On the "secondary reinforcing" effect of shock for the correct response in visual discrimination learning¹

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Abstract

The finding that shock for a correct, food-reinforced response in visual discrimination training tends not to retard performance, and may even facilitate it, has been interpreted by some investigators as indicative of an acquired reinforcing property of the shock. To assess this interpretation, 40 hungry rats were given either no-shock or shock-right acquisition training, followed by extinction training in which the experimental Ss then received (a) shock for the previously correct response, as before, (b) no shock, or (c) shock for the previously incorrect response. The performances of these subgroups provided no evidence of an acquired reinforcing property of the shock, indicating instead an avoidance effect specific to the shocked arm.

Problem

The paradoxical facilitating effect of shock for the correct response in discrimination learning, obtained by Muenzinger et al (1938) with a correction procedure, has generally failed to be replicated with noncorrection training (e.g., Wischner & Fowler, 1964). Nonetheless, the results of noncorrection studies have been generally uniform in showing that a shock experience, which accelerates learning when administered for the incorrect response, affords little if any retardation when applied to the correct response.

Apart from the differences between correction and noncorrection training, the findings of both procedures lend themselves equally well to an interpretation originally offered by Freeburne & Taylor (1952): shock for the correct response serves as a differential cue and, through its association with food reinforcement, as a secondary reinforcer. Thus, the avoidance-producing property of the shock may be offset by its function as a cue which mediates the effect of food reinforcement. To evaluate this interpretation, the present study investigated the effect of shock, administered for the correct response in acquisition training, on extinction performances entailing shock for either the previously correct or incorrect response. Inclusive of no-shock controls for both acquisition and extinction, this design afforded assessment of an acquired reinforcing property of the shock both by way of the shock's potential effect in maintaining the previously learned response and in reinforcing a new, i.e., the previously incorrect, response.

Method

The Ss were 40 naive male albino rats, about 90 days old at the start of training. They were caged

individually in the experimental room under controlled temperature and a reversed day-night cycle.

The apparatus was an enclosed T maze, details of which are reported elsewhere (Wischner & Fowler, 1964). Essentially, each maze section was comprised of two L-shaped strips of sheet metal, each L serving as one wall and half of the floor. Discriminative stimuli were a dark alley and the illumination provided by a 10-w bulb positioned behind the frosted Plexiglas end plate of a goal compartment. A matched impedance shock system (60-cps AC source with a .3 megohm series resistor) delivered shock to S when S interrupted in the appropriate arm an infra-red photobeam crossing the arm at a point midway between the choice and goal sections. A manual priming feature of the circuit insured that S received only one shock on any trial. Shock intensity was held constant at 60 v (measured across the transformer output) and its duration, set at .2 sec.

The procedure included three phases of noncorrection training: pretraining, acquisition, and extinction. A week prior to pretraining, which served to reduce position and brightness preferences, each S was started and maintained thereafter on a daily diet of 12 gm Purina Lab Checkers, with water available ad libitum. For pretraining, each S received 16 forced-choice, food-reinforced trials, administered four per day at 15 min. intervals and distributed such that experiences with lighted and dark goals and with right and left maze arms were balanced. Food reinforcement (P. J. Noyes sugar pellets, 4mm, 45 mg) was liberally spread throughout a goal during the first pretraining day and thereafter systematically reduced until, on the last day, S received only two pellets per trial.

For acquisition training, the Ss were randomly assigned to a control (C) group of 10 Ss, which received only food for a correct response, and an experimental (E) group of 30 Ss which received both food and shock for a correct response. Food reinforcement (two pellets) was obtained only in the lighted goal, the right-left position of which was varied in accord with a predetermined random schedule. Each S received a total of 200 acquisition trials administered four per day at 15 min. intervals for the first six days and eight per day thereafter. For successive four-trial blocks, the first trial was a free choice, the last three, forced choices. Forcing was administered such that, for all Ss after every block of four trials, occasions of reinforcement (and of shock

for the E Ss) were equal and balanced over right and left maze arms.

