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RESISTANCE TO EXTINCTION AS A
FUNCTION OF THE NUMBER OF BLOCKS OF
FIXED-RATIO REINFORCEMENT

Thesis for the Degree of M. A.

MICHIGAN STATE COLLEGE

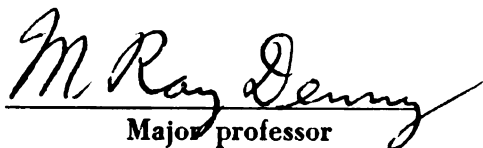
Ruth Holm Wells

1952

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RESISTANCE TO EXTINCTION AS A
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RUTH HOLM WELLS

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OF BLOCKS OF FIXED-RATIO REINFORCEMENT

By

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INTRODUCTION

Until recently most learning experiments were designed to give 100% or continuous reinforcement, that is, one reward for each correct response, during acquisition trials and 0% or no reward during extinction trials. In this context, response strength as measured by resistance to extinction has been postulated as being simply a negatively accelerated increasing function of the number of reinforcements (1). However, this began to appear to be an inadequate generalization when considered in light of the results obtained under conditions of partial reinforcement.

In a recent review of partial reinforcement studies, Jenkins and Stanley (2) draw the following empirical generalizations concerning partial reinforcement:

1. Acquisition. Response strength is built up somewhat more rapidly under a schedule of 100% reinforcement than under a partial regimen. Differences in learning, however, are not always large, and with prolonged training the ultimate level of acquisition for partially rewarded subjects may approach that for the 100% ones.
2. Maintenance. While the behavior in post-acquisition performance is stable in the partial reinforcement situation, it is usually at a lower level than in the 100% instance. Nevertheless, the differences are not always statistically significant and may well be of no great practical consequence.
3. Resistance to extinction. The most striking effects of partial reinforcement are apparent in response strength as measured by resistance to extinction. In almost every experiment, large and significant differences in extinction favoring the groups partially reinforced in conditioning over the 100% ones were found. The practical implication of this principle for maintaining behavior is obvious: Administer the reinforcing stimulus in conditioning according to a partial schedule, and the behavior will be maintained for long periods in the absence of external support from primary reward.

The earliest investigations of partial reinforcement were performed by Skinner in 1933 and 1936, using a bar-pressing apparatus.

According to Skinner he was studying a response chain which included the bar-pressing response, orientation and approach to the food tray, and the eating of a small food pellet which was released mechanically when the bar-pressing response occurred. Since the chain is uninterrupted and consistently reinforced with the occurrence of the terminal member of the chain, eating, he assumed that the response strength of any member could serve as a measure of the response strength of the chain. Thus, the strength of the bar-pressing response, as a convenient member of the chain to measure became the accepted index of the strength of the chain. In a partial reinforcement situation, Skinner also assumed that the rewarded bar-pressing response is but a member of a chain of like responses. The response unit is the complete chain and not any individual part of that chain. The chain itself has strength (reflex reserve) even though only the terminal member of the chain is reinforced. He states, "As a rather general statement, it may be said that when a reinforcement depends upon the completion of a number of similar acts, the whole group tends to acquire the status of a single response, and the contribution of the reserve tends to be in terms of the group." (4) For example, with a fixed-ratio of one reward for five bar presses (1/5), the response consists of four unrewarded bar presses followed by a rewarded one.

In contrast, from the point of view which one might attribute to Hull (1) one could assume that the habit of bar-pressing is being reinforced once and non-reinforced four times. And it is only within this framework that the term, partial reinforcement, actually applies. Within Skinner's system, the total chain of five bar-pressing responses is being reinforced 100% of the time. If one interprets Hullian theory broadly, however, the proper question would seem to be, "Are not the

results obtained from so-called partial reinforcement actually in agreement with the statement that resistance to extinction is a negatively accelerated increasing function of the number of reinforcements?" Each bar-pressing response often has been treated as a discrete habit but whether this is the most accurate and consistent way of analyzing the response pattern being learned is questionable. In other words, if the response being learned is correctly identified it is our contention that resistance to extinction is consonant with a Hullian framework.

In the present study, partial reinforcement is viewed as a rather complex learning situation which differs significantly from the simple continuous reinforcement situation. By administering blocks of 1/5 fixed-ratio reinforcement to animals which have already reached an asymptotic level of habit strength with continuous reinforcement, we expect to demonstrate that an increase in response strength cannot be attributed to a mere strengthening of the previously acquired habit. Rather, it is posited that an increase in response strength must be explained as the acquisition of a new discrimination habit based on the discriminative stimulus present from the mechanical sound of the food-releasing mechanism on the last and rewarded bar press of each block of five responses and also on the response-produced cues of the first four unrewarded responses. This discrimination habit should become apparent as the animals learn to make the response of approaching the food tray at the one point in the sequence which is rewarded. The strength of this new discrimination habit, like other habits, should be an increasing function of the number of reinforcements.

The bar-pressing apparatus most frequently used in partial reinforcement experiments has been a Skinner box with the bar located

directly above or closely adjacent to the food tray. In this type of apparatus it has not been possible to measure the bar-pressing and approaching the food tray responses in an independent fashion. In the present study a modification of the original Skinner box was therefore introduced and a new box was designed and built in order to effect independent measurements. The apparatus has a metal bar at one end of the box and the food tray at the opposite end; thus, the animals' response pattern is broken into two distinct elements, the bar press and the approach to the food tray. Given these two independent measures, it is possible to plot the course of acquisition of the discrimination habit of partial reinforcement in terms of the making an approach to the food tray after each reinforced response and the failure to make approaches to the food tray after the first four bar-pressing responses of each fixed-ratio block.

