

# A note on the conditioned stimulus control of postshock responding\*

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Rats were trained to leverpress to avoid shock. Typically, Ss emitted a burst of lever responses whenever shock occurred. Following 35 avoidance training sessions, Ss were occasionally presented with a tone (CS) for 1 min before an unavoidable, inescapable shock (US) was administered. Avoidance deteriorated dramatically during CS (conditioned suppression), but a burst of responses occurred on termination of CS-US. When CS was presented without US—the classical extinction procedure—avoidance rapidly recovered during CS, but the response burst made to the termination of CS diminished only gradually and as a function of the number of CS presentations.

It is now well established that a rat which has learned to avoid shock by leverpressing will also vigorously make this response when, at some future time, it is shocked in the training apparatus. Some investigators (e.g., Pear et al, 1972) maintain that such responding is attributable to aggression induced by pain and is similar to the attacks noted by Miller many years ago when he paired either toys or a confere with presentations of shock (Miller, 1948). A different interpretation emphasizes the role of shock in providing the motivational conditions of fear and pain which subserved the acquisition and maintenance of conditioned leverpressing behavior (Mowrer, 1960). Yet another interpretation is advanced by Bolles when he suggests that the flurry of postshock responses are reflexive rather than instrumental (operants) in nature (Bolles & McGillis, 1968). The evidence presently available does not allow one to choose among these alternative viewpoints. A question which should be raised, since this answer will affect which of these alternative views of postshock activity is most plausible, concerns the conditionability of such postshock behavior, sometimes referred to as response bursts (Sidman, 1958; Boren, 1961; Hurwitz & Bounds, 1968). This question was studied by the simple method of pairing a tone (CS) with a shock (US) and then presenting the tone on its own, as in classical extinction. If the postshock response burst is classically conditioned, the response bursts should continue after the tone-shock pairing is suspended. It would demonstrate that the response to shock is transferrable to stimulus events associated with shock.

## METHOD

### Subjects

The Ss were 6 female hooded rats purchased from Spruce Farms, New Jersey, weighing about 140 g at the beginning of the

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experiment. The rats were housed individually in the animal vivarium with food and water always available.

### Apparatus

Three 23 x 24 x 14 cm all metal chambers were used, each fitted with a lever which protruded 2.5 cm into the chamber. The lever was 5 cm wide and was positioned 5 cm above floor level. A 10-g deadweight was needed to move the lever from its resting to operating position. The floor consisted of an electrifiable grid. Two houselights were installed at ceiling height. An electrically activated buzzer was mounted behind the lever. It was programmed by a circuit which pulsed the buzzer and raised the noise lever in the chamber from approximately 78 dB to 90 dB (ref: .0002 dynes/cm<sup>2</sup>). Shock was applied to the grid and walls of the chamber via a constant current stimulator which produced .8 mA, 170 ac. The polarity of shock was scrambled across the grids by a home-built device.

### Procedure

Ss were trained to avoid shock under a free operant avoidance schedule as originally described by Sidman (1953). Shocks of .4-sec duration were presented at 5-sec intervals unless a leverpress occurred. Every lever response postponed the shock by 20 sec. After approximately 35 training sessions, the Ss were randomly assigned to one of two groups. For Group A, the avoidance schedule remained in effect at all times, whereas for Group B the avoidance schedule was suspended during presentation of a tone. Both groups were presented with a tone for 1 min (CS) before an inescapable and unavoidable shock (US) was administered. Tone and shock were presented at an average rate of once every 4 min throughout each 2-h session. After 24 sessions, the conditions were reversed so that for Group B the avoidance schedule was in effect at all times (16 sessions). Thus both groups were given CS-US pairings on a periodic schedule but one group had the avoidance schedule suspended during CS-US. Finally both groups were exposed for 19 sessions to a classical extinction procedure: that is, the tone was presented as before, but no further unavoidable shocks (US) were administered.

