

Control of schedule-induced drink durations by interpellet intervals

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Two food-deprived white rats were reinforced with 45-mg Noyes pellets after simple fixed intervals of 15, 30, 60, and 120 sec and after alternating 15- and 120-sec intervals.

"Postpellet" drink duration varied directly with interpellet intervals in the simple fixed-interval case. In the alternating-interval case, postpellet drink durations (or tube contacts) were greater in 120-sec than in 15-sec intervals. Schedule-induced drink durations appear to be controlled by the probability of availability of food.

Since Falk (1961) first reported on schedule-induced polydipsia, fluid consumption has been the main datum of interest in this class of experiments. But Falk also noticed a characteristic pattern of behavior: "Shortly after a pellet is earned a burst of licking ensues, followed by a return to bar-pressing until the next pellet is delivered." Several investigators have confirmed that bursts of licking follow ingestion of intermittently available pellets of food (e.g., Keehn, 1970; Segal, 1969; Stein, 1964) and have described them as postpellet drinks, implying that pellet ingestion is the stimulus for drinking. Keehn & Colotla (1970), using a schedule in which several consecutive barpresses were reinforced at the end of fixed intervals of 60 sec (mix FI 60 crf n), showed, however, that drinking occurred at the beginning of the fixed intervals, not after every pellet. They concluded that the stimulus for the onset of drinking was the unavailability of food, not the presence of food in the mouth. This conclusion places schedule-induced drinking in the same category as schedule-induced aggression (Azrin, Hutchinson, & Hake, 1966) as an extinction-induced phenomenon.

Given that unavailability of food sets the occasion for drinking to begin, it is possible that reavailability of food controls drink termination. Within limits, Falk (1966) and Burks (1970) have shown that quantity of fluid consumed increases with interpellet interval, implying longer drink durations with longer intervals between pellets of food. The present experiment examines this implication in two ways: first, by measurement of drink duration in simple fixed-interval reinforcement schedules of 15, 30, 60, and 120 sec and, second, by measurement of drink durations in the long and the short intervals of an alternating mixed FI 15-FI 120-sec schedule of reinforcement.

SUBJECTS

Two 100-day-old experimentally naive male albino rats were used. They were

individually housed and maintained at 80% ad lib body weight throughout the experiment. Tap water was always available in the home cages.

APPARATUS

The experimental space was a standard Grason-Stadler two-bar rat chamber, Type E3125B. The left-hand bar was removed and its opening covered with a metal plate mounted flush with the wall. A weight of 20 g on the remaining bar activated relay programming and recording equipment. A plastic water bottle was attached to the chamber door such that the glass outlet tube from the bottle was available through a hole 25 mm above floor level and 90 mm from the wall containing the response bar and food magazine. Licks

at this tube were recorded on a Gerbrands cumulative recorder via a Grason-Stadler drinkometer. The experimental chamber was normally housed in a ventilated chest supplied with a viewing window, although occasional sessions were conducted under open conditions for the purpose of videotaping.

PROCEDURE

After one or two preliminary sessions in which barpressing was shaped and maintained with continuous reinforcement (45-mg Noyes rat pellets), experimental sessions were run daily, except weekends, and lasted until S obtained 100 reinforcers (50 in Sessions 41-55) scheduled as follows: FI 30 sec (Sessions 1-20); FI 60 sec (Sessions 21-40); FI 120 sec (Sessions 41-55); FI 15 sec (Sessions 56-65); alternating mixed FI 15 FI 120 sec (Sessions 66-90). Cumulative licking records were obtained regularly along with water consumption per session. Cumulative barpressing records were obtained occasionally.

