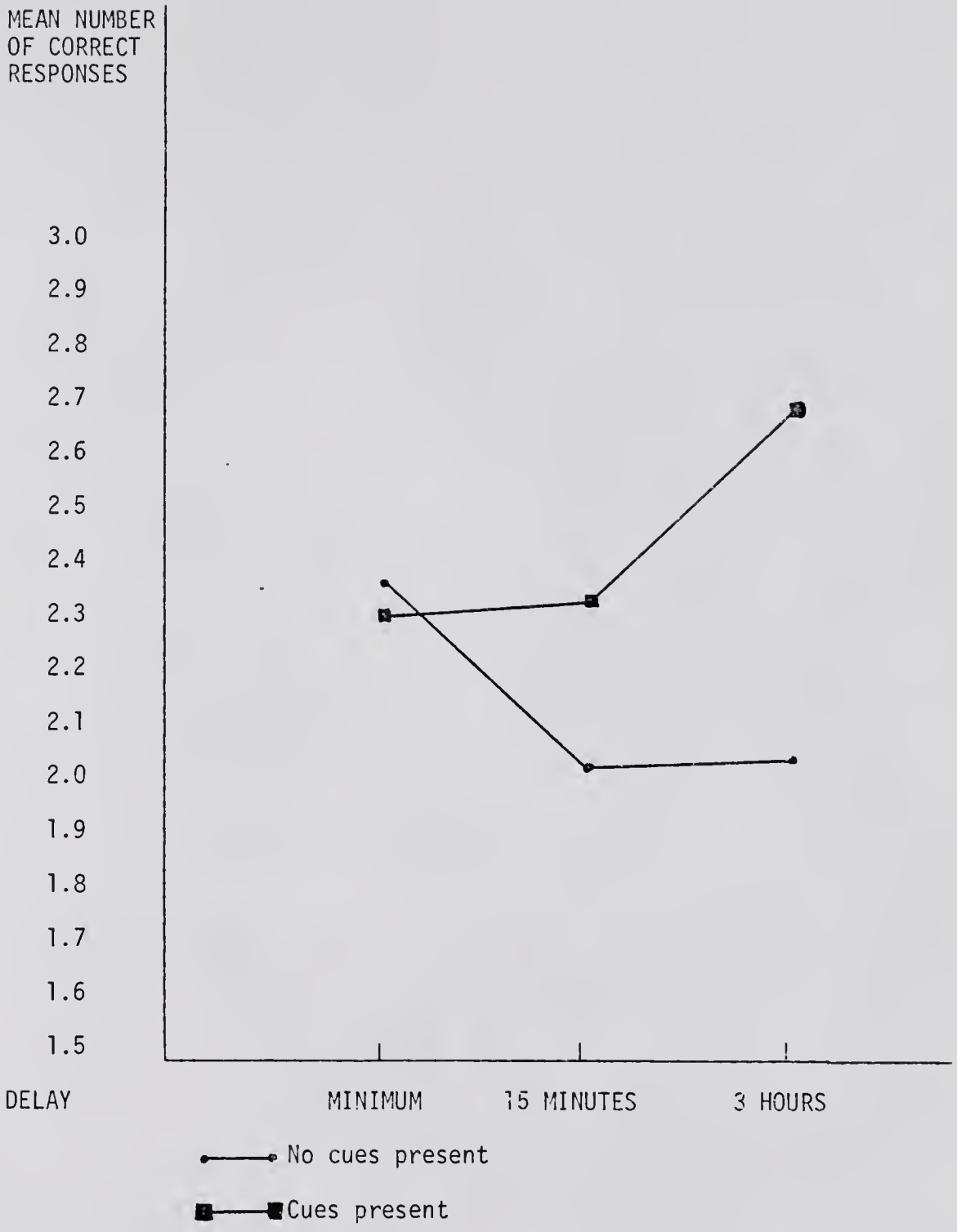


FIGURE 2

MEAN NUMBER OF CORRECT RESPONSES
IN EACH CUE/DELAY CONDITION

resulted in a significantly higher number of correct responses.

In summary the analysis of correct responses indicates that,

1) The presentation of response produced cues resulted in a greater number of correct responses;

2) A 3-hour delay of consequence with response produced cues presented at the time of consequentation (condition F) resulted in a higher number of correct responses than in any other condition, except immediate presentation of consequence when no response produced cues were presented during consequentation (condition A);

3) A greater number of correct responses were obtained on trial six when cues were present than on trial one when cues were present and trials three and four when cues were absent, and a greater number of correct responses were obtained on trial seven when cues were present than on trials three and four when cues were absent.

Analysis of Response Time

The mean response time was the next variable to be investigated. The analysis provides information on the differential effect of the various conditions on the speed of response regardless of the accuracy. The analysis is parallel to analyzing the overall rate of responding due to the fact that the number of responses under each condition was the same.

The four way analysis of variance (Table 5) depicts a significant effect ($P < .01$) due to trials on the response time. Further investigation into this effect was conducted using a Duncan's New Multiple range test (Table 6). This analysis shows that trials two and five result in significantly lower response times (higher rates of behavior) than trial one. Figure 3 portrays the relationship between the number of the trial and mean response time.

TABLE 5

ANALYSIS OF VARIANCE OF RESPONSE TIME

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F RATIO
Trials	6	2855.385	475.897	3.363**
Cues	1	132.606	132.606	0.937
Delay	2	736.455	368.228	2.603
Subjects	9	35293.667	3921.518	
Trials X Cues	6	513.924	85.654	0.605
Trials X Delay	12	4406.064	367.172	2.595**
Trials X Subjects	54	4394.438	81.378	
Cues X Delay	2	1450.216	725.108	5.125**
Cues X Subjects	9	1626.365	180.707	
Delay X Subjects	18	1104.413	61.356	
Trials X Cues X Delay	12	3020.469	251.706	1.779
Trials X Cues X Subjects	54	4394.438	81.378	
Trials X Delay X Subjects	108	11980.733	110.933	
Cues X Delay X Subjects	18	2485.853	138.103	
Residual	108	15280.875	141.490	
TOTAL	419	96856.313		

*Significant at .05
**Significant at .01

TABLE 6

DUNCAN'S NEW MULTIPLE RANGE TEST
ON RESPONSE TIME FOR EACH TRIAL

TRIAL	MEANS	STANDARD DEVIATIONS
One	27.950	17.280
Two	21.100	12.722
Three	26.433	14.252
Four	22.333	9.2583
Five	21.750	14.050
Six	22.933	17.391
Seven	27.000	18.552

TRIAL	2	5	4	6	3	7	1
ORDERED MEANS	21.1	21.8	22.3	22.9	26.4	27.0	28.0
SUBSETS	———	———	———	———	———	———	
			———	———	———	———	———

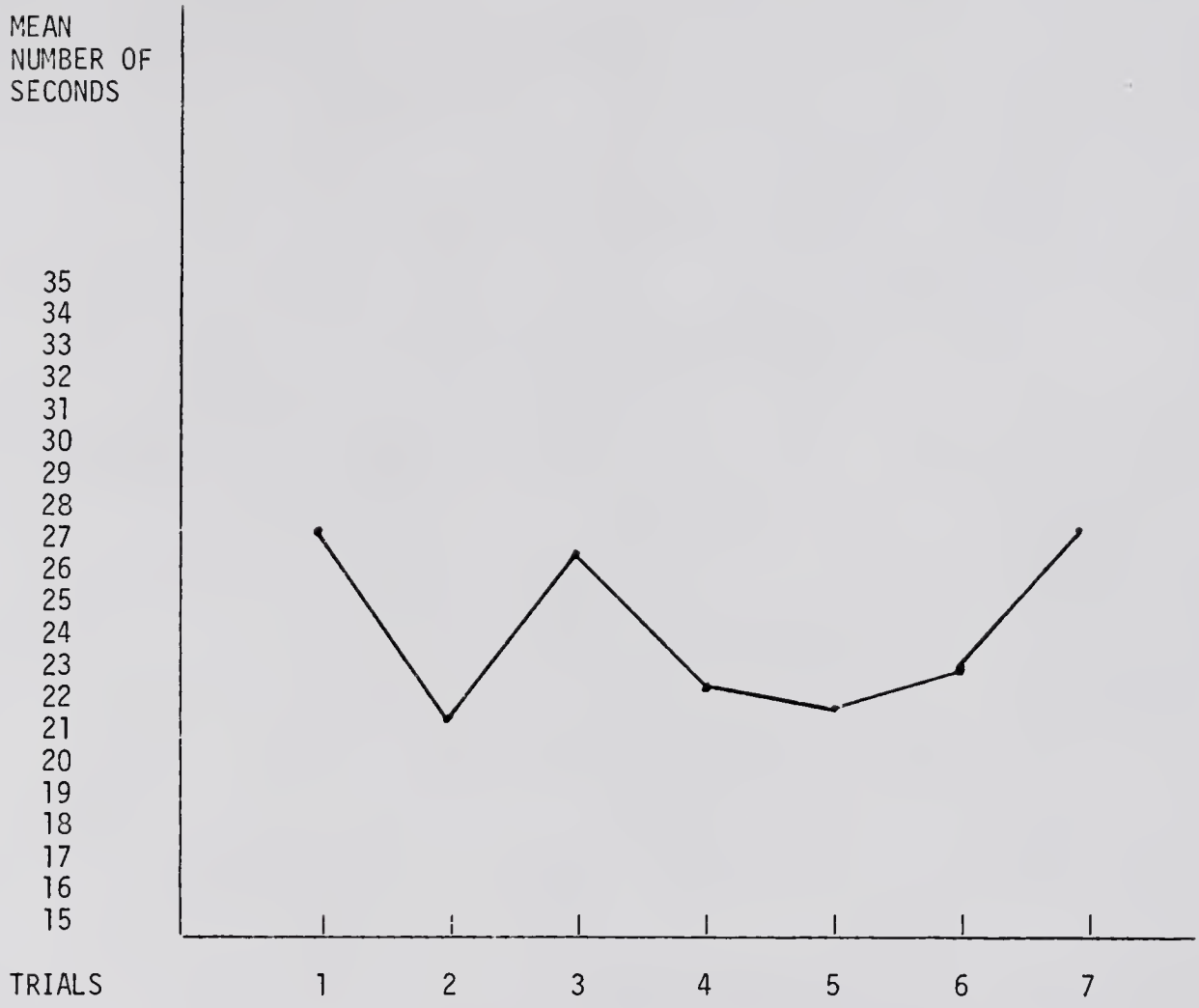


FIGURE 3

MEAN RESPONSE TIME
FOR EACH TRIAL

The effect of the number of trials on the response time cannot be adequately explained without taking into account the significant interaction ($P < .01$) between number of trials and length of delay of consequences. This interaction shows that on trial one the 15 minute delay condition resulted in a significantly higher mean response time than in a three hour delay condition on trial five. This difference is shown more emphatically in figure 4.

As was present in the analysis of correct responses, a significant interaction ($P < .01$) was found between the length of delay and the presence or absence of response produced cues. The analysis of the six conditions using Duncan's New Multiple Range Test (Table 9) reveals the differences. The condition of minimum delay of consequence with response produced cues absent (condition A) and three hours delay of consequence with response produced cues present (condition F) resulted in significantly lower response times than the condition of 15 minutes delay of consequence with response produced cues absent (condition B). This interaction is graphically portrayed (figure 5) for further clarification.

The analysis of response time then points to the following,

1) That a 15 minute delay of consequence with response produced cues absent (condition B) results in significantly higher response time than when consequences are presented immediately with response produced cues absent (condition A) or when consequences are delayed 3 hours and response produced cues are present (condition F);

2) That trials two and five resulted in significantly lower response times than trial one.

3) That trial one in the 15 minute delay condition resulted in a significantly higher mean response time than trial five in the three hour delay condition.

