Properties of a preexposed stimulus*

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The effect of preexposure to a white noise stimulus, using hooded rats in two testing situations, was examined. Consistent with previous research, preexposure to a to-be-conditioned stimulus interfered with acquisition of a CER to that same stimulus. In the second experiment, the preexposed stimulus produced greater disruption of an excitatory CR than was observed in an external-inhibition control when it was superimposed on an already established excitatory stimulus. These two experiments suggest that preexposure of a stimulus interferes not only with the acquisition, but also with the maintenance of excitatory responding. These results seem inconsistent with "loss of salience" notions of latent inhibition.

A number of researchers (Carlton & Vogel, 1967; Chacto & Lubow, 1967; Lubow, 1965; Lubow & Moore, 1959) have shown that nonreinforced preexposure to the CS results in an interference with subsequent acquisition of a conditioned response to that same stimulus. Lubow interprets this latent inhibition effect as being due to an active antagonistic (i.e., inhibitory) effect on the formation of an excitatory CS-US bond (Lubow & Siebert, 1969). However, because of the testing procedures generally employed in demonstrations of latent inhibition, there remains a real question as to whether the preexposed CS has actually acquired inhibitory properties.

There are two basic methods for evaluating the inhibitory properties of a stimulus (Pavlov, 1927; Rescorla, 1969). First, after the presumably inhibitory operation has been performed, the CS may be employed in an excitatory conditioning procedure. This is the tactic employed in previous studies of latent inhibition. But second, the presumably inhibitory CS may be superimposed on an already established excitatory stimulus. This superimposing operation should result in an attenuation of the response normally elicited by the established excitatory stimulus.

Recently, Rescorla (1971), using a CER procedure with rats, has shown that while preexposure of a to-be-conditioned stimulus does interfere with subsequent acquisition, the preexposed stimulus does not disrupt ongoing responding in a superimposing test. Rescorla suggests that these results are due to a "loss of

salience" during preexposure and fail to support Lubow's latent inhibition theory. Prior to the superimposing test, however, Rescorla's groups were not asymptotically suppressed (mean suppression ratios of .21 and .19 for non-preexposed and preexposed groups, respectively). Thus, the disruptive effect could have been offset by the continued acquisition of suppression on the first superimposing trial.

In the following studies, the properties of preexposed stimuli, using both the acquisition and the superimposing test procedure, were examined. Excitatory conditioning was continued until both groups were asymptotically suppressed.

EXPERIMENT 1

Subjects

Sixteen experimentally naive male hooded rats between 250 and 300 g in weight at the beginning of the experiment, obtained from Perfection Breeding Farms, Douglassville, Pa., served as Ss.

Apparatus

The apparatus consisted of eight standard operant conditioning chambers, individually housed in sound-insulated chests. The ceilings, front, and rear walls of the operant chambers were constructed of clear acrylic plastic. The two side walls were constructed of aluminum sheeting. One of the aluminum walls contained a bar and a foodcup. The floor of the chamber was made of stainless grid bars connected to a Grason-Stadler shock generator (Model E1064GS). The US was shock, 0.5 sec in duration and 1 mA (nominal) in intensity.

The CS was a 2-min interval of white noise produced by a Grason-Stadler noise generator (Model 901B), delivered through a loudspeaker located directly below the bar. Noise levels were measured using a General Radio sound level meter (Type 1551-C). An exhaust fan at the side of the chamber provided an ambient noise level of approximately 55 dB. The CS increased the total

measured noise level to 80 dB.

Programming and recording equipment was located in a room adjacent to the experimental room.

Procedure

Preliminary training. Ss were reduced to 75% of ad lib body weight and then maintained at that weight on a 24-h feeding rhythm for the duration of the experiment. Preliminary training concluded with 10 h (five daily 2-h sessions) of barpress training under a 2.5-min variable-interval food-reinforced (45-mg Noyes pellets) schedule. All subsequent experimental sessions were 2 h in duration.

Treatment. The treatment phase, begun on the day following preliminary training, lasted 20 days. Throughout treatment, a black acrylic false wall was inserted into the operant chamber covering the entire side wall containing the lever and foodcup. Thus, there was no possibility of barpressing or of food reinforcement.

During this phase, half of the animals (PCS) were presented during each session with four 2-min CSs on a random schedule. The CSs could occur in any of the 60 2-min intervals of the 2-h session, with the restriction that no two CSs could be immediately adjacent. Thus, by the end of treatment, Group PCS had received 80 exposures to the CS. The remaining eight animals (NT) were placed in the operant chambers for 2 h daily but received no CS presentations.

Operant recovery. On the day following the last day of treatment, the false wall was removed and the animals were allowed to barpress under the same conditions that prevailed during the preliminary training phase. This operant recovery phase continued for 4 h (two daily 2-h sessions).

Testing. Testing was begun on the day following operant recovery. For both groups, the CS was superimposed on the operant baseline with its onset at 18, 56.5, 95, and 112.5 min into the session. Each CS was coterminous with a 1-mA electric shock of 0.5-sec duration. Testing was conducted over two daily 2-h sessions for a total of eight trials.

Measure. During the testing phase, the suppression ratio described by Annau & Kamin (1961) was used to assess the effect of the CS on ongoing responding. The ratio, $B/A + B$, compares number of responses during the CS duration (B) with the number of responses during an equal interval of time immediately preceding CS onset (A). A ratio of .00 indicates complete suppression of responding during the CS. A ratio of .50 indicates no change in responding, while ratios greater than .50 indicate an increase in number of responses. Ratios were

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Fig. 1. Mean suppression, by group, as a function of test trial.

computed for each animal on each trial.

Results

Analysis of baseline barpressing rates failed to yield any significant differences between groups on the last day of preliminary training during the operant recovery phase or during testing.

