Life Sciences Vol. 11, Part I, pp. 1079-1083, 1972. Pergamon Press
Printed in Great Britain

LSD-25 AND LIGHT REINFORCED BEHAVIOUR IN THE RAT; INTERACTION WITH INFANTILE STIMULATION.

G. Lowe and D.I. Williams

Department of Psychology, University of Hull, England

(Received in final form 9 October 1972)

LSD-25 depressed responding for light onset in rats which had been handled prior to weaning, but not in non-handled animals.

It has been suggested (1) that the action of LSD-25, and possibly other hallucinogens, is to increase the significance level of stimuli to which animals are exposed. This change in the perception of stimuli should be reflected in the behaviour of the organism. One way of assessing such changes is to use sensory reinforcement techniques. The effectiveness of light as a reinforcer depends upon the state of the organism. For example, with longer periods in a dark box prior to test a larger light reinforcement effect is found (2). Such results have been interpreted in terms of changes in the arousal level of the organism. We have suggested (3) that hallucinogenic drugs may increase arousal level. An animal under the influence of such a drug would, therefore, be less likely to respond to produce a stimulus change which would further raise arousal level. Thus it is predicted that after administration of hallucinogenic drugs animals would respond less for response contingent light onset than would saline controls. This has recently been confirmed with LSD-25 (4) and with cyprenorphine hydrochloride (3), a drug which has been implicated as a psychotomimetic. Relevant controls showed that this depression was not simply a function of a general depression of motor activity. A parallel result has been found using these drugs with response contingent light offset (4,5). This shows that the depression effect found with light onset is not due to the light appearing brighter in the drug condition and so being aversive, and confirms the hypothesis that the 'need' for stimulus change is reduced by

the drug.

Animals which have been handled prior to weaning (H) respond more for response contingent light onset than those left undisturbed (NH) in infancy (6). Such differences may also be explained in terms of an arousal theory. It is interesting to note the similarity between altering the responsiveness of an animal by infantile stimulation and by LSD-25. These results can be united by arousal theory and a prediction generated. If it is supposed that the action of LSD-25 is to raise arousal level and so reduce the need for further stimulation, then the drug should have less effect with NH animals which are assumed to have a lower optimum arousal level, than with H animals which normally seek a greater degree of stimulus variability. This prediction is tested in the present study.

Methods

Twenty female black-hooded rats (strain PVG/G) were used. On each of 20 days between birth and weaning, half of the rat pups (H) were taken individually and at random from their nests and placed in separate compartments of the 'handling' apparatus (6). This was an open wooden box that contained 12 compartments, each measuring 8.2 x 8.2 x 8.2 cm. When all the pups in the litter had been removed, they were then replaced in the same manner. The operation time for each animal was approximately 30 sec. The remaining 'non-handled' pups (NH) were undisturbed during this period, and all animals remained under normal laboratory conditions until testing. At approximately 100 days of age, each rat was placed in the dark experimental box (3) for 30 min. A response (lever press) produced no change in illumination. On the following day, half the H, and half the NH rats received 0.2 mg/kg of LSD-25 i.p. in 0.9% saline solution; other animals were injected with 0.9% saline. Ten minutes after injection each rat was placed in the dark experimental box for a 1 h period; a lever press this time produced dim light onset for the duration of the response (3).

