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An Examination of the Phenomenon of Preference for Bar Pressong over Freeloading

Phyllis Thomson
Illinois Wesleyan University

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Harlyn D. Hamm
Project Adviser

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INTRODUCTION

Since the discovery of the law of effect, psychologists have been investigating a number of the parameters of reinforcing stimuli. The law of effect states that a response is learned, or not learned, depending upon the events (effects) that follow it. To evaluate the aspects of reinforcing stimuli, typically an organism is deprived of food or water and an increase in the probability or speed of a response is noted when small amounts of food or water are made to follow a response. Using this type of paradigm, characteristics of reinforcing stimuli which have been investigated are number of reinforcers, schedule of reinforcement, magnitude of reinforcement, and their effects on rate of responding and resistance to extinction.

There have been many behavioral laws formulated by similar systematic approaches mentioned above. One is that given two alternative paths through a maze to a goal, an animal will learn to take the shortest path to the goal (Yoshioka, 1929). In other words, the least effortful response will tend to be emitted. However, an apparent exception to this law was reported in a study by Jensen (1963). In his study animals seemingly preferred a more effortful response to obtain a reinforcer. Specifically, rats preferred to press a bar for reinforcement rather than eating pellets from a cup located in the chamber.

If we accept Jensen's data (1963), there are two ways to rationalize the results. The first explanation of habit strength is the one that Jensen himself also proposes. The habit strength interpretation states that behavior which has been heavily strengthened becomes prepotent. A

second interpretation is that the stimuli associated with bar pressing such as the sound of the pellet dispenser click, etc. have become powerful secondary (conditioned) reinforcers. The cumulative effect of the conditioned reinforcers associated with bar pressing help to maintain the preference for bar pressing over eating from a free food cup.

A conditioned reinforcer (secondary reinforcer) has been typically defined as a stimulus, which through repeated pairings with one that is primarily reinforcing, that will acquire reinforcing properties by itself. Primary reinforcers are ones which satisfy a basic need (food, water, sex) or electrical stimulation of the brain.

When Jensen (1963) reported his findings, the results indicated that rats prefer to bar press rather than freeload as a function of the number of reinforced bar presses. Freeloading was operationally defined as eating from a full food cup located in the chamber as opposed to pressing a bar for reinforcement. After the animal had had some past history in receiving food pellets following a bar press response, the animal was given a choice of eating food pellets from a food cup in the chamber or eating pellets earned by bar pressing. Jensen found that after 1280 reinforced bar presses the animals ate 80% of all pellets from bar pressing. In the entire study there were rats with past histories of 40, 80, 160, 320, 640, and 1280 reinforced bar presses before the administration of the one choice period. The animals in groups 40, 80, 160, 320, and 640 ate 20%, 35%, 40%, 45%, 50% respectively of all pellets from bar pressing.

These particular results need to be evaluated in terms of previous studies concerned with reinforcement. Bersh (1951) and Miles (1956) and the classic study of Perin (1942) and Williams (1938) have reported asymptotic functions related to the number of reinforcers. Bersh (1951)

and Miles (1956) have conducted studies determining the effectiveness of conditioned reinforcers as a function of the number of pairings with the primary reinforcer. Both found that the effectiveness of the secondary reinforcers is asymptotic after 100 pairings with the primary reinforcer. Perin and Williams' data showed that the number of extinction trials varied as a function of the number of original reinforcements under two levels of drive but both reached an asymptote after 100 repetitions. In other words, response strength reached a limiting value after varying numbers of reinforced acquisition trials. These four studies are in direct contradiction with the reinforcing functions found in Jensen's study.

Another aspect of Jensen's study (1963) which is contradictory to previous studies concerns the difference between conditioned and unconditioned reinforcers in terms of their reinforcing properties. According to Jensen's results (1963), secondary reinforcers were stronger than primary reinforcers; the rats preferred to obtain food in a more-effortful way. Kelleher and Gollub (1962) in their review of the literature in this area have concluded that in all cases unconditioned reinforcers have been more effective as reinforcers than conditioned ones.

The purpose of the present study reported in this paper was to investigate the variables influencing the preference for bar pressing over free-loading. First an attempt was made to directly replicate the original Jensen study (1963). Since the maximum effect was observed to occur after the animals had made 1280 reinforced bar presses on a continuous reinforcement schedule, E only replicated this part of the original study. Then several systematic manipulations of variables were performed in order to possibly magnify any of the variables that were responsible for the effect. Specifically these variables were the number of bar presses initiating a

session, the effects of having more than just the one choice period for each S, the schedule of reinforcement before and after the choice periods, the body weight of Ss, and the number of food pellets in the freeloading cup.

METHOD

Subjects

Six naive male albino rats served as subjects. The subjects were approximately 140 days old at the beginning of the study.

Apparatus

There were two test chambers used in the study. Test chamber #1 was the one used in Experiment No. 1 and No. 3, and test chamber #2 was the one used in Experiment No. 2. Test chamber #1 was 12 in. by $13\frac{1}{2}$ in. by 13 in.; the manipulandum was a recessed T-bar one inch across which was attached to a microswitch. The bar was 4 in. from the grid floor. Test chamber #2 was 12 in. by 12 in. by $11\frac{1}{4}$ in.; the manipulandum was the standard Lehigh Valley lever for rats which was one inch across and also attached to a microswitch. The bar was $4\frac{1}{2}$ in. from the grid floor. There was a sloping clear plastic avoidance fixture in chamber #2 which had its lowest point 2 in. above the bar. Both bars required 15 grams of pressure to operate. Reinforcement in both chambers was delivered by a pellet dispenser automatically programmed by a series of relays and a variable interval timer. Responses were recorded automatically by cumulative recorders. The session lengths were determined by electric timers. The freeloading food cups used in the study were a circular cup with a 3 in. diameter and $1\frac{1}{2}$ in. deep at its deepest point and a rectangular cup $2\frac{1}{2}$ in. by 2 in. by $1\frac{1}{2}$ in. The pellets delivered from the pellet dispenser and the pellets placed in the food cups were both 45 mg. Noyes pellets. The freeloading food cups were securely fastened to the grid of the chamber by fuse clips.