STATEMENT OF THE PROBLEM

The present experiment was designed to determine the functional relationship between the resistance to extinction of a bar-pressing response and the number of blocks of fixed-ratio reinforcement in a modified Skinner box situation. In general, it is hypothesized that resistance to extinction is directly related to the strength of the discrimination habit of partial reinforcement and that the degree of discrimination obtained is an increasing function of the number of blocks of fixed-ratio reinforcement. With the attainment of perfect discrimination, the proportional increase in resistance to extinction of groups with fixed-ratio reinforcement over groups with continuous reinforcement should be equal to the reciprocal of the reinforcement ratio used, and should approach the reciprocal of that ratio as discrimination approaches perfection. It is further hypothesized that the strength of the habit of approaching the food tray, per se, is independent of the strength of the discrimination habit formed.

The specific hypotheses to be investigated are as follows:

1. The number of bar-pressing responses during extinction will be an increasing function of the number of blocks of fixed-ratio reinforcement.
2. The total number of approaches to the food tray during extinction will remain constant with increasing blocks of fixed-ratio reinforcement.
3. The approaches to the food tray following the first, second, third, and fourth bar presses will tend to drop out with increasing blocks of fixed-ratio reinforcement while the approach response will continue to be made following the fifth or rewarded bar press.

Although the present study was not designed to effect a perfect discrimination habit of partial reinforcement we would expect among the animals receiving the largest number of fixed-ratio reinforcements that there would be a tendency for our results to approach the following relationship.

4. When a perfect discrimination habit obtains during $1/5$ fixed-ratio reinforcement there will be approximately 5 times the number of bar-pressing responses to the extinction criterion as are present with continuous reinforcement.

EXPERIMENTAL PROCEDURE

Apparatus

The apparatus (Figure 1) was an unpainted wooden box, 6 in. in height, 24 in. in length, and $4\frac{1}{2}$ in. in width, the interior of which was lined with tin. The top was a hinged door constructed of hardware cloth. The experimental apparatus was lighted by a $7\frac{1}{2}$ watt bulb which hung 12 in. directly overhead. A piece of tin fashioned into a small food tray was located at one end of the box. Food was introduced through a chute directly into the food tray by means of a mechanically operated food-releasing mechanism connected to the outside of the apparatus. An 8 in. metal plate forming the floor at this end of the box was constructed in such a way that all approaches to the food tray would be automatically recorded. A 2 in. metal bar extended into the box at the opposite end from the food tray. When a pressure of approximately 30 grams was applied to this, the food-releasing mechanism was activated and a pellet of food dropped through the chute and into the food tray. The activation of this food-releasing mechanism produced a discriminative auditory stimulus which was present only at the time of the release of food. Water was present throughout the experiment.

The feeding mechanism and bar were connected to an electronic control panel. This device was designed and built for the Michigan State College Psychology Department by Mr. T.H. Maatsch to remotely control several significant variables employed in learning studies. Among other things, the device allows for fingertip control of the ratio of reinforcement employed and the duration of the delay of reinforcement. Rate of rewarded responding can also be manipulated

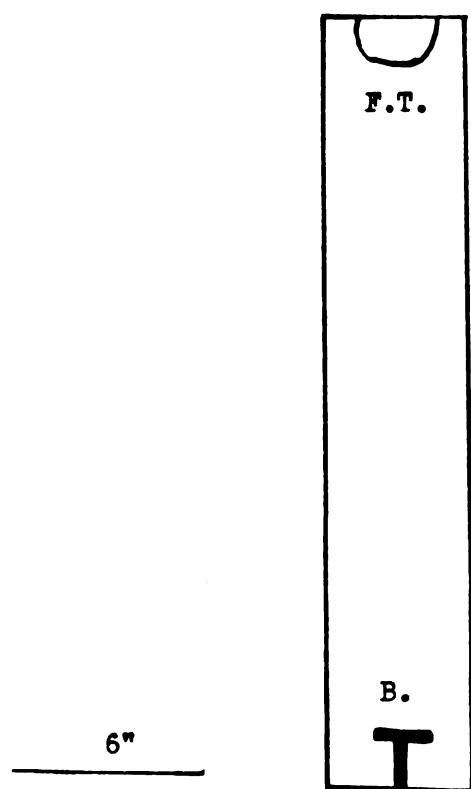


Figure 1. Diagrammatic presentation of the bar-pressing apparatus. F.T. - food tray, B. - bar.

and hoarding through repetitive responding eliminated. The device also records automatically the number and duration of bar pressing, occurrences of reward, time, and presence of the rat at the food tray. The fact that the device is completely automatic and allows for remote control of the relevant variables made it possible to eliminate preliminary training procedures and to simplify the experimental methodology.

Subjects

The subjects used in this experiment were 42 naive albino rats, 30 male and 12 female, from the rat colony maintained by the psychology department of Michigan State College. The animals were between 90 and 120 days old at the time of the experiment.

Preliminary Training

The animals were placed on a 24 hr. feeding schedule and received 9 grams of Purina dog chow for five days. On the fifth day, the animals were fed in individual feeding cages in which they remained for 48 hrs. without additional food so that all subjects started the experiment after a 48 hr. period of food deprivation. The only handling of these animals prior to the experiment was in moving them from the home cage to the individual cages on the fifth day and in placing them in the modified Skinner box at the time of the experiment.

All animals were allowed to explore the experimental apparatus for ten minutes before training was started. During this ten minutes, the bar was in place but there was no food in the food releasing mechanism so that bar pressing did not result in a food reward. Two pellets of food were in the food tray at the beginning of this period to lessen the emotionality of the animals since they were previously unhandled and became disturbed when carried from the

feeding cage to the experimental apparatus.

The operant level of the subjects was measured during the ten minute period and animals which made less than two bar presses were discarded; 3 animals were discarded on this basis. At the end of the exploratory period, a period of approximately 10-15 minutes was used to stimulate faster learning with some animals. For instance, if an animal sat sniffing the food tray instead of exploring any further, a scratching sound was made near the bar to lure the rat in that direction. The food, .05 gram calf mamma pellets, was released manually during this training period so that animals which pressed the bar several times before returning to the food tray received only one pellet instead of several.

