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Frustration effect with a long delay

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Ten Sprague-Dawley females were trained for 10 days in a straight alley with no obstruction of approach to the goal (four 45-mg pellets). During testing the rats received two nonblocked (0-sec delay) and four blocked (4-, 12-, 20-, and 60-sec delay) trials per day for 12 days. Significant frustration effects were obtained for both running speeds and ingestion rates. Both the 4- and 12-sec delays resulted in significantly faster running speeds than the 0-sec delays, and all delay intervals resulted in significantly faster ingestion rates than the 0-sec delay. The 4-sec delay yielded the fastest mean running speed. Plots of mean running speeds and ingestion rates across delay intervals indicate that delays had a similar effect on both.

Holder, Marx, Holder, and Collier (1957) demonstrated the frustration effect with a blocking procedure using an apparatus consisting of a startbox (SB), first alley (A_1), delay box (DB), second alley (A_2), and goalbox (GB). Rats were run using a between-groups design, and it was observed that following training with a 1-sec delay, response strength as measured by start times and run times in A_2 was directly related to length of delay.

Uyeno (1965) obtained a frustration effect using a between-subjects design. Rats were trained with no delay and tested with four trials per day consisting of two 1-sec delays and two no-delay trials. The subjects ran significantly faster in A_2 following the 1-sec delay than on nondelay trials.

Allen (1976) obtained the fastest mean running speed following a 4-sec delay; however, running speed when compared to a 12-sec delay increased with delays of 20 and 45 sec, suggesting that 4 sec may not be the optimal delay interval. The purpose of the present study was to determine the effect of an even longer delay on running speeds and ingestion rates.

METHOD

Subjects

The subjects were 10 experimentally naive female Sprague-Dawley rats obtained from a local supplier. All subjects were approximately 90 days old at the start of the experiment, housed individually, and maintained with Allied Mills mouse breeder blocks on a 23-h food deprivation schedule.

Apparatus

Except for the length of the alleys, the apparatus was similar to one used by Wagner (1959). The flat black startbox was 1 ft (30.48 cm) long and, like the remainder of the apparatus, was 3 in. (7.62 cm) wide and 5.25 in. (13.34 cm) deep. Separating the startbox from Alley 1 (A_1) was a guillotine-type door painted black on both sides. All other doors in the apparatus were also guillotine. A_1 was 3 ft (91.44 cm) long, painted flat black, and had a floor covered with a black rubber mat. Separating A_1 from the delay box was a retrace door painted black on both sides. The delay box was identical to the startbox except that the guillotine door was painted white on the side facing the second alley (A_2). A_2 contained two photoelectric cells, one placed 1 ft (30.48 cm) from the door leading into A_2 which started a timer and one placed 2 ft (60.96 cm) from the same door which stopped the timer. Both photoelectric cells were 1.5 in. (3.81 cm) above the floor and were connected to two Hunter Model 330S photo contact relays. The relays were connected to each other and to a 1/100-sec Stoelting Model 22025-S clock by means of an Advanced Electric and Relay Company Model PC 2C115VA relay. The openings in the alley were covered with thin sheets of red plastic. A_2 was 4 ft (121.92 cm) long, painted white, and had a floor covered with .25 in. (6.35 mm) of mesh hardware cloth. The door separating A_2 from the goalbox was painted white on both sides. The goalbox had the same dimensions as the delay box and was painted white with a white plastic foodcup mounted in the center of the end wall at floor level. The alleys were constructed of wood and were covered with clear Plexiglas; the startbox, delay box, and goalbox were covered with hinged sections of Plexiglas.

The runway, light sources, relays, and clock were placed on a table which was centered against one of the walls of the sound-deadened laboratory. Five gray holding boxes with water available were situated against the opposite wall of the laboratory.

Procedure

Habituation. Preliminary training lasted 10 days, during which a 23-h food deprivation schedule was established. Water was available at all times in the home cage. For 3 days each rat was handled for a 5-min period before being fed for 1 h in an individual home cage; for the next 3 days each rat was placed in a holding box for 15 min before being fed; and for the last 4 days they explored the maze in groups of two for 5 min each day. During this period, the photocells and clock were operating to adapt the rats to these noises. After exploration, each rat was fed five 45-mg Noyes pellets from the floor of the holding box and then was returned to its home cage.

