HUMAN OPERANT RESPONDING ON SCHEDULES OF REINFORCEMENT: AN INVESTIGATION OF THE VERBAL HISTORY AND PUBLIC PERFORMANCE VARIABLES.

by

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B.A., Brandon University, 1969
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A DISSERTATION SUBMITTED IN PARTIAL FULLFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
in the department of
Psychological Foundations in Education

We accept this dissertation as conforming to the required standard

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ABSTRACT

The purpose of the present study was to examine the following conceptual and methodological issue. Human performance on schedules of reinforcement is determined by multiple interacting variables. The most frequently examined variables, instructions and schedules, are important but are not exhaustive of all the contingencies interacting to determine human operant performance. Apart from examinations of other additional variables, investigations into the interaction of instructions and schedules themselves are not sufficiently advanced to support any particular contentions about their nature. It follows that extrapolations from the present data in general are premature. The controversy surrounding the issue of interspecies generality of operant principles, as it is related to human and other animal schedule performance differences, is a case in point.

The present study examines two variables which appear to interact with instructions, schedules, and perhaps other unidentified contingencies to determine human performance on schedules of reinforcement. Will performance on Multiple Fixed Interval Fixed Ratio (MULT FR:50 FI:10 sec.) schedules be systematically

altered by superimposing the terms TEST PERIOD and PRACTICE PERIOD on portions of the session? Will subjects respond differently from periods labelled PRACTICE when experimenter access to performance information is likely? The data generated by six subjects over twelve experimental sessions suggests no particular systematic effects on performance of these manipulations. True to the literature, performance was characterized by intersubject variability. The performance of each subject was reviewed and some methodological issues surrounding human intersubject response variability discussed.

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Acknowledgements

Max Uhlemann for his support. Joe Parsons for his beyond the call participation. Loren Acker for putting up with me over the years. Other committee members: Bev Timmons and Geof Hett for their guidance.

Ann Douglas for her active long standing assistance in all stages of the project from the design of all the computer programs to manuscript preparation.

Chapter 1

Introduction

An Overview of Human Operant Research

The following overview focuses on human operant performance on schedules of reinforcement. Interpretations of human schedule performance are discussed. Additional variables which may be important to the analysis are suggested. Finally some assumptions implicit in the most popular current human operant research paradigm are reviewed and the current study proposed.

Human Operant Research

Operant researchers have traditionally experimented with nonhuman subjects and then speculated about the interspecies generality of operant principles (Lowe & Harzem, 1977; Hake, 1982). Given the assumption of the interspecies generality of operant principles, it was not surprising that a great deal of interest developed when human performance on schedules of reinforcement did not closely resemble the performance of other species (De Casper & Zeller, 1972; Baron & Galizio, 1983; Lowe, Beasty & Bentall, 1983; Weiner, 1983).

In fact, human operant responding is typically different than nonhuman responding (Leander, Lippman & Meyer, 1968; Lowe, Harzem & Hughes, 1978; Weiner, 1982). For instance, humans showed a great deal of intersubject variability in contrast to nonhuman responding (Lippman & Meyer, 1967; Lowe, 1979). In addition, human subjects were generally found to be insensitive to changes in programmed schedules of reinforcement (Ader & Totem, 1961; Harzem, Lowe & Bagshaw, 1978; Shimoff, Catania & Matthews, 1981). Lowe et al (1983) defined insensitivity as a rigidity, a persistance of a particular pattern of responding when contingencies change. This is not usually the case with other animal responding.

By way of illustration - on fixed interval (FI) schedules of moderate duration, pigeons paused after reinforcement and then responded at a positively accelerated rate until a reinforcer was delivered (Ferster & Skinner, 1957). Human responding, on the other hand, was typically of two types: (1) high rate responding without post-reinforcement pausing (PRP) or (2) a long pause with a single response at the end of the interval (Weiner, 1969).

Verbal Skills Mediating Theme

The dominant theme in explanations of human and nonhuman performance differences focuses on the role that verbal rules play in human performance. Researchers recognize that verbal instructions are almost always used in human subject research. Terrell, Bennett, Buskist & Williams (1985) contend that the use of instructions is a prominent methodological feature of the experimental analysis of human behavior.

Lowe, Beasty & Bentall (1983), in a review article, note several studies in which humans were shown to be sensitive to instructional control. Instructions about reinforcement contingencies, for example, can produce schedule performances that are similar to typical animal performances (Baron & Galizio, 1983; Lippman & Meyer, 1967). In addition to exerting control over responding, instructions are also thought to render that performance insensitive to subsequent contingency changes (Matthews, Shimoff, Catania & Sagvolden, 1977). This feature seemed so salient that Shimoff et al (1981) concluded that insensitivity defines instructional control.

Experimenter perception of the instruction variable appears to have gone full circle. This variable, previously thought of as a nuisance variable

(Baron & Galizio, 1983) is now presented as the most likely factor which may prevent the replication, with human subjects, of nonhuman performance on schedules of reinforcement.

Qualifying the Verbal Skills Mediating Theme

Not all researchers are convinced that extrapolating from the current research data is prudent at this time. Weiner (1983), in an analysis of the current state of knowledge, urges caution. In his research (Weiner, 1982), he has been able to demonstrate that effects often ascribed to the operation of verbal rules can be experimentally produced by manipulating the schedule history variable. Weiner (1983) concluded that human schedule performance was more often a function of reinforcement history than current contingencies of reinforcement.

Others argue that the instruction variable itself has not received adequate investigation to warrant claims as to its nature. Le Francois & Chase (1985) note that only a limited range of instructional strategies have been investigated to date. Pilgram (1985) reported that of the 188 studies involving human subjects published in the Journal of Applied Behavior Analysis , 177 utilized instructions and of these only

15 manipulated the instructional variable. I think it is fair to conclude that the instruction variable remains essentially one of those uncharted sources of experimental variability discussed by Lowe (1979). Please refer to Appendix A for a review of human operant literature on schedules of reinforcement.

Other Possible Contingencies: A Verbal History Variable

It seems reasonable to assume that several simultaneously operating contingencies interact in the multiple determination of human schedule performance. This assumption receives support from various sources. Buskist, Bennet & Miller (1981); Poppen (1982) and Barron & Galizio (1983) suggest that current private verbal behavior mediates in some unspecified fashion historical and current contingencies. Barron & Galizo (1983) also commented on an organism's verbal history affecting performance. Matthews, Catania & Shimoff (1985) suggested that some intersubject performance differences were likely a function of the different verbal histories human sujects bring into experimental settings.

Human subjects do not come into experimental settings naive in relation to the instruction variable.

The concept of a verbal history interacting with current contingencies is worthy of investigation. Weiner (1982) demonstrated the powerful role that performance histories play and if we consider verbal behavior to be like other behavior, it follows that verbal histories should influence current instructional control. For example, a history of reinforcement for instruction following should influence current instruction following behavior differently than a history of punishment for instruction following.

The verbal history variable receives additional support in the theoretical literature. Skinner's (1957) extensive analysis of verbal behavior is an example. Members of verbal communities experience extensive and varied verbal and performance histories. Because of diffuse and extended histories various functional themes of verbal behavior are thought to develop. Zettle & Hayes (1982) extrapolated from the work of Skinner (1957) to develop functional themes of behavior from the perspective of the listener. They suggested that instructional contingencies can engage a listener in at least two different ways and the behavior governed by the instruction is likely to be different.

A "Public" Context Variable

One variable that interacts with others to influence human performance is identified in the clinical literature. The effect of public access to performance information is a powerful variable and it is common to clinical and experimental settings. This is true at least to the extent that the clinician and/or the experimenter have access to information concerning their "client's" behavior.

Meichenbaum (1972) demonstrated that self coping statements were effective in modifying some avoidance behavior if the statements were stated publically. Hayes & Wolf (1984) examined the effects of coping statements on tolerance of experimentally induced pain. When the subjects thought no one knew their statements, no theraputic effects were shown. When subjects were aware that the experimenter knew the statements, they tolerated the pain longer and showed specific effects depending on the type of coping statement used. Rosenfarb & Hayes (1984) investigated the effects of self statements and modeling in the treatment of children's fear of the dark. A public context condition improved tolerance of the dark, while the private treatment condition was ineffective. The authors speculated about the role of public contingencies and

ascribed the results of this and related studies to a public context variable.

Some Assumptions Generated by the Button Pressing for Points Paradigm

The most frequently utilized experimental paradigm in investigations of human operant responding on schedules of reinforcement is that of a manipulandum, typically a key or button, being manipulated to earn points exchangeable for money (Galizio, 1985). An assumption easily made is that human button pressing for points is the same as nonhuman responding for food reinforcement. An extension of this analogy is that points exchangeabe for money is the primary, if not the sole, current reinforcement contingency. Given these or functionally similar assumptions, extrapolations from the data seem reasonable. The question is, are the assumptions reasonable? In a typical experiment each point earned is worth about three cents and subjects can earn roughly five to eight dollars per session. Is it reasonable to compare a human subject earning, for example, seven dollars to a rat earning 233 Noyes food pellets? Consider that the rat will have been reduced in weight by approximately 20% of his free feeding weight. How can the relative reinforcement values be

directly compared, and if they cannot, why should we expect similar performances with human and nonhuman subjects?

The Present Study

The one feature common to human subject operant research is the report of intersubject response variability. This variability should be viewed as behavior to be explained, not as a characteristic of the subject (Sidman, 1960). The explanation will evolve from a more complete analysis of the multiple contingencies that operate in human operant experiments.

The present study attempted to address the following questions. Will superimposing the terms "Test Period" and "Practice Period" on multiple fixed interval fixed ratio (MULT:FI:FR) responding influence the response pattern independent of other programmed contingencies? Will subjects respond differentially during periods labelled "Practice Period" when experimenter access to performance information is likely as opposed to when access to performance information is not immediately likely and may be perceived to be impossible?

Chapter II

Method

Subjects

Six adults employed as service providers by a handicapped service organization were recruited. They volunteered in response to a poster asking for subjects to participate in the experiment (Appendix B). Each subject was asked to sign a form indicating his/her agreement to participate in twelve sessions and to maintain confidentiality about his/her performance during the experiment (Appendix C).

Apparatus

An Apple MacIntosh microcomputer was located on a small table in a windowless room measuring 2.6 X 3 meters. Each subject sat on a chair facing the computer keyboard and monitor. Subjects responded by pressing a designated keyboard key. A beep sounded when a schedule contingency was met. Under various conditions, the computer screen displayed stimuli correlated with schedules as well as "Practice" and "Test" conditions. In addition to the schedules and other experimental manipulations, the computer was programmed to produce a cummulative record of responding after each session.

Procedure

Subjects participated individually for twelve 42 minute sessions. Each subject was presented with the same sequence of experimental conditions. Table 1 illustrates the sequence of these conditions.

Immediately prior to the first experimental session, each individual subject was asked to read aloud some general instructions with the experimenter. Appendix D contains the general instructions presented to all subjects. These instructions were followed by the experimenter verbally giving the directions shown in Appendix E. Prior to all sessions, subjects were greeted and their watches and rings requested. They were then escorted into the experimental room, asked to sit, direct their attention to the monitor and proceed. Depending on the session and condition in effect, subjects were able to earn beeps exchangeable for three or six cents each. Subjects earned beeps by pressing the 'V' key on the keyboard. When schedule conditions were met, a 'beep' sounded.

Initially each subject was exposed to a FI:10 second session. This was followed by a FR:50 session. The instructions on the monitor were the same for these two sessions. Appendix F outlines these instructions.

Beeps were scheduled on a MULT FI:10 FR:50

TABLE 1 Sequence of Experimental Conditions

Session	Schedule	Purpose	Variable Manipulations
1	FI:10 sec.		
		To establish	Mult. components
2	FR:50	MULT: FI 10:	alternate every 3 minutes.
		FR 50	3 minutes.
3	MULT	responding.	Beeps earned exchanged
	FI:10		at 3 cents each.
4	FR:50		
5			"Test" and "Practice"
	MULT	To examine	labels introduced.
6	FI:10	the "labelling"	Labels alternate every
	FR:50	variable.	6 min. Beeps earned
7			exchanged for 3 cents each.
8			Test and Practice continue
		To examine the	as in sessions 5 through 7.
9		experimenter	Only responding in Test
	MULT	access to	earns beeps exchangeable
10	FI:10	performance	at 6 cents each. Practice
	FR:50	information	responding earns non-
11		variable.	exchangeable beeps. Total
			beeps earned are displayed
12			in every second
			Practice period.

during Sessions 3 and 4. The FI and FR components alternated every three minutes. As in the case of all multiple schedules, a stimulus displayed on the monitor accompanied each component - a triangle with the FI and a parallelogram with the FR. The instructions for these sessions are outlined in Appendix G.

Sessions 5 through 7 were programmed on the same schedule as Sessions 3 and 4. However, an additional variable was added. The terms "Test Period" and "Practice Period" occasionally appeared on the monitor. These designations alternated throughout the session every six minutes, beginning and ending in "Practice Period". Payment for beeps earned remained independent of the test and practice designations. Appendix H outlines the instructions for Sessions 5 through 7.

Sessions 8 through 12 had beeps programmed on the same schedule as Sessions 3 through 7. In additon, the test and practice designations were displayed as in Sessions 5 through 7. However, only beeps produced during the test condition were exchangeable for money. On the second and fourth period labelled "Practice Period" the number of beeps earned was displayed; on the first and third period, the number of beeps was not displayed. Appendix I contains the instructions utilized during Sessions 8 through 12.

Chapter III

Results

The data generated in the present study were characterized by intersubject response variability. However, analyzed individually, the data were much less variable between and within sessions. The following discussion addresses the data under the headings of (a) general observations and (b) performance of individual subjects.

General Observations

Button press responding occurred immediately following instructions with all subjects. The procedure of scheduling beeps initially on the FI:10 second schedule and following this session with exposure to the FR:50 session appeared to establish response rate differentiation between the FI and FR schedules. FI responding was at a lower rate in all cases relative to responding in the FR condition. This response rate differentiation was maintained in five of six cases during Session 3, the initial presentation of the multiple schedule. Subject 3 did not maintain component differentiated responding. During Session 4, Subject 3 was joined by Subject 1 in undifferentiated responding.

Subjects 2, 5 and 6 maintained differentiated responding. Subject 4 performed at a higher response rate in FR than in FI conditions. However, neither the FR nor the FI patterns were efficient. FR responding was at a rate which produced few beeps and FI responding occurred at a higher rate than necessary to attain beeps. In addition, long pauses in responding in both FR and FI conditions resulted in less frequent opportunities to earn beeps. These effects are evident in the response rate data illustrated in Table 2.

The "Test Period" and "Practice Period" designations were introduced during Sessions 5, 6 and 7. This labelling of the contingency did not produce systematic response pattern changes in all subjects. Subjects continued to respond in these sessions in much the same manner as they did in Session 4. Intersubject variability was evident. Subjects 1 and 3 responded at a high rate in all conditions. Subject 4 responded at a very low rate in all conditions and Subjects 2, 5 and 6 responded at high rates in FR conditions and at much lower rates in FI conditions. These data appear in Table 3.

Response rate data for Sessions 8 through 12 are displayed in two tables. Data on FI conditions are presented in Table 4 and FR data are shown in Table 5.

TABLE 2

The Average Number of Responses Per Minute over Sessions 1 through 4

	Subject					
	1	2	3	4	5	6
Session 1						
FI:10 sec.	26	96	42	8	9	25
Session 2						
FR:50	257	318	343	65	240	312
Session 3						
MULT:						
FI:10 sec.	19	118	352	12	29	14
FR:50	97	358	361	19	276	369
Session 4						
MULT:						
FI:10 sec.	322	102	386	33	36	9
FR:50	321	398	367	77	312	356

TABLE 3

The Average Number of Responses Per Minute over Sessions 5 through 7 in FI:10 sec. and FR:50 -- Components labelled Test and Practice

	Subject					
	1	2	3	4	56	
Session 5						
FI:10 Practice	279	109	360	74*	80	13
FI:10 Test	317	95	369	---	47	9
FR:50 Practice	304	376	309	111*	330	377
FR:50 Test	265	384	344	---	285	404
Session 6						
FI:10 Practice	370	109	363	18	63	9
FI:10 Test	350	97	374	23	44	9
FR:50 Practice	338	404	362	62	265	405
FR:50 Test	302	408	377	59	272	384
Session 7						
FI:10 Practice	297	100	353	20	75	14
FI:10 Test	358	88	396	20	44	10
FR:50 Practice	356	409	397	50	298	342
FR:50 Test	314	411	350	48	265	326

*Repeat of Session 4 - Components were not labelled.

The experimental procedure of making experimenter access to performance information likely in some practice periods and not in others did not systematically alter responding with all subjects. Again intersubject response variability was evident. Subjects responded in the same general pattern as before during periods labelled "Test Period". In the extinction conditions (periods with the "Practice Period" designation) responding varied from virtually no responding (Subject 2) to high rate responding throughout all sessions (Subject 6).

