

FRONTOPOLAR RATS PERFORMANCE IN DASHIELL MAZE

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Abstract. Frontopolar and unoperated control rats were given two or five trials for 20 days in Dashiell maze. Both groups made a negligible number of errors and showed considerable preference for peripheral paths. No marked differences were found in number of perseverative responses, number of different paths chosen and number of shifts between paths. The findings indicate that frontopolar lesion does not increase the perseverative tendency in a situation involving no difficulty in choice behavior. This lesion also does not affect the directional orientation.

INTRODUCTION

I have found in the previous paper (4) that frontopolar rats showed higher number of perseverative errors than unoperated controls in the returning behavior test. This result may be interpreted as an increased tendency to perseveration evoked by the lesion, however, it is also conceivable that perseverative errors appear as a secondary effect of lesion on the returning test performance. I suggested previously (5) that frontopolar lesion decreases attention to response produced cues. Since returning behavior test involves this kind of cues, one may suppose that frontopolar rats being less attentive to relevant cue adopted another way of responding, namely, they tended to repeat the reinforced response. Some data indicate that even normal rats show perseveration habits when facing insoluble or difficult problem (3).

From this point of view it was desirable to check the behavior of frontopolar rats in a test which involves no difficulty but provides conditions of response perseveration. The Dashiell maze seemed to be very suitable for this purpose since animal could choose any of 20 different

routes of equal distance to the goal. If frontopolar lesion really produces the increase of tendency to perseveration, operated rats would be less flexible in shifting paths on consecutive trials.

METHOD

Subjects. The Ss were 44 naive male rats of Wistar strain approximately 120 days old at the start of the experiment. Half of them sustained bilateral frontopolar lesions, performed by suction under Nembutal anesthesia. A typical frontopolar lesion is shown in Fig. 1.

Apparatus and procedure. The apparatus was a checkerboard maze, painted gray, with dimensions described by Dashiell (1). Several fluorescent lamps were suspended over the maze providing uniform lighting conditions.

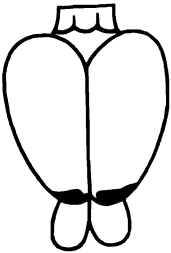


Fig. 1. Frontopolar lesion.

The animals were housed five per cage with ad lib. water. On the 10th postoperative day the animals were placed on moderate food deprivation schedule and subjected to handling. Training to run in a straight alley and to open the door in a detachable goal box started on the 12th postoperative day and was continued for 5 days. Subsequently each rat received two or five trials per day in the Dashiell maze with wet mash as a reward. The route taken by individual rat was traced by the experimenter upon a printed diagram.

An error was considered whenever the rat turned away from the goal. Paths containing a single error or multiple errors were not discriminated.

Experiment I. 12 normal and 12 operated Ss were given two trials a day for 20 days. In the first 10-day period Ss were run in rotation with intertrial intervals (ITI) of around 4 min. In the second 10-day period each S started the Trial 2 as soon as he finished his reward from Trial 1, thus ITI were less than 30 sec.

Experiment II. 10 normal and 10 operated Ss received five spaced trials a day with ITI approximately 4 min, for 20 days.

RESULTS

Experiment I (two daily trials)

As can be seen from Table I there were no marked differences in performance between frontopolar and normal subjects. Although animals could select potentially any of 20 different paths, they did not use even a half of this number; normal rats used about 8 paths, frontopolar rats — 6 paths (Table I — different paths). Operated subjects, similarly to the normal ones, most frequently ran the peripheral L-shaped paths. In the

TABLE I

Mean scores for various indices of maze performance in Experiment I (two daily trials)

Period	1-10th day ITI, 4 min		11-20th day ITI, 30 sec	
	Normal	Frontopolar	Normal	Frontopolar
Subjects				
Trials with errors	2.4	2.4	—	—
Different paths	8.1	6.6	8.8	6.3*
Peripheral paths	10.7	11.9	8.3	12.2*
Response perseveration	1.6	2.4	1.4	2.5

* Difference between normal and frontopolar groups significant at $p < 0.05$ level, Mann—Whitney U test, two tailed.

second 10-day period the preference for peripheral paths decreased slightly in normal subjects, thus the difference between the groups reached the level of significance. It is not known, however, whether this was due to shorter ITI or longer experimental training. Both groups showed only a slight response perseveration; during the first 10-day period normal rats chose the same path in both daily trials in average 1.6 times, frontopolar rats — 2.4 times (the difference was not significant). A shorter ITI did not increase the response perseveration either in normal or in frontopolar rats.