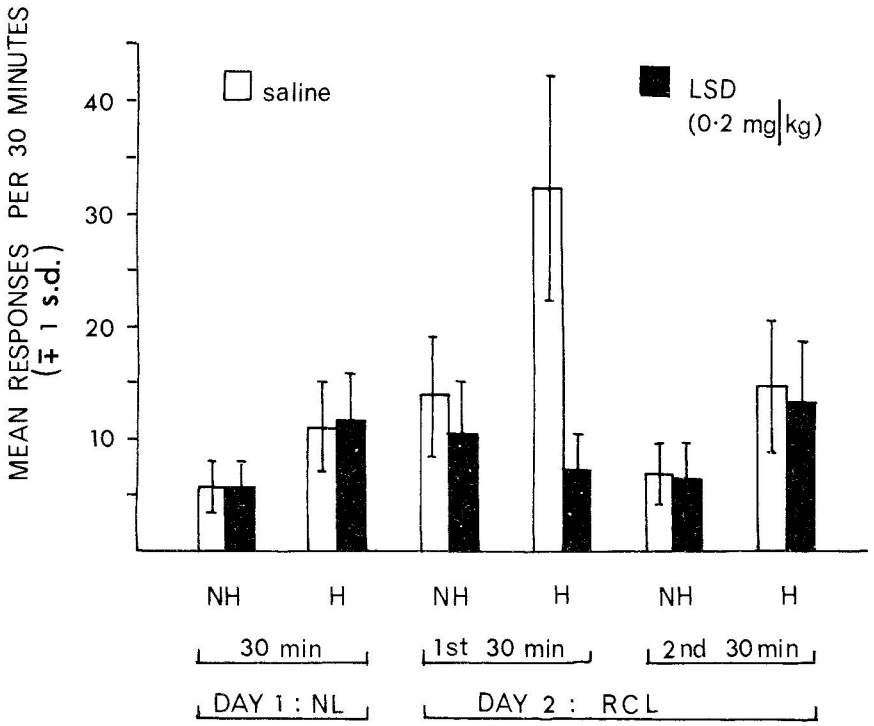

FIG. 1.

Reponse rates of handled (H) and non-handled (NH) rats during NL and RCL sessions. Animals were injected (with LSD-25 or saline) 10 min before the RCL test session on Day 2 (NL = no light; RCL = response contingent light).

Results

Fig. 1 shows response rates for H and NH animals on Day 1 (no injections) and Day 2 (injection of LSD-25 or saline). An analysis of variance of responses made on Day 1 confirms the expectation that H rats respond more than NH ($F = 16.38$; df = 1/18; $P<0.001$). For the Day 2 data, separate analyses were carried out on each 30 min period. In the first 30 min, response rates were significantly higher for handled animals ($F = 4.60$; df = 1/16; $P<0.05$). Moreover, there was a significant drug effect ($F = 11.75$; df = 1/16; $P<0.01$) and a significant handling and drug interaction ($F = 6.85$; df = 1/16; $P<0.01$).

The meaning of this interaction is clear from an examination of Fig. 1; in the saline condition, H animals responded significantly more than the NH animals, and LSD-25 significantly depressed responding only in H animals. For the second 30 min period only the handling effect was significant ($F = 5.71$; df = 1/16; $P < 0.05$).

TABLE 1

Average response durations of handled (H) and non-handled (NH) rats during NL (no light) and RCL (response contingent light) sessions

	Day 1: NL		Day 2: RCL			
	NH	H	NH	H	NH	H
Saline	1.48	0.99	1.87	1.63	1.59	1.60
LSD-25	1.58	1.25	1.51	1.62	2.01	1.60
			(1st 30 min)		(2nd 30 min)	

Since the RC light remained on for as long as the lever was depressed, it is possible that the lower response rates of the handled rats injected with LSD-25 may still have produced an equivalent total light duration if their response durations were longer. There were, however, no significant differences in average response duration amongst the groups (Table 1).

Discussion

The prediction that the effect of LSD-25 in depressing responding for light would be demonstrated more in the H than in the NH animals was confirmed. This observed interaction between the effect of LSD-25 and infantile stimulation is consistent with the notion that the drug decreases the arousal level in handled animals whose optimum level of arousal is higher than that of control animals relatively unstimulated during infancy. In addition, the effect of the drug was seen only in the first 30 min of the experimental period. A previous study

(4), which did not include infantile stimulation as a factor, showed that a longer post-injection interval before testing had no effect on the pattern of responding over time; response rates were still depressed during the first 30 min of the test session. This result, together with the present one, establishes the conclusion that LSD-25 depresses responding for light onset only in circumstances where a significant light reinforcement effect is found. This is what would be expected from an arousal interpretation of light reinforcement and the action of the drug.

Acknowledgements

We are grateful to Brenda Miller and Isla Reid for their assistance in conducting these experiments. The work was supported by a grant from the Medical Research Council.

References

1. P.B. Bradley, Anim. Behav. & Drug Action CIBA Symposium, 119-130, Churchill, London (1964).
2. D.I. Williams and G. Lowe, Quart. J. Exp. Psychol. 24, 98-101 (1972).
3. G. Lowe and D.I. Williams, Nature, 224, 1226 (1969).
4. G. Lowe and D.I. Williams, Psychopharmacologia, in press, (1972).
5. G. Lowe and D.I. Williams, Nature 233, 208-209 (1971).
6. P.A. Wells, D.I. Williams and G. Lowe, Anim. Behav. 19, 115-118 (1971).