Performance of Individual Subjects

Subject 1

Subject 1 responded at a low efficient rate during Session 1; efficient in that few responses are required to meet the FI:10 second schedule condition to earn the maximum number of beeps. Responding during Session 2 was at a relatively high rate which served to meet the FR:50 condition effectively (under FR conditions, the higher the rate, the more beeps produced). Responding during Session 3 FI conditions continued at a low efficient rate. Responding under the FR component in Session 3 was at a lower rate than Session 2 while still being at a higher rate than FI

TABLE 4

The Average Number of Responses Per Minute over Sessions 8 through 12 in FI:10 sec. Conditions labelled Practice (without display), Test, and Practice Displayed (number of beeps earned displayed)

	Subject					
	1	2	3	4	5	6
SESSION 8						
Practice	170	16	351	53	13	11
Test	348	112	394	49	32	16
Practice - Display	201	8	394	29	24	10
SESSION 9						
Practice	252	7	329	17	1	9
Test	270	115	374	53	43	12
Practice - Display	264	8	368	39	15	11
SESSION 10						
Practice	167	5	253	14	1	9
Test	247	114	359	28	83	9
Practice - Display	251	8	86	0	46	11
SESSION 11						
Practice	215	10	156	29	2	16
Test	254	119	353	39	93	11
Practice - Display	194	7	187	0	213	16
SESSION 12						
Practice	155	3	165	13	1	8
Test	279	136	393	20	287	11
Practice - Display	274	8	34	4	5	13

TABLE 5

The Average Number of Responses Per Minute over Sessions 8 through 12 in FR:50. Conditions labelled Practice (without display), Test, and Practice Displayed (number of beeps earned displayed)

	Subject					
	1	2	3	4	5	6
SESSION 8						
Practice	218	0	363	49	42	301
Test	354	429	385	39	339	343
Practice - Display	205	0	360	35	316	283
SESSION 9						
Practice	228	0	339	73	70	311
Test	263	434	373	19	323	310
Practice - Display	179	9	351	19	136	334
SESSION 10						
Practice	212	0	271	6	0	309
Test	262	435	332	17	204	336
Practice - Display	263	62	119	3	183	264
SESSION 11						
Practice	198	0	272	7	0	350
Test	248	438	324	31	332	365
Practice - Display	212	0	77	4	27	353
SESSION 12						
Practice	179	0	124	9	0	300
Test	275	421	379	23	339	357
Practice - Display	282	1	52	1	45	318

responding. The FI pattern produced beeps at roughly 3 times the FR condition rate. Beginning immediately in Session 4, responding in the FI condition occurred at a high rate - a change from approximately 20 to 320 responses per minute. Responding in the FR condition also increased in frequency. The high FI and FR responding both produced a near maximum number of beeps. In the case of the FI condition, the pattern was effective but inefficient in that few responses are necessary to meet the programmed contingency. This same general pattern subsequently occurred throughout Sessions 5 through 12. Figure 1 illustrates FI:10 second responding during Sessions 1 through 12. Figure 2 shows FR:50 responding during Sessions 1 through 12.

Responding in the FI condition during Sessions 5 through 7 appears less variable in periods labelled "Test Period" (T) than does responding in periods labelled "Practice Period" (P). Figure 3 illustrates this pattern. Responding was higher during "Test" than "Practice" in the majority of three minute intervals.

Responding during Sessions 8 through 12 occurred, in general, at a higher rate in the FR component during periods labelled "Practice Period" when performance data was displayed (D) than when it was not (P). Figure 4 illustrates D and P responding in FR

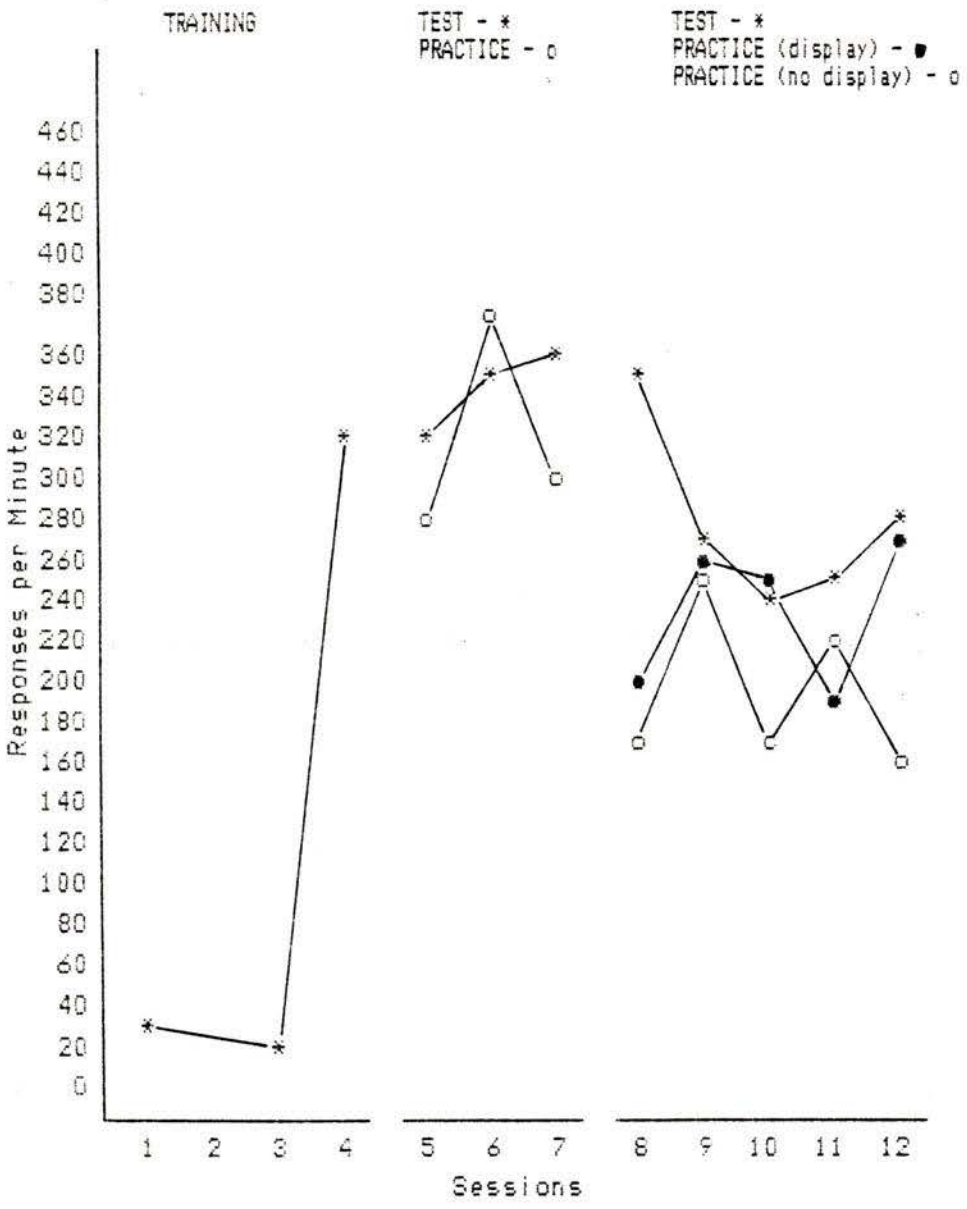

FIGURE 1

Responding by Subject 1 in FI:10 second conditions over Sessions 1 through 12

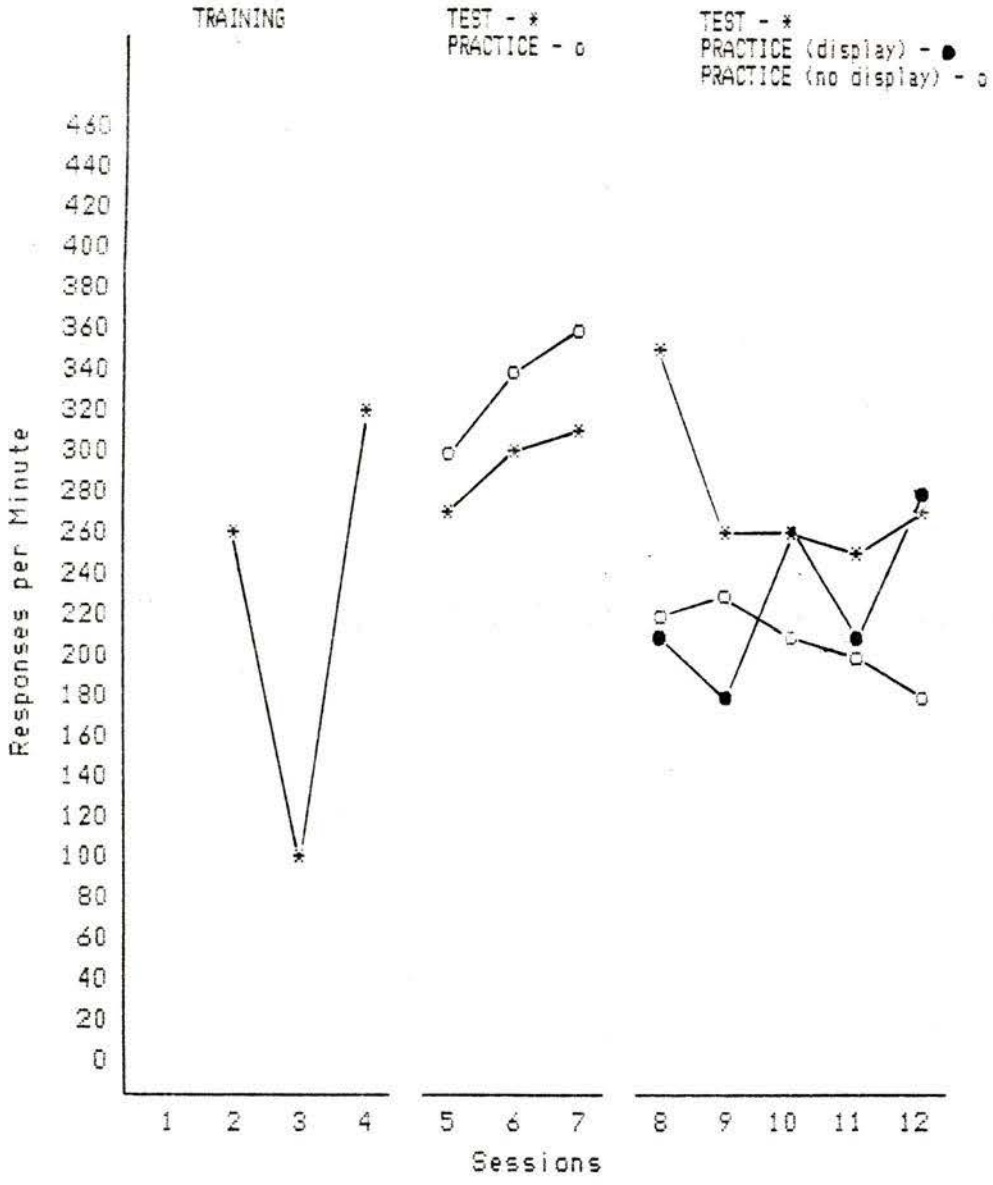

FIGURE 2

Responding by Subject 1 in FR:50 conditions over Sessions 1 through 12

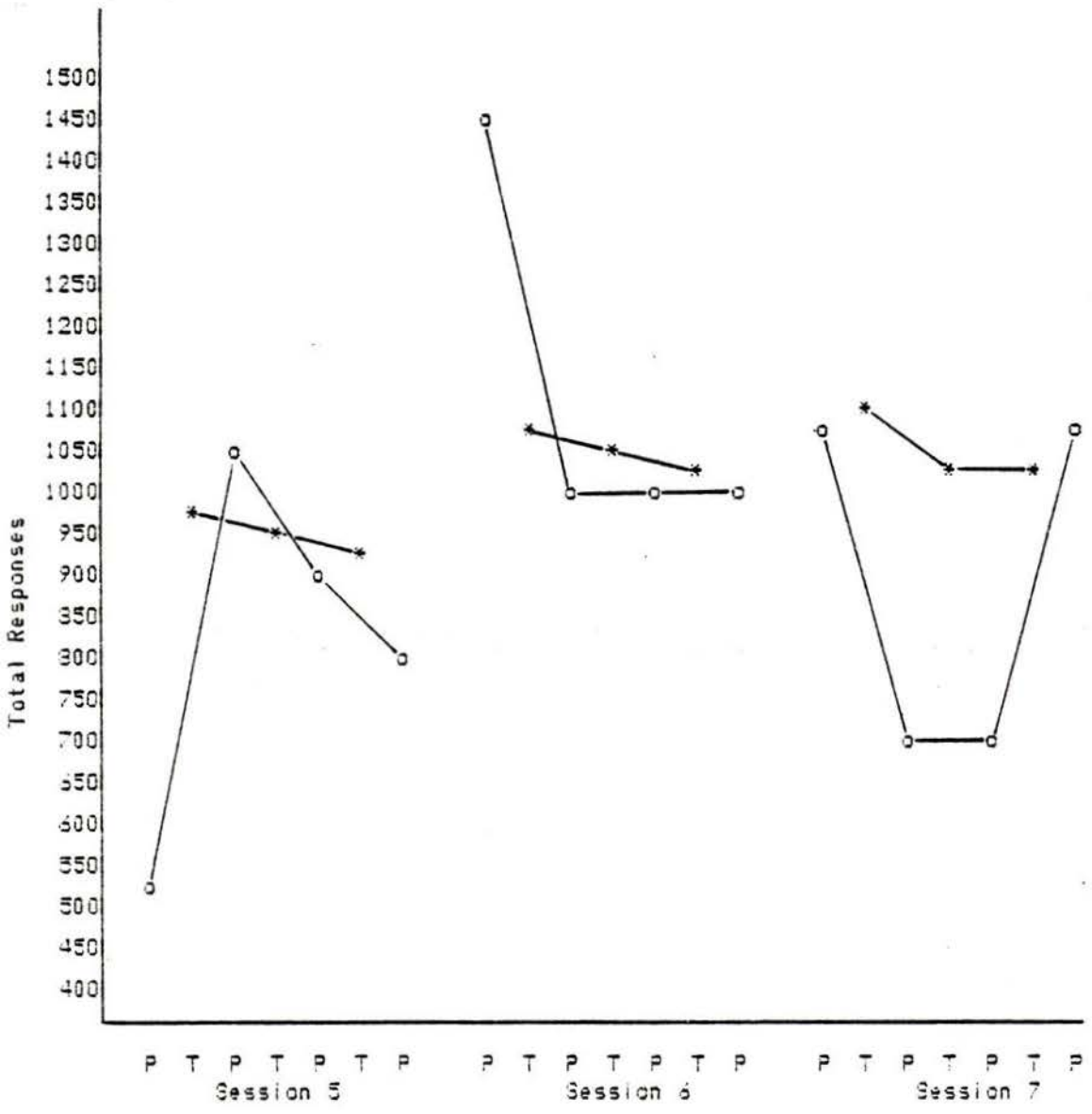

FIGURE 3

FI:10 second responding by Subject 1 in alternating 3 minute conditions labeled Test (T) and Practice (P)

conditions during Sessions 8 through 12.

Subject 2

This subject maintained schedule differentiated responding during Sessions 1 through 7 and during the test conditions of Sessions 8 through 12. Responding in the FR component was at a consistant high rate. Responding in the FI component was of a break and run pattern. In the break and run pattern, responding occurs after a pause and continues at a relatively high and steady rate until reinforcement. These data are recorded in Figure 5 (FI:10 second) and Figure 6 (FR:50).

The formal experimental variable manipulations did not produce any systematic response pattern variations. Neither labelling conditions as "Test Period" or "Practice Period", nor providing differential practice period feedback disrupted the steady state responding. However, the condition introduced in Session 8, of no payment for beeps earned, had an immediate effect. Responding in periods labelled practice virtually ceased. Responding that did occur in practice was frequently an "overrun" -- a response burst not terminating as conditions shifted from FR test to FI practice conditions. While responding was sensitive to

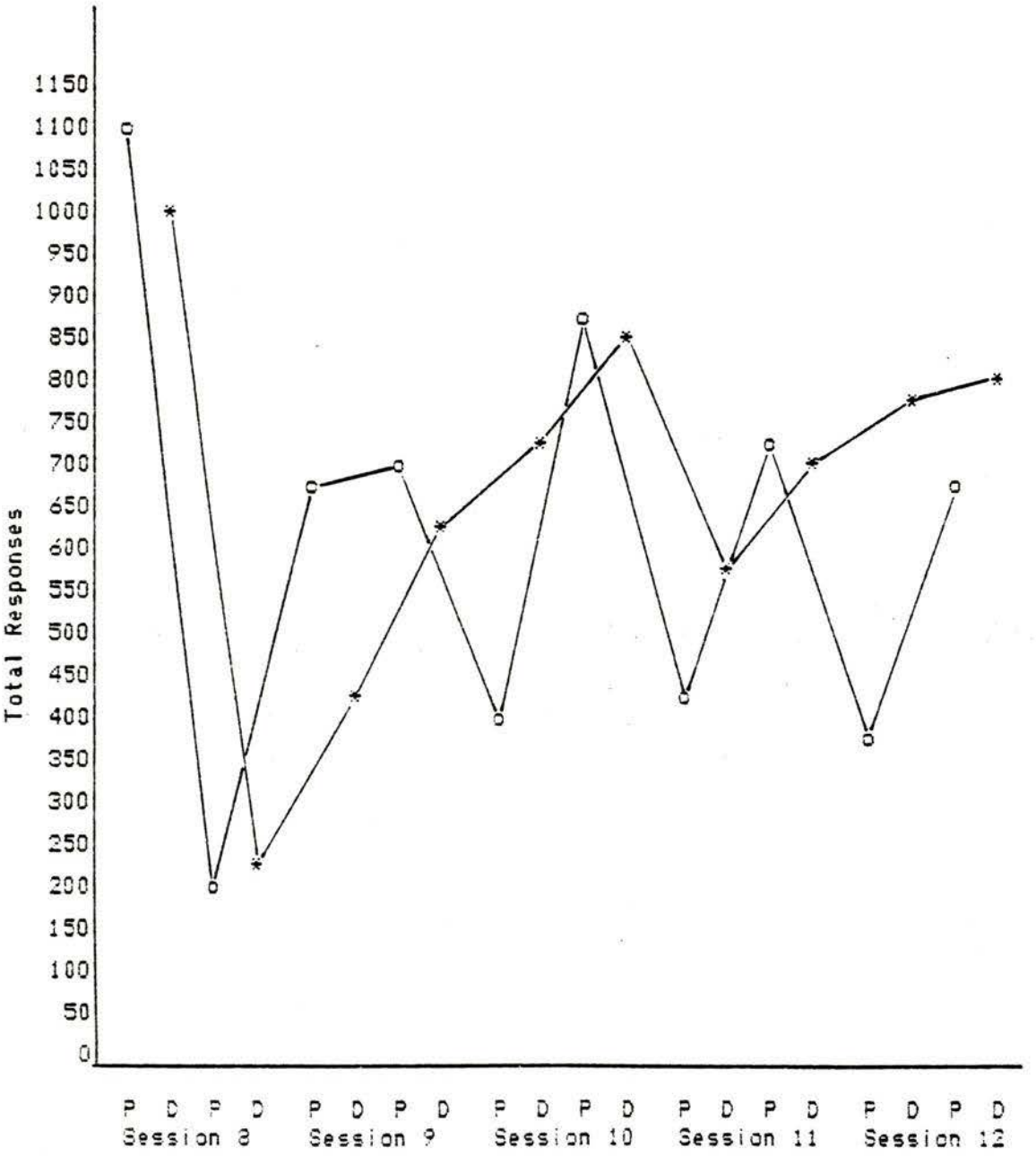

FIGURE 4

FR:50 responding by Subject 1 in alternating 3 minute Practice (P) and Practice with Display (D) conditions

