First attempt at a positive conditioned reinforcement analog of discriminated avoidance[1]

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Abstract

A positive conditioned reinforcement schedule that included provision for restrengthening the conditioned reinforcer whenever it weakened critically proved partially successful in maintaining bar pressing.

Problem

Why are conditioned reinforcers established by pairing with electric shock so long lasting, while conditioned reinforcers established by pairing with food are so short-lived? One among several possibilities is that the different experimental paradigms for studying conditioned positive and negative reinforcement cannot help but produce different performances.

In discriminated avoidance, a common conditioned negative reinforcement paradigm, "A neutral stimulus ...presented just prior to or overlapping with... a primary aversive stimulus, like shock, acquires an aversive property in its own right...When we try to make use of this stimulus as a reinforcing agent, however, a difficulty arises. The reinforcing operation —terminating the stimulus without shock—is incompatible with the establishing and maintaining operation, pairing the stimulus with shock...The difficulty is readily resolved, however, if the pairing is restored whenever the stimulus is weakened and the animal fails to respond within an arbitrary time limit..." (Dinsmoor, 1954). The paradigm includes a feature not seen in positive conditioned reinforcement experiments, a built-in provision for restrengthening the conditioned reinforcer when it weakens critically, and for deciding that that point is when the animal "fails to respond within an arbitrary time limit."

The present experiment matched the discriminated avoidance paradigm by building in a provision for restrengthening the conditioned reinforcer whenever it weakened critically, and a criterion of critical weakening in terms of long pausing.

Method

Two adult, male, albino rats were maintained at 75% of ad lib weight and trained in a 2-lever Lehigh conditioning chamber housed in a sound-resistant shell in a dark, sound-resistant room. Chamber and room contained white masking noise.

Stage 1: Pretraining. Over 10 days, including one of magazine training and one of self-shaping to press the right bar (the left bar was never used) the rats were brought to perform on a complex sechedule.

Stage 2: Establishing the conditioned reinforcer and baseline performance. The schedule was a two-link chain. The stimulus for link 1 was the flickering of a column of three pilot lamps above the right bar. The stimulus for link 2 was the steady illumination of the column of lamps above the left bar. The nature of the events in link 2 were different, depending on the nature of the behavior in link 1. Completion of 50 bar presses (FR 50) in link 1 produced the stimulus for link 2, which remained on for 15 sec. during the first few days of training, and for 17 sec. in all days thereafter. The end of link 2 recycled the chain back to link 1. If the FR 50 performance in link 1 included at least 1 IRT $\geq$ 5 sec. (which included most of the pauses that preceded FR runs) then the rat received a 45 mg sucrose pellet during the ensuing link 2, after a variable time delay from onset of the link-2 stimulus. The sucrose schedule is symbolized FV 1/4: free reinforcement at variable intervals averaging to one pellet in each 1/4-min. link-2 period. If the FR 50 performance included no IRT $\geq$ 5 sec., then the ensuing link 2 included no food. (This happened rarely.) Daily sessions lasted for 30 cycles of the chain. Ten sessions were run.

Stage 3: The avoidance analog. Only one major change was made. Food reinforcement in link 2 was contingent on occurrence of an IRT $\geq$ 55 sec., rather than 5, during the FR 50 of link 1. Sessions 1 and 27-31 were 30 cycles long; sessions 2-26 and 32-45, 60 cycles. During sessions 41-45 the sucrose schedule was changed so that 2-4 pellets, rather than 1, occurred in each link 2 that was programmed to include food.

Stage 3 attempted to maintain the rat's FR bar pressing by the conditioned reinforcer of 17 sec. of the link-2 stimulus. The stimulus was restrengthened with food whenever it weakened critically, as defined by an IRT $\geq$ 55 sec. during completion of the FR 50.

Results

Figure 1 shows performances of one of the two Ss at the termination of stage 2 (top left) and at various points in stage 3. In the upper right is a graph showing the median number of IRTs $\geq$ 55 sec. in the last 5 sessions of stage 2 and in each five-day block of stage 3. (A few blocks were longer or shorter than five, so as not to include 30- and 60-cycle sessions in the same datum.) Almost no IRTs $\geq$ 55 sec. occurred in stage 2, but the number increases progressively through stage 3, indicating that the procedure did not succeed in maintaining the baseline FR performance. Increasing the amount of sucrose associated with the conditioned reinforcer (last 5 sessions) did not reduce the FR pauses.