EXPERIMENT NO. 1

Pre-Experimental Procedure

The deprivation regime and shaping procedure was a direct replication of Jensen's procedure (1963). Two male albino rats served as subjects (F. L. 1 and F. L. 2). The Ss were given 10 grams of finely ground Purina lab checkers for ten days. They were fed at the same time each day. The experimental sessions were begun one hour previous to the scheduled feeding time of the animal. The food was placed in the same cup that was the free-loading cup during experimental sessions. The animals on day 11 were magazine trained by placing them in the test chamber for 25 minutes during which they received 50 pellets delivered by the pellet dispenser every 30 seconds. One half hour after the sessions were over, Ss were given the 10 grams of finely ground lab checkers minus the weight of the pellets received in the magazine training. Using the method of successive approximation, Ss were shaped to bar press on the 12th day. After shaping was completed, Ss were allowed to make 40 reinforced presses and then returned to their home cages. The Ss were fed 10 grams minus the weight of the pellets used in shaping plus the 40 rewarded presses. On days 13 and 14, Ss made 120 reinforced presses and then were returned to their home cages. Again Ss were given finely ground lab checkers so that their daily ration was 10 grams. During days 15 through 20 the animals were reinforced for 160 bar presses and the ration was adjusted to equal intake on days 13 and 14.

Experimental Procedure

Phase I: Beginning on the 21st day, Ss made 40 reinforced bar presses, then the apparatus was turned off and the freeloading food cup containing 250 pellets was inserted. The food cup was securely fastened to the grid

and placed in the furthermost corner from the bar. After Ss had eaten at least two pellets from the cup, the houselight and apparatus were turned on. The choice period (choice of eating from the food cup or pressing the bar for reinforcement) of 40 minutes began. As soon as the 40 minute choice period was over, E immediately removed S from the chamber. The only difference between the procedure in the present study and Jensen's procedure was that the bar was not covered during the 25 minute magazine training. After the direct replication was attempted, Ss were run two more days with the 40 bar presses initiating the session and then the food cup being added immediately after the bar presses.

Phase II: A systematic replication was made at this point by initiating the session with 80 bar presses. This was repeated for three sessions.

Phase III: Sessions were initiated with 80 bar presses with 500 pellets in the food cup. This last manipulation was performed in order to determine if the animal was actually exhibiting a preference for bar pressing over freeloading or merely pressing the bar only after it had eaten all the pellets in the food cup.

In summary the phases were as follows:

Phase I---40 minute choice period/ continuous schedule of reinforcement
40 bar presses initiating the session/ 250 pellets in the freeloading cup
three sessions

Phase II---40 minute choice period/ continuous schedule of reinforcement
80 bar presses initiating the session/ 250 pellets in the freeloading cup
three sessions

Phase III---40 minute choice period/ continuous schedule of reinforcement
80 bar presses initiating the session/ 500 pellets in the freeloading cup
three sessions

Results and Discussion

As seen in Fig. 1, there was not much evidence of bar pressing by F. L. 1 during choice periods. In two sessions the animal pressed the bar while there were still pellets in the food cup. In one sessions when there were 500 pellets in the food cup, the animal ate 227 pellets from the freeloading cup and pressed the bar 4 times. In the other session, the animal ate 222 pellets from the food cup which contained 250 pellets and pressed the bar 9 times. All of the bar presses that usually occurred followed a long pause after the animal had eaten all of the pellets from the food cup. In all cases where it is indicated that the animal did not eat all of the 250 pellets but was very close to 250 pellets (240 to 250), these few pellets can be accounted for in that several were dropped on the floor of the chamber.

With F. L. 2 there was evidence of bar pressing during choice periods three times as seen in Fig. 1 on days 7, 8, and 9. All of these occasions occurred with the 500 pellets in the food cup. However, all of the bar pressing that occurred was within the range of .6% to 4% (the percentages indicate the number of all of the pellets received by bar pressing from the total number eaten). In these three cases, the bar pressing occurred at the very end of the 40 minute choice period as shown by the cumulative record indicating that the animal had eaten the pellets from the food cup, began moving around the chamber, and then began pressing the bar. The bar presses did not occur in rapid succession but long pauses intervened between individual bar presses.