RESULTS AND DISCUSSION

Mean water intakes per pellet of each animal over the last five sessions of the FI 15-, 30-, 60-, and 120-sec schedules, respectively, were: S65—.25, .39, .52, and .58 ml; S54—.18, .35, .42, and .60 ml. These data confirm those of Falk (1966). They could mean that the Ss drank for longer periods between pellets as the

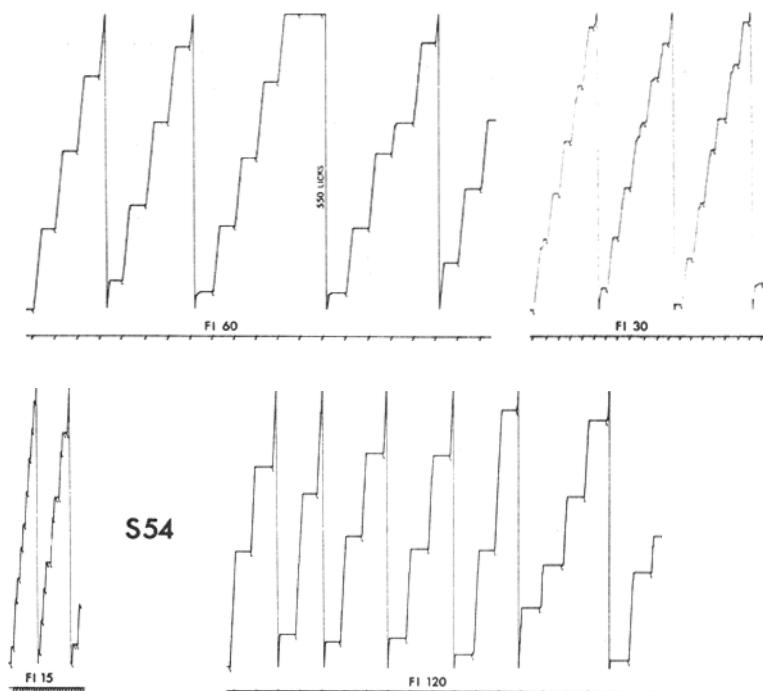


Fig. 1. Typical cumulative records of licking induced by the designated fixed-interval food-reinforcement schedules. Oblique blips on the cumulative records designate reinforcements; the event record is marked at intervals as labeled. The records were taken from Sessions 6 (FI 30); 40 (FI 60); 49 (FI 120); 60 (FI 15).

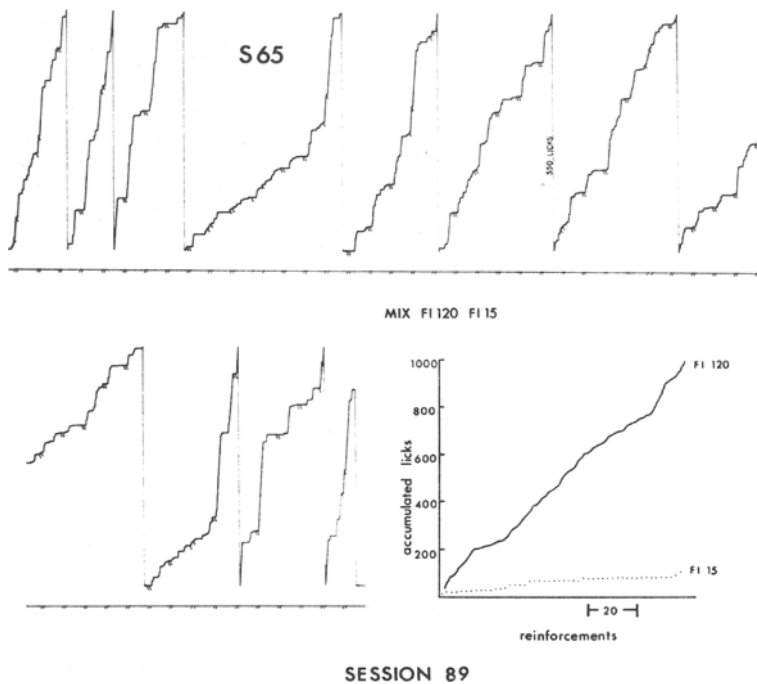


Fig. 2. Cumulative record of contacts with the drinking tube in a whole session with reinforcements scheduled alternately after 15 sec and 120 sec (top to bottom left). Blips on the cumulative and event records designate reinforcements. Bottom right: Contacts with the drinking tube accumulated in the 15-sec and 120-sec intervals separately (multiply ordinate scale by 5.5).

interreinforcement (FI) time increased or that drinking occurred in more of the longer than of the shorter intervals. Figure 1 shows the former to be the case. Mean percent "postpellet" drinks of each animal over the last five sessions of the FI 15-, 30-, 60-, and 120-sec schedules, respectively, were: S65-75, 82, 83, and 88; S54-86, 94, 95, and 100. Although fewer drinks were missed as the interreinforcement interval lengthened, the differences were too small to account for differences in water intakes at the respective intervals. The relationship between pellet deliveries on the various schedules and drink durations is depicted in the representative cumulative licking records shown in Fig. 1.

