Autonomic arousal and affiliation in rats*

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Pairs of rats were injected with adrenalin, placebo, or chlorpromazine and allowed to interact freely in an open field. Adrenalin-injected rats were significantly more sociable than placebo rats, who in turn were more sociable than chlorpromazine. On later test trials, all animals received placebo injections. There were no differences among conditions, suggesting no residual effects of drugs or of drug-induced experiences in the field.

According to Hull (1943), performance is a multiplicative function of habit and drive. Increasing the level of motivation of an animal should increase the emission of responses which are dominant in the response hierarchy unless specific drive stimuli induce competing responses. In many species of animals, including man, social affiliation is a well-established and often dominant response. Thus, if arousal or drive is increased in a situation eliciting affiliative responses, affiliation should be enhanced. Adrenalin leads to increased arousal and might thus be expected to increase gregariousness, while chlorpromazine inhibits arousal and might lead to decreased gregariousness.

If the source of drive is fear, there are other reasons to expect increased affiliation. Schachter (1959) has demonstrated that fear leads to affiliation in humans. It is possible that one reason organisms affiliate is to reduce fear. People (Wrightman, 1960) and rats (Davitz & Mason, 1955; Latané, 1969a; Morrison & Hill, 1967) show fewer signs of fear when in pairs than when alone. If fear leads to affiliation, we would expect animals to show more affiliation under conditions of high fear arousal than under low fear arousal. Adrenalin seems to increase fear (Latané & Schachter, 1962; Singer, 1963) and might thus be expected to increase gregariousness, while chlorpromazine, a tranquilizer, might lead to decreased gregariousness.

The present experiment was designed to explore the relationship between autonomic arousal and affiliation in rats and to test differing predictions based on the hypotheses of fear reduction and generalized drive. Both lines of thought suggest that

drug-induced arousal should lead to increased affiliation. However, they make opposing predictions as to the interaction between drug injection and day of testing.

As animals become familiar with a new environment, they show fewer signs of fear in it. On initial days of testing, while the environment is most fearful, adrenalin should intensify fear and chlorpromazine reduce it, leading to large differences in affiliation. As the field becomes less fear inducive, however, drug injections should have less effect on fear (Singer, 1963) and, consequently, less effect on affiliation. Thus, differences between experimental conditions should decrease over days under a fear-reduction interpretation.

Latané (1969a) has shown that rats are moderately affiliative in an unfamiliar testing environment and that over days, affiliation becomes much more dominant. Increased motivational arousal should enhance dominant responses at the expense of nondominant responses, leaving moderately dominant responses relatively untouched. As affiliation becomes more dominant, it should be more influenced by drug manipulations. Under an interpretation of drive theory, then, differences between experimental conditions should increase over days.

SUBJECTS AND APPARATUS

Forty-eight male albino Wistar rats were 30 days old at the start of the experiment. They were housed in individual cages and fed and watered ad lib.

The apparatus was a circular open field, 4 ft in diam, with an enclosing wall 18 in. high (Latané, 1969a). The wooden floor and wall were painted flat white, and the floor was marked off with black lines into 49 numbered sections of equal area and approximately equivalent shape. A 150-W bulb was hung 5 ft above the center of the apparatus. Rat pairs were placed in the open field and allowed to roam freely for 5 min. During this period, Os recorded the location of

each rat at 10-sec intervals. At the end of 5 min, the rats were removed and the field cleaned with a damp sponge.

PROCEDURE

Rat pairs were placed in the open-field situation under three different drug conditions once a day for 6 days. Eight pairs of rats were injected with .013 mg/100 g of adrenalin in a 1-mg/cc solution in physiological saline. Eight pairs of rats were injected with .27 mg/100 g of chlorpromazine hydrochloride (Smith, Kline, & French Thorazine) in a 3-mg/cc solution in physiological saline. Eight pairs of rats were given control injections of physiological saline in an equivalent volume to the adrenalin and chlorpromazine injections. All chlorpromazine pairs and half the placebo pairs were injected intraperitoneally and observed 45 min later, at which time the effect of chlorpromazine should be at its height. All of the adrenalin pairs and half the placebo pairs were injected subcutaneously in the nape of the neck and observed 8 min later, the height of the adrenalin reaction. Both members of each pair received the same injections.