## RESULTS

Two measures were obtained: measures of the rate of lever pressing and the rate of avoidable shock (Hurwitz, Harzem, & Kulig, 1972). Each measure was obtained during a 1-min period before the CS, and during the 1-min presentation of CS. The rate of response was also

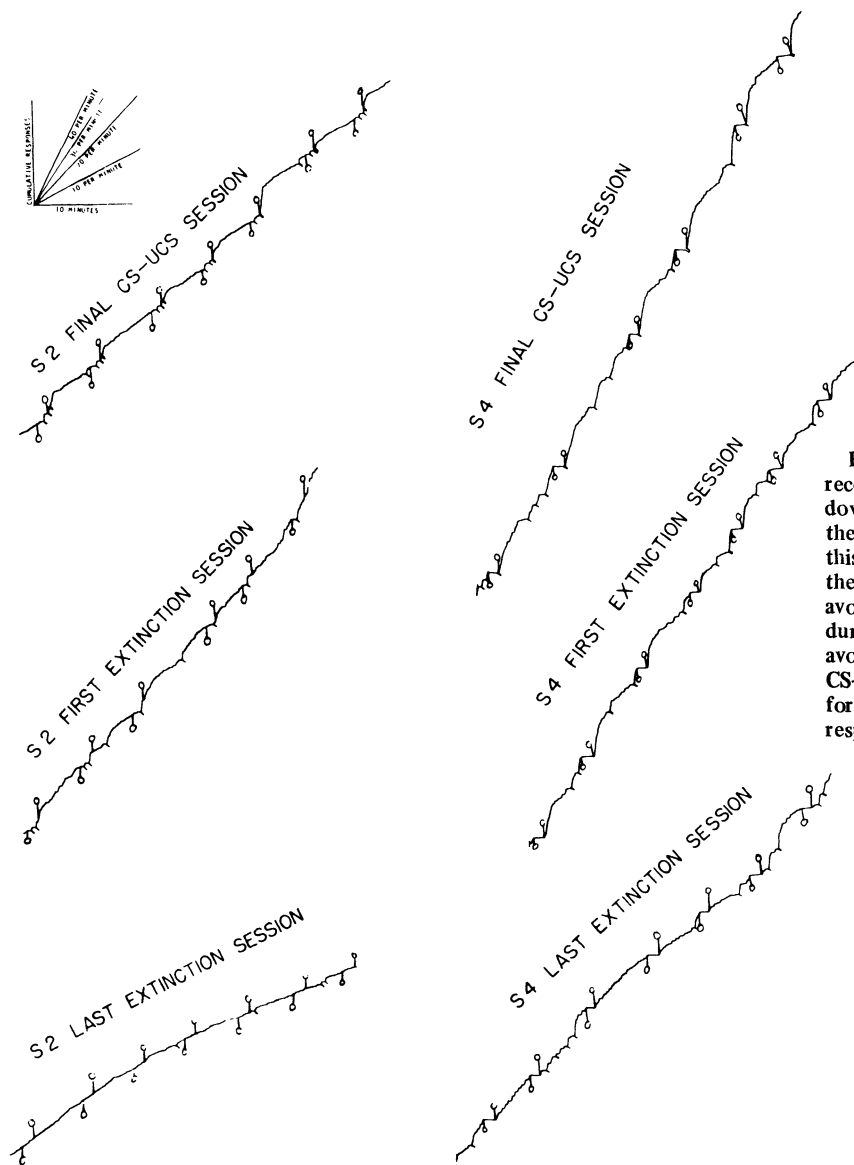


Fig. 1. Sample of cumulative response records for two Ss, S2 and S4. The downward beacon indicates the onset of CS; the upward beacon indicates termination of this CS. The upper records were taken from the final CS-US sessions: for S2 the avoidance schedule remained in effect during CS-US presentation; for S4 the avoidance schedule was suspended during CS-US. Note the increase in rate of shock for S2. Both Ss emitted a high rate of response to US.

determined for each 20-sec period after termination of the CS, during a post-US period.

