Bulletin of the Psychonomic Society
1980, Vol. 16 (1), 51-54

Goal vs. alley punishment after escape training: Massed trials and startbox conditions

DAVID J. MEEKER, HAROLD BABB, and MICHAEL D. MATTHEWS
State University of New York, Binghamton, New York 13901

Two different starting procedures, drop box vs. guillotine door, were used in giving 36 male rats 20 massed shock-escape trials in a straight runway. On subsequent trials, the animals encountered no shock at all, shock punishment in the middle 2 ft of the 4-ft alley, or shock for .5 sec immediately after entering the goalbox. The guillotine-door procedure produced faster running in extinction, alley punishment facilitated responding, and goal punishment suppressed responding. Results were interpreted in terms of stimulus-directive effects, as modified by massing vs. spacing trials.

In the typical study involving "self-punitive" or "vicious-circle" behavior, animals are given a series of trials in a straight runway in which shock is delivered in the startbox and alley, and the animals must escape or avoid it by running out of the startbox, down the alley, and into the shock-free goalbox. Some of the animals are then given extinction trials with shock entirely absent, and others continue to encounter shock outside of the startbox in some segment of the alley. If the latter animals perform as well or better than those that are not punished, they are said to be running self-punitively.

The most popular interpretation of self-punitive responding is Brown's (1969) adaptation of Mowrer's (1947, 1950) two-factor approach. According to that account, the presence of shock as punishment during extinction maintains fear learned during acquisition, and the offset of shock and the reduction of fear when the animal enters the goalbox produce reinforcement that maintains the strength of the instrumental response. This two-factor approach has been generally adequate in accounting for most of the data generated by self-punitive procedures. However, much of the research so far reported has focused on the manipulation of aversive conditions in the startbox and alley. Departing from that emphasis, and possibly from the self-punitive paradigm itself, there are a number of studies (Babb, 1963; Babb, 1980; Babb & Hom, 1971; Hom & Babb, 1975; Matthews & Babb, 1978) in which shock has been applied in the goalbox during extinction, with effects similar to those obtained when punishment is applied in the alley. Since these results did not seem consistent with a reinforcement interpretation, it was suggested that conditioned aversive stimuli may have a behavior-directing capacity as well as an energizing one (Babb, 1980). Nevertheless, the similarity in outcomes between goal-punishment and alley-punishment procedures may not be a simple function of the manipulation of the location of punishment alone, because other differences between the two types of experiments have taken place concurrently. Among those differences, the goal-punishment studies have used a spaced-trials procedure, with each trial initiated by the raising of a guillotine door between the startbox and the alley, whereas the alley-punishment studies have typically used a massed-trials procedure, with trials initiated by dropping the animal from the upper level of a two-level startbox onto the grid floor below. Moreover, the goal-punishment studies have employed a buzzer CS, whereas alley-punishment studies have done so less typically. Since it did not seem practical to manipulate all of these variables concurrently, an experiment was designed in which startbox conditions and location of punishment were varied but all groups were run with massed trials and with a buzzer CS. Throughout the actual experiment, half of the animals were run with a drop-box procedure and half with a guillotine-door procedure. After 20 acquisition trials, one-third of the animals in each startbox condition no longer encountered any shock, one-third encountered shock in a middle portion of the alley on all further trials, and one-third encountered it for .5 sec immediately after entering the goalbox.

METHOD

Subjects

The subjects were 36 naive male rats of Sprague-Dawley descent, bred and reared in the laboratory's colony room, and 110-130 days of age at the beginning of training.

Apparatus

The apparatus consisted of a straight runway with an alley 122 cm long by 15.5 cm wide, a startbox 30 cm long by 15.5 cm wide, and a goalbox 30 cm long by 26 cm wide. The runway was 13 cm high throughout, contained a stainless steel grid floor in the goalbox as well as in the startbox and runway, was covered with clear acrylic, and was a medium gray in color except for the grid floor, the doors, and the ceiling.

The startbox and goalbox were separated from the alley by guillotine doors, and the goalbox door was situated 4 cm from the end of the alley. Both doors were made of clear acrylic and were channeled in aluminum frames that abutted 2 cm into the alley on both sides. The startbox door contained strips of black plastic tape applied horizontally, each with a length of 5 cm and a height of 2 cm, and each .5 cm above the other. The

0090-5054/80/070051-04$00.65/0

bottom strip was 4 cm above the grid floor. A removable drop box (38 cm high x 18 cm wide x 30 cm long) divided into an upper (19 cm high x 18 cm wide x 30 cm long) and a lower (19 cm high x 18 cm wide x 30 cm long) compartment, was placed on top of the startbox. Separating the two compartments of the drop box and attached to the back end of the box by hinges was an opaque acrylic floor that, when released, dropped the subject a distance of 32 cm to the grid below. The upper compartment was covered by a hinged acrylic lid.

