5-1975

Behavioral Induction in Guinea Pigs as a Function of Reinforcement Magnitude in Multiple Schedules of Negative Reinforcement

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BEHAVIORAL INDUCTION IN GUINEA PIGS AS A FUNCTION OF REINFORCEMENT MAGNITUDE IN MULTIPLE SCHEDULES OF NEGATIVE REINFORCEMENT

by

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A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF ARTS

in

Psychology

Approved:

UTAH STATE UNIVERSITY
Logan, Utah

1975

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ABSTRACT

Behavioral Induction in Guinea Pigs as a Function of Reinforcement Magnitude in Multiple Schedules of Negative Reinforcement

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The purpose of this study was to examine the effects of changes in magnitude of negative reinforcement on multiple schedules with the guinea pigs. In both schedule components, the first response (lever press) after an average of 10 seconds was reinforced. In the constant component of this schedule the reinforcement magnitude (time-off from electric foot shock) was always 15 seconds; whereas, in the manipulated component the magnitude changed in the following sequence: 15, 7.5, 15, 30, and 15 seconds. All subjects showed a gradual decrease in response rate across baseline conditions. When behavioral effects were evaluated relative to this changing baseline, five of six subjects demonstrated that as the reinforcement magnitude decreased in one component, the response rates in both components decreased (negative induction). Likewise, when reinforcement magnitude increased in one component, all subjects showed behavioral induction. Specifically, three subjects showed increases in response rate in both components (positive induction), while two subjects showed decreases in response rate in both components (negative induction). This research extends the generality of the behavioral induction phenomena on multiple schedules to in-

clude negative reinforcement with the guinea pig as a function of changes in reinforcement magnitude.

(36 pages)

INTRODUCTION

Four types of behavioral interactions are possible in multiple (mult) schedules (Reynolds, 1961b; Pear & Wilkie, 1971). Table 1 illustrates these interactions (see Table 1, Appendix A). Pigeon studies have typically found positive contrast and/or negative contrast as a function of manipulations in reinforcement frequency (Reynolds, 1961a,b; Nevin & Shuttleworth, 1966; Nevin, 1968; Bloomfield, 1967a,b; Halliday & Boakes, 1971; and Wilkie, 1972). However, four studies reported induction, rather than contrast, as a function of similar changes in reinforcement frequency. Specifically Reynolds (1961b) found both positive and negative induction following certain changes in variable interval (VI) or variable ratio (VR) schedule components to and from extinction (Ext). Likewise, Pear & Wilkie (1971) found positive induction when a *mult* VI Ext schedule was changed to *mult* VI VI. Reynolds (1963) also found positive induction by parametrically manipulating certain low-frequency VI components of a *mult* VI VI schedule. In addition, Bloomfield (1967a) found negative induction as a function of parametric manipulations of the minimum inter-response time in the "differential reinforcement of low rate" (DRL) component of a *mult* VI DRL schedule. One study also found positive induction as a function of parametric manipulations of the shock intervals in free operant avoidance (Herrnstein & Brady, 1958). Specifically, they found that decreasing both the shock-shock and response-shock intervals increased responding in the avoidance (Avoid) component and both extinction (i.e. S^{Δ} or no programmed consequence) components of the four-ply *mult* FI Ext Avoid Ext Schedule. Finally it should be noted that Terrace (1963) has shown that behavioral interactions are not produced when discriminations are developed without errors. Thus, it can be seen that the specific conditions producing contrast, induction, or no interaction are, as yet, unclear.

Most studies investigating behavioral interactions have used food-maintained schedules. Only three studies utilized shock as a controlling variable: Herrnstein & Brady (1958) and Wertheim (1965) used free operant avoidance and Brethower & Reynolds (1962) used punishment. Thus, the present study appears to be the first to investigate such interactions using a negative reinforcement schedule. Also, little data exist on the occurrence of behavioral interactions in species other than pigeons. Interactions have been demonstrated in a few studies using rats (Smith & Hoy, 1954; Herrnstein & Brady, 1958; Herrick, Myers, & Korotkin, 1959; Wertheim, 1965; Pierrel, Sherman, Blue, & Hegge, 1970; Pear & Wilkie, 1971; and Wilkie, 1972) and children (O'Brien, 1968; and Waite & Osborne, 1972). Thus, it also appears that the present study is the first to use the guinea pig as a subject in investigating behavioral interactions.

Most studies investigating behavioral interactions changed either reinforcement frequency or response rate in the manipulated component of the multiple schedule (Freeman, 1971). Only three studies have manipulated reinforcement magnitude in multi-component reinforcement schedules. Specifically, Shuttleworth & Nevin (1965) manipulated the duration of grain hopper presentation on a mult VI VI schedule. They found that reinforcement magnitude was directly related to response rate in the manipulated component but was not systematically related to response rate in the constant component (i.e. no interactions). Catania (1963a) and Mariner & Thomas (1969) also manipulated reinforcement magnitude, but they did not present response rate data from both components across all phases; thus, behavioral interactions could not be examined. Mariner & Thomas (1969) did, however, report peak shift as a function of changes in reinforcement magnitude. Thus, if Terrace's (1968) contention that behavioral contrast is a necessary condition for peak shift is correct, then behavioral contrast might have occurred in Mariner & Thomas's (1969) experiment. However, if the between-subject interpretation of behavioral interactions (both contrast and induction) proposed by Yarczower, Dickson, & Gollup (1966) is accepted, then Terrace's (1968) contention is negated by the former data. In any case, more research is needed to detail the effects of reinforcement magnitude on behavioral interactions.