As soon as the animals showed any overt sign of learning, the food-releasing mechanism was loaded, extraneous cues were discontinued, and the animals were allowed to continue at their own speed. The animals received approximately 5-10 pellets during this 10-15 min. period and then started a block of 40 trials with continuous reinforcement.

Procedure

After preliminary training, the animals were separated into 6 groups, Control Group 40, 9 animals, started extinction trials immediately following the 40 rewarded trials. Control Group 90, 9 animals, received 50 additional rewarded trials before starting extinction trials. These two control groups were used to control the influence of the number of reinforcements, per se, and the influence of 50 additional reward pellets on drive during acquisition and extinction. They also served to establish the minimum level of resistance to extinction which obtains for 40 and 90 reinforcements, when

continuously administered.

Four experimental groups of 6 animals each were used. These groups received varying amounts of fixed-ratio (1/5) reinforcement trials following the 40 rewarded trials and then were immediately extinguished. Experimental Group 10 received 10 blocks of fixed-ratio reinforcement, Group 20 received 20, Group 50 received 50, and Group 80 received 80. A 10 minute period without any bar-pressing responses was used as the extinction criterion for all groups. Each animal followed through the sequence of preliminary training, acquisition trials, and extinction trials during one continuous experimental period lasting from $1\frac{1}{2}$ to $5\frac{1}{2}$ hours.

Summary of Experimental Procedure

<u>Control</u>	
<u>Group 40</u>	<u>Group 90</u>
1. Habituation	1. Habituation
2. 40 Reinforcements continuous	2. 90 Reinforcements continuous
3. Extinction	3. Extinction
<u>Experimental</u>	
<u>Group 10</u>	<u>Group 20</u>
1. Habituation	1. Habituation
2. 40 Reinforcements continuous	2. 40 Reinforcements continuous
3. 10 Reinforcements fixed-ratio	3. 20 Reinforcements fixed-ratio
4. Extinction	4. Extinction
<u>Group 50</u>	<u>Group 80</u>
1. Habituation	1. Habituation
2. 40 Reinforcements continuous	2. 40 Reinforcements continuous
3. 50 Reinforcements fixed-ratio	3. 80 Reinforcements fixed-ratio
4. Extinction	4. Extinction

RESULTS

The mean number of bar-pressing responses made during extinction by each of the 6 groups is shown in Fig. 2, where we see that Hypothesis 1 is clearly confirmed. Statistical analysis of these data, given in Tables 1 and 3, indicates that the two control groups, receiving 40 and 90 rewards, do not differ significantly from each other. From this fact, we can conclude that the subjects reached an asymptotic level of responding in a continuous reinforcement learning situation with 40 rewarded trials, since an added 50 trials made no measurable difference in responses to extinction. Experimental Group 10 does not differ significantly from the two control groups. However, Experimental Group 20 made significantly more responses than the control groups but does not differ significantly from Experimental Group 10. Experimental Groups 50 and 80 made more bar-pressing responses than the control groups, significant at the 1% level of confidence. The difference between Group 10, 46 responses, and Group 50, 89.8 responses, is significant at the 5% level and the difference between Group 10 and Group 80, 105.5 responses, is significant at the 1% level. These results lend support to the hypothesis that fixed-ratio reinforcement yields higher extinction scores than continuous reinforcement.

The mean number of bar-pressing responses made during the last ten minutes of acquisition trials by each of the 6 groups can be used as another measure of the strength of the bar-pressing response. These data are shown in Fig. 3. Statistical analysis of these data, Tables 2 and 4, indicates that the two control groups do not differ significantly from each other. Experimental Groups 10 and 20 do not differ significantly from the control groups nor from each other. However, Group 50

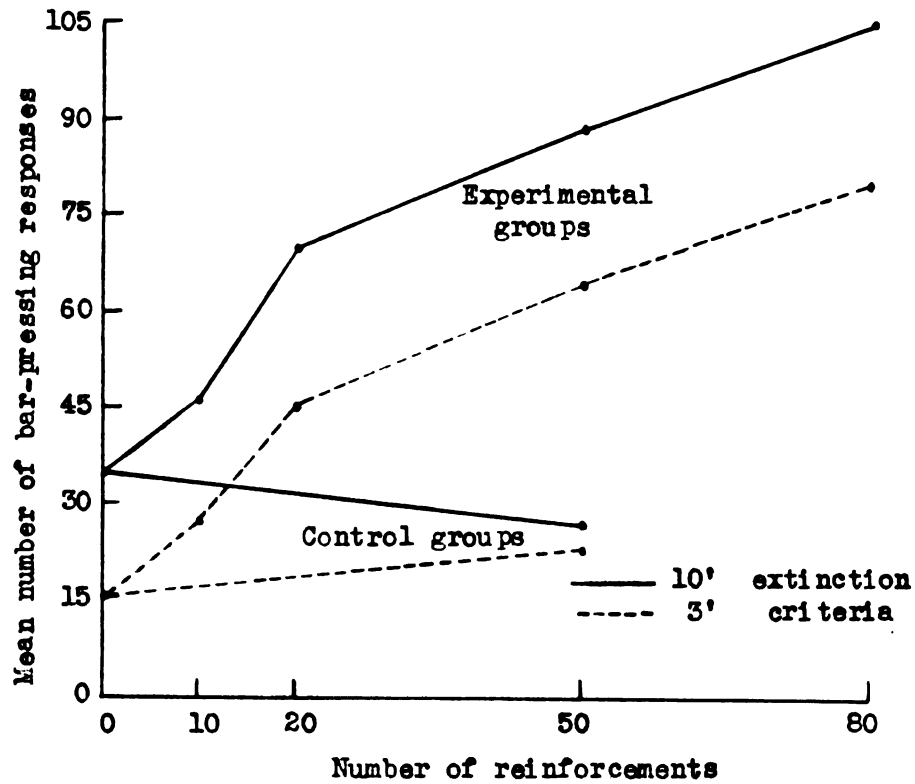


Figure 2. A comparison of the mean number of bar-pressing responses to extinction by control groups with continuous reinforcement and experimental groups with fixed-ratio reinforcement.

