The development of rapid running in T-mazes in the absence of obvious rewards¹

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Rats run in T-mazes with arms inclined or horizontal greatly increased their speed of running during large numbers of unrewarded trials given both prior to and after the introduction of food rewards to the goal boxes. After developing fast speeds on unrewarded trials, the presence of food rewards in the goal boxes caused Ss to decrease their speed of running from the start box to the door of the goal box, although it increased their speed of entering the goal box.

In a series of experiments not yet published, we observed a marked increase in the running speed of rats during prolonged extinction trials in a T-maze with arms inclined at 50°. An initial decrement in running speed and a return of arm preference to chance over the first 40 to 80 extinction trials were followed by a steady increase in speed until, at the end of 300 extinction trials, Ss were running at twice their asymptotic speed of running to food.

The purposes of this experiment were to determine (1) if an increase in running speed over a large number of unrewarded trials is peculiar to a maze with inclined arms; (2) if the phenomenon can be obtained with unrewarded trials before as well as after food-rewarded trials; (3) if Ss run in a T-maze with one arm horizontal and the other inclined at 50° will develop a preference for the 50° arm along with increased speeds on unrewarded trials.

Method

The Ss were nine experimentally naive male hooded rats obtained from the Quebec Breeding Farms of St. Eustache, Quebec. They were 100 days old. Prior to the experiment and between sessions Ss were individually caged in 7 in. x 10 in. x 7 in. Wahmann cages.

The T-maze was 4 in. wide and 12 in. high. The lengths were: start box - 12 in., stem - 24 in., arms - 52 in. The goal boxes were 12 in. x 12 in. x 12 in. The arms, from 12 in. from the stem to 3 in. from the goal box, could be inclined at 50° from the horizontal. The maze, painted flat black, had a Plexiglas top and fine wire mesh on the floors. A guillotine door separated start box from stem. At the entrances to the arms and goal boxes were one-way push-through doors.

Taming and food-deprivation lasted for 14 days during which S was reduced to 75% ad lib weight with a 22-23 hr. food-deprivation schedule and handled for 5 min. each day. Preacquisition consisted of 300 unrewarded trials grouped in 20 daily sessions, acquisition of 105 trials in 7 daily sessions, and extinction of 150 unrewarded trials in 10 daily sessions. During acquisition

there was a 45 mg food pellet in both goal boxes on every trial. The daily food ration was given 1 hr. after the completion of an experimental or handling session.

The running procedure in all phases was as follows. The S was placed in the start box facing away from the guillotine door. When S turned to face the door, the door was raised. The S was timed in .01 min. from start-box departure to arrival at goal-box door and to entry into goal box. After 10 sec. in a goal box S was placed in a holding cage for 15 sec. prior to the start of the next trial. The first 10 preacquisition trials had a maximum limit of 5 min.; thereafter the limit was 2 min. If S had not reached a goal box within the time limit, it was removed directly to the holding cage to await the start of the next trial.

There were three maze conditions: 0°-0° (both arms horizontal), 50°-50° (both arms inclined), and 0°-50° (one arm inclined). Three Ss were run under each condition. No Ss were discarded because of failure to run.

Results

Two running speed measures are reported: runway speed (reciprocal of time from start box departure to arrival at the goal-box door) and goal speed (reciprocal of time from arrival at the goal-box door to goal-box entry). For each of the three groups mean runway speeds and goal speeds over the 37 sessions of 15 trials are shown in Figs. 1 and 2.

Within both preacquisition and extinction runway speed and goal speed increased significantly. The introduction of food into the goal boxes (i.e., acquisition) had opposite effects on the two speed measures, decreasing runway speed and increasing goal speed.

Fig. 1. Runway speed scores during preacquisition, acquisition, and extinction in the 0°-0°, 50°-50°, and 0°-50° T-mazes.

Fig. 2. Goal speed scores during preacquisition, acquisition, and extinction in the 0°-0°, 50°-50°, and 0°-50° T-mazes.

The only effect of maze inclination was a session by inclination interaction in runway speed during preacquisition. This reflected the somewhat delayed development of fast running the 0°-0° maze.

With food in the goal boxes, two of the three Ss run in the 0°-50° maze developed a preference for the 0° arm. During preacquisition and extinction, preference for the 0° and 50° arms varied around chance for all three Ss. An analysis of runway speeds for trials on which the 0° and 50° arms were chosen indicated that speeds were faster with a 50° arm choice during preacquisition, faster with a 0° arm choice during acquisition, and not different with 0° and 50° choices during extinction.

Discussion

The presence of obvious rewards (food) in the goal boxes decreased the speed of running through the major portion of the maze but increased the speed of entering the goal boxes; it also produced a tendency to reach the goal box by the less effortful arm in the 0°-50° T-maze—a tendency which was not present on unrewarded trials. These observations (both of which have been confirmed in other experiments in the series) make it awkward to account for increased

speeds over "unrewarded" trials in terms of a hypothetical reward which acts subsequent to S's arrival in a goal box.

The gradual development of fast speeds over a large number of preacquisition trials bears some resemblance to the gradual development of fast wheel running without extrinsic reward (e.g., Finger, Reid & Weasner, 1957). Demonstrations of the reinforcing value of wheel running (e.g., Premack, Schaeffer, & Hundt, 1964) suggest that running may be an intrinsically appealing or self-reinforcing act for the activity-deprived rat. An experiment is in progress to see if the opportunity to run in a maze will reinforce bar pressing in the start box.

Experiments not yet published suggest that massed trials and brief goal-box confinement times are critical conditions for the development of fast running speeds over unrewarded trials. We are not aware of any experiment with a large number of preacquisition trials which has met these conditions. There are, however, many experiments with brief confinement and massed trials during extinction. Although there probably are other conditions that are critical, the failure of these experiments to obtain increasing speeds during extinction is most easily explained by the early termination of extinction trials. While runway speeds in the present experiment had increased noticeably by the 30th extinction trial, in our previous experiments with no preacquisition trials, speeds during extinction declined in an expected fashion for 40 to 80 trials and reached conventional extinction criteria before beginning to increase.

References

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Note

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