Effects of adaptation and amount of reward on air drinking behavior

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Two experiments concerning procedural influences on air drinking indicated that (1) an hour or more of prior exposure to an air stream enhanced later responding for air puffs, and (2) both air and water yielded similar bar press response rates. Additionally, while the provision of a very small amount of air per response (.05 sec) yielded relatively low bar press rates, no differences were observed with puff durations between .1 and 4 sec. Similarly, the use of water reinforcers in amounts ranging from .01 to .1 cc yielded no rate differences. Neither qualitative nor quantitative variables influenced subsequent responding in extinction.

Several recent experiments have reported some properties of the rat's performance for a non-nutritive reinforcer based on thirst (Treichler & Hamilton, 1967; Riccio, Hamilton, & Treichler, 1967). In these studies, licking at an air stream was observed to be contingent upon fluid deprivation, but was controlled by some factors other than those which normally influence water intake. Additionally, the "drinking" of air appeared to be based on innate sensory effects and was independent of prior experience which might have established a conditioned reinforcing property of the air stream.

In the course of these experiments, some characteristics of performance for this reinforcer were observed which generated several questions about the role of procedural variables in determining air drinking behavior.

First, it appeared that some period of adaptation to the presence of an air stream was necessary for subsequent establishment of stable response rates in consummatory or instrumental test situations. Consequently, an experiment was undertaken to determine rates of tube contacting for an air puff after different durations of adaptation to an air stream. Secondly, some questions arose concerning the comparative reinforcing properties of air puffs and water. This problem was approached by varying the quantity of air or water provided by an S's bar press, and then assessing the effects of amount and kind of reinforcer on performances during acquisition and extinction.

Experiment 1

Methods. Twenty-five 120-day old, male, Holtzman albino rats were maintained at 80% of their ad lib weights by water deprivation. These Ss were randomly assigned to one of five groups which were administered 1 h daily exposure to a continuous air stream for either 0, 1, 2, 3, or 4 days. The air dispensing apparatus was identical to that used by Treichler & Hamilton (1967) which administered either continuous or contact-response contingent air from a stainless steel drinking tube at 5 psi. On the day after the last exposure period, Ss were placed in the apparatus and required to make discrete contacts of the drinking tube to receive each .1 sec puff of air. A 1 h test session was conducted, and response rates were recorded.

Results. Figure 1 displays mean tube contacting rates (in responses per min) for groups which received different amounts of exposure to air. An analysis of variance indicated significant differences among the groups ($F = 4.48$, $df = 4/20$, $p < .01$). Subsequent Newman-Keuls comparisons showed this difference to be dependent upon the relatively low response rates of the Ss with 0 h of adaptation. All other groups did not differ from one another.

Experiment 2

Methods. Forty-eight rats like those of Experiment 1 were maintained at 90% of ad lib weight by restriction of water intake. The test apparatus provided reinforcement delivery contingent upon depression of a conventional Skinner box bar located 3/4 in. below the drinking tube. The Ss were randomly assigned to one of eight experimental groups with four of these receiving air and the other four water reinforcers. The four groups obtaining air represented different amount conditions and were administered either .05, .10, .20, or .40 sec puffs for each bar press response. Similarly, the groups receiving water were given either .0125, .025, .05, or .10 cc per response via an adjustable solenoid-driven microsyringe. Differences in amounts of reinforcers

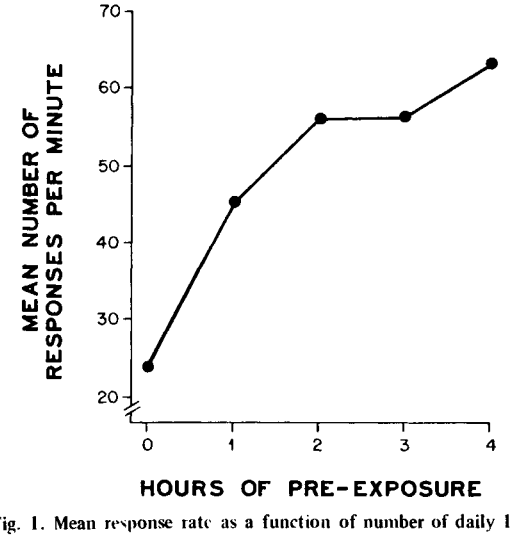

Fig. 1. Mean response rate as a function of number of daily 1 h air stream adaptation sessions (N = 5 Ss per condition).

