Why does a variety of measures of thirst yield different results? An explanation developed by studying the effect of an aversive factor on liquid intake in rats¹

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Rats were given restricted amounts of water (0 cc, 10 cc, 20 cc, or unlimited quantity) for 22 h, then provided with six liquids varying in aversiveness from positive to negative (0.01% quinine, 0.0025% quinine, water, 3% glucose, 0.25% saccharin, or 3% glucose - 0.25% saccharin) for 1 h, followed by 1 h of water. When non-aversive liquids were given the liquid intake level reflected less sharply the water restriction levels than when more aversive liquids were provided. The discrepancy among various measures of thirst observed in many experiments may be attributed to aversive factors.

Different methods of behavioral measures have been shown to yield different results in assessing the effects of food deprivation, water deprivation, hypertonic saline treatment or stomach distention. Miller (1956) reported that the extent of stomach contractions rises rapidly to about 6 h of food deprivation and then levels off. The amount of milk intake shows very little change as the food deprivation level increases. However, when bar-pressing response or quinine-milk drinking scores are used there is a steady increase from low to high-level deprivation. The similar phenomena were reported in the effect of hypertonic saline treatment. Cheng (1959) also showed a similar discrepancy in measuring the effect of stomach distention. Cofer and Apply (1964) comment, concerning this discrepancy: "...we must be constantly alert to the possibility that the results of investigations may hold with one method of inquiry but not with another" (p. 239).

This discrepancy is undesirable because results obtained from different methods are not comparable, but if the variables causing the discrepancy were known comparison would be possible and the method to be used could be better decided. In this study a variable was manipulated in an attempt to produce the discrepancy observed in various methods.

To compare bar-press or quinine scores which produce a steady increment as thirst or hunger increases with stomach contractions or simple drinking scores which do not reflect those variables sharply, it seems that one difference is in the aversiveness involved. Bar-press situations involve considerable amounts of delay, interruption and additional effort before eating, and quinine is bitter. There are aversive factors in both conditions. On the other hand, stomach contractions and simple drinking involve none of these aversive factors.

These aversive factors work against a manifestation of the responses which reflect drive strength. If there is nothing against a response it may reach the maximum strength more quickly than if there are some aversive factors present. In this study an aversiveness was varied by manipulating an incentive variable to see if the discrepancy of various measures could be reproduced.

Method

Twenty female Wistar albino rats of about 110 days and weighing 230 g were given water 2 h a day for a week before starting the experiment. Ss were caged individually in a laboratory that was kept about 75 deg C with 45% humidity. Ss were tested in their home cages

Fig. 1. Mean liquid intake of various liquids with varying levels of water restriction (0 cc, 10 cc, 20 cc, or ad lib); 34.2 cc represents the mean water intake in ad lib condition when unlimited amounts of water were given.

with specially-made graduated drinking tubes which were designed to minimize spillage to less than 0.5 cc in 4 h of drinking.

The Ss were given: (a) no water, (b) 10 cc water, (c) 20 cc water, or (d) unlimited amounts of water (ad lib level) during a 22 h period. This was followed by a 1 h presentation of (a) 0.01% quinine solution, (b) 0.0025% quinine solution, (c) tap water, (d) 3% glucose, (e) 0.25% saccharin solution, or (f) 3% glucose plus 0.25% saccharin solution. The last solution according to Valenstein, Cox, & Kakolewski (1967) is a highly preferred solution. The solvent was distilled water and the solute of USP grade. This 1 h liquid session was followed by giving 1 h of unlimited amounts of water to supplement the reduced intake. The liquid intake in all sessions was recorded.

The Ss were divided into five groups of four each and each group was given one combination of the water restriction level and the liquid variable daily. All 24 combinations were given to all five groups in five randomized sequences.

Results

The main result obtained is shown in Fig. 1. Statistical analysis shows that between water restriction levels and their interaction are all statistically significant ($p < .01$). The slope change (tested by interaction term) from the 0.01% quinine curve, water curve, to glucose-saccharin curve appears to be from a slightly positive acceleration, steep linear increase, to a slight linear increase. Thus, as expected the more the aversive

factor involved, the more sharply the drinking measure reflects the water restriction levels.

Discussion

The major conclusion of this study is that when rats drink liquids with aversive taste, the intake level reflects more sharply the thirst variable than when rats drink non-aversive liquids. Aversiveness involved in the incentive determines the sensitivity of a behavioral measure of thirst. Thus the discrepancy in results obtained when a variety of measures was used may be simply attributed to an aversive factor involved in the testing situation. Aversiveness in a Skinner box situation seems to involve extra effort required, delay, and interruption before eating; in quinine drinking aversiveness is in the incentive. All aversive factors may function similarly in determining the sensitivity of a behavioral measure of thirst and hunger.

References

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Note

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