**EFFECTS OF CHLORPROMAZINE AND
D-AMPHETAMINE ON ESCAPE AND AVOIDANCE
BEHAVIOR UNDER A TEMPORALLY DEFINED
SCHEDULE OF NEGATIVE REINFORCEMENT¹**

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Chlorpromazine hydrochloride and d-amphetamine sulphate were administered to two rats responding on a baseline temporally defined schedule of negative reinforcement which produced both "escape-like" and "avoidance-like" behavior. The effects of these drugs appeared similar to those expected on the more customary sort of non-cued avoidance schedule.

Sidley (1962) has demonstrated that both "escape-like" and "avoidance-like" behavior may be obtained within a single temporally defined schedule of negative reinforcement. It seemed worth ascertaining whether the behaviors generated by that schedule would be affected in a similar way by the same variables that affect customary "escape" and "avoidance" behavior. Among these latter variables are several drugs, including chlorpromazine hydrochloride and d-amphetamine sulphate. The present study examined the effects of these two drugs on the behavior of two animals previously exposed to such a temporal schedule.

Apparatus and Procedure

The apparatus used in the present experiment has been described in detail by Sidley. On the response side, a force of 11 gms was required to depress a stainless steel bar which closed a microswitch activating a system of programming and recording equipment. When scheduled, a 1-milliamp polarity-scrambled shock was delivered to the feet of the animal through 16 stainless steel rods composing the grid floor. The animals used were two male albino Wistar strain rats approximately 170 days old when the experiment began. They were maintained on *ad libitum* food and water throughout. These animals

had been used in Sidley's experiment (from which their identification numbers of 6c and 7c have been continued here), finishing their service there some five days before the start of the present study.

Briefly, the conditioning schedule involved three temporal variables: (1) t_A^D , a period during which an aversive stimulus is scheduled to occur, (2) t_A^A , a period, alternating with t_A^D , during which an aversive stimulus is not scheduled, and, (3) *TO* (Time Out), a response-produced period of time during which any aversive stimulus scheduled to occur is withheld. During *TO*, responding has no effect upon the length of that *TO*. For the present study, the schedule was defined by $t_A^D = 0.5$ sec, $t_A^A = 59.5$ sec, and *TO* = 10 sec. This schedule provides that a 0.5 sec shock will occur every 59.5 sec if the animal does not respond at all. Every response not occurring during a *TO* will initiate a *TO* lasting 10 sec. Thus, a response during a shock will terminate that shock, and any response not in a *TO* which occurs within 10 sec before a scheduled shock will have the effect of canceling that shock.

The drugs were administered intra-peritoneally, always 30 min before an experimental session. Sessions lasted either 100 or 150 min, and were conducted daily, seven days per week. The sequence of drug dosages, identical for both animals, was: drug day 1—1.0 milligram of chlorpromazine per kilogram of body weight; drug day 2—2.0 mg/kg chlorpromazine; drug day 3—4 mg/kg chlorpromazine; drug day 4—0.5 mg/kg d-amphetamine; drug day 5—1 mg/kg d-amphetamine; drug day 6—0.8 mg/kg d-amphetamine. Three 50-min

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control (no drug) days were interspersed between any two drug administrations to counteract the cumulative effect, if any, of the drugs on the baseline behavior.

Results and Discussion

Figure 1 exhibits the cumulative response records of each animal for the entire drug session at each of the dosages. The "pips" on the curves represent shock occurrences. A control (no drug) day's record, taken from one of the three days between the last chlorpromazine dose (4 mg/kg on drug day 3) and the first

d-amphetamine dose (0.5 mg/kg on drug day 4), is inserted for comparison. Cumulative records for control days showed no effects of the drugs, and the two control records shown may be taken as typical of the "baseline" performance of the two animals.

Chlorpromazine has the effect in our data of slowing the overall rate of responding, and the resulting greater number of shocks gives the appearance of a decrease in "avoidance" efficiency. If this drug is not simply a general activity depressant, but rather is specific to behavior maintained by "avoidance" con-

Fig. 1. Complete cumulative response curves for entire drug sessions for both animals in the experiment. Shock occurrences are indicated by "pips." Dosages in mg/kg are shown to the right of their respective records. Each record segment represents 50 min of a session, with total session length being either 100 or 150 min. The uppermost segment of each session's record is the first 50 min, and so on. Control sessions were 50 min long (see text for schedule of control sessions).

tingencies, then the foregoing may be evidence that the temporal schedule in the present study does produce "avoidance" behavior. Verhave, Owen and Slater (1958) have shown that chlorpromazine at some doses can selectively reduce the number of "avoidance" responses by rats while having relatively little effect on "escape" responses. In any event, the relationship between dosage and response rate appears here to be an inverse monotonic one, and this is what Weissman (1959) has reported for a customary non-cued avoidance schedule.

Figure 1 also shows that the effect of d-amphetamine is to increase the rate of response, and thereby to decrease the number of shocks delivered. In addition, the cumulative records are marked by periods of sporadic rapid responding, especially at the 1 mg/kg dose. Sidman (1956) has shown similar effects in rats with amphetamine on a usual non-schedule; and Weissman (1959) has confirmed this finding for a non-component of a multiple schedule, observing also, that at doses below 1 mg/kg the effect of raising response rate was felt throughout the multiple schedule and was not specific to the avoidance component. The heightened "avoidance" effected by the amphe-

tamines must be cautiously interpreted since it may be only an artifactual by-product of the general rise in response rate produced by this family of drugs. It may perhaps be noted in this connection that Owen (1960) has found with rats that d-amphetamine in dosages from 1 to 3.2 mg/kg has the effect of decreasing the rate of response with behavior maintained by a positive reinforcement schedule.

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