The partial reinforcement effect and competing behavior in a latent learning situation

ELVIS C. JONES AND CECIL C. BRIDGES, JR.

TEXAS CHRISTIAN UNIVERSITY

Rats were given partial or consistent reinforcement in a runway while satiated. They were then extinguished while deprived. Measures of runway halts and reversals indicated that the reinforcement groups differed in the frequency of competing behavior during both acquisition and extinction. Spontaneous recovery from competing responses was observed. Results were, in most cases, consistent with an earlier study where Ss were trained while deprived.

Jones & Bridges (1966) found differences in the competing responses produced by Ss which received partial and consistent reinforcement in a runway while deprived. The data in that study tend to support competing response theories of the partial reinforcement effect (e.g., Weinstock, 1954; Hulse & Stanley, 1956; Amsel, 1958).

Some competing response theories (e.g., Hulse & Stanley, 1956) focus on the conditioned eating response and other goal-specific behavior which have only an indirect and inferential bearing on pre-goal behavior. The value of these inferences is open to question since Freides (1957) found that food approaching in a goal box can extinguish without seriously affecting runway behavior. In any case, theories which focus on these goal-specific responses may be inappropriate when partial reinforcement is administered while Ss are satiated.

In the present experiment, Ss received consistent and partial reinforcement in a runway while satiated, and were extinguished while deprived. Runway halts and reversals were analyzed to determine if differences in reinforcement schedules are reflected in competing responses during acquisition and/or extinction. Spontaneous recovery from competing responses was also studied.

Method

The Ss were 20 female Sprague-Dawley rats, 110 days old at the start of the experiment. All Ss were raised on Purina Laboratory Chow, and were kept in individual cages. The Ss were assigned to blocks on the basis of weight and randomly assigned to two experimental groups. The Ss were then trained in a Bridges Runway (Bridges, 1966; Jones & Bridges, 1966), which was 48 in. long, 4-1/2 in. wide, and 6 in. high, excluding the goal box. The goal box was 10 in. x 4-1/2 in. x 6 in., and contained a copper food cup, 2 in. in diameter and 1/2 in. deep. The runway floor was a bar grid.

One set of bars was connected to a common bus-bar and alternate bars were connected between a series

of 15,000 ohm resistors. The series of resistors was connected across the output of a 20-v regulated power supply. The feet of the Ss provided a path for current to flow from the series of resistors to the bus-bar, and thus the device functioned as a voltage divider, with the Ss' bodies acting as the variable contact of a potentiometer. A Sanborn DC amplifier was connected to a Sanborn DC recorder, providing a continuous record of varying voltage levels which were correlated with the Ss' positions in the runway (accuracy within 1 in.).

All Ss were fed only Noyes Precision Food Pellets for 48 hr., then they were given three training trials in the runway every three days for a total of 24 trials. The intertrial interval was 15 min. One group found five Noyes pellets in the food cup on every trial. For the other group, the pellets were present on only 50% of the trials (randomly determined). All Ss were satiated on food and water throughout training.

The goal box door was never opened during the training sessions. On each training trial the S was placed directly into the goal box, facing the food cup. Thirty sec. later, the S was removed to the start of the runway and allowed 2-1/2 min. to freely explore all of the apparatus except the goal box. Prior to each unreinforced trial, the goal box and food cup were washed and dried. The entire apparatus was cleaned after every fourth use. Ss spent the intertrial period in their home cages.

Following the last day of training, each S was deprived of food for 23 hr. and given 12 extinction trials each day for two days. The intertrial interval was 5 min. The pellets were never present in the food cup during extinction. The Ss were placed at the start of the runway and the goal box door was closed behind them as soon as they entered the goal box. Thirty sec. later, the Ss were removed to their home cages to await the next trial. During extinction, the home cages were supplied with water, but no food. Ss were fed for 1 hr., starting 15 min. after the last trial on each extinction day.

