

# Effects of isolation, daily handling, and enriched rearing on maze learning

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Daily handling for 30 days after weaning reduced straight alley running time in isolated rats, but had no significant effect on Lashley III maze learning. Both handled and unhandled isolates were inferior in maze learning to littermates reared in an enriched environment.

It has been known for some time that rats reared in complex social environments are superior to those reared in isolation cages on various problem solving tasks (Hebb, 1949; Hymovitch, 1952; Krech, Rosenzweig, & Bennett, 1962; Rosenzweig, 1966). It has also been found that enriched reared rats differ biologically from isolates in cortical weight and thickness, distribution of some brain enzyme activity, and brain microanatomy (Bennett, Diamond, Krech, & Rosenzweig, 1964; Rosenzweig, Bennett, & Diamond, 1972; Greenough, West, & Fleischmann, 1971), as well as in certain indices of stress, such as adrenal weight (Geller, Yuwiler, & Zolman, 1965). A criticism of the behavioral reports has been that the isolated animals, which have larger adrenals, may react in a different way to E handling and the test situation, since the rearing environment has not adjusted them to the level of stimulation found in the behavioral task (Melzack, 1969; Myers & Fox, 1963). Typically, the isolates are handled as little as possible, while the enriched rats are handled daily (Rosenzweig, Bennett, & Diamond, 1972).

Recently, it has been reported that enriched reared rats show an affinity for their "caretaker" which is not seen in isolated rats (McCall, Lester, & Corter, 1969; McCall, Lester, & Dolan, 1969). This, taken with demonstrations of the interactions between E handling and learning task performance (e.g., Bernstein, 1957), suggests that differential reactions to the E may contribute to the reported differences in problem solving performance. The present experiment was designed to assess the effects of regular handling on the performance of otherwise isolated rats on a learning task which has been shown to differentiate enriched and impoverished reared animals (West & Greenough, 1972). Daily handling has previously been found to have little or

no effect on the gross brain measures affected by enriched rearing (Krech, Rosenzweig, & Bennett, 1960).

## SUBJECTS AND APPARATUS

Twelve male littermate triplet sets of Long-Evans hooded rats (36 individual animals), matched for initial body weight, were weaned and placed in the differential environments at 22-25 days of age. The testing apparatus consisted of a 1.8-m straight pretraining alley and a 1.2 x 0.6 m Lashley III alley maze (Lashley, 1929). All alleys were 10 cm wide x 13 cm high and painted gray.

## PROCEDURE

Enriched (EC) rats were reared in a group of 12 in a single cage (45 x 60 x 70 cm) equipped with a set of toys (homemade and commercially available objects of wood, metal, and plastic), which were changed daily. In addition, they were allowed 30 min daily free play in a 1.2-m-sq field provided with a new set of toys each day. Impoverished (IC) rats were housed singly in 22 x 25 x 30 cm stainless steel cages with wire mesh fronts and bottoms, facing an off-white wall about 1.5 m away. They had no view of other animals, and were handled for only about 20 sec once each week. Handled (HC) rats were housed identically to the IC rats, except that they were taken from their cages, held, and gently stroked for 2 min each day. Animals were kept on a 7 a.m. to 7 p.m. light schedule at 75° ± 3°F, with food and water available ad lib until testing began.

After 30 days of the differential environments, Ss were placed on a 23¼-h water deprivation schedule and were all handled and gentled for 2 days in the manner described above. Ss then began 8 days of training in the straight alley for 0.5 ml water reward (one trial per day, except for one or two extra trials given to four Ss each in the IC and HC groups on the final day). Over the next 5 days, all rats were trained, one trial per day, on the Lashley III maze. An error was scored whenever a rat's head passed a line

5 cm beyond the choice point in one of the blind alleys. Latency from leaving the startbox to entering the goalbox was recorded with a stopwatch. Rats were run in the maze by the same E who had handled them during the differential environmental period, while errors and time were recorded by a second E, who was not told of the treatment condition of the individual animal in the maze.

## RESULTS

Clear differences in straight alley running speed persisted throughout pretraining ( $F = 5.68, p < .01$ ), despite the obvious improvement in all groups across trials (Table 1). Post hoc comparisons (Winer, 1962) showed the EC and HC animals to be significantly faster than the ICs ( $p < .01$ ), while the EC vs HC difference was short of significance ( $.05 < p < .10$ ). The same pattern holds when the final straight alley trial alone is examined. A rather different pattern is seen, however, in Lashley III maze running time, where the ECs differed from both HC and IC groups ( $F = 4.54, p < .05$ ), and no significant difference was seen between the two isolated groups ( $F = 0.32, p > .25$ ). This pattern continues to hold over the final 4 days of training when running speeds are considerably faster. A similar pattern is seen in the total error data. The groups did not differ significantly on the first maze day (when, of course, they have not seen the location of the goalbox), but the ECs are significantly superior to both isolated groups over the final four trials ( $F = 4.21, p < .05$ ).

## DISCUSSION

These results indicate that the handling of the animals may affect a simple task such as is involved in the pretraining alley in which the performance of the animals depends more upon the tendency to "freeze" for varying periods than upon the ability to learn the task. In the more complex task, however, prolonged freezing was relatively rare, and running speed, after the first trial, tended to parallel the number of errors

Table 1  
Mean Daily Latency and Maze Errors for the Differentially Reared Groups

	EC	HC	IC
Alley Running Time (Seconds)			
Day 1	58.2	136.2†	245.9*
Day 8	3.3	10.5	25.7*
Maze Running Time (Seconds)			
Day 1	220.7	282.8	273.8
Days 2-5	28.6	52.7*	60.8*
Maze Total Errors			
Day 1	8.75	8.33	7.33
Days 2-5	6.33	11.42*	11.00*

\*Differs from EC ( $p < .05$  or smaller)  
†Differs from IC ( $p < .05$  or smaller)

on the task. It is possible that, even though the groups were not homogeneous in performance at the end of pretraining, the pretraining adapted them sufficiently to E handling to make them homogeneous in this regard in the maze task. In either case, these results suggest that the behavioral differences reported between enriched and impoverished reared rats following pretraining are not to any great extent due to their reaction to E handling during training. However, the results also suggest that a handled control might be considered preferable to the typical unhandled IC in tasks involving extensive handling or minimal pretraining. This experiment is one of a series designed to factor out behaviorally the components of the general performance differences between enriched and isolation reared animals. Further studies will examine aspects such as memory formation, attention, and motivation.

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