TABLE 7

MEANS AND STANDARD DEVIATIONS
ON RESPONSE TIME FOR EACH
TRIAL/DELAY CONDITION

LABEL	TRIAL / DELAY	MEAN NUMBER OF SECONDS	STANDARD DEVIATIONS
1/0	one / Minimum	20.850	14.229
1/15	one / 15 minutes	38.750	20.805
1/3	one / 3 hours	24.250	10.083
2/0	two / Minimum	19.550	12.198
2/15	two / 15 minutes	19.050	10.812
2/3	two / 3 hours	24.700	14.708
3/0	three / Minimum	26.600	15.329
3/15	three / 15 minutes	25.100	12.506
3/3	three / 3 hours	27.600	15.364
4/0	four / Minimum	20.550	7.522
4/15	four / 15 minutes	23.100	9.904
4/3	four / 3 hours	23.350	10.317
5/0	five / Minimum	23.100	10.736
5/15	five / 15 minutes	26.250	19.676
5/3	five / 3 hours	15.900	7.166
6/0	six / Minimum	24.450	16.694
6/15	six / 15 minutes	23.300	21.263
6/3	six / 3 hours	21.050	14.2170
7/0	seven / Minimum	25.950	18.345
7/15	seven / 15 minutes	27.150	18.180
7/3	seven / 3 hours	27.900	19.989

TABLE 8

DUNCAN'S NEW MULTIPLE RANGE TEST
ON RESPONSE TIME FOR EACH
TRIAL/DELAY CONDITION

TRIAL/DELAY CONDITION	5/3	2/15	2/0	4/0	1/0	6/3	5/0	4/14	6/15	4/3	1/3	6/0	2/3	3/15	7/0	5/15	3/0	7/15	3/3	7/3	1/15
ORDERED MEANS	16	19	20	21	21	21	23	23	23	23	24	24	25	25	26	26	27	27	28	29	39
SUBSETS																					

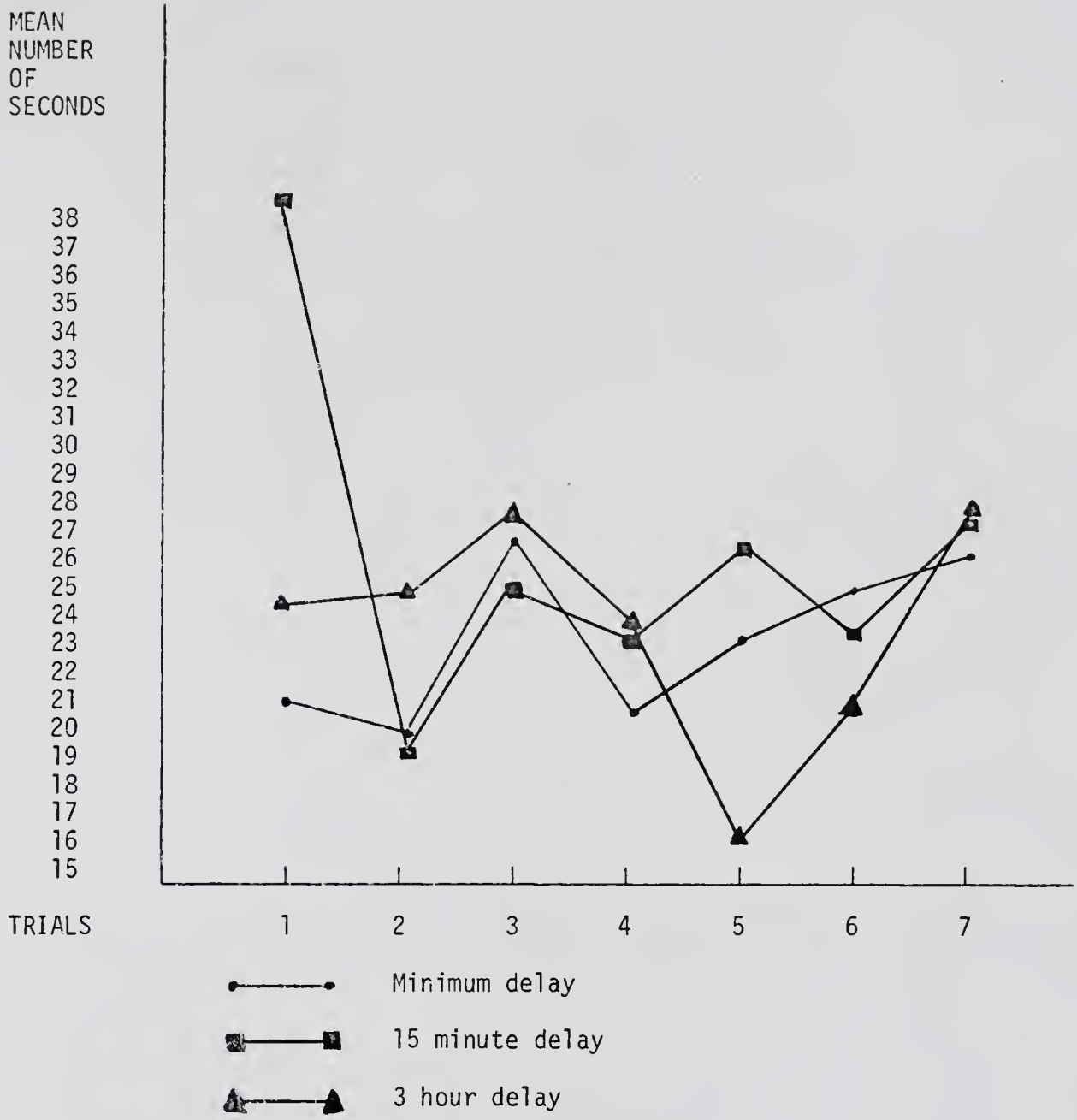


FIGURE 4

MEAN RESPONSE TIME FOR
EACH TRIAL UNDER EACH
DELAY CONDITION

TABLE 9

DUNCAN'S NEW MULTIPLE RANGE TEST ON
RESPONSE TIME IN EACH DELAY/
REPRODUCED CUE CONDITION

CONDITION	MEANS	STANDARD DEVIATIONS
(A) 0 min. delay / No Cues	21.100	12.554
(B) 15 min. delay / No Cues	28.714	20.383
(C) 3 hr. delay / No Cues	24.514	14.860
(D) 0 min. delay / Cues	24.800	15.144
(E) 15 min. delay / Cues	23.371	13.386
(F) 3 hr. delay / Cues	22.786	12.949

CONDITIONS	A	F	E	C	D	B
ORDERED MEANS	21.100	22.786	23.371	24.514	24.800	28.714
SUBSETS	_____	_____	_____	_____	_____	
			_____	_____	_____	_____

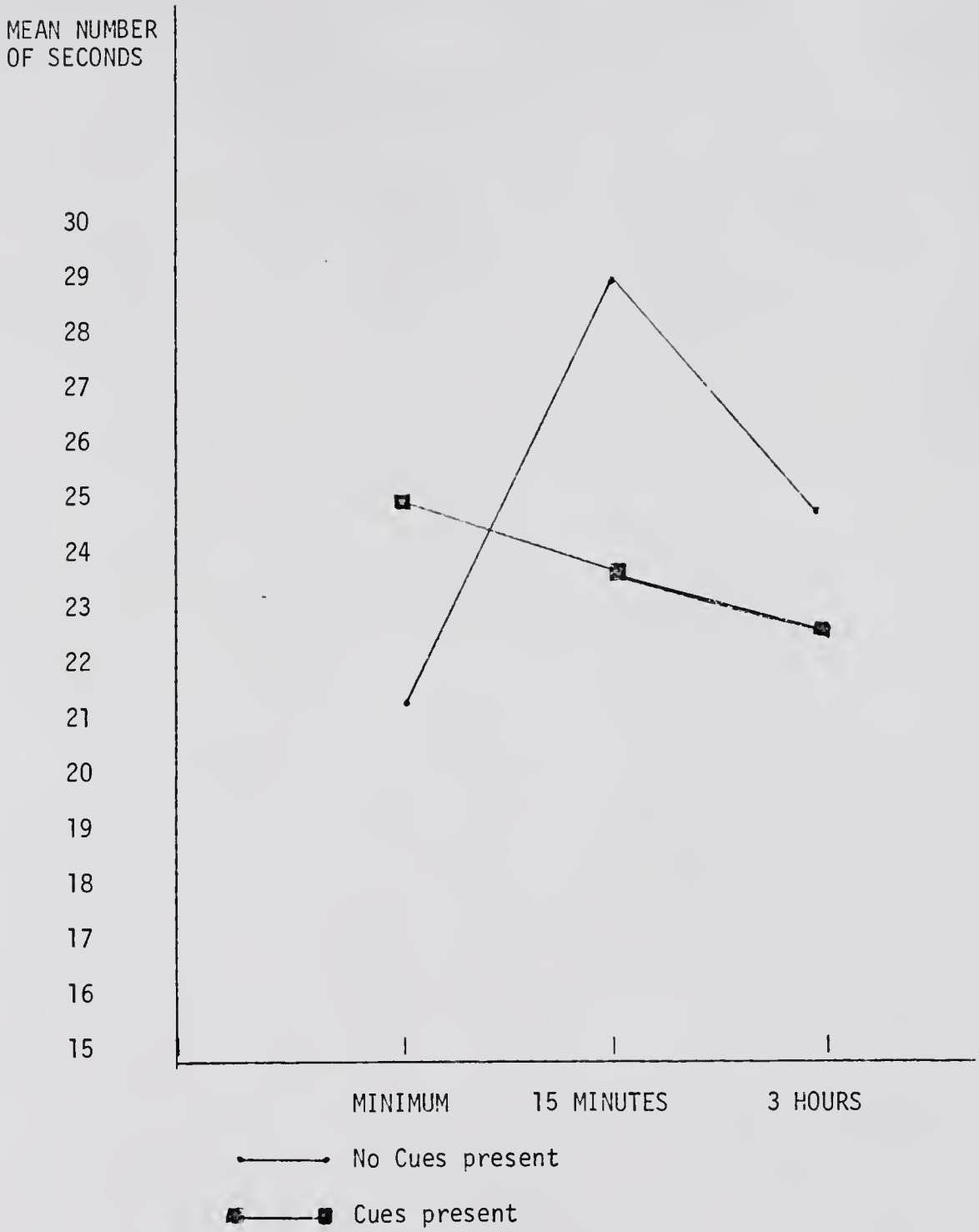


FIGURE 5

MEAN RESPONSE TIME IN EACH
CUE/DELAY CONDITION

Analysis of Log of Rate of Correct Responding

From the number of correct responses and the response time the rate of correct responding was calculated. The log 10 of these rates was then calculated. This provided the variable which is used in this analysis. By combining both time and frequency of responding this variable provides a more precise measure of the effect of the various conditions on the learning of the emotionally disturbed adolescents.

The analysis of variance (Table 10) provides evidence of the increased precision of the measure. This is indicated by the fact that five significant differences were present in this analysis as opposed to three significant differences in each of the previous analyses.

The number of trials had a significant effect ($P < .01$) on the rate of correct responding. The rate of correct responding on trial six is significantly higher than the rate of correct responding on trials one and three. The log of the rate of correct responding on trial three is in addition lower than on all other trials with the exception of trials one and four. Plotting of the data in figure 6 provides visual display of the trend of increasing rates of correct responding as the number of trials increases.

The presence of response produced cues when the consequence was delivered resulted in a significantly higher ($P < .01$) mean rate than when the response produced cues were absent. The mean log of correct responses when response produced cues were present was .815 as opposed to a mean of .749 when they were absent. The length of the delay had a differentially significant effect ($P < .05$) on the rate of correct

TABLE 10

ANALYSIS OF VARIANCE OF LOG OF RATE OF CORRECT RESPONDING

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F RATIO
Trials	6	1.909	0.318	4.863**
Cues	1	0.462	0.462	7.057**
Delay	2	0.477	0.238	3.642*
Subjects	9	8.197	0.912	
Trials X Cues	6	0.925	0.154	2.356*
Trials X Delay	12	1.162	0.097	1.492
Trials X Subjects	54	5.839	0.108	
Cues X Delay	2	1.117	0.558	8.535**
Cues X Subjects	9	1.712	0.190	
Delay X Subjects	18	2.085	0.116	
Trials X Cues X Delay	12	1.280	0.107	1.631
Trials X Cues X Subjects	54	2.825	0.052	
Trials X Delay X Subjects	108	6.390	0.059	
Cues X Delay X Subjects	18	1.398	0.078	
Residual	108	7.065	0.065	
TOTAL	419	42.842		

*Significant at .05
**Significant at .01

TABLE 11

DUNCAN'S NEW MULTIPLE RANGE TEST OF LOG
OF RATE OF CORRECT RESPONDING
FOR EACH TRIAL

TRIAL	MEANS	STANDARD DEVIATIONS
One	0.731	0.3167
Two	0.822	0.2763
Three	0.666	0.3741
Four	0.754	0.2433
Five	0.850	0.3310
Six	0.862	0.2295
Seven	0.790	0.3640

