Differential rearing and free versus forced exploration[1]

RICHARD K. LORE AND AMY LEVOWITZ
RUTGERS UNIVERSITY

Three groups of rats were reared from day 25 to day 65 in either (1) a large free environment cage containing manipulanda, (2) individual restricted environment cages that afforded little sensory or locomotor experience, or (3) in normal cages. Ss were given a brief home cage emergence test designed to evoke "free" exploration. "Forced" exploration was observed by placing each animal in a large cage containing a variety of small objects. FE animals exhibited more exploratory activity in the home cage emergence test but less object exploration in the forced environment.

A number of investigators have found that animals reared in restricted environments (RE) have a higher "exploratory drive" than animals reared in a free environment (FE) and have suggested that RE Ss are poor Hebb-Williams maze performers because their increased attention to irrelevant stimuli interferes with goal directed behavior (Woods, 1959; Woods, Fiske, & Ruckelshaus, 1961; Woods, Ruckelshaus, & Bowling, 1960; Zimbardo & Montgomery, 1957). Other studies have reported either reverse findings (Dawson & Hoffman, 1958; Meyers & Fox, 1963) or no differences (Ehrlich, 1959; Montgomery & Zimbardo, 1957) in the exploratory activity of differentially reared rats.

In resolving this issue the distinction between "free" and "forced" exploration (Welker, 1957) or the similar distinction made by McReynolds (1962) between "novelty seeking" and "novelty adjustive" behavior may be of value, for the various exploratory environments used in the above studies appear to contain elements of both. Hence the present study was designed to compare the exploratory activity of differentially reared animals in two alternate exploratory settings that either (1) afforded S the opportunity to seek novel stimulation from a familiar environment or (2) suddenly forced S to adjust to a radically novel environment.

Method and Procedure

Thirty-six male Wistar rats from seven litters were obtained from Edgewood Breeders, Colonia, New Jersey. The animals were weaned, delivered, the litters split into three equally sized groups and the rats placed in the appropriate rearing conditions when 25 days old.

FE animals were reared in a large cage measuring 48 in. x 26 in. x 10 in., constructed of hardware cloth on a wooden frame. The cage contained two seesaws, two tunnels and a small maze. RE animals were placed in individual confinement cages made entirely of hardware cloth and measuring 5 in. x 3 in. x 3-1/2 in. These small cages were located within a standard Wahmann cage (9-1/2 in. x 7 in. x 7 in.) that formed the floor and front of the smaller cage. Visual stimulation was markedly reduced by attaching the feeding bin to the cage front. Normal cage (NC) animals were reared in standard sized Wahmann cages. Colony room temperature was maintained at $77^{\circ} \pm 2^{\circ}$ and the six to six light dark cycle was automatically controlled. Food and water were available ad lib throughout the experiment.

Forced exploration was measured in a rectangular cage (36 in. x 12 in. x 10 in.) constructed of hardware cloth supported by a metal frame. The cage contained five wooden objects of various shapes (e.g., a toy elephant, building blocks, wooden disk) and 10 small metal objects similar to those used recently by Woods & Bolles (1965).

The test apparatus was located in a small, windowless room adjacent to the main colony. Ss were observed by a single E seated at a table six feet from the test cage. E's head was visible but the recording activity could not be seen or heard by S since the timing and counting equipment were located in another room.

After 40-41 days of differential rearing, all the animals were housed in standard Wahmann cages for the duration of the experiment. When the animals were 86-88 days old, "free" exploration was observed by simply giving the animals the opportunity to either peer out or emerge from the top of their home cages. To initiate the test E slowly opened the cage 3 in. and quietly took a seat behind a table 5 ft. from the cage rack. Three measures were taken: (1) latency to the first appearance of any portion of the rat's body above the cage top (invariably the head), (2) total time during the 5 min. open cage period when any portion of the rat's body was above the cage and (3) the number of animals in each group who left the home cage entirely. All 36 Ss were tested on three successive days during the early afternoon.

The forced exploration task was administered when the animals were approximately 121 days old. Each S was placed directly in the cage and his exploratory activity continuously recorded for the next 15 min. by a procedure similar to Woods & Bolles (1965). E recorded (1) the number and duration of all sniffing and front leg manipulatory contacts with the stimulus objects and (2) the number and duration of all nonobject exploratory behaviors on two channels of an event recorder. For scoring purposes all stimulus contacts of less than 1 sec. duration were scored as 1 sec.

