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Stimulus properties of sympathomimetic and sympatholytic drugs*

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Albino rats were trained in shuttlebox avoidance under one of the three drug conditions: Sus-Phrine (S), D. H. E. - 45 (D), or placebo (P). Twenty-four hours later the animals were tested for retention in the same or a different drug state. No evidence was found for a drug sequence effect although the D group exhibited significantly more avoidances. An operant conditioning procedure yielded results supporting discriminative stimulus properties of D. H. E. - 45. The results are discussed as they relate to the discriminative control of behavior through stimuli of an autonomic character.

Aversive tasks appear to be among those most easily subject to state-dependent learning (SDL) with ethyl alcohol. Cases in point include Overton's shock T-maze (1966), Crow's active avoidance shuttlebox tasks (1966), and Halloway's active and passive avoidance situations (1972). Alcohol (and other central nervous depressants) appears to be especially potent in the discriminative control of behavior, and an hypothesis of the relative importance of aversive stimuli (Crow, 1970) led to consideration of responses of an automatic character being involved by virtue of changes in their intensity. Thus the present study was undertaken to observe transfer effects of drugs acting on autonomic effector sites utilizing sympathomimetic and sympatholytic preparations designed to produce opposing reactions that would endure throughout an experimental conditioning session.

METHODS

Subjects

Thirty-seven male albino rats of the Holtzman strain were used. The animals were approximately 90 days of age and naive to all experimental conditions.

Apparatus

The apparatus was a shuttlebox 20 x 30 x 57 cm. A spring-loaded barrier, 4 cm high, separated the grids. Twenty-five watt light bulbs were located on the ceiling of each side to serve as conditioned stimuli (CS). The scrambled shock intensity was 1 mA.

A Ralph Gerbrands conditioning chamber was used in conjunction with Grason-Stadler programming equipment for the operant stimulus discrimination training.

Procedure

A training and 24-h subsequent testing session for each animal consisted of 100 trials given at a 30-sec intertrial interval. A trial consisted of the onset of the CS on the animal's side of the box followed 5 sec later by the onset of the US. The CS and US were terminated only when the animal crossed the barrier. Latencies shorter than 5 sec were avoidance responses.

Nine groups of four animals each provided the sequences of Sus-phrine (S), control (C), or D. H. E. - 45 (D) states in the training and testing sessions (SS, SC, SD, CS, CC, CD, DS, DC, DD).

An animal was maintained at approximately 80% bodyweight through food deprivation and trained in a daily 30-min period of fixed interval 22-sec food reinforcement schedule. The 30-min session was then divided into three 10-min segments, the second of which was a dark "time-out" period. That is, during the 11th through 20th minutes, no reinforcement conditions obtained and chamber lights were turned off. After the animal had learned not to respond during this middle 10-min segment, the drug conditions were imposed in the following way: *Drug discrimination condition.* The animal was injected intraperiotoneally with D. H. E. - 45, and 10 min later was put into the conditioning chamber. In this condition, the dark 10-min segment was reinforced by using a fixed interval 44-sec reinforcement schedule. *Placebo condition.* The animal was given a saline placebo injection and placed in the conditioning chamber 10 min later. The dark 10-min segment was in this condition identical to the original training, that is, a no reinforcement condition in the dark. The initial and final 10-min segments were always reinforced under fixed interval 22 sec.

Dosages

Sus-phrine (epinephrine suspension 1:200, Cooper Laboratories) dosages were 0.0045 cc/100 gm (note: this was not a U.S.P. 1:1000 dose), D. H. E. - 45 (dihydroergotamine mesylate, Sandoz Pharmaceuticals) were 0.03 cc/100 g, control injections were isotonic saline. All injections were given intraperiotoneally 10 min prior to the conditioning sessions.

RESULTS AND DISCUSSION

The data were analyzed separately for CAR and latency measures. Figure 1 shows the mean percent CAR for groupings of drugs in the training and testing sessions. For the training session the D group differs significantly (alpha of .05) from the control group and from the S group. Although approaching significance, the difference between the S and C groups is not reliable. In the testing session only the S and D conditions differ significantly.