TRIAL	3	1	4	7	2	5	6
ORDERED MEANS	.67	.73	.75	.79	.82	.85	.86
SUBSETS							

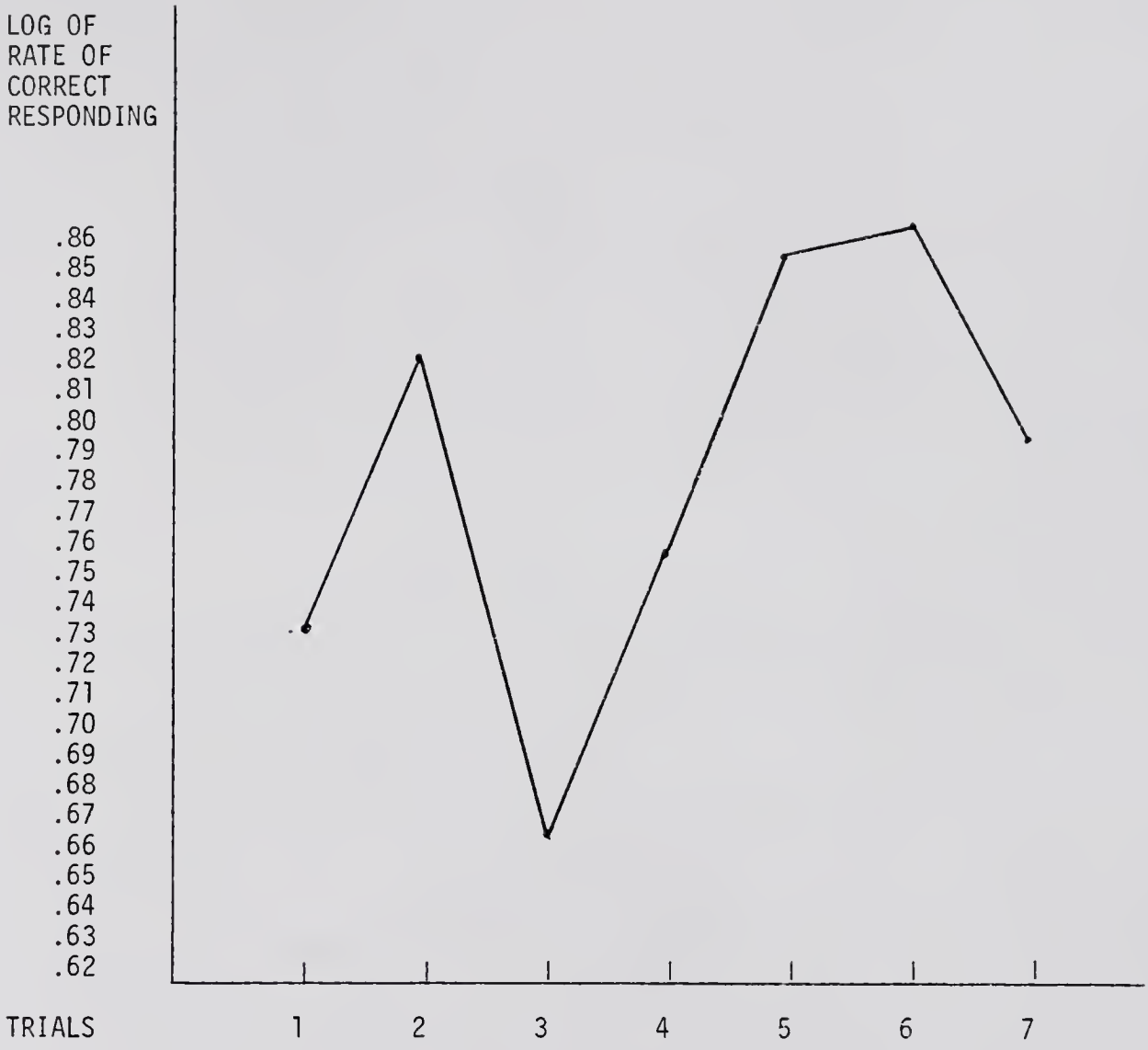


FIGURE 6

MEAN LOG OF RATE OF CORRECT RESPONDING ON EACH TRIAL

responding. The Duncan's New Multiple Range Test (Table 12) pointed out that a minimum delay in consequation produced a significantly higher log of rate of correct responding than the 15 minute delay of consequence. Figure 7 provides a visual display of the differences.

In addition to the three significant main effects two significant interactions were found. Trials by cues (P .05) and cues by delay (P .01) proved significant. Analysis of the trials by cues interactions (Table 13) generated the conclusions that, 1) trial six with cues present resulted in a higher rate than trials three or four with cues absent; and 2) trial three with cues absent resulted in a lower rate than all other trial/cue conditions except trial four with cues absent.

The graphic portrayal (Figure 8) of the means provides a very good picture of the interaction between number of trials and presence or absence of cues. In the plot it is readily apparent that rate of correct responding tends to steadily increase as the number of trials increase when response produced cues are present. However no definite trend either in increase or decrease is observed when response produced cues are absent.

The analysis of the cues by delay interaction resulted in several significant differences (Table 14): Immediate delivery of consequence with response produced cues absent (condition A) resulted in a higher correct rate of responding than under conditions of a 15 minute or three hour delay - cues absent (conditions B and C). A higher rate of correct responding was also present under conditions of 15 minute and 3 hour delays - cues present (conditions E and F) than under the condition of a 15 minute delay of consequence - cues absent. To point out clearly these differences the mean values are plotted in figure 9.

TABLE 12

DUNCAN'S NEW MULTIPLE RANGE TEST OF
LOG OF RATE OF CORRECT RESPONDING
FOR EACH DELAY LENGTH

DELAY LENGTH	MEANS	STANDARD DEVIATIONS
Minimum	0.817	0.287
15 Minutes	0.730	0.312
3 Hours	0.798	0.353

DELAY	MINIMUM	3 HOURS	15 MINUTES
ORDERED MEANS	.82	.80	.73
SUBSETS	_____	_____	_____

FIGURE 7

MEAN LOG OF RATE OF CORRECT RESPONDING
IN EACH DELAY CONDITION

TABLE 13

DUNCAN'S NEW MULTIPLE RANGE TEST OF
THE LOG OF RATE OF CORRECT
RESPONDING FOR EACH TRIAL
AND CUE CONDITION

LABEL	TRIAL / RESPONSE PRODUCED CUES	MEANS	STANDARD DEVIATIONS
1NC	1 / No Cues	0.742	0.353
1C	1 / Cues	0.719	0.281
2NC	2 / No Cues	0.845	0.288
2C	2 / Cues	0.798	0.266
3NC	3 / No Cues	0.550	0.422
3C	3 / Cues	0.781	0.282
4NC	4 / No Cues	0.693	0.221
4C	4 / Cues	0.815	0.252
5NC	5 / No Cues	0.842	0.328
5C	5 / Cues	0.858	0.339
6NC	6 / No Cues	0.832	0.228
6C	6 / Cues	0.893	0.283
7NC	7 / No Cues	0.747	0.375
7C	7 / Cues	0.833	0.354

LABEL	3NC	4NC	1C	1NC	7NC	3C	2C	4C	6NC	7C	5NC	2NC	5C	6C
ORDERED MEANS	.55	.69	.72	.74	.75	.78	.80	.82	.83	.83	.84	.85	.86	.89
SUBSETS														

