The influence of early climbing experience upon later climbing behavior¹

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Two groups of albino rats were raised individually in cages that were identical except that one group had the opportunity to climb on a vertical wire-mesh cage front (C), while the other group did not (NC). Testing in an exploratory box with horizontal, sloping, and vertical planes showed that the C group explored more in the vertical plane than did the NC group. No performance differences were found on a straight alley task involving a forced climb.

In an observational study of the ontogenesis of behavior in white rats, Bolles & Woods (1964) reported a high frequency of climbing in young rats reared in standard laboratory cages. At 18 days the rats began to climb the cage walls, a form of activity that greatly increased in frequency and duration and was still present at 36 days of age when the study ended. In the third week of life, climbing constituted more than half the total time the rats spent in locomotion.

Ravizza & Herschberger (1966) examined the effects of early restriction of climbing on a variety of later behaviors in rats. Animals were raised from birth in metal cages with hardware-cloth floors, fronts, and ceilings, or in similar cages with Plexiglas placed inside the hardware cloth of the ceiling and cage front. When tested at maturity, the rats that had the opportunity to climb showed more activity and less emotionality in table-top exploration, performed better on the Hebb-Williams maze task, and initially ran more in an activity wheel than did the non-climbing animals.

These findings suggest that climbing behavior may be an important facet of early sensory-motor experience. The present study sought to examine the effect of restricted opportunity to climb on later tasks involving climbing, with a procedure designed to control for the possible differences in auditory and olfactory stimulation, air circulation, temperature, and litter variables that were not balanced in the Ravizza and Herschberger study.

METHOD

Subjects

Ss were 35 male Holtzman rats from seven litters with five in each litter. However, respiratory infections reduced the number to 20 with 10 in each group.

Apparatus

Rearing. The sheet metal pre-weaning cages measured 16-1/2 x 9-1/2 x 7 in. The wire mesh fronts were covered with plywood on the inside to insure that no climbing occurred before the experimental manipulation was begun. The experimental rearing cages were metal 5-gallon pails,³ 11-1/2 in. in diameter and 13 in. deep, placed on their sides and braced securely. The smooth interior surface of the pails prevented climbing on these surfaces. Each cage had a removable front of 3/16 in. Plexiglas with holes for water bottle and air circulation arranged so that they could not be used for climbing. A circle of 1/2 in. hardware cloth was mounted on four bolts 1/4 in. inside the Plexiglas on the front of the cages permitting climbing. On the cages restricting climbing, identical hardware cloth was mounted 1/4 in. *outside* the Plexiglas. Climbing and nonclimbing cages were placed alternately on shelves in a restricted colony room. Therefore, insofar as possible the visual experience of the climbing and nonclimbing groups was identical, and variables such as auditory and olfactory stimulation, air circulation, and temperature were equated.

Testing. The exploration box was of plywood and measured 48 x 36 x 24 in. A sheet of plywood 36 x 25-1/2 in. was inserted at each end of the box, forming a 45 deg angle with the floor and meeting the end wall 6 in. below the top. Hardware cloth (1/2 in.) was mounted directly on one of these sloping surfaces, and fine wire screening was attached to the other. Hardware cloth (1/2 in.)

was also mounted on the two vertical side walls, while the 12 x 36 in. floor area was bare. All interior surfaces of the box were painted flat gray.

The straight alley was 4 in. wide, 20 in. high, and 72 in. long with a 12 in. start box and a 15 in. goal box. The interior surfaces were painted flat black. A barrier of hardware cloth on a wood frame, painted flat black, could be placed in the alley near the entrance to the goal box. The barrier was 12 in. high with a 13 in. surface facing the start box and forming an 80 deg angle with the floor of the alley, and a 17 in. surface sloping down to the goal box at a 40 deg angle. Three photocells wired to time clocks were located at the entrance to the alley, 28 in. along the alley just before the barrier, and at the entrance to the goal box just beyond the barrier. They permitted timing of running speed to the barrier and climbing speed over the barrier when the barrier was in place.

Procedure

Litters of Ss and their mothers arrived at the lab at age 8 days and were kept in the pre-weaning cages until Ss were 18 days old. Half the Ss in each litter were then randomly assigned to each rearing condition, climbing (C) or nonclimbing (NC). Ss were reared individually and lived in the experimental cages throughout rearing and testing. Ss were kept in a quiet room at a temperature of 76 deg $\pm$ 2 deg with a 12 h light-dark cycle. During the rearing period each S was observed nightly under red light once every 5 sec for 1 min, and its behavior was recorded. These observations showed that the C group initially spent as much time climbing as in all other locomotion. Although climbing became increasingly rare, it was still present at 47 days when the exploration testing was begun.