Results and Discussion

Table 1 presents the results of the home cage emergence test. The latency data indicate that initial cage

Table 1. Free Exploration Data

Group	Average latency (in sec.) to first response	Total exploration time (in sec.)	Whole Body emergence-number per group
Free Environment	58.2	68.2	8
Normal	61.8	39.2	0
Restricted Environment	80.5	30.45	0

emergence was fastest for the FE group, but an analysis of variance of the reciprocal time scores did not show differences among latencies of the groups to be significant ($F = 1.55$, $df = 2/33$, $p > .10$). However, in terms of total exploration, i.e., the time any portion of S's body appeared over the cage top, the group differences were significant ($F = 4.63$, $df = 2/33$, $p < .025$). Further, eight of the FE animals left the home cage entirely during the 5 min. open cage period while none of the NC or RE Ss did so. Thus, FE animals on all three measures consistently evidence more free exploratory behavior.

As shown in Table 2, more object exploration was elicited from the RE animals when the task involved an immediate adjustment to an array of novel stimuli ($F = 6.41$, $df = 2/33$, $p < .01$). However, there were no reliable differences between the groups in either nonobject exploratory activity ($F < 1.00$) or in the length of the average exploratory period for both object and nonobject exploration. Weight data on days 25, 70, and 130 indicated that although the FE Ss were slightly larger on day 130, none of these differences were statistically significant.

Table 2. Forced Exploration Data

	Object Exploration		Nonobject Exploration	
Group	Average contact time (in sec.)	Length of average contact (in sec.)	Average time (in sec.)	Average time per event (in sec.)
Free Environment	168.8	5.13	166.9	2.9
Normal Cage	173.7	5.25	173.7	2.4
Restricted Environment	252.8	6.32	162.6	2.9

The results indicate that the effect of early environment on exploratory behavior is contingent on the type of exploratory behavior involved. The forced exploration data support the contention of Woods et al, concerning the differential role of distracting stimuli in studies that compare the problem solving abilities of animals reared in impoverished and enriched environments. However, the results do not justify the conclusion that RE animals have an "increased exploratory drive" for, when given the opportunity to seek novelty from a familiar environment, they exhibited relatively less exploratory activity.

References

Dawson, W. S., & Hoffman, C. S. The effects of early differential environments on certain behavior patterns in the albino rat. *Psychol. Rec.*, 1958, 8, 87-92.

Ehrlich, Annette. Effects of past experience on exploratory behavior in rats. *Canad. J. Psychol.*, 1959, 13, 248-254.

Meyers, R. D., & Fox, J. Differences in maze performance of group vs. isolation reared rats. *Psychol. Rep.*, 1963, 12, 199-202.

Montgomery, K. C., & Zimbardo, P. G. Effect of sensory and behavioral deprivation upon exploratory behavior in the rat. *Percept. mot. Skills*, 1957, 7, 233-229.

McReynolds, P. Exploratory behavior: a theoretical interpretation. *Psychol. Rep.*, 1962, 11, 311-318.

Welker, W. I. "Free" vs. "forced" exploration of novel situation by rats. *Psychol. Rep.*, 1957, 3, 95-108.

Woods, P. J. The effects of free and restricted environmental experience on problem-solving behavior in the rat. *J. comp. physiol. Psychol.*, 1959, 52, 399-402.

Woods, P. J., & Bolles, R. C. Effects of current hunger and prior eating habits on exploratory behavior. *J. comp. physiol. Psychol.*, 1965, 59, 141-143.

Woods, P. J., Fiske, Anne S., & Ruckelshaus, Susan I. The effects of drives conflicting with experience on the problem-solving behavior of rats reared in free and restricted environments. *J. comp. physiol. Psychol.*, 1961, 54, 167-169.

Woods, P. J., Ruckelshaus, Susan I., & Bowling, D. M. Some effects of "free" and "restricted" environmental rearing conditions upon adult behavior in the rat. *Psychol. Rep.*, 1960, 6, 191-200.

Zimbardo, P. G., & Montgomery, K. C. Effects of "free environment" rearing upon exploratory behavior. *Psychol. Rep.*, 1957, 3, 589-594.

Note

1. This research was supported by a grant from the Rutgers Research Council.