Yoked comparisons of contingent and noncontingent US presentations in human eyelid conditioning¹

I. Gormezano, INDIANA UNIVERSITY

John W. Moore, UNIVERSITY OF MASSACHUSETTS

Abstract

Thirty pairs of Ss were run in a yoking procedure in which an eyeblink by the contingent S resulted in contiguous presentation of the US to the pair of Ss. Although Ss in the contingent and noncontingent groups revealed similar probability functions they were inferior to a control group of 30 Ss run under a conventional classical conditioning procedure.

Problem

A common interpretation of eyelid conditioning experiments employing a corneal air puff is that the anticipatory blink (CR) serves to attenuate the effects of the puff by preventing it from falling on the cornea (Kimble, 1961, p. 79; Solomon & Brush, 1956, p. 250). Implicit in such a formulation is the notion that eyeblinks which overlap the puff are reinforced through a Thorndikian law of effect (i.e. rewarded by reducing the noxiousness of the puff). Although the mechanism for CRs not overlapping the puff still awaits discovery, proponents of the "strong" law of effect analysis assume that puff presentations on the closed lid has a greater reinforcement effect. One possible method for assessing the appropriateness of this formulation is to employ a contingency procedure in which the puff is always presented on the closed eyelid and to contrast the performance obtained with a procedure in which the puff is presented independently of the eyelid position. The present investigation was concerned with making such a comparison.

Method

The Indiana eyelid conditioning laboratory has been described (Moore & Gormezano, 1961). In brief, S's room contained two identical enclosures which permitted two Ss to be run simultaneously. The Ss wore elastic headbands supporting a stimulus air jet with a 2 mm diameter orifice and a rotary potentiometer for recording eyelid movement from the stimulated eye. The US was a 3.86 psi puff of compressed nitrogen of 100 msec. duration. The CS consisted of a change in hue and illumination of a 10-cm circular milk glass window.

Thirty Ss (15 men and 15 women) were assigned to each of three experimental groups. Two of the groups were: a contingent group (Group L) and a yoked-control group (Group LY) in which two Ss one from each group, were run simultaneously in a yoking procedure whereby the occurrence of an eyeblink at a latency greater than 150 msec. after CS onset by the S in Group L, resulted in the occurrence of the US for both Ss, 110 msec. after

initiation of the response. This contingent time delay assured in every instance the occurrence of the US on the closed lid of Ss in Group L. On each trial of acquisition the CS remained on until the US occurred and then both stimuli terminated simultaneously. Thus, Ss in both groups were run under a varying CS-US interval in which the interstimulus interval on any acquisition trial was completely determined by the latency of an eyeblink by the S in Group L. The third group, a conventional classical conditioning group (Group C), received the US on every trial at a CS-US interval of 500 msec. In extinction all groups received the CS alone for 600 msec.

All Ss received 70 acquisition and 20 extinction trials at an average intertrial interval of 25 sec. (timed from US offset.). In all groups eyeblinks were scored as CRs in the 150 to 525 msec. interval after CS onset in acquisition and in the 150 to 600 msec. interval in extinction. Since only anticipatory responses were scored as CRs, an eyeblink by an S in the yoked-classical group (Group LY) was scored only if it occurred within 25 msec. after the onset of the US.

Results and Discussion

Figure 1 presents a plot of the percentage CRs and Fig. 2 the distribution of response latencies for the three groups in acquisition and extinction. Examination of Fig. 1 reveals that Group C attained an asymptotic level of approximately 80% whereas, Groups L and LY

Fig. 1. The percentage CRs plotted in 10-trial blocks during acquisition and 5-trial blocks during extinction. The initial acquisition points are the mean percentages of responses on the first trial.

Fig. 2. The distribution of response latencies of eyelid responses in acquisition and extinction.

rose more gradually to asymptotic levels of approximately 42%. In extinction, there do not appear to be appreciable differences among the three groups in response frequency. Examination of Fig. 2 indicates that the principle modes in acquisition of Groups L and LY both had a latency of 225 msec. and that of Group C a modal value of 275 msec. It is of particular interest to note that although all eyelid responses by Ss in Group L of a latency greater than 150 msec. were contingently reinforced with the US (no matter how late the response) that the unimodal distributions obtained for Groups L and LY indicated little evidence of being truncated at the 525 msec. cut-off.

Analyses of variance revealed significant differences among the three groups on percentage ($F, 4.48; df, 2/84; p < .001$) and latency ($F, 12.43; df, 2/84; p < .001$) of CRs in acquisition but no significant differences in extinction for either measure. Multiple t -test comparisons indicated that the percentage and latency of responses of Groups L and LY were not significantly different from one another in acquisition or extinction, but both groups were significantly different from Group C in acquisition on percentage (Group L vs. C: $t, 4.28; df, 1/58; p < .001$. Group LY vs. C: $t, 5.14; df, 1/58; p < .001$) and latency scores (Group L vs. C: $t, 2.60; df, 1/58; p < .02$. Group LY vs. C: $t, 2.99; p < .01$). Thus, although for Ss in Group L the temporal occurrence of the air puff was contingent on the time

of occurrence of the eyeblink and always fell on the closed lid, this contingent relationship did not produce differences in latency or frequency of responses from that of a yoked-classical group where no contingency existed. Since this finding can become definitive only if the null hypothesis can be proved, it is proper to indicate that with 30 Ss in each group the power of the comparisons was considerable. It might be argued of course by proponents of the "strong" law of effect that the comparable performance of Ss in the yoked-classical group arose from their also receiving the air puff on the closed eyelid. However, on the average this occurred on only 40% of the trials.

Surprising perhaps, for proponents of the position that behavior must be functionally adaptive, is the fact that Group L showed any conditioning (i. e., a progressive increase in responding within the 525 msec. interval) under a "punishment" contingency. One possible explanatory mechanism consistent with the functional point of view is that since the CS remains on until an eyeblink occurs, S responded to the CS to terminate a fear conditioned stimulus (acquired through the adventitious correlation of the CS with the air puff). If this were the reinforcing mechanism, then one might have expected Ss in Group L to show, relative to Group LY, a greater proportion of responses within the 525 msec. interval. This was clearly not the case. There is little difficulty in explaining these results, however, if it is recognized that a basic datum of both classical and instrumental conditioning procedures is that as the strength of the association increases the response moves forward in time.

References

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