The mean water intakes per pellet over the last five sessions in which reinforcers were scheduled alternately after 15 and 120 sec were .46 ml (S65) and .35 ml (S54). These intakes are appropriate for an average interreinforcement interval of about 60 sec and could mean that the Ss behaved in the manner depicted by the FI 60 cumulative licking record shown in Fig. 1. However, they did not. A typical performance of S65 is shown in Fig. 2. The figure contains a cumulative licking record (from top to bottom) of a complete session and a manually constructed record in which licks in the 120- and 15-sec intervals

were accumulated separately (lower right quadrant). Clearly, drinking was much less likely to occur in the 15-sec than in the 120-sec interval.

The cumulative licking record in Fig. 2 is much more ragged than those shown in Fig. 1. This is because S65 engaged in considerable "operant nosing" at the drinking tube (cf. Segal, 1969), in addition to normal licking. The drinking records of S54 on the mixed schedule were more regular, resembling those in Fig. 1. However, this S also exhibited differential drink durations according to the interreinforcement interval. Figure 3 shows the drink durations in the 120-sec and 15-sec intervals accumulated separately over several sessions. Animal S54 almost always drank longer in the 120-sec than in the 15-sec interval over the final 10 sessions, but the extreme separation that occurred in Session 83 was not maintained.

From the above data it is possible to conclude that, just as the unavailability of food sets the occasion for schedule-induced drinking to begin (Keehn & Colotla, 1970), so stimuli associated with the reavailability of food set the occasion for drinking to end, for the longer the interreinforcement interval, the longer the Ss drank. This conclusion pertains, however, only for intervals up to 2 or 3 min, for Falk (1966) has shown that the relationship between

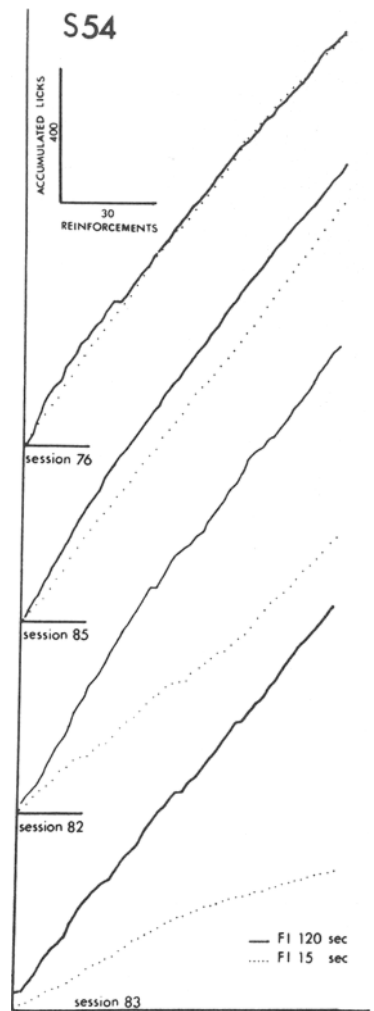


Fig. 3. Accumulated licks of Animal S54 in the 15-sec and 120-sec intervals of a mixed FI 15 FI 120 schedule of food reinforcement over several sessions, as marked (multiply ordinate scale by 5.5).

interreinforcement interval and schedule-induced water consumption is curvilinear. There are, as yet, no behavioral data on how this curvilinearity comes about.

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to S's breaking a light beam 1 ft from the door; running times were measured over the next 31 in. of the runway.