In conclusion, the purpose of this study was to examine the phenomena of behavioral interactions by manipulating a rarely studied variable, reinforcement magnitude, on a previously unused paradigm, negative reinforcement, with a novel species, the guinea pig.

METHOD

Subjects

Six experimentally naive adult female guinea pigs were used. Food and water were continuously available to all subjects in their individual living quarters.

Apparatus

The apparatus consisted of two identical 23.5 by 20.0 by 19.5 cm small animal chambers with 5.0 cm wide levers, mounted 8.0 cm off the floor and extending 1.5 cm into the chamber. A force of 0.34 N closed a microswitch and activated standard electromechanical control and recording equipment housed in an adjacent room. One Lehigh Valley Electronics (LVE) model SG-903 shock generator plus model SC-902 shock scrambler provided continuously scrambled shock to each chamber, grid floor, and lever. The grid floor for each chamber was 16 steel rods having a diameter of 0.34 cm and a length of 24.4 cm. For subjects A157, B487, and B473, and 3B the shock intensity was set at 1.7 mA; while for subjects A491 and A470 it was set at 1.8 mA. Since shock intensity and escape response rate vary directly, these intensities remained constant after initial training. The stimulus lights consisted of two 1.7 cm diameter lights mounted 14.0 cm off the floor and 2.5 cm to the right (red) and left (green) of the lever. Response rates were calculated by dividing the total time per component by the total number of responses per component in each session.

Procedure

All subjects were trained to lever press in the presence of continuous foot shock for approximately 6 sessions using the titration technique developed by Khalili, Daley, & Cheney (1969). Briefly, this procedure provides a long (i.e. 30 sec) time-off from shock after every twentieth response (i.e. fixed-ratio 20), with a short time-off from shock following each intermediate response (i.e. fixed ratio 1). When response latencies decreased to approximately 1 or 2 sec the short time-off from shock was gradually reduced from 5.0 to 0.5 sec, and then eliminated. Throughout the rest of the experiment, the subjects were maintained on a mult VI 10-sec VI 10-sec schedule of negative reinforcement. That is, in both 4 min components of the multiple schedule, the first response (i.e. lever press) after an average of 10 sec was reinforced. A geometric variable interval schedule was used in an attempt to provide a stable baseline. For subjects A157, and A491, and A470 the constant component was signalled by the right stimulus light (i.e. red) and the manipulated component was signalled by the left stimulus light (i.e. green); whereas, for subjects B487, 473, and 3B the position and colors were reversed. The time-off from shock (i.e. the magnitude of reinforcement) was always 15 sec in the constant component; whereas in the manipulated component it varied with each experimental phase (i.e. I, 15; II, 7.5; III, 15; IV, 30; and V, 15 sec).

Two subjects were assigned to each of three conditions in an attempt to partially equate the two schedule components with respect to each of the following: number of time-outs from shock (#TO), total time in the presence of shock (TST), and total time in the absence of shock (TAS). Table 2 shows that this attempt was accomplished by varying the number of presentations of each schedule component per session during the treatment phases of each conditon (See Table 2, Appendix A). That is, in the first condition (i.e. #TO for subjects A157 and A491) there were twice as many presentations of the schedule component having the larger reinforcement magnitude; in the second condition (i.e. TST for subjects B487 and B473) there was an equal number of presentations of both components in each phase; and in the third condition (i.e. TAS for subjects A470 and 3B) there were twice as many presentations of the schedule component having the smaller reinforcement magnitude. Subjuct A470 did not participate in the "Treatment-30" phase of the "TAS" condition due to a drastic 536 percent decrease in her response rate on the eleventh day of the second baseline.

During each week all subjects received seven sessions, each having an approximate duration of sixty min. The criterion for changing experimental conditions was the absence of a consistent trend (i.e. either increasing or decreasing) in the subject's response rate in both schedule components during the last five days of each experimental condition.

RESULTS

All subjects learned the lever-press escape response in about six sessions and thereafter most showed a gradual decrease in response rate across baseline conditions (See Table 3, Appendix A). Such a trend was probably due to behavioral adaptation to shock and/or to the gradual development of calluses on the subject's foot-pads as a result of repeated exposure to grid shock.

Figure 1 shows the absolute and relative changes in response rates as a function of the absolute changes in reinforcement magnitude (See Figure 1, Appendix B). These data points were calculated using the following three formulas:

(1) $AMC = (M_{x+1}) - (M_x)$

(2) $ARC = (R_{x+1}) - (R_x)$

(3) $RRC = \frac{100(R_{x+1})}{R_x}$

Symbol Key

AMC = The absolute change in reinforcement magnitude from one phase to the next.
ARC = The absolute change in response rate from one phase to the next.
RRC = The relative change in response rate from one phase to the next.

M = The reinforcement magnitude.
R = The response rate.
x = In any of the first four phases.
x+1 = In the phase immediately following phase-x.

For all subjects, response rate changes in the constant component roughly paralleled those in the manipulated component. For three of five subjects (i.e. A157, A491, & B473), decreasing the reinforcement magnitude by 15 sec produced a greater decrement in response rate in the manipulated component than a corresponding 7.5 sec decrease in magnitude. Similarly, for all subjects, decreasing the reinforcement magnitude by 7.5 sec produced a greater decrement in response rate in the manipulated component than a 7.5 sec increase in magnitude. However, for three of five subjects (i.e. A157, B487, & 3B), increasing the reinforcement magnitude by 15 sec produced a greater decrement in response rate in the manipulated component than a corresponding 7.5 sec increase in magnitude.