As seen in Fig. 1, the animals pressed the bar more times when there were 250 pellets in the food cup. The initiating bar presses seemed to have no effect on the number of bar presses emitted per 40 minute choice period. As indicated in the last manipulation of the experiment (see Fig. 1), the bar pressing decreased considerably for F. L. 2 who had made more bar presses

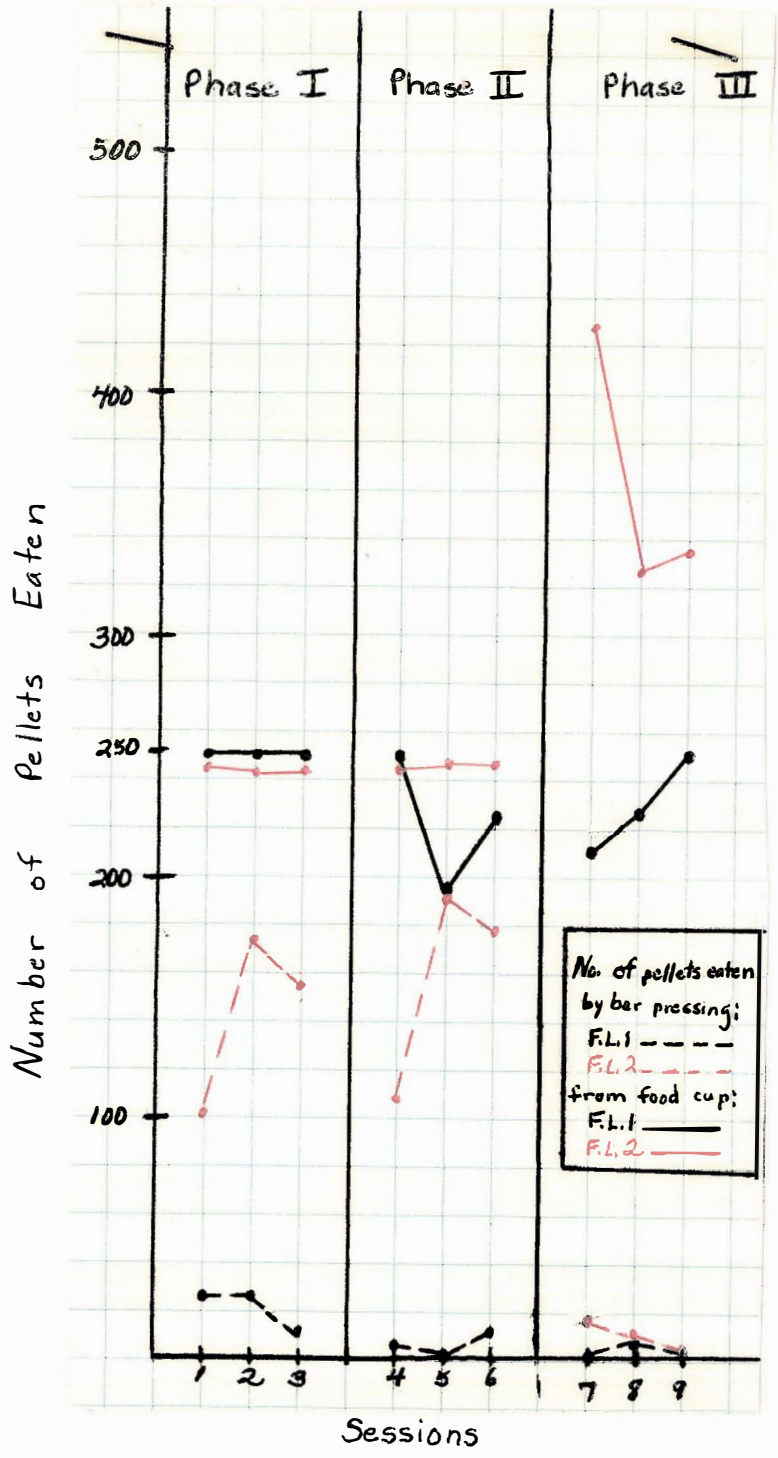


Fig. 1: Noncumulative record of the number of pellets eaten by bar pressing or from the freeloading cup during choice periods of Experiment No. 1. Phase I included a 40 minute choice period with a continuous schedule of reinforcement. 40 bar presses initiated the session and there were 250 pellets in the freeloading cup. Phase II included a 40 minute choice period with a continuous schedule of reinforcement. 80 bar presses initiated the session and there were 250 pellets in the freeloading cup. Phase III included a 40 minute choice period with a continuous schedule of reinforcement. 80 bar presses initiated the sessions and there were 500 pellets in the freeloading cup.

than F. L. 1 in the first six sessions. However, judging from the number of pellets eaten daily by F. L. 2, the bar presses in sessions 1-6 can be attributed only to seeking more food after all of the pellets in the food cup were eaten and not to a preference for receiving pellets by bar pressing. This was apparent from the cumulative records because the animals pressed the bar only at the very end of the choice period.

EXPERIMENT NO. 2

Pre-Experimental Procedure

During the shaping sessions and throughout the beginning sessions of this set of experiments, Ss were at 80% of their body weight. Two male albino rats served as subjects (F. L. 3 and F. L. 4). Using the method of successive approximation, Ss were shaped to press the bar as soon as their body weight was at 80%. The animals were then put on a continuous reinforcement schedule (Crf) of 1200 bar presses (200 per session).

Experimental Procedure

Phase I: Following Crf, a food cup containing 250 pellets was placed in the chamber in the corner furthermost from the bar. Then S was placed in the chamber and as soon as S had eaten several pellets from the freeloading food cup, the houselight and apparatus were turned on. The choice period of 40 minutes began. This particular procedure was followed for the entire six days for F. L. 4. F. L. 3's sessions differed on days 4 and 5 in that 500 pellets were placed in the freeloading food cup.

Phase II: Since body weight was a possible variable related to the phenomenon of bar pressing in preference to freeloading, body weight was manipulated. Both animals were brought up to 85 % of their body weight and given the same choice period.

Phase III: After three days at 85% body weight, Ss were given 450 reinforced bar presses (150 per session) on a Crf schedule. While on the Crf schedule, body weight was increased to the next percentage by giving the animals additional food in the home cage.