With discontinuance of food reinforcement in extinction, the C Ss were continued as before under no-shock training (NS-C). The E Ss were randomly assigned to three subgroups of 10 Ss each: a shock-right (SR) group which continued to receive shock for the previously correct response; a shock-wrong (SW) group which now received shock for the previously incorrect response; a no-shock (NS) group which served as a control for the shock experienced during acquisition. All Ss received a total of 200 trials, all free choice, administered eight per day at 15 min. intervals.

Results and Discussion

Examination of choices on the first trial of successive four-trial blocks of acquisition training (the only scorable trial) showed an orderly and almost identical rate of error elimination for the C and E groups. Accordingly, mean errors for the C and E groups throughout acquisition (50 scorable trials) were 11.00 and 11.47, respectively, a non-significant difference ($t, .30$; $df, 38$; $p > .70$). This lack of retardation from shock-right acquisition training is in accord with previous findings (e.g., Wischner & Fowler, 1964) showing also that a reliable error reduction obtains when the same shock experience is applied to the incorrect response.

Mean "errors" during extinction (i.e., responses to the previously incorrect arm) are presented in 20-trial blocks in Fig. 1 for the NS-C group and the three E subgroups. Analysis of variance of group mean errors throughout extinction showed that the overall group differences depicted in Fig. 1 were reliable ($F, 2.90$; $df, 3/36$; $p < .05$).² These differences provided no evidence, however, of any acquired reinforcing property of the shock. Instead of protracting responses to the "correct" arm, the SR extinction condition had the opposed effect of rapidly increasing responses to the "incorrect" arm. Moreover, as the SWs exhibited progressively more errors in approaching chance performance (hence increasing their receipt of shock) responses to the non-shocked "correct" arm were augmented. In effect, the only apparent function of shock during extinction was to produce avoidance

of the response with which the shock was associated. This observation is supported both by a reliable difference in errors between the SR and SW groups ($F, 5.17$; $df, 1/36$; $p < .05$) and by a significant difference among the SR, NS and SW groups in frequency of Ss above and below chance during the last half of extinction ($X^2, 7.50$; $df, 2$; $p < .025$).

In contrast to the avoidance-producing effect of shock during extinction, Fig. 1 suggests that the effect of shock-right acquisition training was to facilitate extinction, the NS subgroup (or the three E subgroups collectively) showing a more rapid progression of errors to chance than the NS-C group. As assessed by polynomial comparisons in the analysis of variance of errors, however, the difference between the NS and NS-C groups was unreliable, and only of marginal significance in a comparison of the NS-C group and the three E subgroups collectively ($F, 3.13$; $df, 1/36$; $p < .10$). This trend, albeit non-significant, suggests the possibility and hence need for assessment of a facilitating influence of shock-right acquisition training on subsequent tasks such as a discrimination reversal.

Regarding the general issue of shock-right acquisition training, the present results indicate that the reported findings of either facilitated or (as in the present study) non-retarded performance are independent of any acquired reinforcing property of the shock, per se. These results do not vitiate, however, the potential "cue" effect that shock may provide (Fowler & Wischner, 1965). As a distinctive cue which is associated with only the correct response, shock may serve, in addition to its avoidance-producing function, to increase the discriminability of the goal arms, thereby delimiting generalization of secondary reinforcement from positive to negative cues, and thus reducing errors. During acquisition training, this cue function of the shock could be sufficient to offset or outweigh its aversive effect; during extinction, however, removal of the incentive and rapid dissipation of all secondary reinforcers should enable the avoidance function to predominate.

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Notes

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- 2 Analysis of variance was also performed on errors over the last half of extinction training. The results were the same as those reported for the F-test of errors over all extinction trials.

Fig. 1. Mean extinction "errors" (responses to the previously incorrect arm) in 20-trial blocks for the no-shock control group (NS-C) and the three experimental subgroups (SR, NS and SW).