Recording of skin resistance in the unrestrained rat: A possible measurement artifact

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Skin resistance of rats who urinated during exposure to a novel environment was lower than that of rats who never urinated in the environment. The utility of the technique used for recording skin resistance in unrestrained animals may be limited by a measurement artifact resulting from urination on the grid floor electrodes of the test chamber.

Following the original description of a technique for skin resistance recording in unrestrained animals (Kaplan & Kaplan, 1962; Kaplan & Hobart, 1964, 1965) a number of studies have appeared utilizing such measurements as an indicant of arousal, emotionality, or alertness (e.g., Anderson & Paden, 1966; Anderson, Plant, & Paden, 1967; Kaplan, 1963; Walker, Cohen, & Doyle, 1964; Walters & Tullis, 1966). The recording electrodes used in this technique are the grid bars which constitute the floor of a test chamber. In such a situation, the freely-moving animal will occasionally urinate on the recording electrodes and collect urine on its footpads. One would expect that under these conditions skin resistance would suddenly decrease resulting in a measurement artifact. This paper presents evidence that urination may indeed produce such a recording artifact.

Method and Procedure

The Ss in the original sample were 65 naive male hooded rats obtained from Canadian Research Animal Farms. Rats were 90-120 days old at the beginning of the study; all Ss were housed in individual home cages and maintained on ad lib food and water throughout the study.

All testing was carried out in two leverless Grason-Stadler E3125B chambers housed in sound-attenuated boxes; exhaust fans served to mask extraneous sounds. All recording equipment was located in a separate room from the test chambers and the entire experiment was conducted in a temperature and humidity controlled laboratory.

For two weeks prior to the beginning of the experiment, all Ss were handled daily in order to accustom them to being removed from their home cages. Handling consisted of lifting each individual S from its home cage and allowing it to remain in E's hand for approximately 5 min.

Skin resistance was recorded over five consecutive days, each recording session lasting 20 min. A recording session simply involved placing Ss, individually, into the novel environment of the test chamber and allowing it to move about freely. The running schedule and assignment to one of the two chambers were randomized throughout the experiment. Upon removal of S from the chamber at the end of each session E noted whether S had urinated on the floor grids and the paper toweling located underneath the grids; E also recorded defecation scores for each S. The grid floors were thoroughly dried and cleaned with emery cloth following the running of each animal.

Of the original group of 65 animals, nine Ss were observed to have urinated on both the grids and toweling on each of the five test days ("urinators"); 13 Ss showed no signs of urination on either the grids or toweling ("nonurinators") on any test day. These two groups contributed the data upon which the following results are based.

Results and Discussion

Skin resistance records were scored by taking each individual S's lowest resistance value during each minute of each daily recording session; these scores were then converted to conductance units. Thus, each S yielded 20 scores during every recording session and the median of these 20 scores was used to summarize the daily conductance values of individual animals. Daily group means were derived from these individual medians and the resulting distributions for urinators and nonurinators are shown in Fig. 1. An overall comparison of these distributions as well as single day group differences were made using the Mann-Whitney statistic; all probabilities reported are two-sided values.

The distributions shown in Fig. 1 indicated that urinators exhibited generally higher conductance scores over the five test days than did nonurinators ($U = 2$, $p < .002$). Within-group comparisons of skin conductances for Day 1 vs Day 5 of testing showed that

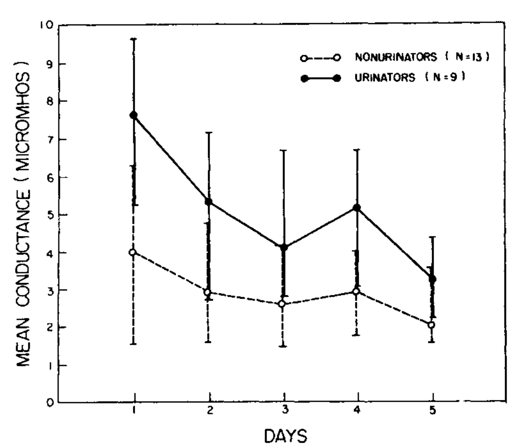

Fig. 1. Skin conductance over each of the five test days.

both urinators and nonurinators had significantly lower conductance scores by the last test day ($U=0$, $p<.001$; and $U=29$, $p<.02$, respectively). Thus, although the urinators displayed higher absolute conductance levels than nonurinators there is some evidence that each group showed some degree of "habituation" to the novel environment of the test chamber by the last test day. This finding is in accord with our previous results (Walters & Tullis, 1966).

The present findings raise a major interpretive problem. It is not clear from the evidence presented that the differences in skin conductance between the two groups are necessarily due to a urination artifact. One could argue that the two groups represent extremes from the original sample of 65 animals and that the obtained conductance differences are not due to urination per se but to differences in emotionality or arousal level which are correlated with, but not caused by urination. This argument is supported by the finding that the urinator group did show a decline over the five test days despite the fact that these Ss urinated on the grid electrodes on each test day. However, no differences in defecation were found between the two groups and, to the extent that defecation is often used as an indicant of emotionality, one would expect urinators to have defecated more frequently than nonurinators if emotionality was the primary factor contributing to conductance differences. Additionally, pilot work has indicated that wetting S's footpads with a hypertonic saline solution before testing results in a sharp increase in conductance. Given the evidence, it seems likely that urination is one factor affecting skin conductance as measured by the Kaplan & Kaplan (1962) technique and investigators using this technique would do well to consider the possibility of a measurement artifact produced by urination.

One final point is interesting to note. Despite the number of papers published in which the present technique has been used to record skin resistance changes in the rat, it is not altogether clear that the rat is provided with sweat glands! We have been unable to find unequivocal evidence that the rat does indeed have sweat glands. For example, Rowett (1962) claims that "The rat does not have any sweat glands . . ." while Rewell (1949) has provided evidence of a sweat-gland tumor in the cotton rat and concludes that ". . . rodents do possess sweat glands."

References

ANDERSON, D. C., & PADEN, P. Passive avoidance response learning as a function of prior tumbling-trauma. *Psychon. Sci.*, 1966, 4, 129-130.

ANDERSON, D. C., PLANT, C., & PADEN, P. Conditional suppression of a running response as related to competing responses, drive, and basal skin resistance level. *J. comp. physiol. Psychol.*, 1967, 63, 282-287.

KAPLAN, R. Rat basal resistance level under stress and nonstress conditions. *J. comp. physiol. Psychol.*, 1963, 56, 775-777.

KAPLAN, S., & HOBART, J. L. New technique for recording skin resistance. *Amer. J. med. Elec.*, 1965, 4, 117-120.

KAPLAN, S., & KAPLAN, R. Skin resistance recording in the unrestrained rat. *Science*, 1962, 128, 1403-1404.

REWELL, R. E. Sweat-gland tumor in a cotton rat, *Sigmoden hispidum. J. Pathol. Bacteriol.*, 1949, 61, 147.

ROWETT, H. G. Q. *The rat as a small animal.* (2nd ed.). London: John Murry, 1962.

WALKER, E. L., COHEN, A. H., & DOYLE, C. L. Skin resistance in relation to stimulus chance and estrus in rats. *Psychol. Rec.*, 1964, 14, 25-30.

WALTERS, G., & TULLIS, CAROLE. Skin resistance changes in the rat during repeated encounters with electric shock. *Psychon. Sci.*, 1966, 5, 359-360.

Note

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