Phase IV: In the next three sessions, Ss were run at 90% body weight and given the 40 minute choice period with the freeloading food cup in the chamber.

Phase V: After three sessions at 90% body weight, Ss were given 450 reinforced bar presses (150 per session) on a Crf schedule. While on the Crf schedule, body weight was increased to the next percentage by giving the animals additional food in the home cage.

Phase VI: In the next three sessions, Ss were run at 95% body weight and given the 40 minute choice period with the freeloading food cup in the chamber.

Phase VII: On the fourth day at 95% body weight, 500 pellets were placed in the freeloading food cup.

In summary the phases were as follows:

Phase I--- 40 minute choice period/ continuous schedule of reinforcement
250 pellets in the freeloading cup
F. L. 3-seven sessions (500 pellets in the freeloading cup on days 4 and 5)
F. L. 4-six sessions

Phase II---40 minute choice period/ continuous schedule of reinforcement
250 pellets in the freeloading cup
85% body weight
three sessions

Phase III---150 reinforced bar presses/ continuous schedule of reinforcement
three sessions

Phase IV---40 minute choice period/ continuous schedule of reinforcement
250 pellets in the freeloading cup
90% body weight
three sessions

Phase V---150 reinforced bar presses/ continuous schedule of reinforcement
three sessions

Phase VI---40 minute choice period/ continuous schedule of reinforcement
250 pellets in the freeloading cup
95% body weight
three sessions

Phase VII---40 minute choice period/ continuous schedule of reinforcement
500 pellets in the freeloading cup
95% body weight
one session

Results and Discussion

As seen in Fig. 2, there was never any indication of preference for bar pressing over freeloading with F. L. 3. When given the choice of eating from the food cup or pressing the bar for pellets, S preferred eating pellets from the freeloading food cup. Fig. 3 shows one representative session with F. L. 3 when there were 250 pellets in the freeloading food cup. This cumulative record is typical of the majority of sessions with other Ss also for it indicates that bar pressing occurred only at the very end of the 40 minute choice period when all the pellets in the freeloading food cup had been eaten. No bar pressing occurred when 500 pellets were placed in the food cup; instead, the animal ate approximately 370-380 pellets each session. The cumulative record when there were 500 pellets in the freeloading food cup is represented in Fig. 4. When switched back to 250 pellets in the food cup, S ate the 250 pellets and then pressed the bar. The cumulative record of this session is similar to Fig. 3 for bar pressing again occurred at the very end of the session. At 90% body weight, F. L. 3 indicated a marked tendency to press the bar more times than at any other body weight. The reason for this particular effect is not known. However, in all cases S still ate all 250 pellets in the food cup and then pressed the bar.