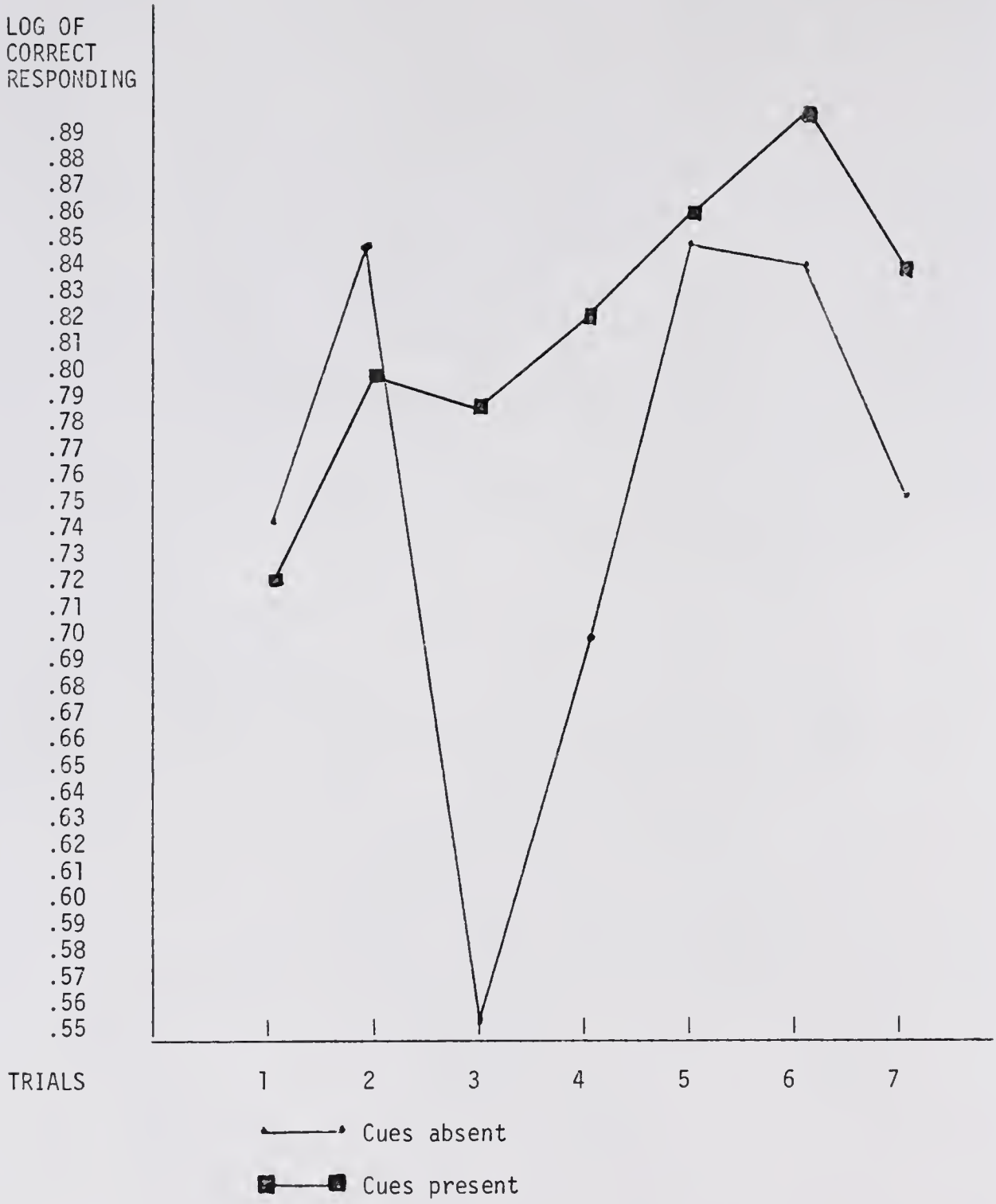


FIGURE 8

MEAN LOG OF RATE OF CORRECT RESPONDING ON EACH TRIAL UNDER CUES ABSENT/CUES PRESENT CONDITIONS

TABLE 14

DUNCAN'S NEW MULTIPLE RANGE TEST ON
LOG OF RATE OF CORRECT RESPONDING
IN EACH DELAY/RESPONSE
PRODUCED CUE CONDITION

CONDITION	MEANS	STANDARD DEVIATIONS
A	0.877	0.272
B	0.675	0.333
C	0.72	0.384
D	0.774	0.236
E	0.795	0.282
F	0.852	0.302

CONDITIONS	B	C	D	E	F	A
ORDERED MEANS	0.675	0.720	0.774	0.795	0.852	0.877
SUBSETS						

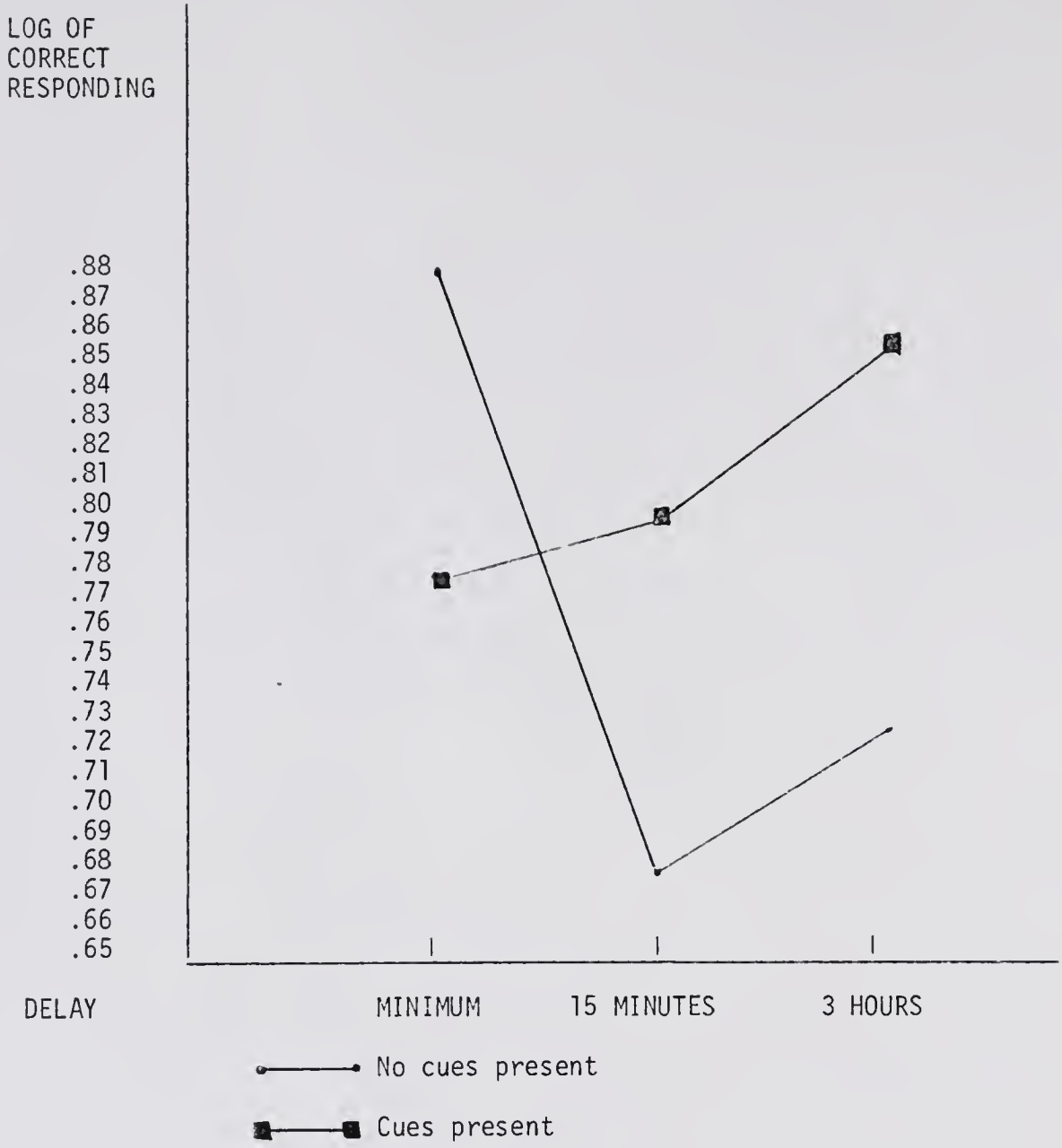


FIGURE 9

MEAN LOG OF RATE OF CORRECT RESPONDING
IN EACH CUE/DELAY CONDITION

In summary the analysis of the log of rate of correct responding provides the following:

1) That the presentation of response produced cues results in higher rates of correct responding;

2) That immediate consequentation resulted in higher rates of correct responding than a 15 minute delay in consequence;

3) That immediate delivery of consequence cues absent (condition A) resulted in a higher rate of correct responding than under conditions of a 15 minute or three hour delay - cues absent (conditions B and C).

4) That a higher rate of correct responding resulted from a 15 minute or 3 hour delay - cues present (conditions E and F) than under the condition of a 15 minute delay of consequence - cues absent.

5) That the rate of correct responding was lower on trial three than on all trials except one and four.

6) That trial six resulted in a higher rate of correct responding than on trials one and three.

7) That trial three with cues absent resulted in a lower rate than all other trial cue conditions except trial four with cues absent; and

8) That trial six with cues present resulted in a higher rate than trials three or four with cues absent.

Analysis of Celeration Ratios

A line of best fit was calculated for the log 10 of correct responding using linear regression. From this the predicted log 10 of the rate of correct and incorrect responding for each day was calculated. From this information the celeration coefficient for correct and incorrect was calculated. This is the number one must multiply the predicted rate of responding on day n to obtain the predicted rate of responding on day n + 7. The coefficients are presented in Table 15 and 16. Celeration ratios were then calculated by dividing the celeration coefficient of rate of correct responding for each subject

TABLE 15

CELERATION COEFFICIENTS FOR CORRECT RESPONDING

	CONDITIONS					
Subject	A	B	C	D	E	F
1	1.354	1.201	0.767	1.460	0.520	2.785
2	0.682	1.248	0.250	0.297	0.139	0.716
3	2.257	0.778	0.458	0.633	1.831	1.482
4	0.540	2.121	0.360	2.187	0.454	2.515
5	1.045	1.959	1.877	1.064	1.646	3.065
6	0.955	2.079	0.943	1.090	2.392	1.429
7	1.050	1.094	0.979	1.153	2.347	1.760
8	1.082	2.078	1.364	0.693	0.688	3.261
9	0.889	1.744	8.459	2.389	5.293	1.922
10	0.667	0.481	0.841	1.821	1.076	1.355

TABLE 16

CELERATION COEFFICIENTS FOR INCORRECT RESPONDING

	CONDITIONS					
Subject	A	B	C	D	E	F
1	0.666	1.688	1.02	0.734	0.549	1.245
2	0.724	0.909	0.602	0.515	0.340	0.608
3	2.196	0.407	1.200	0.283	1.714	0.926
4	0.952	1.016	1.747	0.589	1.898	1.120
5	0.924	0.919	2.217	2.459	0.941	0.570
6	0.779	2.034	1.108	1.020	0.395	0.254
7	0.340	0.682	5.336	0.158	1.686	0.972
8	0.448	1.498	0.590	0.406	0.898	1.386
9	1.284	5.607	0.483	0.535	1.935	0.827
10	0.717	4.872	2.755	1.101	1.242	0.194

in each condition by the respective celeration coefficient for rate of incorrect responding.

The three way analysis of variance (Table 17) reveals one significant effect. The absence or presence of cues during consequation has a significant effect on the celeration ratio. The mean celeration ratio was significantly higher in the cues present condition than in the cues absent condition. This is in line with the analysis of number correct and rate of correct responding.

Looking at the data on an individual student basis provides some additional information. A celeration ratio of over one indicates higher increase in rates of correct responding than incorrect responding, which is an indication that learning in the desired direction has occurred for that subject in that condition.

Analyzing the celeration ratios in this fashion indicates that learning took place for,

1) six subjects under condition A.
2) seven subjects under condition B.
3) two subjects under condition C.
4) eight subjects under condition D.
5) five subjects under condition E.
6) ten subjects under condition F.

This indicates more subjects learned under condition F than under any other condition.

TABLE 17

ANALYSIS OF VARIANCE OF CELERATION RATIOS

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F RATIO
Cues	1	1.09595	1.09595	6.0316*
Delay	2	0.31030	0.15515	.8539
Subjects	9	1.38916	0.15435	
Cues X Delay	2	0.70913	0.35457	1.9514
Cues X Subjects	9	1.13922	0.12658	
Delay X Subjects	18	2.80871	0.15604	
Residual	18	3.27060	0.1870	
TOTAL	59	10.72307		

*Significant at .05

TABLE 18

CELERATION RATIOS

	CONDITIONS					
Subject	A	B	C	D	E	F
1	2.033	0.712	0.752	1.989	0.947	2.237
2	0.942	1.373	0.415	0.577	0.409	1.178
3	1.028	1.911	0.382	2.237	1.068	1.602
4	0.567	2.088	0.206	3.713	0.239	2.246
5	1.131	2.132	0.847	0.433	1.749	5.377
6	1.226	1.022	0.851	1.069	6.056	5.878
7	3.088	1.602	0.183	7.297	1.392	1.811
8	2.415	1.387	2.312	1.707	0.766	2.353
9	0.692	0.311	17.513	4.465	2.735	2.324
10	0.930	0.099	0.305	1.654	0.866	6.985

Summary of Results

This section summarizes the foregoing analysis in terms of the null hypotheses stated on page 11.

1) Analysis of correct responding indicated no significant effect due to length of delay taken by itself. So null hypotheses one cannot be rejected.

2) Analysis of response time resulted in no significant effect due to length of delay. Therefore null hypotheses two cannot be rejected.

3) Analysis of rate of correct responding resulted in a significant effect due to length of delay. Therefore null hypotheses three is rejected. There is an effect on rate of correct responding due to the length of the delay. The minimum delay of consequence resulted in a higher correct rate of responding than a 15-minute delay of consequence.

4) Analysis of the celeration ratios resulted in no significant effects due to length of delay. Therefore null hypotheses four cannot be rejected.

5) Analysis of correct responses resulted in a significant effect due to presence or absence of response produced cues. Thus null hypotheses five is rejected. The number of correct responses is effected by presence or absence of cues. The presence of response produced cues during consequation results in higher numbers of correct responses.

6) Analysis of response time resulted no significant effects due to cue presence or absence. Therefore null hypotheses six cannot be rejected.

7) Analysis of rate of correct responding resulted in a significant effect due to cue presence or absence. Thus null hypothesis seven is rejected. The rate of correct responding is effected by presence or absence of cues. The presence or response produced cues during consequention results in higher rates of correct responding.

8) Analysis of the celeration ratios resulted in a significant effect due to presence or absence of response produced cues. Therefore hypotheses eight is rejected. The presence of response produced cues during consequation results in higher celeration ratios.

9) Analysis of the number of correct responses resulted in a significant effect due to the interaction of delay length and cue condition. Thus null hypotheses nine is rejected. The interaction is due to the fact that the number of correct responses with a three hour delay-cues present (condition F) was higher than every other combination except a minimum delay of consequence-cues absent (condition A).

10) Analysis of the response time resulted in a significant effect due to the interaction of delay length and cue condition. Thus null hypotheses ten is rejected. The interaction is due to a lower response time when consequences are presented immediately and response produced cues are absent (condition A) and when consequences are delayed three hours and response produced cues are present (condition F) than when consequences are delayed 15 minutes and response produced cues are absent. (Condition B).

11) Analysis of rate of correct responding resulted in a significant effect due to the interaction of delay length and cue condition. Thus null hypotheses 11 is rejected. This interaction is due to, 1) a higher rate of correct responding with immediate delivery of consequence-cues absent (condition A) than under conditions of a 15 minute or three hour delay cues absent (conditions B and C); and 2) a higher rate of correct responding with a 15 minute or 3 hour delay of consequence-cues present (conditions E and F) than with a 15 minute delay of consequence-cues absent.

12) Analysis of celeration ratios resulted in no significant interaction due to delay length and cue condition combination. Therefore hypotheses 12 is not rejected.

Table 19 presents a summary of significances. This indicates that 7 of the null hypothesis were rejected, 5 of the 7 at the .01 level and 2 at the .05 level.

TABLE 19

SUMMARY OF SIGNIFICANT EFFECTS

VARIABLES	NUMBER CORRECT	RESPONSE TIME	RATE OF CORRECT RESPONDING	CELERATION RATIOS
Delay Length	Not Significant	Not Significant	Significant ($P < .05$)	Not Significant
Cues	Significant ($P < .01$)	Not Significant	Significant ($P < .01$)	Significant ($P < .05$)
Delay Length X Cues	Significant ($P < .01$)	Significant ($P < .01$)	Significant ($P < .01$)	Not Significant

CHAPTER V

CONCLUSIONS

This study was undertaken to investigate the effects of delays of consequence on the learning of emotionally disturbed adolescents. The effects of the delays were investigated in situations where response produced cues were presented at the time the consequence was delivered and where response produced cues were absent during consequation.

The major questions were whether:

1) delays in the delivery of consequences of 15 minutes or 3 hours have detrimental effects on the learning of emotionally disturbed adolescents when no stimulus or response produced cues are present;

2) delays in the delivery of consequences of 15 minutes or 3 hours have detrimental effects on the learning of emotionally disturbed adolescents when stimulus and response produced cues are present.

The analysis of the results of the effects on four dependent measures indicates that:

1) Delays of 15 minutes and 3 hours have a detrimental effect on the rate of correct responding when no response produced cues are present.

2) A delay of 15 minutes has a detrimental effect on the response time when no response produced cues are present.

3) Delays of 15 minutes or 3 hours have no detrimental effect on number of correct responses or celeration ratios.

4) Delays of 15 minutes and 3 hours have no detrimental effect on any of the four dependent measures when response produced cues are present. In fact performance was superior under conditions of 3 hour delay as measured by number of correct responses.

It therefore appears that the detrimental effects of delays of reinforcement can be overcome by the presentation of stimulus and response produced cues at the time the consequence is delivered. This means that modification techniques used with emotionally disturbed students may successfully employ techniques not centered around immediate delivery of consequences, resulting in the design and adoption of techniques which are not as tedious as the present ones and which may be utilized more readily without tremendous outside support. These techniques however should be limited to behaviors in which stimulus and response produced cues can be presented during consequation.

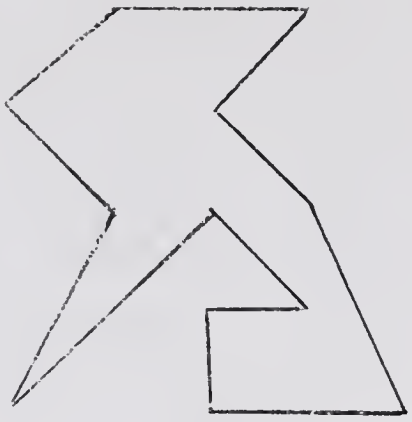
Several factors are deserving of further investigation. The most unexpected result was the higher mean number of correct responses under a three hour delay than a delay of 15 minutes or the immediate presentation of the consequence when cues were present. This effect may be due to the fact that a smaller time period passed between the time the cues were presented and the next trial (approximately 20 hours as opposed to 23 hours). It may also be due to the fact that due to the school's schedule academic work followed the presentation of cues in all the conditions except the three hour delay. Thus the academic work may have interfered with remembering the correct responses. Both these possibilities should be investigated.

