Satiation and recovery of the "air-drinking" response in rats¹

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Abstract

Thirsty rats were given either 0, 15, 30, 60 or 120 min. of free access to an air stream delivered through a drinking tube in a Skinner box and then were immediately administered a 15-min. test of bar pressing for additional 3-sec. air presentations. A negative relationship was found between length of the pre-test session of air drinking and the number of bar presses. Then the same Ss were tested either 0, 15, 30, 60 or 120 min. following a 2-hr. session of free access to air and a rapid recovery from satiation was found with responses for air presentations varying positively with length of delay following the 2-hr. pre-test session.

Problem

In a series of experiments reported by Hendry and Rasche (1961) it was found that thirsty rats would continually lick a stream of air delivered through a drinking tube. With maze running tests it was demonstrated that "air drinking" served as a reinforcer when rats were thirsty but not when they were satiated. Free access to the air tube for 1 hr. led to a reduction in water consumption and in the rate of bar pressing for water. Because rats continued to lick the air tube for 1 hr. with no noticeable reduction in rate, Hendry and Rasche concluded that air drinking is subject to little or no self-satiation. The present study was designed to investigate in a parametric manner the possible motivational effect of free access to the air tube on subsequent bar pressing for air and then, if a satiation effect is observed, to study the temporal course of recovery from satiation after air drinking.

Method

The Ss were 5 male albino Sprague-Dawley rats about 190 days old. An ad lib weight measure was based on the average weight over 5 days of free access to both food and water. On the 6th day and throughout the remainder of the study Ss were deprived of water (but not food) sufficient to maintain them at 85% of their ad lib weight. Dry Purina lab chow was available at all times in the home cages.

A Skinner box was modified so that air could be delivered through an ordinary drinking tube located 1 in to the right of the bar. The air was supplied from a compressed air line in the building and was reduced by an adjustable valve to 5 lbs/sq in. Each bar press by the Ss opened a solenoid valve for a period of 3 sec. during which the air stream was available to the S at the drinking tube. Discrete responses were required for each 3-sec. presentation of air.

During an initial adaptation session air was delivered

continuously for 5-min. periods. Next, 3-sec. air presentations were delivered by E until S rapidly approached the tube and began licking with the onset of the air. Subjects were then trained by the method of successive approximations to press the bar for air presentations. Finally, Ss were given 15-min. training sessions each day on continuous reinforcement. An average of 7 days was required for stabilization of bar-pressing rates.

The effects of satiation were tested by allowing free access to a continuous air stream (without bar pressing) for periods of 0, 15, 30, 60 and 120 min., and then observing the number of bar presses made to obtain 3-sec. air presentations during a subsequent 15-min. test session. By means of a counter-balanced design each S was tested after each of the 5 pre-test exposure conditions. Testing was conducted for 5 consecutive days with a different S assigned to each pre-test exposure duration on that day.

Approximately 1 week later the second phase of the study was initiated. Five individual cages were fitted with air tubes and supplied with air at a pressure of 5 lbs/sq in. The Ss were first adapted to the new situation by being placed in the individual experimental cages and given free access to air for 2 hr. On the 2nd day all Ss were again placed in the cages and allowed a 2-hr. exposure to air. Following this session, however, 1 S was immediately placed in the Skinner box for 15 min. and his total number of bar presses for air presentations was recorded. The remaining 4 Ss were each tested in a similar manner at 15, 30, 60 or 120 min. following the termination of the 2-hr. session of air drinking. Likewise on the next day all Ss were given 2-hr. air-drinking sessions and then tested after the various delays. During 5 such days, using a counter-balanced design, all Ss were tested under each of the delay conditions.

Results

Figure 1 shows the effect of exposure duration on the rate of bar pressing for air presentations during 15-min. tests. The mean number of bar presses for each condition was obtained by pooling the results of the 5 separate test days. The figure shows that with longer pre-test exposures there is a systematic reduction in the number of responses made to obtain air presentations. Analysis of variance yields an $F(4/16 = 9.69, p < .01)$. The differences between the 2-hr. condition and the other conditions are all statistically significant beyond the .05 level. None of the other comparisons achieve statistical significance. Thus, the satiating effect of air drinking is most apparent with a relatively long period of access to air prior to testing. Analysis of variance of responses

Fig. 1 Satiation and recovery from satiation as a function of time spent air drinking and time expended since air drinking, respectively.

pooled across conditions on the separate test days shows no significance, indicating that the self-satiating effect of air drinking is relatively temporary and that it has little or no "carry-over" effect during consecutive days of testing.

The mean number of responses for air presentations after the various delay conditions is also shown in Fig. 1. Clearly there is a definite systematic temporal course of recovery from air satiation. Analysis of variance yields an $F(4/16) = 3.29$, $p < .05$.

Discussion

In this study evidence was obtained to indicate that air drinking is self-satiating and reduces the reinforcing

value of subsequent air drinking. This finding is consistent with a series of experiments by Miller (1957) which found that pre-feeding with saccharin solution (also a non-nutritive reinforcer) reduces the rate of barpressing for saccharin. The results of both phases of this study suggest that the satiating effect of air drinking is relatively weak and temporary. Studies of the self-satiating effect of saccharin (Miller, 1957) also demonstrate a rapid recovery from satiation. The parallel between saccharin and air drinking studies may prove useful. It has been shown that when saccharin is normally ingested it has a reinforcing effect which is absent when saccharin is placed directly in the stomach (Tobin, 1949; Miller, 1957). Nutritive substances, on the other hand, are known to have both an oral and a gastric reinforcing effect (e. g., Miller et al., 1957). Quite possibly it is the absence of a gastric effect (which would apply both to saccharin and air drinking) which accounts for the relatively rapid recovery from satiation effects in both of these situations.

References

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Note

1. This research was supported in part by National Institute of Mental Health Research Grant MH-04203-03 to the third author.