

The rat's preference for saline solutions as measured by licking reinforced on a variable interval schedule¹

EDWARD M. STRICKER²
YALE UNIVERSITY

Predrinking or preloading different volumes of water or 0.9% saline reduced the rate of licking reinforced with 0.11 ml of water or 0.9% saline on a 1-min. VI schedule. Saline pretreatment always had less effect on the licking response than comparable volumes of water. These results replicate previous findings and confirm the utility of lick rate on a VI schedule as a measure of motivation and incentive value.

In a recent study, a new technique for measuring thirst motivation and the incentive value of liquid rewards was described, in which lick rates were recorded in rats reinforced with water on variable- or fixed-interval schedules (Stricker & Miller, 1965). This procedure was found to be as sensitive an index of thirst as the volume consumed ad lib, the standard measure of thirst, without having its disadvantageous satiation effects. The present study further illustrates the utility of this new technique, by replicating various aspects of the well-documented preference by rats of dilute saline solutions.

Method

Subjects. The Ss were six male albino rats of the Sprague-Dawley strain, approximately 120 days old and weighing 350-400 gm at the beginning of the experiment. They were individually housed in standard mesh-wire cages in a well-illuminated, temperature-controlled room.

Apparatus. A complete description of the apparatus was given in a previous report (Stricker & Miller, 1965). Briefly, it consisted of a small Plexiglas cage in which S could obtain water by licking a recessed stainless steel drinking tube. Each lick completed a circuit which operated a solenoid valve controlling the delivery of the 0.11 ml reinforcement on a 1-min. variable interval (VI) schedule. A second drinking system, delivering 0.11 ml of physiological (0.9%) saline as a reinforcement, was also presented at the same single location, although only one tube was made available during each test session.

Procedure. For one week prior to training, Ss received their total water intake in 1 hr. of ad lib drinking in home cages each day; Purina Lab Checkers were always available except during this hour. During the next 6-9 days, Ss were placed in the apparatus each morning for 30 min. and trained to lick for water on a 1-min. VI schedule. They were then returned to their home cages, permitted ad lib water for 30 min., and then water-deprived for 23 hr. under ad lib food condi-

tions. Testing began when Ss' total licking responses in the 30-min. trials fluctuated less than 5% over four successive days. For the subsequent 16 days Ss were given distilled water (W) or 0.9% saline (S) to drink before placing them in the apparatus, where they received either water or 0.9% saline on a 1-min. VI schedule. (These conditions will be referred to as W-W, W-S, S-W, and S-S to indicate the fluids predrunk and used as a reinforcement, respectively.) The volumes predrunk represented 0%, 25%, 50%, or 75% of their mean daily water consumption, as averaged in the preceding 4-day period. These three variables, i.e., the type of fluid predrunk, the volume of fluid predrunk, and the type of fluid obtained as a reinforcement, were associated in a balanced factorial design and randomly assigned to the Ss.

After a comparable period of pretraining, this procedure was repeated for another 16 days on the same six

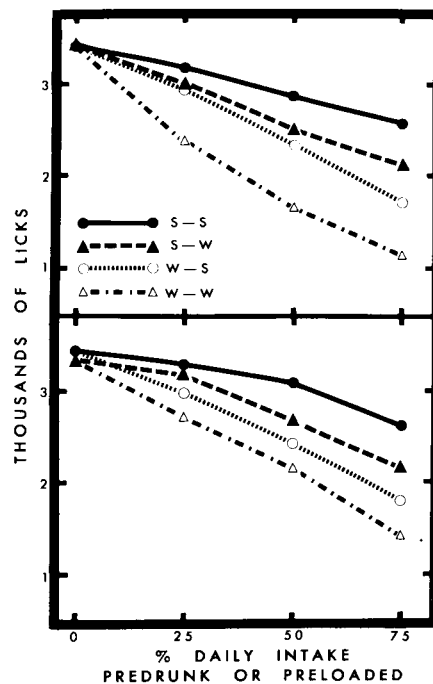


Fig. 1. The mean total licking responses, reinforced with water (W) or 0.9% saline (S) on a VI schedule, of six rats after predrinking (Upper) or preloading (Lower) of different volumes of water or 0.9% saline.

Ss which, instead of predrinking, now received the fluids through an oral catheter (0.217 cm O.D.).

Results

Two four-way analyses of variance revealed that each of the three treatment effects was statistically significant regardless of whether the fluid was predrunk or preloaded. As Fig. 1 shows, the Ss licked more when saline rather than water was predrunk (or preloaded), when the amount of fluid predrunk (or preloaded) was small, or when saline rather than water was the reinforcement. In addition, the mean total licks of the six Ss during the 30-min. sessions were inversely related to the amount of fluid predrunk or preloaded, and a highly significant linear trend was found for each of the eight conditions ($p < .001$).

To study the differences between treatments, the eight slopes for each S were determined by the least-squares method and collectively analyzed in an 8 by 6 single factor design with repeated measurements (Winer, 1962). The results of these analyses revealed that the slopes under S-S and W-W conditions were significantly different from the other slopes under pre-drink conditions ($p < .05$). That is, increased predrinking had significantly less effect on the licking response when saline was both predrunk and used as the reinforcement, and had significantly more effect when water was used in both instances. These results were comparable to those obtained when the fluids were preloaded, although not all of the differences were still significant.

The licking rates for saline and water reinforcements virtually coincided when no fluid was predrunk or preloaded. A ceiling effect (i.e., an inadequacy of the measure, making high thirst states indistinguishable) was contraindicated, however, by a 25% increase in response for water after pretreatment with hypertonic saline.

Discussion

The significant decreases in licking responses following increasing preloads of water, and the increased response rate when saline was preloaded instead of water, parallel similar effects of these treatments on ad lib water intake (O'Kelly, 1954; Stellar, Hyman, & Samet, 1954) and on bar-pressing performance (O'Kelly & Falk, 1958). Licking on a VI schedule also yields essentially the same results as brief exposure 2-bottle preference tests (Falk & Titlebaum, 1963; Young & Falk, 1956), with respect to the rat's preference for saline over water when relatively satiated (i.e., after considerable predrinking) and the absence of such preference when thirsty. Since only small volumes of fluid were consumed in these experiments (a maximum of 3.3 ml in the present 30-min. sessions), it seems more likely that gustatory factors rather than gastric or postingestional effects were operating. By limiting fluid intake, the present procedure avoids the shortcomings of single-bottle ad lib situations (O'Kelly, 1954; Weiner & Stellar, 1951) in which the greater

intake of saline than water might be interpreted as due to the comparative inability of isosmotic saline to quench thirst (Mook, 1963). These different satiating properties of the two fluids were demonstrated in the present experiment when the saline had a smaller effect on the licking response than did comparable volumes of water, both under preload and predrunk conditions. Thus the present technique apparently constitutes a sensitive one-bottle, brief exposure paradigm for testing fluid preferences.

Finally, the somewhat steeper slope when comparable volumes of fluid were predrunk instead of preloaded in each of the four conditions confirms previous observations that fluids injected directly into the stomach do not reduce thirst as much as comparable volumes of the same fluid drunk normally by mouth (Miller, Sampliner, & Woodrow, 1957).

In sum, the present findings have confirmed an earlier report that licking reinforced on a schedule is a good measure of thirst and incentive values (Stricker & Miller, 1965), by demonstrating in a single study various aspects of the well-known preference by rats of dilute saline solutions to water which have been indicated by a variety of other techniques in many separate studies.

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Notes

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