For the exploration task each S was placed in the center of the exploratory box. During the following 5 min, two Es recorded (a) the amount of time S spent on each of four different surfaces (floor, hardware cloth slope, screen slope, and vertical walls), (b) the amount of time S was in motion on each surface, and (c) the number of fecal boluses. Each S was tested once daily for six consecutive days.

After the exploration testing Ss were gradually placed on a 23-1/2 h water-deprivation schedule over a 10 day period, and were then tested in the straight alley. Each S received 10 consecutive trials in the alley for a 5 sec water reward for nine days without the barrier present. The total running time was obtained by adding the times for the two portions of the alley. On the 10th day the barrier was placed in the alley. Each S received 10 trials daily for six days with the barrier present. Running times were then obtained separately for the distance from start box to barrier and for the barrier itself.

RESULTS

Exploration

Since the data revealed a very high correlation between total time and time spent in locomotion, the analyses were based only on total times. A Rearing by Days repeated measures analysis of variance of total time spent off the floor of the box revealed no significant rearing effects ($F(\text{Rearing}) = 1.29$, $df = 1/18$; $F(\text{Rearing by Days}) = 1.40$, $df = 5/90$). This suggests that the C and NC groups explored the nonhorizontal surfaces the same amount of time.

Since the nonhorizontal surfaces varied in degree of similarity to the climbing surface in the rearing cages, it was asked whether Ss differed in exploration of these particular surfaces. However, the data were highly skewed. In fact, climbing on the vertical surface was so rare that a parametric analysis was not appropriate. To correct for skewness, a log transformation of the form $\log(X + 1)$ was performed on the data for the two sloping surfaces. A three-way Rearing by Surface (hardware cloth and screen slopes) by Days repeated measures analysis of variance was then carried out. Again there were no significant rearing effects ($F(\text{Rear-}$

ing) = 2.38, $df = 1/18$; $F(\text{Rearing by Surface}) = .25$, $df = 1/18$; $F(\text{Rearing by Days}) = 1.80$, $df = 5/90$; $F(\text{Rearing by Surface by Days}) = .47$, $df = 5/90$).

In contrast, exploration of the vertical hardware cloth walls was dependent on rearing. During the six days of testing only five Ss climbed on the vertical walls at all, and all of these Ss were in the C group. A Fisher's exact probability test showed this difference to be significant at the $p < .016$ level.

In terms of emotionality during the exploration testing as gauged by number of fecal boluses, there was no difference between the rearing conditions.

Straight Alley

On both the habituation phase with no barrier (Days 1-9) and when the barrier was present (Days 10-16) the running speed curves for the two rearing conditions were virtually identical.

DISCUSSION

The results showed that Ss allowed early climbing experience were more likely to explore a vertical surface than Ss that had not had such experience. Climbing experience seemed to have no effect on exploration in the sloping or horizontal planes. Further, it had no effect on the speed with which the Ss surmounted a barrier placed in a straight alley. In view of the fact that these tasks seem to be more closely related to the experimental manipulation than the tasks in the Ravizza and Herschberger study, the relative weakness of the effect in this study is somewhat surprising.

There are several possible explanations of the discrepancy between the two studies. In the first place, the uncontrolled variables permitted by the procedure used by Ravizza and Herschberger may have led to spurious effects. On the other hand, the tasks selected for the present study differed from those used previously and may not have been as sensitive to group differences. However, it is hard to imagine that climbing experience could affect other behaviors without affecting climbing behavior itself, particularly in view of the fact that the observed effects were restricted to the portion of the testing (vertical hardware cloth) that most resembled the rearing experience.

REFERENCES

- BOLLES, R. C., & WOODS, P. J. The ontogeny of behaviour in the albino rat. *Animal Behaviour*, 1964, 12, 427-441.
RAVIZZA, R. J., & HERSCHBERGER, A. C. The effect of prolonged motor restriction upon later behavior of the rat. *Psychological Record*, 1966, 16, 73-80

NOTES

1. This research was supported by an NIH Biomedical Sciences Support Grant awarded to the University of North Carolina at Chapel Hill.
2. Now at Fels Research Institute, Yellow Springs, Ohio.
3. Pails were obtained through the cooperation of R. S. Sawyer, Vice President, United Steel Barrel Company.