Resistance to extinction as a function of mode and time of removal from goal box

W. EDWARD BACON

NATIONAL INSTITUTE OF MENTAL HEALTH

Twenty-eight thirsty rats were trained for 60 trials to run an alleyway. During 30 extinction trials, the mode of removal from the goal box and goal-box confinement duration were combined factorially such that Ss were allowed to escape from the goal box or were removed by hand either immediately upon entry or after 120 sec. Both variables had an effect upon resistance to extinction: resistance was greater with short confinements than long confinements and with escape than hand removal.

Extraordinary resistance to extinction has been found in rats allowed to escape, i.e., jump, from the empty goal box after traversing an alley (Adelman & Maatsch, 1955). The group data showed no evidence of any extinction during 30 nonrewarded trials. It is not clear, however, whether the unusual resistance was due to the method of exiting from the goal box or the correlated short duration of goal-box confinement. Short compared to long confinements usually increase resistance to extinction (Capaldi, 1966; Capaldi & Poyner, 1965; Klugh, 1961; Stanley & Rowe, 1954). In the present experiment, escape and non-escape conditions were combined factorially with short and long goal-box confinement durations to determine whether escape from the goal box per se has an effect on resistance to extinction.

Method

The Ss were 28 male, naive, Sprague-Dawley rats approximately 110 days of age at the start of the experiment. The apparatus was a right-turn, black, enclosed, L-shaped alley with 9.5 in. high walls. The start box was 9 in. long x 6 in. wide; the main arm, 55 in. long x 4 in. wide; and the short arm (goal box), 14 in. long x 6 in. wide. On reinforced trials, the goal box contained a metal drinking tube which projected through a hole in the far wall. On nonreinforced trials, the hole was blocked by a false end wall. A guillotine door separated the start box from the remaining alleyway and a second guillotine door, located 15.5 in. from the end wall of the main arm, confined Ss in the goal area. A ledge, 3.5 in. wide, was attached to the top external edge of the goal box walls, providing a perch outside the goal box for Ss. A Standard Electric timer started when the start-box door was opened and stopped when a photoelectric light beam, located 2.5 in. beyond the door, was interrupted. A second timer started on interruption of the first light beam and stopped when a second beam, located 42 in. further down the alley, was interrupted. The two timers provided measures of starting and running times, respectively.

The Ss were gentled and placed on a 22-23 hr. water deprivation schedule 11 days prior to acquisition training.

Beginning two days prior to training, Ss were given one direct placement daily into the goal box for 2-3 min. access to water. All Ss received five acquisition trials per day with an average intertrial interval of 4 min. (range: 2.5-7 min.). Each S had 30 sec. access to water in the goal box on each trial and 30 min. access to water on a feeding stand approximately 1/2 hr. after the last trial of the day.

Following the 60th acquisition trial, Ss were divided into four groups with equivalent running time means based on the last 20 acquisition trials, and then given 30 extinction trials, five trials per day, under either escape (E) or non-escape (N), and immediate (I) or delayed (D) conditions. The four groups were designated EI, ED, NI, and ND. The Ss receiving the E treatment were allowed to jump or climb out of the goal box onto the ledge while Ss receiving the N treatment were removed by hand. Under the I treatment, Ss were manually removed or allowed to escape (the goal-box lid was opened) immediately following entry into the goal box, whereas D treatment Ss were confined in the goal box for 120 sec. before being removed or given the opportunity to escape. If, under the E treatment, an escape response did not occur within 30 sec. after the goal-box lid was opened, the S was slowly lifted up by hand until climbing or crawling onto the ledge occurred. All E treatment Ss were removed from the ledge within 5 sec.

During training and extinction, starting and running times were recorded to the nearest .01 sec. All Ss failing to start or to run the alley within 2 min. were removed from the apparatus and given a starting and/or running time score of 120 for that trial. During extinction, escape latencies (the interval from the opening of the goal-box lid until S's four paws were on the ledge) were measured by stopwatch to the nearest 1 sec. for EI and ED Ss. Any E treatment S failing to escape within 30 sec. was assigned a latency of 30 sec.