TABLE 1

Summary of analysis of variance of two control groups, 9 animals each, and four experimental groups, 6 animals each, of the number of bar-pressing responses made to extinction.

Source of variance	d.f.	Mean Square	sig. F	p
Total	83			
Between subjects	41			
Between groups	11	5,831.4	4.95	.01
Extinction criteria (3' - 10')	1	7,150.2	6.06	.05
Experimental condition	5	11,139.2	9.45	.01
Extinction criteria and exp. condition	5	259.8		
Between subjects within group	30	1,179.2		
Within subjects	42			

TABLE 2

Summary of analysis of variance of two control groups, 9 animals each, and four experimental groups, 6 animals each, of the number of bar-pressing responses made during 10 min. period immediately prior to extinction.

Source of variance	d.f.	Mean Square	sig. F	p
Total	41			
Between groups	5	537.4	8.0	.01
Within groups	36	67.5		

TABLE 3

Summary of t ratios for comparison of control and experimental groups based upon the number of bar-pressing responses to extinction.

Group	N	M	t	p
Control groups	18	31.25		
Experimental 10	6	46.0	.91	---
Control groups	18	31.25		
Experimental 20	6	70.7	2.43	.03
Control groups	18	31.25		
Experimental 50	6	89.8	3.62	.01
Control groups	18	31.25		
Experimental 80	6	105.5	4.58	.01
Experimental 10	6	46.0		
Experimental 20	6	70.7	1.25	---
Experimental 10	6	46.0		
Experimental 50	6	89.8	2.21	.05
Experimental 10	6	46.0		
Experimental 80	6	105.5	3.01	.01
Experimental 20	6	70.7		
Experimental 50	6	89.8	.96	---
Experimental 20	6	70.7		
Experimental 80	6	105.5	1.76	---
Experimental 50	6	89.8		
Experimental 80	6	105.5	.79	---

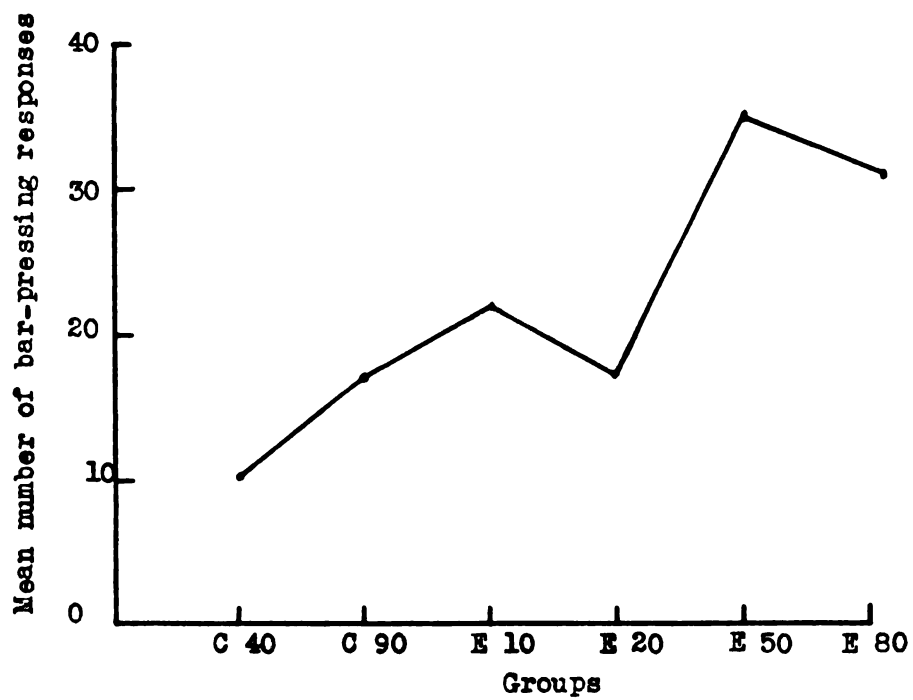


Figure 3. Mean number of bar-pressing responses made during 10 min. period immediately prior to extinction. (C - control; E - experimental)

TABLE 4

Summary of t ratios for comparison of control and experimental groups based on number of bar-pressing responses during 10 min. period immediately prior to extinction.

Group	N	M	t	p
Control groups	18	15.05		
Experimental 10	6	22.3	1.67	---
Control groups	18	15.05		
Experimental 20	6	17.0	.45	---
Control groups	18	15.05		
Experimental 50	6	34.7	4.53	.01
Control groups	18	15.05		
Experimental 80	6	31.3	3.75	.01
Experimental 10	6	22.3		
Experimental 20	6	17.0	1.12	---
Experimental 10	6	22.3		
Experimental 50	6	34.7	2.62	.02
Experimental 10	6	22.3		
Experimental 80	6	31.3	1.89	.07
Experimental 20	6	17.0		
Experimental 50	6	34.7	3.74	.01
Experimental 20	6	17.0		
Experimental 80	6	31.3	3.02	.01
Experimental 50	6	34.7		
Experimental 80	6	31.3	.72	---

made significantly more responses during the 10 minute period than the control groups, Group 10, and Group 20; and Group 80 made significantly more responses than the control groups and Group 20, although the difference between Group 80 and Group 10 is only significant at the 7% level of confidence.

