

The role of odor in latent extinction*

LINDA K. PRATT and H. WAYNE LUDVIGSON[†]
Texas Christian University, Ft. Worth, Tex. 76129

To test the hypothesis that an apparent latent extinction effect in rats can result from the Ss' reaction to their own odor excreted during prior placements, four groups of 10 Ss each were given 28 runway acquisition trials followed by four 1-min latent extinction placements. Two groups received placements in the empty goalbox. For one of these groups, the goalbox was cleaned before extinction to remove odor cues; for the other group, it was not cleaned. Two additional groups received placements in a neutral box. One of these groups entered a clean goalbox on the first extinction trial, while the other entered a goalbox that (presumably) contained any odors emitted by another animal during placement. Both the odor and site-of-placement variables produced a "latent extinction" effect in the goal-entry speeds, suggesting that latent extinction is a genuine phenomenon but that an apparent latent extinction effect from a response to residual odor is readily obtainable.

Certain data (e.g., McHose & Ludvigson, 1966) suggest that odors resulting from a rat's response to differential reinforcement may serve as unconditioned stimuli for differential responding in other rats. Later studies (e.g., Ludvigson & Sytsma, 1967; Ludvigson, 1969) further suggest that odors from Ss' reaction to reward and nonreward can also serve as conditioned discriminative stimuli for a running response.

These effects, particularly the former, may operate to produce all or part of the latent extinction effect often observed in a runway apparatus, an effect characterized by a decrement in running speed following nonrewarded placements in a previously rewarded goalbox. If the rat excretes an odor during placements that renders that portion of the apparatus distinctive, then such an odor may later slow traversal of the runway. To test this hypothesis, the variables, presence vs absence of odor from placements and site of placement (goalbox vs neutral box) were combined in a between-groups factorial design.

SUBJECTS AND APPARATUS

The Ss were 40 experimentally naive female Sprague-Dawley rats, approximately 90 days old on the first day of deprivation.

The apparatus was a straight enclosed flat-white alley, 10.16 cm high and 11.43 cm wide. The startbox was 30.48 cm long, the runway was 99.06 cm long, and the L-shaped goalbox was 23.49 cm long, not including the 23.49 x 12.70 cm base of the L. "Start time" was the time between the raising of the start door and the S's

breaking a photoelectric beam 7.62 cm outside the door. "Run time" was measured over the next 91.44 cm of the runway, and "goal time" was measured over the last 5.08 cm of the runway plus the first 20.32 cm of the goalbox. Additional equipment included 40 strips of green desk-blotter paper that covered the floor of the alley from just outside the startbox through the base of the L. The neutral box was 38.10 cm long, 10.16 cm wide, 11.43 cm deep, painted flat black, and covered with a clear Plexiglas lid.

PROCEDURE

On Day 1 Ss were placed on a 23-h food-deprivation schedule. On both Days 8 and 9, each S was handled 2 min in the colony room. On Days 10-12, Ss explored the alley in groups of four for 10 min per day, with clocks and photocells functioning. On Days 11-12, Ss were allowed, in the home cage, to eat 10 45-mg Noyes food pellets of the type later used as reward before receiving the regular daily ration of lab chow.

On Days 13-19, Ss, in squads of four, received four training trials per day at an intertrial interval of 30 sec. The Ss remained in the goalbox until the six reward pellets were consumed. Four blotter pads were assigned to each squad. On a given training day, Ss ran on only one pad, but the pads were randomly interchanged within a squad from day to day. The Ss were randomly assigned to four groups with the restriction that a

squad be composed of one S from each group.

On Day 20 Ss received four 1-min nonrewarded placements at a 1-min interplacement interval. Beginning 10 min after the last placement, 10 extinction trials, separated by 30-sec intertrial intervals, were administered. During extinction, Ss were confined to the goalbox for 15 sec on each trial.

The order of placements and extinction for the four Ss in a squad is outlined in Table 1. The S from Group OGB (odor, goalbox) was placed into the goalbox onto a pad that was the same one used by that S on the previous day's training trials. Following placements, the pad remained in the alley and the alley was not swabbed or otherwise disturbed during the 10-min interval. Following the last extinction trial, the alley was swabbed with fresh water and the pad was discarded.

Next the S from Group NONB (no odor, neutral box) received placements in the neutral box. During extinction the pad in the alley was the one used by the given S during the previous day's training trials. The alley was swabbed and the blotter was discarded after this S completed extinction.

Third, the S from Group ONB (odor, neutral box) was given placements in the neutral box. Following this, the S from Group NOGB (no odor, goalbox) was given placements in the goalbox on the blotter used by the ONB S during the previous day's training trials. Approximately 2 min after the NOGB S received its last placement, the ONB S received its extinction trials. The alley was not swabbed and the blotter was not changed following the last placement of the NOGB S. After the ONB S completed extinction, the alley was swabbed with fresh water and the blotter used by the NOGB S on the last training day was placed in the maze. The NOGB S was then given its extinction trials.

RESULTS

The scores on the first extinction trial were of primary interest because only on this extinction trial would the effect of odor left during placement not be confounded with that left during extinction. A 2 by 2 analysis of variance was performed on first-trial goal times

Table 1
Temporal Order of Goalbox (GB) or Neutral Box (NB) Placements, Extinction (E), and Swabbing (||) Within a Squad of Four Ss. The arrows indicate manipulated residual odor.