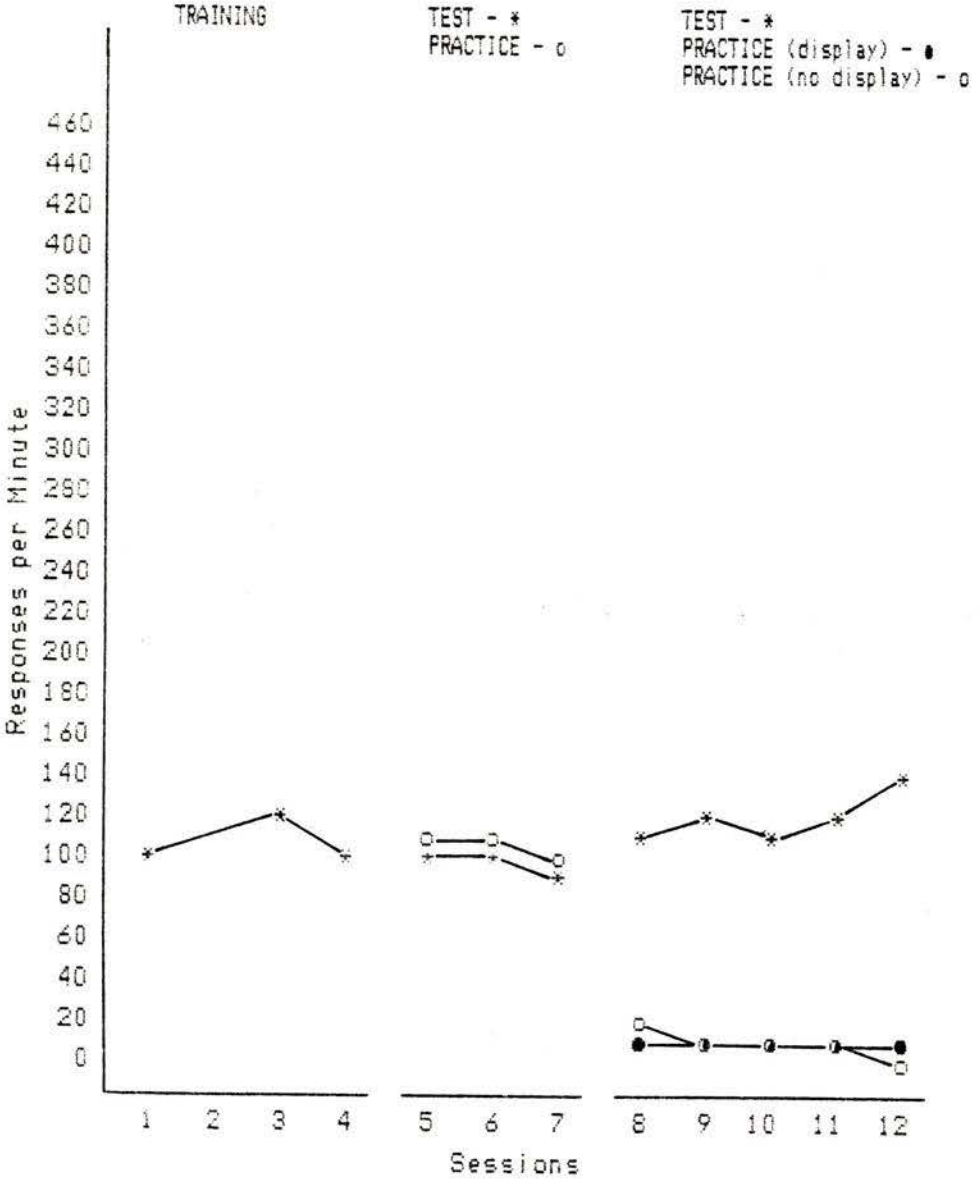

FIGURE 5

Responding by Subject 2 in FI:10 second conditions over Sessions 1 through 12

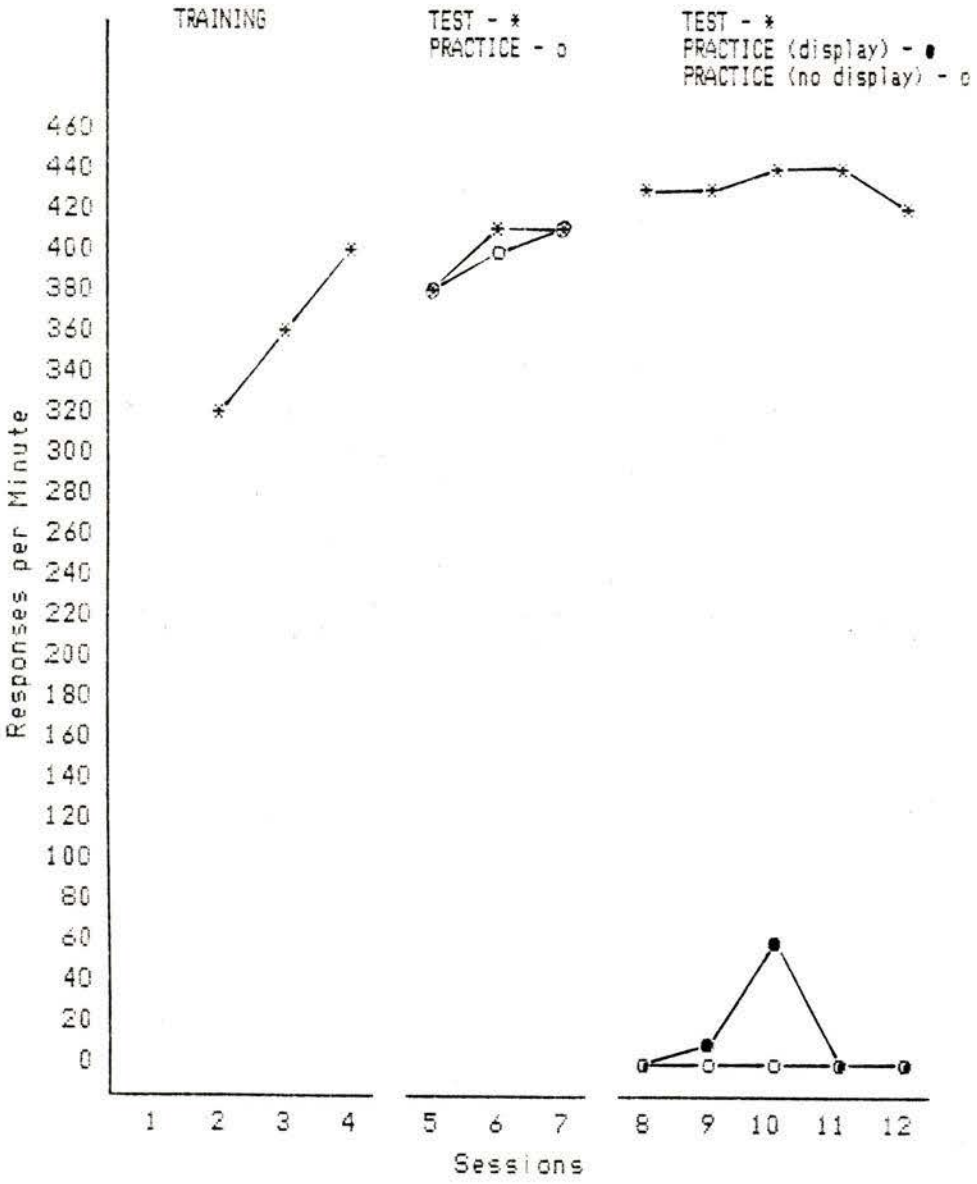

FIGURE 6

Responding by Subject 2 in FR:50 conditions over Sessions 1 through 12

this change in contingencies, the reason was not extinction. Responding stopped immediately while extinction is characterized by more erratic, possibly higher rate initial responding, followed by gradually decreasing response rates.

Subject 2 displayed some unique response characteristics. The break and run pattern that occurred in the FI conditions was unusual in that the break did not occur immediately upon the occurence of a beep. The pause began characteristically several responses after the beep. In the FI conditions, the initial response pattern always was high rate responding. Typically the subject received one to three beeps while responding at a high rate prior to beginning the break and run pattern. Figure 7 illustrates both patterns.

Subject 3

The response pattern evident in Session 1 belied the FI pattern to come in subsequent sessions. After some initial high rate responding, Session 1 responding was characterized by pausing followed by 4 or 5 slow responses until reinforcement. Session 2 responding quickly became high rate and steady throughout the session. However, multiple schedule component

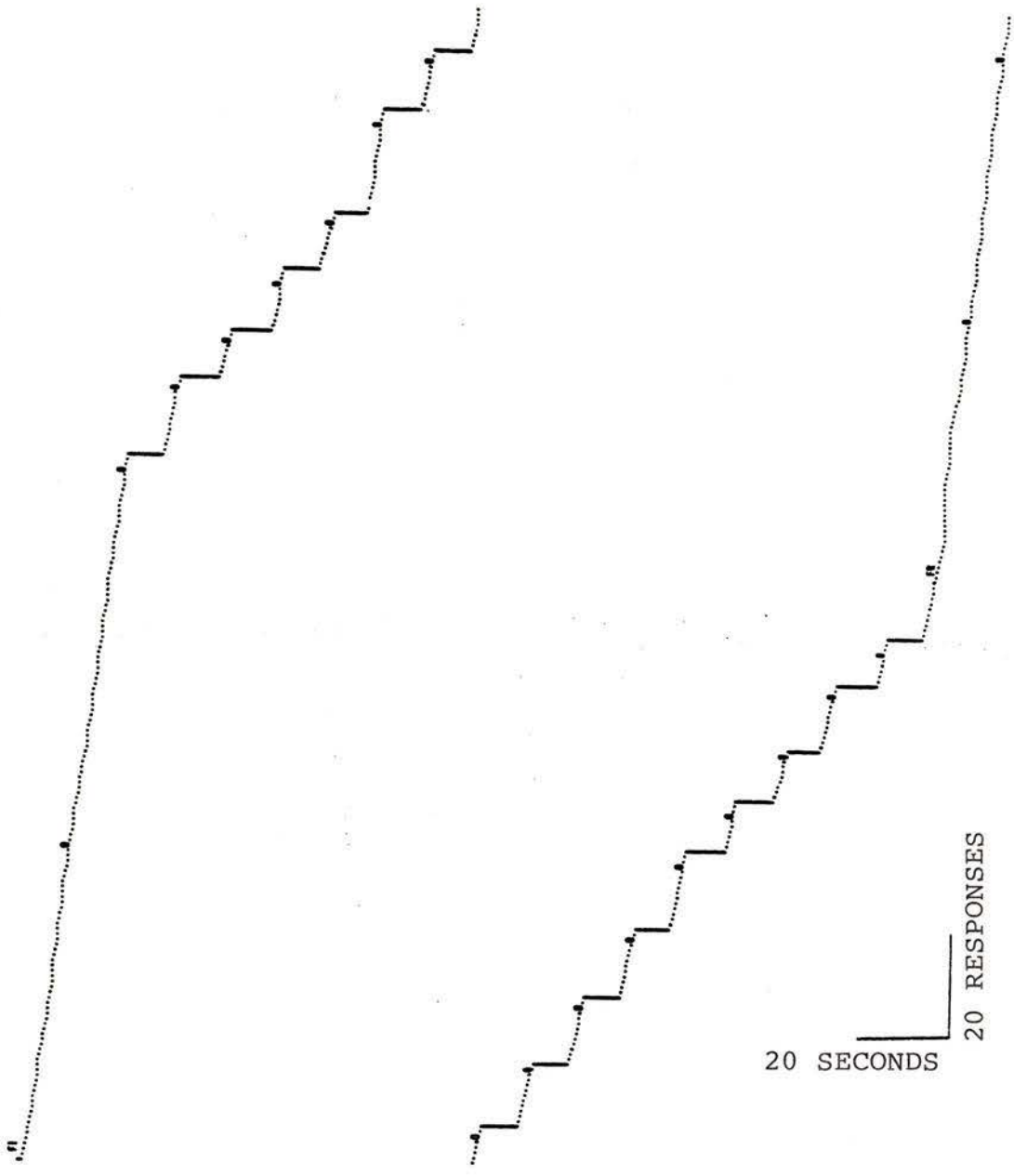

FIGURE 7

Representative cumulative records of Subject 2 illustrating a characteristic initial period of high rate FI responding followed by a break and run pattern in FI:10 second conditions
The "o" indicates the occurrence of a beep.

differentiation did not take place during any subsequent session; responding occurred at a high rate in all conditions. Figure 8 (FI:10 second) and Figure 9 (FR:50) illustrate these data.

The experimental manipulations of superimposing the terms "Test Period" and "Practice Period" produced no noticeable systematic response pattern changes for Subject 3. In addition, providing differential feedback in some conditions labelled "Practice Period" during Sessions 8 through 12 resulted in no noticeable performance differences during practice periods. The subject responded consistantly at a high rate during all test conditions.

Responding during Sessions 8 and 9 practice periods occurred at a very high rate (330-400 resp./min.), suggesting an insensitivity to the condition of no payment for beeps earned. This high rate pattern occurred during the initial period labelled "Practice Period" of all remaining sessions. However, beginning in Session 10 and extending through Sessions 11 and 12, responding in other periods labelled "Practice Period" within the sessions decreased in frequency. The reduced responding which occurred during Sessions 10, 11 and 12 suggests a within session sensitivity to changing experimental parameters. Figure