Photoelectric beams were situated in the alley 1 cm past the startbox door and 1 cm before the goalbox door, and also within the goalbox, 11 cm past the goalbox door. Grid floor bars were 6.3 mm wide and 6.3 mm apart. As measured on the grid, shock of 1 mA was delivered by an Applegate shock source and a Davis scrambler, with the latter connected successively to every 18 bars. Latency measures were taken by Tektronix TM 503 timers. Other related equipment consisted of Hunter and BRS/LVE timers and relays.

An Ēdwards Lungen buzzer (Model 115-2, 24 V ac) was situated 15 cm from the end wall of the startbox, rested on soft plastic foam, and was attached to the apparatus platform with a rubber strip. The buzzer emitted an 81- dB noise, as measured inside the startbox. The ambient noise level in the startbox was 54 dB, which partially reflected the fact that the runway and noise-free clocks were situated inside a sound-insulated room and intermittent noise-making portions of the apparatus were on the outside. Noise levels in the runway were measured with a General Radio 1551C sound-level meter using the 20-kHz scale.

Procedure

The experiment consisted of three phases: pretraining, acquisition, and extinction. In pretraining, each animal was handled for 5 min on each of 3 consecutive days. On the following day, the animal was handled for 2 min, was placed in a metal carrying cage, and was transported to the experimental room, where it was placed in the alley of the runway for 2 min and then in the goalbox for 3 min. On the next day, Day 5, all 20 acquisition trials were given, followed immediately by all 50 extinction trials.

On each acquisition trial, an animal was placed in the upper compartment of the drop box or directly onto the grid floor of the startbox. After 5 sec, the floor of the drop box was released or the guillotine door was raised vigorously, and the buzzer CS, shock, and a timer came on simultaneously. On leaving the startbox, an animal would interrupt the photobeam just inside the alley, which would stop the start timer and initiate a run timer, which would, in turn, be stopped by the eventual interruption of the photobeam at the end of the alley. Since shock was not present in the goalbox, shock was terminated as the animal left the runway. The CS, however, was not terminated until the animal interrupted the photobeam inside the goalbox. When it entered the goalbox, an animal was allowed to remain there for 30 sec, after which it was removed and returned to the startbox or drop box to commence the next trial. On all trials, the door between the startbox and the alley was lowered after the animal had entered the alley, and the door at the end of the alley was lowered when the animal had entered the goalbox.

In extinction, alley-punished subjects encountered shock in the middle 58 cm (2 ft) of the 122-cm (4 ft) alley, but not in any other part of the alley, startbox, or goalbox. Goal-punished animals encountered no shock in the startbox or in any part of the alley, but they did receive .5 sec of shock in the goalbox .2 sec after interrupting the photobeam inside the goalbox. The no-punishment subjects did not encounter shock in any part of the apparatus during extinction trials. As in acquisition, measures taken consisted of start time and run time. In a few instances, however, if the photobeam at the end of the alley was interrupted but the animal failed to enter the goalbox immediately, run timing was continued until entrance was accomplished. On any extinction trial, if an animal accumulated 60 sec of combined start time and run time without entering the goalbox, it was not run on further trials, and it was also arbitrarily assigned a start time and a run time of 60 sec thereafter.

RESULTS

In the analysis of results, start and run times were converted to speed scores by taking the reciprocal of the median of each successive block of five trials and multiplying it by 100. Only the final block of acquisition trials ("TA) in Figure 1) was analyzed, but all 10 blocks of extinction trials were subjected to analysis. For significance estimates, a rejection region of $p < .05$ was selected. On a very general basis, the analysis indicated that animals given the guillotine-door procedure ran faster in extinction than animals given the drop-box procedure and that punishment in the goalbox suppressed responding, whereas punishment in the alley facilitated it.

More specifically, as reflected in the terminal acquisition block of trials, animals given the guillotine-door procedure started faster than those subjected to the drop-box procedure [$F(1,30) = 25.76$]. However, differences in timing operations may have contributed to the differences in start speeds. In any event, there were no other differences in start times in acquisition, and there were no differences at all in run times.

