

The effects of training and effortfulness on rats' choice behavior in a modified T-maze

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Rats were trained and tested in a modified T-maze in which one path to a goalbox was twice as long as the other. Both goal boxes contained food. One group of four rats received 60 training trials in the short alley alternated with 60 trials in the long alley before choice testing. Another group of six rats received 45 training trials in the short alley followed by 90 trials in the long alley. All animals received 120 choice trials in which both paths were available, conducted in eight blocks of 15 trials each. The equal-training group chose the short alley in all choice blocks, gradually increasing this preference. The second group, which received unequal training, chose the short path on only 20% of the first 15 choice trials and then preferred the short alley in subsequent blocks. The results are compared to studies of contrafreeloading.

Since Jensen's first study in 1963, there have been numerous investigations which have demonstrated that animals will continue to obtain some reinforcers by performing an operant rather than obtain identical reinforcers by simply taking them from a "free" source. In the training paradigm of Carder and Berkowitz (1970), deprived rats which have received three daily training sessions of eating free food in operant chambers followed by six sessions of barpress training, will prefer to obtain 70% to 90% of the food pellets consumed via barpressing in subsequent choice sessions and will maintain the preference over many choice periods (Carder & Berkowitz, 1970; Tarte & Snyder, 1972, 1973).

Stolz and Lott (1964) examined contrafreeloading in the straight-alley maze. Rats received varying amounts of training in running the 8-ft alley for a single food pellet. During choice trials a pile of 1500 pellets was placed halfway down the alley. Rats which received more training ran significantly more to the goalbox than did animals with less training.

Two other examinations of contrafreeloading in the runway have been published. Leung, Jensen, and Tapley (1968) gave two groups of rats either 75 or 285 reinforced runs before presenting them with the choice between free loading from a dish of pellets in the start-box or running the alley for a single pellet. Leung et al. found that animals which had received fewer trials ate less free food before traversing the runway and reached the goalbox faster than animals which had received more training. In the second experiment, Jensen, Leung, and Hess (1970) compared contrafreeloading in the runway

with the operant chamber as a function of amount of prechoice training. They found that rats which received more training trials in the operant chamber tended to leave free food to barpress for identical pellets sooner than animals which received less training, while the opposite trend prevailed in the runway.

The contrafreeloading studies cited have employed concurrent operants which were dissimilar in response topography and effort. Little research has been conducted which is related to the phenomenon using similar operants. Havelka (1956) found that, when food was available in two goalboxes differing in distance from the startbox, rats preferred the goal nearer to the start box. Catania (1966) reported that, if an animal is presented with the concurrent choice between two different fixed-ratio (FR) schedules in an operant chamber, it will prefer the smaller ratio. Tarte and Cathcart (Note 1) examined the effects of various training paradigms involving FR1 and FR2 schedules on rats' preferences when confronted with the concurrent choice between the two. It was found in four experiments that rats which received extensive FR2 training just prior to choice testing preferred to obtain pellets via the FR2 lever rather than via FR1. Further, more training on the more effortful operant was required in order to obtain a preference for that response than is required in the contrafreeloading design in which dissimilar responses are employed.

The present study was conducted in order to examine rats' preferences when the choice involves similar operant responses in a maze situation. A second purpose was to compare choice behavior in this situation with that found employing similar operants in the operant chamber and with behavior when dissimilar operants had been used. Like many previous investigations, amount of training on the two responses has been varied such that one group received equal training on the two and another group received more extensive training on the more effortful operant response.

Requests for reprints should be sent to Robert D. Tarte, Department of Psychology, University of Nevada, Las Vegas, Nevada 89154. We wish to thank the Department of Psychology, Northeastern University, Boston, Massachusetts, for providing financial support and technical assistance while the second author was there on sabbatical leave. The first author is now at Northeastern University, Boston, Massachusetts.

METHOD

Subjects

Ten naive male albino rats of Wistar strain, weighing approximately 250 g each, served as subjects. The animals were housed two to a standard laboratory cage. Four rats were randomly assigned to the group which received equal training on the two responses, and six animals were assigned to a group which received unequal training.