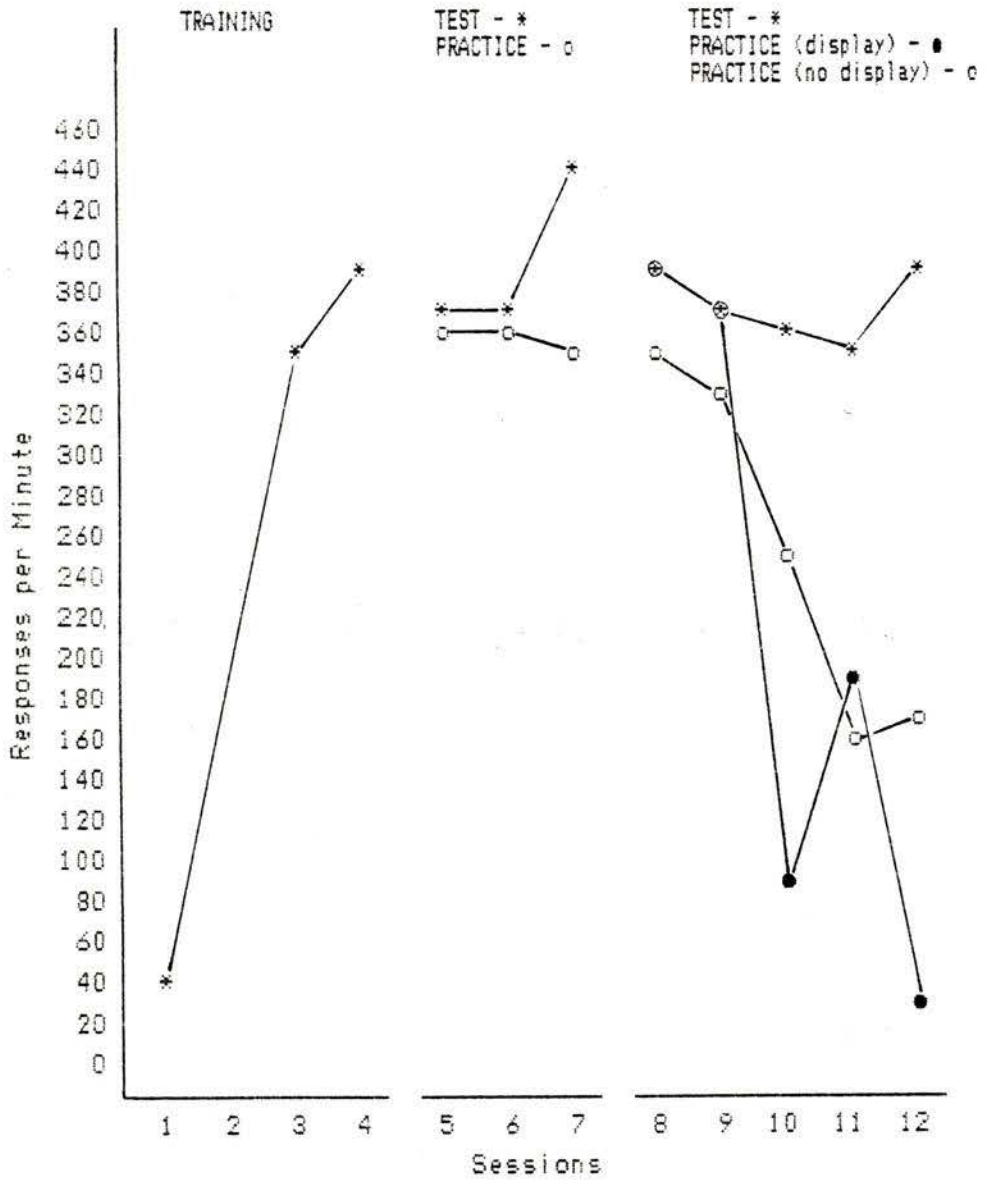

FIGURE 8

Responding by Subject 3 in FI:10 second conditions over Sessions 1 through 12

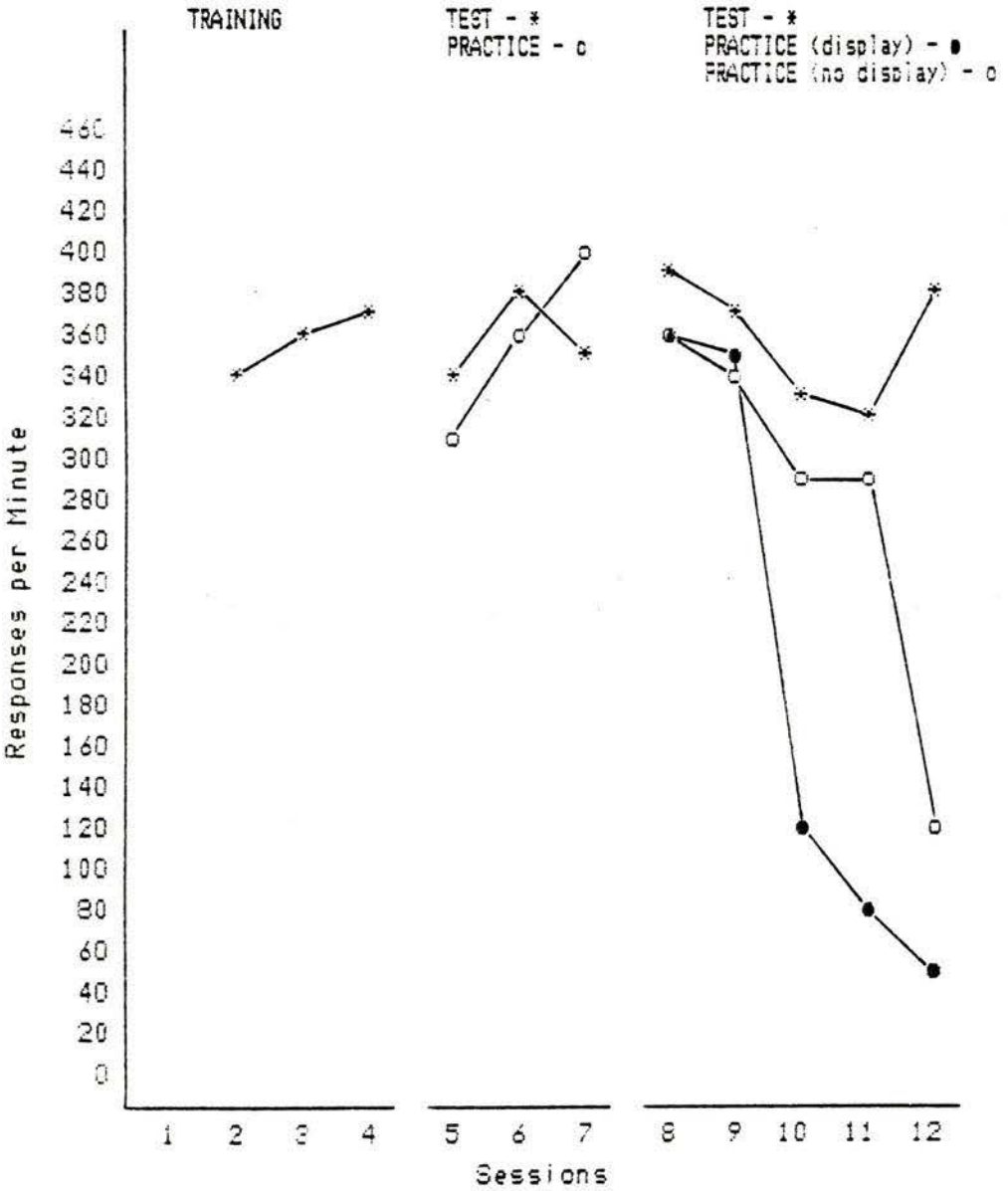

FIGURE 9

Responding by Subject 3 in FR:50 conditions over Sessions 1 through 12

10 illustrates this effect.

Subject 4

This subject did not come under effective schedule control at any time throughout the experiment. Responding in FI conditions did not follow any discernable pattern. Responding in FR conditions was typically of a higher frequency than FI condition responding. However FR condition responding was never at a high enough rate to efficiently engage the "beep" stimulus.

In an effort to increase FR responding prior to manipulating the formal experimental variables, Session 5 was conducted as an additional training session. Overall response rate per minute in FI/FR components increased from 11.5/18.9 in Session 3, to 33.2/77.4 in Session 4, and to 74.4/110.7 in Session 5. This trend of increased FR responding was not maintained. Session 6 saw a major decrease in overall response rates in all conditions. Figure 11 (FI:10 second) and Figure 12 (FR:50) illustrate responding during Sessions 1 through 12.

The manipulation of the formal experimental variables did not result in any discernable differences in responding. The condition of no payment for beeps

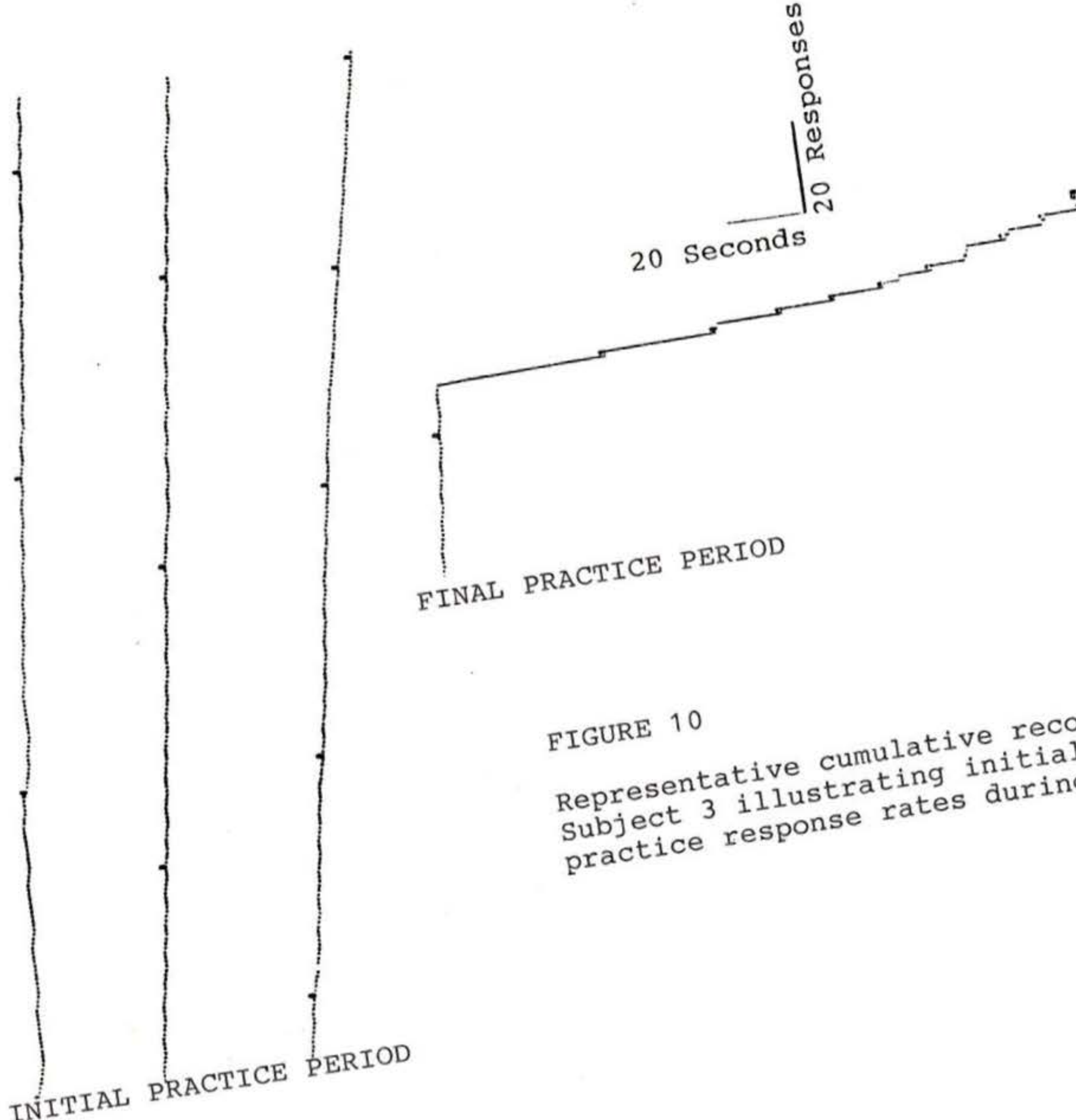

FIGURE 10

Representative cumulative records of Subject 3 illustrating initial and final practice response rates during Session 12

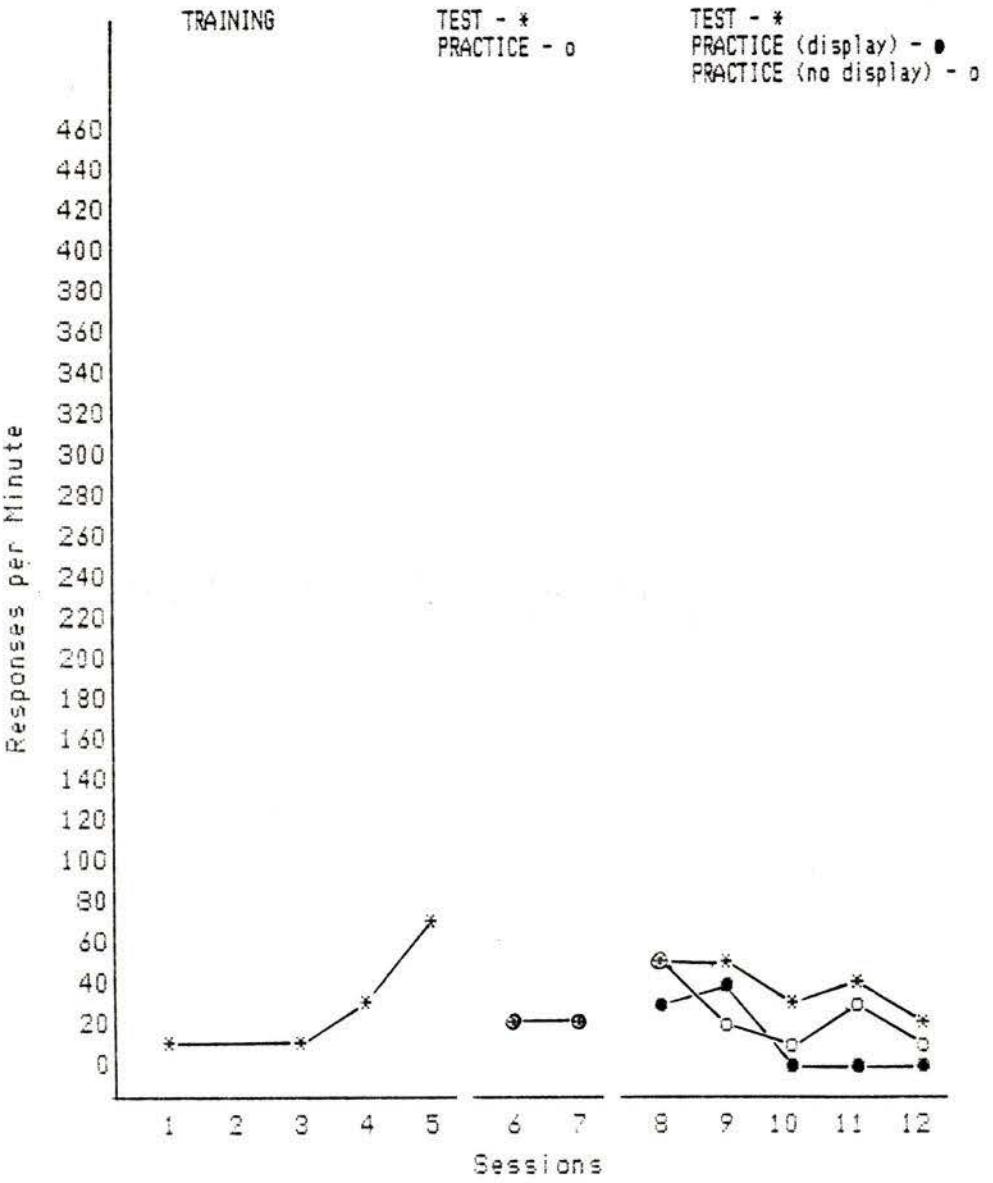

FIGURE 11

Responding by Subject 4 in FI:10 second conditions over Sessions 1 through 12

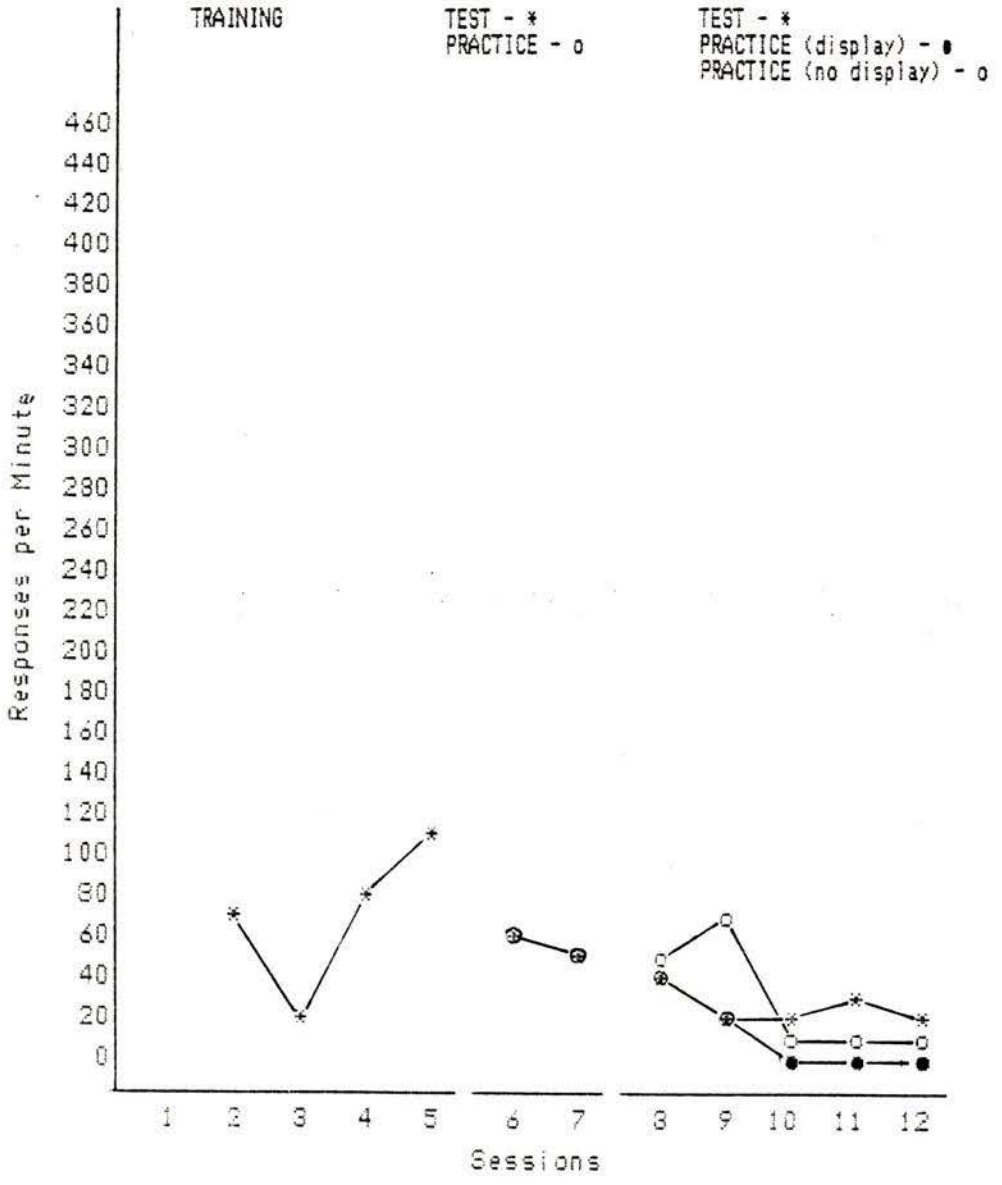

FIGURE 12

Responding by Subject 4 in FR:50 conditions over Sessions 1 through 12

earned, beginning in Session 8, did not produce an immediate change. However, during Session 10, responding in practice conditions decreased. For example, response rates in FR conditions changed from approximately 45 to 5 responses per minute.

Responding in conditions labelled "Test Period" during Sessions 8 through 12 was maintained in the FI condition but decreased during the FR component. The subject's history of FR responding had never been rich in earned "beeps". For example, during Sessions 6 and 7, FI condition responding earned approximately 2.5 times the beeps earned in FR conditions, yet FR responding occurred at a higher rate than FI responding. Decreased FR responding in test conditions may represent extinction for this condition.

