A Gravimetric Method for the Measurement of Total Spontaneous Activity in Rats (44429)

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Abstract. **Currently available methods for the measurement of spontaneous activity of laboratory animals require expensive, specialized equipment and may not be suitable for use in low light conditions with nocturnal species. We developed a gravimetric method that uses common laboratory equipment to quantify the total spontaneous activity of rats and is suitable for use in the dark. The rat in its home cage is placed on a top-loading electronic balance interfaced to a computer. Movements are recorded by the balance as changes in weight and transmitted to the computer at 10 Hz. Data are analyzed on-line to derive the absolute value of the difference in weight between consecutive samples, and the one-second average of the absolute values is calculated. The averages are written to file for off-line analysis and summed over the desired observation period to provide a measure of total spontaneous activity. The results of *in vitro* experiments demonstrated that: 1) recorded weight changes were not influenced by position of the weight on the bottom of the cage,values, 3) the constantly decreasing force exerted by a swi the balance was accurately recorded, 4) the measurement of activity was not influenced by the evaporation of a fluid such as urine, and 5) the method can detect differences in the activity of sleeping and waking rats over a 10-min period, as well as during 4-hr intervals recorded during active (night-time) and inactive (daytime) periods. These results demonstrate that this method provides an inexpensive, accurate, and noninvasive method to quantitate the spontaneous activity of small animals.**

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Methods for measuring the spontaneous movement of unrestricted animals without altering the animal's environment are useful in the study of physiology and behavior. Presently available methods for the measurement of animal activity require expensive, specialized equipment. These methods provide measurement of either total activity or a variety of specific patterns of behavior, such as circling or rearing (1). They include the use of photoelectric beam arrays, video tracking, and capacitative detectors (2–7). The photoelectric beam method uses an array of photoelectric beams and detectors that register movement as interruptions of infrared beams. Only movements that interrupt the beams are detected; therefore, the number and position of the beams limit the sensitivity of the method.

The video tracking system transmits the image of an animal from a video camera to a contrast-sensitive tracker that continually records the coordinates of the point of highest contrast on the animal. Movement is registered as the difference between consecutively sampled points, providing improved resolution compared to other methods (6). One disadvantage of this method is that the use of a video camera by its nature requires that the testing occur in some level of light. Light required in this measurement will influence the activity of nocturnal animals during measurements in the dark phase. Capacitative detectors use sensors that measure the change in position of the animal as a change in the electric field of the detector. The sensors create a waveform in which the amplitude is proportional to the mass of the

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body and the velocity of movement. An analog-to-digital converter digitizes the waveform, and the digital data are collected by a PC for off-line analysis. This sensor is non-

actual value. At the start, a 50-g weight was placed on the platform, and the balance was tared to zero. Data collection began, and a reading of zero was recorded for 5 sec. Then four different consecutive weight changes were produced: 1) a 100-g weight was placed on the platform for 5 sec, 2) the 100-g weight was removed and zero weight recorded for 5 sec, 3) the 50-g weight was removed so that the balance recorded −50 g for 5 sec; and 4) the 50-g weight returned to the balance so that zero grams were recorded for

were recorded within the first 0.1 sec, during the following 0.9 sec a value of zero was recorded (no change in weight). The average of the change in weight sampled in 0.1 sec and the 0.9 sec of zero values yields a number 1/10th the actual change in weight.

To determine the precision of the method, six trials with sequences of known weight changes were carried out. For each trial, six sequential weight changes were induced with 50- and 100-g weights. Keeping in mind that with our method of sampling, weight changes accomplished in 0.1 sec yield values that are 1/10th the actual weight change, the

measurements, 450.5 g ± 94 ($P < 0.0007$). These results demonstrate the ability of the technique to detect differences between rats exhibiting varying levels of activity and the