Apparatus

A modified T-maze was used. Arms were extended from the two ends of the T, parallel to and continuing in the same direction as the initial stem of the maze, such that an animal must turn left-right or right-left to reach a goalbox. One path from the choice point to the goalbox was twice as long as the other, the difference in distance being due to the length of the extended arms. Choice point to goalbox distance for the short alley was 122 cm, and 244 cm for the longer alley. The startbox and the goalboxes were 45.7 cm long; the stem of the maze was 30.5 cm; the arms of the T were 91.4 cm each, and the extended arms from the ends of the T to the goalboxes were 30.5 cm and 152.4 cm. The width of the maze was 16.5 cm throughout, and the walls were 30.5 cm high. A guillotine-type door, constructed of sheet metal, separated the startbox from the maze, and two such doors were located at the choicepoint in order to block one path or the other during training. One-way swing doors, constructed of poster board, separated the arms from the goalboxes. The entire maze was painted flat black. A supply of approximately 500 Noyes 45-mg food pellets was maintained in each of two 7.6-cm diam metal food dishes, secured to the floor at the ends of the goal boxes.

Procedure

Three days before exposure to the maze, all animals were placed on 23-h food deprivation schedules. Water was continuously available in home cages. During the experiment animals were allowed access to rat chow for 30 min once per day following each second experimental session. All sessions lasted for approximately 30 min and were conducted at 12-h intervals. Initially, there were two adaptation sessions during which cage-mate pairs of animals were allowed to roam the entire maze and could eat freely in both goalboxes. In the third and fourth sessions, single animals were exposed to the same pre-experimental conditions. The following four sessions were used to shape maze running by progressively allowing individual animals more and more of the maze to run beginning with the goalbox. During the fourth shaping session, all animals explored the entire maze. Formal training began in the session following shaping. To control for directional effects and preferences in training and in testing, the left alley was the long one for one half of the animals within each group and the short one for the other half. The rats were allowed to eat from the filled dish in the goalbox for 10 sec after each training and choice run. In all trials the startbox door was raised and a timer was activated when the animal in the startbox was facing the door. Rats in the equalized training group were given eight training sessions of 15 runs each, spanning 4 days, in which runs to the short and long alley were alternated such that each animal made 60 runs to each goalbox and two rats' last run was to each alley. This was accomplished by blocking the appropriate alley on each run at the choice point. The six rats in the unequal-training group received training similar to the Carder and Berkowitz (1970) and Tarte and Snyder (1973) design, by which contrafreeloading has been demonstrated using dissimilar operants. They were first given three 15-run sessions, in which they were forced to run the short path, followed by six 15-run sessions to the long alley. Time from start to goalbox was recorded for all rats during training. For both groups, eight 15-run choice sessions, 120 trials in all,

followed training and spanned 4 days. During choice sessions, the entire maze was open from start- to goalboxes. Alley preference and running times from start to goalbox were recorded. In all cases cage-mates were run together, alternating trials between them so that the ITI varied, depending upon how long an animal's cage-mate took on a particular run.

RESULTS

There were no significant differences between the two groups in the last block of 15 trials in training, on long or short alley runs. The median number of seconds for those final training runs were: equal training, short alley = 2.90; equal, long = 4.25; unequal, short = 3.00; unequal, long = 3.67. The preferences over choice blocks are shown in Figure 1. Median percentages of trials in which the shorter path was chosen over the eight blocks of 15 trials each are presented for the two groups. As can be seen in Figure 1, both groups progressively chose the shorter alley more frequently, and both preferred the shorter alley overall. The median percentage of short alley choices for the equal-training group was 77%, and for the other group 90%, over all eight blocks, or 120 trials per animal. There was no significant difference between groups over all choice trials, $F(1,8) = .78$. Only in the first block of 15 choice trials were the two groups very different in preferences; the equal-training group chose the short alley on 60% of the trials, and the unequal-training group chose the short path on 20% of the trials. This difference was statistically significant, $\chi^2 = 10.39$, 1 df, $p < .01$. Within the first block of choice trials, as in the others, animals were highly consistent. Therefore, the median percentages represent percentages of animals as well as of trials. Most of the