PROCEDURE

During the first 8 days, the Ss were reduced to 80% of their normal body weights, handled, and adapted to the runway. On Days 9 and 10 the Ss had one rewarded runway trial and two trials on Day 11. The Ss in Group 1 received one 45-mg Noyes pellet; the Ss in Group 11 got 11 pellets. The Ss in Group 1-10 got one pellet in the runway goalbox, were kept in a handling box for 30 sec, were given 10 pellets in the white intertrial box, and were then returned to the handling box. The Ss were run in squads of six, with two Ss from each treatment. Training consisted of 21 days with four trials per day rotated among six Ss. The intertrial interval was approximately 5 min throughout the study. Extinction lasted for 8 days with four rotated trials per day. Following extinction, the Ss were retrained for 8 days under the same reward conditions as in training. During training and retraining, the Ss were confined to the goalbox until the reward was consumed. In extinction the Ss were kept in the goalbox for 15 sec. If an S's running time exceeded 60 sec, it was placed in the goalbox for the usual detention period, and a running time of 60 sec was recorded.

RESULTS

Each S's daily median start and running times were transformed into reciprocals. The transformed scores were divided into blocks of 3 days in training and blocks of 2 days in extinction and retraining. The mean starting speeds for the three reward groups during the three phases of the study are shown in Fig. 1. The overall Ms for the three groups differed significantly in training ($F = 22.30$, $df = 2/27$, $p < .001$) and retraining ($F = 8.44$, $df = 2/27$, $p < .01$) but not in extinction ($F < 1$). Tukey b tests (Ryan, 1959) of the Ms in training and retraining revealed that in each phase Group 11 started significantly faster ($p < .01$) than Groups 1 and 1-10 and that the latter two groups did not differ from one another.

The mean running speeds for the three reward groups during three phases of the experiment are shown in Fig. 2. The overall Ms in training and for the last three blocks of training for the three reward groups differed significantly ($F_s = 19.62, 15.96$; $df = 2/27$, $p < .001$). During extinction the performance did not vary from chance ($F = 1.82$), but in retraining the groups again differed significantly ($F = 16.01$, $df = 2/27$, $p < .001$). By use of Tukey b tests it was found that all comparisons among the overall Ms in training and at the asymptote of training were significantly

Runway performance and reward magnitude*

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The training, extinction, and retraining performance of three groups of rats with large rewards (11 45-mg), small (45-mg) rewards, and small (45-mg) rewards with intertrial feedings (10 45-mg) was investigated in a runway. The results were in accord with the generalization that asymptotic performance is directly related to the magnitude of reward and differed from results recently reported by McCain.

There is considerable evidence (Pobols, 1960; Logan, 1960; Bitterman & Schoel, 1970) demonstrating that asymptotic performance in noncompetitive instrumental response situations is directly related to the magnitude of reward. Recently, Black (1969) and McCain (1970) have reported data contrary to this generalization. McCain has concluded that "... after about 60 consistently reinforced acquisition trials in a straight alley, the acquisition effects of different reward magnitudes are either minimal or absent [1970, p. 140]." The main purpose of the present study was to check McCain's conclusion in an investigation involving relatively long-term training and reward magnitudes comparable to those employed by McCain. Since both the Black and McCain studies used more than one trial per day, it is possible that their magnitude

results were confounded by drive differences. Accordingly, a control group with intertrial rewards was included to evaluate the possible role of drive confounding.

SUBJECTS

The Ss were 30 naive female Holtzman albino rats, about 70 days old at the start of the study. They were kept in individual cages and were randomly assigned in equal numbers to the three reward treatments described below.

APPARATUS

The apparatus was a 50-in.-long black L-shaped runway that has been described fully elsewhere (Wike & Atwood, 1970). The 13.5 x 8 x 5.5 in. goalbox contained an aluminum reward dish that was 3.85 in. in diam and 0.9 in. deep. The intertrial rewards were given in a glass furniture coaster, located in a 10 x 10 x 7.5 in. white goalbox that was placed adjacent to and 1 ft from the runway goalbox. Start and running times were taken from two Hunter Klockounters. The start time was the period from the elevation of the start door

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