The development of water drinking on a dry-food free-reinforcement schedule¹

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Abstract

Rats were given a food pellet every 60 sec., not contingent on operant responding. All rats developed over days a pattern of prolonged water drinking following delivery of food pellets. One of the rats, whose operant-level lever pressing was recorded concurrently with licking, developed a complex pattern of drinking and bar pressing which persisted even after a 5-sec. delay of reinforcement for bar presses was introduced.

Problem

Several investigators have reported unusual frequencies and quantities of water drinking by rats maintained on interval reinforcement schedules for food. VI (Clark, 1962; Falk, 1961, 1964), DRL (Segal & Holloway, 1963; Segal & Deadwyler, 1964b) and free-reinforcement (Segal & Deadwyler, 1964a) schedules produce the polydipsia, liquid as well as dry food reinforcers are effective (Falk, 1964), and alcohol solutions (Lester, 1961) as well as water are drunk. The aims of the present experiments were (1) to follow the time course of the development of polydipsia over days, and (2) to observe the interaction of water drinking and bar pressing, where neither was related to the delivery of reinforcements.

Method

Experiment 1. Two naive, adult, male, albino rats, A-2 and A-3, were maintained at 80% of ad lib weight, and received daily experimental sessions in a sound-insulated, ventilated, lighted chamber containing a lever in one wall, a food cup in a second wall, and a water-bottle nozzle in a third wall. Sessions consisted of the delivery of 100 45-mg Noyes pellets, one every 60 sec. (an F60 schedule). Licks at the water nozzle were recorded, but neither licks nor bar presses affected the delivery of pellets. The experiment lasted 30 days.

Experiment 2. Two additional naive, adult, male, albino rats, O and C-A, were subjected to an F60 schedule, but this time the lever, food cup and water-bottle nozzle were on the same wall of the chamber, with the lever in the middle. Operant-level lever presses, as well as licks, were recorded. After the eleventh session, a 5-sec. delay of reinforcement was imposed, so that a pellet was never delivered sooner than 5 sec. following a bar press. The experiment lasted 16 days.

Results and Discussion

Experiment 1. The upper portion of Fig. 1 shows the first 10-pellet deliveries from sessions 2, 3, 6, 13 and 14 (no graphic records were taken on session 1). The pattern of drinking was relatively stable from session 14 on. The upper tracing in each day's record

Fig. 1. Top: Experiment 1. Cumulative licks and pellet deliveries. Bottom: Experiment 2. Cumulative bar presses, cumulative licks, and pellet deliveries. Day 11: last day before introduction of 5-sec. delay. Day 16: Fifth day with the 5-sec. delay.

shows cumulative water licks between food pellets; diagonal deflections indicate 2-sec. intervals during drinking bursts. The lower tracing shows the delivery of food. Both rats drank more frequently, and for longer durations, as the experiment went on. A2 drank after 16% of the pellets on session 2, 65% on session 6, 86% on session 13, and 95% on session 14. Thereafter the percentages fluctuated between 74% and 96%. A3 drank after 24% of the pellets on day 2, 75% on day 6, 85% on day 13, and 94% on day 14. Thereafter the percentages fluctuated between 55% and 89%. The modal duration of a drinking burst by A2 was about 5 sec. on day 2, 8 sec. on day 6, 12 sec. on day 13, 35 sec. on day 14, and thereafter fluctuated between about 25 and 58 sec. The modal duration of a drinking burst by A3 was about 5 sec. on day 2, 10 sec. on day 6, 28 sec. on day 13, 22 sec. on day 14, and thereafter fluctuated between about 22 and 32 sec.

Clark (1962) suggested that water drinking on a VI bar-pressing schedule is maintained adventitiously by the arrival of reinforcements soon after the subject shifts from drinking to bar pressing. A similar position was advanced by Segal & Holloway (1963), who concluded that collateral water drinking on a spaced-response reinforcement schedule was part of a chain of behavior initiated by food and terminated by the next bar press. However, Segal & Deadwyler (1964b), on the basis of drinking data obtained while rats were under the effects of amphetamine, argued that the drinking is probably nothing more than "prandial" drinking prompted by thirst sensations produced by eating dry food, and is not adventitiously maintained by reinforcement contingencies. The issue is still unsettled, but the present data support an adventitious reinforcement interpretation. Thus, as A2's drinking record for day 14 shows, a drinking burst often continued until the arrival of the next pellet, and so drinking might easily have been maintained by adventitious reinforcement. A3's data offer a problem, however. It seems unlikely that a pellet arriving 30 sec. after the termination of a drinking burst could have been maintaining the drinking adventitiously, yet, as Fig. 1 shows, A3 commonly ceased drinking about 30 sec. before the arrival of the next pellet, as did the two Ss of an earlier (Segal & Deadwyler, 1964a) experiment. But perhaps more complex patterns of behavior, including drinking as only one of several response components, are generated and maintained adventitiously by pellet deliveries. The ingestion of the pellet might initiate the first member of a chain, drinking, and this might lead to other behavior that fills up the remainder of the interval until the arrival of the next pellet. If the drinking is under the control of the pellet acting as a discriminative (or "pseudo-eliciting?") stimulus, then the absence of drinking when reinforcement is made infrequent by amphetamine administration on a DRL schedule (Segal & Deadwyler, 1964b) would not necessarily constitute negative evidence for the chaining hypothesis. If such a multi-response chain did develop under free reinforcement, it should be consistent from one occasion to the next. Experiment 2 demonstrated the possibility of such heterogeneous chaining.

Experiment 2. The lower portion of Fig. 1 shows about the first 40 pellet deliveries from sessions 11 and 16, for subject O. The upper tracings show cumulative bar presses and, as downward deflections, pellet deliveries. The lower tracings show cumulative water

licks between pellet deliveries. As in Experiment 1, both rats developed a pattern of prolonged drinking following almost every pellet delivery. In addition, placing the lever close to the food cup and water-bottle nozzle was successful, in rat O but not the second subject, in inducing a fixed-interval-like pattern of bar pressing, concurrently with water drinking. The complete behavior chain was: ingestion of the food, drinking for about 30 sec., and then bar pressing until the arrival of the next pellet. The effect of introducing a minimum 5-sec. delay between bar presses and pellets appears in the day 16 record. Bar pressing was not eliminated; instead, the behavior pattern became more complex: eating, then drinking, then bar pressing, then "something else" until the arrival of the next pellet. How consistent the final chain was is unknown, inasmuch as "something else" was not recorded.

The consumption of unusually large amounts of water by rats under interval dry-food reinforcement schedules does not seem accountable by thirst alone. It is difficult to see, for example, why several days should be required for full-scale polydipsia to develop, if the rat is simply drinking to wash down the pellet. Adventitious reinforcement would seem to account for the induced polydipsia, if allowance is made for the possibility that the drinking become only the early (food-prompted) member of a more complex chain, as in Experiment 2. The drinking may begin as a normal consequence of eating dry food, but over time, may become elaborated and maintained by the adventitious reinforcement contingencies. Just how elaborate such adventitious chains may become remains to be determined.

References

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Note

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