Analyses of variance were carried out with both CAR and latency scores by means of mixed factorial designs of between drug effects in training and testing, and a within session effect. The higher order interactions of this design (especially the triple order effect) were

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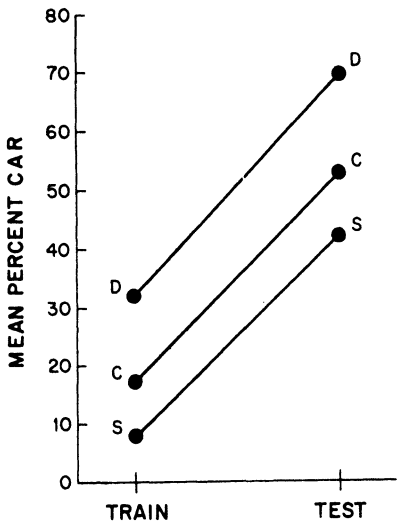

Fig. 1. Mean percent avoidances for the drug groups in the training and testing sessions. For each group N = 12.

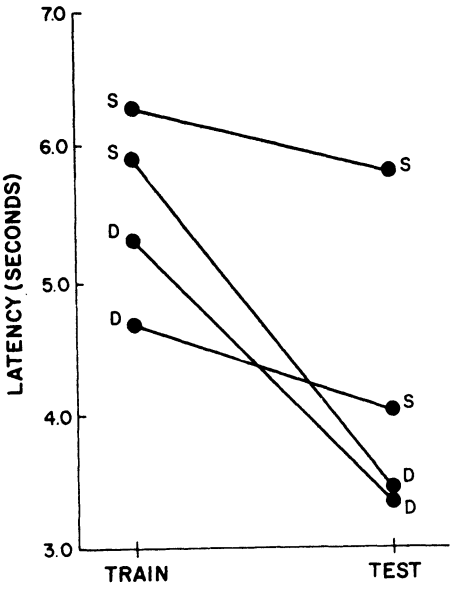

Fig. 2. Mean latency as a function of drug sequence.

thought to provide a liberal opportunity for drug transfer effects to be noted. For neither the CAR scores nor the latency scores were the training by testing drug interactions significant. For example, such an analysis of the latency data for the S vs D treatments yielded a significant (alpha of .05) training treatment effect ($F = 5.437$, $df = 1/12$), and a significant within sessions effect ($F = 51.951$, $df = 1/12$), but did not yield a significant Training by Testing interaction ($F = 2.625$, $df = 1/12$) nor a significant Training by Testing by Within Session interaction ($F = 0.889$, $df = 1/12$). An overall summary of these data is presented in Fig. 2.

The results appear to conform to drug facilitation effects as opposed to SDL effects (Overton, 1972), and there is no discernable confounding of the two. Although a general consideration of avoidance responding and sympatholytic drugs is beyond the scope of the present discussion, the findings do not appear surprising in that Latané, and Schacter (1962) have shown that high dosages of epinephrine impair avoidance acquisition.

With respect to SDL the results are consistent with those of Overton (1971), in which case neither tetraethylammonium chloride (antinicotinic ganglionic blockade) nor phenoxybenzamine (alpha-adrenergic blockade) yielded effective response control. However, that such stimuli of an autonomic character may serve as discriminative stimuli is supported by the operant conditioning study the results of which are depicted in Fig. 3. It may be seen that some degree of discriminative properties of D. H. E. - 45 is evident. A similar attempt to obtain discriminative control with Sus-Phrine was not successful. In man autonomic responses may be subject to SDL (Powell, Goodwin, Janes, & Hoine, 1971; Crow & Ball, 1974), and it is likely that SDL is accompanied by corresponding changes in autonomic activity in the case of aversive conditioning in the rat. Any relation of autonomic reactivity to SDL would appear to hinge on central as well as peripheral changes, a state of affairs long acknowledged in the area of emotion (Wenger et al, 1960).