In evaluating behavioral interactions on changing baselines, one's frame of reference becomes critical. When comparing the effects of a treatment on such a baseline at least two baseline phases surrounding each treatment phase must be considered. In fact, behavioral interactions become most apparent when a theoretical curve is fitted through all the baseline points. Since these baseline curves are in the best predictors of behavior as a function of time in the absence of treatment, behavioral interactions can be most clearly determined by the relative deviations of each pair of treatment points around their respective theoretical baseline curves. Figure 2 graphically compares the four behavioral interactions from Table 1 using hypothetical data with changing baselines; one increasing (e.g. acquisition) and one decreasing (e.g. adaptation) (See Figure 2, Appendix B). The critical nature of this method of evaluation is illustrated by the first hypothetical subject's "Treatment A" data points (i.e. a and b of Figure 2). If an attempt were made to evaluate these two data points relative to their respective "Baseline-1" data points (i.e. c and d of Figure 1), it could only be concluded that since both treatment data points had increased from their former baseline points, weak positive induction must be in evidence. However, in comparing the relative deviations of these same treatment data points from their respective projected baseline curves (i.e. g and h of Figure 2), the opposing deviations are clearly seen (i.e. positive contrast).

By visualizing theoretical baseline curves one can similarly compare the relative deviations of each set of treatment points around their respective baseline curves using the actual data presented in Figure 3 (See Figure 3, Appendix B). This figure shows that for five of six subjects, a decrease in reinforcement magnitude in the manipulated component (i.e. from 15 to 7.5 sec of time-out from shock) resulted in a decrease in mean response rate in both components of the multiple schedule (i.e. negative induction). This effect is shown most strongly in three subjects (i.e. 3B, A470, and A157), and to a lesser degree in two subjects (i.e. B487, and B473). Subject A491 showed a very slight negative contrast effect as a function of this manipulation when the behavioral interaction is defined by relative deviations from these theoretical baseline curves. When the reinforcement magnitude was increased in the manipulated component (i.e. from 15 to 30 sec of time-off from shock) all subjects showed bahavioral induction. For three subjects this treatment resulted in relative increases in the mean response rates in both schedule components (i.e. positive induction). This effect is shown most strongly in one subject, A491, and to a lesser degree in two subjects, B487 and B473. For the remaining two subjects this treatment resulted in relative decreases in the mean response rate in both schedule components (i.e. negative induction). This effect is shown most strongly in subject 3B and to a lesser degree in subject A157. Subject A470 did not participate in this final treatment phase due to a drastic 536 percent decrease in her response rate on the eleventh day of the second baseline. Baseline data were taken on this subject for thirty-four additional days but no significant increases in this near-zero rate were observed. This rapid decrement and subsequent low rates (i.e. mean = 3.57 responses per min) were probably due to some novel unauthorized escape response (e.g. urination on the grid floor causing a partial "short circuit").

DISCUSSION

In summary, the present study has shown that positive induction, negative induction, and no systematic interactions can be produced on negative reinforcement schedules by manipulating reinforcement magnitude. Previous research has shown that response rate in a single stimulus, free operant situation is insensitive to changes in reinforcement magnitude; however, when different reinforcement magnitudes are correlated with different stimuli, reinforcement magnitude has the same direct relation to response rate as reinforcement frequency (Keesey & King, 1961; Catania, 1963; and Shettleworth & Nevin, 1965). Likewise, Premack (1965) asserted that manipulations of reinforcement frequency and magnitude are interchangeable procedures for producing behavioral effects which vary with the total amount of reinforcement. Given this similarity, two questions arise: (1) why have changes in reinforcement frequency produced behavioral interactions with more consistency than changes in reinforcement magnitude, and (2) why do changes in reinforcement frequency magnitude on multiple schedules sometimes produce contrast, sometimes induction, and sometimes no systematic effects? By proposing possible solutions to these two general questions, the author intends to explain how and/or why the present data fit into the existing body of literature on behavioral interactions and reinforcement magnitude.

To the first questions, two possible explanations (see Mariner & Thomas, 1969) are suggested and may be labeled: (a) the conditioned reinforcement hypothesis, and (b) the delayed reinforcement hypothesis. The conditioned reinforcement hypothesis suggests that stimuli associated with reinforcement (e.g. magazine light and the sound of magazine operation) come to serve as conditioned reinforcers. In reinforcement magnitude studies, to the degree that these conditioned reinforcers acquire control of beahvior, differences in response rate may be reduced because the amount of conditioned reinforcement is equal in both schedule components. Thus, most reinforcement magnitude studies vary primary but not secondary reinforcement, while reinforcement frequency studies vary both primary and secondary reinforcement. This absence of differential secondary reinforcement could explain why, in the present study, changes in reinforcement magnitude produced some variable main effects.

The delayed reinforcement hypothesis suggests that when reinforcement magnitude is temporally varied, differences in the delay of the end of the reinforcement period (e.g. the magazine cycle or the time-off from shock) constitute differential reinforcement. That is, the first part of both the long and short reinforcement durations are identical; only after the short duration has ended can the subject be differentially affected by the two reinforcement durations. This delay of differential consequences would be expected to decrease the effect of different reinforcement magnitudes. Thus, in reinforcement frequency studies, the differential consequences immediately follow responses; whereas, in reinforcement magnitude studies, the differential consequences are delayed. In the present study, this delay may have been sufficient to partially offset the major effects of the changes in reinforcement magnitude. In summary, either of both of the hypotheses proposed above could account for the decrease in response rate following a 15 sec increase in reinforcement magnitude by three of five subjects in the present experiment.