As seen in Fig. 2, F. L. 4 showed more evidence of preference for bar

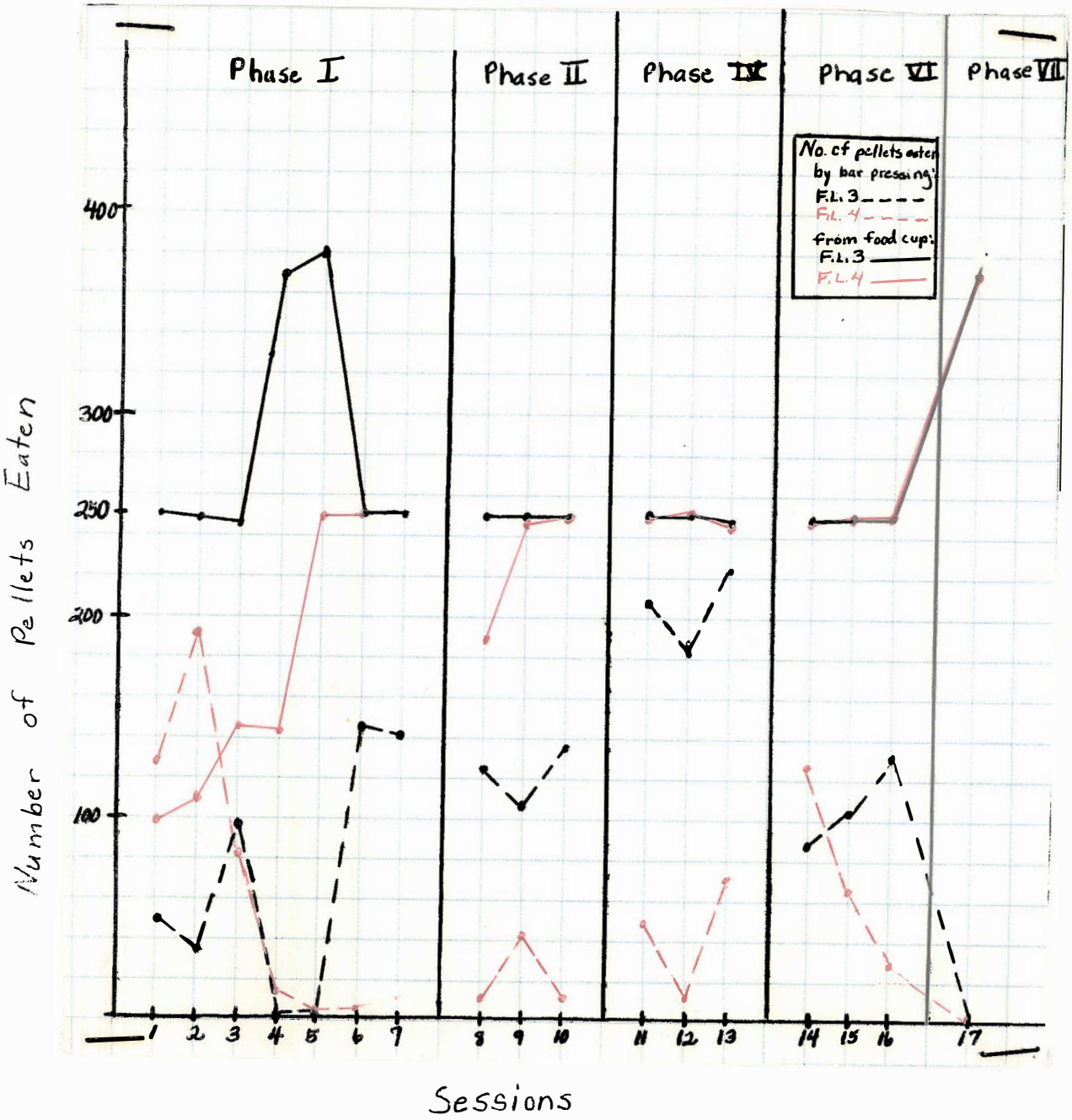


Fig. 2: Noncumulative record of the number of pellets eaten by bar pressing or from the freeloading cup during choice periods of Experiment No. 2. Phase I included a 40 minute choice period, continuous schedule of reinforcement, with 250 pellets in the freeloading cup except for trials 4 and 5 for F.L. 3 when there were 500 pellets. Phase II included a 40 minute choice period, continuous schedule of reinforcement, with 250 pellets in the freeloading cup. The animals were at 85% body weight. Phase IV included the same features as Phase II except the animals were at 90% body weight. Phase VI included the same features as Phase II except the animals were at 95% body weight. Phase VII included a 40 minute choice period, continuous schedule of reinforcement, with 500 pellets in the freeloading cup. The animals were at 95% body weight

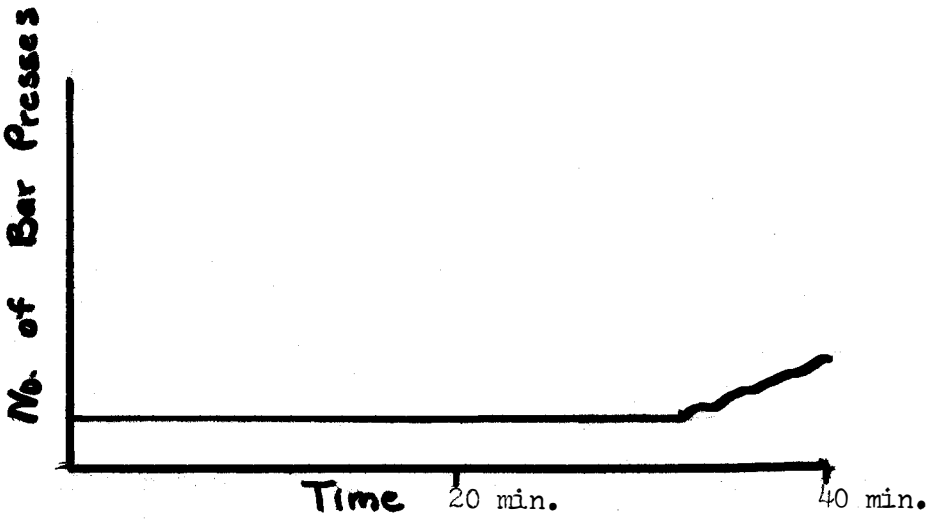
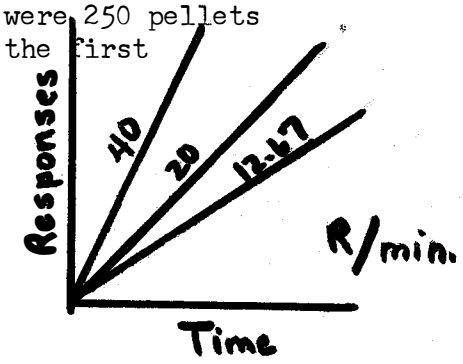


Fig. 3: Representative cumulative record of the number of bar presses during a 40 minute choice period of Experiment No. 2. The record is for F. L. 3 when there were 250 pellets in the freeloading food cup. The session is the first choice period after the 1200 reinforced bar presses.



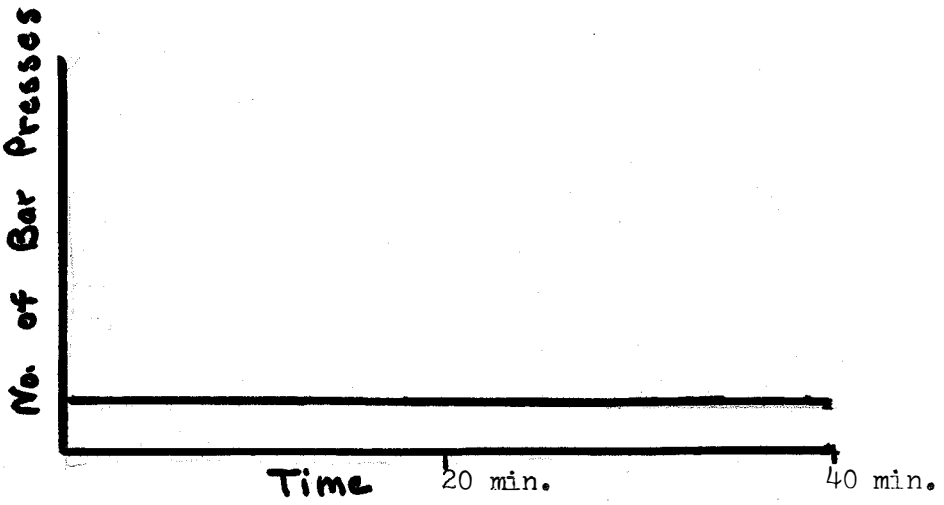


Fig. 4: Representative cumulative record of the number of bar presses during a 40 minute choice period of Experiment No. 2. The record is for F. L. 3 when there were 500 pellets in the freeloading food cup. The session is the fourth choice period after the 1200 reinforced bar presses.

