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Strain differences in open-field behavior of the rat. II

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Strain differences in parameters of open-field behavior measures were replicated after a 7-year interval for the Har sublines of 12 inbred strains of rats: ACI, A990, A35322, F344, INR, IR, MNR, MNRA, MR, TS1, TS3, and WAG, and were extended to an additional strain: B. Breeding stocks had been subjected to major environmental stress in the intervening years. No significant changes were found. The B strain was found to be distinctiive in showing both high ambulation and high defecation.

Identification and precise definition of animal models for research has been a major area of methodological advance in the life sciences in the past decade. The National Academy of Sciences now offers over 50 animal standards and animal model reference works in its publications list. The choice of an animal model rests first on the phenomena to be studied. Frequently, the precision of definition, hence replicability, is enhanced by also specifying the breeding background of the animal. For this reason, genetic animal stocks, which originally may have been developed for genetic studies, have taken on added value simply because particular lines have shown particular characteristics of direct interest. For example, Broadhurst's (1960) two-way genetic-selection experiment yielded the Maudsley Reactive and Maudsley Nonreactive lines of rats, which are now useful for research designs requiring differentiation on the basis of reactivity. Thus, the lines are essentially behaviorally defined, although also genetically specified.

Because of the popularity of the rat for psychological research and the lack of behaviorally defined models, I set about to collect data and to catalog some behavioral characteristics of the 12 inbred strains of rats most frequently cited in the behavioral literature (Harrington, 1968). A series reporting results began in 1971 (Harrington, 1971a, 1971b, 1972).

In 1972, a major fire interrupted this program. Retrieval, insofar as possible, of the previously collected data from charred records has just now been completed. However, the fire also necessitated emergency evacuation of all animals from the third floor of a smoke-filled building. Racks were pushed to bump down stairs, losing some cages en route. Some cages were dropped down shafts. Once out, cages and racks remained in open campus areas with thousands of students milling about. In subsequent months, difficulties in breeding attested to the stress of smoke, noise, and violent handling. Additionally, the removal to outdoor areas introduced parasites and disease problems into the breeding colony. This raises the critical question: Did factors associated with the fire significantly alter the characteristics of the animal lines? The colony has been maintained as a reference standard. Approximately 40 investigators have used lines derived from this laboratory in their research. If changes have taken place, then data collected, at least on animals provided prior to the fire, would not be comparable to those based on later animals. This is relevant both to the investigators and to those who read their results. Moreover, data previously collected in this laboratory for purposes of behavioral definition might not be applicable to currently available lines. It has seemed important, therefore, to replicate some prefire data to establish whether or not significant behavioral changes have occurred.

The majority of users of lines from this collection have shown most interest in behavioral definition related to open-field behavior. Therefore, the present study is a replication of previously reported open-field behavior (Harrington, 1972). The previous report was based on data collected before the fire and the present on data collected after the fire, with approximately 7 years intervening. Additionally, data are reported for a strain not previously covered.

METHOD

Subjects

The subjects were 8 rats, age 70-75 days, for each sex for each of 13 inbred strains, a total of 208 animals. The strains were ACI/Har, A990/Har, A35322/Har, B/Har, F344/Har, INR, IR, MNR/Har, MNRA, MR/Har, TS1, TS3, and WAG/Har. All are fully identified in the fourth international listing (Festing & Staats, 1973). All animals were maintained at 78°F ± 2°F and 40% ± 5% relative humidity. Breeders and pups were maintained on a natural light cycle. Pups were handled for 1-min periods on alternate days from 14 to 45 days of age, weaned at 23 days of age, and transferred to 24-h light conditions at 45 days.

Apparatus

The test apparatus followed the Broadhurst (1957) standardization, a white circular stimulus field 83 cm in diameter, 165-fc illumination at the floor with 79 ± 1 dB white noise (B scale).

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Table 1
7-Year Stability of Means of Open-Field Measures for Inbred Rat Strains

	Defecation (Boli)*				Ambulation (Meters × 4.63)*			
	Males		Females		Males		Females	
Strain	1972	1979	1972	1979	1972	1979	1972	1979
ACI	16.66	23.00	12.03	15.57	165.7	257.1	222.8	291.9
A990	19.83	16.88	16.00	10.25	158.7	242.9	188.3	282.9
A35322	18.79	18.76	20.82	21.74	180.6	173.0	261.1	248.4
B	**	21.00	**	26.00	**	408.0	**	438.1
F344	12.23	17.00	13.97	14.62	188.7	194.1	226.1	359.1
INR	13.27	12.12	8.93	.88	360.3	373.9	392.7	502.1
IR	14.06	17.25	12.86	19.88	235.3	218.5	316.2	261.9
MNR	10.75	10.98	10.50	11.14	194.4	192.8	205.1	208.9
MNRA	10.53	9.62	9.10	1.75	296.1	335.6	288.6	344.6
MR	22.36	24.50	19.84	23.25	196.0	232.5	224.5	218.4
TS1	12.98	14.25	12.32	20.88	109.4	126.2	164.8	136.9
TS3	12.25	11.25	10.03	4.38	250.7	315.2	306.8	394.4
WAG	12.44	13.41	13.00	13.06	337.4	326.0	342.2	339.4

*Note—For each sex within each strain, $18 \leqslant n \leqslant 44$ for 1972, $n = 8$ for 1979. *4 days, 4 min/day. **Not included in 1972 report.*

Procedure

Testing was for 4 min/day for 4 days, differing from Broadhurst's (1957) 2-min daily periods. Defecation was measured by the total number of fecal boli deposited throughout the testing. The ambulation measure was the total number of floor grid spaces entered throughout the testing. The grid arrangement was such that division by 4.63 yields Broadhurst's measure of meters traversed.

RESULTS

The mean number of fecal boli and the mean ambulation (grid squares traversed) is shown for each sex within each strain for the data published in 1972, with the current, 1979, data. No significant differences are evident. Excluding Strain B, the differences of means of strain means for males and females, respectively, are, for defecation, $t = -1.39$ and $t = .11$, and, for ambulation, $t = -2.44$ ($p < .05$) and $t = -2.12$. There are no significant differences in defecation. Combining both sexes, it is clear that ambulation levels are higher in 1979 than in 1972. For purposes of behavioral definition, the primary question is one of relationship between the strains. The product-moment correlations between strain means are, for males and females, respectively, .82 and .75 for defecation and .88 and .78 for ambulation. Combining sexes increases the correlations.

DISCUSSION

Clearly, for comparative purposes, the relationship between strains in 1979 does not differ from that which prevailed in 1972. Similarly, defecation has not changed. Absolute activity levels as measured by ambulation are overall somewhat higher, but since this appears to be a uniform change, it is more readily attributable to a general change in the laboratory environment. The behavioral definition of these genetic lines has not been affected by time or intervening events.

For Strain B/Har, standard deviations for males and females, respectively, were 4.87 and 5.53 for defecation and 96.7 and 71.1 for ambulation. These are very consistent with previously reported data for other strains. The results for this section suggest a potentially useful model. Genetic correlations between defecation and ambulation are negative (Harrington, 1972). B is unusual in showing both very high defecation and very high ambulation, suggesting a usefulness for research designs where it is desirable to differentiate between effects on these two measures.

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