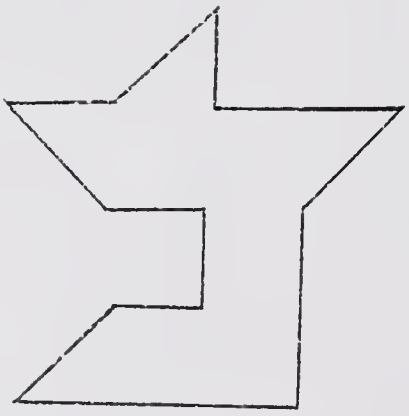
It would be desirable to investigate the effect of delays in other populations of emotionally disturbed adolescents, with different learning tasks, stronger consequences and different time lengths. There is enough evidence from this study and two applied studies (Schwartz and Hawkins, 1970; Sluyter and Hawkins, 1971) to show teachers of

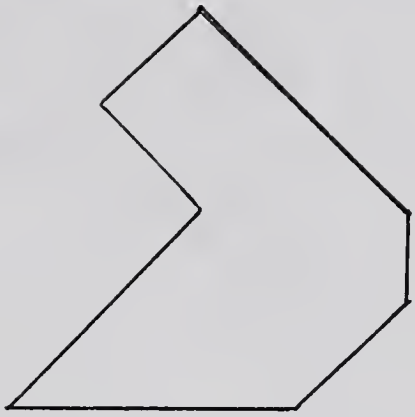
emotionally disturbed adolescents that less tedious modification procedures centered around delayed consequences can and should be employed effectively.