Subject 5

Low rate FI responding and high rate FR responding are generally representative of this subject's performance. The efficient pattern in FI conditions which occurred in Session 1 changed to a break and run pattern during the FI portions of Sessions 3 through 11. Figure 13 illustrates FI:10 second responding and Figure 14 illustrates FR:50 responding over Sessions 1 through 12.

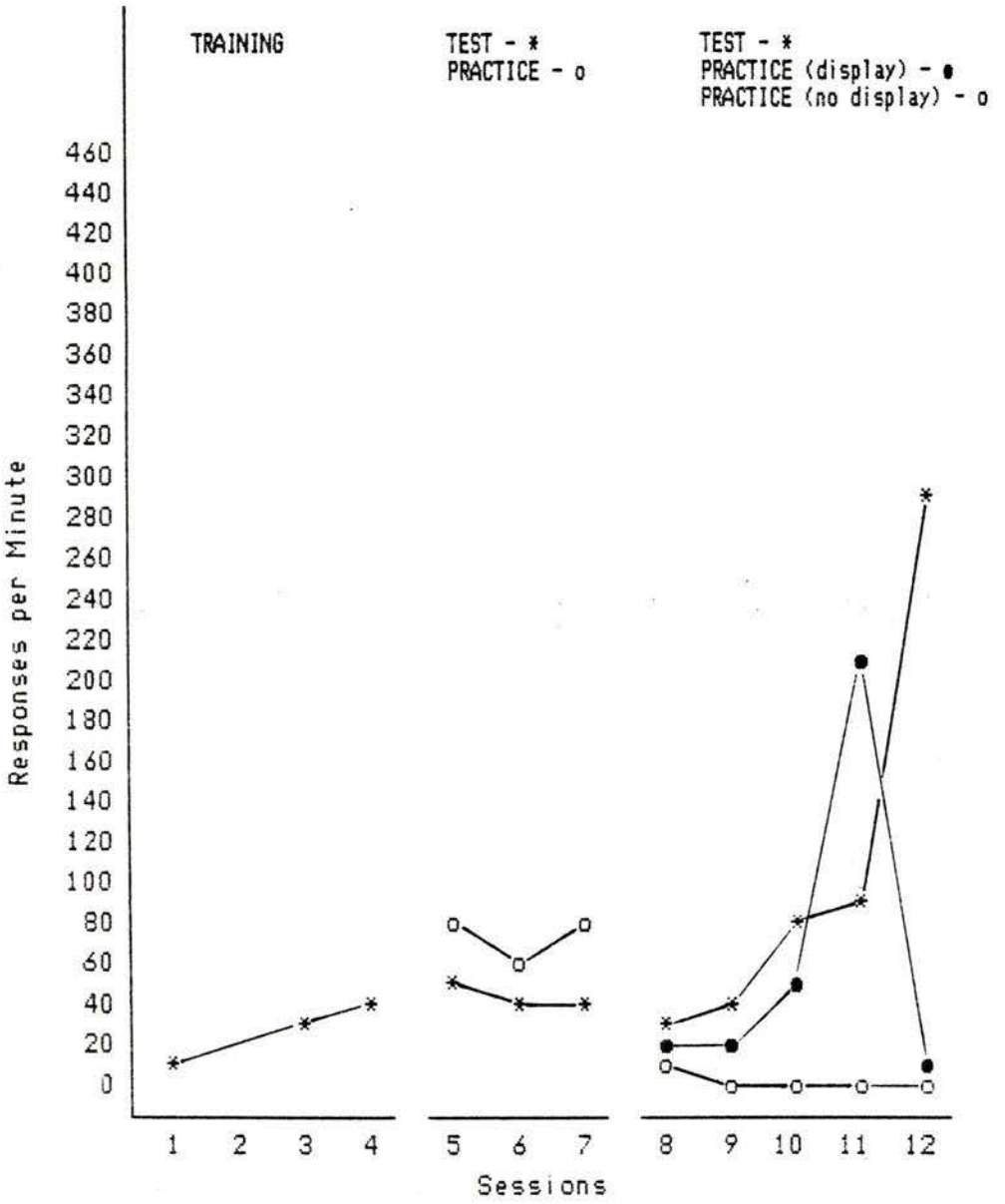

FIGURE 13

Responding by Subject 5 in FI:10 second conditions over Sessions 1 through 12

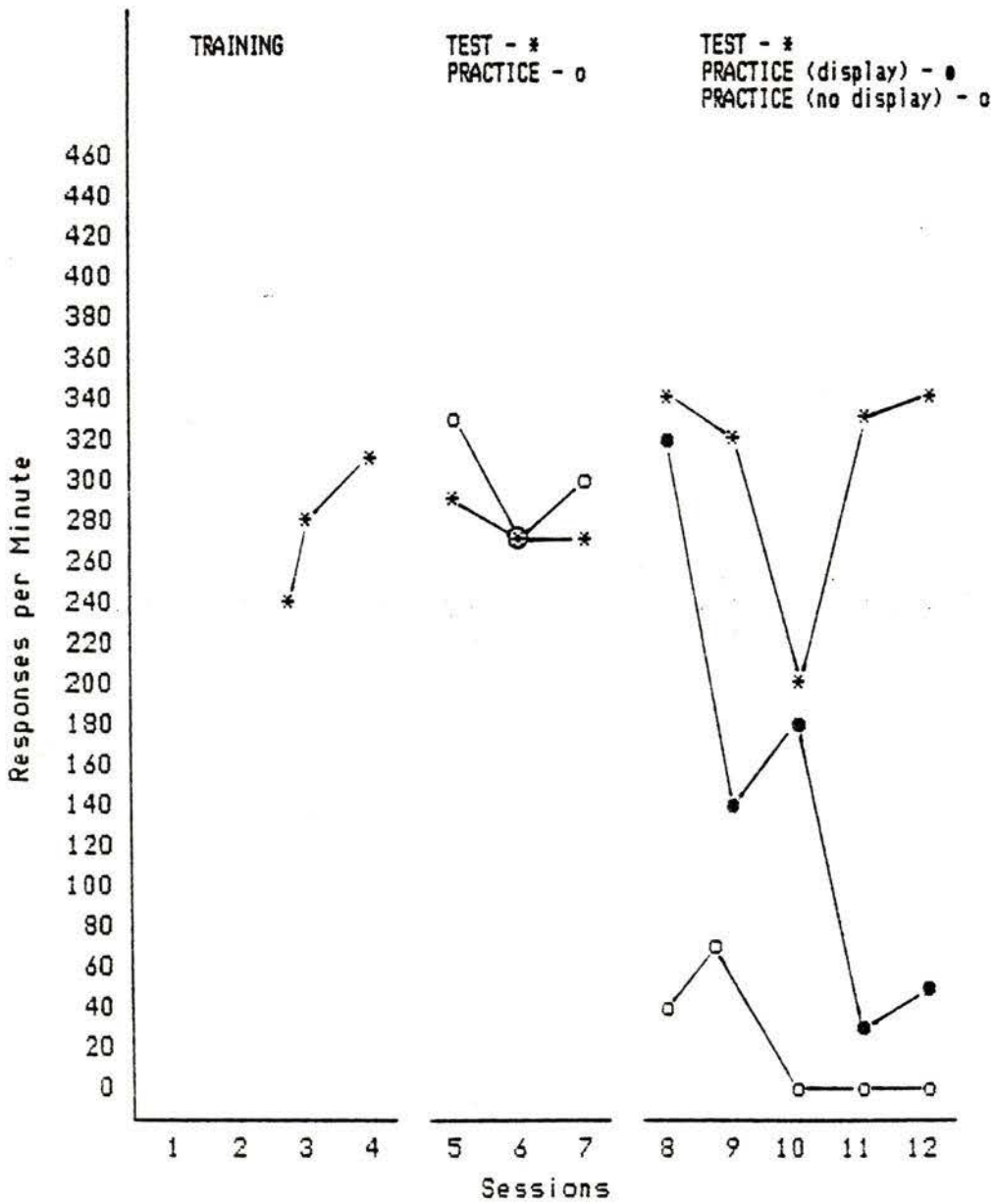

FIGURE 14

Responding by Subject 5 in FR:50 conditions over Sessions 1 through 12

Responding during conditions labelled "Test Period" appears consistently at a lower less variable rate than does responding in conditions labelled "Practice Period". Figure 15 illustrates these response patterns.

During Sessions 8 through 12, in practice with display (D) conditions, the subject consistantly responded at a higher rate than in practice with no display (P) conditions. Figure 16 illustrates responding in FR component practice conditions.

The FI response pattern is interesting. The rate of response in FI test conditions during Sessions 8 through 12 increased over all sessions. The break and run pattern was clearly evident in FI conditions throughout these sessions. However, the length of the pause became progressively shorter. In Session 12, the break and run pattern changed to that of high rate consistant responding. Figure 17 illustrates the shortening break period from Session 8 and Session 10 and the loss of programmed schedule control in Session 12.

Subject 6

Throughout the experiment, Subject 6 responded in FR conditions at a high rate and FI conditions at a

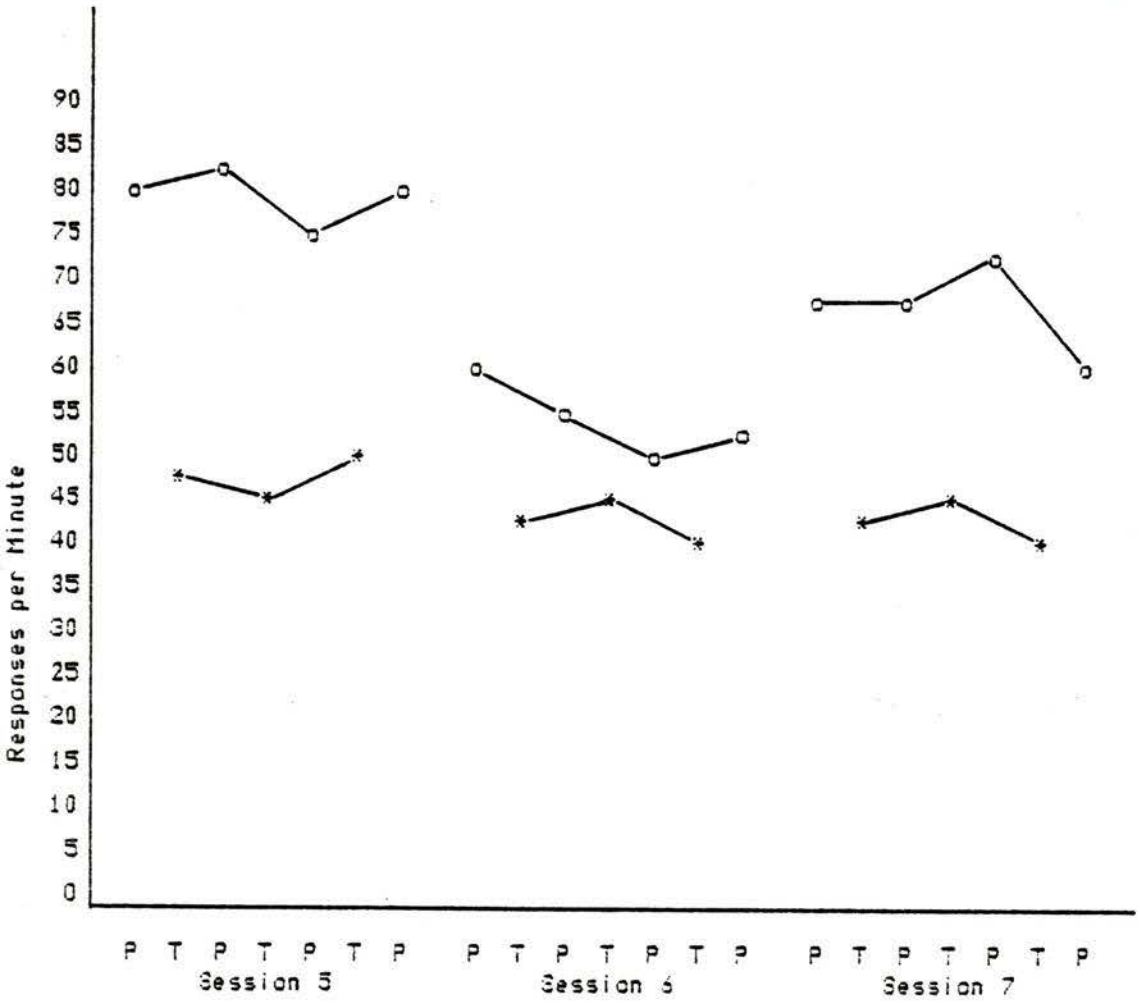

FIGURE 15

Responding by Subject 5 on FI:10 second under alternating conditions of labelling periods Practice (P) or Test (T)

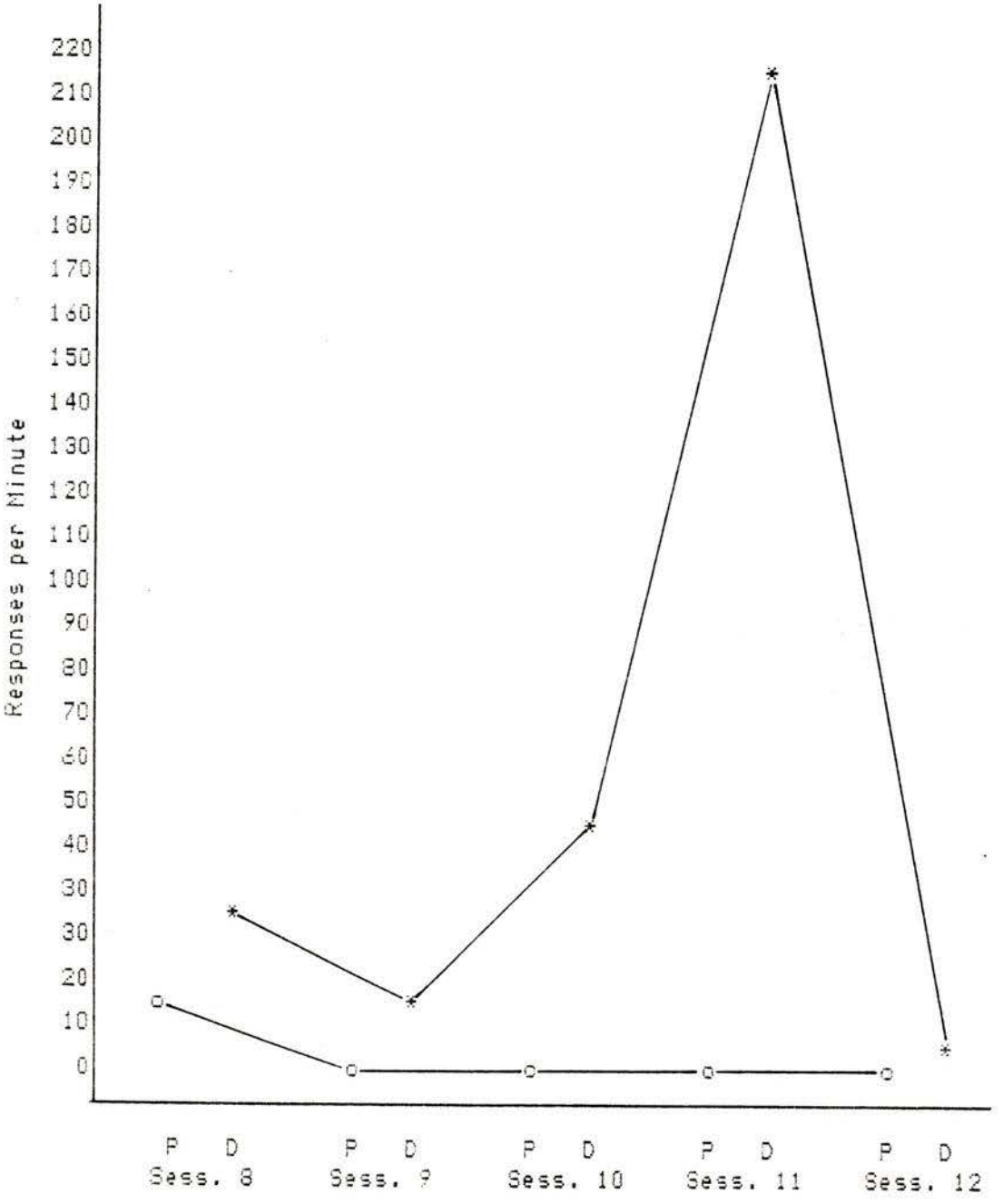

FIGURE 16

Responding by Subject 5 on FR:50 Practice (P) and Practice with Display (D) conditions

