The effects of an interpolated ITI stimulus on classical conditioning of the nictitating membrane response of the rabbit¹

NEIL M. KETTLEWELL AND JAMES D. PAPSDORF
UNIVERSITY OF MICHIGAN

Fourteen rabbits underwent classical conditioning of the nictitating membrane response while restrained in a darkened experimental enclosure. The experimental Ss, subjected to a 10 sec period of illumination of the experimental enclosure occurring 40 sec after UCS offset and 40 sec prior to CS onset, conditioned at a significantly slower rate.

Pavlov's (1927) investigations of external inhibition phenomena, i.e., decrements in the amplitude of salivary CRs in dogs upon presentation of novel "nongustatory" stimuli, were generally concerned with the effects of such stimuli delivered on isolated test trials and presented just prior to or during CS onset. The concern of the present investigation was to determine whether an extraneous stimulus presented more temporally removed from CS onset and delivered after every conditioning trial would have any effect on the rate of acquisition or asymptotic performance level of the classically conditioned nictitating membrane response of the rabbit.

Method

The apparatus and procedure employed in classical conditioning of the nictitating membrane response has been described in detail by Gormezano (1967). Briefly, 14 albino rabbits, 80-100 days old, were prepared 48 h prior to conditioning by tying a nylon loop into the nictitating membrane and implanting wound clips into the skin approximately 1/2 in. caudal to the right eye. On the day following preparation, S was placed in a Plexiglas restraining box and a head harness, with a photoelectric transducer, mounted on its muzzle. The Ss were then placed in a darkened sound attenuating chamber for a 15 min habituation period. On each of the subsequent conditioning sessions, given one per day for five days, Ss received 18 CS-UCS pairings at a fixed intertrial interval of 90 sec. The CS, a 93 dB, 1000 cps tone, was presented for 1100 msec with the UCS, a 3.0 mA, 60 cps shock, overlapping the last 100 msec of CS presentation. The Dark (N=7) and Light Disrupt (N=7) groups were run under identical conditions except that Ss in the latter group were subjected to a 10 sec period of illumination of two 1-1/2 V bulbs, located directly in front of and above S's head. Light onset occurred approximately 40 sec after UCS offset and terminated approximately 40 sec prior to CS onset. CRs were defined as a 1 mm or more deflection of the Offner recording pen

occurring 50 msec after CS onset and up to the moment of UCS presentation.

Results and Discussion

The mean percentage of CRs across blocks of 18 trials for each of the two groups is plotted in Fig. 1. As can be seen in the figure, the Light Disrupt group conditioned at a considerably slower rate than did the Dark group ($F=17.40$, $df=4/40$; $MS\ error=765.20$, $p<.01$) with both groups eventually reaching the same asymptote.

The pronounced depression produced by the interpolated intertrial interval stimulus can be presently accounted for by two theoretical positions. The first, Pavlov's (1927) competing response hypothesis, contends that novel stimuli elicit the investigatory reflex and that once this "...investigatory reflex is elicited, the conditioned reflex is consequently inhibited" (p.46). While cortical desynchronization, a correlate of the investigatory or orienting reflex, usually persists for only 10 sec following termination of a novel stimulus, which would argue against the application of Pavlov's competing response notion to the present results, both the grossness of the EEG recording as an analytical tool and the known dissociation between behavioral arousal and cortical desynchronization make it hazardous to utilize such evidence in evaluating this response

Fig. 1. The percentage CRs for the two experimental groups plotted in 18-trial blocks.

competition hypothesis. A more adequate demonstration of its validity would consist in showing that interpolated stimuli presented closer to CS onset have more of a depressive effect on conditioning than stimuli more temporally removed. Contrary to this prediction, a recent investigation from the Michigan lab (Papsdorf & Kettlewell, in preparation) indicates that an extraneous stimulus presented 10 sec prior to CS onset produces less of a depression on the acquisition rate of the classically conditioned nictitating membrane response than one presented 30 sec prior to CS onset.

The second theoretical position relevant to explaining the effects of the interpolated stimulus would contend that the depression is due to some combination of reactive and generalized conditioned inhibition (Hull, 1943). However, as the Light Disrupt Ss blinked on less than 2% of the intertrial interval light presentations, it seems unlikely that the consequent inhibition, conditioned and reactive, could have produced the deficit obtained. Finally, the results of the Papsdorf and Kettlewell study cited above would also argue against attributing this depression to reactive inhibition.

Another theoretical approach which could account for the obtained results more adequately would assume that the reaction of the animal to the extraneous intertrial interval stimulus disrupts the ongoing consolidation process. Partial support for a consolidation process in classical conditioning of the nictitating membrane response resides in the observation of Papsdorf, Snyder, & Cholewiak (in preparation) that injections of strychnine sulphate at the end of each conditioning session facilitate, given certain conditions, response acquisition. Finally, the observation that interpolated stimuli presented 10 sec prior to CS onset have less of a depressive effect on the rate of response acquisition than do stimuli presented 30 sec prior to CS onset (Papsdorf & Kettlewell, 1967) provides additional support for this position, since it would predict that fewer traces have consolidated shortly after CS-UCS presentation than later in the intertrial interval.

Ready signals have been generally observed to depress classical human eyelid conditioning. Turner (1963), in her investigations of the effect of different ready signal-conditioned stimulus (RS-CS) intervals,

obtained a curvilinear relationship with the extent of depression diminishing as the RS-CS interval decreased from 7 sec to 2 sec, and a subsequent increase in the depressive effect of the ready signal with a further increase in proximity of the latter to CS onset. Penneypacker (1967) accounts for Turner's findings concerning the RS-CS gradient by assuming that the ready signal produces three discrete effects: (1) a general inhibitory effect on CR level due to complex mediational processes; (2) a conditioned readiness which partially offsets the cognitive inhibition and conditions maximally with a 2 sec RS-CS interval; (3) an evocation of a transient (approximately 2 sec) orientation response which competes with CR performance. However if, in contrast to Penneypacker, the depressive effects of ready signals presented more than 2 sec prior to CS onset are attributed to disruption of consolidation occurring in the intertrial interval and if, in agreement with Penneypacker, CS presented less than 2 sec after a ready signal are presumed to be incapable of eliciting CRs due to response competition, then the RS-CS gradient obtained by Turner can be adequately explained without recourse to presumed cognitive inhibition.

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