pressing over freeloading than any other animal in the entire study. In sessions 1 and 2, 56% and 64% of all pellets eaten were from bar pressing. Fig. 5 and Fig. 6 are the cumulative records for the sessions of 56% and 64% of all pellets eaten by bar pressing. As can be seen by the cumulative record, there was bar pressing throughout the major part of the session. However, in neither case was the percentage of preference as high as what Jensen (1963) reported his mean percentage to be. (After 1280 bar presses, the mean percentage in his study was 80%). The phenomenon began diminishing with F. L. 4 after two days and by the 5th day the animal was eating all of the 250 pellets in the freeloading food cup. The cumulative record for the fifth day was similar to Fig. 3. At 85% body weight on day 8, there was some bar pressing when there were still pellets in the food cup as 6% of all pellets eaten were received by bar pressing. On the last day the animal exhibited no bar pressing when given the choice of pressing the bar for food or eating all of the pellets from the food cup.

Since weight of the animals was a possible reason for the bar pressing effect, the animals' body weight was varied from 80% to 85% to 90% to 95%. From the results it seems that this was not a significant variable since the animals characteristically ate the 250 pellets in the food cup first and then pressed the bar for additional pellets. The reason for having C_{rf} periods between each body weight condition was to maximize the conditioned reinforcer's effect again.

After testing the variable of weight, the animals were given 500 pellets in the food cup. Both animals showed no bar pressing in the last session which indicates that the animals preferred to eat from the freeloading cup than press the bar for reinforcement.

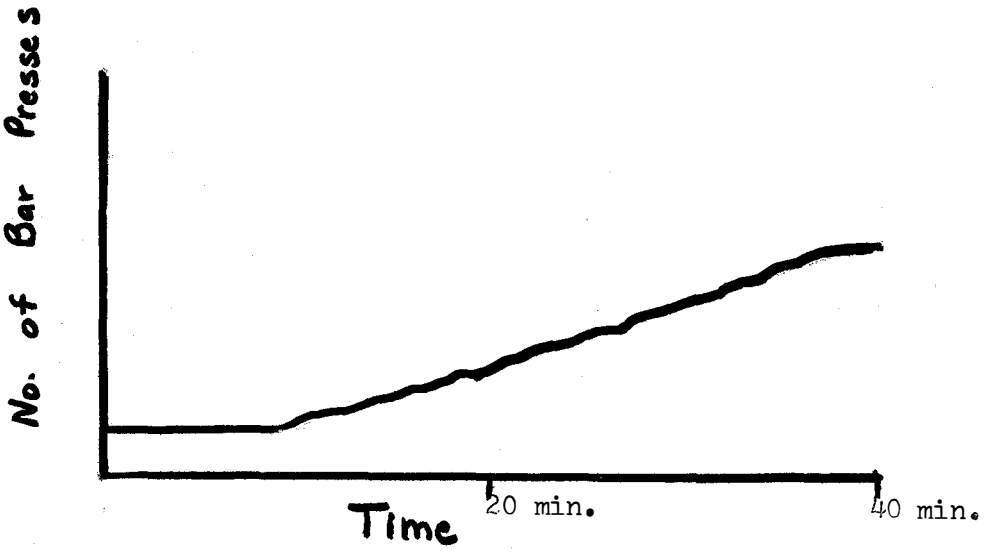


Fig. 5: Representative cumulative record of the number of bar presses during a 40 minute choice period of Experiment No. 2. The record is for F. L. 4 when there were 250 pellets in the freeloading food cup. The session is the first choice period after the 1200 reinforced bar presses.

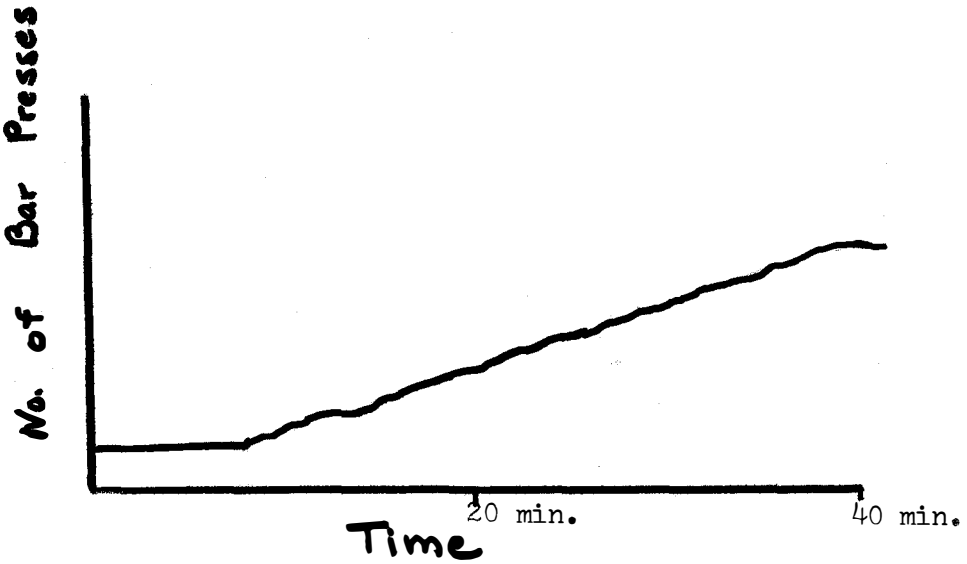


Fig. 6: Representative cumulative record of the number of bar presses during a 40 minute choice period of Experiment No.2. The record is for F. L. 4 when there were 250 pellets in the freeloading food cup. The session is the second choice period after the 1200 reinforced bar presses.

