— Note —

A New Model Cage for Simultaneous Measurements of Wheel-running and Ambulatory Activity in the Rat

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A new type of cage including a running wheel basket and tilting floor was developed. Using this cage it was possible to record simultaneously wheel-running and ambulatory activity of the rat.

There are various methods for measuring the motor activity of rats and mice, for example, running wheel cages [3, 4, 6, 8], induction coils [5], photo-cells [7] and flat floor cages [1, 2, 9, 10]. Motor activity measured by these methods may be classified into two types: running activity in the running wheel cages and ambulatory activity in the flat floor cages. Numerous experiments on the motor activity of small rodents have been performed using the running wheel cage. However, it has been suggested that these two types of activity appear to differ in quality [10]. Recently, we recognized that estrogen administration enhanced the wheel-running activity in the rat but did not affect ambulatory activity. On the other hand, methamphetamine hydrochloride potentiated only ambulation (unpublished). Therefore, it is important to measure these two types of activity simultaneously. The present paper discusses a new type of cage whereby it is possible to measure both types of activity at the same time.

In the present experiment, three different kinds of cages were used: a running wheel cage for measuring wheel-running activity, an ambulo-drinko meter for measuring ambulatory

activity, and a new type of cage developed by the authors for the simultaneous measurement of both types of activities. The running wheel cage (O'hara & Co., Ltd., Tokyo Japan) included a wheel basket (11.0(W), 29.0(O.D) cm) and resting cage (23.0×11.0×13.0 cm). Every time the wheel basket completes 1/3 of a revolution, it is taken as one count. In the ambulo-drinko meter (O'hara & Co. Ltd., 20×40×25 cm), ambulatory activity is measured by a tilting floor which is supported by two steel beams [10]. The new cage is shown Figs. 1. and 2. The cage is composed of two parts: a running wheel basket (9.0(W), 29.0 (O.D) cm) and tilting floor cage (11.0×40.0×26.0 cm). An animal may enter both parts freely. With this setup, it is possible to record simultaneously wheel-running and ambulatory activity. Fifteen male Crj:CD (SD) rats, 8 weeks old and weighing 280–310 g (Charles River Japan Inc.), were used. The animals were housed individually in three different kinds of cages and allowed free access to a commercial diet (CE-2, CLEA Japan, Tokyo) and water. They were reared in a room with the temperature controlled at $25 \pm 1^\circ\text{C}$, the relative humidity at $55 \pm 5\%$ and the lights on from 7.00 to 19.00.

The running wheel basket was used to measure wheel-running activity and the tilting floor, ambulatory activity.
Fig. 1. A new type of cage including a running wheel basket and tilting floor.

Counts of motor activity were collected every hour and analyzed by the time series method. Results were expressed as mean $\pm$ S.E. Significance was assessed by Duncan's multiple test.

The changes in motor activity as measured by the three types of cages are presented in Fig. 3. Regardless of the type of cage used, a clear diurnal rhythm of motor activity cha-

A: Running wheel basket, B: Tilting floor cage, c: Entrance, d: Sensor unit box.
Fig. 2. Illustration of the new type of cage.

racterizing nocturnal animals was observed. From 77 to 98% of total activity was recorded during the dark periods. Total activity as measured by the three types of cages was stable throughout the experimental period, and there was no significant difference in total activity between the mean counts on the first and seventh days of the experiment. Total wheel-running activity measured using the new model on the 7th day of the experiment was found to be about 50% that estimated using

Table 1. Changes in total activity measured in three different types of cages.

Cage	Activity	No. of rats	Days of experiment						
			1	2	3	4	5	6	7
Amburo-drinko meter	Ambulation	5	559	544	561	601	622	601	557
			70	64	100	116	86	80	51
Running wheel	Wheel-running	5	5733	7216	6495	7447	8564	9194	9375
			1799	2348	2189	2131	2764	3217	2932
	Ambulation	5	222	283	274	283	355	317	266
			35	44	41	28	50	112	75
New model	Wheel-running	5	2303	3098	3499	3685	4959	4609	4026
			480	445	779	1020	1588	2794	1436

Upper values represent the mean of 5 determinations. Lower values represent $\pm$ S. E. Significance was assessed by Duncan's multiple range test between the mean on day 1 and others.

Each column represents mean activity of five determinations during a period of two hours. Dark bar indicates 12 hr dark period and light bar, 12 hr light period.

Fig. 3. Comparison of diurnal patterns of wheel-running and ambulatory activity as measured by three different types of cages.

the running wheel cage. Ambulatory activity as measured by the new model was also found to be about 50% of that estimated by the ambulo-drinko meter (Table 1). The diurnal rhythm of the wheel-running activity and that of the ambulatory activity as measured by the new cage were found to be synchronized.

From these results, it was concluded that both wheel-running and ambulatory activities are inherent behavior in the rat, because the total amount of these activities measured by the new cage decreased to 50% of those in standard cages. The present study demonstrated the possibility of simultaneous measurements of wheel-running and ambulatory activity by using the new type of cage.

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位置移動運動と走行運動の同時測定が可能な 新しいラット用運動測定ケージ

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シーソー式の平面床と回転カゴとからなる新しいラット用自発運動測定ケージを作製した。このケージを用いて測定されたラットの位置移動運動量と走行運動量はそれぞれ従来の平面ケージあるいは回転ケージで測定された運動量の半分であった。新しいケージで測定された位

置移動運動と走行運動にも明確な日周リズムがみられ、また互いに同調していた。このケージを用いることによりラットの位置移動運動と走行運動を同時に測定することが可能である。