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Strain differences in activity of the rat using a home cage stabilimeter

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Activity using an electronic version of the classic tambour mounted cage was measured for 557 rats from 12 inbred strains: ACI, A990, A35322, F344, INR, IR, MNR/Har, MNRA, MR/Har, TS1, TS3, WAG. The method provides an activity measure that in principle has some advantages over alternative measures. The results provide parametric data for methodological use and add to the standardization of these strains as behaviorally defined lines.

Richter (1927) measured activity in the rat by use of an activity cage mounted on three tambours connected to a kymograph. Use of this apparatus died out, perhaps because of relative inconvenience of usage. Tilting stabilimeters with microswitches gained automation in recording movement at the price of measuring intensity. Activity wheels provided automation of recording but introduced apparatus variables obscuring interpretation (Lacey, 1944; Seigel, 1946). Thus the tambour cage, as compared to more recent methods, provided a data record more closely related to amount of energy expended and did so in an apparatus more closely resembling the normal environment of the laboratory rat.

In earlier studies of genetic variation in the rat, no genetic correlations were detectable between activity measures based upon open-field ambulation, upon activity wheel rotations, or upon spontaneous shuttle box crossings (Harrington, 1971b, 1972, 1979b). Since the tambour mounted cage seemed a measure more closely related to underlying physical and physiological variables, it seemed possible that it might be more appropriate for examination of genetic variation. The interest in genetic variation arises not only out of substantive behavioral questions but also out of the contemporary interdisciplinary methodological concern for precise specification and standardization of laboratory animals (International Committee on Laboratory Animals, 1971). The present 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 the characteristics of those 12 genetically defined lines of the laboratory rat having the highest citation frequency in the behavioral literature. This step in their standardization provides data on activity as measured with a modern version of the classic tambour mounted cage.

METHOD

Subjects

Subjects were 557 rats, 75-89 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, MR/Har, 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 apparatus consisted of a metal platform suspended at three points on rubber shear mounts. A monophonic phonograph cartridge was rigidly mounted under the center of the platform so that the stylus was horizontal. A small weight was affixed to the stylus with epoxy cement. The weight on the stylus thus provided an inertial object, so that movement of the platform generated a cartridge signal. The cartridge output drove a linear dc amplifier, which in turn drove a voltage-to-frequency converter under the control of an on-line computer that recorded the output. That is, the recorded output was the integral of the envelope of the cartridge waveform output. The weight on the stylus and suspension were adjusted so that cartridge output frequencies were within the linear range of both cartridge and amplifier. Additional replacement cartridges were prepared by using two electric motors as standards to vibrate the platform at two intensity levels. Stylus weights were adjusted so that the output at both points was within 5% of that of the first cartridge.

Procedure

Subjects were individually housed in Wahmann LC75A cages. Daily for 5 days, each subject with cage was weighed. The total weight was adjusted to a standard. The subject's home cage containing the subject was placed on the apparatus platform, and cartridge output was recorded for an interval of 16-2/3 min.

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Table 1
Home Cage Stabilimeter Activity of 12 Inbred Strains of Rats

	Relative Kinetic Energy*			
	Males		Females	
Strain	Mean	SD	Mean	SD
ACI/Har	3.2	.88	2.9	.81
A990/Har	4.5	2.60	4.1	3.10
A35322/Har	5.0	1.80	5.6	2.30
F344/DuHar	3.2	1.20	3.0	1.30
INR	7.1	2.30	6.1	2.10
IR	3.4	1.50	3.0	1.30
MNR/Har	2.6	.43	2.2	.46
MNRA	4.4	1.90	3.8	1.60
MR/Har	5.6	1.10	4.8	1.10
TS1	3.6	1.30	3.6	1.40
TS3	7.6	1.80	7.7	1.90
WAG/Har	4.2	1.50	3.6	1.40

*Note–$N \geq 20$ for each sex within each strain. *Arbitrary units.*

RESULTS AND DISCUSSION

The units of measurement are purely a function of the specific electronic components used and are both arbitrary and relative. Data collection was segmented into small time units for purposes of reliability determination. Early results showed a stepped-up reliability coefficient which I recall as being greater than .90, but those records were lost in a fire and cannot be retrieved for verification.