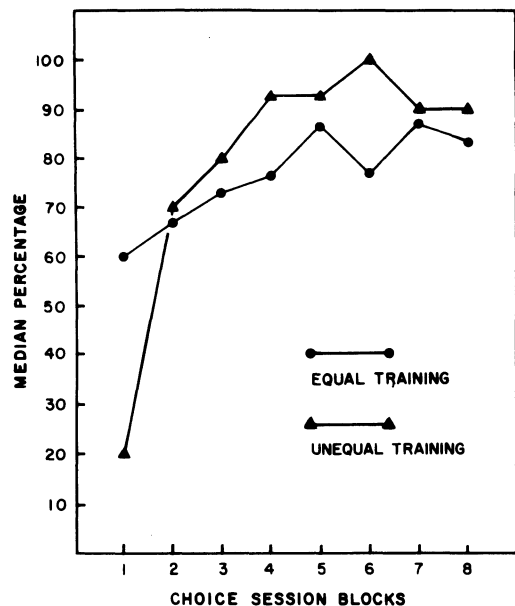


Figure 1. Median percentages of trials in which the shorter alley was chosen across blocks of 15 trials.

changes in preference occurred between blocks, rather than within them. An analysis of response changeovers from long to short alley, or from short to long, showed no significance. However, numerically, animals in the equal-training group did change in choice more than rats in the other group.

A two-way analysis of variance of running times from start to goalbox revealed that there was no significant difference between groups, between alley lengths, or for the interaction. A similar analysis of running times in the first block of choice trials, however, resulted in a significant interaction of Groups by Alley Lengths, $F(1,8) = 16.34$, $p < .005$, although neither main factor was statistically significant. A Tukey's test of the interaction revealed that the equal-training group ran the short alley significantly faster than the long alley ($p < .01$), and that the group with unequal training ran the long alley faster than did the equal-training group ($p < .05$). In fact, the mean running time of the unequal-training group was faster for the long alley (3.68 sec) than for the short alley (4.77 sec) in the first choice block. The mean running times for the equal-training animals were 3.19 sec for the short alley and 6.17 sec for the long.

DISCUSSION

In this study it was found that providing extensive training in running the more effortful (i.e., longer) alley of a maze resulted in rats preferring that alley when initially given the choice between it and a shorter alley, but after the first block of 15 choice trials and subsequently, they preferred the shorter path. Rats which received equal amounts of training on both alleys maintained a preference for the short alley throughout choice testing. The two groups were significantly different, in preference and in running times, only in the first choice block. There was a crossover in responding in that the unequal-training group showed a much lower percentage than the equal group of choosing the short alley in the initial choice block, but chose the short alley more frequently than the other group in the subsequent seven blocks of choice trials. No explanation of this effect is readily apparent, but it is similar to that reported in one study of contrafreeloading which employed dissimilar operants (Taylor, 1972), and one involving similar responses in the operant chamber (Tarte & Cathcart, Note 1). If the change from long to short alley could be viewed as a change in frequency of reinforcement, this greater ultimate preference for the short path might be considered a behavioral contrast effect.

While the apparatus and design were different, the results of the present study are similar to those of Stolz and Lott (1964), who found that rats which received more training ran significantly more to the goalbox, over a pile of pellets located halfway down a straight-alley runway. Leung, Jensen, and Tapley (1968) and Jensen, Leung, and Hess (1970), however, found the opposite relationship between amount of training and contrafreeloading in the runway when the free source of food was located in the startbox. Studies of contrafreeloading in the operant chamber, employing dissimilar operants (Jensen, 1963; Tarte & Snyder, 1973) or similar operant responses (Tarte &

Cathcart, Note 1), have found a direct relationship between amount of training and amount of contrafreeloading like that found here in the initial block of choice trials.

During the first choice block, animals in the unequal-training group simply continued to follow the path they had in the last 90 training trials, and at speeds equal to those at the end of training. Only gradually did individual animals try the short alley and change to a preference for it. However, they all did run the short alley at least once early in training, so the choice of the long alley was not due to the animals being unaware of the alternative. When they did choose the short path early in testing, the running times were greater than for the long alley. The equal-training group, on the other hand, sampled both alternatives right at the beginning of choice testing and quickly established a preference for the short path.

In conclusion, this study has demonstrated that rats which have received extensive training on the "more effortful" response in a modified T-maze prior to choice testing initially prefer that response. This result is similar to the previous findings of studies employing similar and dissimilar responses in operant chambers or runways. In the present study the response required of the subjects and animals' interaction with the experimental environment was very different from previous research on the contrafreeloading phenomenon.

REFERENCE NOTE

1. Tarte, R. D., & Cathcart, K. *The effect of training on rats' choice between two simple concurrent operants*. Manuscript submitted for publication, 1976.

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(Received for publication February 19, 1976.)