EXPERIMENT NO. 3

The present experiment was initiated because of data reported by Ulrich and Allen (1966) which stated that a preference for bar pressing over free-loading was occurring with an animal that had had a long variable interval of 30 seconds schedule of reinforcement (VI-30).

Pre-Experimental Procedure

Throughout experiment no. 3, Ss were at 80% of their body weight. Two male albino rats served as subjects (F. L. 5 and F. L. 6). After initial shaping, each bar press was reinforced on a Crf schedule until 1200 reinforced bar presses had occurred (200 per session). Following Crf, a VI 30 schedule of reinforcement was imposed until 1200 reinforcements were delivered on this schedule (150 per session).

Experimental Procedure

Phase I: After the animals had been on the VI 30 schedule for eight days receiving 150 pellets per day, a choice period of 60 minutes was initiated on the 9th day. The E placed the food cup in the chamber in the furthermost corner from the bar. The freeloading food cup contained 250 pellets. The E then placed S in the chamber with the power off and waited until the animal had eaten two pellets from the freeloading food cup before turning the apparatus on. F. L. 5 followed this procedure for four sessions, and F. L. 6 followed the procedure for five sessions.

Phase II: During the fifth session for F. L. 5 and during the sixth session for F. L. 6, the same procedure was followed as in Phase I except there were 350 pellets in the freeloading food cup.

Phase III: The Ss were returned to a Crf schedule without the freeloading

food cup in the chamber and received an additional 800 reinforced bar presses in the next four sessions (200 per session).

Phase IV: The Ss were given a 40 minute choice period with the freeloading food cup in the chamber.

Phase V: The Ss were given 150 reinforced bar presses.

Phase VI: For the next three sessions, Ss were given a 40 minute choice period with the freeloading food cup in the chamber and 250 pellets in the freeloading cup.

In summary the phases were as follows:

Phase I---60 minute choice period/ VI 30 schedule of reinforcement
250 pellets in the freeloading food cup
F. L. 5-four sessions
F. L. 6-five sessions

Phase II---60 minute choice period/ VI 30 schedule of reinforcement
350 pellets in the freeloading food cup
one session

Phase III---200 reinforced bar presses/ continuous schedule of reinforcement
four sessions

Phase IV---40 minute choice period/ continuous schedule of reinforcement
250 pellets in the freeloading food cup
one session

Phase V---150 reinforced bar presses/ continuous schedule of reinforcement
one session

Phase VI---40 minute choice period/ continuous schedule of reinforcement
250 pellets in the freeloading food cup
three sessions

Results and Discussion

As seen by Fig. 7, F. L. 5 exhibited no bar pressing preference over freeloading throughout any of the manipulations. The S ate all of the pellets in the food cup and then pressed the bar. The explanation for the amounts below 250 pellets can be attributed to the fact that several times pellets were dropped on the chamber floor.