Subject	Temporal Order of Events										Treatment	
	1	2	3	4	5	6	7	8	9	10		
1	GB →		E									OGB
2				NB		E						NONB
3							NB		E			ONB
4								GB ↗		E		NOGB

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†Reprints may be obtained from H. W. Ludvigson, Department of Psychology, Texas Christian University, Fort Worth, Tex. 76129.

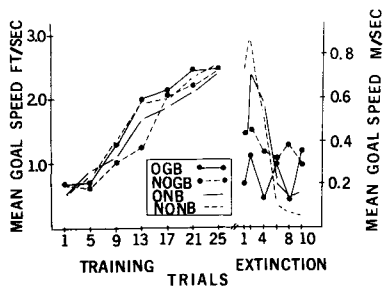


Fig. 1. Mean acquisition goal speed for the first trial of each training day, the first extinction trial, and for blocks of three extinction trials thereafter.

transformed to speed measures (meters/second and feet/second). The effects of odor and placement box were both significant, $F(1,36) = 8.82$ and 8.14 , respectively, $p < .01$. As may be seen in Fig. 1, goal speeds were diminished more following goalbox than following neutral-box placements; and goal speeds were faster with placement odors diminished than when these cues were not removed.

The goal speed data over all 10 extinction trials, in two-trial blocks, were subjected to a 2 by 2 by 5 analysis of variance. The placement box effect was significant, $F(1,36) = 6.66$, $p < .05$, as was the trial effect, $F(4,144) = 17.56$, $p < .01$, and the Placement Box by Trial interaction, $F(4,144) = 11.94$, $p < .01$. The interaction resulted from the neutral-box placement groups' being faster than the goalbox placement groups on the first block of extinction trials but slower, though not significantly so, on the last block of extinction trials.

Analyses were also performed on the start speeds and the run speeds for the first extinction trial. The differences in start speeds were not significant but were in the same direction as the differences in the goal speeds. The analysis of the run speeds indicated that goalbox placements produced slower speeds than neutral-box placements, $F(1,36) = 6.60$, $p < .05$. All 10 extinction trials of run speed data were also subjected to a 2 by 2 by 5 analysis of variance. On this measure only the trial effect and the Placement Box by Trial interaction were significant, $F(4,144) = 40.95$ and 11.32 , respectively, $p < .01$. As with the goal speed data, the interaction resulted from the neutral-box placement groups' being faster than the goalbox placement groups on the first block of extinction trials.

DISCUSSION

These data demonstrate that an apparent latent extinction effect is readily obtainable when an animal-produced

odorant resulting from goalbox placement is not removed from the goalbox. Some, if not most, of the earlier latent extinction studies might have been influenced by such an odor effect, and thus they bear reexamination. The extent of the possible confounding, while determinable only from further work, may be great, since an odor effect would often be expected to interact with certain variables in the same manner as a genuine latent extinction effect. Thus, data suggesting the spontaneous recovery of a latently extinguished response might also be expected from a dissipation of odor over time (Deese, 1951; Dyal, 1961b; Robinson & Capaldi, 1958). As another example, it would be anticipated that an odor effect would be most apparent on performance closest to the goal. It is interesting to note that Seward & Levy (1949) reported that their Ss visibly slowed their speed as they approached the goal platform. Similarly, Dyal (1961a) has reported the goal time to be the most sensitive measure of the latent extinction effect and has used this measure as his principle unit of data analysis in subsequent studies (1961b, 1962, 1963). In view of the present data, particular caution should be exercised in interpreting the results of latent extinction studies that utilize only goal times as dependent measures.

While the present data implicate the operation of a confounding odor variable, the most plausible interpretation of the placement-box effect is in terms of genuine latent extinction. However, there are two factors that render this interpretation tentative. First, all of the odor may not have been removed by the cleaning procedure. In this case, part of the apparent placement effect for an NOGB S may have resulted from its reaction to unremoved odor from its own placement and from the extinction trials of the paired ONB animal. Second, assuming that the odors are different from S to S, each animal may be most sensitive to its own odor. The reaction of the OGB S to odor traces would then have been stronger than the reaction of the ONB S, and the NOGB S would have been more sensitive to any unremoved odor than the NONB S because some of the odor would have been its own. Another factor that would cause any unremoved odor to affect Group NOGB more than Group NONB was that for the former group less time was available for odor dissipation prior to extinction. (See Table 1.)

This study leaves unanswered questions about the nature of the odor and the mechanisms that mediate the apparent latent extinction effect. Regarding the nature of the odor, more of a characteristic

scent may accrue to the goalbox during placements than during training merely because the animal is confined in the goalbox for a longer period of time. Alternatively, the placement odor may be qualitatively or quantitatively different from that excreted on reinforced trials because of the nonreward treatment. In this case, the odor might be a unique product of a specific organismic state (e.g., "frustration") or it might be the common result of a number of states (e.g., inconspicuous urine residue might result from nonreward, trail-marking activity, and normal elimination).

The mechanism by which the odor, whatever its nature, lowers speed might simply be competing, investigatory behavior elicited because the odor is novel or unanticipated. Second, the odor might elicit an unlearned "alarm" or "avoidance" reaction, though this seems unlikely if the odor is merely a characteristic animal scent. Third, it is at least possible that the odor emitted during placement is conditioned, during the placement, as a signal or CS for nonreward. It may be noted that to explain the present data these latter two possibilities require the assumption that the odor be similar across animals.

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