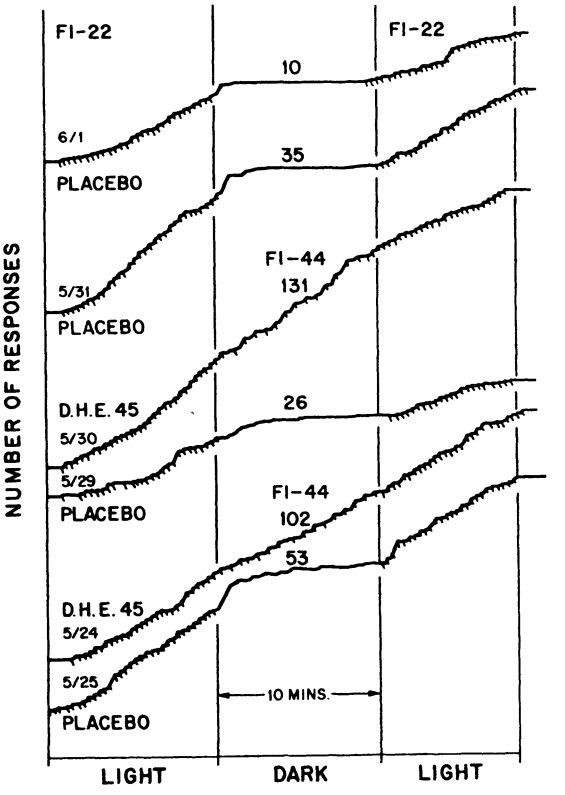

Fig. 3. Drug stimulus discrimination training. Each cumulative record represents a daily 30-min session (see text).

REFERENCES

Crow, L. T. Effects of alcohol on conditioned avoidance responding. Physiology & Behavior, 1966, 1, 89-91.
Crow, L. T. Alcohol state transfer effects with performance maintained by intracranial self-stimulation. Physiology & Behavior, 1970, 5, 515-517.
Crow, L. T., & Ball, C. Alcohol state-dependency and autonomic reactivity. Paper presented at the meetings of the Federation of American Societies for Experimental Biology, April, 1974.
Halloway, F. A. State-dependent effects of ethanol on active and passive avoidance learning. Psychopharmacologia (Berl.)., 1972, 25, 238-261.
Latané, B., & Schachter, S. Adrenalin and avoidance learning. Journal of Comparative & Physiological Psychology, 1962, 55, 214-216.
Overton, D. A. State dependent learning produced by depressant and atropine-like drugs. Psychopharmacologia (Berl.). 1966, 10, 6-31.
Overton, D. A. Discriminative control of behavior by drug states. In Thompson, T. and R. Pickens (Eds.) *Stimulus properties of drugs.* Appleton-Century-Crofts, 1971, Pp. 87-110.
Overton, D. A. Experimental methods for the study of state-dependent learning. Paper prepared for presentation at the meetings of the Federated Societies for Experimental Biology in Atlantic City, New Jersey, 1972.
Powell, B., Goodwin, D. Janes, C., & Hoine, H. State-dependent effects of alcohol on autonomic orienting responses. Psychonomic Science. 1971, 25, 305-306.
Wenger, M., Clemens, T. Darsie, M., Engel, B., Estess, F., & Sonnenchein, R. Autonomic response patterns during intravenous infusion of epinephrine and nor-epinephrine. Psychosomatic Medicine, 1960, 22, 294-307.

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Effects of narrative stories on recall*

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Effects of narrative stories on recall of words using lists of different interitem associative strength after different delayed intervals of recall were investigated. Sixteen lists of 10 nouns were presented to 36 Ss. Each S studies lists of different interitem associative strength. Four of the 16 lists were narrative report lists and were used only to control narrative Ss following instructions. Control Ss received a study time equal to that of their yoked narrative Ss. Ss were required to recall the lists immediately after learning, at the end of session, and either 7, 14, or 28 days later. Significant differences were obtained between the two study groups on a session recall test and on the delayed recall interval tests but not on immediate recall test. Statistical significance was also obtained among lists of different interitem associative strength; recall was greater from lists of high interitem associative strength than from either zero or low interitem associative strength. The results support and extend those reported by Bower and Clark.

In 1969 Bower and Clark reported that Ss who were asked to create narrative stories around unrelated words recalled significantly more words than Ss given no special instructions in the use of a mnemonic technique. Bower and Clark state that "the narrative Ss recalled six to seven times more than their yoked controls. There was no overlap in recall scores of the two groups on any list; the average of the median scores was 93% for the narrative Ss vs 13% for their yoked controls [pp. 181-182]." Several early experiments in our laboratory attempting to replicate and extend the results of Bower and Clark by using word lists of different interitem associative strength were not successful. The major difficulty in our experiments was the failure of our narrative Ss in constructing narratives when instructed to do so. Interviews with our Ss after the experiments revealed that about one third made up stories in learning the word lists. To insure that narrative Ss would create such narratives when their yoked control Ss would not, the present experiment required occasional reports of the nattatives constructed for particular word lists and after Ss learned of these lists, the narrative S were asked to give their stories. In this way it could be determined if Ss were constructing narrative stories and following instructions. Additionally, frequency and associative strength of words were controlled for each list. Frequency of occurrence was determined by the use of Thorndike and Lorge Tables, and associative strength by using lists of different interitem associative strength. Deese (1959) defines interitem associative strength as "the average

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