Two hypotheses have also been proposed to explain why similar conditions sometimes produce contrast, sometimes induction, or sometimes no systematic effects. These hypotheses may be labeled: (1) the stimulus control hypothesis, and (2) the elicitation hypothesis. Pear & Wilkie (1971) suggest that the degree of stimulus control may interact with other treatment variables in the production of behavioral interactions. More specifically, if stimulus control is "strong," then behavioral contrast would be expected; if stimulus control is "weak," then behavioral induction would be expected; and if stimulus control is at some intermediate value, then behavioral interactions may be absent or variable. This account seems to explain why contrast is more reliably found when one component of the multiple schedule is extinction than when other parametric manipulations are in effect. That is, when extinction is present in one component, two cues differentiate the schedule components: (1) the discriminative stimulus and (2) the occurrence of reinforcers. Thus, when extinction is used, schedule components are more easily discriminated than when other conditions are used (Pear & Wilkie, 1971). Since extinciton was not used in the present study, stimulus control may have been weak or intermediate; thus, "strong" behavioral induction in most subjects and "weak" behavioral contrast in one phase with one subject may be more understandable.

On the other hand, the elicitation hypothesis suggests that the presence or absence of responses elicited by stimuli paired with differential reinforcement may be responsible for behavioral interactions on multiple schedules (Keller, 1974). More specifically, if the stimulus signaling the "more favorable" schedule component is projected on the response operandum, then this stimulus may elicit a second class of additional responses which are responsible for behavioral contrast. Conversely, if the stimulus signaling the "more favorable" schedule component is not projected on the response operandum, then elicited responses will be directed away from the operandum and beahvioral induction will occur. This account seems to explain why contrast is most often found by experimenters using pigeons as subjects. That is, in bird chambers, stimuli are usually projected on the response operandum (i.e. on the key); whereas, in other animal chambers, stimuli are not usually projected on the operandum (i.e. lighted levers are rare). Since stimuli signaling schedule components were not projected on the operandum in the present experiment, behavioral induction is perfectly understandable given the elicitation hypothesis. In any case, further research to determine the contribution of stimulus control and/or elicited responses to behavioral interactions is needed.

In conclusion, this study extends the generality of the beahvioral induction phenomena by manipulating a rarely used variable, reinforcement magnitude, on a different paradigm, negative reinforcement, with a novel species, the guinea pig.

REFERENCES

Bloomfield, T.M. Behavioral contrast and relative reinforcement frequency in two multiple schedules. Journal of the Experimental Analysis of Behavior, 1967, 10, 151-158. (a)

Bloomfield, T.M. Some temporal properties of behavioral contrast. Journal of the Experimental Analysis of Behavior, 1967, 10 159-164. (b)

Brethower, Dale M. and Reynolds, G.S. A facilitative effect of punishment on unpunished behavior. Journal of the Experimental Analysis of Behavior, 1962, 5, 191-199.

Catania, A. Charles. Concurrent performances: A baseline for the study of reinforcement magnitude. Journal of the Experimental Analysis of Behavior, 1963, 6, 299-300.

Freeman, Betty Jo. Behavioral contrast: reinforcement frequency or response suppression? Psychological Bulletin, 1971, 75, 347-356.

Halliday, M.S. and Boakes, R.A. Behavioral contrast and response independent reinforcement. Journal of the Experimental Analysis of Behavior, 1971, 16, 429-434.

Herrick, Robert M.; Myers, Jerome L.; and Korotkin, Arthur L. Changes in SD and in S rates during the development of an operant discrimination. Journal of Comparative and Physiological Psychology 52, 359-364.

Herrnstein, R.J. and Brady, J.V. Interactions amoung components of a multiple schedule. Journal of the Experimental Analysis of Behavior, 1958, 1, 293-301.

Keesey, Richard E. and Kling, J.W. Amount of reinforcement and free-operant responding. Journal of the Experimental Analysis of Behavior, 1961, 4, 125-132.

Keller, K. The role of elicited responding in behavioral contrast. Journal of the Experimental Analysis of Behavior, 1974, 21, 249-257.

Khalili, Jamshid; Daley, Marvin F.; and Cheney, Carl D. A titration procedure for generating escape behavior. Behavior Research Methods and Instrumentation, 1969, 1, 293-294.

Mariner, Robert W. and Thomas, David R. Reinforcement duration and the peak shift in post-discrimination gradients. Journal of the Experimental Analysis of Behavior, 1969, 12, 759-766.

Nevin, John A. Differential reinforcement and stimulus control of not responding. Journal of the Experimental Analysis of Behavior, 1968, 11, 715-726.

Nevin, John A. and Shettleworth, Sara J. An analysis of contrast effects in multiple schedules. Journal of the Experimental Analysis of Behavior, 1966, 9, 305-315.

O'Brien, Floyd. Sequential contrast effects with human subjects. Journal of the Experimental Analysis of Behavior, 1968, 11, 537-542.

Pear, Joseph J. and Wilkie, Donald M. Contrast and induction in rats on multiple schedules. Journal of the Experimental Analysis of Behavior, 1971, 15, 289-296.

Pierrel, Rosemary; Sherman, J. Gilmour; Blue, Scot; and Hegge, Frederick. Auditory discrimination: a three-variable analysis of intensity effects. Journal of the Experimental Analysis of Behavior, 1970, 13, 17-35.

Premack, David. Reinforcement theory. In David Levine (Ed.) Nebraska Symposium of Motivation, 1965, 123-180.