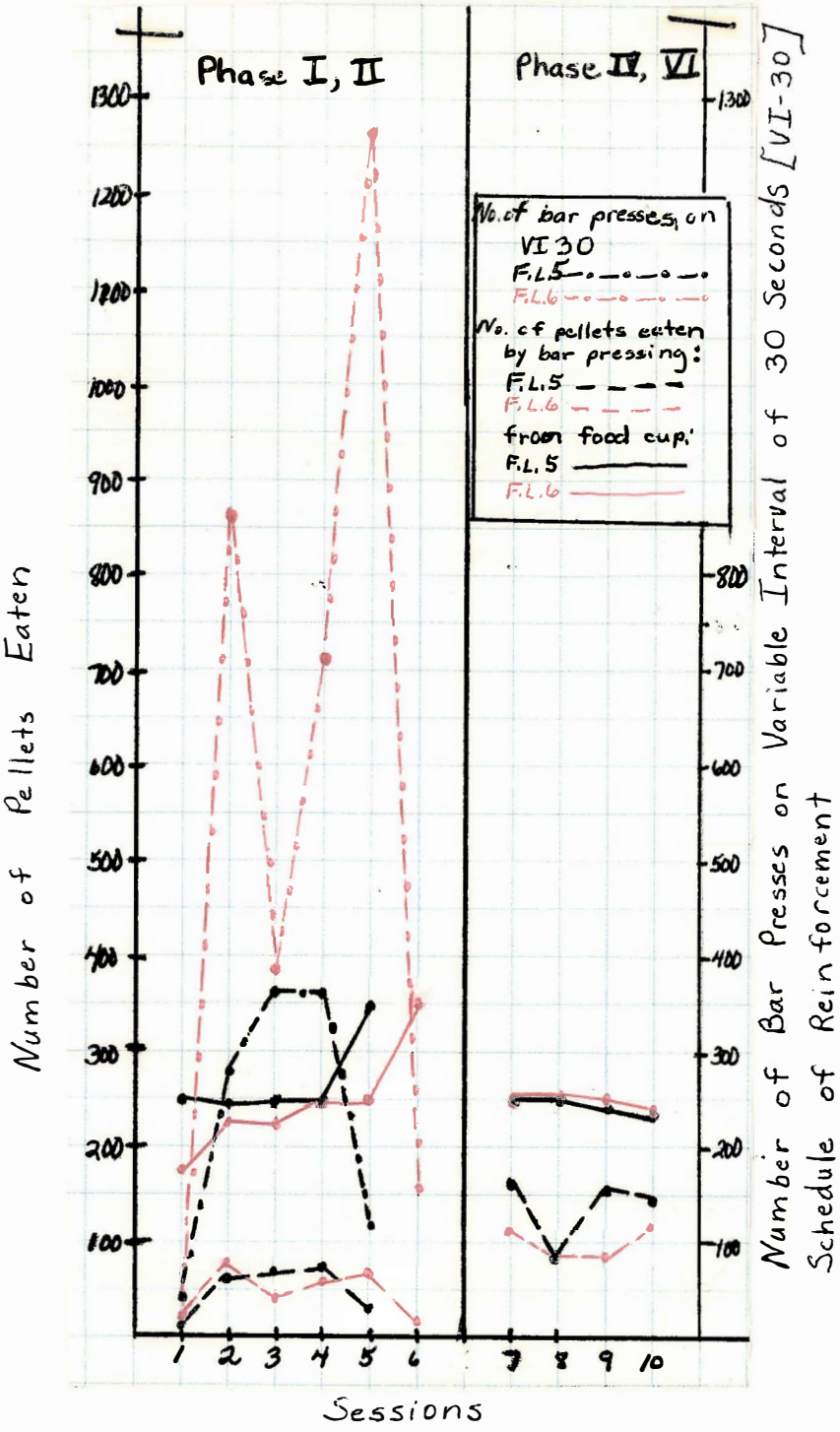


Fig. 7: Noncumulative record of the number of pellets eaten by bar pressing or from the freeloading cup during choice periods of Experiment No. 3. Phase I included a 60 minute choice with a variable interval of 30 seconds schedule of reinforcement. There were 250 pellets in the freeloading cup. Phase II included the same features as Phase I except there were 350 pellets in the freeloading cup. Phase IV, VI included a 40 minute choice period with a continuous schedule of reinforcement. There were 250 pellets in the freeloading cup.

With F. L. 6 there was some indication of bar pressing while there were still pellets in the freeloading food cup in the initial three sessions as seen in Fig. 7. On the first experimental day, the percentage of all pellets eaten by bar pressing was 5%, the second day was 24%, and the third day was 16%. None of these figures closely resembles the 80% figure that Jensen (1963) reported.

DISCUSSION

Throughout the entire study only on two occasions was there any evidence of preference of bar pressing to the degree close to what Jensen's results (1963) indicated. With F. L. 4 on the first two days of the experimental procedure, there was evidence of bar pressing while there were still pellets in the freeloading food cup. The preference for bar pressing was only transitory as shown by the third day when the effect started to diminish. By the fifth day, the animal was eating all of the pellets from the food cup and then pressing the bar as indicated by cumulative records such as Fig. 6.

The apparatus difference between Jensen's study (1963) and the present study need to be stated in order to eliminate this as a possibility for the failure to replicate Jensen's findings. Jensen's chamber was 9 7/8 in. by 11 1/2 in. by 11 3/4 in. as compared with the two chambers used in the present study which were 12 in. by 13$\frac{1}{2}$ in. by 13 in. and 12 in. by 12 in. by 11$\frac{1}{4}$ in. It does not seem feasible that this difference was great enough to occasion such large discrepancies in results. The cups were also not significantly different as Jensen's cup was 2$\frac{1}{2}$ in. in diameter and 1$\frac{1}{4}$ in. deep as compared with the two cups used in the present study which were 3 in. in diameter and 1$\frac{1}{2}$ in. deep and 2$\frac{1}{2}$ in. by 2 in. by 1$\frac{1}{2}$ in. The type of bar used in Jensen's study was not reported so this manipulandum cannot be compared.

It was difficult to assess the nature of the phenomenon that Jensen (1963) reported because the study was confined to the reporting of group means and no direct measure of individual variability within groups is available from his analysis. That this variability was large can be

surmised from the fact that only one group mean (group 1280) in his study differed reliably (P .05) from other group means. The degree of individual replication one should be able to reasonably expect on the basis of his results is therefore difficult to ascertain from the data reporting.

A similar difficulty in assessment arises from the absence of information about the pattern of responding within a session in Jensen's study (1963). The present results indicate that there are distinctive patterns, and the pattern is that most of the responding occurs at the end of the session.

The short term nature of the Jensen (1963) results (a single test session) presents the possibility that the phenomenon is transitory and possibly a result of very accidental occurrences in handling, training, etc. Indications from the present study are that preference for bar pressing diminishes rapidly if it occurs at all.

SUMMARY

This study examined the phenomenon of preference for bar pressing over freeloading as a function of reinforced trials. After an attempt to directly replicate Jensen's study (1963), several systematic replications were also attempted to possibly magnify the phenomenon.

In all but one subject there was no significant preference for bar pressing over freeloading. Bar pressing in this study seemed not to be a function of reinforced bar presses but of number of pellets in the food cup.

In the future, research will be conducted to determine what effect length of time on a particular schedule will have on the amount of preference for bar pressing.

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