Facilitative effects of reward increase: An apparent "elation effect"

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Magnitude of reward in the first goal box (G1) of a double-alley was aperiodically increased for two groups of rats. Speeds following these increases were faster than the second alley speeds of a third group which consistently received the large G1 magnitude. These results are discussed with respect to the Crespi-elation effect and previous double-alley findings.

A number of recent studies have investigated a phenomena first reported by Crespi (1942) in which facilitation of subsequent responding followed an increase in reward magnitude. Several studies report a failure to find facilitated performance (Spence, 1956; Metzger, Cotton, & Lewis, 1957; Capaldi & Lynch, 1967; Schrier, 1967). Furthermore, several authors (Spence, 1956; Schrier, 1967) have offered methodological criticisms of studies supporting the elation effect.

Two procedural aspects of previous single-alley work on the elation effect may have produced the inconsistency apparent in that literature. First, these studies have employed a consistent shift upward in reward magnitude (i.e., Ss receive the larger magnitude of reward on all trials following the initial shift). Consequently, only a single trial-to-trial increase in reward actually occurs. Second, any facilitative effects of reward increment may be reduced by the intertrial interval or events occurring during this interval (e.g., handling).

In the present study, a "test" trial condition was used in which larger reward magnitudes were presented on some trials in the first goal box (G1) of a double alley. This procedure allowed several trial-to-trial increases in incentive to occur enabling repeated measurement of a response following an increase. Furthermore, the referent (second alley) response subsequent to the reward magnitude increase occurred without handling and with a minimum of delay after the increase.

Previous work on the effects of incentive decrease (i.e., frustration) has employed this or similar paradigms extensively. Notable in this respect is the success which frustration studies have had in demonstrating the facilitative effects of several incentive reduction manipulations (cf. Barrett et al, 1965; Wagner, 1959; McHose, 1966). Furthermore, a few studies in this literature suggest, albeit tangentially, that reward magnitude increases may facilitate subsequent responding (Wagner, 1959; Amsel & Hancock, 1957).

METHOD

Forty-eight male albino rats received 48 acquisition and 60 postshift trials in an L-shaped double alley apparatus. The apparatus consisted of an 11-in. start box (S1), 24-in. alley (A1) and an 11-in. goal box (G1), and a second 24-in. alley (A2) and an 11-in. goal box (G2), with G1 serving as a start box for A2. Solenoid-operated, dropping doors separated S1 from A1 and G1 from A2. Upward acting retract doors, normally open, were positioned between A1 and G1 and between A2 and G2. A translucent (clouded) Plexiglas dome formed the top and sides of the entire runway, yielding a 3½-in. base width and 2½-in. apex width. The apex was 4½ in. above the floor. The clear Plexiglas floor was scribed the width of the alley at 1/8-in. intervals through the runway. Two neutral density filters fitted to the second alley dome provided differential first and second alley brightness. Photocell-clock circuitry provided traversal time measures over a 6-in. section of A2 beginning ¼ in. from the start door leading to A2 and the next 1-ft section of A2.

Ten days prior to the first day of training, Ss were placed on a 23-h deprivation cycle, maintained throughout the experiment. On the fourth, fifth, and sixth days prior to training, Ss were individually handled and allowed to eat about 20 45-mg Noyes pellets in their home cage prior to their daily ration. For the three days just prior to training, Ss were placed in

carrying cages, taken to the experimental room and allowed to explore S1 and A1 with the dome covering raised.

Subjects were randomly assigned to one of three groups, which were designated according to the number of 45-mg pellets received on each acquisition trial in G1: Groups 1, 3, and 7C. During the postshift period, Groups 1 and 3 received occasional 7-pellet "test trials" in G1. These test trials occurred at pseudo-random times on a ratio of one per two-day interval or one out of six trials. A recurring 30-trial series was used in which magnitude increase trials fell on Trials 2, 11, 13, 21, and 28. All Ss received two 45-mg pellets in G2 throughout both phases of the experiment.

On the first day of training, each S received one trial, on the second day, two trials, and three trials per day thereafter. The within-day intertrial interval was approximately 5 min for each S. The start door separating G1 from A2 was opened after S had consumed the G1 reinforcement and had maintained an orientation toward the door for 3 sec.

RESULTS

Group mean A2 starting and running speeds as a function of blocks of 12 trials are presented in Fig. 1. In each half of the figure, the three unconnected points represent the group mean speeds over the last 12 trials of the acquisition period. The remaining trial blocks represent the postshift, testing phase speeds for the various conditions. Within each postshift block for Group 1, mean speed for the 10 trials on which Ss received one pellet and the two trials on which they received seven pellets in G1 are plotted separately. Similarly, the mean speed for the 10 three-pellet trials and the two seven-pellet trials are plotted separately for Group 3. In correspondence with the standard (S) and test (T) magnitude conditions of the two experimental groups, the mean speed data for Group 7C are plotted separately, although the separate plots do not represent G1 magnitude differences for this group as they do for the other groups. Hence, the 7C-Test trend line represents the mean speed of Group 7C for those trials on which seven-pellet G1 reward was received by Ss in Groups 1 and 3.

