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# SHORT COMMUNICATION

# Effects of Floor Textures on Open-Field Behavior in Selected Lines of Mice

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*Mice representing the twenty-second generation of selection for high and low open-field activity were tested on four different floor textures: soil, bedding, metal, and astroturf. Members of both groups were most active on soil and least active on the metal floor surface. Although floor texture significantly affected activity level, rank order of the high and low selected groups was maintained. In general, defecation scores were negatively correlated with activity.*

**KEY WORDS:** open field; floor textures; selected groups; mice; activity.

## INTRODUCTION

The open-field test has been extensively used as a behavioral measure. The type of field used has varied from the circular washtub used initially by Hall (1934) to the more sophisticated arena (McClearn and Meredith, 1964), enclosed maze (Lester, 1968; Bruell, 1969), and plexiglas-square open fields (DeFries, 1964) used by many investigators today. Although effects of the size of the field have been investigated (Broadhurst, 1957), as well as differences in test illumination (DeFries *et al.*, 1966; McReynolds *et al.*, 1967; Dixon and DeFries, 1968*a*), there has been no systematic investigation of the effects of differing floor surfaces on the activity of animals in the open field. This investigation was carried out to determine how lines of mice selected for high and low open-field activity (DeFries *et al.*, 1970) might react in the open field with different floor surfaces. Four different textures were chosen: soil, bedding, astroturf, and metal. These differing

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surfaces provided several different sensory cues, including tactile, olfactory, visual, and possibly thermal stimulation. We hypothesized that changing floor surfaces in the open field would change activity levels and defecation levels in the selected groups of mice.

## METHOD

### Subjects

Mice representing the twenty-second generation of selection for high and low open-field activity were the subjects for this study. Two high lines ($H_1$ and $H_2$) and two low lines ($L_1$ and $L_2$) were derived from the $F_3$ of a cross between C57BL and BALB/CJ (DeFries *et al.*, 1970). Since members of the two high lines are very similar in activity, as are those of the two low lines (DeFries *et al.*, 1974), lines were combined across replicates to constitute two genetic groups for the purpose of this study.

The subjects had been tested on each of 2 successive days in a white, plexiglas open field at 40 $\pm$ 5 days of age. Thus all *S*s had two prior experiences in an open field. Only males were used as *S*s in this study.

### Rearing

Up to 40 days of age, the mice were kept in polypropylene cages (11¼ by 7¼ by 5¼ inches) with members of their own litter. After 40 days of age, the animals were housed individually in 9- by 5- by 4-inch metal cages with aspen shavings as bedding on the floor. Rearing conditions were maintained constant throughout the experiment. *S*s were on a constant 12-hr light–dark cycle throughout rearing and testing.

### Open-Field Test

The square (36 by 36 inches) open field was made of sheet metal and the floor textures used were soil, bedding, metal, and astroturf. A grid composed of five lengthwise and five crosswise metal wires was placed above the field to act as a counting area in each direction, hence dividing the field into 36 equal 6-inch squares. Placement of the markings above the field was effective in not distracting the *S*s during testing. An investigator was placed on each of two sides of the open field to count the number of lines the *S*s crossed.

Prior to the time of testing, within-litter assignments were randomly made for each of the four test conditions. This was done to assure that behavioral similarities between mice from the same litter would be distributed

at random throughout each test condition. If there were fewer than four animals per litter, the remainder of the animals were chosen from another litter until each of the four test conditions had been assigned.

Eighty subjects were tested, ten of each selected group (high and low activity) on each of the four different field textures. All *S*s were tested in the open field for 3 min (between 10 A.M. and 10 P.M.) on each of 2 successive days, beginning at 55–65 days of age. No more than five *S*s were tested in any field texture before the environmental field was changed; each group of five *S*s included at least two high-line *S*s and two low-line *S*s tested in a nonsystematic order. Procedures after testing included removing fecal boluses from the field and cleaning the surface of the field. The metal surface and the astroturf were cleaned with water after each 3-min test. The bedding and soil were mixed after each test, and after five successive mice had been tested, the soil or bedding was replaced.

Illumination levels were maintained at the level used for the initial plexiglas field test (approximately 48 ft-candles). The illumination was measured on each type of texture; readings were taken with a Sekonic light meter placed on the field surface at the four corners and the center of the field. An illumination-level adjuster was used to maintain the same illumination levels for each field texture. The four 150-watt light bulbs placed at each corner of the open field were 1½ ft above the testing area.

### Data Analysis

Because of the heterogeneous group variances in the raw data, square root transformations were applied to both activity and defecation scores. However, since defecation scores were relatively low, 0.5 was added to each *S*'s defecation score prior to transformation. A 4 × 2 (four test conditions × two selected groups) factorial analysis of variance was carried out on the transformed data.

