# The effects of shock intensity and d-amphetamine on avoidance learning

*GEORGE A. CICALA, University of Delaware, Newark, Dela. 19711, and EDWIN KREMER, Princeton University, Princeton, N. J. 08540*

*The effects of shock intensity and d-amphetamine on a shuttlebox avoidance response were factorially assessed. Avoidance learning was facilitated by the drug and inversely related to shock intensity but the two variables did not interact. The results were discussed in terms of D'Amato's anticipatory response hypothesis.*

D'Amato, Fazzaro & Etkin (1968) have proposed that variables which increase anticipatory responding or saliency cues facilitate avoidance conditioning. These mechanisms may help to clarify some presently inconsistent findings. For example, Moyer & Korn (1964) have demonstrated an inverse monotonic relation between UCS intensity and shuttle avoidance. It is not immediately apparent why increasing the intensity of one source of motivation for the avoidance response should lead to decrements in the response. It is possible, as Moyer and Korn suggest, that high shock levels increase freezing tendencies which compete with the avoidance response and these tendencies produce the decrement in anticipatory responding.

Numerous studies have shown that amphetamine compounds increase avoidance responding (e.g., Teitelbaum & Derks, 1958) and these compounds also have a direct effect on motor activity (Ross & Schnitzer, 1963). These findings are consonant with the anticipatory response hypothesis in that the increase in motor activity produced by amphetamines may be responsible for the occurrence of anticipatory responses which increase opportunities for reinforcement of avoidance behavior.

The present study is an attempt to assess factorially the relative and interactive effects of d-amphetamine (D-Am) and shock level on avoidance learning. It was predicted that avoidance learning would be facilitated by D-Am and negatively related to shock level. Further, it was expected that if these two factors are operating through the common mechanism of anticipatory responses a significant interaction would be obtained.

## METHOD

The Ss were 61 male albino Wistar rats from 110-120 days of age at the beginning of the experiment. One S was eliminated due to procedural error.

The training apparatus was a shuttle box, 16 x 7 x 7 in., made of aluminum with a Plexiglas top. The floor of the chamber consisted of 3/32-in. stainless steel rods spaced ½ in. apart. Each half was individually mounted and connected to a mercury switch to monitor the location of the animal. The CS was a 75-dB white noise from a Grason-Stadler noise generator (Model 901). The US was provided by a variable output matched impedence shock source (Campbell & Teghtsoonian, 1958). The apparatus was enclosed in a sound-attenuating chamber and located in a room adjacent to the room containing the automatic programming and recording equipment.

All Ss were allowed ad lib feeding and drinking throughout the experiment. Animals in the drug groups were injected with 2 mg/kg of D-Am in isotonic saline. The Ss were placed in the shuttling apparatus ½ h after injection. The white-noise CS preceded the onset of the US by 5 sec and was continuous with the 5-sec US. The shuttling response during the CS terminated the white noise and prevented US onset. A response during the US immediately terminated the shock. The intertrial interval was 37 sec. All animals were run to a criterion of 10 successive avoidances or for 150 trials.

The animals were randomly assigned to six experimental groups. Twenty animals were run at each of three shock intensities, 80 V (Groups 80 D, 80 P), 130 V (Groups 130 D, 130 P) and 180 V (Groups 180 D, 180 P). Ten of the 20 animals in each shock-level group were injected with 2 mg/kg of D-Am (Groups 80 D, 130 D, 180 D), the remaining 10 animals were injected with isotonic saline (Groups 80 P, 130 P, 180 P). The animals in all groups were run in a balanced random order.