However, the records of sessions 1-3 of stage 3 show that the attempt at avoidance analogy was temporarily

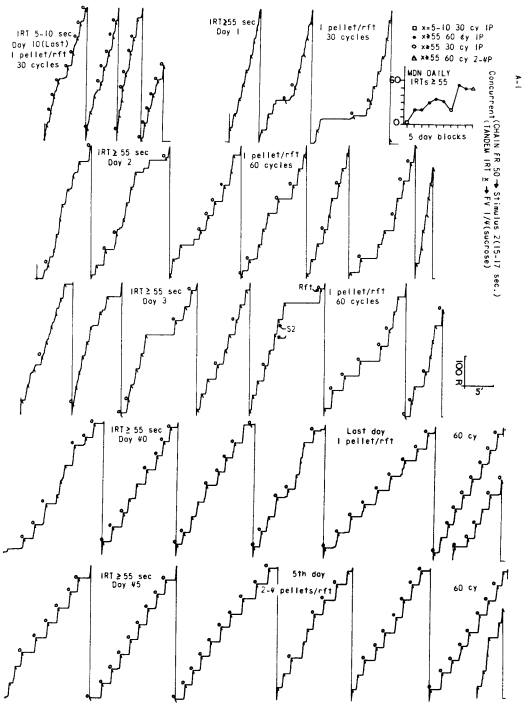

Fig. 1. Sample performances by rat A-1 during the first link of the chain. The recorder motor stopped during link 2. Pen deflections show the omitted link-2 intervals. Open circles above the pen deflections show primary reinforcements in link 2.

successful. On the first day, several FRs were run off at rates comparable to those of the last day of stage 2. Gradually, the pauses preceding FR runs lengthened, until the 55-sec. weakening criterion was reached and food occurred in the next link-2 period. Another 55-sec. pause followed, and another sucrose reinforcement. Then performance recovered, and several FRs were run off at stage-2 rates. Gradually the pauses lengthened, primary reinforcement was given twice, and another cycle of shorter-to-longer pauses began. The performance resembles that obtained on Sidman avoidance schedules (Sidman, 1955) where avoidance bar pressing rate gradually falls off during the session until one or two shocks occur, and then the rate rises, only to fall gradually again until more shocks occur. Days 2 and 3 of stage 3 show similar cycles of shorter-to-longer pauses.

By the 40th day the performance was different. Sucrose was delivered in many of the chains, and the pauses in FR performances appear to have stabilized at lengths much greater than those of stage 2. (Almost identical results were obtained from the other S, and from two Ss run earlier on a similar schedule.)

Discussion

It is now clear that several important features of discriminated avoidance were overlooked in the design of the present experiment. (1) In avoidance, not only do pauses set the occasion for restrengthening the conditioned aversive stimulus by pairing with shock; pauses are directly punished by shock. In this experiment pauses $\geq$ 55 sec. were directly and positively reinforced with food. (2) In discriminated avoidance, the S^D for the avoidance response is the same stimulus whose offset acts as S^r for the response. In this experiment the S^D for link 1 was necessarily different from the S^r for FR responding. (3) In avoidance, every response that meets the conditioned reinforcement contingencies (i.e., occurs during the WS-Shock interval) is reinforced by terminating the warning stimulus and the avoidance trial. In this experiment, only the 50th link-1 response was directly followed by onset of the S^r. (See also Sidman & Boren, 1957 a,b).

Only further experiments can tell whether matching the contingencies of the avoidance schedule in the respects suggested above will yield a procedure that maintains behavior by positive conditioned reinforcement as well as the avoidance procedure maintains avoidance behavior. In the meantime, it does not seem unlikely that the complex contingencies of the avoidance paradigm may contribute as much as shock itself to the lasting maintenance of avoidance responding.

References

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Note

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