

# Fear conditioning as a function of CS duration during acquisition and suppression tests

JAMES A. DYAL AND EDWARD D. GOODMAN

TEXAS CHRISTIAN UNIVERSITY

*The effects of CS duration during fear conditioning were assessed using a secondary punishing technique. CS duration was not found to be an influencing variable. Inadequacies of the secondary punishment procedure utilized by Mowrer and his colleagues were noted and it was suggested that more extensive comparisons be made of the CER technique with an improved secondary punishing procedure.*

In investigating critical parameters of fear conditioning, Mowrer & Aiken (1954) and Mowrer & Solomon (1954) used the technique of conditioned suppression via a secondary punisher. In this procedure a rat is trained to make an operant bar press on a CRF schedule for food. Concurrently, but in a different environment, a CS (light) is presented immediately prior to shock, i.e., a fear conditioning procedure. After several training sessions in each situation, the CS is used as a secondary punisher by being made contingent on the bar press. The fear arousing capacity of the light is inferred from the amount of response suppression which occurs during the secondary punishment phase. This procedure differs from the more widely used conditioned emotion response (CER) procedure (Estes & Skinner, 1941) in that in the CER technique the presentation of feared stimulus is *not* contingent upon S's response. It is programmed independently of the food reinforcement schedule. The amount of response suppression which occurs while the conditioned stimulus is present is taken as an index of its fear arousing capacity.

Kimble (1961, p. 270) states that "...the function relating strength of fear to the time separating neutral and noxious stimuli resembles that for other classically conditioned responses." However, this generalization has a very limited empirical support being based primarily on studies of avoidance conditioning rather than fear conditioning per se. Those experiments which have studied fear conditioning using a CER procedure have typically found optimal durations to be considerably longer than the .5 sec. which Kimble implies. Libby (1951) found that response suppression increased with increases in CS duration up to 7 sec., but observed no increases between 7 sec. and 30 sec., i.e., the function was a negatively accelerated increasing one which was asymptotic around 7 sec. Using pigeons, Lyon (1963) found that as the CS duration increased from 100 to 300 sec., the amount of suppression increased. Similarly, Stein et al (1958) and Carlton & Didamo (1960) found *relative* CS duration to be an important parameter of conditioned suppression.

The purpose of the present experiment was to determine if similar results would be obtained if the CS

were made response contingent and thus used as a secondary punisher. It seemed reasonable to use, where possible, the same procedures and parametric values which were used in the original experiments by Mowrer and his colleagues, since they had obtained differential response suppression.

## Method

The Ss were 75 male and female Sprague-Dawley rats ranging in age from 100 to 200 days at the start of training. Age and sex were balanced over the experimental treatments. The apparatus was a Grason-Stadler operant conditioning unit, consisting of an operant box, with relay and timing units which provided for automatic programming and recording. The box was modified by the insertion of a black and aluminum colored Masonite partition which divided the box approximately in half, and provided the side next to the bar with a black Masonite floor and wall. The left half of the box consisted of the aluminum colored wall of the partition, plus the regular box walls and grid floors. During fear conditioning the CS was the onset of the light, which normally provided "house light" for the box. It was removed from its usual location and hung inside the shock-box section. The UCS was a 3 sec. duration shock delivered through the Grason-Stadler Model 1064GS shock generator set at a dial intensity of 1.0 ma.

The training procedure was the same as that used by Mowrer and Solomon (1954). Its essential features were as follows: On Day 1, S was brought to the experimental room and placed into the food-reward side of the apparatus. There were four .45 mg food pellets in the food magazine. S was permitted to make 20 food reinforced bar presses. The S was transferred to its home cage for 30 min. access to wet mash and then returned to the experimental room and placed into the fear-conditioning side of the box. After 5 min. the CS was presented followed at the appropriate interval by shock. On training Days 2-5 the procedure was the same except that S received only 5 reinforced bar presses instead of 20. On Day 6, S was placed into operant compartment and permitted 5 min. of CRF. Immediately following this period in which each bar press produced a food pellet and the CS.

The independent variables were CS duration during acquisition (p. 5, 5.0, 15, 30, and 60 sec.) which was factorial to CS duration during the suppression test (0.5, 5.0, 15, 30, and 60 sec.).

## Results and Discussion

It may be seen in Fig. 1 that substantial response suppression occurred in all groups. Statistical analysis

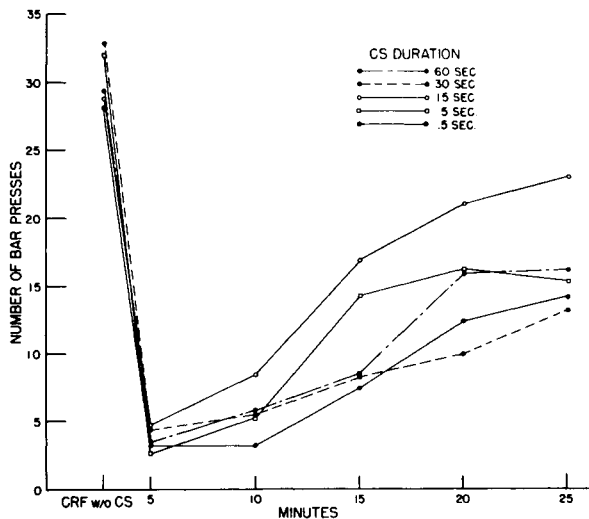


Fig. 1. Mean number of bar presses during the suppression test as a function of CS duration during fear conditioning. CRF w/o CS refers to the 5 min. period of CRF during which a bar press resulted in food reinforcement but no light (CS).

of the difference between the 5 min. of CRF with the first 5 min. of the suppression test revealed reliable response suppression for all acquisition groups. Similar conclusions obtain if the response suppression is evaluated by analysis of extinction durations over all acquisition durations. It should be noted that although the obtained response suppression may be reasonably interpreted as reflecting the aversive properties of the CS, it is also probable that some suppression would have been obtained by merely introducing the novel light stimulus. The appropriate controls are not present in this experiment to separate these two effects.

Although significant response suppression was obtained, factorial analysis of variance of total number of responses during the suppression period revealed no differential effects of CS duration during either acquisition or extinction. Since it was possible that the lack of differential effects might have resulted from the excessive suppression during the first 10 min. of the suppression test, an ad hoc factorial analysis of vari-

ance was applied to the data for the last 15 min. only. Again the results revealed no differential effects attributable to CS duration either during acquisition or extinction.

These results are contrary to those of Carlton & Didamo (1960), Stein et al (1958), Libby (1951), and Lyon (1963) using a CER procedure. They are consistent with results obtained by Brush (1957) who found that CS duration did not effect traumatic avoidance learning by dogs in a shuttle box.

It is our feeling that the lack of differential effects of CS duration in the present experiment may have been due to the fact that the Mowrer and Solomon procedure did not require the operant to be trained to a sufficiently stable level. As a result, variability during the suppression test is quite high and thus masked whatever CS duration effect may have been present. On the other hand, it may be that different functional relations will hold between various independent variables and response suppression, depending on whether the CER or secondary punishment techniques are used. It would appear that an experimental comparison between the CER procedure and the secondary punisher procedure with response rate stabilized would be in order before further experiments are conducted with the secondary punisher procedure.

## References

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