Increased responding to CS⁻ in differential CER[1]

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Rats were given differential conditioning to a tone (signal for shock) and a light (signal for no shock) using the CER procedure. Response rate in the presence of the CS⁻ (light) was compared to the unconditioned effects of the light upon the VI response rate in a no-shock control group. CER Ss showed enhanced response rates during the light, to an extent greater than that during the light presented to the control group.

There are several ways of combining Pavlovian conditioning and instrumental training procedures in the control of instrumental responding. Rescorla & LoLordo (1965) trained dogs to jump to avoid shock on a Sidman schedule, and then they tested the dogs with brief presentations of a CS+ that had been paired with shock and a CS⁻ that had been paired with absence of shock during Pavlovian conditioning. The CS+ was excitatory, increasing the jumping rate, but the CS⁻ was inhibitory, actively suppressing the jumping. In this experiment both the Pavlovian US and the instrumental reinforcer were aversive.

In contrast, the standard CER experiment combines an aversive Pavlovian conditioning procedure with an appetitive instrumental training procedure; and, in addition, most CER experiments have been non-discriminative, using a CS+ paired with shock but no contrasting CS⁻ paired with absence of shock. Therefore, we are not yet certain whether the CS+ and CS⁻ of a Pavlovian fear conditioning procedure would have effects on appetitive instrumental responding analogous to those found by Rescorla and LoLordo for aversive instrumental responding. We know that a CS+ paired with shock will suppress appetitive instrumental responding. We have, however, only hints about the action of a CS⁻ paired with absence of shock. Ray & Stein (1959) did differential conditioning with two tones of different frequency using the CER procedure. They found enhancement of instrumental responding to the presentation of the CS⁻ after three months of differential conditioning.

In the present study, the investigation of the inhibition of fear in the CER paradigm is improved by the use of a CS+ and CS⁻ which are markedly different from each other.

Method

Sixteen albino rats were divided into a CER and a no-shock control group.

Four automatically programmed Skinner boxes were used. Ss were given six 2 hr. daily sessions of VI-1 min. training for water reward (under 21-1/2 hr. deprivation). On both the fifth and sixth day of VI training, a flashing light (6 w bulb) and a tone (3000 cps) were each presented three times. Stimulus duration was 3 min. No shock was presented on these days. This procedure was then continued for another 15 days for the control group. For the CER group, the stimuli were presented in the same fashion on these 15 days, but the tone (CS+) always terminated in a .5 sec., .72 ma, scrambled grid-shock. Thus the CER group received three tone-shock trials and three light-no-shock trials a day, for a total of 45 reinforced trials.

Results

Suppression ratios were calculated for the responses to the stimuli (A/A+B, where A is the rate during the 3 min. stimulus and B is the rate for the 3 min. immediately preceding the stimulus).

The suppression ratios produced by the CS+ and CS⁻ for the CER group on the two pre-test days and the 15 conditioning days are shown in Fig. 1. Also shown are the control group's ratios to the light on these days. A ratio greater than .50 indicates enhancement of bar-pressing, and a ratio of less than .50 indicates suppression. Suppression of bar-pressing by the "fear" stimulus or CS+ occurred from day 3 on, and is comparable to data from typical non-discriminative CER studies. Enhancement of bar-pressing to the CS⁻ occurred from days 3 to 9 and then slowly declined. A repeated-measures analysis of variance was run for both groups on the ratios produced by presentations of the light (CS⁻ in the CER group) across conditioning days (groups by days, factorial). Ratios produced by

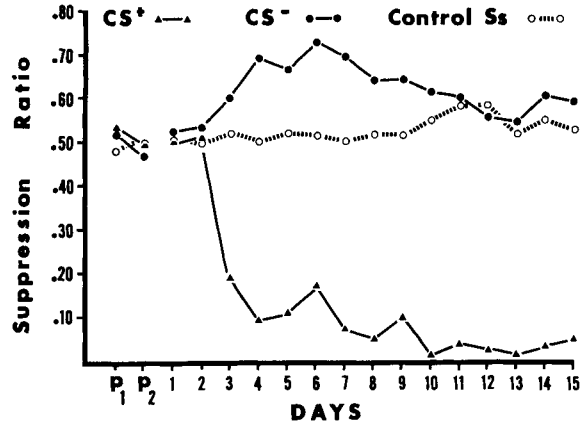

Fig. 1. Suppression ratios to the tone (CS+) and light (CS⁻) in the CER group, and suppression ratios to the light in the control group.