Tapes from the Sanborn recorder were analyzed to determine the number of halts and reversals in the runway. A halt was defined as the S's staying within a 3-in. section of the runway for 1 sec. or more, regardless of the direction of movement prior to the halt. A reversal was defined as a movement of 3 in. or more away from the goal box when preceded by a movement of 3 in. or more toward the goal box. Movements could be disrupted by halts with-

Fig. 1. Runway halts, comparing partial and consistent reinforcement groups.

out affecting the criteria of reversals. Scores were converted to $1 - \frac{1}{X+1}$ to normalize distributions.

Results and Discussion

Although the groups tended to differ in halts during acquisition, plots of individual trial means indicate numerous crossovers. Also, there was extreme variation between individual Ss, resulting in considerable group overlap. Therefore, despite what appears to be a sharp group difference in halts during acquisition in Fig. 1, the difference was not statistically significant ($.10 > p > .05$). During extinction, however, within-group variances were small, and there were few crossovers. As can be seen in the extinction part of Fig. 1, the partial reinforcement group produced fewer halts than did the consistent reinforcement group ($F=7.47$, $df=1/17$, $p < .05$). Trend analysis over 3-trial blocks did not indicate that the groups differed in trend during either acquisition or extinction ($p > .45$ and $> .10$, respectively).

As can be seen in Fig. 2, the groups did not differ in the total number of reversals during acquisition ($p > .25$). However, there was a significant difference in trends ($F=2.38$, $df=7/126$, $p < .05$). During extinction, the groups differed not only in total number of reversals produced ($F=6.93$, $df=1/17$, $p < .05$), but also in linear trend ($F=4.28$, $df=1/126$, $p < .05$), as predicted on the basis of Jones & Bridges (1966).

Correlated t tests of spontaneous recovery from halts and reversals, comparing the last trial of each day and the first trial of the next, were not significant during acquisition ($p > .40$ in both cases). During extinction, however, spontaneous recovery from halts was significant ($t=1.87$, $df=19$, $p < .05$), as was spontaneous recovery from reversals ($t=1.90$, $df=19$, $p < .05$).

Correlations between the combined groups' trial means over the 24 extinction trials were: speed and

Fig. 2. Reversals of direction in the runway, comparing partial and consistent reinforcement groups.

halts, $-.71$; speed and reversals, $-.68$; and, halts and reversals, $.73$ (in each case, $df=22$, $p < .001$). These correlations are very similar to those obtained by Jones & Bridges (1966), even though the Ss were trained while deprived in that study. Correlations between competing behavior and running speed were not possible during training, since Ss were not allowed to run to the goal box. It was, however, possible to correlate halts and reversals during acquisition. Unlike the earlier study, the correlation between halts and reversals during acquisition in the present experiment was low ($-.17$, compared with $.73$ in the earlier study). There are too many differences between procedures in the two experiments to allow for a confident explanation of this difference in correlation.

The results indicate that even when reinforcement is administered under satiated conditions, differences between reinforcement schedules are detectable in terms of competing responses during acquisition (reversals), and extinction (halts and reversals). Further, spontaneous recovery from both halts and reversals occurs between extinction days.

References

- Amsel, A. The role of frustrative nonreward in noncontinuous reward situations. *Psychol. Bull.*, 1958, 55, 102-119.
- Bridges, C. C. All-electric recording in a straight alley. *Amer. J. Psychol.*, 1966, 79, 131-133.
- Freides, D. Goal-box cues and pattern of reinforcement. *J. exp. Psychol.*, 1957, 53, 361-371.
- Hulse, S. H., Jr., & Stanley, W. C. Extinction by omission of food as related to partial and secondary reinforcement. *J. exp. Psychol.*, 1956, 52, 221-227.
- Jones, E. C., & Bridges, C. C., Jr. Competing responses and the partial reinforcement effect. *Psychon. Sci.*, 1966, 6, 483-484.
- Weinstock, S. Resistance to extinction of a running response following partial reinforcement under widely spaced trials. *J. comp. physiol. Psychol.*, 1954, 47, 318-322.