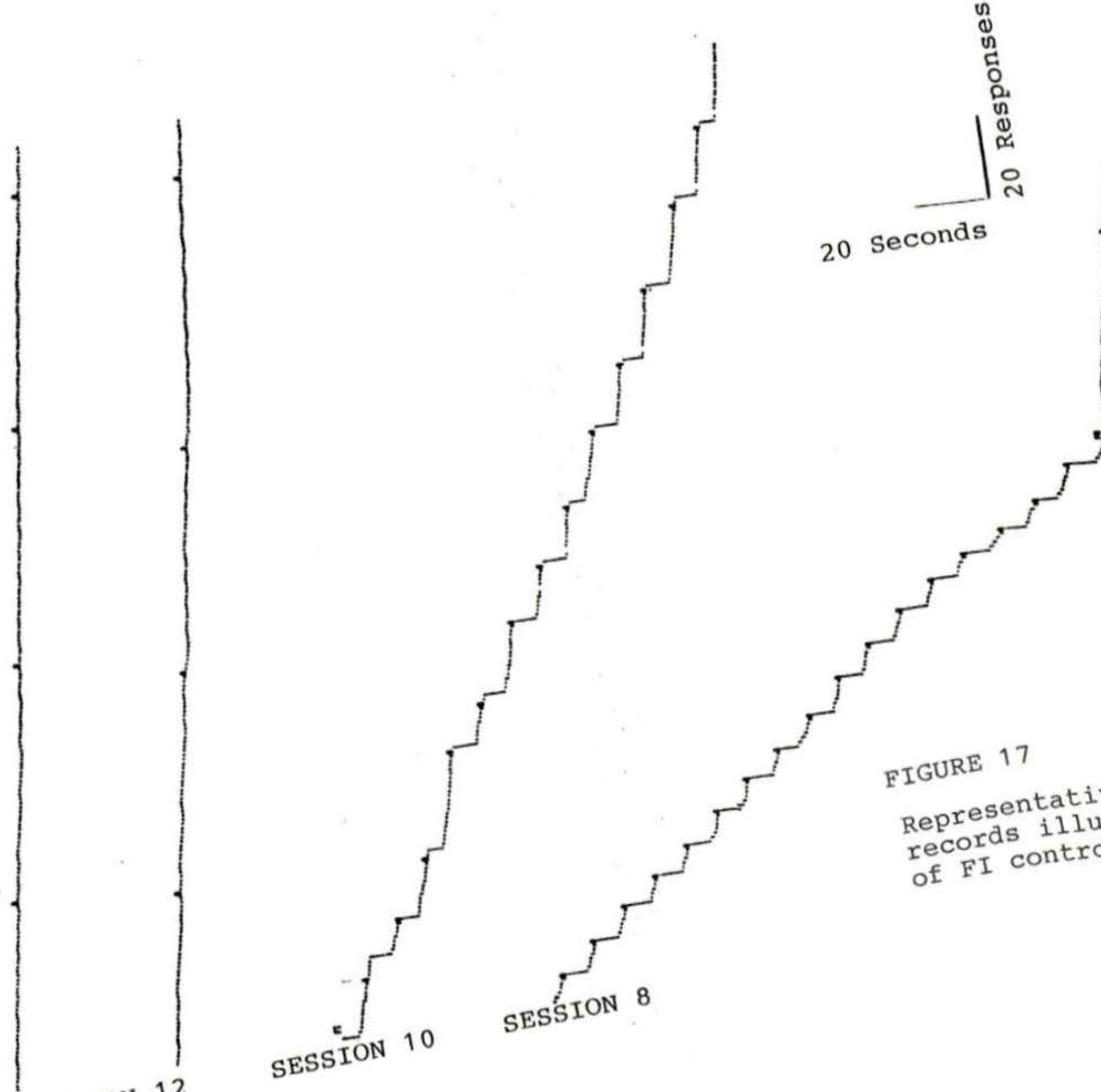

FIGURE 17

Representative cumulative records illustrating loss of FI control by Subject 5

low and efficient rate. Figure 18 (FI:10 second) and Figure 19 (FR:50) illustrate this effect.

Manipulating the formal experimental variables did not result in any systematic response pattern changes. Responding in both FI and FR conditions remained stable despite experimental condition changes. These changes include the condition of no payment for beeps earned in practice without display (P) and practice with display (D) of Sessions 8 through 12. Responding was sensitive relative to the alternating schedule conditions but insensitive to the "no payment" condition. Response rates of 300+/min. in "no payment" conditions suggest that the responding is being maintained by conditions other than beeps exchangeable for money.

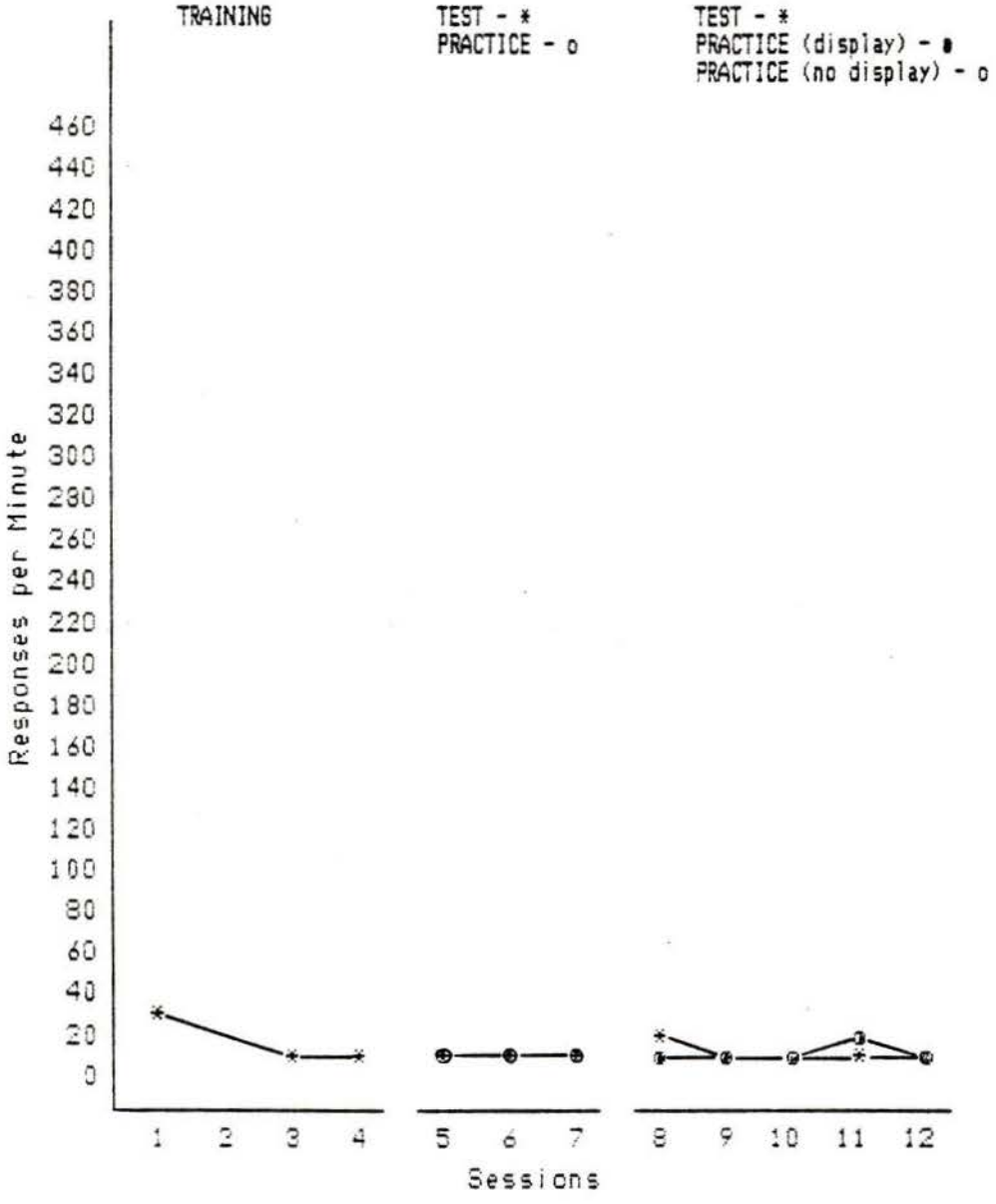

FIGURE 18

Responding by Subject 6 in FI:10 second conditions over Sessions 1 through 12

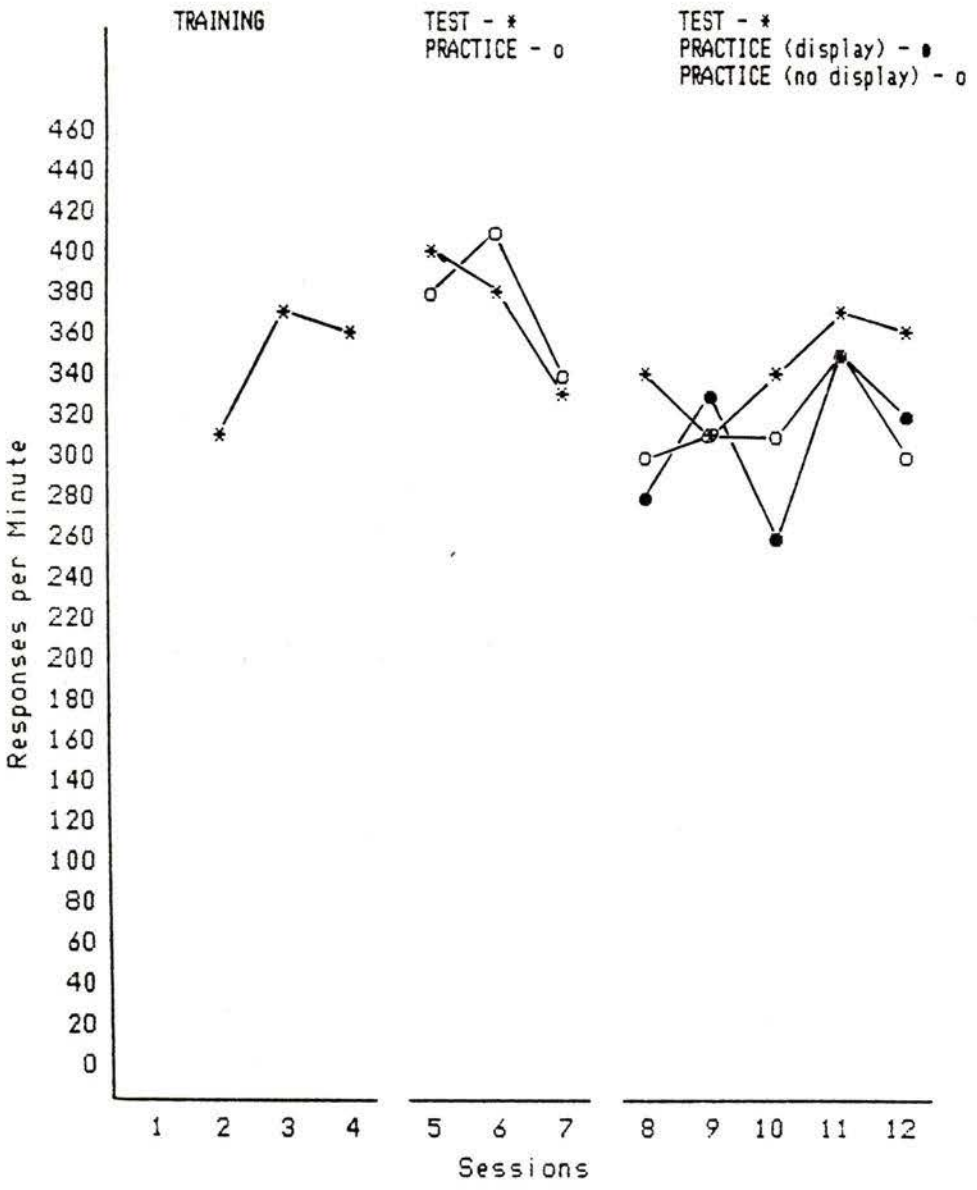

FIGURE 19

Responding by Subject 6 in FR:50 conditions over Sessions 1 through 12

Chapter IV

Discussion

The purpose of this study was to examine human operant laboratory performance on schedules of reinforcement and the possible effects of several variables, current and historical. The experimental manipulations in the current study were (1) labelling portions of MULT FI:10 FR:50 schedule responding as "Test Period" or "Practice Period", and (2) displaying performance data during some Practice Periods which allowed experimenter access to performance information. These manipulations did not produce systematic response pattern changes. The common human subject research feature of intersubject response variability (Galizio, 1983) was evident in the current data. However, intrasubject response variability was low. Viewed individually, the patterns of responding were relatively stable within and between sessions. When changes occurred in responding, they did so in a seemingly systematic fashion. This observation is addressed later in this chapter under the heading of "Response Patterns".

In more general terms, the data generated by the present research are meaningful in that they were

obtained systematically in a manner consistant with standard practices. Sidman (1960) argued for the separation of data from the reasons for its investigation. Reasons for investigations change as the current trends and fashions of scientific interest change. What remains are data and the data are valuable irrespective of the reasons for its investigation. The present data warrant a more detailed discussion in regard to the following two issues; (1) the experimental procedures utilized, and (2) the response patterns generated.

Standard Human Operant Experimental Procedures

Most human operant studies are programmed so that subjects respond on one key to meet program contingencies and then press an additional key to deliver the point. One reason for this sequence is to provide an additional response, pressing the second key, which is meant to be analogous to the consumatory response in nonhuman operant studies (Galizio, 1985). Typically, after hearing the 'beep' produced by meeting the schedule contingency, the human subject presses a key resulting in a number being added to a counter. The analogy, for example, to rat research is that the button is the equivalent to a lever, a "beep" equivalent

to the sound of the food mechanism firing and pressing another key the procedural equivalent of eating a food pellet.

The present study varied from this standard procedure in not requiring the additional response. The "beep" sounded when programmed contingencies were met, but the total number of points earned was presented at the end of the session without any additional response being required. This procedure resulted in schedule performance patterns not unlike those generated with the standard procedure. The logic for using the current technique was as follows. Points earned in human operant studies could be regarded as conditioned reinforcers in that they are exchangeable for money. Associating the beeps with the points directly as the typical paradigm requires could, because of repeated pairings, produce a strong current conditioned reinforcer. Simply presenting the number of points earned at the end of the session should be procedurally weaker in developing a conditioned reinforcer. Subsequently, the procedure of providing experimenter access to performance information in some practice periods during Sessions 8 through 12 would be less likely to introduce a conditioned reinforcer variable.

Performance differences which may have been

produced by these procedural differences were not evident in the present data. This suggests that the unanalyzed use of procedures in human subject research, which in form approximate nonhuman subject research procedures, is unwarranted and could be dangerous. It is potentially dangerous because it tends to support the assumption that procedures are sufficiently alike in function to permit precise comparisons between subjects of different species. Concentrating on formal as opposed to functional similarities could also serve to divert attention from other experimental procedural differences such as the relative state of subject deprivation.

Fixed Interval Response Patterns

A generally accepted finding in the literature is that humans respond on FI schedules with either of two characteristic patterns (Weiner 1969). One pattern is of consistant high rate responding without post reinforcement pausing; the other pattern is of a long pause followed by one or a few responses. In addition, according to Bentall, Lowe and Beasty (1985), with verbal subjects the characteristic FI scallop evident in nonhuman performance is virtually never seen.

In the case of subjects who respond at high rates, an assumption is made that the subjects who exhibit this pattern are insensitive to subsequent contingency alterations (Shimoff et al, 1981). Part of the logic for this assumption comes from the observation that responding at a high rate under FI conditions is itself an example of insensitive performance. Some of the current data suggest that high rate FI responding develops over sessions. It is not always a relatively immediate performance characteristic. Subjects 1 and 3 in the present study clearly did not respond at a high rate in Session 1. However, they developed high rate FI performance over the next two or three sessions. The reasons for this are not discernable in the present data. Some research (Weiner, 1982) suggest a possible history effect. Session 2 (FR:50) generated high rate responding in all subjects. Why this high response rate history would generate high rate responding under FI conditions with some subjects and not others is unclear.

It is the actual, as opposed to the programmed, contingencies that determine current performance (Galizio, 1983). High rate responding in FI conditions earns maximum programmed reinforcers which may serve to maintain the high rate - it simply does so

inefficiently. The pattern of a long pause followed by one response is the most efficient. LeFrancois and Chase (1985) argue that this pattern is the most sensitive to FI conditions and to term it insensitive simply because it is not characteristic of other species responding on FI schedules is a mistake.

Beginning in Session 8, beeps earned for performance in periods labelled "Practice Period" were not exchangeable for money. This constitutes an extinction condition relative to the reinforcing value of the money. Subject 3 responded in a pattern termed insensitive to the components of the multiple schedule in that responding was at a high rate in both FI and FR conditions. However, responding in practice periods alone dropped dramatically in Session 10 and remained low in Sessions 11 and 12 suggesting a sensitivity to the extinction condition. Contrast this with Subject 6 who was sensitive to the components of the multiple schedule and yet insensitive to the extinction condition. Evidently some subjects who respond at high rates in FI conditions and are therefore thought to be insensitive to contingency alterations are sensitive to some contingency manipulations but not to others. It appears the same can be said of some subjects exhibiting FI response patterns termed sensitive.

Subject 2 and Subject 5 performed under FI conditions in a pattern termed break and run. They did so virtually throughout the experiment with Subject 5 altering the pattern in Session 12. Two additional subjects, 1 and 3, also exhibited this pattern at different times during the experiment. The break and run pattern is a description of FI performance suggested by Schoenfeld and Cole (1972). This pattern is also described somewhat inappropriately as scalloping. For example, a review of the data termed scalloping found in Bental et al (1985) indicates that these may be more appropriately termed break and run patterns. The break and run pattern has a pause followed by a relatively high steady response rate until reinforcement. The scallop effect is produced by a pause followed by accelerating responding until reinforcement. Assuming that the break and run pattern is what Bentall et al (1985) term scalloping, this study has generated response patterns that are virtually never seen in verbal subjects. Why this may be the case is not readily evident as all subjects in the current study were verbal.

The observation that the scallop effect is rarely seen in verbal subjects but is evident in the performance of nonverbal subjects stems primarily from

two investigations, Lowe et al (1982) and Bentall et al (1985). Because infant response patterns on FI schedules include the FI scallop and presumably, verbal children and adults do not, verbal behavior is advanced as the cause of the different performances. The procedural difficulty is that the independent variable was not directly manipulated. In this case, verbal behavior gains speculative support for its status as the salient independent variable because the effects of other possible variables have been reduced primarily by subject selection. Other issues which may be relevant to the observation, for example, receptive and expressive language abilities, have yet to be discussed. The problem is one of ascribing the cause of behavior to a subject characteristic. When causes of behavior are located within the subject, further investigation of environmental determinants is discouraged.

