Discrimination reversal under sodium pentobarbital¹

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Four groups of rats were trained on a two lever spatial discrimination problem. Ss injected with pentobarbital during acquisition and placebo during reversal learned the discrimination reversal with fewer errors than control group Ss which never received pentobarbital. Administering pentobarbital only during reversal learning impaired acquisition of the new response.

Two recent experiments have examined the effect of the barbiturates on the acquisition and extinction of a simple running response in a straight alley. Barry, Wagner, & Miller (1962) conditioned deprived rats to traverse an alley for water reinforcement. Ss which acquired the response while undrugged were divided into drugged and undrugged groups during extinction. The drugged Ss, which received 20 mg/kg amobarbital, were slower to extinguish than the saline control group. Bindra, Nyman, & Wise (1965) reported another experiment which gave contradictory results. Ss which had been trained to make an escape response while undrugged were divided into drugged and undrugged groups during extinction. In this study the drugged Ss, which received 30 mg/kg phenobarbital, extinguished more quickly than the controls. Both studies also included groups in which Ss were conditioned while drugged. Under these circumstances, both experiments showed that administering barbiturates during extinction slowed extinction.

There is also evidence that barbiturates affect discrimination learning and reversal. Overton (1964) showed that rats could learn a discriminative escape response in a T maze under high dose of sodium pentobarbital. When run in an undrugged state, the Ss were unable to make the response learned under drug at greater than chance accuracy. The Ss were also able to learn a different response for each drug state when pentobarbital and a placebo were administered on alternative days. We wished to study the effects of sodium pentobarbital on discrimination learning and discrimination reversal of positively reinforced behavior. The results reported by Barry et al (1962) suggested that different effects might be obtained by administering barbiturates during acquisition as opposed to reversal.

Method

The Ss were 30 Long-Evans hooded rats, approximately 90 days old at the beginning of the experiment. They were given a water ration after each session sufficient to keep all Ss between 225 and 275 gm during the course of the experiment. Food was available ad lib, in the home cage.

A Skinner box (7-3/8 in. x 12 in. x 8 in.) with two retractable levers, 1.5 in. above the floor, was used. Reinforcements were delivered by a 0.06 cc liquid dipper located in the middle of the base of the front wall. The dipper was available to S at all times except when in operation.

The Ss were magazine trained and placed on continuous reinforcement (CRF) during their first session. There were three additional 1-hr. sessions of CRF during which only one of the levers was available to S. Each lever was present on alternate days, with the preferred lever on the first day determining the sequence. Following the CRF sessions, there were six 1-hr. sessions of variable interval 1-min. (VI 1) reinforcement for responses on the one available lever. Each lever was again retracted and available on alternate days.

The experiment consisted of five sessions of 15 reinforcements each. Both levers were available to S during this training. Responses on lever A were reinforced on a VI 1 min. schedule while an extinction schedule was in effect on lever B. Two days of rest after the training sessions were followed by three sessions of reversal training during which responses on lever A were never reinforced; responses on lever B were reinforced on a VI 1 min. schedule. For half the Ss lever A was on the right; for the other half it was on the left.

The Ss were divided into four groups. Saline control Ss (N=12) were given a placebo injection before each training and reversal session; the second group (N=6) were injected with pentobarbital before each training session and placebo before each reversal session (PB-S); the third group (N=6) received placebo injections during training and pentobarbital during the reversal phase (S-PB); the fourth group (N=6) were injected with pentobarbital prior to both training and reversal sessions (PB-PB).

Drug or placebo was administered 20 min. before each experimental session. Pentobarbital was always administered in 10 mg/kg doses and prepared in concentration of 10 mg/cc. Isotonic saline was used as the placebo and was injected in the same volume to weight ratio as the pentobarbital.

Results

The data obtained during original training were analyzed in terms of proportion of total response emitted on lever A and total number of responses. There were no significant differences on either measure when drugged and non-drugged animals were compared.

Fig. 1. Mean percent correct responses during reversal training sessions.

Total number of responses did not differ significantly among the four groups during reversal training. Drug treatment, however, had a significant effect on the proportion of responses emitted on lever B on day 1 ($F=4.85$, $df=3/25$, $p < .01$) and day 2 ($F=3.14$, $df=3/25$, $p < .05$) of reversal training. By the third day of reversal training the difference among groups was no longer significant. Figure 1 shows the mean percent correct responses for each group on the first two days.

On the first day of reversal training the PB-S group rats emitted a higher mean percentage of their responses on lever B than did Ss in the other three groups. By the second day the difference between the PB-S group and the saline control group had disappeared. The S-PB group had the lowest mean percentage of responses on lever B on the second day but was not significantly

different from any other group. Analysis of data from the third day of reversal training did not show any significant differences.

Discussion

There is general agreement that a response which has been learned under a barbiturate is weakened by the change to an undrugged state. The more rapid reversal learning of the PB-S group compared to the control group provides further confirmation of this phenomenon.

We have already cited the contradictory results obtained when a barbiturate was administered during the extinction of a response learned in the undrugged state. To the extent that the slow reversal learning of our S-PB group implies slow extinction of the original responses, our results agree with those reported by Barry et al (1962). Miller (1964) has compiled a considerable body of evidence which shows that at least one barbiturate serves to reduce the "frustrational effect of experimental extinction" (p. 12) and such an effect would satisfactorily explain our results. The extinction of an escape response, on the other hand, does not generate any frustrational effect. Consequently, the change in chemical state caused by injecting a barbiturate during escape extinction might be expected to facilitate extinction of an escape response.

References

- Barry, H., Wagner, A., & Miller, N. Effects of alcohol and amobarbital on performance inhibited by experimental extinction. *J. comp. physiol. Psychol.*, 1962, 55, 464-468.
- Bindra, D., Nyman, K., & Wise, Jr. Barbiturate-induced dissociation of acquisition and extinction: Role of movement-initiating processes. *J. comp. physiol. Psychol.*, 1965, 60, 223-228.
- Miller, N. E. The analysis of motivational effects illustrated by experiments on amylobarbitone sodium. In H. Steinberg (Ed.), *Animal behavior and drug action*. Boston: Little, Brown and Company, 1964. Pp. 1-18.
- Overton, D. A. State dependent or "dissociated" learning produced with pentobarbital. *J. comp. physiol. Psychol.*, 1964, 57, 3-12.

Note

1. In conducting the research reported herein, the investigators adhered to the "Principles of laboratory animal care" as established by the National Society for Medical Research.