It is worth mentioning that Ss perseverated almost exclusively the peripheral paths. Nevertheless, in many runs in which peripheral paths were selected in both daily trials, Ss shifted from the left to the right path (or vice versa) showing some response variability even being limited by strong preference to particular type of paths. This held for normal as well as for frontopolar rats.

One should notice in Table I that performance of operated rats in Dashiell maze was errorless after a very few trials which indicates that frontopolar lesion does not affect the directional orientation.

Experiment II (five daily trials)

Since it seemed interesting to know whether Ss would repeat the same path in several successive trials, in the other groups of frontopolar and normal rats 5 daily trials were administered. Table II presents the results separately for the first and the second 10-day period of the experiment, in order to make clear the effect of length of experimental training.

As in Experiment I, both normal and frontopolar groups showed a preference for peripheral paths, more pronounced in the first than in the second period. The response variability measured in terms of the number of both the different paths used and the shifts between the paths was similar in both groups. As the experimental training proceeded the response variability tended to decrease. Frontopolar and normal subjects showed increasing tendency to stereotyped response pattern, thus in the second period of the experiment they selected consistently the same path in all daily trials in approximately half of the sessions. No differences between normal and frontopolar rats were observed in both quantitative and qualitative aspects of stereotypy. At the beginning of Experiment II, both groups repeated mainly peripheral paths, whereafter some other paths, similar for frontopolar and normal subjects were included in their repertoire.

TABLE II

Mean scores for various indices of maze performance in Experiment II (five daily trials)

Period	1-10th day		11-20th day	
Subjects	Normal	Frontopolar	Normal	Frontopolar
Trials with errors	1.8	1.7	—	—
Different paths	7.5	8.4	4.3	5.4
Peripheral paths	18.9	21.3	13.9	12.8
Shifts between paths	11.9	14.8	6.9	8.5
Stereotypy ^a	2.6	2.7	5.3	5.7

a Number of cases when subject selects the same path in all daily trials.

DISCUSSION

The present experiments revealed no marked differences in performance of frontopolar and normal rats in Dashiell maze. Subjects of both groups showed a good directional orientation, committing errors only in first few trials. They selected a limited number of different paths with considerable preference for peripheral L-shaped paths, particularly in the

earlier period of experimental training. The preference for the particular kind of paths was the main cause of response perseveration in Experiment I where two daily trials were applied. In Experiment II in which the subjects received more training due to a larger number of trials per day, the Ss started to select more consistently other types of paths with marked tendency to stereotypy. However, there was no significant difference in response perseveration and stereotypy between normal and operated rats, which indicated that frontopolar lesion does not increase the tendency to perseveration and stereotyped responses in situations involving no difficulty.

It is of interest that Niki (6) studying the performance of hippocampally lesioned rats in Dashiell maze, found that operated rats made more errors and were less flexible than control subjects. Although many studies have demonstrated major similarities between animals with septal and hippocampal lesions, Ellen and Bate (2) failed to find group differences of septal and control rats in measurements reflecting acquisition and response variability in Dashiell maze. Those authors, however, reported the differences in the kinds of paths selected by control and septal rats: control rats showed preference for central zig-zag paths, while septal rats ran more frequently peripheral paths. Paradoxically, normal rats in the present study behaved like septally lesioned rats, since they had definite preference for peripheral paths. It should be mentioned that several years ago I have observed in pilot experiments the same kind of differences between normal and frontopolar rats as those reported by Ellen and Bate (2) for normal and septal rats. However, in experiments reported in this paper, normal rats did not show any marked preference for central paths. Inspection of original data presented by Dashiell (1) revealed that some of the subjects indeed tended to select the central paths, whereas the others preferred the peripheral paths. It is possible that preference for different kinds of paths may be related to some aspects of personality of subjects, perhaps motor activity or emotionality.

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