

*SOME OBSERVATIONS ON THE ADVENTITIOUS
REINFORCEMENT OF DRINKING UNDER FOOD
REINFORCEMENT¹*

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The development of strong postreinforcement drinking behavior under variable-interval food reinforcement in rats was found to be influenced by the proportion of short intervals in the VI and the proximity of the water tube to the lever.

Falk (1961) has recently noted the development of rather strong adventitiously reinforced drinking behavior in rats responding under a variable-interval food reinforcement schedule. These observations were presented as suggesting a technique for the production of high water intake without concomitant aversive stimulation (*cf.* Williams & Teitelbaum, 1956). Under a 1-min VI, water consumption was increased approximately threefold over that under free feeding, although body weights, and presumably food intake, were greater during free feeding. In Falk's data, bursts of licking followed nearly all reinforcements and were often sustained for 30 sec or more, so that reinforcements following shorter intervals were "held" for appreciable times.

A similar phenomenon has been noted in our laboratory, although we had never seen it in previous work with VI's. When the purpose is to produce a stable VI base line for a subsequent treatment, the presence of strong competing behavior with a definite pattern of occurrence has considerable nuisance value. The following observations regarding the establishment and removal of conditioned drinking under VI reinforcement are presented from this point of view.

Figure 1A shows a typical lever-pressing performance of a rat displaying a pattern of sustained drinking following food reinforcements under VI 45 sec. In the first portion of the record, postreinforcement pauses of 10-50 sec follow every reinforcement; and most of these are followed immediately by a

reinforced lever press. Drinking is not recorded; but observation revealed that these pauses are filled with licking on the water tube. At the arrow (a) the water bottle was removed. Immediately, postreinforcement pausing decreased, and both grain and stability of the rate improved.

These data are representative of nine animals, which were Sprague-Dawleys about 150 days old and weighed about 400 g at 80% of their free-feeding weights. These subjects were running 2 to 4 hr per day on VI's after the usual deprivation, feeder training, and bar-training preliminaries. Reinforcements were 0.045-g Noyes pellets; and water tubes were 3 in. from levers on the same cage end and on the side opposite the food tray. Two tapes were used. The VI 45 sec in Fig. 1A contained 26 intervals, ranging from 2.5 to 90 sec, with 46% of the intervals 30 sec or less. The second tape was a VI 60 sec, containing 45 intervals from 2.5 to 120 sec, with 40% of these 30 sec or less. As in Falk's (1961) report, systematic postreinforcement drinking developed very rapidly on both these tapes, and was usually well established by the third 2-hr session.

In an attempt to break the pattern in Fig. 1A, the following operations were carried out, with three animals for each case:

- (a) After the behavior in Fig. 1A had developed, a conjunctive schedule was put in effect in which a 5-sec inter-response time halted the VI and erased any reinforcements locked up. The VI was then restarted by the next response. This schedule was considered a stronger deterrent to pausing

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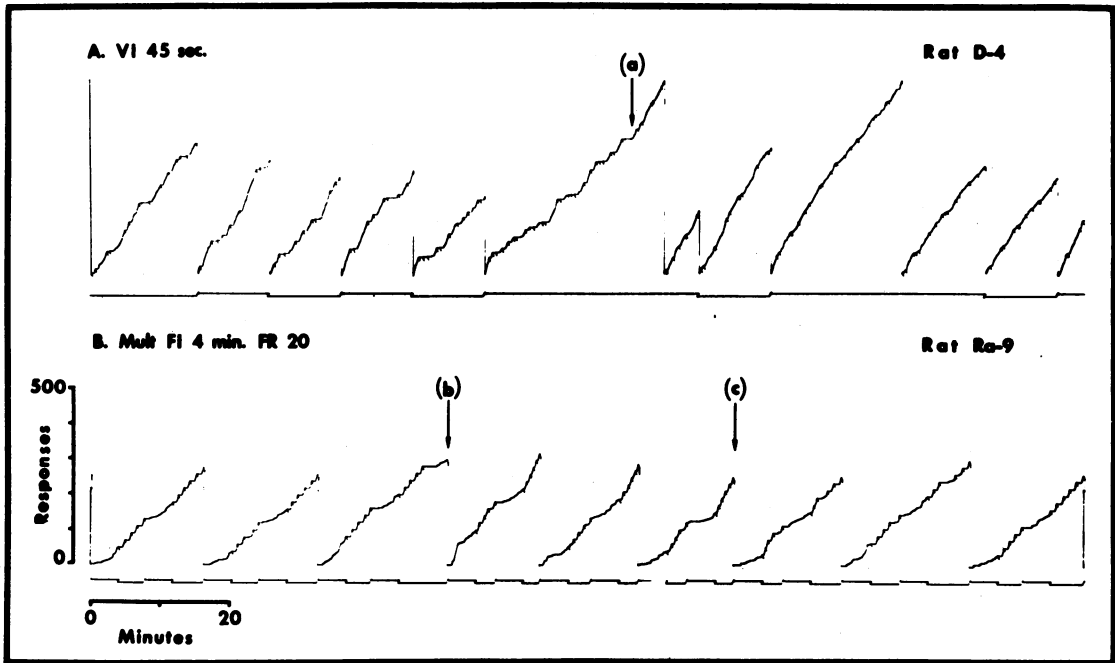