were designed to provide a geometric relationship among conditions in order to equate our procedures and those used by Hutt (1954) in a similar evaluation of the behavioral effects of different quantities and qualities of reinforcement. All groups were given 1 h of adaptation in the test compartment on the day prior to training. For the Ss in the groups receiving air, this period also provided an air stream exposure session like the ones administered in Experiment 1.

On each of the next five days, Ss were placed in the compartment and allowed to make 300 continuously rewarded discrete responses. Type and amount of reinforcement were determined by group assignment and the time required for performance of 300 responses was recorded for Ss under the various conditions.

On the sixth test day, all Ss were extinguished by disconnecting the manipulandum. This assured that no differential secondary reinforcing effects were provided by operation of the water and air delivery mechanisms. A criterion of no responses in 1 min was established as the indicator of extinction and both the time and number of responses required for meeting the criterion were recorded for each S.

Results. An analysis of variance indicated significant differences in the amounts of time required to meet the acquisition criterion as a function of different amounts of reinforcement ($F=4.72$, $df=3/40$, $p< .01$). However, no differences were indicated as consequence of the different kinds of reinforcers (air vs water; $F=3.58$, $df=1/40$, $p>.05$), but a significant interaction ($F=5.82$, $df=3/40$, $p< .01$) between these variables was observed. Additionally, significant differences in time to criterion meeting were observed as a consequence of the successive test days ($F=86.1$, $df=4/160$, $p< .01$), but no interactions involving this variable were revealed. A Newman-Keuls comparison indicated that differences among performances on the various days were solely dependent on the relatively greater time required for criterion meeting on Day 1. This score was significantly different ($p< .05$) from the ones for all other days and the latter did not differ from one another.

Newman-Keuls comparisons were subsequently applied to the data involving the different types and amounts of reinforcers. This procedure indicated that the significant interaction between these variables was dependent upon the large amount of time required for criterion meeting by the Ss receiving air puffs of the shortest duration (.05 sec). Scores for this groups were significantly higher than all the other groups, which did not differ from one another.

The results of analyses of variance of the extinction measures indicated no significant differences (all $ps > .05$) in either the time or number of responses required to meet the 1 min no response criterion as a function of the type of amount of reinforcement used in training. Additionally, no significant interactions were observed.

Discussion

The results of Experiment 1 indicated that some exposure to the presence of an air stream enhanced subsequent responding for this reinforcer. One hour appeared to be a sufficient adaptation period, and only slight rate increases were observed with longer durations of prior exposure.

In Experiment 2 it was demonstrated that air and water yielded strikingly similar response rates. Manipulation of amounts of water reinforcement within the range used in this investigation had no differential influence upon behavioral measures. However, the use of an air puff of .05 sec, in contrast to puffs of .1 sec and longer, yielded a consistently low rate of response. Neither the various types nor amounts of reinforcers yielded any differential effect on extinction measures.

It is concluded that the amount of water dispensed for a discrete response has little effect on bar press rate, but this generalization must be limited to the range and amounts used in the present investigation. However, provision of larger amounts of water entails procedural difficulties concerning either maintenance of deprivation conditions or limitation of measurement periods. Responding for air is influenced by duration of the delivered puff, but puffs of .1 sec or longer all appear to generate maximal rates, while only extremely short delivery durations (.05 sec) yield slow responding.

The absence of qualitative differences between air and water as reinforcing agents is of interest since one earlier experiment (Treichler & Hamilton, 1967) had indicated that air puffs yield comparatively higher consummatory response rates. In addition to the different nature of the response, the previous experiment also used a shorter measurement period and a somewhat less reliable water dispensing apparatus. However, the present study indicates that air is, at least, the qualitative equal of water as a reinforcer in the bar press situation.

References

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Note

1. Now at University of Kentucky.