Conditioned reinforcement strength as a function of the pattern of reward and nonreward

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Two groups of rats ($N = 20$) received 50% reinforcement for responding in the presence of a light stimulus. For one group, there were long runs of reinforced and nonreinforced stimulus presentations; for the other group, the runs were short. Response latencies indicated that the reinforcement pattern was not discriminated. A test for conditioned reinforcement strength revealed that the stimulus acquired more strength in the group which had experienced longer runs of reinforcement and nonreinforcement.

The pattern of rewards and nonrewards in a partial-reinforcement schedule would seem to be a factor affecting resistance to extinction, especially under conditions of relatively short intertrial interval. Capaldi (1966, 1967) has suggested that the average length of runs of consecutive nonreinforced trials (N-length) is one of the crucial factors in determining resistance to extinction (RE). Since variables which have been found to influence the RE of a conditioned response have usually been found also to influence the RE of a conditioned reinforcer, McCausland (1969) investigated the effects of the pattern of stimulus-reinforcement pairings on conditioned reinforcement strength. Two groups of rats were conditioned to leverpress in the presence of a light stimulus. Approximately 50% of the responses of both groups were followed by primary reinforcement. One group experienced a 90% transition from nonreinforced (N) stimulus presentations to reinforced (R) stimulus presentations and a 90% transition from reinforced stimulus presentations to nonreinforced stimulus presentations. This schedule produced a high number of N-R transitions between short runs of nonreinforced and reinforced stimulus presentations. The second group experienced a 10% probability of an N-R transition and a 10% probability of an R-N transition. This schedule produced a low number of N-R transitions between long runs of nonreinforced and reinforced stimulus presentations. Strength of conditioned reinforcement was then evaluated during an extinction session composed of ABBA counterbalanced 30-sec periods. A leverpress during one period produced the light stimulus; a leverpress during the other period did not. There was an indication that the

stimulus had acquired conditioned-reinforcement strength in both groups, but there was no difference in stimulus strength between the two groups. However, response latencies (time between stimulus onset and a response) during acquisition indicated that the pattern of reinforcement was discriminated by both groups. Ss experiencing a high transition probability had significantly shorter response latencies on trials which followed a nonrewarded trial; Ss experiencing a low transition probability had significantly shorter response latencies on trials which followed a rewarded trial. Koteskey & Stettner (1968) suggested that the effects of pattern of reward and nonreward on response strength may be eliminated or attenuated in situations where the reinforcement pattern is discriminated. This suggestion, if applied to conditioned reinforcement strength, provides a possible explanation for the absence of a difference in strength of conditioned reinforcement produced by the two reinforcement patterns used by McCausland.

The purpose of the present study was to investigate the effects of the pattern of stimulus-reinforcement pairings on strength of conditioned reinforcement in a situation where the pattern would not be discriminated. Thus the method was identical to that of McCausland (1969), except that the transition probabilities were 70% and 30% instead of 90% and 10%.

METHOD

Twenty naive male Sprague-Dawley albino rats, 100-120 days old, were fed 10 g of Purina Lab Chow per day for 10 days prior to the initiation of training and 10 g per day immediately after each experimental session. Water was continuously available.

Two Lehigh Valley operant conditioning chambers

(Model 1316-2), each equipped with a 45-mg pellet dispenser, were controlled by programming and recording devices located in an adjacent room. The houselight in the chambers functioned as the paired stimulus; otherwise, the chambers were unlit.

The Ss were magazine trained and shaped to leverpress on Days 1 and 2. On Day 3, the Ss were given 150 reinforcements on a continuous reinforcement schedule. On Day 4, the Ss were divided randomly into two equal groups ($N = 10$) and presented with the light stimulus which terminated after 5 sec or immediately following a leverpress. The stimulus was programmed to appear at irregular intervals, with an average interval of 30 sec. A daily session consisted of 50 stimulus presentations. A response in the presence of the light stimulus produced reinforcement on approximately 50% of the trials. However, the probability of reinforcement on any particular trial was a function of the occurrence of reward (R) or nonreward (N) on the previous trial. Group 70%T experienced N-R and R-N transition probabilities of 70%. Thus this group experienced a large number of N-R transitions between short runs of nonreinforced and reinforced trials. Group 30%T experienced N-R and R-N transition probabilities of 30%. Thus, this group experienced a small number of N-R transitions between long runs of nonreinforced and reinforced trials. The transition probabilities were controlled by random probability generators. The Ss were exposed to the appropriate schedules on Days 4-8. Response latency was defined as the interval of time between stimulus onset and the next response. Response latencies on trials following both reward and nonreward were recorded.