Fig. 1. A. Performance of a subject showing strong postreinforcement drinking under VI food reinforcement. The water bottle was removed at the arrow (a). B. Postreinforcement drinking pauses in the FR component of mult FI FR after transfer from VI reinforcement. The water bottle was removed at the arrow (b) and returned at (c). Resets and event-pen displacements in the upper record have no significance here. In the lower record, resets occur after every 11 reinforcements, and the event pen is displaced during FR.

than a simple limited hold. During 10 daily 4-hr sessions, however, no effect on the duration or frequency of postreinforcement drinking was observable. Response rates following pauses were somewhat increased by this treatment.

(b) Three later subjects showing similar behavior on VI 1 min were removed from this schedule and placed on fixed ratios. Beginning with FR 5, the ratios were gradually increased to FR 50 over a 12-day period, keeping the number of reinforcements per session approximately constant. This procedure produced normal FR rates, with only occasional postreinforcement pauses exceeding 5 sec and only occasional drinking. When subjects were returned to the VI 1 min, however, the original pattern of drinking after each pellet returned within the first session.

(c) Removal of the water bottle obviously eliminates the drinking, and with it the pauses. Substitution of a dry bottle had a

similar, though less immediate, effect. Finally, the filled water bottle was moved from the bar end to the opposite end of the cage, changing the distance between bar and water tube from 3 in. to 9 in. In one of three animals performing on the VI 1 min described above, postreinforcement drinking was gradually eliminated, and a normal VI grain emerged. In the other two cases, the high probability of prolonged drinking immediately following reinforcements persisted, the adventitious chain being merely lengthened to include two crossings of the cage.

The last case described was the only one in which such a pattern was eliminated under VI reinforcement once established. Figure 1B is an example of the persistence of the phenomenon. After strong drinking developed under VI reinforcement, this subject was transferred to mult FI 4 min FR 20; and it had been on this schedule for 20 6-hr daily sessions at the time the record in Fig. 1B was taken. Both the FI and FR components are

fairly well developed except for the postreinforcement pauses in FR, which are unusually long for this value of the ratio either alone or in multiple with the FI. At the arrow (b) in Fig. 1B, the water bottle was removed. Immediately, postreinforcement pausing decreased in both FI and FR. At the arrow (c), water was returned to the box and long pauses in FR gradually reappeared. In two cases of transferring a postreinforcement drinking pattern developed under VI to multiple FI FR, drinking in the FR component was eliminated by installing the water bottle at the opposite end of the cage and by removing it entirely for 1 to 2 hr of the daily session over a period of 5 to 10 days.

In all these cases, it proved uneconomical (though informative) to attempt to eliminate postreinforcement drinking once established. Subsequently, it was found that superstitious drinking did not develop when the water tube was 9 in. from the lever and subjects were moved to VI 1 min containing only 35% of intervals equal to or less than 30 sec (Clark, 1958) after not more than four 2-hr sessions on a smaller VI.

This drinking behavior obviously was developed and maintained by adventitious reinforcement. Once established, it was highly resistant to change. In the first cases to occur, the postreinforcement pause had developed before drinking was systematically observed. In four later cases, the development of this topography was followed visually. The controlling conditions appear to be the same as those operating in other cases of adventitious reinforcement (Skinner, 1948; Morse & Skinner, 1957; Sidman, 1960). Initially, drinking is likely to follow ingestion of several pellets close together. When a short interval in the VI follows drinking, the next lever press is immediately reinforced, so that the probability of drinking after reinforcement further increases. This process will continue if the proportion of short intervals in the VI is sufficiently high. Further, because the proportion of intervals less than a given time increases as a function of time, longer periods of drinking will be more frequently reinforced. Figure 1A shows two cases in which a single lever press immediately following 50 sec of licking is reinforced.

Two factors appear to be principally responsible for superstitious drinking in the rat under VI reinforcement. The first is proximity of the water bottle to the lever, which influences the initial frequency of drinking following reinforcement. The second is the proportion of short intervals in the VI, which may result in differential reinforcement of responses following longer and longer periods of drinking. Because of the construction of both the box and the animal, and because the discriminative stimulus controlling drinking is provided by the previous reinforcement, sequences of intervals less than 30 sec appear critical in this regard.

Phenomena similar to those described here may occur under a variety of schedules if the conditions provide for the reinforcement of an experimentally defined response immediately following any undefined behavior which has a high initial probability for extraneous reasons. Thus, what is considered "typical" behavior under a DRL schedule is generated by an entirely similar set of variables. A topography which is stereotyped in the individual case but differs among animals usually develops during inter-response times. On the other hand, a "good" variable-interval will ordinarily develop a variable topography during inter-response times, although the average rate may be of the same order as that developed under a DRL.

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