Reports and Letters

Evaluation of Four Activity Techniques for Monkeys

In a study of whole-body x-irradiation (*1*), it was thought that lightly motivated behavior such as "spontaneous" activity, rather than strongly motivated behavior, might provide the more sensitive measure of radiation damage. The large variety of activity apparatuses previously devised is evidence of the difficulties involved, which are greater with monkeys than with rats.

Few of these apparatuses have been studied in respect to reliability (*2*). Nor, apparently, has anyone attempted to discover the validity of any technique or to compare one technique quantitatively with another. This is surprising in view of the interest in activity measures shown by biologists, psychologists, physiologists, and especially, pharmacologists. The purpose of this study was to find a procedure suitable for the monkey and to determine its reliability and validity. To this end, ratings by an observer, Siegel's electric-eye technique (*3*), and two variations of the suspended-floor technique were compared, and the reliability of each was established.

Nineteen *Macaca mulatta* served as subjects. An expanded metal cage (24 in. by 18 in. by 22 in.) was equipped with a plywood floor that was suspended free of the walls on instrument shock mounts. Two 4-lb shock mounts, mounted face to face and bolted to the cage floor and the corners of the plywood floor, gave adequate vertical movement without horizontal sway. The following four methods of measuring activity were used.

1) A work adder (*4*) was mounted below each corner of the cage. The work adder consists of a large ratchet wheel, with very fine teeth, attached to a pulley, about which was looped a weighted piece of steel fishing leader connected to the cage corners. The ratchet wheel responded to small, as well as large, movements when the cage floor was depressed. When the floor returned to its normal position, a pawl held the wheel, and the wire slid back over the pulley. The work adders and the observer reading them were located inside a cupboard under the cage, hidden from the monkey's view. The total score for all four work adders was used in the statistical analysis.

2) A microswitch that was sensitive to a 0.005 to 0.008-in. excursion, was mounted beneath the center of the floor, just far enough so that movement, but not the animals' weight, would close it. The switch operated an electric oscillator that drove an electric counter at the rate of 10 impulses per second.

3) A beam of visible light, focused on a photo-electric cell, operated a counter through a relay. One observer recorded scores of two counters, which were in separate rooms.

4) An observer noted total activity on a rating sheet bearing five linear rating scales of length 10 cm, that contained five equally spaced reference points. The rater, whose presence was familiar to the monkeys and therefore did not arouse them, sat 10 ft in front of the cage.

The experimental room was isolated but not soundproof, so that slight noises from the colony, laboratory, and counters were audible. An animal was allowed time in the cage to familiarize itself with its surroundings. During this period, all equipment was operating. Upon a light signal given by one observer, all observers recorded readings and ratings simultaneously once each minute.

Reliability coefficients, correlating the odd-minute interval scores with the even-minute scores are presented in Table 1, as are the intercorrelations among methods, based on the total 60-minute score for each animal. These correlation coefficients are all significant at better than the 1-percent level of confidence.

On the basis of the reliability coefficients, there is little choice between these four techniques for measuring the spontaneous activity of a monkey. The intercorrelations vary somewhat more, but all correlation coefficients are statistically significant. Although a test is reliable, it is not necessarily valid—that is, it may or may not be measuring the desired behavior. The high degree of intercorrelation suggests that the three mechanical devices were measuring the same or quantitatively related behavior. The microswitch scores correlated least well with the other measures. This probably reflects the difficulty in obtaining equal sensitivity of the system for all animals. One of the accepted ways of validating a test is to compare scores on it with observer ratings. Both the electric-eye and the work-adder scores correlate highly with activity ratings by an experienced observer. Because of its somewhat higher reliability coefficient and its readier adaptation to multiple-unit, automatic recording, the electric eye was judged best for recording cage activity by a monkey.

Table 1. Reliability coefficients and intercorrelations of four activity measures ($N = 19$).

Item	Rating	Work adders	Electric eye	Oscillation
Rating	.976	.968	.946	.849
Work adders		.932	.928	.838
Electric eye			.993	.789
Oscillation				.993

The electric-eye technique was then used to measure the activity of 16 monkeys during a 44-day period. A reliability coefficient of .948 was obtained by correlating the sums of the odd days' activity scores with those of even days. Such a correlation coefficient is significant at the 1-percent level of confidence.

WALTER ISAAC
THEODORE C. RUCH
Department of Physiology and Biophysics, University of Washington School of Medicine, Seattle

References and Notes

1. This investigation was supported by a research grant (No. G3440) from the National Institutes of Health, U.S. Public Health Service.
2. B. A. Campbell, *J. Comp. and Physiol. Psychol.* **47**, 90 (1954); P. S. Siegel and J. S. Hard, *J. Gen. Psychol.* **42**, 159 (1950).
3. P. S. Siegel, *J. Psychol.* **21**, 226 (1947).
4. Made by the Harvard Apparatus Co. and illustrated in their catalog.

20 February 1956

Enhancement of the Central Nervous System Effects of Strychnine and Pentobarbital by Diphenhydramine

The discovery in recent years of new compounds having marked effects on the central nervous system (CNS) has greatly stimulated interest in this aspect of the field of neuropharmacology. One of the earliest of these drugs was diphenhydramine (Benadryl), widely used for its antihistaminic activity but possessing in addition certain so-called "side-effects" involving the central nervous system which are apparently unrelated to its antihistaminic potency (*1*). Among these side-effects of this drug in man are drowsiness, which often follows administration of therapeutic doses (*2*), and convulsions after ingestion of toxic quantities (*3*). Thus the compound seemingly exerts a "depressant" effect at low-dosage levels and a "stimulant" effect after excessive quantities.