In considering the mean number of approaches to the food tray during extinction, we find, as predicted in Hypothesis 2, no statistically significant differences among any of the experimental groups, Table 5. Fig. 4 shows a comparison of the bar-pressing response and the response of approaching the food tray as functions of the number of blocks of fixed-ratio reinforcement.

When the response of approaching the food tray is considered from the viewpoint of mean approaches per bar press during the acquisition trials, it is found that significantly fewer approaches were made during the last block of ten trials than during the first block of ten trials, Fig. 5. This graph shows a steady decrease in the number of approaches per block of 5 bar presses with added trials. Fig. 6 shows a comparison of the mean number of approaches made on the first, third, and fifth of the block of 5 individual bar presses for every 10th acquisition trial. Inspection of this graph indicates that the animals continued to respond on the fifth or rewarded bar press but that the earlier or non-rewarded responses tended to drop out. This lends support to Hypothesis 3.

Fig. 7 presents the mean number of approaches made on the first, third, and fifth individual bar presses during alternate extinction trials; inspection of this figure will show that the discrimination habit persists throughout extinction. The approach response tended to drop out after the first and third bar presses while after

TABLE 5

Summary of analysis of variance of four experimental groups, 6 animals each, of the number of approaches to the food tray during extinction.

Source of variance	d.f.	Mean Square	sig. F	p
Total	47			
Between subjects	23	841.7	---	---
Between groups	7	272.0	---	---
Extinction Criteria	1	1344.1	---	---
Exp. condition	3	139.8	---	---
Criteria and exp. condition	3	46.8	---	---
Between subjects within group	16	1091.0		
Within subjects	24	112.3		

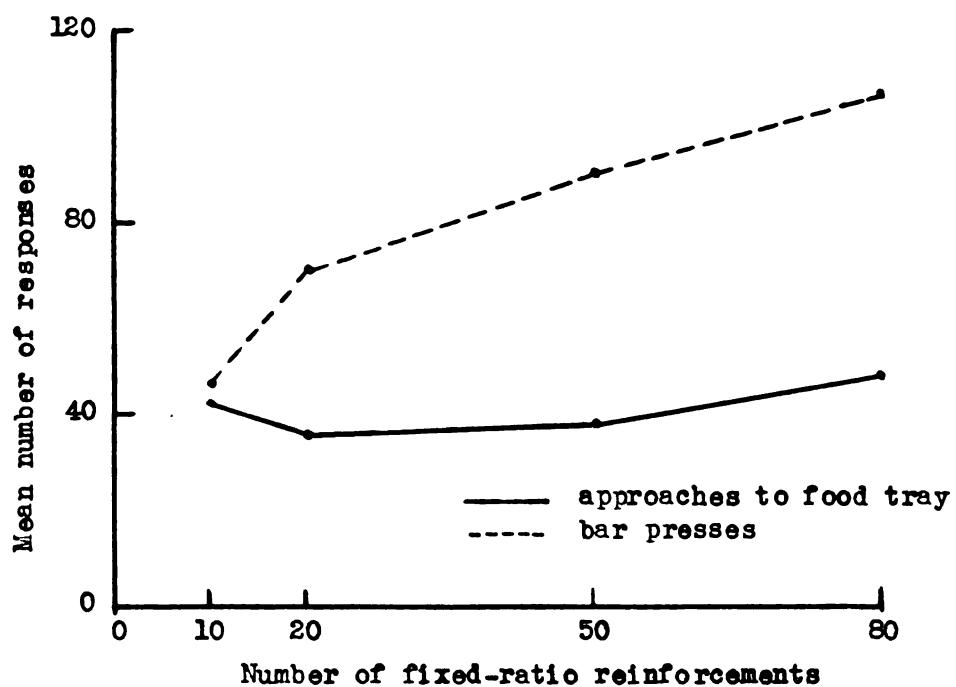


Figure 4. A comparison of the mean number of responses of bar-pressing and approaching the food tray during extinction.

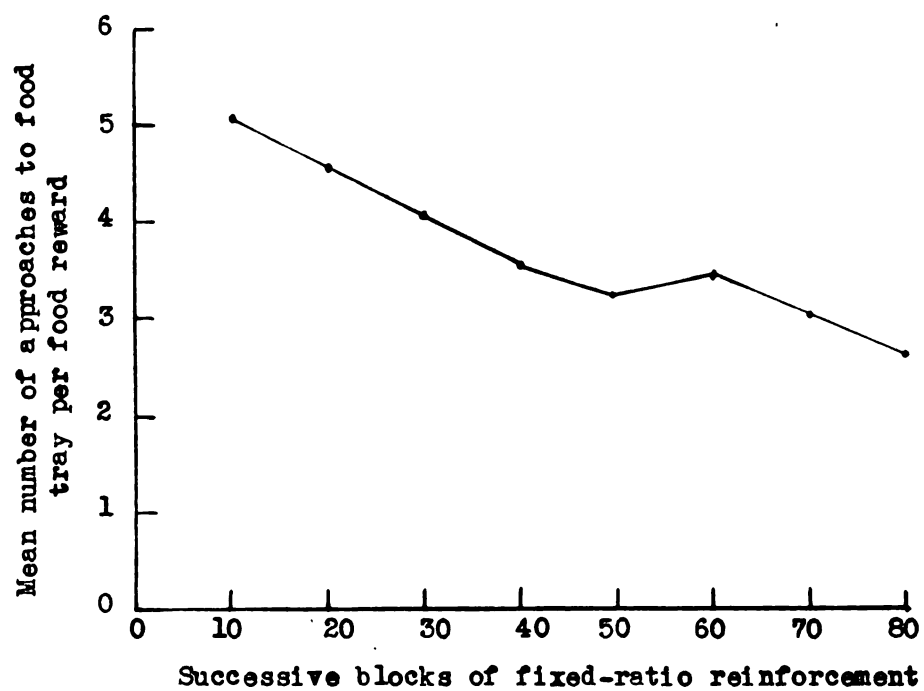


Figure 5. Discrimination habit strength as a function of the number of blocks of fixed-ratio reinforcement.

