

Effects of fear upon exploratory behavior

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Rats were given a 20 min period of exploration in a Y maze. The fear level of the animals was manipulated by using elevated or enclosed mazes and by depriving the animals of food for 0 or 24 h. Elevation of the maze reduced activity but food deprivation had no effect on activity. Both deprivation and type of maze affected the alternation of choices made by the rats on the first trial in the maze.

Montgomery (1955) allowed rats to explore elevated and enclosed Y-mazes and found that rats in elevated mazes made fewer arm entries than rats in enclosed mazes. The type of maze had no effect on the orderliness of the exploration. Lester (1967b) suggested that this latter result is misleading. Given that rats in elevated mazes have higher fear levels than rats in enclosed mazes, then rats in elevated mazes should show more repetition than rats in enclosed mazes. Consider a rat in Arm A who enters Arm B and then turns around to face the choice point again. The higher the rat's fear level the more likely it should be to enter the most recently visited arm, Arm A, since that arm should arouse less fear than the arm not recently visited, Arm C. Lester suggested that Montgomery's failure to find this result might have arisen from his consideration of the total exploration period rather than the first choice. After the initial choices, all arms have been visited and so may not differ in the fear that they give rise to.

Mowrer (1960) has suggested that a hungry rat is a scared rat. Mowrer talks of rats developing thirst fear and hunger fear (1960, pp. 147-148). Thus, it might be expected that deprivation versus satiation should have a similar effect on exploratory behavior as does elevating or enclosing the maze.

The present experiment sought to test these ideas.

Method

The Ss were 80 naive male albino rats of the Charles River Breeding Laboratories strain CD with minimal experience of handling. They were 120-124 days old.

The apparatus consisted of two Y-mazes made of wood. Both had arms 22 in. long and 6 in. wide. One was enclosed, with arms 6 in. high covered with hardware cloth. The other was elevated 25 in. An observer was seated behind a screen equipped with an observation hole.

The rats were run either in elevated mazes (E1) or enclosed mazes (En) and either with 0 h or 24 h of food deprivation. There were four groups each with 20 rats: E1-0, E1-24, En-0, and En-24. Each rat was placed in the Y-maze for one 20 min exploration period and the sequence of arms entered was noted. An entry into an arm was defined as made when all

four paws of the rat were in the arm. Five rats from Group E1-0 and four from E1-24 fell off the elevated maze and their data were discarded.

Results

The number of arms entered by the rats was analyzed by a two-way analysis of variance (since the criterion of homogeneity was met). The effect of the maze was significant with the number of entries significantly reduced in the elevated maze ($F=18.70$, $df=1/67$, $p<.01$), but there were no significant effects from deprivation ($F=.18$, $df=1/67$) or the interaction ($F=.11$, $df=1/67$). The mean number of arms entered by the groups is shown in Table 1.

Montgomery (1955) measured alternation behavior by noting each triad of successive choices made by the rats. A triad in which three different arms were entered was counted as an alternation. A triad in which only two different arms were entered was counted as a repetition. For each rat the proportion of alternation triads was calculated. Here there were no differences between the groups. The median percentages of alternation were: E1-0 64.3%, E1-24 65.3%, En-0 67.1%, and En-24 65.2%. The two satiated groups differed most but a Mann-Whitney U-test indicated that the difference was not significant ($U=163$, $p>.10$). To check on the possibility of differences, the number of alternations made by the rats in the first 10 triads was analyzed by a two-way analysis of variance. None of the effects was significant at the .10 level.

The first choice of each rat was noted. The proportion of rats in each group alternating was: E1-24 0.41, E1-0 0.60, En-24 0.65, and En-0 0.80. The difference between E1-24 and En-0 was significant ($X^2=5.89$, $df=1$, $p<.02$). The difference between E1-24 and E1-0 combined with En-24 was not significant ($X^2=1.75$, $p<.20$) and between En-0 and E1-0 combined with En-24 also was not significant ($X^2=2.18$, $p<.20$).

The association between the number of arms entered and the orderliness of the rats was investigated by means of a median test. There was no association and cell frequencies were equal. However, a plot of the points showed that the 16 rats who entered 40 or more arms had alternation percentages of less than 70% and that the 24 rats with alternation percentages of 70% or more had activity scores

Table 1 The number of arms entered by the rats

	deprivation			
	0 hours		24 hours	
	mean	s.d.	mean	s.d.
Elevated maze	28.0	8.1	27.4	8.1
Enclosed maze	37.8	7.1	36.3	11.8

of less than 40 arms entered. Thus, a slight negative association between arms entered and orderliness is indicated.

Discussion

These results replicate Montgomery's study. Elevation of the maze reduced the activity of the rats but failed to affect alternation behavior. Deprivation was found to have no effect on either measure. This agrees with Lester's review of the literature (1967a) which indicated that deprivation had been shown to have no consistent effect on activity or orderliness measures of exploration.

The prediction that elevation of the maze and food deprivation would show an effect on the first choice in the maze was supported. When the four groups were ordered according to the proportion of alternation on the first choices in the situation, then the order was approximately the same as that of increasing fear. Elevating the maze or depriving the rats reduced the alternation and combining these procedures reduced the alternation still further. The cumulative effect of deprivation and maze elevation supports Mowrer's contention that deprivation increases the fear level of animals.

An explanation of the effects of deprivation on initial choices in the maze in terms of fear is perhaps too simple since deprivation did not affect activity scores. It may be that deprivation increases both activity and fear levels in rats and in the present situation these separate effects cancel out for the measure of number of arms entered. In the case of the alternation measure, only the fear level of the rat should have an effect and so there will be no cancelling out effect.

No support was apparent here for the idea that slight increases in fear can facilitate exploration (Lester, 1967a). Perhaps if rats tamer than those used in the present experiment were utilized some facilitatory effects might be found.

References

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