Sequential effects in differential human eyelid conditioning¹

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Human Ss were given 300 differential eyelid conditioning trials. Although response probability increased with each successive CS+, and decreased with each successive CS-, the increment following the first in a sequence of CS+ trials was smaller than that following the second in a sequence of CS+ trials. This outcome is not compatible with expectation from an unmodified linear operator model of differential conditioning performance.

The present study was originally conducted to investigate differential conditioning as a function of similarity of stimuli where physical separation of CS source was the experimentally manipulated dimension. As it turned out, spatial separation of stimuli was not correlated with degree of differential conditioning, so we were unable to address the problem of interest. However, some of the results are new, and are being reported for that reason.

Apparatus

The basic apparatus for transducing and recording has been reported by Prokasy, Carlton, & Higgins (1967). CS+ and CS- were changes in brightness of a .75 in. red cut-glass jewel lighted behind by a 7.5 W bulb. The UCS was a 50-msec puff of Hg to S's right cornea, which occurred at CS+ offset.

Subjects

The Ss were 180 students from introductory psychology courses at Pennsylvania State University who received partial course credit for volunteering to be Ss. An additional three Ss were run, but were eliminated due to E error or apparatus failure.

Procedure

The independent variables were interstimulus interval (ISI) and width of physical separation between CS+ and CS-. The three levels of ISI (and CS+ and CS-) were 360, 500, and 800 msec. The two widths were 2.5 and 5 in. at a distance of 60 in. from S. The 180 Ss were assigned unsystematically to the six treatment combinations until a total of 30 Ss were in each group. Ss were given taped instructions which emphasized "letting your reactions take care of themselves." These were followed by 12 adaptation trials: three of each CS and six UCS in a random order. A total of 300 conditioning trials was administered, 150 of CS+ and 150 of CS-, in a random order with the restriction that the number of CS+ and CS- trials be equal in each of two blocks of 150 trials. A CR was defined as a pen movement of at least 1 mm in the intervals from 148 to 384, 148 to 524, and 148 to 824 msec after CS onset for the 360, 500, and 800 msec ISIs, respectively. The intertrial interval averaged 10 sec.

Results and Discussion

Spatial separation of CS+ and CS- was neither a main nor interacting effect, so the data of interest will be collapsed across that variable.

Table 1 provides response probability as a function of sequences of CS+ and CS-, with the data partitioned into two trial blocks of 150 trials each. It might be noted initially that overall response probability to CS+ increased as a function of ISI, $F(2, 176) = 16.83$, but probability to CS- did not vary as a function of ISI, $F(2, 176) = .35$.

Of major interest is the shape of the sequential curves. If a general conditioning-extinction theory (see Kimble, 1961, p. 364) of performance is adequate to describe differential eyelid conditioning, response probability should increase with successive CS+ trials and decrease with successive CS- trials. This, in fact, occurred

Table 1
Response Probability as a Function Sequence
of CS+ and CS- Trials^a

ISI	Event	Successive Events					
		Trials 1-150			Trials 151-300		
		1	2	3	1	2	3
360	CS+	348	339	429	478	497	555
	CS-	512	369	323	361	316	246
500	CS+	525	535	615	663	672	733
	CS-	383	251	212	418	255	222
800	CS+	659	643	732	754	736	787
	CS-	318	279	253	331	266	208

^aDecimals omitted

in both experiments and across all treatment combinations. A more specific form of the theory is the linear-operator model described by Bush & Mosteller (1951). This model requires that the size of increment (or decrement) be larger between sequential Positions 1 and 2 than between sequential Positions 2 and 3. In contrast with this requirement, Table 1 shows that all sequential CS+ curves exhibit a larger increment in response probability between sequential Positions 2 and 3. Discounting the ties, 41 of 58, 39 of 59, and 40 of 59 Ss in, respectively, the 360, 500, and 800 msec treatments yielded a higher increment between Positions 2 and 3 in the first block of trials. The chi-squares, 1 df, were, respectively, 9.93, 5.40, and 7.47. The same trend existed in the second block of trials, though it was not reliable, with only 100 of a total of 172 Ss showing that relationship, $\chi^2 = 4.5$.

What this study shows is that both the differential stimulus and the aftereffects of presence or absence of the UCS combine to determine performance in differential eyelid conditioning. The former is shown by the fact that response probability is higher to CS+ on the first point of the sequential curves, and the latter by the fact that, overall, response probability increases with successive reinforcements and decreases with successive nonreinforcements of, respectively, CS+ and CS-. The particular complication introduced by the greater increment in probability following the second, rather than the first, in a sequence of CS+'s, is that an unmodified linear-operator version of incremental-decremental theory is inadequate to account for the data. It may be that the trial-by-trial transition probabilities by which the CS+ and CS- trials were generated, i.e., the likelihood of a CS+ (CS-) trial following a CS+ (CS-) trial, is an important factor in this result, as it appears to be with intermittent reinforcement schedules (Prokasy & Higgins, 1968); but this cannot be determined from present data.

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NOTE

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