The effect of cutaneous vibration on weight loss

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The local administration of 1 hr. of cutaneous vibration through the locomotion surface contact extremities of 10 white rats produced a marked loss (over 2%) in gross body weight. The weight losses which were significantly greater (p < .01) than two control groups could not be accounted for by an increase in activity. After examining several alternate views, the author postulates a facilitating effect on the catabolism of fatty tissue to explain the effect.

One of the most widespread yet least explored influences on behavior is vibration. There has been some work done rather incidentally using vibration as a stimulus in psychological scaling (Stevens, 1959) and in studies on cutaneous channels of communication (Bice, 1953; Geldard, 1957, 1961; Howell, 1956). In addition vibration has been used to test Hebb's (1949) theory of affective arousal as well as Helson's (1959) adaptation level hypothesis (Hunt & Quay, 1961; Soskin, 1963). Since Hunt & Quay's (1961) study has been subject to serious criticism by Hoffman & Bell (1962) these studies leave us with only one piece of unequivocal information concerning vibration per se. That is, animals will work to escape it.

Two earlier studies have demonstrated that *whole body* vibration has profoundly debilitating (sometimes lethal) physiological and behavioral effects (Schaefer, Link, Farrar, Wiens, & Dinsmore, 1959; Schaefer, Ulmer, & Link, 1959). However, since virtually all vibration encountered in nature is of the locally administered, cutaneous variety, whole body vibration seems to be primarily a laboratory artifact with no environmental analog.

It is to investigate some behavioral and physiological effects of locally administered, cutaneous vibration, that a current series of studies is being conducted. This first experiment is an examination of the effects of vibration, locally administered through the locomotion surface contact extremities, on gross body weight.

Method

Subjects. The Ss were 30 male DUB/SDD white rats obtained from a local supplier. The Ss were housed three to a cage on ad lib food and water in a room adjacent to the experimental room. At the start of the study Ss were 99-103 days old and averaged 331.8 gm in weight.

Apparatus. The apparatus was a 9 in. by 7 in. Plexiglas cage, mounted totally independent of its floor. The cage floor was a sheet of 3/8 in. thick Plexiglas painted black on the underside. Bolted firmly to the center of the floor was a 24 V, 4200 rpm (no load) electric motor with an eccentric on the drive shaft. This unit produced a steady vibration of approximately one-sixteenth in. amplitude with an estimated frequency in the neighborhood of 2000 cps. Oscillographic monitoring showed that the vibration was evenly distributed about the entire floor.

Bisecting the long dimension of the cage was a photoelectric beam with a red filter which insured its invisibility to the rat. This device provided information as to the animals' activity during the experimental session.

The entire unit including the cage and activity monitoring equipment was mounted in a sound attenuating cubicle to eliminate the sound of the recording equipment and other environmental noise.

Procedure The Ss were ranodmly divided into three groups of 10 animals. Group V (331.0 gm mean initial wt) received 1 hr. of vibration, group N (333.3 gm mean initial wt) was placed in the apparatus on a supplementary floor for 1 hr. so that they received the sound accompanying vibration (90 db) without receiving the vibration itself. The third group S (331.2 gm mean initial wt) was placed in the same cage for 1 hr. receiving neither sound nor vibration.

Each S was weighed before and after the experimental sessions which were randomized to equalize the influence of the different times of day.

Results

The weight loss and activity data are presented in Table 1. The data were analyzed with Duncan's Range Test. The weight loss differences between group V and group N as well as those between group V and group S were significant (p < .01). The differences between group N and group S were not significant, nor were there any significant differences between groups on the activity measure.

Discussion

The data indicate that vibration, locally administered through the locomotion surface contact extremities, produces a significant (p < .01) loss in gross body weight. The activity data indicate that this loss is not

Table 1. Group mean number of activity responses and mean % wt. loss over the three treatment conditions.

Treatment	Silence	Noise	Vibration
Mean number of activity responses	195.6	186.8	175.8
Mean % weight loss	0.972	0.813	2.077

the product of an increase in activity, at least of the type of activity measured here. This leads us to look for another mechanism to explain the effect.

There remain several broad possibilities to account for the data, all centering around the animals' metabolic processes. The first concerns the excretion of waste products. This process has been shown to be related to the emotionality of the animal. Indeed, defecation has often been used as a behavioral measure of emotionality, although the use of urination as an index of emotionality seems to have been ignored. The little information that does exist concerning defecation in rats is based only on bollus counts and there is no data on the weights involved. The nature of this particular apparatus made it impossible to measure these variables, and since the literature offers little further enlightenment on this subject, the magnitude of this effect remains uncertain. However, Bolles[2] states that it is highly unlikely that losses as great as these (over 2% of total body weight in 1 hr.) could be accounted for in this manner. A study is now underway to examine just this question.

If, as it seems very unlikely, defecation and urination cannot account for all of the weight loss there is another metabolic process that may provide us with the solution. That is, vibration may cause an increase in the animals' rate of breaking down fatty tissue. The next question is just how does it cause this increase in catabolism? Does it work through stimulating some internal mechanism(s) or does it simply provide an external mechanical augmentation of an internal process? Another position could result from a combination of the two preceding ones. Although these questions remain unanswered they present some fascinating avenues for further research which could yield valuable information regarding both mechanism of weight loss and the relationship between internal processes and the external environment.

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Notes

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2. Robert C. Bolles, personal communication. 1965.