As may be seen in Fig. 1, differences between groups on final acquisition, S, and T trials occurred with Group 3 displaying faster speeds than Group 1 which in turn ran faster than Group 7C. Analyses of variance of the 12-trial terminal acquisition start and run speeds showed significant ($p < .01$) groups effects ($F_s = 6.48$ and 6.17 , respectively, $df = 2/45$). Tukey "A" tests performed on the group totals revealed significant ($p < .05$) differences between Group 7C and the two other groups; however, Group 3 and Group 1 did not differ significantly.

Fig. 1. Group mean A2 speeds as a function of blocks of trials.

Fig. 2. Group mean A2 speeds on test trials relative to Group 7C speeds.

An analysis performed on the postshift start speed data over Blocks 2-5 showed a significant ($p < .025$) Groups effect ($F = 4.48$, $df = 2/45$), and a significant ($p < .01$) G1 magnitude effect ($F = 8.45$, $df = 1/45$) within groups. Subsequent Tukey "A" tests yielded significant ($p < .01$) differences among the three groups on both T and S trials, except for Group 1 vs Group 3 on trials ($p < .05$). The postshift running speed data were analyzed in the same manner as the starting speeds. In this analysis a significant ($p < .01$) G1 magnitude effect within groups and a significant Groups by G1 Magnitude interaction were obtained, $F_s = 53.9$ and 8.25 , $dfs = 1/45$ and $2/45$, respectively. However, the comparisons between groups using the Tukey test were somewhat less reliable.

A significant Trial Block effect occurred, $F(3/135) = 12.77$ and 6.93 , for the start and run measures, respectively, $p < .01$; but Trial Blocks did not interact significantly with any main effects or main effect interaction.

The statistically significant differences between groups on 7-pellet test trials are more easily illustrated by Fig. 2 which presents the differences between mean start and run speeds for each of the two experimental groups from the mean speed of Group 7C as a function of postshift trial blocks.

DISCUSSION

During the postshift period, Groups 1 and 3 ran faster in A2 following a 7-pellet reward in G1 than did a control condition, Group 7C. Thus, the present data clearly indicate that an increase in reward magnitude will enhance the level of a response following the reward increase. Furthermore, the A2 starting speeds for both groups give no indication of any diminution of facilitation during the 60-trial postshift period.

The present paradigm seems optimal for demonstration of the contextual or relative effects of an increase in magnitude of reward. Previous studies which failed to obtain an elation effect in the single alley have used a one-trial-per-day procedure, thereby "maximizing" the delay between the reward increase and the subsequent referent behavior. Moreover, in such an extended intertrial interval, various types of handling and feeding intervene. In addition, all but one of these studies (Capaldi & Lynch, 1967) have administered a single trial-to-trial reward increase only, as compared to 10 such increases in the present study.

In the traditional single-alley paradigm, Ss with a history of continuous small reward training are placed on a continuous large reward schedule of reinforcement. Assume with Capaldi (cf. Capaldi & Lynch, 1967) that large and small reinforced events generate different stimulus aftereffects (S_L and S_s , respectively). In the single-alley paradigm, S_L and S_s are differentially reinforced, locomotion in the presence of S_L being systematically followed by the larger reward. This aftereffect-reinforcement magnitude contingency is similar to the reinforcement contingencies used in the typical

differential conditioning paradigm. Any facilitative effects of large reward, then, may well be attenuated by the tendency of Ss to run slower to the larger of two rewards in a differential conditioning situation than does a nondiscrimination (large reward) control condition (cf. Mackinnon, 1967). In the present study, reward magnitude in G2 is not varied and is thus independent of the occurrence of S_L or S_s in G1.

In view of the previous considerations, the present study is perhaps most similar to a single-alley random-varied magnitude study in which Ss receive several trials each day. Interestingly, Beier (in Logan, 1960) found that in such a situation, Ss ran faster on trials following large as compared to small reward.

Besides relating to the elation phenomenon, the present results are relevant to some phenomena previously observed in the double-alley apparatus. The inverse relationship between preshift A2 speeds and G1 reward magnitude is consistent with previous findings (McHose & Ludvigson, 1965), and the suggestion that this function is nonmonotonic in the 0-4 pellet range is consistent with previous data (Daly, 1968). Also, an inverse function relating number of pellet increase to amount of A2 facilitation is similar to the inverse relation obtained by Barrett et al (1965) between size of shift to nonreward and A2 facilitation.

Finally, the present (reward increase) study in conjunction with the previous double-alley frustration studies on reward reduction forms a conceptual design for separating the effects of prior training magnitude from its interaction with the shifted-to magnitude. The fact that both reward increases and some reward decreases produce facilitation, but that no changes in reward have produced debilitation in A2, warrants the conclusion that magnitude change per se (i.e., pre- by postshift G1 magnitude) is responsible for the facilitative effects obtained in the present study and in the studies shifting to nonreward in G1.

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NOTES

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