## RESULTS

The analysis of variance summary for the transformed open-field activity and defecation data is shown in Table I. It can be seen that there are significant main effects of testing the animals on the different floor textures as well as significant effects due to selected group differences for both activity and defecation scores; in addition, there is a significant interaction for defecation.

The mean open-field scores (nontransformed data) for the two selected groups tested under the four floor textures are listed in Table II. The mean scores of the same animals tested in the plexiglas open field 20 days earlier

**Table I.** ANOVA Summary for Transformed Open-Field Activity and Defecation Scores in Selected Groups of Mice Tested with Four Floor Textures

| | | Activity | | Defecation | |
|---|---|---|---|---|---|
| Source | df | MS | *F* | MS | *F* |
| Floor textures | 3 | 145.90 | 16.0[a] | 2.92 | 73.0[a] |
| Selected groups | 1 | 2306.44 | 252.9[a] | 5.79 | 145.0[a] |
| Interaction | 3 | 4.32 | 0.5 | 0.14 | 3.5[b] |
| Error | 72 | 9.12 | | 0.04 | |

[a] $P < 0.01$.
[b] $P < 0.05$.

are given in the same table for comparison. Since the animals were randomly assigned to the test conditions, there are no significant differences in the scores of the animals within selected groups when tested in the plexiglas field. In each of the test condition experiences, activity scores generally decreased compared to the initial scores of the naive animals. This could be due to the effect of repeated testing (Dixon and DeFries 1968*b*), the different open field, or some combination of the two. *S*s of both groups ran least on the metal floor surface. *A posteriori* comparisons were carried out using Tukey's *w* procedure as described in Sokal and Rohlf (1969). Comparisons between means showed highly significant differences between all scores except astroturf and bedding scores for the high-group *S*s.

Mean nontransformed defecation scores are shown in Table III. The defecation scores generally show the opposite trend from the activity

**Table II.** Mean Open-Field Activity Scores for High and Low Selected Groups of Mice Tested in a Sheet Metal Open Field with Four Floor Textures[a]

| | Metal | Astroturf | Bedding | Soil |
|---|---|---|---|---|
| High active | 188.8<br>(417.5) | 310.6<br>(399.0) | 309.8<br>(392.1) | 398.8<br>(435.2) |
| Low active | 6.1<br>(64.6) | 53.8<br>(65.9) | 67.6<br>(58.1) | 66.8<br>(65.8) |

[a] Average activity scores of these mice when tested 20 days earlier in a standard plexiglas open field are indicated in parentheses for comparison. $n$ = ten mice per cell.

**Table III.** Mean Open-Field Defecation Scores for High and Low Selected Groups of Mice Tested in a Sheet Metal Open Field with Four Floor Textures[a]

| | Metal | Astroturf | Bedding | Soil |
|---|---|---|---|---|
| High active | 3.2 (2.1) | 3.5 (3.6) | 0.9 (4.3) | 1.4 (4.6) |
| Low active | 6.2 (5.6) | 4.7 (6.8) | 2.5 (7.6) | 3.4 (5.7) |

[a] Average defecation scores of these mice when tested 20 days earlier in a standard plexiglas open field are indicated in parentheses for comparison. $n$ = ten mice per cell.

scores, so that the highest scores are found on metal and astroturf, the lowest scores on bedding and soil. Comparisons between means showed that the differences between defecation scores for astroturf vs. metal and soil vs. bedding were not significantly different in both the high and low selected groups; all other differences were highly significant.

## DISCUSSION

Results of this experiment support the hypothesis that floor texture will affect open-field activity and defecation in mice. It is interesting to note that there was no genotype–environment interaction for activity: mice of both high and low selected groups were affected similarly when tested on the different textural conditions. Although there is a statistically significant genotype–environment interaction for defecation, an examination of the data indicates that this interaction is probably due to a difference in magnitude between the high and low groups tested on either metal or bedding surfaces, since there is no directional difference between the two groups tested on the various surfaces.

There were some behavioral responses noted during testing which were not well quantified but which deserve mentioning. For instance, all 20 mice from both groups tested on the bedding floor spent some time burrowing (or digging) into the bedding (12 burrowed both days; four high-active mice and four low-active mice burrowed during only 1 of the 2 test days). On the soil floor, no time was spent digging into the soil except by two of the low-active mice on 1 test day. On the soil surface, however, there was a considerable amount of sniffing (especially by the low-active animals), and both groups showed a considerable amount of rearing behavior. These be-

haviors were not particularly pronounced on the metal and astroturf surfaces.

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