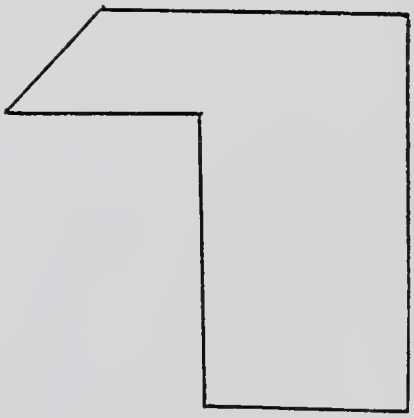
APPENDIX

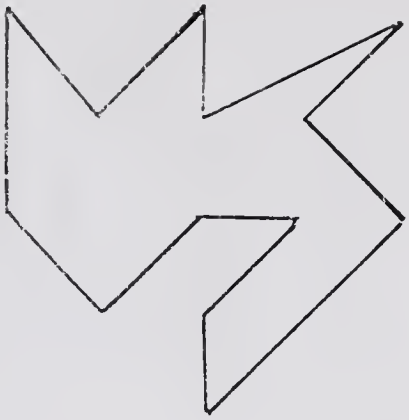
A

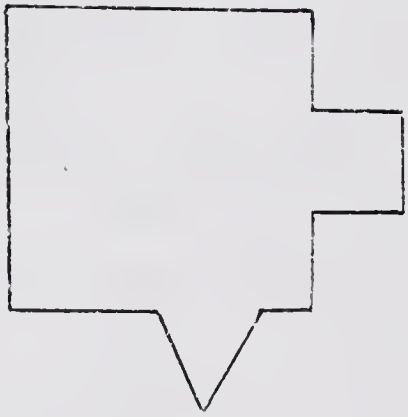


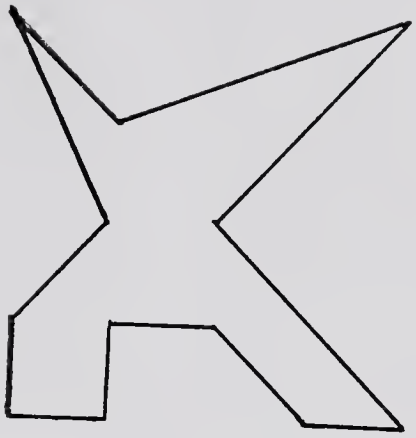


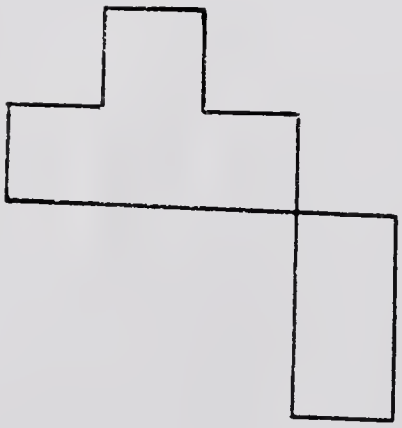






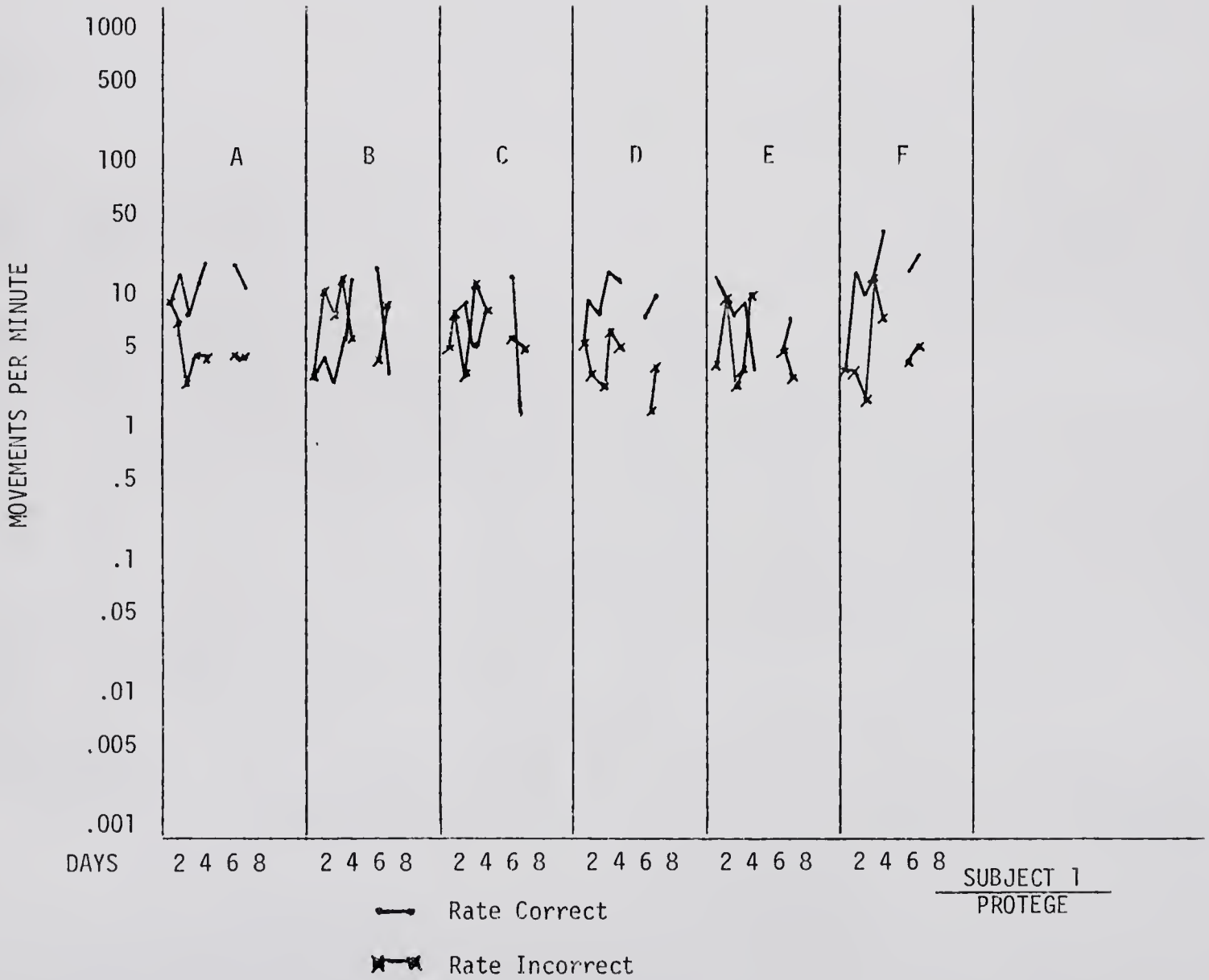


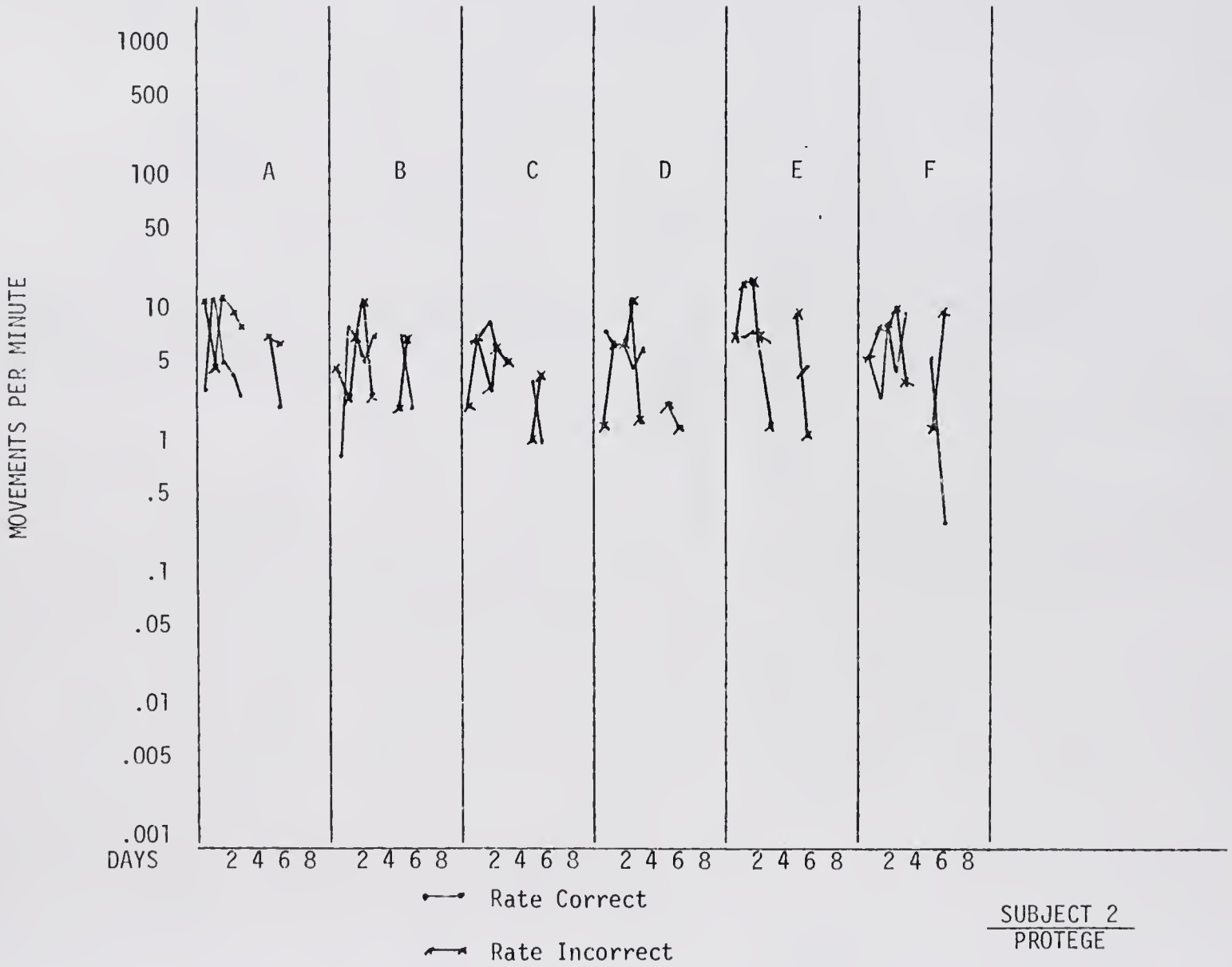




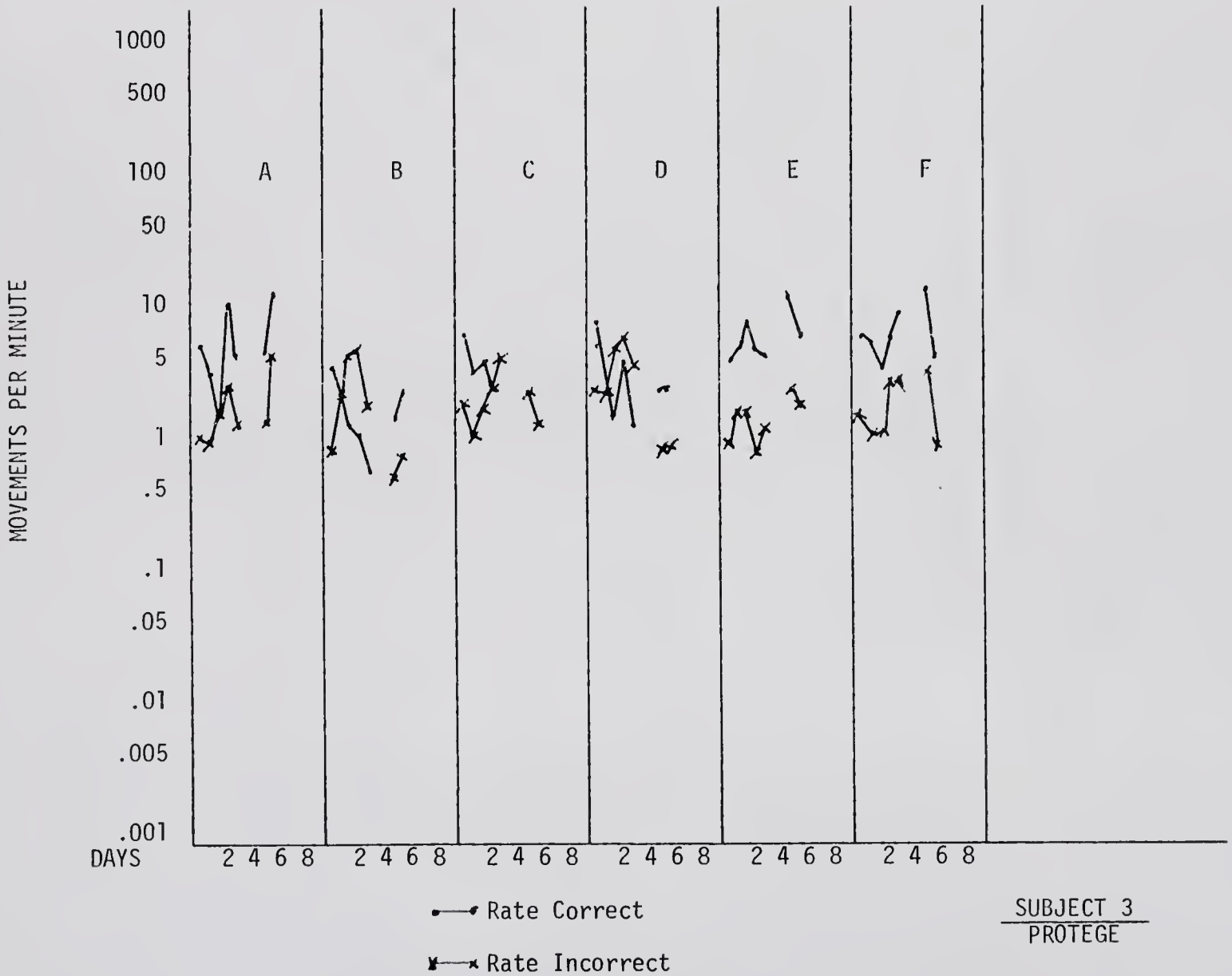
APPENDIX

B

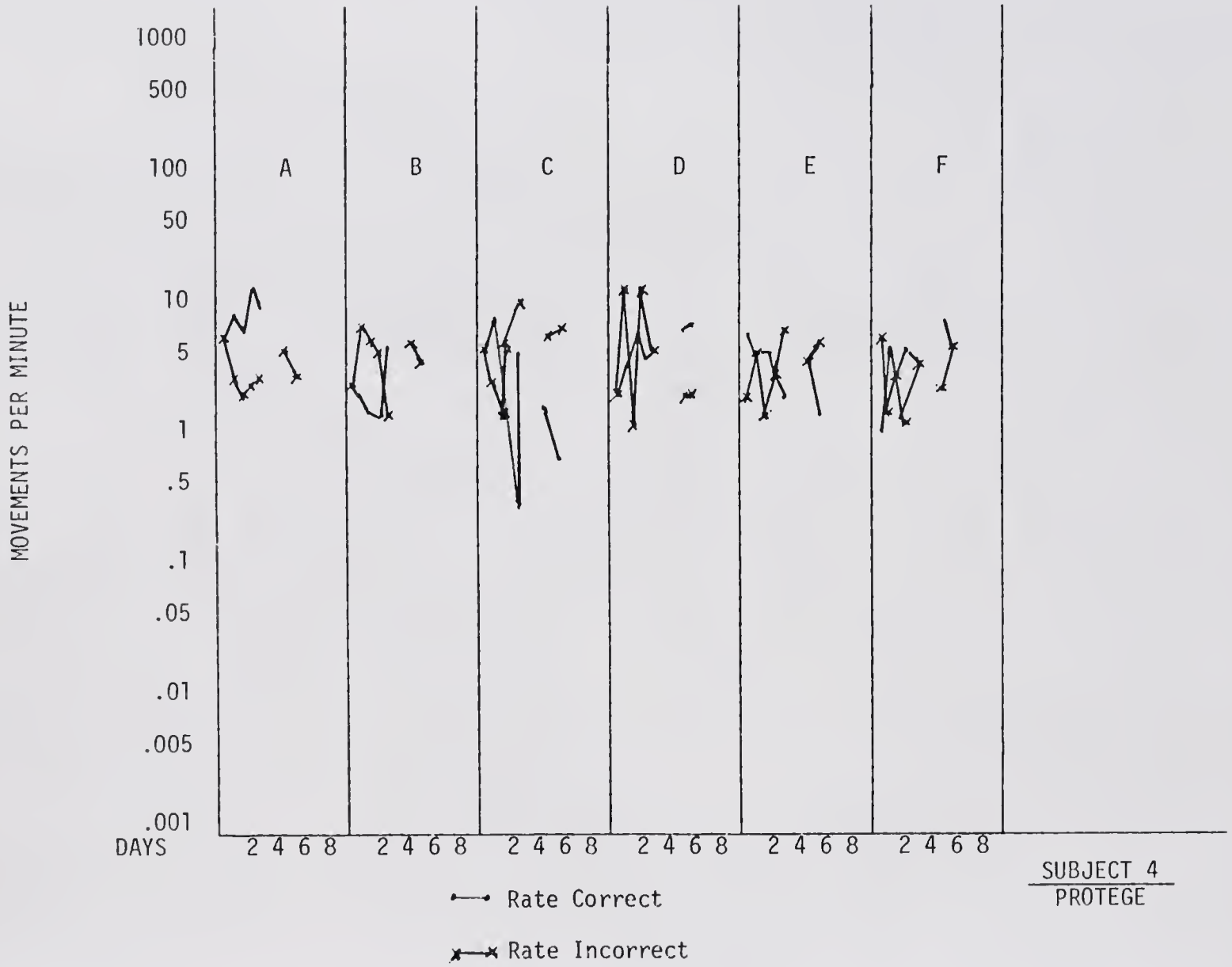

MOVEMENTS PER MINUTE
1000
500
100
50
10
5
1
.5
.1
.05
.01
.005
.001
A
B
C
D
E
F
DAYS
2 4 6 8
SUBJECT 1
PROTEGE
Rate Correct
Rate Incorrect

