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Strain differences in activity of the rat in a shuttle stabilimeter

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Activity using an electronic shuttle "stabilimeter" was measured for 505 rats from 12 inbred strains: ACI, A990, A35322, F344, INR, IR, MNR/Har, MNRA, MR/Har, TS1, TS3, WAG. The results provide parametric data for methodological use and add to the standardization of these strains as behaviorally defined lines. Strain differences in activity measured by this method were not correlated with activity measured by activity wheels nor with activity measured by ambulation in an open field.

Bousfield and Mote (1943) invented the extensively used tilting stabilimeter as an instrument for measuring activity by counting the number of times the animal runs back and forth in the apparatus. It became a standard means of measuring spontaneous activity in part because it overcame many of the problems associated with the use of activity wheels, such as effects of curved surfaces (Seigel, 1946) and lack of interdevice reliability (Lacey, 1944). Objecting to the "instability of environment" of a see saw device, Seigel (1946) stabilized the platform, substituted a photocell and electric counter for the mechanical tilt recorder, and reported .87 reliability for this mode of measurement.

Beginning with Rundquist (1931, 1933), a considerable body of literature has accumulated concerned with genetic variation in spontaneous activity of the rat. The data have been almost entirely based on the activity wheel. The present study examined genetic variation using Seigel's (1946) more reliable shuttle device or stable "stabilimeter." One purpose was to provide standardization data on activity for those 12 genetically defined lines of rats having the highest citation frequency in the behavioral literature. Standardization of the laboratory animal has been one of the major areas of methodological developments in other disciplines in the past decade (International Committee on Laboratory Animals, 1971). This study is one of a number of studies (Harrington, 1971a, 1971b, 1972, 1979a, 1979b, 1979c, 1979d, 1979e, 1979f, 1979g, 1979h; Harrington & Hellwig, 1979a, 1979b) cataloging characteristics of these genetically specified strains for purposes of behavioral standardization.

METHOD

Subjects

Subjects were 505 rats, 75-82 days of age, with a minimum of 20 animals of each sex within each of the following 12 inbred strains: ACI/Har, A990/Har, A35322/Har, F344/DuHar, INR, IR, MNR/Har, MNRA (formerly MNR-a/Har), TS1, TS3, WAG/Har. All lines are designated by the standard nomenclature for this species and are described in the fourth international listing (Festing & Staats, 1973). Animals were bred and maintained at 25.5°C ± 1.1°C and 40% ± 5% relative humidity. Breeders and pups were housed under natural light cycle. Pups were handled for 1 min on alternate days from age 14 to 45 days. At 45 days, they were transferred to individual cages with 24-h light cycle. More detailed descriptions are available elsewhere (Harrington, 1968).

Apparatus

The activity chamber was 58 cm long with photocell at the middle, 15 cm wide, and 25 cm deep, with a 1.25-cm wire-mesh floor and solid top. The interior was painted medium gray. Both photodiode and focusable light source were mounted 2.5 cm from the interior wall surface, with the light beam passing through a 1.25-cm hole covered on the interior with a flush-mounted circular glass plate. The apparatus stood on 6-cm legs above a light brown wax-paper surface. Illumination was solely that reflected from the floor and from light-beam scatter. The illumination was measured and standardized, but the record of the level was destroyed in a fire.

Procedure

Animals were placed in the apparatus for 1,000 sec/day for 6 days. Center crossings (light-beam interruptions) were counted, recorded, and filed with a data-acquisition system.

RESULTS AND DISCUSSION

Table 1 displays the means and standard deviations of number of crossings over five daily sessions for each of the 12 strains. For research where a sharp differentiation in activity as measured by this method would provide useful experimental control, A35322 would be the most appropriate model of high activity, and ACI of low activity. For use where coat color is relevant, MNRA was the most active albino, WAG the least.

In reporting on this apparatus, Siegel (1946) reviewed, primarily in terms of reliability, some of the literature on methods of measuring activity. Comparing these data with similar data using the activity wheel (Harrington, 1971b) as a measuring instrument, the rank-difference correlation between strain means was .21 for males and −.05 for females. Apparently, these two measures are unrelated, at least with respect to genetic variation.

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Table 1
Shuttle "Stabilimeter" Activity of 12 Inbred Strains of Rats

	Activity*			
	Males		Females	
Strain	Mean	SD	Mean	SD
ACI/Har	318	91	387	101
A990/Har	468	102	498	96
A35322/Har	620	133	756	204
F344/DuHar	399	192	482	108
INR	381	82	403	98
IR	326	81	390	140
MNR/Har	415	69	439	67
MNRA	523	102	524	142
MR/Har	434	76	533	116
TS1	343	71	395	77
TS3	421	89	507	98
WAG/Har	365	92	396	96

Note–N ⩾ 20 for each sex within each strain.
**Center crossings per 5 days for 1,000 sec/day.*

Open-field ambulation has also been a popular activity measure. Comparing these data with comparable open-field ambulation data (Harrington, 1972) yielded a rank-difference strain correlation of .03 for males and .06 for females. These measures also appear to be genetically uncorrelated.

These results suggest that shuttle activity, rotating wheel activity, and open-field activity are quite distinct measures. Although they may be related by a common construct of activity, the genetic variables involved are apparently different. The data speak only to the question of group correlations, and not to individual correlations. As a problem for further study, it is reasonable to inquire whether the measures show a high degree of genetic specificity that would be masked in a heterogeneous population. In a maze-learning context, it has been demonstrated that maze problems show a sufficient degree of specificity with respect to genetic group membership to introduce interactions that have the effect of biasing "intelligence" tests against genetic minorities (Harrington, 1966, 1975). It was suggested that those results implied such bias is a general phenomenon of psychometric procedures rather than being restricted to "intelligence" measures. The present data suggest that, indeed, similar bias might obtain with measurement relating to a different construct such as activity.

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