Reynolds, George S. Behavioral contrast. Journal of the Experimental Analysis of Behavior, 1961, 4, 57-71. (a)

Reynolds, George S. An analysis of interactions in a multiple schedule. Journal of the Experimental Analysis of Behavior, 1961, 4, 107-117.

Reynolds, George S. Some limitations on behavioral contrast and induction during successive discrimination. Journal of the Experimental Analysis of Behavior, 1963, 6, 131-139.

Shettleworth, Sara and Nevin, John A. Relative rate of response and relative magnitude of reinforcement in multiple schedules. Journal of the Experimental Analysis of Behavior, 1965, 8, 199-2-2.

Smith, Morcrieff H., Jr. and Hoy, William J. Rate of response during operant discrimination. Journal of Experimental Psychology, 1954, 48, 259-264.

Terrace, H.S. Discrimination learning with and without errors. Journal of the Experimental Analysis of Behavior, 1963, 6, 1-27.

Terrace, H.S. Discrimination learning, the peak shift, and behavioral contrast. Journal of the Experimental Analysis of Behavior, 1968, 11, 727-741.

Waite, Wendon W. and Osborne, J. Grayson Sustained behavioral contrast in children. Journal of the Experimental Analysis of Behavior, 1972, 18, 113-117.

Wertheim, George A. Behavioral contrast during multiple avoidance schedules. Journal of the Experimental Analysis of Behavior, 1965, 8, 269-278.

Wilkie, Donald M. Variable-time reinforcement in multiple and concurrent schedules. Journal of the Experimental Analysis of Behavior, 1972, 17, 59-66.

Yarczower, Matthew, Dickson, James F.; and Gollub, Lewis R. Some effects on generalization gradients of tandem schedules. Journal of Experimental Analysis of Behavior, 1966, 9, 631-639.

APPENDIXES

Appendix A.

Tables

TABLE 1

A Graphic Comparison Of the Various Types Of Behavioral Interactions As a Function Of the Relative Changes In Response Rate Within the Constant And Manipulated Components Of a Multiple Schedule Of Reinforcement.

RELATIVE DIRECTION OF THE BEHAVIORAL INTERACTION	ABSOLUTE CHANGE IN RESPONSE RATE IN THE CONSTANT COMPONENT	ABSOLUTE CHANGE IN RESPONSE RATE IN THE MANIPULATED COMPONENT
Induction "Same"	Positive "Increase"	"Increase"
	Negative "Decrease"	"Decrease"
Contrast "Opposite"	Positive "Increase"	"Decrease"
	Negative "Decrease"	"Increase"

TABLE 2

A Comparison Of the Experimental Conditions In the Constant And Variable Components Of the Mult VI 10-Sec VI 10-Sec Schedule of Negative Reinforcement.

SUBJECTS	CONDITION	PHASE	CONSTANT COMPONENT		MANIPULATED COMPONENT	
			NUMBER OF COMPONENTS PER SESSION	REINFORCEMENT MAGNITUDE	NUMBER OF COMPONENTS PER SESSION	REINFORCEMENT MAGNITUDE
A157 A491	#TO	Baseline-1	8	15	8	15
		Treatment-7.5	12	15	6	7.5
		Baseline-2	8	15	8	15
		Treatment-30	6	15	12	30
		Baseline-3	8	15	8	15
B487 B473	TST	Baseline-1	8	15	8	15
		Treatment-7.5	8	15	8	7.5
		Baseline-2	8	15	8	15
		Treatment-30	8	15	8	30
		Baseline-3	8	15	8	15
A470 3B	TAS	Baseline-1	8	15	8	15
		Treatment-7.5	6	15	12	7.5
		Baseline-2	8	15	8	15
		Treatment-30*	12	15	6	30
		Baseline-3	8	15	8	15

Symbol Key: #TO = Approximately equal number of time-outs from shock per component
TST = Approximately equal time in the presence of shock per component
TAS = Approximately equal time in the absence of shock per component

*Subject A470 did not participate in the Treatment-30 Phase due to an unexpected 536% decrease in response rate on the eleventh day of Baseline-2.

TABLE 3

The Means And Standard Devaitions Of the Subjects' Response Rates In the Constant And Manipulated Components Of the Mult VI 10-Sec VI 10-Sec Schedule Of Negative Reinforcement.

