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NOTES

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2. Incidental evidence suggested that there was little or no tendency for the Ss to expect reward upon home cage removal or handling. Although the E (surgical gloves) who fed the Ss in the home cage noticed general excitement, including scratching and biting, the second E (ungloved) who handled the Ss noted a lack of excitement and a general docility.
3. The findings considered above, it has been suggested by Lawrence and Festinger, are favorable to their dissonance position. It is difficult to understand, however, why dissonance theory, no less than frustration theory (and more or less for the same reasons), would not expect R to E to increase as number of rewards increased with number of nonrewards being held constant (number of dissonant experiences equated, but intensity of these varied due to greater expectation).

Types of Pavlovian conditioning procedures used in establishing CS+ and their effect upon avoidance behavior

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The purpose of this study was to determine the effects on avoidance responding of superimposing fear stimuli (CS+) established by Pavlovian delay and trace conditioning. Coterminous delay conditioning resulted in an accelerated avoidance-response rate, but the effect of CS+ offset was not clear, since the suppression effect expected for CS+ offset did not occur in all Ss. On the other hand, a CS+ established by trace conditioning enhanced avoidance responding both during and after presentation.

Superimposing a CS associated with a random conditioning procedure resulted in near base-rate avoidance performance.

It has been demonstrated repeatedly that Sidman avoidance response rate can be altered by the presentation of a fear stimulus (CS+) established by Pavlovian conditioning procedures. The effects on response rate may, however, vary as a function of the temporal relation between the CS and US used in establishing the CS+. A CS+, established by coterminous Pavlovian delay conditioning, enhances the avoidance-response rate during presentation, while its offset depresses

avoidance relative to the baseline rate (Herendeen & Anderson, 1968; Kamano, 1968; Rescorla, 1967a). On the other hand, a CS+ established by Pavlovian trace conditioning may not exert such an antagonistic effect. Relatively short CS-offset/US-onset intervals in trace-conditioning procedures produce a CS+ whose presentation also enhances avoidance but does not suppress avoidance-response rate following offset (Rescorla & LoLordo, 1965).

The purpose of the present study was to repeat the experiments of delay and trace conditioning with a control procedure added to provide a baseline from which the effects of these conditioning procedures could be evaluated. This study, using rats as Ss, involved a direct comparison within a single S of the three procedures.

SUBJECTS

The Ss were three 60-day-old male Wistar albino rats from the colony maintained at the Galesburg State Research Hospital and were housed in individual cages throughout the experiment.

APPARATUS

The apparatus was a modified Mowrer-Miller shuttlebox, with a 10.16-cm-high hurdle and a drop gate that, when lowered, prevented crossing. A 10-W light bulb, mounted above each compartment, served as the CS, and shock was delivered through a grid floor. Details of the apparatus and shock source are described elsewhere (Kamano, 1968).

PROCEDURE

Previous studies of the interaction between Pavlovian and instrumental avoidance conditioning (e.g., Rescorla, 1967; Rescorla & LoLordo, 1965) served to guide the procedure used in this study.

Avoidance training, Pavlovian conditioning (alternating with avoidance training), and a test period were given in sequence to all Ss. This entire training sequence was repeated for each of the three Pavlovian procedures; however, the three different Pavlovian training conditions (delay, trace, and random-control) were administered to each S in a different order. Thus, for each S, the sequence and order of training was as follows: S A, avoidance training (AT)—random control (RC)—test (T) first, then AT—delay conditioning (DC)—T, then AT—trace conditioning (TC)—T. S B, AT-TC-T first, then AT-DC-T, then AT-RC-T. S C, AT-DC-T first, then AT-RC-T, then AT-TC-T.

Avoidance Training

The Ss received shuttlebox avoidance training on a Sidman avoidance schedule, with a shock-shock interval of 5 sec, response-shock interval of 30 sec, and shock intensity of 450 microamperes. One

Table 1
Response Ratios of Each Subject on Each Condition

Subject	Condition					
	Random		Delay		Trace	
	B/(A+B)	C/(A+C)	B/(A+B)	C/(A+C)	B/(A+B)	C/(A+C)
A	.565	.630	.787	.413	.690	.639
B	.444	.545	.729	.644	.682	.841
C	.589	.557	.721	.472	.684	.709
Mean	.533	.577	.746	.510	.685	.730

30-min avoidance training session per day was given until performance had stabilized to a level where S received no more than six shocks per session over 2 consecutive days.

