Open-field activity and exploratory behavior¹

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In two experiments, rats were exposed to a stimulus change involving either stimulus introduction or stimulus removal in a familiar open field. Activity and exploratory behavior (as indexed by increased time spent in proximity to the locus of stimulus change) were recorded. Introduction of a novel stimulus resulted in increased exploratory behavior which habituated over trials, but total locomotor activity did not significantly change. Removal of a familiar stimulus resulted in increased exploratory behavior which rapidly habituated and in increased locomotor activity.

In a study by Corman, Meyer & Meyer (1967), open-field activity was investigated with normal rats, as well as with rats having septal or amygdaloid lesions. A stimulus change was introduced into the open-field and changes in activity and amount of time spent in the center of the field were observed. Although the study was not directly concerned with exploratory behavior, the basic technique appears to provide an adequate setting for observing exploratory behavior in its relation to stimulus properties of the environment.

It is well known (and demonstrated by this experiment) that rats exhibit a "wall-hugging" tendency in apparatus. Using an open-field, this tendency can be utilized to demonstrate the effects of stimulus introduction. In the homogeneous open-field the rat spends relatively little time in the area toward the center of the field. An area may be defined as the center of the field, and stimuli can be introduced into this area. If the stimulus elicits approach, it is over-riding the "wall-hugging" tendency and a reliable difference between time-in-center scores with and without specific stimuli in the center of the field should be observed.

The purpose of the present study is to introduce a relatively simple stimulus change into the open-field environment and to observe whether the change is sufficient to alter the behavior of the S.

EXPERIMENT 1

METHOD

Subjects and Apparatus

The Ss were 27 male hooded rats. The rats ranged from 81 to 84 days of age at the beginning of the experiment. The Ss had continual access to food and water except during test trials.

The apparatus was an open field 45-in. sq, enclosed by walls 24-in. in height. The walls of the apparatus were dark grey, and the floor consisted of 9-in. sq of black linoleum tile. A removable start box, 9-in. by 9-in. by 12-in., was used. The start box had two sides and was placed in one corner of the open field so that the walls of the field completed the box. A hinged top permitted insertion of the animal into the start box and a long handle permitted the box to be lifted from the field at the beginning of the trial. The field was illuminated by a 15-W florescent light suspended 20-in. above the center of the field. The experimenter sat adjacent to the field in the otherwise darkened room. Two hand switches connected to a graphic recorder permitted recording of locomotion and the amount of time spent in the center of the field.

PROCEDURE

Prior to the beginning of the experiment, the animals were gentled. At the beginning of a test period the animal was

placed in the start box. One min later the start box was gently lifted from the open-field apparatus. The animal was then observed for three min. Three behavioral measures were taken: latency in leaving the starting square, a locomotion score (number of squares entered during the test period), and time-in-center (total time, in seconds, in contact with squares other than those adjacent to the walls of the apparatus). A square was counted as entered if the animal placed one or more paws in the square. Each animal received one trial per day. Between trials (and Ss) the field was wiped with a damp sponge and allowed to dry. On Trials 1-5 the floor of the field was composed of all black squares for all Ss. At this point, a total locomotion score for the five trials was computed for each S, and the Ss were ranked for this score and placed in blocks of three animals on the basis of this rank. The animals in each block were then randomly assigned to one of three groups. On Trial 6 the black center square was replaced by a white square of the same material for Groups 2 and 3. On Trial 7 the black center square was returned for Group 2. Group 2 was terminated after Trial 8. Groups 1 and 3 were continued under the same conditions through Trial 13.

RESULTS AND DISCUSSION

The results for Trials 1-5, during which all Ss experienced the black field, were analyzed by ANOV. Results on Trials 6 and 7 were analyzed by the Friedman Two-way ANOV. A trend of decreasing latency in leaving the starting square during the first five trials was not statistically significant, nor was there a significant difference between groups on Trials 6 or 7.

Figure 1 represents median locomotion scores during the experiment. Neither the trend on Trials 1-5 nor the group differences on Trials 6 or 7 are statistically significant.