In order to assess possible carryover or chronic effects of the drugs, all rat pairs were given placebo injections on Days 7-9 and observed in the open field. On the 10th and last day of the experiment, reversal trials were given. Those rat pairs who had previously received chlorpromazine now received adrenalin, while those who had previously been injected with adrenalin now received chlorpromazine. Placebo pairs continued to receive placebo.

Affiliation was measured by the average distance in inches maintained between members of a rat pair during the daily 5-min periods. Distance scores were calculated on a computer from the recorded locations for each rat and averaged over the 30 observations in each test session. Distance scores could range from 0 to 40, with lower scores indicating greater affiliation.

RESULTS

Overall, rats were quite gregarious, staying an average of 9 in. apart, as compared to the 24.5 in. to be expected if the rats were entirely uninfluenced by each other (Latané, 1969a). Rats became more gregarious over days of testing, maintaining a distance of about 16 in. on the first day and only 8 in. by the sixth day [$F(5,105) = 38.3$, $p < .001$]. This effect has been strongly present in all previous experiments in this series and is probably due to the fact that as the field itself becomes familiar and less fearful, competing exploratory responses tend to drop out, making

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Fig. 1. Effect of adrenalin, placebo, and chlorpromazine injections on affiliation.

affiliative responses more dominant (Eckman, Meltzer, & Latané, 1969).

Drugs, as predicted, had strong effects on affiliation on Days 1-6 [$F(2,21) = 30.2$, $p < .001$]. Adrenalin pairs affiliated significantly more than placebo pairs, who, in turn, affiliated significantly more than chlorpromazine pairs ($p < .01$). Adrenalin pairs maintained a mean distance of 7.9 in., placebo pairs stayed 9.6 in. apart, while chlorpromazine pairs separated themselves by 14.7 in.

Contrary to expectations, the Days by Drugs interaction was not significant [$F(10,105) = 1.27$, n.s.]. Both the hypothesis of fear reduction and the drive theory interpretation predicted significant, though opposite, interactions. Neither position was supported by the data.

On Days 7-9, all pairs received placebo injections in order to see if there were any residual effects of drugs or of drug-influenced experiences in the field. All rats were equally gregarious, no matter what their previous experience in the field had been.

On Day 10, pairs who had previously received adrenalin now received chlorpromazine, previous

chlorpromazine pairs now received adrenalin, and placebo pairs again received placebo. The mean distance between rats who received adrenalin on Day 10 was 3.9 in., those receiving placebo, 5.9 in., and those receiving chlorpromazine, 9.8 in. Within Day 10, the differences between groups were all significant by t test. While the switched drug groups each differed significantly from their performance on Day 9, the placebo group did not.

DISCUSSION

Although physical distance is a simple, literal, and objective measure of attraction, it does raise some conceptual difficulties. If animals come together to fight as well as to play, then physical distance may prove to be an ambiguous measure of sociability. For the laboratory rat, however, this problem does not arise—our rats were never observed to fight or to engage in other aggressive activity. Their interaction seemed, subjectively, to depend upon curiosity and playfulness more than anything else.

Physical distance provides a reliable indication of social affiliation, but it is misleading in one respect—rats did not spend much time maintaining their

“average” distance from each other. Rather, they engaged in more or less frequent bouts of direct physical contact separated by periods of nonsocial activity. Later research indicates that time in contact may be a more basic measure of affiliation than distance for rats (Latané, 1969b). However, the two measures typically show very high correlations, ranging from $-.62$ to $-.92$ (Latané, Joy, Meltzer, Lubell, & Cappell, in press).

The major finding of the present experiment is that affiliation in rats appears to be a positive monotonic function of the arousal level operating at the time of the interaction between pairs. Adrenalin increased affiliation and chlorpromazine decreased it. Neither the drugs themselves, nor any drug-mediated experiences in the open field appeared to carry over from one day to the next. The effects of adrenalin and chlorpromazine were not influenced by the fearfulness of the field or by the dominance of the affiliative response, contrary to both lines of thought that originally predicted the main effect.

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