Effects of reinforcement shifts upon subsequent sucrose consumption*

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Elation of sucrose consumption was not observed among male or female rats following a temporary shift to water. These data are contrary to earlier work which employed saccharin as the reward.

Recent investigations involving saccharin drinking in rats observed immediate and durable elation effects following temporary shifts to water (Ashton, Gandelman, & Trowill, 1970; Gandelman & Trowill, 1969). The present experiments extend the paradigm to sucrose as the reward. The Hypothesis was simply that the animals in the previous experiments were responding only to the taste stimulus (nondeprived animals drinking a nonnutritive solution) and that sucrose solutions would give comparable results.

EXPERIMENT 1

Subjects

Six 150-day-old male albino rats, bred in the University of Massachusetts Psychology Department colony, were selected from a group prescreened as sucrose drinkers. All Ss were individually housed and maintained on ad lib food (Purina Lab Chow pellets) and tap water in a ventilated room under conditions of continuous illumination. Testing was done in cages similar to the home cages but fitted with clips to accommodate graduated water bottles. No food was present during testing.

Procedure

The Ss were moved to their individual test cages and were allowed 5 min to habituate to the change of environment. A graduated water bottle (Wahmann LC-274) containing an 8% (w/w) sucrose-tap water solution was then attached to each cage for 1 h during 28 consecutive days. Nothing was given on Days 29-31. Sucrose was again available until Session 40, when 3 days of tap water were substituted for the more palatable sucrose. Finally, sucrose was again given during the remaining 6 days of testing.

Results and Discussion

Figure 1 shows the mean intake of

sucrose and water throughout the experiment. Also shown are the daily ranges of intake. Sign tests compared the intake of the first postshift session to a mean of the intakes for the 3 days immediately preceding the shift. A sign test evaluating the shift to water was not significant ($N = 6$, $p < .109$), indicating that a contrast effect was not in evidence. A sign test evaluating the shift to no solution was significant ($N = 6$, $p < .016$). However, this test indicated a tendency for decreased intake. A t test confirmed the statistical reliability of this decrease ($t = 4.70$, $df = 5$, $p < .01$).

The results of this experiment indicate that responding for a sweetened solution is not a sufficient condition for obtaining a positive contrast effect, at least for the chosen sucrose concentration. It was noted, however, that the animals in this experiment were tested outside of the home cage, whereas those in the previous studies employing saccharin were done in the home cage. Experiment 2 investigated the effect of that variable.

The unanticipated depression of intake following no solution remains unexplained.

However, it is possible that a downward trend of sucrose intake that began prior to the shift simply continued through the shift to the postshift days.

EXPERIMENT 2

Subjects and Procedure

Six 150-day-old male albino rats were selected and maintained as in Experiment 1. All Ss were given 8% (w/w) sucrose solutions as in Experiment 1 but in the home cage. All Ss were shifted to water on Sessions 22, 23, and 24 and were returned to sucrose for Sessions 25-30.

Results and Discussion

Figure 2 shows mean intake of sucrose and water for Sessions 16-30. A sign test was done as in Experiment 1 and indicated no contrast effect ($N = 6$, $p < .344$). These results indicate that handling Ss and testing outside of the home cage were not responsible for the absence of a positive contrast effect in Experiment 1.

Experiment 3 was designed to rule out sex differences.

EXPERIMENT 3

Subjects and Procedure

Sixteen 60-day-old female albino rats, bred in the University of Massachusetts Psychology Department colony, were assigned randomly to one of two groups. One group was maintained on ad lib food and water while the second group was allowed only 8 g of food daily but with continuous access to water. All other conditions were similar to those of Experiment 1. All Ss received 29 1-h presentations of 8% (w/w) sucrose solution in their home cage over 29 consecutive days. Tap water was substituted for the sucrose on Days 30-32 and 8% sucrose was again available during Sessions 33-35.

Fig. 1. Mean intake and daily ranges of sucrose and water consumption over the entire experimental period expressed in milliliters.

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Fig. 2. Mean sucrose and water intake over last 15 experimental sessions expressed in milliliters.

Results and Discussion

Figure 3 shows mean intake of sucrose and water over the entire experimental period. One S in the deprived condition died before shift data could be collected. Sign tests were performed as in Experiment 1. None were significant beyond a criterion of $p < .05$: deprived group, $N = 7$, $p < .062$; nondeprived group, $N = 7$, $p < .227$.

These data indicate that sex differences cannot account for the absence of contrast effects using sucrose as the incentive.

CONCLUSIONS

The absence of evidence for positive contrast of intake of sucrose under the conditions of these three experiments seriously questions the simple role of palatability shifts in contributing to the results reported earlier with saccharin (Ashton, Gandelman, & Trowill, 1970; Gandelman & Trowell, 1969). However, the procedures should be replicated using other concentrations of sucrose before a definite sucrose-saccharin intake difference can be proposed. Such a replication is currently being carried out in our laboratory.

A second consideration involves the response measure to be used in assessing responding following palatability shifts. Other data collected in our laboratory shows that positive contrast is obtained using sucrose when the short-term postshift lick rate is examined (Ashton & Trowill, 1970; Panksepp & Trowill, in press). However, in each instance with licking, the postshift elation is short-lived, and lick rate rapidly assumes a level appropriate for the solution available. Apparently, such a transient increase would be completely obscured when intake is measured over a long term such as was done here.

In any event, a sweet taste (8% sucrose) is not necessarily a sweet taste (.25%

Fig. 3. Mean sucrose and water intake over the entire experimental period expressed in milliliters.

saccharin) to a rat when his responding is measured under conditions like those employed in this set of studies.

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Effects of reinforcement shifts upon lick rate*

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Marked increments in lick rate were observed in saccharin drinking following a temporary shift to water in both deprived and nondeprived rats. Similar increases were not observed when sucrose was the reward. Similarities and differences of lick rate data to intake data were discussed.

Immediate and durable positive contrast effects have been observed in saccharin drinking following a temporary shift to tap

water (Ashton, Gandelman, & Trowill, 1970a; Gandelman & Trowill, 1969). This same effect, however, was not observed in sucrose drinking (Ashton, Gandelman, & Trowill, 1970b). The present experiments examine more closely the actual consummatory response during these palatability shifts, using lick rate as the dependent measure.

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