The terminology utilized in the preceding discussion, and which is commonly found in the literature (Matthews et al, 1977; Lowe et al, 1983), illustrates the issue. Subjects are referred to as high rate FI subjects as opposed to a subject who responds at high rates under FI conditions. Subjects are also described as "insensitive" to changing contingencies. Insensitivity becomes a subject characteristic as

opposed to a description of performance. Direct manipulation of the instructional variable is rarely the case in current investigations of the verbal skills variable. Catania and his collegues are somewhat unique in this regard. Their investigations are characterized by the direct manipulation of the verbal instruction variable. The feature of direct independent variable manipulation is basic to single subject research (Sidman, 1960). Hake (1982) cautions that the first step at innovation is not to "loosen" methodological requirements. Studying publically observable interactions between behavior and environment are preferable to speculation. Weiner (1983, p. 320) agrees with this observation suggesting that "no compromises with solid methodological procedure need to be made." "The identification and experimental manipulation of sources of intersubject variability are much more useful activities" (Weiner, 1983, p. 530).

Chapter V

Conclusions and Directions for Future Research

Human operant research in general, and the button pressing for points exchangeable for money paradigm in particular, could be argued to have the status of a fad or trend in behavioral science. Among operant researchers, experimentation with humans as subjects is in voque (Galizio, 1985). Some evidence for this popularity exists with the formation of special human subject interest groups within the Association for Behavior Analysis. One special interest group is concerned with an experimental analysis of verbal behavior and another more generally with the experimental analysis of human behavior.

Adapting the methods and procedures developed in the animal laboratory to the human operant area is not a particularly recent phenomena. Kantor, for example, attempted to generate reinforcement schedule effects using a verbal behavior dependent variable in 1958. Other innovative and respected researchers (Bijou & Orlando, 1960; Barrett & Lindsley, 1962; Ferster & De Meyer, 1962; Lindsley, Hobika & Etsten, 1961) championed the procedures and speculated positively of future applications. The method was seen as making possible

breakthroughs in the investigation of a multitude of human problems. The problems ranged from the behavior of autistic children and psychotic adults to assessing the effectiveness of television advertising (Lindsley, 1962).

In the following twenty years it is safe to say that the original optimism was not totally warranted. However, the data generated in these pioneering studies are "good data" (Sidman, 1960). It provides a base upon which to build. It is my observation that the data generated by some of the current research will not stand independent from the reasons for their investigation. Part of the reason for this is because the rudiments of an experimental analysis have been altered if not abandoned.

The issue of direct manipulation of the independent variable discussed in Chapter IV illustrates one of the problems. Obtaining data about the instruction variable primarily from post experiment questionaires does not meet the requirement of experimental rigor necessitated by single subject research designs (Weiner, 1983).

In addition to the issue of the direct manipulation of independent variables is the important role of baseline conditions. A stable baseline is

prerequisite to the evaluation of other variables as they are measured relative to the baseline. Implicit is the assumption that the variables governing baseline behavior have been identified and are controlled. In human subject operant research this is not typically the case (Matthews et al, 1977). For example, reinforcement control is generally not experimentally demonstrated prior to manipulating other variables. Because of this, support in the literature for the utilization of complex schedules and designs (Galizio, 1983) is premature. We are still at the stage of identifying and controlling variables responsible for baseline behavior utilizing simple schedules.

The present arguments advanced for the necessity of an experimental analysis of human behavior (Hake, 1982; Johnson, 1983; Weiner, 1983) are the same as those advanced twenty plus years ago (Lindsley, 1962). A compromise is required between two species Lindsley identified as "Rigorless Magician" and "Rigor Mortitician." He suggested developing a "Rigorous Clinician." Bringing the rigor of the operant laboratory to bear on important human problems is the goal. Undoubtably some of the experimental rigor will have to be set aside, at least temporarily, in the compromise. However essential features of the

experimental analysis should not be left behind. This is particularly important in the face of research evidence demonstrating procedural adaptability (Weiner, 1983).

The assumption that a single contingency, money for points earned, controls human operant responding should be made with extreme caution. What variables interact to control human operant responding on schedules of reinforcement remains a subject for further experimentation. The two variables researched in the present study require investigation within more basic experimental contexts. In addition, it has become clear that an experimental analysis of these variables would be more valuable to the field.

The present study fell short of an experimental analysis of the questions posed on two main accounts. First, relatively stable performance developed but the variables accounting for the performance were not clearly identified. It follows that, without clear independent variable identification, the demonstration of experimental control of behavior is impossible. Sidman (1960) commented that without techniques for behavioral control a science of behavior is impossible. A second shortcoming was the assumption that the subjects had various behavioral repretoires. Subjects

were thought to respond differently under conditions labelled "Test" as opposed to "Practice". In addition, subjects were assumed to respond differently under conditions where experimenter access to performance data was certain versus conditions where access could be perceived as less probable. Regardless of the accuracy of these assumptions, the investigation of the variables responsible for these repretories is a more fruitful direction for future research. The experimental manipulation of behavior is more valuable to behavioral science than is witnessing the effects of an unanalyzed variable on baseline performance.

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APPENDIX A

REVIEW OF THE LITERATURE

This review is confined to the literature concerning human performance on schedules of reinforcement. The features of intersubject variability, between and within experiments, and the concept of subject insensitivity to schedule changes are emphasized. The format of the presentation is designed to highlight two themes of experimentation typically offered as explanations of the data. These two themes are that human schedule performance is mediated by human verbal skills and that human performance on schedules of reinforcement is primarily a function of a performance history variable.

Verbal Skills Mediating Theme

Azrin (1958) experimented with a key press operant utilizing an "observing" response. With young soldiers as subjects, he programmed a needle to deflect on a dial on a fixed interval (FI) 3 minute schedule. The key press response illuminated the dial, making needle deflections easier to detect. One feature of the procedure was that subjects typically did not key press unless instructed to do so. The implication was that a verbal component might be necessary in human

operant studies. At the very least, speculation was that a verbal component would save the time and work involved in shaping a key press response. Once instructed to respond, the subjects responded at high rates and continued to do so even after prolonged exposure to the schedule. This pattern was subsequently found to be one of two typical patterns of human FI responding (Weiner, 1969), the other pattern being low frequency responding with long interresponse times (IRT). This pioneering study served to identify two areas of research which have subsequently received considerable scrutiny during the following two and one half decades. One, the finding that human subjects often respond for prolonged periods under extinction conditions is now characterized as "schedule insensitivity". This behavior is often presented as being characteristic of human operant responding (Shimoff, Catania and Matthews, 1981). Two, the technique of increasing the force required for the key press has been utilized extensively by Weiner (1969, 1972). The technique brings responding into contact with contingencies of reinforcement. Lack of effective contact with contingencies had been offered as an explanation for lack of contingency control.

Ellis, Barnett and Pryer (1960) conducted an

experiment with people classified "retarded" as subjects. These subjects were thought to be untestable and of no value for experiments which use verbal instructions. Using a lever pull task for M & M's, they found schedule sensitive performance and concluded that most subjects, including those of lowest intelligence, are sensitive to schedule changes. Subject 6 provided a glimpse of things to come in the human operant arena. He performed in a pattern now termed as insensitive, responding for eleven days at a high rate on a FI:10 second schedule. In addition, this subject continued to respond at a high rate three sessions into extinction. This response pattern is typical of subjects (usually college students) with fixed ratio (FR) schedule experience (Weiner, 1982). The study was conducted to advance operant responding as a diagnostic tool but is often used in support of an argument for verbal skills mediating operant responding. Note that the subjects used were nonverbal. Lowe (1983) suggested that the absence of verbal skills is a major factor in schedule sensitive human responding.

Laties and Weis (1963) specifically advanced the concept of covert mediating behavior in the operant behavior of humans to explain discrepant human and nonhuman performance on similiar schedules of

reinforcement. Latties and Weis (1963, pp 443): "We propose that the presence of this mediating behavior is an important factor in accounting for the formal similarities found when adult human behavior is compared to the behavior of lower animals on FI schedules with added clocks." Their experiment utilized the observing response technique introduced by Azrin (1958). Subjects were exposed to an FI schedule until steady state response patterns were obtained. Once steady state responding developed, a concurrent subtraction task was introduced. The result was response pattern disruption ranging from a complete loss of the former pattern to slightly shorter post reinforcement pauses (PRP). The results were attributed to the disruption of self-produced verbal chains, counting or reciting, that presumably govern human responding on this schedule.

Advancing hypothetical variables to explain behavior is common place and verbal skills are an obvious feature unique to humans. Lovaas (1961 p. 329) concluded that "all mediational hypothesis assume that it is the cue property of the (hypothetical) verbal response that provides the connecting link to other behavior." Lovaas (1964) found some support for the premise that control of motor responding can be increased by reinforcing appropriate verbal responding.

However, he cautioned against the simple interpretation of verbal behavior controling motor behavior and suggested that other factors could also interact. Common emotional states and common reinforcing stimuli were suggested. It follows that with common elements an operation on one system should impact another. The degree of influence and direction of influence are empirical matters.

Brodsky (1967) further commented upon the prevalent practice in psychology of advancing hypothetical variables to explain behavior. He suggested that a common assumption in psychology is the notion that if a person talks differently he will behave differently. This assumption lacked what he termed convincing evidence. While the verbal behavior of people may very well influence their subsequent behavior, it is premature to adopt that assumption as fact. Additional research is needed to determine the environmental conditions that influence verbal control. Investigations into the conditioning history and how these factors influence subsequent verbal and motor performance seems appropriate. Brodsky's (1967) research with two female subjects diagnosed as retarded showed that reinforcing appropriate verbal behavior did not result in any increase in corresponding motor

performance. The direct reinforcement of nonverbal behavior did result in increases in subsequent nonverbal target behaviors.

Lippman and Meyers (1967) conducted a study to assess the effects of verbal instruction on FI schedule performance. The subjects consisted of 16 young adults. Three subjects were instructed that the contingency depended on passage of time, three that the number of responses was critical, and ten were not given any instructions regarding the contingency. Using a button press task, they found subject performance to be consistant with instructions. In addition, using data from a post experiment questionaire, they concluded that schedule performance is related to verbalizations of the contingency. In a related experiment utilizing 80 subjects and FI reinforcement schedules, Leander, Lippman and Meyer (1968) found that subject performance and post experiment verbalizations regarding perceived contingencies were related to the initial rate of responding but unrelated to FI duration. The speculation was that subjects may form their own "instructions" regarding contingencies perhaps based on early schedule performance.

Self instructions as a factor influencing motor performance gained additional support in an experiment

by Bem (1967). She experimented with a matching task using 3 and 4 year old children. The task involved pulling a lever a number of times to correspond to the number of illuminated lights on a multilight display. Four year olds had no difficulty with the task while 3 year olds had great difficulty. Utilizing a procedure involving social reinforcement for verbalizations of each lever pull to correspond to an illuminated light, followed by fading out the "feedback", three year olds were able to markedly improve performance on subsequent matching trials. She speculated that the procedure resulted in their performance coming under control of self instruction.

Buskist, Bennett and Miller (1981) and Buskist, Miller and Bennett (1980) investigated the interaction of instructions and FI contingencies. They promoted the feature of utilizing a consumatory response in an attempt to diminish motivational differences in human and animal studies. Instructions to conserve time produced high rate responding, response conservation instructions produced intermediate rate responding and no instructions resulted in low rate responding. The results were characterized by a diversity of response patterns. This diversity was suggested to underscore the contributions of extra-experimental contingencies

and the sensitivity of human FI responding.

Duvinsky and Poppen (1982) investigated human performance with conjunctive fixed interval fixed ratio schedules. The conjunctive schedule was suggested to be more like many human work situations in that reinforcement comes as a function of performance but only after the passage of time. A variety of response patterns are typically available. For instance, some people may work quickly initially to get it over with in as short a time as possible, others may opt for the slow but steady approach and some choose to wait until the last moment to respond. Their subjects were college students who answered an advertisement soliciting people for a "problem solving experiment". All subjects were initially exposed to an FI 80 second schedule for 10 sessions on a lever pull task. Prior to the eleventh session they were divided into three groups of six subjects, each group receiving a different FR component of 10, 80 or 120 responses. Subjects were tested for approximately 30 minutes per session, attending a minimum of 5 sessions per week for 20 sessions. After finishing the project they completed a post experiment questionaire relating to the description of the conditions they thought necessary to earn points in Sessions 1-10 and 11-20. The FR component was not

effective in establishing schedule control on the high rate FI responders, who continued to respond at a high rate regardless of the FR requirement. The authors concluded that contingency control was related to subjects verbalizations of the contingencies. The direction of the assumed verbal control was not possible to assertain. Speculation was offered as to the subjects coming under some contingency control that they then tact or of subjects emitting verbal hypothesis that impact on subsequent motor performance.

Poppen (1982) conducted two experiments investigating human FI performance with concurrently programmed schedules. Using a lever press task and concurrent FI-DRL, FI-FR schedules he looked at history effects and the role of verbal strategies in mediating history effects. A change over delay (COD) procedure was adopted to decrease the rate of schedule alternation. "Reinforcers" consisted of points accumulated on a counter combined with the flash of a red light. In the conjunctive schedules, where it was possible to complete the ratios before the interval expired, S's typically responded on the FR component early in the FI period. Change overs occured after reinforcement delivery. Responses on the FI component occurred late in the interval or after it had elapsed.

When it was not possible to meet the FR program requirement response patterns were more varied. The DRL component of the conjunctive FI:100 DRL:10 second experiment resulted in severely inhibited FI responding. With short FI requirements and longer DRL periods subjects tended to operate on the FI component and did not switch to the DRL. Poppen concluded that human FI performance is determined at least in part by what else there is to do in the situation. Even in single operant studies other contingencies, unspecified and perhaps unobserved, abound. He speculated regarding response patterns that lead to decreased reinforcement, suggesting that human subjects generate rules, verbal statements of contingencies, and that these verbal rules continue to govern behavior when current contingencies change. Lowe, Beasty and Bentall (1983) also promote the concept that human subjects formulate descriptions of contingencies. These, necessarily verbal descriptions, accurate or not, act in such a way to result in schedule performance which differs from animal schedule performance. They regard the instruction variable as a powerful variable which may interact with self instructions and other contingencies. When instructions are minimized self instructions are thought to play a more dominant role in governing

schedule performance. Their conclusion is basically that the unique verbal ability of humans accounts for many major differences between human and other species performance on schedules of reinforcement.

Further support for this conclusion was gathered in an experiment using two preverbal human infants (Lowe, Beasty & Bental, 1983). The response was touching a metal cylinder located in front of the infants while they sat in a high chair or their mother's lap. Reinforcers were small snack items for one child and a 4 second exposure to music from a variety of music boxes for the other. Cylinder touching was shaped using the method of successive approximations and for two sessions each touch was reinforced. Subsequently reinforcers were presented on FI schedules ranging in value from 10 to 50 seconds. In the case of both subjects, response rates increased in later sessions and a pause response pattern developed following reinforcement. In addition, accelerated responding which terminated in reinforcement, the "scalloped" pattern characteristic of animal FI performance, was the predominant response pattern. The authors concluded (p. 161) that in the case of human infants, the effects of reinforcement on behavior are indistinquishable from those well documented in the literature on animal

learning. This is true of both response patterning and sensitivity to the FI parameter. They note that the youngest subjects of earlier research (De Casper & Zeiler, 1972; Zeiler & Kelly, 1967) were at least four years old and the stable FI performance in these cases was of either the high or low rate type characteristic of adult performances. These data and evidence from previous studies suggest that verbal behavior is a variable that can function to alter the effects of other variables such as scheduled reinforcement.

Bental, Lowe and Beasty (1985) continued to conduct research with children as subjects. Building on previous research (Lowe, Beasty & Bentall, 1983), they argued that if verbal behavior is the variable responsible for human and nonhuman schedule performance differences, that the schedule performance of preverbal infants would show animal rather than adult human characteristics. With four groups of subjects divided by age groups, preverbal infants, 2.5 to 4 years, 5 to 6.5 years and 7.5 to 9 years, they manipulated FI values. "Reinforcement" for the three older groups of children consisted of illuminating some lights, a cartoon slide projected on a screen for 10 seconds and the appearance of "Sooty", a puppet who dropped a favorite snack to be consumed by the child. The

infants' (4 subjects) reinforcement consisted of illuminating a row of lights for 5 seconds accompanied by music and the presentation of a cuddly doll. The infants produced a pattern termed scalloping by the authors. In addition, all of the children in the 2.5 to 4 year old group produced scalloping at some point in the development of FI performance although this pattern did not persist. The children in the two older age groups, 5 to 6.5 and 7.5 to 9 years responded in patterns typical of adult humans. The different patterns between most age groups was argued to support the theory that verbal behavior accounts for interspecies performance differences. In addition, these authors suggest that developmental differences which have largely been ignored need to be explored.

The basic position that it is a mistake to ignore the role of covert verbal stimuli has long been supported by C.F. Lowe, among other researchers. In a five experiment study, Harzem, Lowe and Bagshaw (1978, pp. 420-421) concluded, "In order to explain these phenomena, it is necessary to take into account the fact that the human subject in an operant experiment can verbally describe to himself or herself the contingencies in operation and that such description itself comes to act as a controlling stimulus." The

argument is based on the evidence that if externally stated instructions can govern the effects of contingencies there is little reason to doubt that instructions to oneself can be similarily effective. Lowe (1979), in a literature review paper, suggests that extrapolations from the animal laboratory to human subject research are justified if the role of verbal factors in human subject performance is recognized. Lowe (1979, pg. 189) states that: "Although the interactions between self instructions and operant schedule performance may be complex and difficult to investigate such interaction had better be recognized and if possible controlled than allowed to remain an uncharted source of experimental variability."