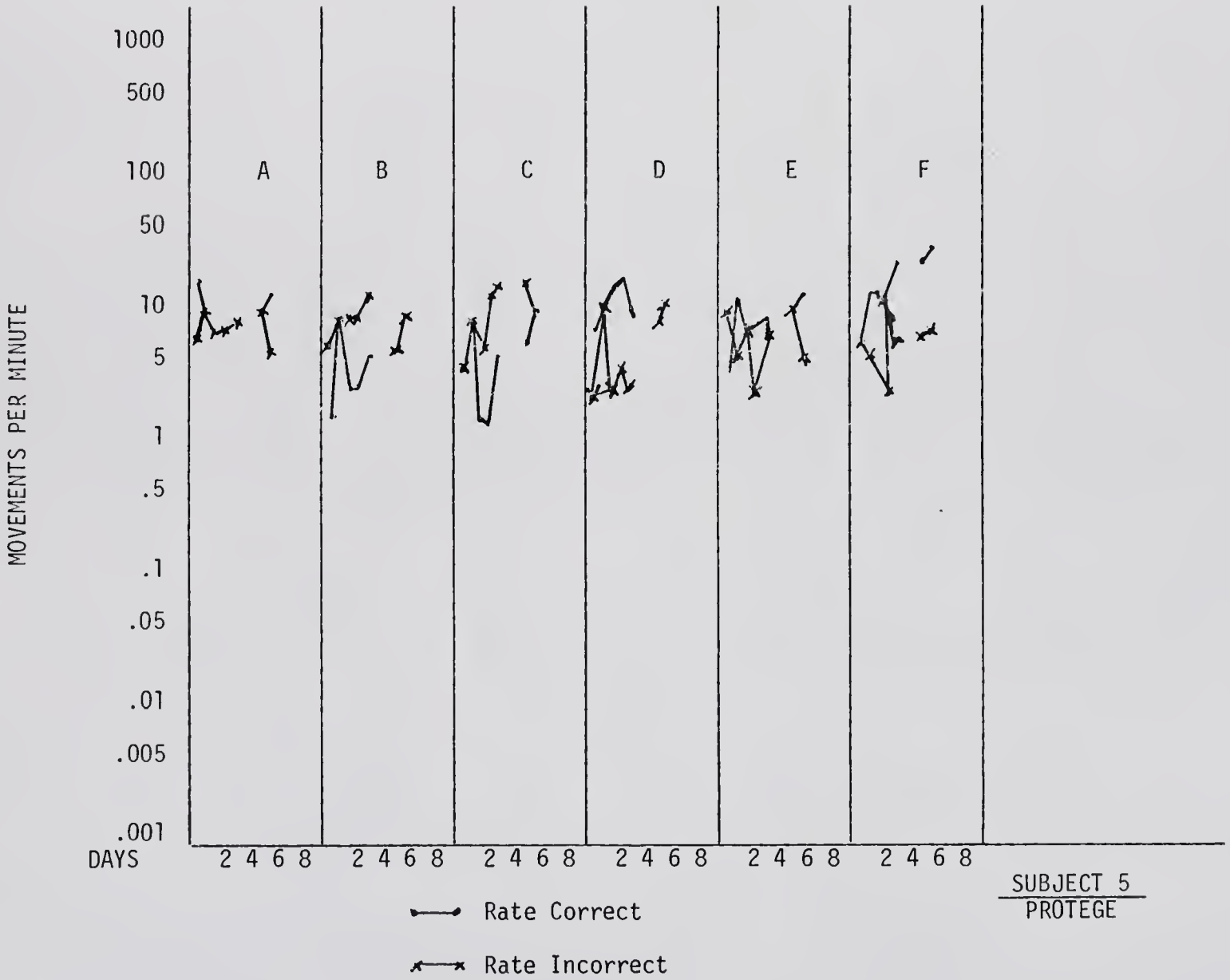


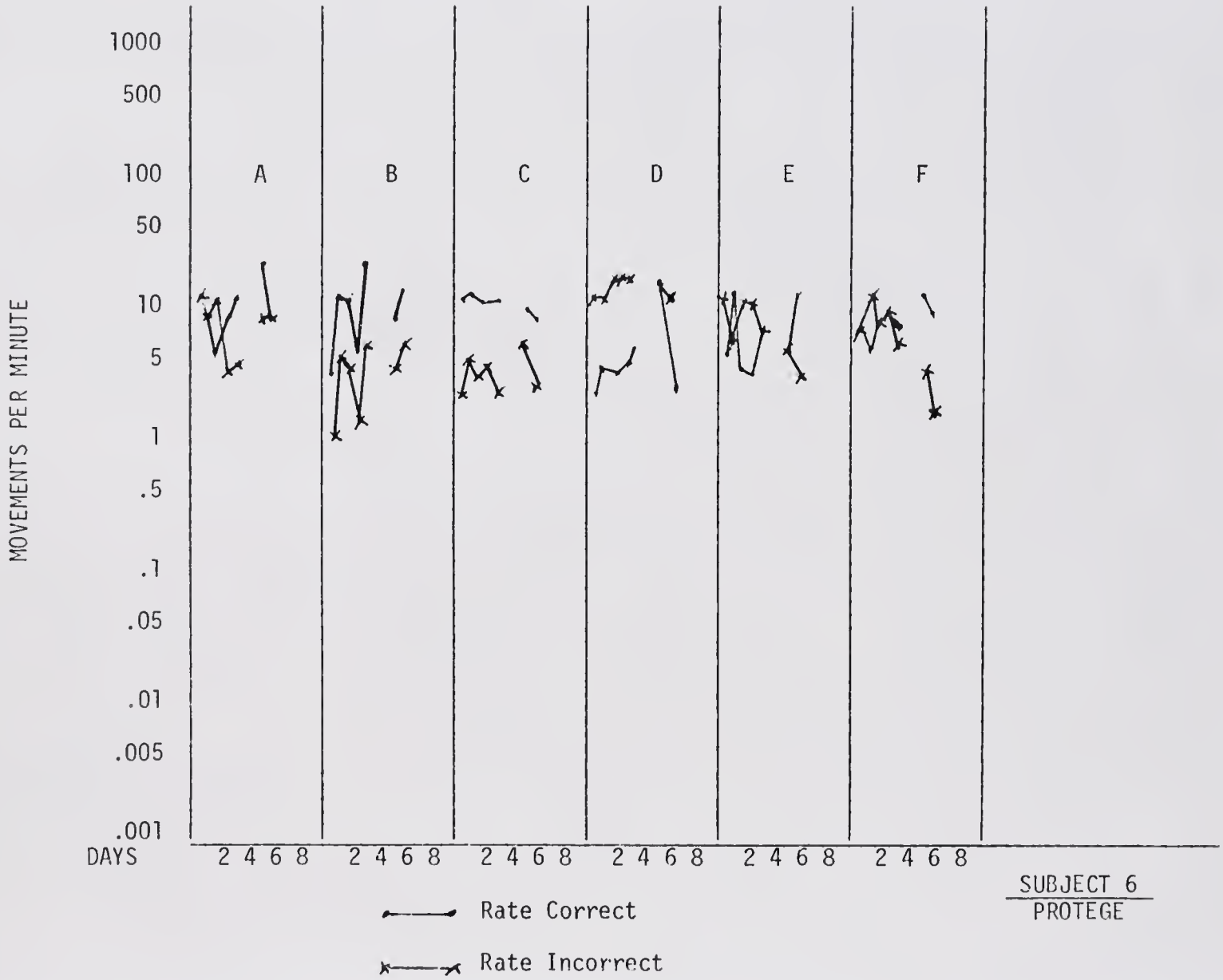
SUBJECT 2
PROTEGE

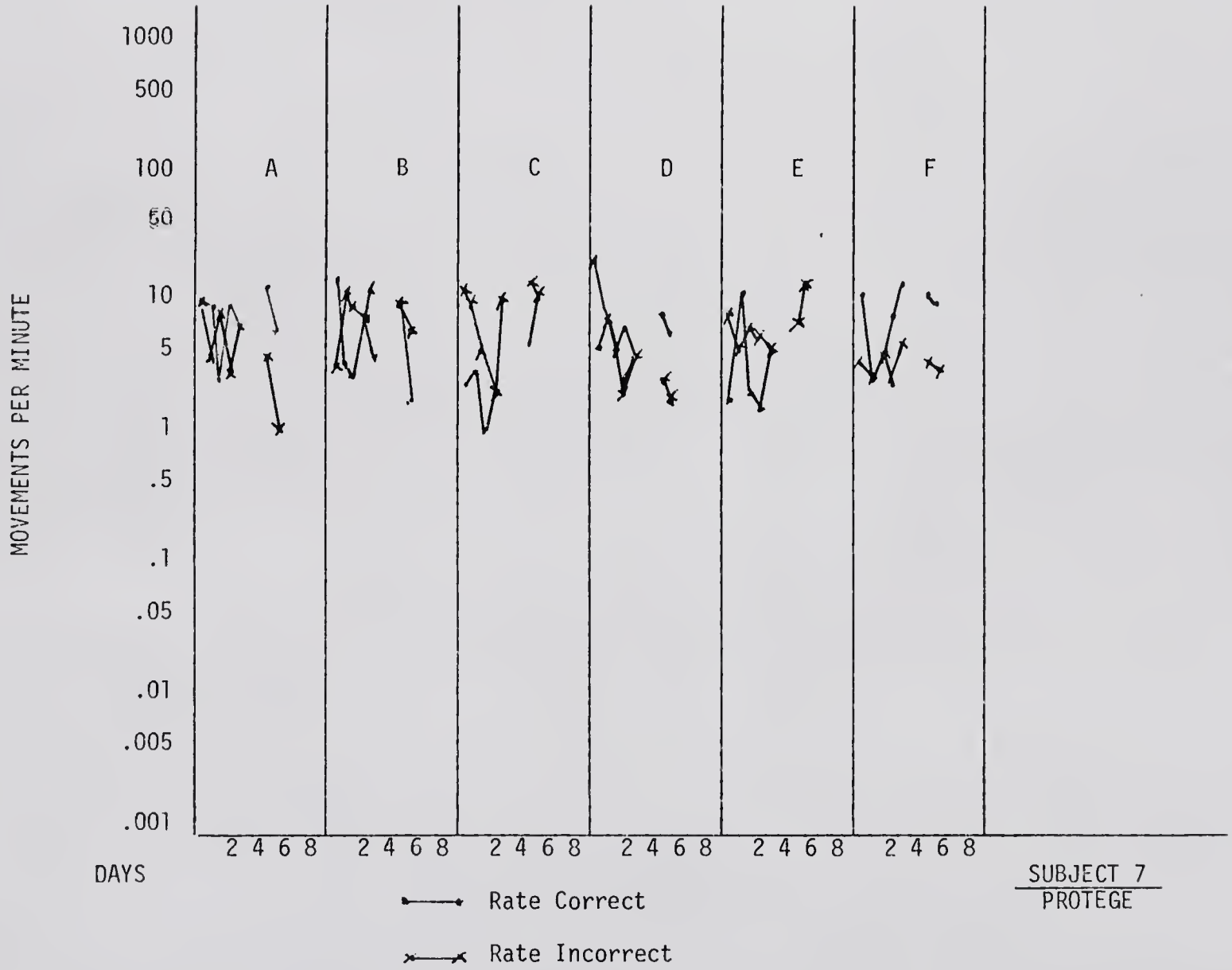


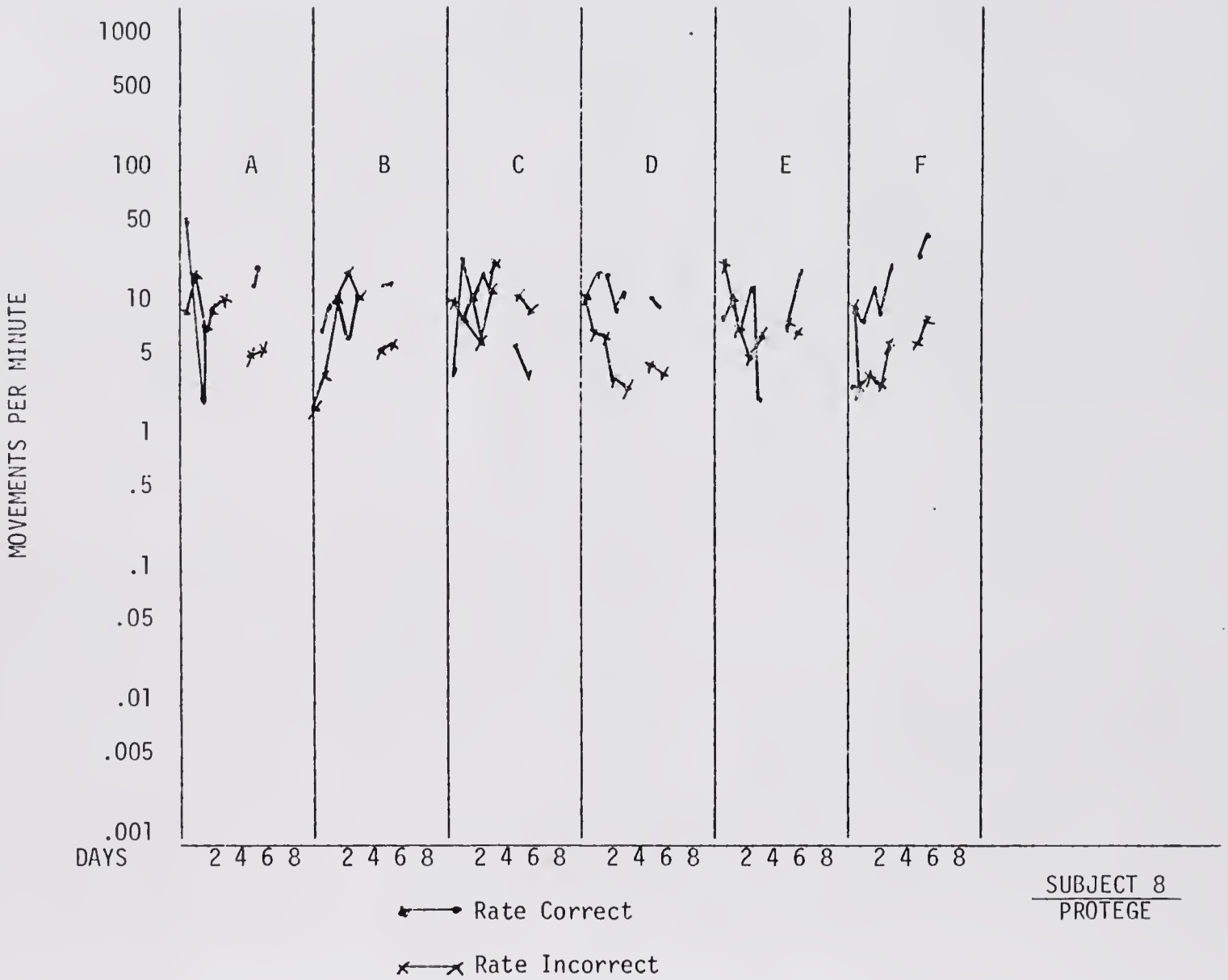
SUBJECT 3
PROTEGE


MOVEMENTS PER MINUTE
1000
500
100
50
10
5
1
.5
.1
.05
.01
.005
.001
DAYS
A
B
C
D
E
F
2 4 6 8
Rate Correct
Rate Incorrect
SUBJECT 4
PROTEGE

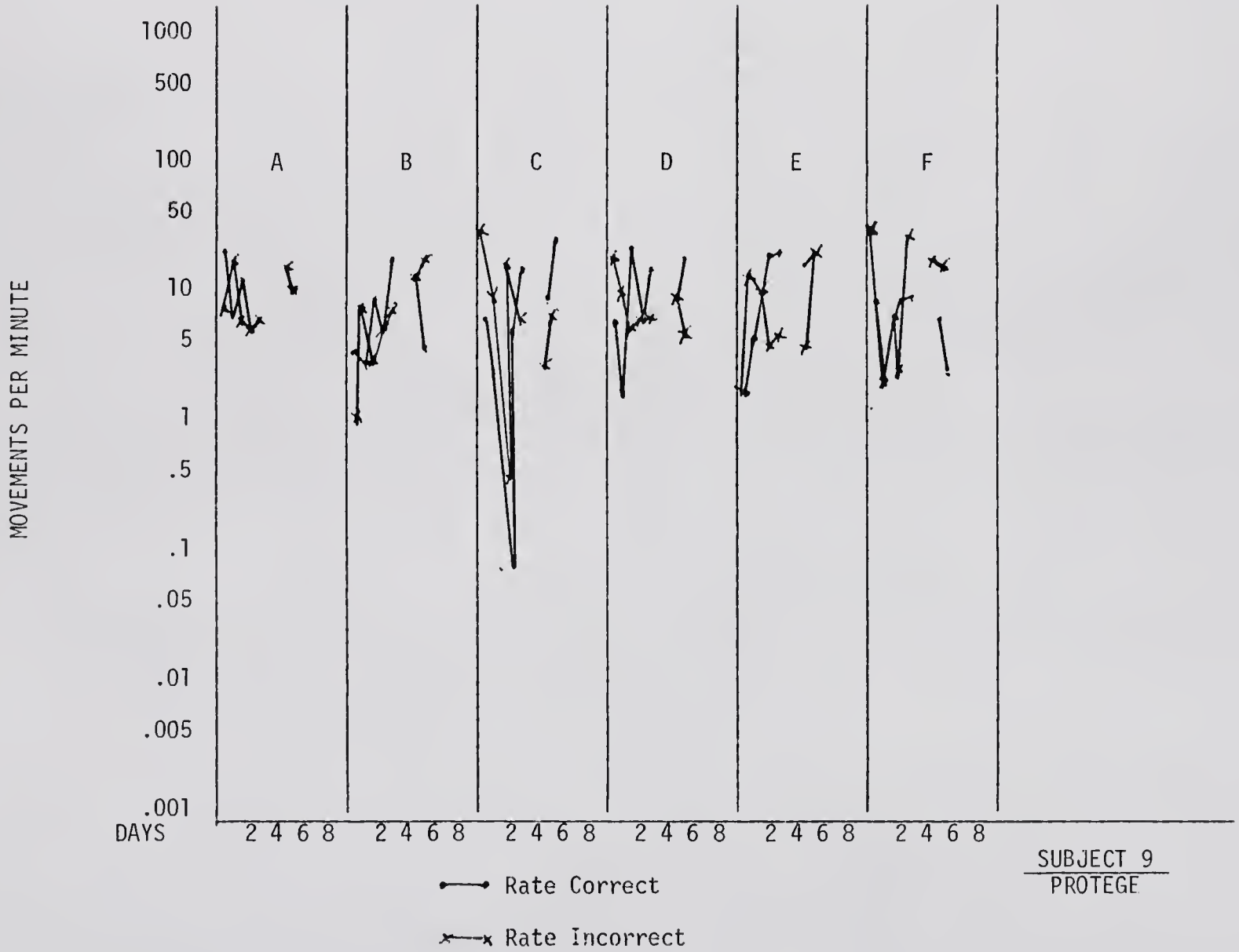

MOVEMENTS PER MINUTE
1000
500
100
50
10
5
1
.5
.1
.05
.01
.005
.001
A
B
C
D
E
F
DAYS
2 4 6 8
2 4 6 8
2 4 6 8
2 4 6 8
2 4 6 8
2 4 6 8
SUBJECT 5
PROTEGE
Rate Correct
Rate Incorrect