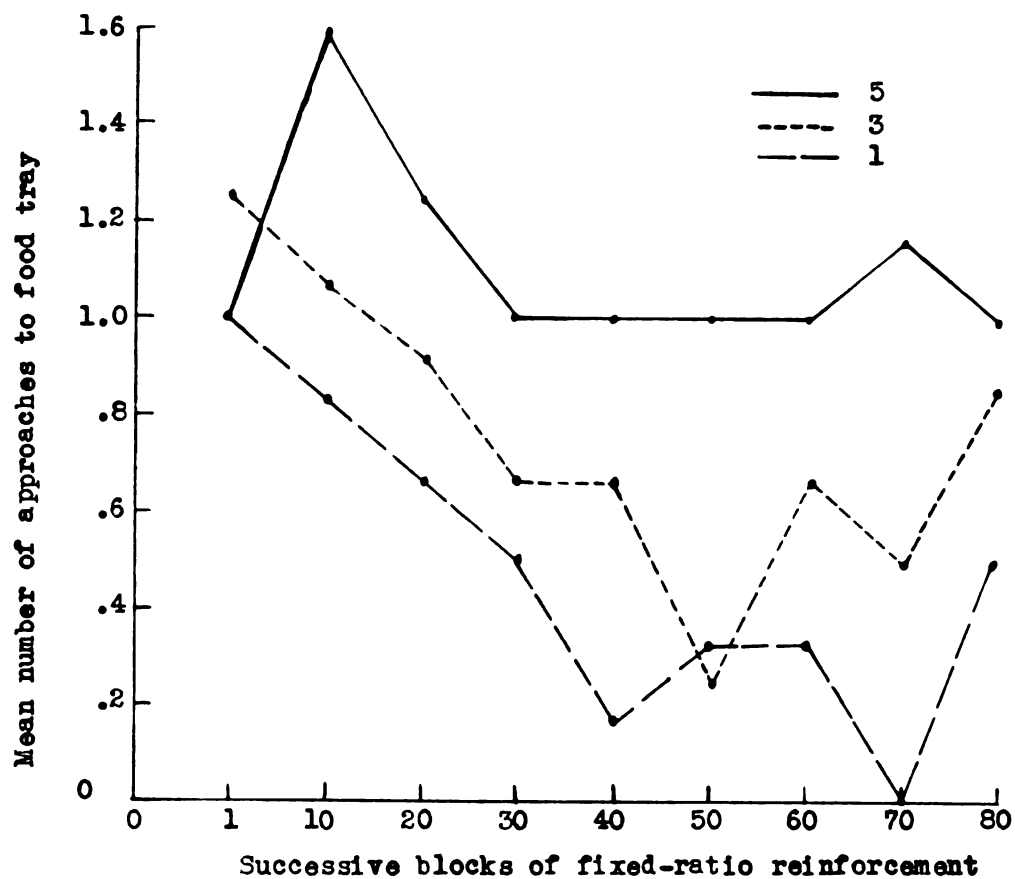


Figure 6. Mean number of approaches to food tray after first, third, and fifth bar presses of a block during successive acquisition trials by Experimental Groups 50 and 80.

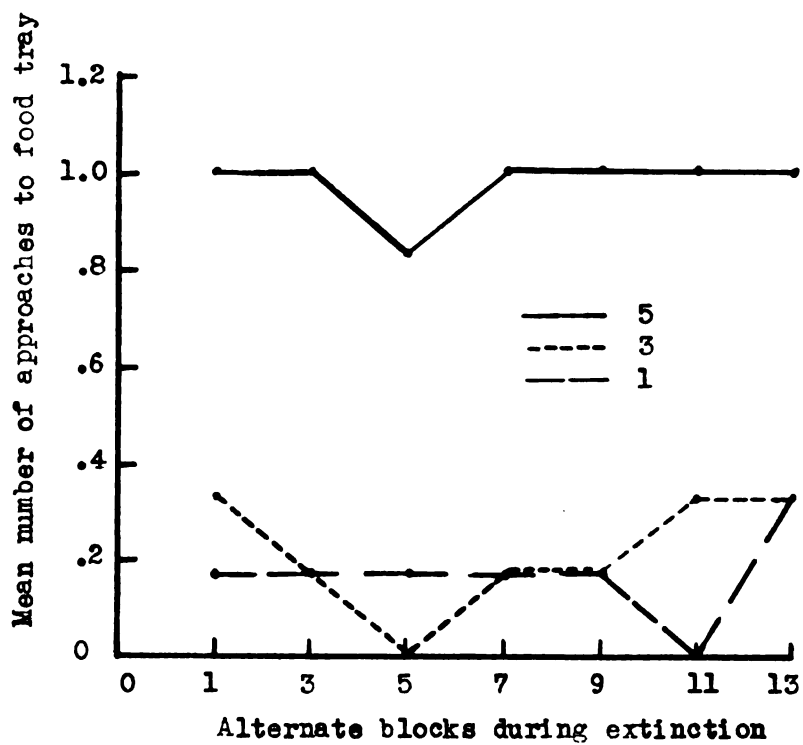


Figure 7. Mean number of approaches to food tray after the first, third, and fifth bar presses of a block during extinction by Experimental Groups 50 and 80.

the fifth bar press, the approach continued to be made on almost every trial.

If the mean number of approaches to the food tray occurring after each of the 5 bar presses in a block is determined for every 10th block of bar-pressing responses throughout the acquisition series and for alternate trials throughout the extinction series, it may be shown that the decrease in the number of approaches to the food tray is approximately equal for all four responses that precede the fifth or rewarded response of each fixed-ratio block. These data are presented in Fig. 8. From this graph, we may also note that the discrimination habit of partial reinforcement seems to improve during the extinction procedure.

