Drugs and avoidance performance

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Cocaine and pipradrol facilitated the avoidance performance of rats in Skinner boxes. When the drugs were withdrawn performance deteriorated to levels shown by rats that had never been drugged. The drugs seemed to temporarily affect either emotionality or activity rather than to permanently affect learning. Tricyanoaminopropene did not affect performance.

Do some drugs permanently affect avoidance learning or do they temporarily facilitate performance? Facilitation of performance may come about in at least two ways. If learning is permanently improved, the facilitation should persist or develop after drugs are withdrawn, but if other states such as emotionality or level of motor activity are temporarily changed, the facilitation should persist only while organisms are under the effects of drugs. Several drugs have facilitated the avoidance performance of rats. The facilitation with d-amphetamine (Hearst & Whalen, 1963) and pipradrol (Stone, 1960) may be related to their ability to counteract the propensity of rats to freeze after being shocked. However, the facilitation with tricyanoaminopropene, a nucleic acid stimulator, may be a permanent learning effect (Chamberlain, Rothschild, & Gerard, 1963). We studied the avoidance performance of rats in Skinner boxes under drug and nondrug conditions to determine whether facilitation would be permanent or temporary.

Method

Naive male Sprague-Dawley rats weighed from 200 to 290 gm at the start of training in Skinner boxes (details of apparatus in Pearl & Edwards, 1962). A warning signal, white noise at 72 db, was presented every 20 sec. for 200 trials of training each day. If S pressed the bar within 5 sec. after the onset of the warning signal, the signal ended and the electric shock was avoided. If S did not avoid the shock the signal continued and was joined by 2 ma of shock for 3 sec. or until S escaped from shock by pressing the bar, whichever occurred first. Holding the bar down continuously was ineffective; S had to release the bar and press it again to avoid or escape shock. Training sessions were on Monday through Friday of the first week and Monday through Thursday of the second week. Experimental Ss received drug on alternate days beginning on the second day of training and control vehicle on the other days; additional groups received control vehicle on all days. Seven Ss were injected subcutaneously with 6 mg/kg pipradrol hydrochloride 30 min. before testing, and eight were injected with 10 mg/kg of cocaine hydrochloride. A control group consisting of 15 Ss received 1 ml/kg of distilled water each day. Two groups of eight Ss each were injected intraperitoneally with either 15 mg/kg of tri-

cycanoaminopropene 45 min. before testing or a 1% aqueous solution of gum tragacanth.

Results and Discussion

Pipradrol hydrochloride (6 mg/kg) and cocaine hydrochloride (10 mg/kg) temporarily facilitated avoidance performance (Fig. 1). All of the Ss given pipradrol or cocaine made more avoidance responses during the four days on which drug was given than during the subsequent four days (Days 3, 5, 7 and 9) on which drug was not given. Each time the drugs were withdrawn the performance of the groups deteriorated to about the level shown by the control groups¹. Additional groups given lower doses of pipradrol hydrochloride (3 and 1.5 mg/kg) or cocaine hydrochloride (5 and 2.5 mg/kg) showed at best only slight and temporary facilitation. The escape performance of the groups was similar under drug and nondrug conditions.

The fact that all of the Ss given pipradrol pressed the bar more often during the drugged condition than during the nondrugged condition (Fig. 2) suggests that pipradrol may have stimulated Ss and thereby increased the probability of avoidance responding. Or the stimulation may have served to counteract freezing, a response antagonist of the avoidance response. The finding that cocaine did not increase bar pressing while facilitating

Fig. 1. Mean percentage of avoidance responses. Groups given 6 mg/kg of pipradrol hydrochloride and 10 mg/kg of cocaine hydrochloride received the drugs on even numbered days and control vehicle on odd numbered days.

Fig. 2. Mean number bar presses. The pipradrol and cocaine groups received drugs on even numbered days and control vehicle on odd numbered days.

avoidance performance is similar to results obtained with d-amphetamine. Another similarity between the two stimulants is that they increase the amount of motor activity in situations which do not involve shock. In avoidance situations the propensity for increased activity may be manifested in the form of counteracting the response of freezing during the warning stimulus and thus increase the likelihood of avoidance responding.

Tricyanoaminopropene did not affect any of the indicators of performance. The percentages of avoidance responses made by the group given 15 mg/kg of drug were 21 during the drug state and 19 during the nondrug state. The percentages of avoidance responses for this group from Days 1 to 9 were 9, 14, 15, 20, 16, 24, 15, 27, and 30, and that of the corresponding group which

received control vehicle throughout was 14, 21, 25, 32, 30, 38, 40, 42, and 39. If anything, the avoidance performance of the control group remained slightly better than that of the drug group. Further, no effects on avoidance and escape performance or on bar pressing were noted in groups given 7.5 or 30 mg/kg of drug.

Our results with tricyanoaminopropene are inconsistent with those of Chamberlain et al who obtained facilitation of avoidance performance in a cylindrical bar-pressing apparatus, but are consistent with those of Brush, Davenport, & Polidora (1966) who did not obtain facilitation of performances in shuttle boxes and in water mazes. Our test may be inappropriate for facilitating performance with tricyanoaminopropene and perhaps, as Chamberlain et al have suggested, simpler tasks may be more appropriate. Nonetheless, facilitation of performance with tricyanoaminopropene seems to have limited generality.

References

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Note

- Several of the Ss were tested for four days after withdrawal of pipradrol or of cocaine and all still made less avoidance responses under the nondrug than under the drug state. It does not do to give these doses of pipradrol and of cocaine to Ss on their first day of training before they are proficiently escaping from shock because the combination of current and drug incapacitates or kills them. However, three of seven such Ss remained coordinated on four consecutive days under 4 mg/kg of pipradrol hydrochloride and achieved high levels of avoidance performance. But Ss lost their performance when pipradrol was withdrawn and did not regain it during the seven days of training under the nondrug state.