SUBJECT	COMPONENT	EXPERIMENTAL CONDITIONS BASELINE-1 MEAN (N) S.D.	TREATMENT-7.5 MEAN (N) S.D.	BASELINE-2 MEAN (N) S.D.	TREATMENT-30 MEAN (N) S.D.	BASELINE-3 MEAN (N) S.D.
A157	constant	154.9030 (15) 43.2436	139.5930 (15) 30.0084	141.1510 (15) 27.9291	102.1030 (14) 17.3645	81.5607 (14) 41.9111
	manipulated	156.4790 (15) 39.2590	140.5020 (15) 20.5033	143.7210 (15) 26.3386	115.5860 (14) 14.0876	101.1340 (14) 23.4501
A491	constant	78.9713 (15) 27.7288	66.3079 (15) 24.8896	62.9860 (15) 30.2068	64.7028 (14) 41.7764	9.0034 (10) 8.1741
	manipulated	82.3490 (15) 19.7205	72.4676 (15) 23.4037	56.6473 (15) 30.4286	73.6143 (14) 47.7644	13.3000 (10) 9.4539
B487	constant	56.0193 (15) 20.5686	41.3420 (15) 29.2019	38.4520 (15) 18.9186	31.3581 (16) 11.4479	14.3727 (15) 4.8861
	manipulated	63.9693 (15) 27.0880	43.3893 (15) 17.2061	33.6760 (15) 16.2195	30.3894 (16) 12.5972	12.7360 (15) 5.6006
B473	constant	18.8993 (15) 9.3669	8.1113 (15) 4.9966	6.8746 (13) 4.3613	13.9400 (15) 9.1406	9.3625 (16) 5.9928
	manipulated	20.3560 (15) 9.0890	8.8273 (15) 7.3697	6.1585 (13) 3.7226	12.4980 (15) 8.5458	8.8875 (16) 5.1213
A470	constant	33.1340 (15) 18.3347	17.4180 (15) 18.7863	26.5920 (10) 13.5365	not run	2.6291 (35) 2.5080
	manipulated	32.3033 (15) 22.5286	26.2313 (15) 22.5356	32.0940 (10) 13.7664	not run	4.3166 (35) 3.7219
3B	constant	41.2467 (15) 33.0675	22.7520 (15) 7.3168	37.1440 (20) 16.8601	21.5500 (14) 12.5813	28.2045 (11) 10.1999
	manipulated	44.8766 (15) 36.1165	22.8733 (15) 7.1675	38.7415 (20) 16.8557	24.1643 (14) 12.8091	28.8491 (11) 9.3796

Symbol Key: S.D. = standard deviation
(N) = number of sessions

Appendix B

Figures

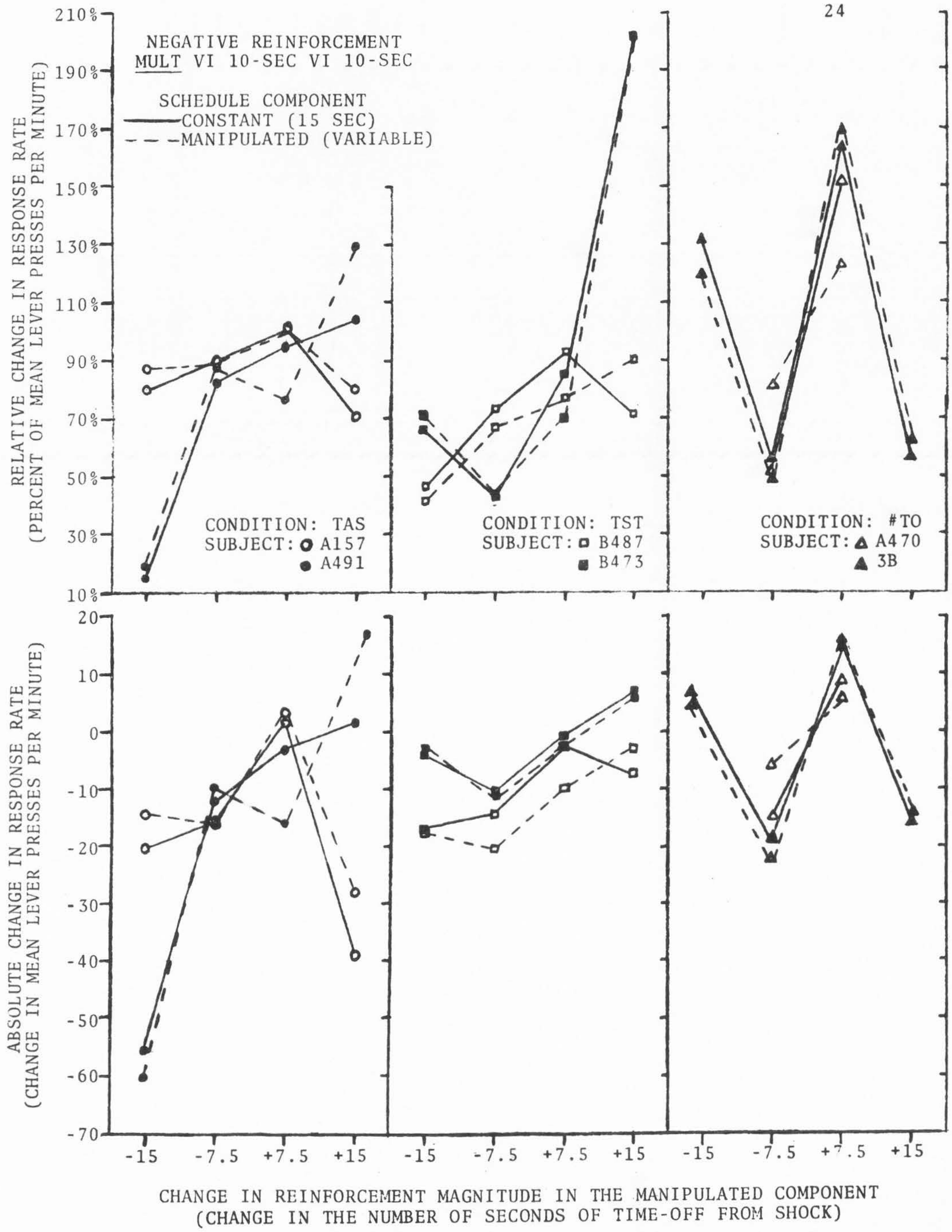

Figure 1. Absolute and relative changes in mean response rates in the constant and manipulated components as a function of four changes in reinforcement magnitude in the manipulated component of a mult VI 10-sec VI 10-sec schedule of negative reinforcement.

