The effects of long-term training with delayed reward and delay-box confinement on instrumental performance¹

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Thirty-five rats were trained for 36 days (6 trials/day) in a runway with 20 sec delay (D) or no delay (ND). Each training group was divided in extinction into 20 sec delay-box confinement (D) or no confinement (ND). Extinction lasted for 12 days (6 trials/day). Despite the long term training the D Ss were still running slower at the end of training. The D Ss were also far more variable than the ND Ss. Resistance to extinction varied inversely with duration of confinement in extinction. Increases in confinement from training to extinction produced faster extinction; decreases produced slower extinction.

In two previous studies (Wike, Mellgren, & Wike, 1967) it was observed that rats with 20 sec delays on all trials initially ran very slowly in a runway but with continued training they tended to improve. The purposes of the present study were: (a) to determine whether or not the deleterious effects of delay can be overcome as a result of long term training; and (b) to investigate further the influence of delay-box confinement during extinction upon extinction performance. The work of Tombaugh (1966) and our previous studies suggest that increases in confinement duration from training to extinction hasten extinction, and decreases retard extinction.

Method

The Ss were 35 male Sprague-Dawley rats, 65 days old. One additional S died during the experiment. The Ss were randomly assigned to the four treatments described below.

The L-shaped runway consisted of an 8 in. long start box, a 33.5 in. long alley, a 16.5 in. long delay box, and a 8 in. x 13.5 in. goal box. The unpainted 4.75 in. wide delay box had a Plexiglas cover; the rest of the 4 in. wide runway and the goal box were painted black and covered with hardware cloth. The response measure, running time, was the time between E's elevation of the start box door and S's breaking a light beam located 3 ft from the start door.

During the first 14 days Ss were put on a 23 h hunger cycle with 1 h daily feedings, handled, adapted to the runway, and given two immediately rewarded (two 45 mg Noyes pellets) runs. Training extended over 36 days. Each S had six trials per day with the trials being rotated among six Ss. The 18 Ss in Group ND were rewarded immediately; the 17 Ss in Group D were delayed for 20 sec on all trials. In extinction the two training groups were divided

randomly with half of the Ss receiving no confinement in the delay box (ND) and half being confined for 20 sec (D). Thus, the experiment involved a 2 by 2 factorial design with 0 and 20 sec delay-box confinement in training and extinction. On all extinction trials Ss were kept in the goal box for 10 sec. Extinction extended over a 12 day period, with six rotated trials per day as in training.

Results and Discussion

The median running times from pretraining (P), training, and extinction are displayed in Fig. 1. The slight difference between Groups D and ND prior to training was in favor of D and was not significant ($p > .05$). It may be observed that after 216 training trials the two groups still remained separated. No statistical analysis was performed on the training data because the D group was obviously slower by inspection. For example, on the last five days of training the running times from the two groups formed two nonoverlapping distributions in which every S from Group ND ran faster than every S from Group D. The effects of delay upon variability were even more striking: The range of scores for the last five days was 1.31-18.98 sec in Group D as against .65-1.11 sec in Group ND. With regard to the first purpose of the study, while the D Ss showed some recovery from the effects of delay, they failed to achieve the level of performance obtained by the ND Ss.

The median running times in extinction were subjected to an analysis of variance.² This analysis revealed that longer confinement to the delay box in extinction produced significantly slower running during extinction ($F = 16.13$, $df = 1/31$, $p < .001$). This result is congruent with the findings reported by Capaldi & Poyner (1965) and Tombaugh (1966).

The most interesting result of the present investigation concerns the rank ordering of the four extinction means, which is in perfect agreement with the means of the corresponding groups in Tombaugh's experiment. The two investigations demonstrate that: Increases in confinement from training to extinction (e.g., Group ND-D) result in faster extinction; decreases in confinement from training to extinction (e.g., Group D-ND) retard extinction; and groups unchanged from training to extinction (e.g., Groups D-D and ND-ND) fall in between the above groups. These results provide an explanation for some puzzling findings reported earlier by Marx, McCoy, &

Fig. 1. Median running times in training and extinction as a function of delay and delay-box confinement.

Tombaugh (1965) in which constant delay of reinforcement in training appeared to produce enhanced resistance to extinction. The empirical generalization stated above would suggest that the results of Marx et al were due to the combination of conditions—delay in training and no delay in extinction—which prevailed in the Marx et al investigation, rather than to constant delay of reinforcement in training per se. In conclusion, delay of reinforcement is not a static parameter, but instead the effects of delay are dependent upon conditions of delay which have been encountered by the organism previously in the situation.

References

CAPALDI, E. J., & POYNER, H. B. Nonreward confinement duration:

The complement of reward magnitude. *Psychon. Sci.*, 1965, 3, 515-516.

MARX, M. H., MCCOY, D. F., & TOMBAUGH, J. W. Resistance to extinction as a function of constant delay of reinforcement. *Psychon. Sci.*, 1965, 2, 333-334.

TOMBAUGH, T. N. Resistance to extinction as a function of the interaction between training and extinction delays. *Psychol. Rep.*, 1966, 19, 791-798.

WIKER, E. L., MELLGREN, R. L., & WIKER, S. S. Instrumental performance as a function of delayed reinforcement and delay-box confinement. Unpublished research, 1967.

Notes

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2. The missing observation for Group D-ND was replaced by the mean of the group and the error df was reduced accordingly.