Pavlovian Conditioning

After reaching the avoidance training criterion, each S was given four Pavlovian conditioning sessions, with avoidance training continuing on alternate days. The side of the shuttlebox used for the Pavlovian procedure alternated from day to day. Each session consisted of 12 trials, with a mean intertrial interval of 1.5 min (range, 1-2 min). In the Pavlovian delay-conditioning procedure, the 10-sec CS and 5-sec US (450-microampere shock) were coterminous. In the trace procedure, the 5-sec US was presented an average of 3 sec (range, 2-5 sec) after termination of the 10-sec CS. The random control procedure, as recommended by Rescorla (1967b), involved 12 10-sec CSs, with a mean interval of 1.5 min, and 12 5-sec, 450-microampere USs presented randomly during the session. The same light CS was used in the different conditioning procedures. Pavlovian conditioning and avoidance training sessions were alternated for a total of four Pavlovian and four avoidance sessions.

Test Period

Warm-up effects were eliminated by postponing the beginning of the test session until four consecutive avoidance responses were made. The fourth of these began the test session, which was actually a dual extinction procedure in that the Sidman avoidance contingencies were *not* in effect and CS+ presentations were *not* followed by the US. Superimposed upon the test session were the 10-sec CSs presented at 90-sec intervals. The number of avoidance responses during the 10-sec periods preceding, during, and following CS presentation, plus the total number of avoidance responses were recorded. Testing was conducted in one session until a

criterion of no avoidance responses over a 3-min period was reached or for 2 h, whichever occurred first. Then, another training sequence was instituted 2 days later.

RESULTS AND DISCUSSION

The baseline response rate (i.e., the rate of response during the 10-sec periods immediately preceding the onset of the CS) was used to evaluate the CS and post-CS effects. The CS effect was determined by the ratio $B/(A+B)$, where B is the number of responses during the 10-sec CS periods and A is the baseline response rate. The post-CS effect was determined by the ratio $C/(A+C)$, where C is the number of responses during the 10-sec periods immediately following the CS offset and A is the same as above. Response ratios above and below .500 indicated enhancement and suppression of avoidance response, respectively.

The response ratios for each S on each condition (random, delay, and trace) are presented in Table 1. It can be seen that the effect of CS+ established by delay conditioning was to enhance the avoidance response rate, but the effect of its offset was not clear. In two Ss, avoidance responding was slightly suppressed relative to the base rate but was accelerated in the other at CS+ offset. In this latter S, however, responding did diminish from the level achieved during the CS+. On the other hand, with trace conditioning, avoidance responding was enhanced by both the CS+ and its offset. Both the CS and CS offset under the random condition produced response rates that fluctuated around the baseline rate.

To determine the consistency of the avoidance-response rates in the absence of the CS+ effect of each S from one condition to another, the baseline pre-CS+ response rates were evaluated. A within-S analysis of variance revealed that the response rates during the baseline period did not vary significantly among the

random, delay, and trace conditions ($F = 4.07$, $df = 2/4$). This suggests that the results reported in Table 1 reflected the effects of the CS+ and not any fluctuating effect of the baseline avoidance response rate.

The small "n" methodology employed in the present study permitted the direct comparison within a single S of the three Pavlovian procedures. The data were generally consistent with the conditioned acceleration literature except for the delay-conditioning procedure. Superimposing the CS+ established by Pavlovian delay conditioning upon avoidance behavior resulted in enhanced avoidance-response rate, but the effect of its offset was not consistent for all Ss. The S that did not show post-CS+ depression in the delay condition was the only one to have had the trace conditioning prior to delay conditioning. A carry-over effect from the previous trace conditioning could have contributed to this lack of suppression effect in this case. However, the suppression effect for the other two Ss was very slight indeed, thus, the suppression effect expected for CS+ offset with the delay procedure was not clearly demonstrated. The Pavlovian trace procedure, however, had a dual accelerating effect in that its presentation and offset both resulted in enhanced avoidance responding relative to the baseline rate. The random procedure resulted in near-base-rate avoidance performance.

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NOTE

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