A 2 by 3 analysis of variance was performed on each of two measures of avoidance learning and on an activity index. These data are presented in three separate graphs in Fig. 1. The top

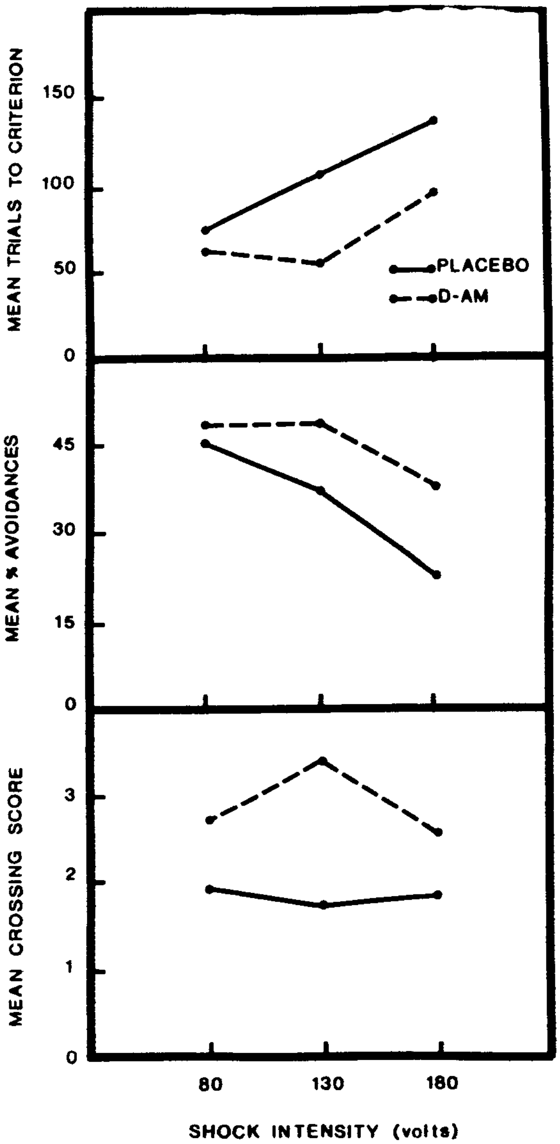


Fig. 1. Trials to criterion (top), per cent avoidances (middle), and activity index as a function of shock level for D-Am and placebo groups.

graph shows trials to criterion as a function of shock intensity for D-Am and placebo groups. The main effects of the Shock Intensity and Drug variables were in the predicted direction and highly significant ($F = 9.41$, $df = 1/54$, $p < .01$; $F = 7.10$, $df = 2/54$, $p < .01$, respectively). The interaction fell far short of significance ($F = .94$, $df = 2/54$). The middle graph shows per cent avoidances as a function of shock intensity. Here again, the Shock Intensity and Drug variables produced highly significant effects in the predicted direction ($F = 11.55$, $df = 2/54$, $p < .01$; $F = 13.54$, $df = 1/54$, $p < .01$, respectively) while the interaction was again far short of significance ($F = 1.22$, $df = 2/54$).

In addition to the avoidance measures, an activity index (total crossings/trials) was computed for each S. The means of these scores appear in the lower graph of Fig. 1. An analysis of variance on these scores indicated that the D-Am were more active than placebo groups ($F = 14.22$, $df = 1/54$, $p < .01$) but shock level was not related to the activity score. The Shock Intensity by Drug interaction also was not significant.

## DISCUSSION

The results in this experiment clearly indicate an inverse relation between shock intensity and avoidance learning and as such strongly support the findings of Moyer & Korn (1964). Further, the facilitative effects of D-Am on avoidance learning evidenced at all shock levels studied and the strong effects of D-Am on the activity scores are interpreted as supportive of the anticipatory response hypothesis proposed by D'Amato et al (1968). It is certainly conceivable that the energizing effects of D-Am results in the occurrence of more anticipatory responses which provide greater opportunity for reinforcement of avoidance behavior.

The data, however, do not support an anticipatory response interpretation of the effects of shock intensity on avoidance learning. In the first place, D-Am and shock level did not interact on any of the measures taken, which may suggest that the two variables affect avoidance learning through different mechanisms. More importantly, the activity measure was unrelated to shock level.

It might be possible to extend a unitary anticipatory response interpretation to the results of shock intensity if one proposes that although the overall quantity of activity did not decrease with increasing shock levels, the pattern of activity may have been influenced by shock intensity. At low-shock levels, activity may occur throughout the intertrial interval, whereas at high-shock levels activity may occur only immediately after shock termination. Thus, the total amount of activity at different shock levels may be constant as the data suggest but only at low-shock levels does the activity produce truly anticipatory behavior.

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