In extinction, the guillotine-door procedure continued to produce faster start speeds than the drop-box procedure [$F(1,30) = 7.82$], and since the differences could have been a function of timing operations, it seemed appropriate to perform further analyses with the data from each startbox condition considered separately. For the guillotine-door condition, the punishment variable produced significant differences [$F(2,15) = 7.81$], with alley-punishment [$F(1,15) = 8.48$] and no-punishment [$F(1,15) = 14.26$] animals starting faster than goal-punished animals. Mean speeds for each of those groups were 288, 337, and 120, respectively. The effect of successive trial blocks was significant [$F(9,135) = 1.62$], as was the interaction of trial blocks with punishment conditions [$F(18,135) = 2.28$]. Further analysis indicated that goal-punished animals extinguished significantly faster than alley-punished animals [$F(9,135) = 4.09$]. Similarly, with the drop-box condition, the effects of trial blocks [$F(9,135) = 5.23$] and the interaction between trial blocks and punishment conditions [$F(18,135) = 2.38$] were again significant, as was the finding that goal-punished animals decreased their start speeds faster over successive extinction trials than did the alley-punished animals [$F(9,135) = 4.09$]. Mean speeds for the three drop-box groups were 92, 222, and 142, for the goal-punished, alley-punished, and no-punishment groups, respectively.

Turning to the run speed data for extinction, there was no significant effect of the different startbox procedures, as a main effect or as an interaction. Accordingly, the two sets of data were combined for further analyses, and the effects of punishment conditions

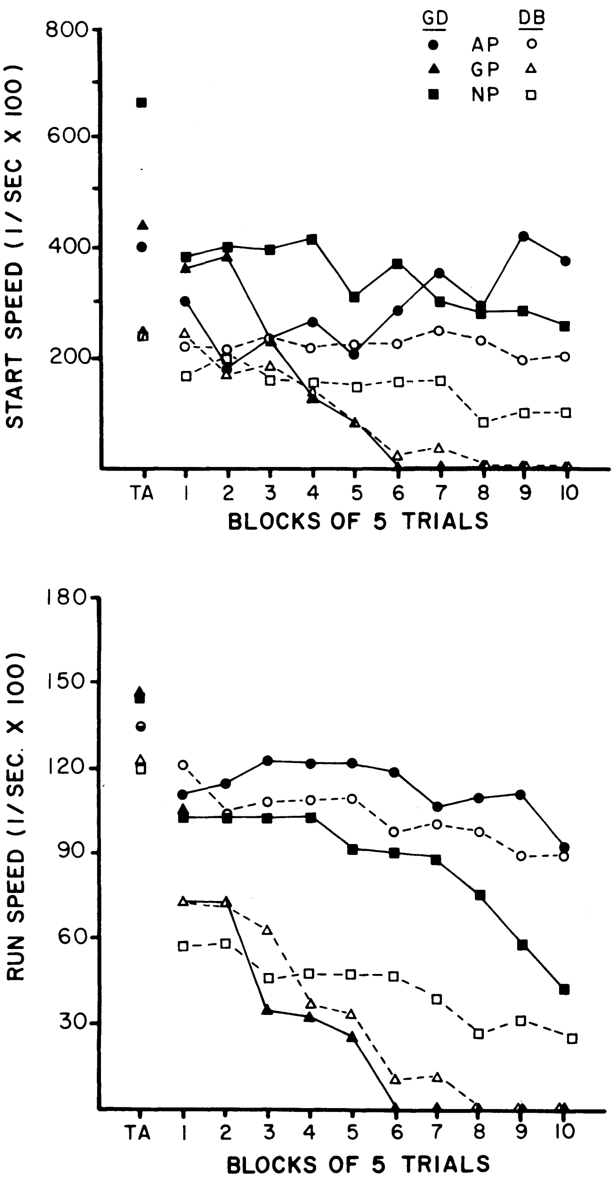

Figure 1. Start speeds and run speeds on the terminal block of acquisition trials (TA) and over blocks of extinction trials for guillotine-door (GD) and drop-box (DB) procedures, and for alley punishment (AP), goal punishment (GP), and no punishment (NP).

[F(2,30) = 16.32], trial blocks [F(9,20) = 14.98], and their interaction [F(18,270) = 3.85] were all found to be significant. Analyses of simple effects indicated that the animals punished in the alley ran faster [F(1,30) = 10.32] and those punished in the goalbox ran slower [F(1,30) = 6.17] than the no-punishment control group. Moreover, the goal-punished animals extinguished more rapidly than the alley-punished [F(9,270) = 13.77] and no-punishment [F(9,270) = 8.15] animals as extinction trials continued. The mean run speeds over all extinction trials were 108 for alley punishment, 64 for no punishment, and 30 for goal punishment.

Returning to the finding that drop-box and guillotine-door procedures had no effect on run speeds in extinction, it seems possible that the large differential effects of the location of punishment may simply have "overshadowed" them. A comparison of the two no-punishment groups by themselves should provide an indication of the effects of the startbox procedures uninfluenced by the punishment variable. Accordingly, a comparison of the two groups disclosed that the animals started with the guillotine door ran significantly faster than those that were started with the dropbox [F(1,30) = 4.83]. The failure to obtain an effect of the start procedures in the overall analysis of run speeds may have been prevented by a ceiling effect for the two groups punished in the alley and by a floor effect for the two groups punished in the goalbox.