Results

Starting and running times were averaged across blocks of five extinction trials for each S and analyses of variance carried out on these means. The results of the analysis on running times showed significant time of removal ($F=11.93$, $df=1/24$, $p<.01$), mode of removal ($F=10.13$, $df=1/24$, $p<.01$), trial block ($F=12.86$, $df=5/120$, $p<.01$), and mode of removal by trial block interaction ($F=2.48$, $df=5/120$, $p<.05$) effects. The upper graph of Fig. 1 indicates that immediate removal or short confinement duration was associated with greater resistance to extinction than the longer confinement duration. The lower graph denotes that initially Ss allowed to escape from the goal box performed about the

Fig. 1. The effect of time (I vs. D) and mode (E vs. N) of goal-box removal on running time during extinction.

same as non-escape Ss. On the later trials, the former were more resistant to extinction. The starting time measure yielded a similar picture graphically; however, statistically only the mode of removal ($F=4.50$, $df=1/24$, $p<.05$), trial block ($F=7.12$, $df=5/120$, $p<.01$), and mode of removal by trial block interaction ($F=2.89$, $df=5/120$, $p<.05$) effects reached a conventional level of significance.

During extinction, the E treatment Ss escaped from the goal box within 30 sec. on only 55% of the trials. There was no significant difference ($ps>.05$) between Groups EI and ED on either the percentage of escape responses or escape latency measures. There was a tendency for escape performance to improve across blocks of five extinction trials (percentage: $F=2.70$, $df=5/60$, $p<.05$; latency: $F=2.90$, $df=5/60$, $p<.05$), with Group ED showing somewhat more rapid improvement than Group EI (percentage: $F=8.38$, $df=5/60$, $p<.01$; latency: $F=8.91$, $df=5/60$, $p<.01$). There was no significant ($ps>.05$) correlation between the escape and running measures; however, the lack of correlation may have been due to the curtailed distribution of escape latencies resulting from the 30 sec. no-response criterion.

Discussion

The greater resistance to extinction under escape vs. non-escape conditions cannot be accredited simply to concomitant variations in confinement durations. Mode

of goal-box removal and duration of confinement combined additively to determine resistance to extinction. These results would seem to be handled best by an interference theory. First, short goal-box confinement durations should have provided less opportunity for the occurrence of competing responses than long confinement (Stanley & Rowe, 1954). Second, the escape response was presumably more compatible with running than the last response (usually freezing) to occur in the goal box under the non-escape condition (Adelman & Maatsch, 1955). Thus, because of less interference, greater resistance to extinction would be expected and was found with immediate as compared to delayed removal and with escape as compared to non-escape conditions.

Prior attempts to demonstrate an escape effect have not always been successful (Barrett & Carlson, 1966; Theios & Bower, 1964). It is possible that other factors (such as stimulus variation introduced by matching confinement times with escape times or lengthy no-response criteria for escaping combined with frequent failures to escape) may have obscured or masked the effect of escape per se.

It should be noted that the resistance to extinction of the running response in the present study was not as pronounced as that reported by Adelman & Maatsch (1955). The failure of the running response to resist extinction completely may be related to the relatively long escape latencies and the fact that many Ss tended to climb leisurely out of the goal box. Such behavior is atypical of that commonly associated with frustrative or aversive situations but adds support to recent doubts (Schaub & Honig, 1967; Wong & Pavlik, 1966) concerning the aversive properties of cues associated with non-reward.

References

- Adelman, H. M., & Maatsch, J. L. Resistance to extinction as a function of the type of response elicited by frustration. *J. exp. Psychol.*, 1955, 50, 61-65.
- Barrett, G. V., & Carlson, N. J. Effect of escape versus non-escape responses from the goal box during extinction. *Psychol. Rep.*, 1966, 19, 447-454.
- Capaldi, E. J. Stimulus specificity: Nonreward. *J. exp. Psychol.*, 1966, 72, 410-414.
- Capaldi, E. J., & Poynor, H. B. Nonreward confinement duration: The complement of reward magnitude. *Psychon. Sci.*, 1965, 3, 515-516.
- Klugh, H. E. Speed of running in extinction as a function of differential goal box retention time. *J. exp. Psychol.*, 1961, 61, 172-177.
- Schaub, R. E., & Honig, W. K. Reinforcement of behavior with cues correlated with extinction. *Psychon. Sci.*, 1967, 7, 15-16.
- Stanley, W. C., & Rowe, M. I. Extinction by omission of food as a function of goal-box confinement. *J. exp. Psychol.*, 1954, 48, 271-274.
- Theios, J., & Bower, G. H. A test of the competing response-interference hypothesis of extinction. *Psychon. Sci.*, 1964, 1, 395-396.
- Wong, R., & Pavlik, W. B. Cues associated with frustrative nonreward do not necessarily have aversive motivational properties. *Psychon. Sci.*, 1966, 5, 325-326.