Conditioned fear as a function of US intensity under conditions of drive constancy¹

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The present study was designed to evaluate the associative consequences of US intensity on acquisition of a conditioned fear response in the rat. An equal number of high and low shock escape trials were presented to four groups. For one group (CS_H) a CS was paired only with high shock trials, and, for the other (CS_L), only with low shocks. The other two groups served as controls. The CS_H group ran faster to the CS than the other groups on trials in which shock was omitted. The CS_L group performance was indistinguishable from controls. Shock intensity was found to be a potent performance variable.

Spence and his students (Spence, 1956; Spence, Haggard, & Ross, 1958a, 1958b; Spence & Platt, 1966) have demonstrated for special case of classical defensive eyelid conditioning, and Anderson, Plant, & Paden (1966) for special case of classical fear learning, that US intensity is a learning as well as an associative variable. In the Anderson et al (1966) study, the procedure involved an indirect methodology and depended upon the disruptive effects of fear for its response indicant. The present experiment capitalized on the facilitative motivational effects of fear assumed to be acquired as part of an escape learning task in an attempt to summon additional support for the US intensity-associative variable position.

Method

The Ss were 24 naive male albino rats, 90 to 100 days of age. Escape training was administered in an alley which consisted of a startbox (5 in. wide x 12 in. high x 18 in. long, inside), a gridded runway (3 in. wide x 12 in. high x 6 ft. long, inside), and a goalbox (GB) (12 in. high x 12 in. wide x 15 in. long, inside). The startbox (SB), described in detail elsewhere (Brown, Martin, & Morrow, 1962), was composed of an upper holding compartment and a lower gridded portion. A mechanically operated trapdoor separated these compartments, and, when dropped, activated the first of a series of clocks. Photo-relay devices controlled clocks, shock, and CS termination. A guillotine-type door was located at the entrance of the goalbox (GB).

An intermittent buzzer CS (.21 sec. on; .12 sec. off) was located below and in the middle of the alley (CS onset produced a 24 db increment in sound level above a 36 db background or room level noise). The shock source was a variable autotransformer through a series-connected 20 K resistor.

Two experimental and two control groups of six Ss each, equated for weight, were administered, in a semi-random sequence, 18 high (75 v), 18 low (50 v), and 12

non-shock escape trials over a five-day period followed by extinction. For one experimental group (CS_H), the CS was paired with high shock trials only, and for the other (CS_L), only with low shock trials. The CS was never presented on shock trials for the control groups. On the 12 non-shock trials the two experimental and one control (C-2) groups were presented the CS while, for the remaining control group (C-1), the CS was omitted. All groups received an equal number of randomly alternated high and low shock trials prior to insertion of each non-shock test trial. A trial consisted of placement of S in the upper compartment of the SB. Following a 5-sec. "waiting" period, S was dropped onto the electrified SB floor. The CS, when presented, was during the last 3 sec. of the "waiting" period, and continued until S entered the GB. The inter-trial interval was approximately 12 min.

Following acquisition, all groups except C-1 were extinguished in the presence of the CS (Group C-1 was extinguished without the CS). Extinction training consisted of 13 no-shock trials per day until S failed to enter the GB within 60 sec. on two consecutive trials.

Results

Full alley running times were converted to speed measures. Medians for blocks of three trials were computed for each S for high and for low shock trials, respectively. Medians for blocks of two trials were computed for the no-shock test trials. Medians for blocks of six trials also were computed for the first 60 extinction trials.

Group acquisition speeds, averaged and analyzed for trial blocks, under 0.0 v, 50 v, 75 v, respectively, are illustrated in the three panels of Fig. 1. Several important conclusions, supported by appropriate analyses, are represented in this figure. The overall Fs for groups ($F=3.88$, $df=3/20$, $p<.025$), shock level ($F=59.59$, $df=1/20$, $p<.001$), and trial blocks ($F=20.89$, $df=1/20$, $p<.001$) were significant. While there were no significant three- or two-way interactions, group differences were quite variable from one shock level to the next. The F for the effects of conditioning treatments at 0.0 v barely reached significance ($F=3.49$, $df=3/20$, $p<.05$), was not significant at 50 v, and was at 75 v ($F=3.59$, $df=3/20$, $p<.05$). Under 0.0 v, Group CS_H performed faster than the weighted average of the other three ($F=8.70$, $df=1/20$, $p<.01$), while all Fs based on remaining comparisons were not significant ($Fs<1$). The CS_H group performance under 75 v also was faster than the weighted average of the remaining

Fig. 1. Group escape acquisition speeds, averaged and analyzed for trial blocks, under 0.0 v (panel 1), 50 v (panel 2), and 75 v (panel 3), respectively. The same groups are represented for each panel. For Group C-1 the CS was omitted for all shock conditions. For Group C-2 the CS was presented on 0.0 v trials only. Group CS_h was administered the CS on both 75 v and 0.0 v trials, and Group CS_l received the CS on 50 v and 0.0 v trials.

three ($F=8.61$, $df=1/20$, $p<.01$), while no other grand mean comparisons produced significant F s.

Two grand mean comparisons involving shock level were made. The performance total under 75 v, averaged over groups, was compared with the weighted totals under 50 v and 0.0 v. The F was highly significant ($F=90.99$, $df=1/11$, $p<.001$). The second comparison, based on averaged performance totals under 50 v and 0.0 v, also produced a significant F ($F=25.40$, $df=1/11$, $p<.01$).

To determine whether the exaggerated performance of the CS_h group under 0.0 v and 75 v was due to a selection (sampling) error, a replications by treatment (the study was run in two replications of three Ss per each group) analysis of variance was performed on the data. It was reasoned that an identical sampling error for successive replications would have been highly unlikely, and, thus, neither a replication nor treatment by replication effect would be expected. Neither of the F s were significant (F s < 1). Additional argument against a sampling error explanation emerged from the fact that the CS_h group did not elicit superior acquisition performance until the second trial block.

Analysis of the extinction data produced a significant F for groups ($F=3.73$, $df=3/20$, $p<.05$), and for trial blocks ($F=27.56$, $df=1/20$, $p<.01$), but not for the interaction ($F<1$). Again, appropriate grand mean comparisons indicated that the significant F was due to the enhanced performance of the CS_h group.

Discussion

The results of this study were not entirely unambiguous. While clear evidence of conditioning to the CS was provided for the CS_h group, it was apparent that no comparable learning took place for the CS_l group. One possible explanation for this seeming paradox was that the low shock level, while sufficient to produce escape learning, was not intense enough to produce conditioning to the CS in the present situation. A similar case in which a low shock produced evidence of pain but not of conditioning has been presented by Annau & Kamin (1961). Additionally, the very nature of the task combined with the partial-reinforcement-like insertion of non-shock test trials during acquisition may have "masked" the desired effect. It may well be that when the effects of classically conditioned fear are to be revealed under circumstances where both training and testing also involve concomitant instrumental behavior, such vitiates chances of obtaining a clear reflection of either process. One additional comment to be made is the clear demonstration of the effects of shock intensity on escape learning. Indeed, the within-Ss design employed here provided an unusually sensitive reflection of the role of US intensity as a potent performance variable.

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Notes

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