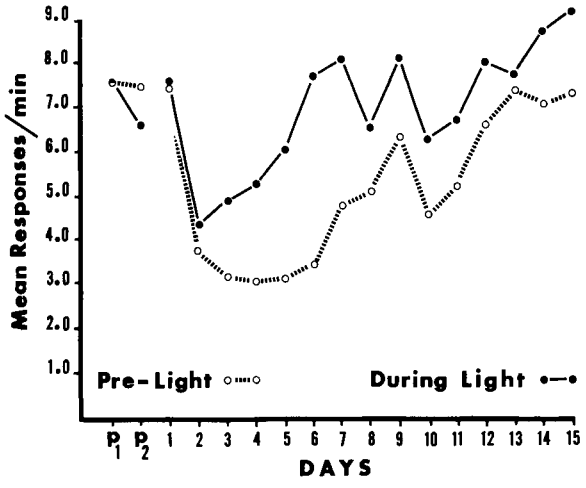

Fig. 2. Mean number of responses for the 3 min. period preceding the light and the 3 min. period during the light for the CER group.

presentations of the light were significantly greater for the CER group than they were for the control group ($F = 13.72$, $df = 1/14$, $p < .01$). The days effect was not significant, but the groups by days interaction was significant ($F = 2.46$, $df = 14/196$, $p < .01$). An analysis of the simple effects of the group factor for each day (Winer, 1962) revealed that the light ratios in the CER group were significantly larger than in the control group for days 3 through 9 ($p < .05$ or less), but were not significantly different on the other days.

Figure 2 shows the mean number of responses made during the 3 min. period immediately preceding the light and the mean number of responses made during the 3 min. light period for each day for the CER group. A three-way analysis of variance (stimulus conditions by days by subjects) was computed on the data from the 15 conditioning days. The mean number of responses made in the presence of CS^- was significantly greater than the mean number of responses made in the 3 min. period preceding the CS^- ($F = 26.13$, $df = 1/203$, $p < .01$). The days effect was also significant ($F = 4.42$, $df = 14/203$, $p < .01$), but the interaction was not significant ($F < 1$).

Discussion

When markedly different stimuli were used in the differential CER situation, enhancement of instrumental responding in the presence of CS^- appeared early in acquisition (during trials 6-9) and developed at the same time as did conditioned suppression in the presence of CS^+. These enhancement effects were not produced by presenting the flashing light to a non-shock control group.

The decline of the enhancement on later conditioning days may seem inconsistent with an interpretation based on Pavlovian inhibition, but this temporary nature of the effect can be evaluated by an examination of the operant baseline. In Fig. 2, the baseline is represented by the mean number of responses made during the 3-min., pre-light periods. This response rate drops sharply on the second conditioning day to 50% of the baseline rate on the pre-test days and it remains at that level for several days. The enhancement effect is observed mainly during this period of temporary baseline suppression, but is not seen when baseline responding is close to pre-shock levels. Thus enhancement is markedly related to the occurrence of the baseline suppression resulting from the introduction of shock. Furthermore, response rate during the CS^- never substantially exceeds the rate in the presence of the light observed prior to introduction of shock. It may be concluded that the response rate enhancement does not reflect greater absolute rate of responding to the light, but only a return to the pre-shock level of responding occasioned by the presence of the light. Since the lowered response rate resulting from shock is temporary, the enhancement effect is also temporary.

The lowered baseline rate probably reflects "fear" conditioned to the apparatus cues. Shock occurs only after the compound CS of tone plus apparatus cues. This is the Pavlovian paradigm for conditioned inhibition; the apparatus cues eventually become inhibitory stimuli when presented alone and excitatory when combined with the tone. Such an explanation would predict recovery of the baseline after its initial depression.

References

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Note

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