Fig. 2. Response rates in the baseline session (15 min) and in the five subsequent experimental sessions (15 min each).

df = 33, $p < .01$), whereas the flickering-light group did not ($t = 1.59$, df = 33, $p > .1$). Average response rates for each group over the subsequent four sessions (Fig. 2) were significantly different (Kruskal-Wallis: $H = 10$, $p < .01$); each group was significantly different from the others (Mann-Whitney: U , in each case, = 0, $p < .02$).

DISCUSSION

Contrary to expectations, steady light proved to be a more effective reinforcer than flickering light, this being the reverse of the previous finding. The only differences between these two studies were in the length of the test period and length of baseline. The reversal in the effectiveness of these stimuli as reinforcers cannot be dealt with by any theory which seeks to explain the relative effectiveness of sensory reinforcers solely in terms of the characteristics of the reinforcing stimulus, e.g., preference theory (Lockard, 1963), scanning theory (Robinson, 1959), or simple stimulus change theory (Kish & Antonitis, 1955). It is necessary to take into account the existing state of the animal in relation to the stimulus conditions. For example, Berlyne, Koenig, & Hirota (1966) argued that reward value of a stimulus is an inverted U-shaped function of arousal value, and claimed that the relative effectiveness of novel or familiar stimuli as reinforcers was reversed for animals maintained in a noisy room (high arousal), as compared with animals raised in a quiet room (low arousal). Similarly, Berlyne sees arousal level as being enhanced as a result of a period of deprivation of stimulus change. Thus, the reversal of the

effectiveness of steady light and flickering light as reinforcers could be due to differences in arousal level produced by the different periods of pretest familiarization with the apparatus.

REFERENCES

- APPEL, J. B., & HURWITZ, H. M. B. Studies of light-reinforced behavior: IV. Effects of apparatus familiarization. *Psychological Reports*, 1959, 5, 355-356.
- BERLYNE, D. E., KOENIG, I. D. V., & HIROTA, T. Novelty, arousal, and the reinforcement of diversive exploration in the rat. *Journal of Comparative & Physiological Psychology*, 1966, 62, 222-226.
- FORGAYS, D. G., & LEVIN, H. Discrimination and reversal learning as a function of change of sensory stimulation. *Journal of Comparative & Physiological Psychology*, 1959, 52, 191-194.
- KISH, G. B. Learning when the onset of

illumination is used as a reinforcing stimulus. *Journal of Comparative & Physiological Psychology*, 1955, 48, 261-264.

KISH, G. B., & ANTONITIS, J. J. Unconditioned operant behavior in two homozygous strains of mice. *Journal of Genetic Psychology*, 1956, 88, 121-129.

LOCKARD, R. B. Some effects of light upon the behavior of rodents. *Psychological Bulletin*, 1963, 60, 509-529.

LOWE, G., & WILLIAMS, D. I. Light reinforcement in the rat: The effects of visual pattern and apparatus familiarization. *Animal Behaviour*, 1968, 16, 338-341.

ROBINSON, J. S. Light onset and termination as reinforcers for rats living under normal light conditions. *Psychological Reports*, 1959, 5, 793-796.

WILLIAMS, D. I., & LOWE, G. Bar pressing in the rat as a function of variable visual stimulation. *Psychonomic Science*, 1967, 7, 231-232.

Disinhibition effect of chlordiazepoxide

PAUL W. WEDEKING, *Department of Pharmacology, The Squibb Institute for Medical Research, New Brunswick, N.J. 08903*

Various doses of chlordiazepoxide were administered to rats conditioned to discriminate between two levers for food reinforcement on a multiple FR 25 15-sec time-out schedule. Significant increases in responding during the time-out and in incorrect responses, as well as biphasic effects in correct response rates, were produced at the various dose levels. These results are discussed in terms of a possible disinhibition effect of chlordiazepoxide.

The appetite-stimulating effects of chlor-diazepoxide (CDP) were among the first pharmacological observations reported by Randall, Schallek, Heise, Keith, & Bagdon (1960). Recently, a disinhibition effect of CDP has been suggested by Margules & Stein (1967), who reported that CDP and other minor tranquilizers markedly increased the occurrence of previously suppressed behavior from inhibition.

A previous report (Wedeking, 1968) described results observed when CDP was administered to rats conditioned on a multiple FR 25 10-sec time-out (TO) schedule; significant increases in response rates were produced during both stimulus presentation and TO. These increases were attributed to both appetite stimulation and a disinhibition effect of CDP. In the previous experiment (Wedeking, 1968) it was not possible to distinguish between these alternatives. In order to distinguish between these two possibilities, CDP was adminis-

tered to rats conditioned on a food-reinforced discrimination FR with TO schedule.

APPARATUS

The discrimination apparatus was a standard operant conditioning box (Lehigh Valley Electronics) with two conventional rat levers located 6 in. apart on one end of the box. A white stimulus light was positioned 1½ in. above each lever; to activate either lever, the S had to exert a downward force of 15 g or more on the lever. A food cup was centered between the two levers. Reinforcement was a single 45 mg Noves food pellet.

The box was contained in a ventilated sound-attenuated chamber into which white noise was delivered. The complete unit was isolated from programming and monitoring equipment.

