

Effects of olfactory stimuli on Y-maze exploration of rats¹

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The effects of olfactory stimuli from other rats on the orderliness of exploration by rats was investigated. It was found that the presence of olfactory stimuli from other rats made exploration less orderly.

In certain situations, the rat appears to respond to self-generated olfactory stimuli. Douglas (1966) found that two cues alone were operative in the determination of spontaneous alternation: a tendency to move in a direction opposite to that recently traveled and a tendency to avoid own odor trail. Lester (1968), however, found that the effects of pre-exposure to one arm of a maze on subsequent choice in the maze was not affected by whether the rat's own odor trail was removed during the interval between the pre-exposure and free choice trial.

Douglas (1966) found no tendency of rats to avoid the odor trail laid by other rats and Halliday (1967) found no effect on the activity of rats in a Y-maze from the presence of odor trails from decoy rats. Halliday argued that olfactory cues play a minor role in the control of exploratory behavior. However, Halliday did not investigate the orderliness of the rats' exploratory behavior and it seems likely that a role for olfactory stimuli in the control of exploratory behavior might be found if the orderliness of the behavior is noted.

The present experiment was designed to test this idea.

Method.

The Ss were 30 female rats from the Charles River Breeding Laboratories, strain CD. They were caged singly and given ad lib food and water. They were 153 days old.

The Y-maze was made of wood and covered with wire mesh. Each arm was 18 in. long, 6 in. wide, and 6 in. deep. The floor of the maze was of newspaper.

On Day 1 each rat was placed in the maze for 5 min. The sequence of arms entered was noted. An entry was defined as made when all four paws of the rat had entered into the arm. For half of the rats the newspaper was fresh and for half of the rats the same newspaper was left in place for all the rats.

On Day 2 each rat was again given one 5 min period of exploration in the maze. Again the sequence of arms entered was noted. This time each rat was tested under the other condition (newspaper changed/unchanged) to that experienced on Day 1.

Results.

Of the 30 rats, 17 were more active on clean newspaper and 11 were more active on dirty newspaper (with two rats showing the same activity in the two conditions).² This difference was not significant on a binomial test ($z = 0.945$, $p = 0.17$).

The data were analyzed by a two-way analysis of variance for repeated measures (Winer, 1962).³ The data are shown in Table 1.

Table 1

The Mean Number of Arms Entered by the Rats in Each Group

| | | odor from other rats present | odor from other rats absent |
|------------------|-----------------------------|------------------------------|-----------------------------|
| order of testing | clean paper/ dirty paper | 21.6 | 22.1 |
| | dirty paper/ clean paper | 23.5 | 23.2 |

None of the effects were significant (effect of olfactory stimuli $F = 0.02$, $df = 1,28$; effect of order of testing $F = 0.29$, $df = 1,28$; interaction $F = 0.25$, $df = 1,28$; all nonsignificant).

Of the 30 rats, 20 were more orderly on clean newspaper and 10 were less orderly.⁴ This difference was significant on a binomial test ($z = 1.643$, $p = 0.05$).

On Day 1 the median orderliness of the rats run on clean newspaper was 75.0% and for those run on dirty newspaper 71.4%. This difference was not significant on a Mann-Whitney U-Test ($U = 89$, $z = 0.99$, $p = 0.16$).

On Day 2 the median orderliness of the rats run on clean newspaper was 71.8% and for those run on dirty newspaper 66.7%. This difference was significant ($U = 56$, $p < 0.02$, two-tailed test).

Although the data do not constitute a ratio scale, a two-way analysis of variance for repeated measures was carried out to investigate the overall effect of clean versus dirty newspaper. The data did meet the criterion for homogeneity of variance. The effect of clean versus dirty newspaper was significant ($F = 5.47$, $df = 1,28$, $p < 0.05$). The effect of order of testing was not significant ($F = 2.01$, $df = 1,28$) but the interaction was significant ($F = 6.61$, $df = 1,28$, $p < 0.05$).

Discussion.

The present experiment has confirmed Halliday's result (Halliday, 1967) that there is no effect from olfactory stimuli from other rats on the activity of rats. However, the present experiment has shown an effect from olfactory stimuli on the orderliness of exploration. The more olfactory stimulation present from other rats' trails, the less orderly is the exploratory behavior. Olfactory stimuli do, therefore, play a role in the control of exploratory behavior.

Two conflicting predictions could have been made for the direction of this effect. If the absence of olfactory stimuli is seen as depleting the environment, then exploration should be less orderly in the absence of such stimuli. Lester (1967) has shown, for example, that eliminating visual stimuli (by blinding rats) does reduce the orderliness of exploration. However, if the presence of odor from other rats is seen as making it more difficult for the rat to discriminate his own odor trail then exploration should be less orderly in the presence of olfactory stimuli, as was found in the present experiment.

REFERENCES

- DOUGLAS, R. J. Cues for spontaneous alternation. *J. comp. physiol. Psychol.*, 1966, 62, 171-183.
- HALLIDAY, M. S. The influence of olfactory cues on exploratory behavior. *Psychon. Sci.*, 1967, 9, 595-596.
- LESTER, D. Exploratory behavior of peripherally blinded rats. *Psychon. Sci.*, 1967, 8, 7-8.
- LESTER, D. Pre-exposure and stimulus choice: effects of odor trail. *Psychon. Sci.*, 1968, in press.
- SIEGEL, S. *Nonparametric statistics for the behavioral sciences*. New York: McGraw-Hill, 1956.
- WINER, B. J. *Statistical principles in experimental design*. New York: McGraw-Hill, 1962.

NOTES

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2. Activity was defined as the number of arms entered by the rat.
3. The data met the criterion for homogeneity of variance.
4. The derivation of an orderliness measure has been described previously (Lester, 1967).