Training. Each rat was given six 0-sec-delay training trials daily during the 10 days of training and received four pellets in the GB following each trial. The order in which the rats were run was randomized before each day of training and testing.

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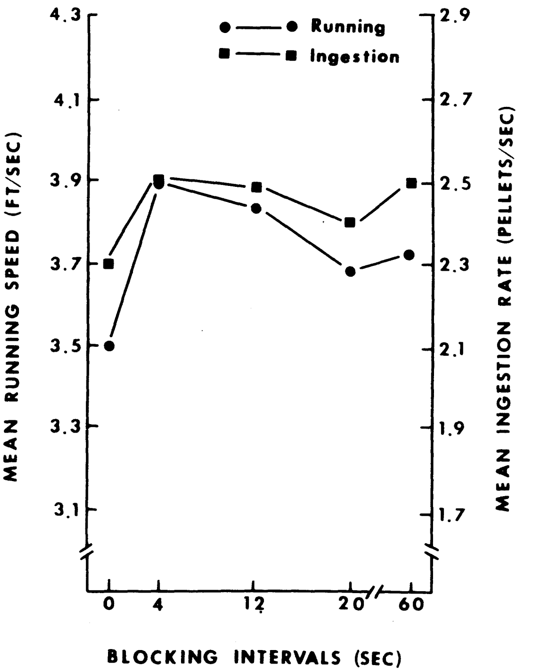

Figure 1. Mean running speeds and ingestion rates at each blocking interval during Days 7-12 of testing.

A 0-sec-delay trial was initiated with the introduction of the rat into the startbox. All doors from the startbox to the goalbox were left open, allowing the rat to traverse the entire length of the runway unobstructed. The first time on each trial that the rat passed through both photobeams while maintaining its goal orientation, the time was recorded as the running time for that trial. If a rat broke only the first beam and then retraced, the clock was reset. As soon as the rat entered the goalbox, the retrace door was closed and ingestion time was recorded. Ingestion time was measured by starting a stopwatch when the rat took the first pellet into its mouth and stopping it when it had taken the last pellet. Each rat was removed from the goalbox as soon as it had eaten.

Testing. Each of the 12 testing days consisted of six trials, two 0-sec-delay trials and four trials on which each rat was held in the delay box for either 4, 12, 20, or 60 sec. The opaque door into A_2 was not opened following the delay intervals until the rat was oriented toward it. The order in which the intervals were presented was randomized each day with the stipulation that the two 0-sec-delay trials could not follow each other. Running times and ingestion times were measured and recorded as in the training trials.

The minimum intertrial interval throughout was 7 min. After being run, the rats were placed in their home cages for 5 min and then fed for 1 h.

RESULTS AND DISCUSSION

All running times were converted to running speeds (feet/second), and all ingestion times were converted to ingestion rates (pellets/second).

Dependent t tests were conducted between mean running speeds obtained following the 0-sec delay and the other delay intervals for the last 6 days of testing. Both the 4- and 12-sec delays produced significantly faster mean running speeds than the 0-sec delay [$t(9) = 2.26$, $p < .05$ and $t(9) = 2.64$, $p < .05$, respectively]. The 4-sec delay resulted in the fastest mean running speed (see Figure 1).

Dependent t tests between mean ingestion rates obtained following 0-sec delays and other delays for the same 6 days of testing revealed that all delay intervals resulted in significantly faster ingestion rates than the 0-sec delay. The mean ingestion rates for the 4-sec delay were faster at the .01 level [$t(9) = 2.88$] and the 12-, 20-, and 60-sec delays resulted in faster ingestion rates than the 0-sec delay at the .05 level [$t(9) = 2.11$, $t(9) = 2.12$, $t(9) = 1.84$, respectively].

The present study indicates that the 60-sec delay does not result in a mean running speed or ingestion rate which is faster than that obtained with a 4-sec delay.

An apparent discrepancy between the present results and those obtained by Allen (1976) is the lower mean running speed and ingestion rate following the 20-sec delay than following the 12-sec delay. The fact that this shift was obtained for both mean running speeds and ingestion rates may indicate that the long 60-sec delay effectively reduced the shorter delays, making them appear shorter by contrast. In any event, the present study has confirmed the previous observations that the frustration effect exists for both running speeds and ingestion rates, the 4-sec delay results in the fastest mean running speed, and frustration has similar effects on running speeds and ingestion rates across delay intervals.

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