The relationship obtaining between the degree of discrimination effected and the number of bar-pressing responses to extinction is illustrated in Fig. 9. Using the obtained points and extrapolating beyond the findings of the present study, it can be seen that the number of bar-pressing responses to extinction seems to be a linear function of the degree of discrimination attained. This lends support to Hypothesis 4.

A subsidiary result of the present study concerns the use of 10 min. and 3 min. extinction criteria. The experimental data on total bar-pressing responses during extinction and total approaches to the food tray during extinction were analyzed with the 10 min. extinction criterion mentioned previously and also with a 3 min. extinction criterion. There were no significant differences between the two criteria with regard to either of these measures.

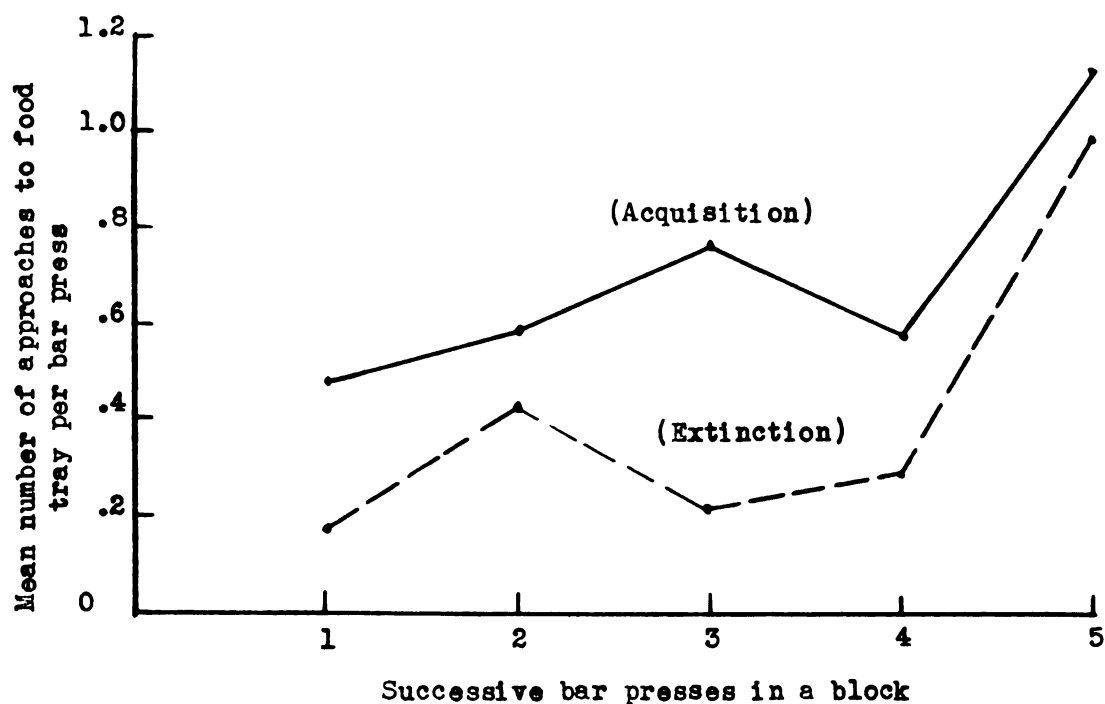


Figure 8. A comparison of the mean number of approaches to the food tray per bar press after each of the five individual bar presses in a block during acquisition and extinction by Experimental Groups 50 and 80.