Figure 1 presents mean suppression to the test CS for each group over the eight test trials. From the figure, Group PCS appears to have acquired suppression more slowly than Group NT. An analysis of variance on suppression ratios from the first test session (Trials 1-4) confirms this observation, the effect of treatment being significant ($F = 15.31$, $df = 1/56$, $p < .01$). The effect of trials was also significant ($F = 9.35$, $df = 3/56$, $p < .02$), indicating simply that both groups acquired suppression to the CS over the session.

Within Group NT, suppression to the CS on the first test trial can be taken as a measure of the unconditioned excitatory properties of the noise stimulus. On the first test trial, the mean suppression ratio for Group NT was .33. Seven of the eight Ss in this group had ratios less than .50.

As is clear in Fig. 1, the two groups did not differ from each other over the second test session, both groups being almost completely suppressed.

EXPERIMENT 2

Subjects

The Ss were 16 experimentally naive male hooded rats, between 250 and 300 g in weight at the beginning of the experiment, obtained from Perfection Breeding Farms, Douglassville, Pa.

Apparatus

The apparatus used in this experiment was the same as that employed in the first experiment. Again, the preexposed CS was an 80-dB white noise 2 min in duration. During the testing phase, the noise CS was superimposed on a second stimulus which previously had been paired with a 1-mA electric shock of 0.5 sec duration. A light, provided by a 7.5-W bulb mounted on the ceiling of the isolation chest directly above the center of the operant chamber, was used as the second stimulus. The light was diffused through a translucent acrylic sheet which covered the top surface of the operant chamber. The light CS was 2 min in duration.

Procedure

Preliminary training. Treatment during this phase was the same as in the first experiment, both groups receiving 10 h of barpress training in five daily 2-h sessions. As a light CS was to be used during treatment and testing, the houselights were extinguished on the second day of barpress training and remained extinguished for the balance of the experiment.

Treatment. On the day following the last barpress session, the black acrylic false walls were again inserted, covering the bars and foodcups. For the first 20 days of this phase, two groups were treated exactly as the two groups in the first experiment. One group (PCS) received four 2-min noise CSs per day on the same random schedule as used in Experiment 1. Group NT received no-noise CSs throughout the 20 days of treatment. Following this phase, the false walls

were removed and the animals allowed to barpress on a VI 2.5-min schedule for two daily 2-h sessions.

On the day following the second operant recovery day, four light stimuli were superimposed on the ongoing operant baseline with onsets of 18, 56.5, 95, and 112.5 min into the 2-h session. Each 2-min light CS was coterminous with a 1-mA electric shock of .5 sec duration. This phase was continued for 6 days, giving both groups a total of 24 light-shock pairings.

Testing. The test CS for each group was a light-noise compound, both stimuli acting together and being coterminous with the US. Testing was conducted for four trials in a single 2-h session. The compound-shock pairings were presented at 18, 56.5, 95, and 112.5 min into the 2-h session.

Results

There were no differences between groups in baseline barpressing rates on the last day of preliminary training during the operant recovery phase or during testing.

There were no differences between groups during acquisition of the CER to the light CS. By the first trial of the second acquisition session (Trial 5), the mean suppression ratio for Group PCS was .04 and for Group NT was .02. Except for minor fluctuations, mean suppression ratios remained about .00 for all subsequent trials. On the last trial of acquisition to the light CS, the mean suppression ratio for Group PCS was .02 and for Group NT was .01.

Figure 2 presents the mean suppression ratio for both groups for the four test trials to the light-noise compound. Using a Wilcoxon matched-pairs signed-ranks test, both groups showed a significant attenuation of suppression as compared to suppression on the last light-shock pairing (for both groups, $T = 0$, $p = .01$). As can be seen in Fig. 2, this disruption appears greater for Group PCS than for Group NT. An

Fig. 2. Mean suppression, by group, as a function of test trial.

analysis of variance over the four test trials indicated that the difference in degree of attenuation was significant ($F = 7.06$, $df = 1/56$, $p < .05$). The effect of trials, however, was not significant.

DISCUSSION

The results of Experiment 1 are consistent with previous research. Preexposure of a to-be-conditioned stimulus retards subsequent acquisition of excitatory properties. This observation by itself can be adequately explained as a removal of unconditioned effects of the CS during the preexposure treatment. That is, the preexposure procedure reduces the nonconditioned excitatory properties of the to-be-conditioned stimulus but does not necessarily make that stimulus inhibitory. The present data indicate clearly that, without preexposure, the CS in fact does have some nonconditioned excitatory effects.

The results of the second experiment, however, demonstrate that preexposure to the CS has effects in addition to simple "removal" of nonconditioned excitatory properties. Within Group NT, superimposing the noise CS on the already established excitatory stimulus resulted in a

significant disruption of the excitatory CR—external inhibition (Pavlov, 1927). However, within Group PCS, this same superimposing operation resulted in a significantly *greater* disruption of the excitatory CR. Quite clearly, preexposure in this situation has not diminished the ability of the preexposed CS to produce an external inhibition effect. Thus, on this superimposing measure at least, preexposure does not result in loss of stimulus salience.

The results of the second experiment in this report suggests that preexposure is a sufficient condition for the acquisition of inhibitory properties according to the definition suggested by Rescorla (1969). The preexposed group showed significantly greater disruption of suppression than the non-preexposed group. This finding appears to contradict results reported by Rescorla (1971, Experiment 3), which demonstrate that preexposure retards the acquisition of inhibitory properties. However, certain methodological difficulties (i.e., the use of a differential conditioning procedure with the preexposed stimulus compounded and presentation of the data in terms of difference scores)

confound interpretation of his results.

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