The two procedures of presenting CS-US yielded distinctly different results: (a) when the avoidance procedure was suspended during CS, responding during CS ceased. This is shown in a cumulative record taken from the final CS-US session of S4 (Fig. 1, see also Hurwitz & Roberts, 1969). When the avoidance procedure remained in effect during CS, responding during CS continued although often at a reduced rate. This is shown in the cumulative record taken from the final CS-US sessions of S2. (Fig. 1, see also Hurwitz & Roberts, 1969; Roberts & Hurwitz, 1970). The rate of shock measure also indicated that during the minute before CS was presented, Ss received an average .25 shocks/min, whereas during CS the rate increased five fold to 1.2 shocks/min (see also Hurwitz & Roberts, 1971). Irrespective of whether the avoidance schedule was in operation during CS or not, the presentation of

US—which coincided with the termination of CS—resulted in a substantial burst of lever responses, the rate of responses being at least four times the rate observed during free operant avoidance training (see Fig. 2).

In the final phase of the study an extinction procedure was introduced, so that CS was presented without US. During CS the avoidance schedule remained in effect for one group of Ss and was inoperative for the other group. Ss continued to respond to the termination of CS with a burst of lever responses. This tendency, illustrated in the middle and lower panel of Fig. 1 and in the form of a ratio measure in Fig. 2, declined very gradually over the 10 extinction sessions. Figure 1 furthermore shows that the response rate during CS recovered in the case where the avoidance schedule was in effect (e.g., S2, Fig. 1) but failed to recover when the avoidance schedule was suspended during CS (e.g., S4, Fig. 1).

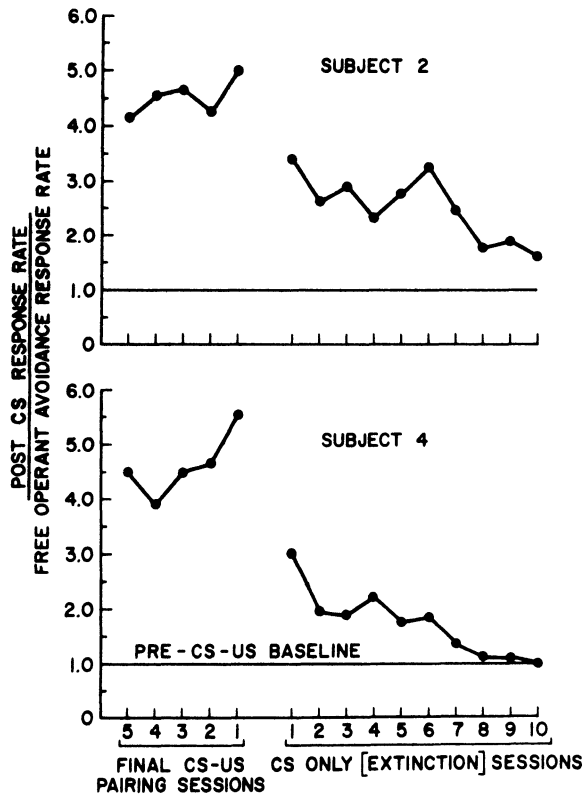


Fig. 2. Data for the final five sessions of the CS-US condition and the first 10 sessions of extinction for S2 and S4, respectively. The measure of response used in the ratio of post-CS responding sampled over 20 sec to rate of response during the pre-CS period. The ratio declined immediately after extinction commenced although the post-CS response rate exceeded the preCS rate for at least 8 sessions. The decline in this function was orderly over successive sessions.

The question raised in the introduction, whether response bursts to shock become conditioned to

pre-shock events, is therefore answered in the affirmative. Note that it is the termination of the CS which appears to be the conditioned stimulus for responding vigorously on the lever. This tendency declined only gradually, after many presentations of CS and after many sessions. It should be noted that this extinction of the conditioned response rate was associated with a recovery of responding during CS.

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