SUBJECTS

Six experimentally naive, male Long-Evans rats, 200 days of age at the start of experimentation, served as Ss. They were housed in individual cages with water available ad lib.

PROCEDURE

Each S was conditioned to discriminate between the two levers by pressing the lever 25 times under the stimulus light (S^D) that was lit for a single food pellet reinforcement. Only responses on the lever below the lit stimulus light (correct responses) produced reinforcement while responses on the other lever during S^D (incorrect responses) were counted but did not effect food delivery. Immediately following reinforcement, there was a 15-sec TO (S^A) period. If the S failed to complete 25 correct lever-presses during 2 min. the S^D was terminated and a TO

initiated; there was a random, 50% probability for either stimulus light to be lit during SD. Eighty reinforcements constituted a daily session for each S and a houselight was turned on in the chamber at the termination of the session.

The number of correct responses and incorrect responses during SD and responses during TO for each lever were tabulated separately. The total length of time the SD was presented over each lever was also recorded.

After each S was conditioned to its asymptotic performance level, various dose levels of chlordiazepoxide HCl [selected from a previous study (Wedeking, 1968)] were administered intraperitoneally as aqueous solutions in a dose volume of 0.1 ml/100 g body weight. Fresh solutions of CDP were made on test days with a 7-day interval between drug days. Each S received each of the doses selected (in random sequence) with additional doses given to the Ss to replicate results (except at 0.5 mg/kg). Ss were injected 15 min prior to being placed in the test chamber.

RESULTS AND DISCUSSION

As illustrated in Fig. 1, Ss injected with CDP at dose levels of 1.0-10.0 mg/kg showed increases in their responses during the TO when compared to their control data obtained on the previous day; the increases in TO responses were significant ($p < .05$, paired t-test). The Ss also showed increases in incorrect responses (i.e., responses on the unlit lever during SD) at 5.0 and 10.0 mg/kg doses of CDP when compared to controls; the increases in incorrect responses at these two dose levels were significant ($p < .01$, paired t-test).

As data presented in Table 1 show, there were biphasic effects on the correct response rates generated during SD by the Ss following CDP administration when compared to their control rates; however, only the increases in rate at the 5.0 mg/kg dose of CDP and the decreases in rate at 10.0 mg/kg were significant ($p < .05$, paired t-test). At the 0.5 mg/kg dose of CDP, the results were essentially indistinguishable from control values.

Basically, the results replicate the effects of CDP observed in the previous multiple FR TO study (Wedeking, 1968). In addition, however, the dose-dependent increases in incorrect responses during SD in particular and the increases in responses during TO (see Fig. 1) seem to indicate that there was a general breakdown of inhibition of responding to the unlighted lever during SD and either lever during TO. The disinhibition produced by CDP was also manifested in the

Table 1
Effects of Chlordiazepoxide given to Rats on Correct Response Rates.

CDP dose (mg/kg)	No. of drug sessions	Correct response rates		Per cent of control
		Control: Mean responses/min	CDP: Mean responses/min	
0.5	6	79.4	74.1	93%
1.0	18	65.9	79.3	120%
5.0	11	68.3	97.2*	142%
10.0	7	62.9	45.7*	73%

*Significant ($p < .05$) changes from control

Fig. 1. Effects of chlordiazepoxide given to rats on incorrect responses and responses during time-out.

decreases in correct response rates generated during SD at 10.0 mg/kg since the Ss utilized a portion of the SD period to make incorrect responses and did not concentrate their responses on the correct lever.

Another factor that should be considered was the general debilitation (muscle relaxation, ataxia, etc.) produced by the high dose of CDP. The debilitating effects could possibly have interfered with the ability of the S to approach the correct lever and could have reduced lever-manipulating efficiency. However, the debilitation produced by CDP would be expected to have equal effects on responding on both levers and therefore cannot account for the specific increase in incorrect responses.

Also, there were no indications that CDP was affecting the vision or other sensory organs of the Ss which would have interfered with their capabilities to perceive the stimulus light when lit. This is evident from the increases in the correct response rates at the 1.0 and 5.0 mg/kg dose levels and the lack of significant increases in incorrect responses at 1.0 mg/kg.

The appetite-stimulating effect could

serve as an explanation for the increases in correct response rates at the 1.0 and 5.0 mg/kg doses of CDP, but cannot logically explain the marked increases in the incorrect responses observed. However, even the appetite-stimulation effects might be interpreted as disinhibition—i.e., a breakdown of the S's normal inhibition of food consumption produced by satiation.

REFERENCES

- MARGULES, D. L., & STEIN, L. Neuroleptics vs. tranquilizers: Evidence from animal behavior studies of mode and site of action. In H. Brill (Ed.), *Neuropsychopharmacology*. New York: Medica Foundation, 1967. Pp. 108-120.
- RANDALL, L. O., SCHALLEK, W., HEISE, G. A., KEITH, E. F., & BAGDON, R. E. The psychosedative properties of methamindiazepoxide. *Journal of Pharmacology & Experimental Therapeutics*, 1960, 129, 163-171.
- WEDEKING, P. W. Stimulating effects of chlordiazepoxide in rats on a food reinforced FR schedule. *Psychonomic Science*, 1968, 12, 31-32.