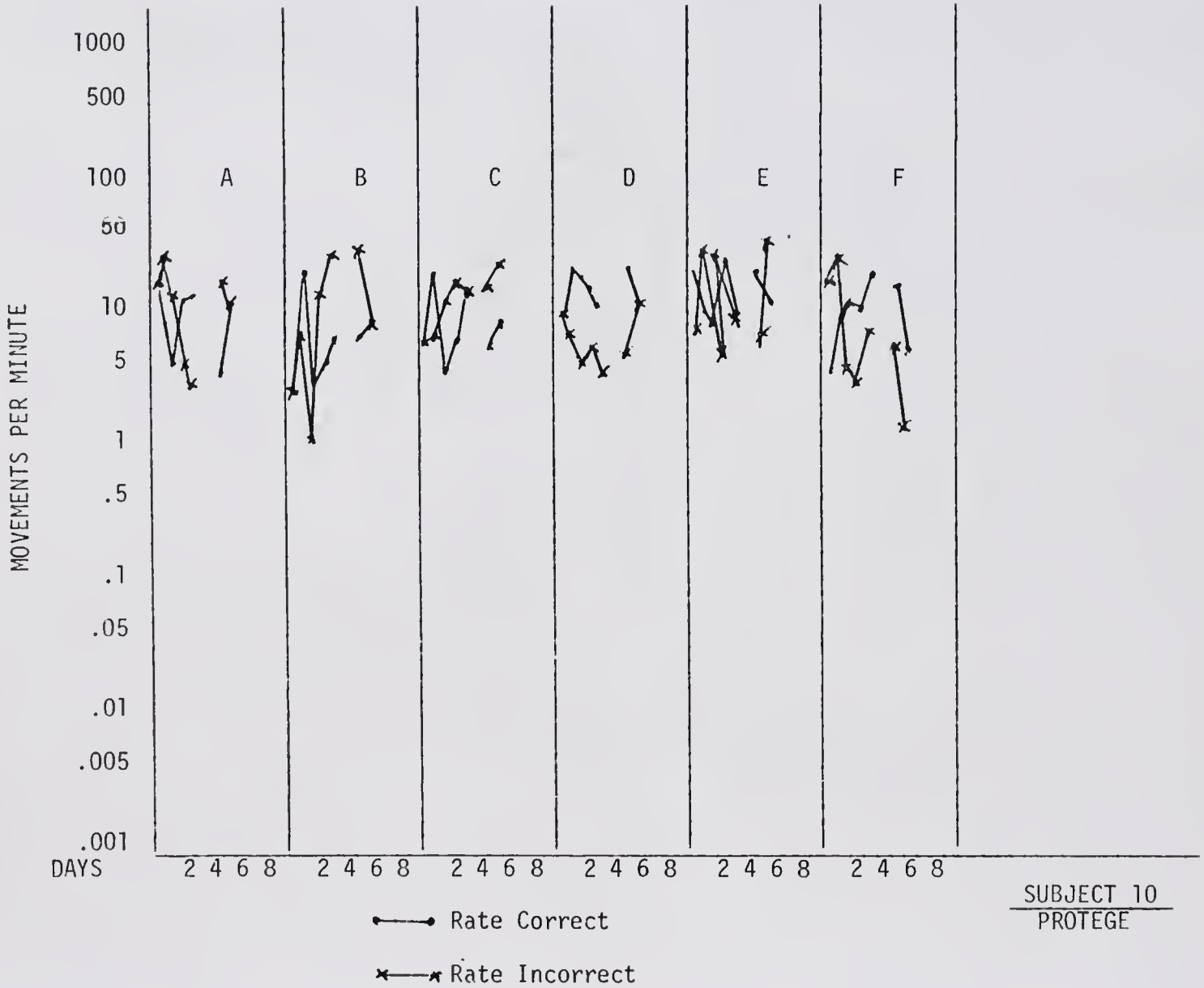

MOVEMENTS PER MINUTE
1000
500
100
50
10
5
1
.5
.1
.05
.01
.005
.001
A
B
C
D
E
F
DAYS
2 4 6 8
Rate Correct
Rate Incorrect
SUBJECT 6
PROTEGE


MOVEMENTS PER MINUTE
1000
500
100
50
10
5
1
.5
.1
.05
.01
.005
.001
A
B
C
D
E
F
2 4 6 8
DAYS
Rate Correct
Rate Incorrect
SUBJECT 7
PROTEGE



SUBJECT 8
PROTEGE


MOVEMENTS PER MINUTE
1000
500
100
50
10
5
1
.5
.1
.05
.01
.005
.001
DAYS
A
B
C
D
E
F
2 4 6 8
Rate Correct
Rate Incorrect
SUBJECT 9
PROTEGE


MOVEMENTS PER MINUTE
1000
500
100
50
10
5
1
.5
.1
.05
.01
.005
.001
A
B
C
D
E
F
DAYS
2 4 6 8
Rate Correct
Rate Incorrect
SUBJECT 10
PROTEGE

BIBLIOGRAPHY

Allen, E., Hart, B., Buell, J., Harris, F., and Wolk, M. "Effects of Social Behavior on Isolate Behavior of a Nursery School Child," Child Development, 1964, 35, 511-518.

Becker, W., Madsen, C., Arnold, C. and Thomas, D. "The Contingent Use of Teacher Attention and Praise in Reducing Classroom Behavior Problems," Journal of Special Education, 1967, 1, 287-307.

Bilodeau, E. A. and Bilodeau, I. M. "Variation of Temporal Intervals Among Critical Events in Five Studies of Knowledge of Results," Journal of Experimental Psychology, 1958, 55, 603-612.

Brackbill, Y., and Kappy, M. S. "Delay of Reinforcement and Retention," Journal of Comparative Physiological Psychology, 1962, 20, 433-434.

Carlson, C., Arnold, C., Becker, W. and Madsen, C. "The Elimination of Tantrum Behavior of a Child in an Elementary Classroom," Behavior Research and Therapy, 1968, 6, 117-119.

Denny, M. R., Allard, M., Hall, E. and Rokeach, M. "Supplementary Report: Delay of Knowledge of Results, Knowledge of the Task and Intertrial Interval," Journal of Experimental Psychology, 1960, 60, 327.

Erickson, M. and Lipsitt, L. P. "Effect of Delayed Reward on Simultaneous and Successive Discrimination Learning in Children," Journal of Comparative Physiology, 1960, 53, 256-260.

Glavin, J. P., Quay, H. C., Annesley, F. R., and Werry, J. S. "An Experimental Resource Room for Behavior Problem Children," Exceptional Children, 1971, 38, 131-137.

Goldstein, S. B., and Siegel, A. W. "Observing Behavior and Children's Learning," Child Development, 1971, 42, 1608-1613.

Grubard, P. S. "Utilizing the Group in Teaching Disturbed Delinquents to Learn," Exceptional Child, 1969, 36, 267-72.

Hanley, E. M. "Review of Research Involving Applied Behavioral Analysis in the Classroom," Review of Educational Research, 1970, 40, 597-627.

Hewett, F. M., Taylor, F. D., and Artuso, A. A. "The Santa Monia Project: Evaluation of an Engineered Classroom Design with Emotionally Disturbed Children," Exceptional Child, 1969, 35 523-529.

Li, J. C. Statistical Inference I, Edward Brothers, Inc., Ann Arbor Michigan, 1964.

Lovitt, T. "Behavior Modification: The Current Scene," Exceptional Children, 1970, 37, 85-93.

Mischel, W. "Preference for Delayed Reinforcement: An Experimental Study of a Cultural Observation," Journal of Abnormal and Social Psychology, 1958, 56, 57-61.

Mischel, W. "Preference for Delayed Reinforcement and Social Responsibility," Journal of Abnormal and Social Psychology, 1961, 62, 1-7.

Mischel, W. and Metzner, R. "Preference for Delayed Reward as a Function of Age Intelligence and Length of Delay Interval," Journal of Abnormal and Social Psychology, 1962, 64, 425-431.

Morris, S. M. The Effects of Reward Value and Delay of Reward on the Acquisition and Retention of a Simultaneous Discrimination Task with Emotionally Disturbed Children. Dissertation Abstracts, 70-1299, University of Connecticut, 1969.

Mower, O. H. and Ullman, A. D. "Time as a Determinant in Integrative Learning," Psychological Review, 1945, 52, 61-90.

O'Leary, K. and Becker, W. "Behavior Modification of an Adjustment Class: A Token Reinforcement Program," Exceptional Children, 1967, 37, 637-642.

Piper, T. J. "Effects of Delay of Reinforcement on Retarded Children's Learning," Exceptional Children, 1971, 38, 139-145.

Quay, H. Sprague, R., Werry, J. and McQueen, M. "Conditioning Visual Orientation of Conduct Problem Children in the Classroom," Journal of Experimental Child Psychology, 1966, 5, 512-517.

Renner, K. E. "Delay of Reinforcement: A Historical Review," Psychological Bulletin, 1964, 61, 341-361.

Ross, L. E., Hetherington, M., and Wray, N. P. "Delay of Reward and the Learning of a Size Problem by Normal and Retarded Children," Child Development, 1965, 36, 509-517.

Schoelkopf, A. M. and Orlando, R. "Delayed Versus Immediate Reinforcement in Simultaneous Discrimination Problems with Mentally Retarded Children," Psychological Record, 1965, 16, 15-23.

Schoelkopf, A. M. and Orlando, R. "Reinforcement Delay Gradients of Retardates with a Current Discrimination Task Procedure," Psychological Record, 1966, 16, 113-128.

Schwartz, M. L. and Hawkins, R. P. "Application of Delayed Reinforcement Procedures to the Behavior of an Elementary School Child," Journal of Applied Behavior Analysis, 1970, 3, 85-96.

Skypeck, G. A Descriptive Study of Three Methods of Programming Flash Cards. Doctoral Dissertation, University of Florida, 1971.

Sluyter, D. J. and Hawkins, R. P. "Delayed Reinforcement of Classroom Behavior by Parents," Journal of Learning Disabilities, 1972, 5 20-21.

Ward, L. C. and Baumeister, A. A. "Effects of Temporal Variables, Monetary Incentive, and Method of Information Feedback on the Paired-Associate Learning of Retardates," American Journal of Mental Deficiency, 1971, 75, 712-718.

Watson, J. B. "The Effect of Delayed Feeding Upon Reaction," Psychobiology, 1917, 1, 51-60.

BIOGRAPHICAL SKETCH

Robert Keith Brown was born October 22, 1946, at Winter Haven, Florida and is the second of six children of Mr. and Mrs. R. McDonald Brown. He attended elementary school at Winter Haven, Florida and was a member of the last graduating class of St. Leo College Preparatory School, St. Leo, Florida in 1964.

In September, 1964 he entered the University of Florida and in August, 1968 received the Bachelor of Arts Degree, majoring in psychology. He then enrolled in the graduate program in special education at the University of Florida. Mr. Brown received his Master of Education Degree, majoring in teaching emotionally disturbed children, in 1970.

He worked full time for Dr. Robert S. Soar at the Institute for the Development of Human Resources as a research assistant for 6 months before continuing his work toward a Doctorate of Philosophy in Special Education. Since June, 1971 he has been employed by the Duval County School Board in the position of Coordinator of Research and Evaluation for Exceptional Child Education.

Mr. Brown has made a number of presentations on topics ranging from accountability to sensitivity training at state and National Conventions. He has three major publications in the area of emotionally disturbed children and is presently engaged in developing evaluative technique for the trainable mentally retarded.

Mr. Brown holds memberships in the Council for Exceptional Children, the American Educational Research Association and Phi Kappa Phi.

Mr. Brown is divorced and has one lovely daughter Kelly Christine Brown.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

William R. Reid, Chairman
Professor of Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Lyndal M. Bullock, Co-Chairman
Assistant Professor of Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Henry Boudin
Assistant Professor of Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Henry S. Pennypacker
Professor of Psychology

This dissertation was submitted to the Dean of the College of Education and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

June, 1973

Dean, College of Education

Dean, Graduate School