Fig. 1. Mean response latencies during acquisition for Groups 30%T and 70%T on trials following rewarded trials (TFR) and on trials following nonrewarded trials (TFN).

Responding was extinguished on Day 9 during a 30-min session which consisted of 15 A B B A counterbalanced blocks, with each block composed of 30-sec periods. Each response during the stimulus-available (SA) periods produced the light stimulus for 1 sec; each response during the stimulus-not-available (SNA) periods did not.

RESULTS

Group 70%T received an average of 87.2 N-R transitions following N-lengths which averaged 1.47 consecutive nonreinforced stimulus presentations. Group 30%T received an average of 36.9 N-R transitions following N-lengths which averaged 3.40 consecutive nonreinforced stimulus presentations. Each of these values is quite close to the expected value.

Average response latencies for both groups on trials following a rewarded trial and on trials following a nonrewarded trial are depicted in Fig. 1. An analysis of the latency data revealed that (1) latencies decreased significantly across days, $F(4,72) = 47.33$, $p < .001$; (2) latencies on trials following nonreward were significantly longer than on trials following reward, $F(1,18) = 18.50$, $p < .001$; (3) the Days by Type of Latency (N vs R) interaction was significant, $F(4,72) = 9.95$, $p < .001$; and (4) the effect of groups and all other interactions were not significant, $F < 1.0$ in each case. Simple main effects tests on the Days by Type of Latency interaction revealed that latencies on trials following nonreward were significantly longer than on trials

following reward on Days 4 and 5, but not on Days 6, 7, and 8.

Group 70%T emitted an average of 98.8 and 72.7 responses during the SA and SNA extinction periods, respectively. Group 30%T emitted an average of 192.1 and 114.6 responses during the SA and SNA extinction periods, respectively. The analysis of these data revealed that (1) Group 30%T emitted significantly more extinction responses than did Group 70%T, $F(1,18) = 4.46$, $p < .05$; (2) significantly more responses were emitted during the SA periods than during the SNA periods, $F(1,18) = 28.90$, $p < .001$; (3) the Groups by Stimulus Availability interaction was significant, $F(1,18) = 6.85$, $p < .05$; (4) responding during extinction decreased across extinction blocks, $F(14,252) = 3.77$, $p < .001$; and (5) all other interactions were not significant, $F < 1.0$ in each case. Simple main effects tests on the significant Groups by Stimulus Availability interaction revealed that (1) Group 70%T emitted significantly more extinction responses during the SA periods than during the SNA periods, $F(1,18) = 7.08$, $p < .05$; (2) Group 30%T emitted significantly more extinction responses during the SA periods than during the SNA periods, $F(1,18) = 24.40$, $p < .001$; (3) the two groups did not differ significantly in the number of responses emitted during the SNA periods, $F(1,18) = 2.59$, $p > .10$; and (4) Group 30%T emitted significantly more responses than did Group 70%T during the SA periods, $F(1,18) = 7.73$, $p < .05$.

DISCUSSION

The absence of a significant effect

in either the Groups by Type of Latency interaction or the Groups by Type of Latency by Days interaction indicates that the pattern of reinforcement was not discriminated by either group. Thus the use of less extreme transition probabilities eliminated the problem of pattern discrimination observed in the earlier study (McCausland, 1969). The extinction test revealed that the light stimulus did become a conditioned reinforcer in both groups but that the effect was greater in Group 30%T than in Group 70%T. These results suggest that N-length is the factor responsible for the greater strength of conditioned reinforcement acquired by a stimulus paired with a partial reinforcement schedule, and they extend Capaldi's (1966, 1967) sequential effects hypothesis to conditioned reinforcement. The results of the present study, taken in conjunction with those of McCausland (1969), also support Koteskey & Stettner's (1968) contention that a discrimination of the reinforcement pattern can attenuate the effects of the pattern on resistance to extinction.

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