The role of verbal behavior in mediating motor performance is an inference based on experiments manipulating the instruction variable, information from post experimental interviews or data from preverbal humans. The direct manipulation of verbal behavior to demonstrate a reliable corresponding change in the dependent variable has not been a feature of the studies reviewed to this point. Shimoff, Catania and Matthews (1981) investigated the effects of "instructions" on random interval (RI) and random ratio (RR) schedules. They observed that human behavior is sometimes

insensitive to reinforcement contingencies when responding is initiated by instructions. This may be particularly true when responding is at such a high rate that the response precludes contact with contingencies. They investigated schedule sensitivity to low-rate responding. Utilizing RR or RI schedules with superimposed DRL contingencies low rate responding on a key press task for points was established. Schedule sensitivity was tested by relaxing the DRL contingency. Responding should increase if sensitive to the RI or RR contingency. The key press was established in two different ways. One group of eleven subjects was issued written instructions to key press and the other group of eleven had the key press response shaped. The data indicated that low rate responding established by shaping was generally sensitive to contingency change. Instructions on the other hand tends to produce responding that is insensitive to contingency change. The authors suggested that the insensitivity feature virtually defines instructional control.

Catania, Matthews and Shimoff (1982) followed up on the differences found in performances of shaped and instructed subjects. Instructions were equated to rule governed behavior and the study was seen as an extension of the rule governed behavior concept to verbal

behavior. The concepts of rule governed behavior and contingency managed behavior (Skinner, 1969) would suggest behavior governed by rules to be less sensitive to change than behavior managed by contingencies. The authors pointed out that just as you can shape or instruct nonverbal behavior, you can shape or instruct verbal behavior. They examined the effects of shaping or instructing subjects' verbalizations in relation to the contingencies on a button pressing for points task. Button pressing was maintained on alternating RR and RI schedules. The points earned varied directly with response rates on the RR schedule whereas they remained roughly constant over a range of RI rates. The RR schedule typically maintains higher rates than those generated by RI schedues. Instructions to press fast or slow could procedurally operate to accent or oppose the rate generated by the RR or RI schedules. In addition the instructions could be shaped or instructed. These procedural variations allowed the ivestigators to look at a variety of instruction and performance interactions. Generally instructions established by the shaping procedure resulted in a corresponding differential pressing rate regardless of the schedule in effect, indicating control from shaped verbal behavior to motor behavior. This was not typically the case when

instructions were instructed. The authors concluded that in the case of shaped instructions pressing rates corresponded with the verbal behavior (press fast or slow) even though the contingencies for pressing were unchanged. However, when neither guesses or presses were instructed, RR rates were higher than RI rates and reversed, along with corresponding guesses, when the RR and RI conditions were reversed. This indicated control operates in either direction, nonverbal to verbal as well as verbal to nonverbal. Consistant control of pressing by shaped guessing was generally evident while instructed guessing did not typically control pressing rates. The implication of the study is that verbal behavior is more likely to influence motor behavior when the verbal behavior is "shaped" rather than instructed.

Matthews, Catania and Shimoff (1985) further analysed inferences from their previous research and investigated the effects of shaping versus instructing verbal behavior. In this study they differentiated between performance and contingency descriptions. Performance descriptions were "press slowly" or "press fast" while contingency descriptions include a response or time element. Subjects who's verbal behavior was shaped to a performance description showed a consistant correspondance between response rates and the

descriptions of performance. Contingency description subjects did not consistantly show this correspondence. The variability within this group presumably depends in part on the varied verbal repretories that different subjects bring to experimental settings. Pilgrim (1985) investigated the differential effects on performance caused by instructing or shaping verbal rules. She provided subjects with repeated opportunities to assess the effects of various instructions. The data indicated that regardless of the number of points earned by guessing problem rules, subjects come under control of reinforcement contingencies when rules are shaped.

Schedule History Theme

The major researcher with respect to the schedule history variable has been H. Weiner. In a series of human subject experiments spanning more than twenty years, he has been able to make a strong case for the effects of performance history interacting with current contingencies to determine current performance. His position is that the apparent lack of schedule sensitive responding in many studies can be explained to a large degree by schedule history differences. The effects of schedule histories is well documented in operant literature. In addition, Weiner (1983) notes

that histories relating to schedules of reinforcement on key press tasks are directly observable and manipulable. This feature he regards as preferable to that of making inferences about covert mediating processes.

Weiner (1962) investigated the effects of response cost on human performance with various schedules of reinforcement. An observing response was utilized where the ability to effectively observe was made contingent upon pressing and releasing a key. Subjects pressed a report lever every time they observed the target stimulus and received 100 points on a counter for doing so. The cost condition consisted of point loss for pressing the key making the observing response more probable. Simply put, subjects received points for observing the stimulus and lost points for making stimulus identification likely. The experimenter manipulated cost or no cost conditions, instructions, and the schedule of stimulus presentation. All subjects had in common the information that a stimulus (red light) would appear at random. Some had no additional information related to stimulus presentation, other groups had information related to the schedule of stimulus presentation, FI:1, 3, or 9 minutes. The response cost feature served to supress responding in the FI:1 minute condition, but did not disrupt the

consistancy of responding in the FI:3 or FI:9 conditions. With alternating cost and no cost conditions while responding on FI schedules, response rates decreased regardless of schedule information and regardless of cost-no cost conditioning sequences. He concluded that some human FI responding is sensitive to the response cost variable. Regardless of the exact role of response cost, it is a feature that has to be taken into account. Attempts to explain FI responding that deal only with the contingencies of positive reinforcement may be inadequate in specifying the complete range of controlling variables.

Weiner (1965) followed up the implications of his previous research and looked at the conditions under which a person will respond between reinforcements despite cost punishments which result in preventable loss of reinforcers. He had six human subjects responding on a microswitch and manipulated their recent reinforcement history. Initial histories consisted of FR:40, FI:10, and DRL:20 second training sessions. After 10 one hour training sessions, schedules were switched to a FI:10 second with a point cost component. Following FR:40 histories, subjects maintained inefficient (maladaptive) high rate responding in the FI:10 second cost condition. Subjects with FI:10 second

histories and DRL histories were more adaptive. They emitted relatively low respnse rates and received more reinforcers in the FI:10 second condition. Weiner suggested that the ratio, as opposed to the interval nature of the conditioning history, may account for the performance of FR:40 history subjects in the FI:10 second condition. His analysis of dfferential FR and DRL schedules suggests that the same conditioning hstory may produce either adaptive (contingency sensitive) or maladaptive subsequent responding depending on the nature of the subsequent reinforcement contingencies. For example, a FR history is more adaptive than a DRL when the subsequent reinforcement contingeny is a VI:10 second as opposed to a FI:10 second contingency. The implication being that both historical and current contingencies have to be considered when attempting to predict human operant behavior.

Weiner (1970) investigated the persistance of responding by human subjects under conditions of preventable withdrawal of reinforcement. He observed that the operant behavior of an organism does not turn off and on like a switch. Operant behavior tends to persist when the contingencies responsible for its development and maintenance are no longer in effect. Weiner (1970, pg. 445) speculates that there are at

least two reasons why this may occur:

> First, they may not change because they know only one way of behaving. Critically needed alternative behaviors are not in their repretories. Second, they may not change because the current environment provides some reinforcement for persisting. One-behavior organisms tend to persist as long as there is any gain for doing so --- the fact that greater reinforcement is possible by changing may not be sufficient to change one-behavior organisms.

Weiner (1970) conducted a systematic replication of his 1962 experiment. The apparatus consisted of a microswitch key, a five digit scoreboard and some discriminative lights. Subjects sat in front of this console and were instructed to use the key to earn as many points and to lose as few points as possible. In addition, they were told they could press or not press the key as they wished. Inital exposure to FR:40 produced stable fairly high rate responding. After 10 FR:40 one hour conditioning trials, a FI:10 second cost schedule was introduced. In this condition all responses between reinforcers produced withdrawal of reinforcement and were not necessary for reinforcement. This condition produced irratic performance but high rate responding continued between reinforcements. Weiner notes that the continued responding is not simply extinction responding after FR:40 histories. In extinction, subjects typically cease responding well

within 10 sessions. If you then expose extinguished subjects to FI:10 cost schedules, most will respond at high constant rates. An observation Weiner derived from these data was that extinction apparently does not extinquish the history effects of the FR:40 responding, even though responding ceases in extinction. Organisms are not made niave by the process of extinquishing their behavior.

In order to prevent the problem of continued high rate responding in FI:10 cost conditions, subjects were provided with a history of DRL:20 second conditioning. This provided the subjects with a behavioral repretoire of low rate responding and consistant pausing between reinforcements. When presented once more with FI:10 cost conditions, subjects who had this history typically emitted low response rates with virtually no responding between reinforcements. Weiner concluded that (pg. 450) "a conditioning history can determine changes in human behavior even though it has occurred in the somewhat remote past and despite the fact that different behavioral histories have intervened." His data suggest that behavior change can be produced, without relapse, by providing organisms with certain critical repretoires. The training of alternative repretoires is

a potential solution to the "one-game" individuals described by Szasz (1961). Szasz (1961, pg. 308) theorized that:

> Man is confronted by the imperative need to relinquish old games and to learn to play new ones. Failing this he is forced to play new games by old rules, the old rules being the only ones he knows how to play. This fundamental game conflict leads to various problems in living. It is these that the modern psychotherapist is called upon to treat.

Humans are persistant responders; in order to facilitate change, the environment may need to make all reinforcement contingent upon change. Once new repretoires are learned, it becomes reasonable to lessen environmental constraints. Weiner (1972) further manipulated FR, FI, and DRL histories. With mixed schedules, he demonstrated that responding under a FR schedule does not carry over to effect DRL responding and DRL histories do not determine final response rates and patterns on FR schedules. In addition, he noted that the human subject's characteristic response pattern of high and low rate FI responding can be produced experimentally and hence controlled by alternating DRL:10 second or FR:80 with a FI:10 second in mixed schedules. FR and DRL histories can exert differential effects on FI performance regardless of different amounts of training or whether the training is occurring

simultaneously to FI performance in the mixed schedule format.

Weiner (1970) tested the effects of instructions describing contingencies on responding under various schedules. This work systematically replicated an experiment by Baron, Kaufman and Stauber (1969). During an extinction condition following an FI:10 second conditioning history, he noted that subjects given false maximum reinforcement instructions had higher response rates than subjects with instructions indicating that reinforcement was not available during extinction. However, subjects given false maximum reinforcement instructions had lower extinction rates than subjects given no instructions. The implication is that instructions about reinforcement reduce responding during extinction regardless of the accuracy of such instructions.

De Casper and Zeiler (1972) noted that the number of sessions typically allowed to estabish schedule effects without instructions averaged 10 sessions of 1 hour duration. Working with children on a lever pull task, they extended the non-instructed conditioning trials to over 30. The children gained access to their school lockers by lever pulling. Access to the locker was necessary for school purposes. After

Session 1, there was no subject-experimenter interaction. The lever pulling behavior simply persisted over sessions as part of the natural environment. This research replicated parts of Weiner's work (1965, 1970, 1972). With multiple FR:FI and DRL:FI schedules they found that the history effects of FR and DRL components produced corresponding high or low rate responding in the FI condition. Responding did not change markedly over sessions. Low FI reesponding after DRL training continued for the duration of the experiment as did high FI responding following the FR history.

In a series of five experiments, Weiner (1982) attempted a further analysis of the DRL contingency. He speculated that response omission appears to be an important feature of DRL responding which may enable it to influence subsequent FI performance. A number of schedule relationships were evident in the data. Low rate FR:40 responding resulting from a DRL:10 second history was prevented by providing a FR:40 history prior to DRL:10 second conditioning. Under extinction conditions, response persistance varied positively with the number of conditioning histories. DRL histories tend to surpress FR:40 responding in relation to the length of the period of non responding, eg. DRL:10

second does not supress FR:40 responding as effectively as DRL:20 second conditioning. A procedure termed by Weiner as "learning", which involved initial continuous reinforcement and a gradual snifting to an intermittant contingency, was successful in counteracting the effects of DRL or DRO responding on a final FR:40 schedule performance. Weiner concluded that human schedule performance was more often a function of reinforcement history than current contingencies of reinforcement. Weiner (1983) pointed out that the reinforcement contingencies which encourage the persistance of history related responding (i.e. interval schedules) also represent the contingencies where human and nonhuman performance is most discrepant. However, when humans and animals are given the same reinforcement history, they do produce similiar schedule effects (Urbain, Poling, Millam & Thompson, 1978). In addition, the commonly obtained human versus nonhuman performance discrepancies can be produced or removed by providing subjects with particular reinforcement histories (Weiner 1970, 1972, 1982).

APPENDIX B

ADVERTISING FOR SUBJECTS

ADVERTISING FOR SUBJECTS

Wanted

Volunteers to paticipate as subjects in an experiment on learning.

Participants will be able to earn some money during the experiment. In addition all participants who attend as agreed upon will be eligible for a $100.00 prize draw.

If you are interested and/or wish further information please contact:

John Douglas
#100 1268 - 5th Ave.
Prince George, B.C.
Phone: 564-6408

APPENDIX C

SUBJECTS' AGREEMENT OF PARTICIPATION

SUBJECTS' AGREEMENT OF PARTICIPATION

Conditions of Experimental Participation

This is to confirm that I am volunteering to take part in this experiment and that I am under no external pressure to do so.

I agree to attend all twelve (12) sessions. Information concerning my participation will be held in confidence. During the experiment I will keep private any and all information regarding the experimental requirements and the nature of my participation.

A complete review of the experiment will be conducted shortly after its completion. All enquiries will be entertained at that time.

_____

Participant

_____

Experimenter

APPENDIX D

GENERAL INSTRUCTIONS ABOUT THE EXPERIMENT

GENERAL INSTRUCTIONS

This is an experiment in learning. It is not a psychological test of any type. I am interested in aspects of learning common to all people. During the sessions, you will be alone in the room until the session ends. Instructions as to how to begin the session and any additional information relevent to the experiment will appear when appropriate on the computer monitor. Simply press the key indicated in the instructions to begin the session. An extended auditory signal will sound to let you know that the session has begun. The session will last 42 minutes, when it is over the monitor will so indicate. The goal is for you to make short auditory signals, "beeps", occur by pressing the V key on the computer keyboard. Some occurrances of this signal are exchangeable for money. The monitor will indicate when and how much each "beep" is worth.

APPENDIX E

INSTRUCTIONS PRIOR TO SESSION PARTICIPATION

GENERAL VERBAL INSTRUCTIONS

For the sake of consistancy among participants I would like you to leave your watches and rings with me during each session. If you have any questions ask them now because I will not be able to answer questions during the sessions.

APPENDIX F

INSTRUCTIONS FOR SESSIONS 1 AND 2

INSTRUCTIONS FOR SESSIONS 1 AND 2

Welcome to the Experiment!

The goal is to produce a short auditory signal by pressing the 'V' key on the keyboard.

Only the 'V' key presses will produce the 'beep'. Each beep is worth 3 cents. A rectangle will appear on the monitor. This is a counter. The number of beeps you produce will appear in this counter at the end of the session.

Prior to beginning the session, locate the V key on the keyboard.

When you are ready, press RETURN. An extended signal will indicate the start of the session.

APPENDIX G

INSTRUCTIONS FOR SESSIONS 3 AND 4

INSTRUCTIONS FOR SESSIONS 3 AND 4

Welcome to the Experiment!

Again the goal is to produce 'beeps' by pressing the V key on the keyboard.

Only the 'V' key presses will produce the 'beep'. Each beep is worth 3 cents. At the end of the session, the number of beeps produced will appear on the counter.

When you are ready, press RETURN. An extended signal will indicate the start of the session.

APPENDIX H

INSTRUCTIONS FOR SESSIONS 5 THROUGH 7

INSTRUCTIONS FOR SESSIONS 5 THROUGH 7

Welcome back to the Experiment!

The goal is to produce 'beeps' by pressing the 'V' key on the keyboard. Only the 'V' key presses will produce the 'beep'.

This session has been divided into components labelled PRACTICE and TEST. Beeps produced in both the PRACTICE and the TEST period are worth 3 cents.

The number of beeps earned in the test condition will be counted and displayed at the end of the session on the right counter. The number of beeps earned in the practice condition will be counted and displayed at the end of the session on the left counter.

When you are ready, press RETURN. An extended signal will indicate the start of the session.

APPENDIX I

INSTRUCTIONS FOR SESSIONS 8 THROUGH 12

INSTRUCTIONS FOR SESSIONS 8 THROUGH 12

Welcome back to the Experiment!

The goal is to produce 'beeps' by pressing the 'V' key on the keyboard. Only the 'V' key presses will produce the 'beep'.

A change in format has occured since you last participated. In some previous sessions, you were able to produce beeps worth money in both practice and test. During this session, beeps produced in the TEST condition ONLY are worth money. Each beep is worth 6 cents.

During the PRACTICE periods, pressing will produce beeps in the same way as in the test condition. For purposes of additional feedback to you, the number of beeps produced in every SECOND practice period will be displayed. The word "Display" will appear under the counter only during the practice periods during which the beeps are counted.

When you are ready, press RETURN. An extended signal will indicate the start of the session.

VITA

Surname: Douglas Given Names: John Oliver

Place of Birth: Kamsack, Saskatchewan

Date of Birth: May 16, 1945

Educational Institutions Attended, with Dates of Entering and Leaving:

Brandon University, Manitoba	1966	to	1969
University of Saskatchewan, Saskatoon	1969	to	1972
University of Victoria, B.C.	1983	to	1986

Degrees Awarded with Dates and Names of Institutions:

B.A.	1969	Brandon University, Manitoba
M.A.	1972	University of Saskatchewan, Saskatoon

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Title of Dissertation

Human Operant Responding on Schedules of Reinforcement: An investigation of the verbal history and public performance variables.

Autho[redacted]

John Oliver Douglas

August 21, 1986