DISCUSSION

The findings that the guillotine-door procedure produced faster running speeds in extinction for no-punished animals than did the drop-box procedure is inconsistent with the results of an experiment reported by Delprato and Meltzer (1974) and directly the opposite of results reported by Delude (1973). Moreover, in those studies, the guillotine-door procedure did not produce self-punitive responding, but it did produce such responding in the present study. In addition, in other research reported by Delude (1974), alley-punished animals run with the drop-box procedure were found to be superior to those run with the guillotine-door procedure; no such differences were obtained in the present study. None of the above-cited studies employed a formal CS, however, such as a buzzer or tone, and other research (Babb, 1980) suggests that responding with the guillotine door may be facilitated by the addition of an efficient formal CS. Assuming that Delprato and Meltzer (1974) are correct in concluding that the operation of a guillotine door comprises a relatively less effective CS condition than the stimulation produced by being dropped from a drop box, the addition of a buzzer CS to the operation of the door may correct that inequity and provide an improved basis in acquisition and in punished extinction for conditioning and/or generalization.

The results pertaining to the location of punishment are generally consistent with many prior studies in demonstrating facilitative effects from alley punishment (e.g., Brown, Martin, & Morrow, 1964), but they are quite inconsistent with the findings of studies in which .5 sec of shock in the goalbox has been administered, just after entrance, as the punishment condition (Babb, 1980; Babb & Hom, 1971; Hom & Babb, 1975; Matthews & Babb, 1978). In all of the latter studies, responding was facilitated by goal punishment, not suppressed. However, since those studies employed spaced trials, whereas the present one used massed trials, the trial distribution variable would appear to be a probable source of the differences that were obtained. Nevertheless, alley punishment has produced self-punitive responding with massed trials (e.g., Brown, Anderson, & Weiss, 1965) as well as with spaced trials (e.g., Brown et al., 1964), and the massed-trials procedure reportedly leads to an earlier divergence of punished and nonpunished groups (Brown et al., 1965). It would seem, then, that the distribution of trials may interact with the location of punishment to produce differential effects on self-punitive responding. However, if goalbox punishment has the potential for producing suppression through the evocation of incompatible locomotor reactions (Brown, 1969), it is not altogether clear why there should be more, or stronger, reactions under massed-trials conditions. Alternatively, if the strength of the incompatible locomotor reactions, or directed response tendencies, were a consequence of the strength of conditioned aversion (Babb, 1980), then the present results could be accounted for on the basis that massed trials may lead to a faster accumulation of conditioned aversion when punishment is located in the goalbox.

REFERENCES

Babb, H. Reinforcement and punishment of an escape response. *Psychological Reports*, 1963, **13**, 542.

Babb, H. Facilitation by goal punishment after escape conditioning: CS intensity effects. *Psychological Record*, 1980, **30**, 229-236.

Babb, H., & Hom, H. L., Jr. Self-punitive responding by goal-shocked rats. *Journal of Comparative and Physiological Psychology*, 1971, **77**, 482-488.

Brown, J. S. Factors affecting self-punitive locomotor behavior. In B. A. Campbell & R. M. Church (Eds.), *Punishment and aversive behavior*. New York: Appleton-Century-Crofts, 1969.

Brown, J. S., Anderson, D. C., & Weiss, C. G. Self-punitive behavior under conditions of massed practice. *Journal of Comparative and Physiological Psychology*, 1965, **60**, 451-453.

Brown, J. S., Martin, R. C., & Morrow, M. W. Self-punitive behavior in the rat: Facilitative effects of punishment on resistance to extinction. *Journal of Comparative and Physiological Psychology*, 1964, **57**, 127-133.

Delprato, D. J., & Meltzer, R. J. Type of start box and goal box distinctiveness in self-punitive running in rats. *Journal of Comparative and Physiological Psychology*, 1974, **87**, 548-553.

Delude, L. A. Factors affecting the strength of the vicious circle phenomenon. *Psychological Record*, 1973, **23**, 467-476.

Delude, L. A. Starting procedures and the vicious circle phenomenon. *Canadian Journal of Psychology*, 1974, **28**, 125-130.

Hom, H. L., Jr., & Babb, H. Self-punitive responding in rats with goal shock and color change. *Animal Learning & Behavior*, 1975, **3**, 152-156.

Matthews, M. D., & Babb, H. Effects of the percentage of goal-punished extinction trials on self-punitive behavior. *Bulletin of the Psychonomic Society*, 1978, **12**, 64-66.

Mowrer, O. H. On the dual nature of learning—A reinterpretation of "conditioning" and "problem-solving." *Harvard Educational Review*, 1947, **17**, 102-148.

Mowrer, O. H. *Learning theory and personality dynamics*. New York: Ronald Press, 1950.

(Received for publication May 8, 1980.)