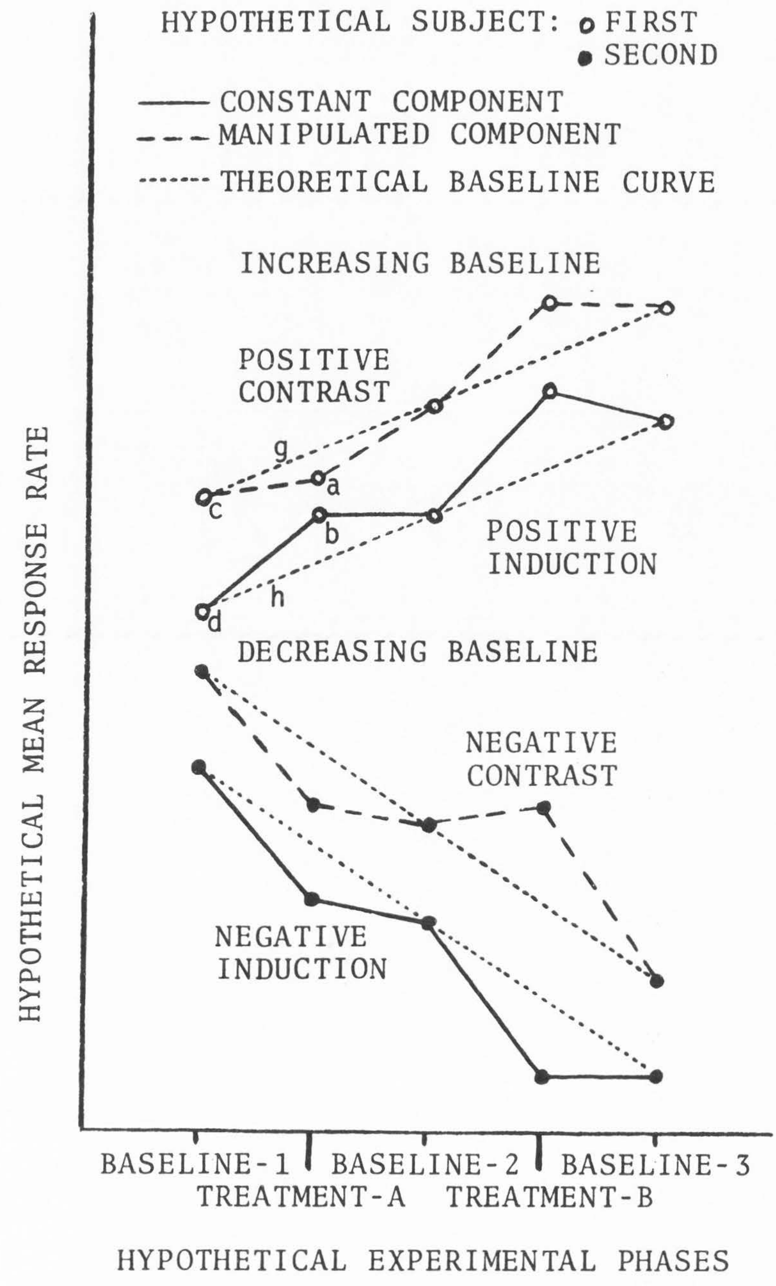

Figure 2. Hypothetical data from two "subjects on a multiple schedule of reinforcement presented to graphically illustrate a method for evaluating behavioral interactions on changing baselines (i.e. increasing or decreasing).