Time-in-center scores are shown in Fig. 2. The increase in t-i-c over Trials 1-5 is statistically significant ($F = 5.86$, $df = 2/16$, $p < .01$). On Trial 6, the difference between groups is significant ($\chi^2_r = 10.9$, $p < .01$). On Trial 7 the groups again differ significantly ($\chi^2_r = 12.0$, $p < .01$), but the Median test does not reveal a significant difference between Groups 2 and 3. The performance of Group 3 over the remaining trials indicates that the presence of the white square maintains a t-i-c score higher than that of the control group (Group 1).

The results indicate:

(1) Within a homogeneous environment, the rat spends increasing time in the center of an open field as a function of trials. However, the proportion of time spent in the center of the field is much less than its relative area.

Fig. 1. Median Locomotion Scores (Experiment 1).

Fig. 2. Median Time-In-Center (Experiment 1).

Fig. 3. Median Locomotion Scores (Experiment 2).

Fig. 4. Median Time-In-Center (Experiment 2).

(2) The introduction of a novel stimulus produces an immediate increase in the amount of time spent in the area into which the stimulus is introduced which apparently reflects investigation of the stimulus. The fact that the increased time in the area is maintained over a series of trials suggests that it is not only the change per se that is important, but also the continuing difference between the stimulus area

and the rest of the environment on any given trial. The removal of the stimulus after one exposure produces a marked decline in time spent in that portion of the field. Again, this suggests that it is not simply a matter of a change having occurred.

On Trial 6, when the white square was introduced, two factors made the locus of stimulus change distinctive. First, the contrast with the appearance of that area on past trials, and second, the contrast between that area of the field and the remainder of the field. Thus, the approach could have been due to its contrast with the field on prior trials. A second experiment was performed to provide information on this question.

EXPERIMENT 2

METHOD

In the second experiment, the apparatus and the general procedures were the same, except that the white square was initially present within the otherwise black field. The Ss in the second experiment were 20 male hooded rats, approximately 100 days old at the beginning of the experiment. At the conclusion of Trial 5, the animals were matched on locomotion scores and a randomly selected member of each pair was assigned to Group 1 and the other member to Group 2. For Group 1, the field remained unchanged for the ten trials that constituted the experiment. For Group 2, the white square was replaced by a black square on Trial 6. Thus for Group 2 on Trial 6, a stimulus change occurred which made the field visually homogeneous. On Trial 10, the white square was returned for Group 2.

Trial effects during the first five trials were analyzed by ANOV, and differences between groups on Trials 6 and 10 were analyzed by the Walsh Test.

RESULTS AND DISCUSSION

With regard to latencies, there was no significant trials effect on Trials 1-5 nor was there a significant difference between groups on either Trial 6 or Trial 10.

Figure 3 presents locomotion scores during Experiment 2. There was a significant trials effect on Trials 1-5 ($F = 3.69$, $df = 4/19$, $p < .05$). Group 1 and Group 2 differed significantly in locomotion on Trial 6 ($p < .01$), but did not differ significantly on Trial 10.

Figure 4 shows time-in-center scores during Experiment 2. There was no significant trials effect on Trials 1-5. Group 1 and Group 2 differed significantly in time-in-center on Trial 6 ($p < .05$), but did not differ significantly on Trial 10.

The results of the second experiment indicate that a stimulus change which produces field homogeneity will also elicit approach to the locus of change. Also such a change produces a significant increase in total locomotion.

On Trial 6, the Ss in Group 2 made repeated entries into the center of the field. However, the animals did not remain in proximity to the center square as did the animals in Experiment 1 who experienced the introduction of the white square. It is possible that the failure to find a significant increase in total locomotion in Experiment 1 was due to the occurrence of these activities.

REFERENCES

CORMAN, C. D., MEYER, P. M., & MEYER, D. R. Open-field activity and exploration in rats with septal and amygdaloid lesions. *Brain Research*, 1967, 5, 469-476.

NOTE

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