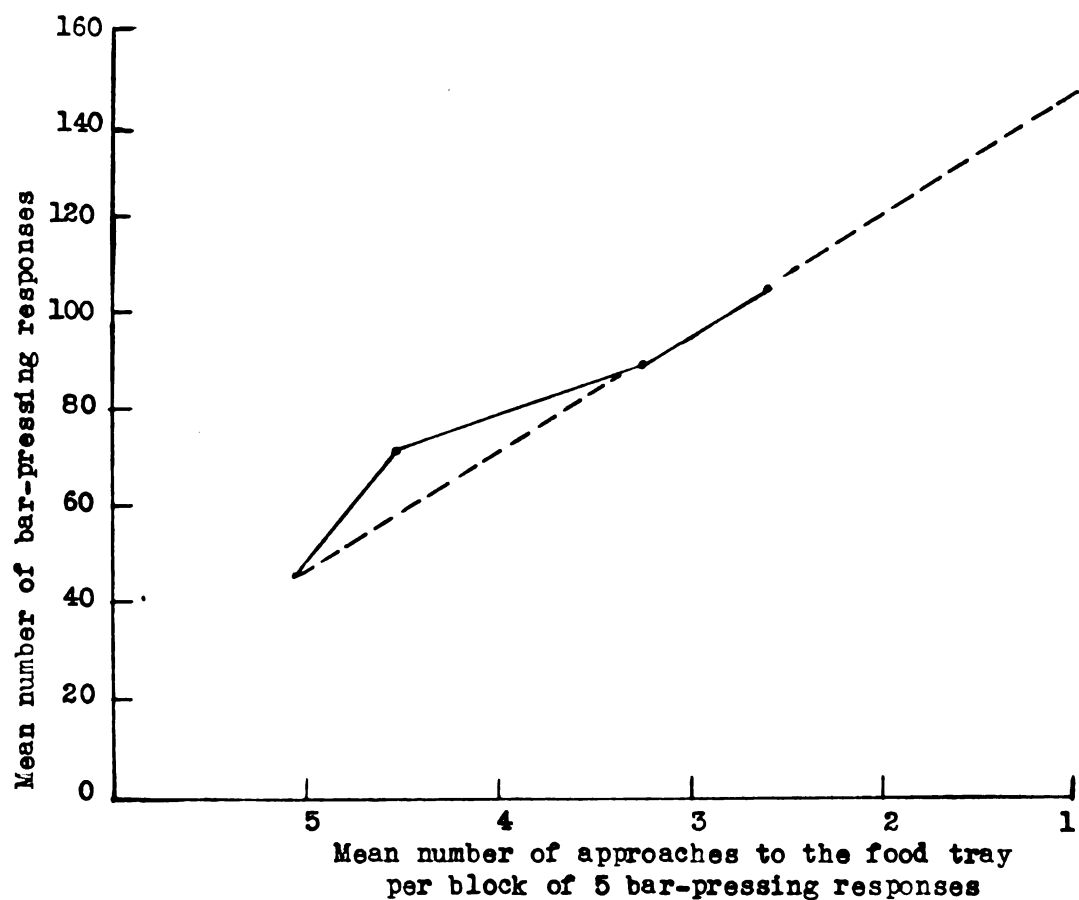


Figure 9. Average number of bar-pressing responses during extinction as a function of the amount of discrimination attained during acquisition.

----- Extrapolated line for estimating values beyond the range of the present study.

DISCUSSION

Summarizing the results, we find:

1. Additional reinforcements continuously administered after a maximal response tendency has been attained do not increase the number of responses obtained when the response is subjected to extinction procedures.

2. Additional reinforcements administered at a fixed ratio after a maximal response tendency has been attained sizeably increase the number of responses obtained when the response is subjected to extinction procedures. The number of responses obtained during extinction is an increasing negatively accelerated function of the number of fixed-ratio reinforcements administered.

3. With additional reinforcements, the number of approaches to the food tray during extinction remains constant regardless of the number or type of reinforcements administered after a maximal response tendency has been reached.

4. The administration of partial reinforcement after a maximal response tendency has been attained by continuous reinforcement results in a gradual reduction of the number of approach responses per bar-pressing response as a function of the number of reinforcements administered in this manner.

5. The approach responses tend to drop out during partial reinforcement after each of the first four responses of a fixed-ratio block but continue after the fifth.

6. The discrimination habit of partial reinforcement seems to improve under the extinction procedure.

7. With additional reinforcements administered at a fixed-ratio the number of trials to extinction is an increasing linear function of the degree of discrimination attained. A linear extrapolation of the curve of the discrimination habit of partial reinforcement as shown in Fig. 9 intersects a perpendicular erected at the point of perfect discrimination at 145 bar-pressing responses to extinction. This is quite close to the value of 156 obtained by multiplying the extinction level of the continuously reinforced control groups (31.25) by the reciprocal of the fixed ratio of $1/5$ used, as was predicted in Hypothesis 4.

What we should like to emphasize, above all, is that all the experimental hypotheses were clearly confirmed and thus the present theoretical position was strongly supported. The theoretical orientation for the present research was provided by Mr. Jack L. Maatsch (3). Next, we should like to point out that the most crucial confirmation of this position was the fact that the approach to the food tray segment of the response chain was not uniformly strengthened to all bar-pressing responses but discriminatively so to the terminal bar-pressing response of the block.

The fact that the Experimental Groups 50 and 80 made significantly more bar-pressing responses during the last ten minutes of the acquisition series than the other groups, although this was not explicitly hypothesized, is necessary to support our discrimination learning interpretation of the results of greater bar-pressing responses during extinction with partial reinforcement. Because the discrimination habit is assumed to be gradually acquired, the increase in the tendency to make bar-pressing responses must also be present during acquisition. The absence of this result would have been an argument against our theoretical position.

That the response of approaching the food tray tended to be restricted to the final response of the bar-pressing sequence seems to indicate that the discrimination habit of the present study is based primarily on the discriminative auditory stimulus which accompanied only the terminal response of the block. That this habit is based largely on the auditory cue rather than the response produced cues of the previous bar-pressing responses of each block is shown by the fact that the number of approaches following bar-pressing responses 1 through 4 during acquisition and extinction is roughly the same. There is no tendency for more approaches to the food tray to be made after each successive bar press from 1-4.

SUMMARY

The present study was conducted to determine the relationship between the resistance to extinction of a bar-pressing response and the number of blocks of fixed-ratio reinforcement.

Two control groups, 9 animals each, and four experimental groups, 6 animals each, were run in a modified Skinner box situation. All six groups received 40 continuous reinforcements. One control group began extinction trials after these 40 trials while the second control group received 50 additional continuous reinforcements, and then started extinction. After the 40 trials with continuous reinforcements, the four experimental groups received varying amounts of fixed-ratio reinforcement, the first group received 10, the second group received 20, the third group received 50, and the fourth group received 80 reinforcements. All six groups started extinction trials immediately after the acquisition trials.

The apparatus was a modified Skinner box with the food tray at the opposite end from the bar, designed to get independent measures of the bar-pressing response and the approach to the food tray.

The results revealed significant differences between the control groups (continuous reinforcement) and the experimental groups (fixed-ratio reinforcement) in the number of bar-pressing responses made during extinction. A significant amount of discrimination occurred during the acquisition trials of the fixed-ratio reinforcement schedule; that is, animals continued to approach the food tray after the fifth or rewarded bar press but gradually ceased to make the approaching response after the first, second, third, and fourth bar presses.

The results obtained would seem to indicate that:

1. The number of bar-pressing responses during extinction is an increasing function of the number of blocks of fixed-ratio reinforcement.

2. The number of approaches to the food tray during extinction does remain constant with increasing blocks of fixed-ratio reinforcement.

3. The approaches to the food tray after the first four bar presses in each block tend to drop out with increasing blocks of fixed-ratio reinforcement while the approach response continues to be made after the fifth or rewarded bar press.

4. If a perfect discrimination habit of partial reinforcement were effected, the number of bar-pressing responses during extinction would be equal to the reciprocal of the ratio used times the number of bar-pressing responses to extinction obtaining with continuous reinforcement.

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