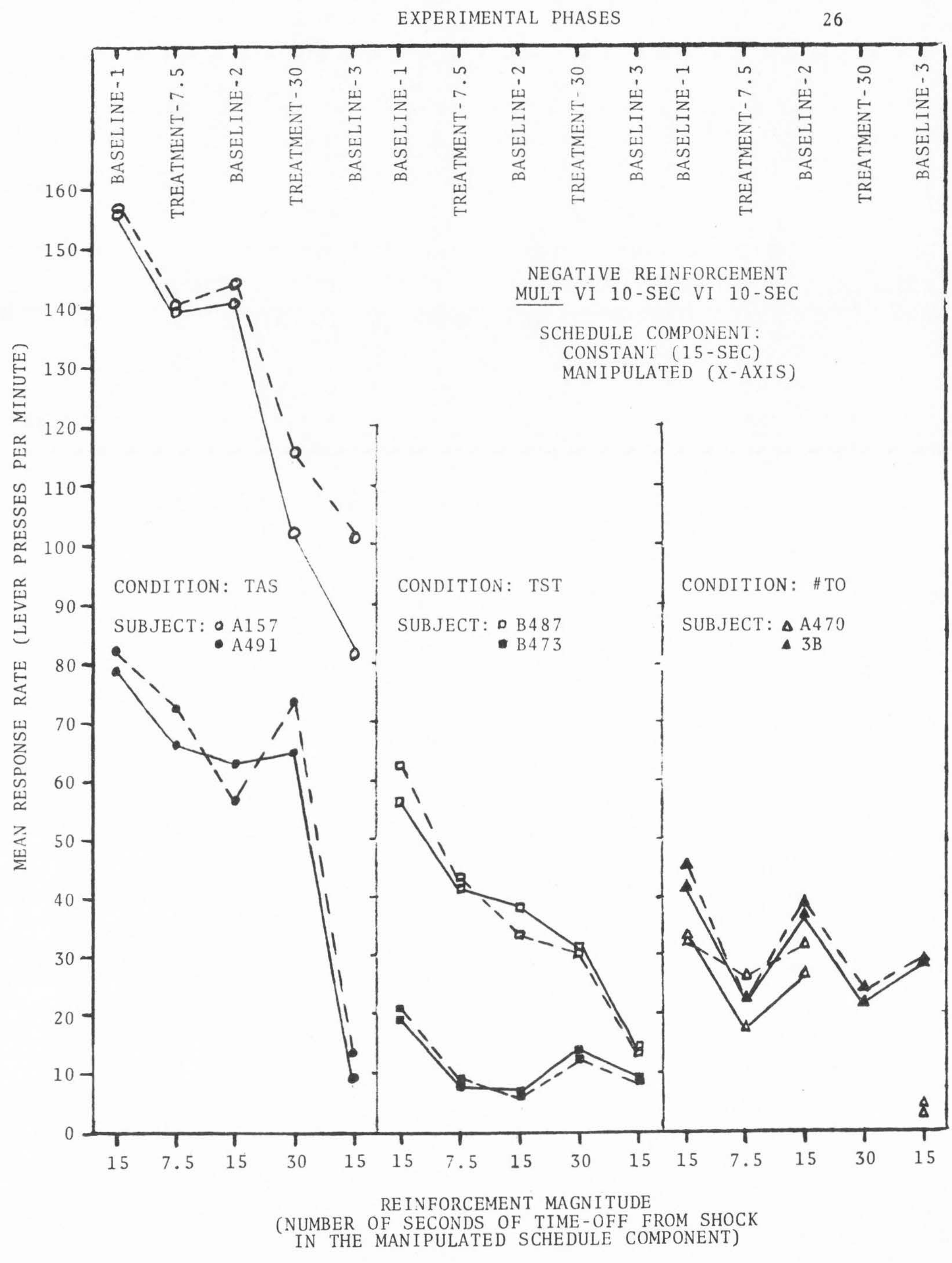

Figure 3. Mean response rate as a function of five experimental phases in which reinforcement magnitude was manipulated on a mult VI 10-sec VI 10-sec schedule of negative reinforcement.

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TEACHING EXPERIENCE

1972 Guest Lecturer, Introductory Psychology, Department of Psychology, Utah State University, Logan, Utah.

1972 Graduate Instructor, Department of Psychology, Utah State University, Logan, Utah. Taught Perception.

1971	Guest Lecturer, Introductory Psychology, Department of Psychology, Utah State University. Logan, Utah.
1970 - 1971	Teaching Assistant, Physiological Psychology Department of Psychology, Utah State University, Logan, Utah.
1970	Student Teacher, Portage Junior High School, Portage, Michigan. Taught Biology and Chemistry.
1969	Teaching Assistant, Behavior Modification II, Department of Psychology, Western Michigan University, Kalamazoo, Michigan.
1968	Teaching Assistant, Psychology I, Department of Psychology, Western Michigan University. Kalamazoo, Michigan.

RESEARCH AND RELATED EXPERIENCE

1974 - 1975	Research Design Specialist and Materials Programmer, Instructional Development Contract Number OEC-0-74-9327, Bureau of Education for the Handicapped, Department of Health, Education, and Welfare.
1974	Supervisor of Research Design and Evaluation, Davis County In-Service Training Program, Davis County School District, Utah Public Schools.
1973 - 1974	Programmed Experiments and Statistical Analyses in ASSEMBLER and FOCAL on the Digital Computer (PDP-8/L), Exceptional Child Center, Utah State University.
1970 - 1973	Set up and Programmed Electromechanical Equipment for Basic Animal Research, Psychology Animal Laboratory, Utah State University.
1970 - 1973	Conducted Basic Animal Research in Escape Behavior, Psychology Animal Laboratory, Utah State University.
1969	Conducted Basic Animal Research in Aggression, Psychology Animal Laboratory, Western Michigan University.

ADMINISTRATIVE, SUPERVISORY, AND OTHER RELATED EXPERIENCE

1974 - 1975	Field Coordinator for "The Development of Mediated Training Programs for Workers with the Handicapped."

1974 — Developed evaluation materials for the following Projects and Programs Funded under Title I of the Developmental Disabilities Act and Administered by the Governor's Developmental Disabilities Council for the State of Idaho:

(a) The Idaho Epilipsy League Project,
(b) The Idaho Association of Retarded Children Program,
(c) The Idaho Cerebral Palsy Association Program,
(d) The Preschool Learning Laboratory Program,
(e) The State School and Hospital in Physical Therapy Program,
(f) TORCH (The Teen Organization of Retarded Children),
(g) The Work Activity Center

1973 - 1974 — Developed, Managed, and Evaluated the Davis County In-Service Training Program, Davis County School District, Utah Public Schools.

HONORS AND AWARDS

1970 - 1973 — National Defense Education Act Fellowship

1967 - 1970 — State of Michigan Scholarship

PROFESSIONAL AFFILIATION

American Association of University Professors
American Psychological Association, Division 25
Digital Equipment Computer Users Society

PUBLICATIONS, BOOKLETS, AND PAPERS

Dissertation -- The Effects of Rapid Feedback and Prescriptive Remediation via the computer program "Student Monitor III" on Student Grades and Attitudes.

Burns, Dennis L. and William R. Jenson (Eds.) Classroom Management and Communication, Logan, Utah: U.S.U. Copy Center II, 1974.

Burns, Dennis L. and William R. Jenson (Eds.) Developing Communication Skills, Logan, Utah: U.S.U. Copy Center II, 1974.

Thesis -- Behavioral Induction in Guinea Pigs as a Function of Reinforcement Magnitude in Multiple Schedules of Negative Reinforcement.

REFERENCES

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