The means and standard deviations of these activity measures are shown for each of the 12 strains in Table 1. One noteworthy difference between this and other measures was the lack of sex differences. While females show more ambulation in the open field, more revolutions in an activity cage, and more crossings in a shuttle, they also weigh less. With this measure more closely correlated with actual energy expenditure, sex differences tended to disappear. The strain differences are therefore more evident. The strain characteristics on this meaure are most closely related to those obtained in a shuttle measure (Harrington, in press-b). The Spearman rank-difference correlation between strain means on the two measures was .49 for males and .58 for females. The relationship between these two measures for individuals rather than genotypes cannot be resolved from these data.

For methodological purposes where control of spontaneous kinetic energy output might be useful in an experimental design, TS3 or INR would be indicated as high-activity specimens, with MNR, ACI, or F344 for low activity. It is interesting to note that the two Maudsley nonreactive lines, MNR/Har and MNRA, differ markedly on this measure of activity.

The measurement method appears to come closer to measuring activity in terms of energy than do other measures. Since energy has a fundamental physical meaning with absolute units of measurement, it would seem worthwhile to refine the apparatus and to calibrate it in absolute physical units. Research to that end is now in progress.

REFERENCES

FESTING, M., & STAATS, J. Standardized nomenclature for inbred strains of rats. *Transplantation*, 1973, **16**, 221-245.

HARRINGTON, G. M. Genetic-environmental interaction in "intelligence. I: Biometric genetic analysis of maze performance of *Rattus Norvegicus*. *Developmental Psychobiology*, 1968, **1**, 211-218.

HARRINGTON, G. M. Strain differences among rats initiating exploration of differing environments. *Psychonomic Science*, 1971, **23**, 348-349. (a)

HARRINGTON, G. M. Strain differences in rotating wheel activity of the rat. *Psychonomic Science*, 1971, **23**, 363-364. (b)

HARRINGTON, G. M. Strain differences in open field behavior of the rat. *Psychonomic Science*, 1972, **27**, 51-53.

HARRINGTON, G. M. Strain differences in activity of the rat in a shuttle stabilimeter. *Bulletin of the Psychonomic Society*, 1979, **13**, 149-150. (a)

HARRINGTON, G. M. Strain differences in free operant leverpress levels in the rat. *Bulletin of the Psychonomic Society*, 1979, **13**, 153-154. (b)

HARRINGTON, G. M. Strain differences in light-contingent barpress behavior of the rat. *Bulletin of the Psychonomic Society*, 1979, **13**, 155-156. (c)

HARRINGTON, G. M. Strain differences in open-field behavior of the rat. II. *Bulletin of the Psychonomic Society*, 1979, **13**, 85-86. (d)

HARRINGTON, G. M. Strain differences in passive avoidance conditioning in the rat. *Bulletin of the Psychonomic Society*, 1979, **13**, 157-158. (e)

HARRINGTON, G. M. Strain differences in runway learning in the rat. *Bulletin of the Psychonomic Society*, 1979, **13**, 159-160. (f)

HARRINGTON, G. M. Strain differences in shuttle avoidance conditioning in the rat. *Bulletin of the Psychonomic Society*, 1979, **13**, 161-162. (g)

HARRINGTON, G. M. Strain differences in simple operant barpress acquisition to an auditory stimulus by rats. *Bulletin of the Psychonomic Society*, 1979, **13**, 163-164. (h)

HARRINGTON, G. M., & HELLWIG, L. R. Strain differences in basal metabolism of behaviorally defined rats. *Bulletin of the Psychonomic Society*, 1979, **13**, 165-166. (a)

HARRINGTON, G. M., & HELLWIG, L. R. Strain differences in organ weights of behaviorally defined rats. *Bulletin of the Psychonomic Society*, 1979, **13**, 167-169. (b)

INTERNATIONAL COMMITTEE ON LABORATORY ANIMALS. *Defining the laboratory animal.* Washington, D.C: National Academy of Sciences, 1971.

LACEY, O. L. Revised procedure for the calibration of the activity wheel. *American Journal of Psychology*, 1944, **57**, 412-420.

RICHTER, C. P. Animal behavior and internal drives. *Quarterly Review of Biology*, 1927, **2**, 307-343.

SIEGEL, P. S. A simple electronic device for the measurement of the gross bodily activity of small animals. *Journal of Psychology*, 1946, **21**, 227-236.

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