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Effects of experience on stimulus-produced reflex inhibition in the human

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The eyeblink reflex to a corneal airpuff was elicited on 10 occasions: 5 times preceded by a light flash at an interval of 100 msec and 5 times by itself. The amplitude of the reflex was inhibited by the light flash, an effect which was evident on the very first trial but increased in strength with further testing. That inhibition was obtained prior to the subject's having had any experimental experience with the stimulus conditions indicates that inhibition does not depend on an associative conditioning process. The subsequent enhancement of the effect, which has been seen previously with rats, may reflect the modulation of inhibition by the subject's state of alertness or arousal.

The eyeblink reflex elicited by a corneal airpuff or by an intense noise burst is inhibited if the puff or the noise is preceded by an extraneous stimulus (Graham, 1975; Krauter, Leonard, & Ison, 1973; Reiter & Ison, 1977), the lead time yielding maximum inhibition being on the order of 100 msec. The purpose of the present experiment was primarily to determine whether inhibition would be present on the first exposure to the initial stimulus (Si) and the eliciting stimulus (Se) and, then, to see if there were any changes in inhibition in the immediately following trials thereafter. The theoretical concern behind this experiment was whether the occurrence of inhibition in humans depends on some sort of learning or conditioning process, a process perhaps as primitive as a priming or sensitizing of the neural mechanisms responsible for the reflex by exposure to Se. We have previously reported that inhibition was present on a first pair of trials (that is, a Se-alone control trial and a Si-Se paired trial), but in that experiment Si was an acoustic stimulus which itself produced a measurable eyeblink (Krauter et al., 1973). In addition, the experiment was run as an introduction to a study of a different problem and used only a single pair of trials. In other work we have reported that inhibition is present in a first block of trials (Reiter & Ison, 1977), and Graham (1975) presented a figure (Figure 6, p. 241) depicting the first three trials for one subject in which inhibition was apparent from the beginning, using an acoustic Si. These several reports do not provide a sufficiently detailed or systematic experimental analysis of the effects of the subject's first exposures to the stimulating conditions. In the present experiment we used a visual Si and extended the series of trials to 10, 5 Se-alone control trials and five Si-Se paired trials.

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METHOD

Subjects

The subjects were 16 students enrolled in an introductory psychology course who served in order to fulfill a course requirement. There were 6 males and 10 females.

Apparatus and Procedure

The subjects were run while seated comfortably in a large double-walled Industrial Acoustics Company sound-attenuating chamber (8 x 12 ft, 2.44 x 3.66 m). Eyeblinks were recorded by means of a plastic lid taped to the subject's right eyelid and linked to the arm of a microtorque potentiometer mounted on a lightweight head set. Eyelid movements were amplified on a Grass polygraph and graphically displayed on a storage oscilloscope from which blink amplitudes were measured in millimeters. The oscilloscope triggered on the presentation of Si and thus disturbances in the position of the eyelid during the interstimulus interval could be detected.

Blinks were elicited by an airpuff, 70 msec in duration at .75 psi via a nozzle, mounted on the head set, that was directed to the skin 5 mm lateral to the right eye. The visual stimulus (3 fc) was produced by a 28-V light bulb mounted on a stalk attached to the head set and set out 15 cm from the forehead. The bulb was energized at a low background level (.5 fc) between light flashes. The onset and duration (20 msec) of the light flash as well as the duration of the interval between light flash and airpuff (100 msec) were controlled by a bank of four solid state millisecond timers. A continuous background level of 48-dB (re: .0002 dynes/cm^2) white noise produced by a Grason-Stadler white-noise generator was delivered through an 8-in. cabinet-enclosed speaker set at eye level, located 6 ft (1.83 m) in front of the subject. The experimenter and the control and recording gear were located outside the chamber. Details of the apparatus are available in Reiter and Ison (1977). A closed-circuit television system permitted the experimenter to monitor the subject's behavior and thus avoid giving trials if the subject was yawning or moving.

The subjects were told that the experimenter was studying blink reflexes to a puff of air and the air delivery mechanism was pointed out as it was fitted on. They were asked to sit quietly with their eyes open and to maintain a steady gaze on the opposite wall. Experimental trials began 3 to 5 min afterward. Each person was exposed to two kinds of trials, each

five times (Se-alone control trials and the Si-Se paired trials), in the order A B B A A B A B B A, half beginning with Se alone and half beginning with the pair. The average intertrial interval was 15 sec (range 8-50 sec).

Relative response amplitudes were used in all calculations. These were formed by computing for each subject the sum of his or her 10 trials, then expressing each individual trial as a percentage of that sum.

RESULTS AND DISCUSSION

The outcome of this experiment is depicted in Figure 1, which gives the mean relative response amplitudes for each of the Se-alone control trials and the Si-Se paired trials. Three features of the data are important. First, it is most evident that the visual stimulus inhibited the eyeblink reflex. Over all trials the amount by which the response was inhibited averaged 30.7% ($t = 5.98$, $df = 15$, $p < .01$). On no paired trial was there any indication that the visual stimulus elicited a blink response which preceded the response to the airpuff. Second, inhibition was present on the first pair of trials. In this first pair the amount of inhibition was 20.5% (for the within-subjects analysis, $t = 2.85$, $df = 15$, $p < .02$). A between-subjects analysis of the first trial compared the relative response amplitude in the Si-Se trial in one subgroup with the Si-alone first trial in the other subgroup. The inhibited trial was 23.9% below the control trial ($t = 2.01$, $df = 14$, $p = .064$). Third, there was a tendency for inhibition to increase across the series of trials. Inhibition on the fifth pair of trials averaged 39.8% compared to 20.5% in the first pair ($t = 2.12$, $df = 15$, $p = .051$).

These data agree with or extend the outcomes of past studies of reflex inhibition conducted with both humans and rats, with a single exception noted below. First, visual stimuli do inhibit eyeblink reflexes in humans (Reiter & Ison, 1977) and acoustic startle reflexes in rats (Ison & Hammond, 1971; Schwartz, Hoffman, Stitt, & Marsh, 1976). Second, inhibition has been shown to occur on the first appearance of an auditory stimulus in humans (Krauter et al., 1973), which is extended here to demonstrate the same effect for a visual stimulus which did not elicit an eyeblink on its first presentation (as the auditory stimulus had done). Third, it has been shown in the rat (Ison, Hammond, & Krauter, 1973) that inhibition of the acoustic startle reflex produced by a light flash increases over the course of a sequence of 10 trials identical to those given in the present experiment, a finding extended here to the human subject.

The major difference between the human data gathered in the present experiment and those reported earlier for the rat startle preparation is that the rat showed no inhibition until after at least one startle stimulus had been presented (Ison et al., 1973,

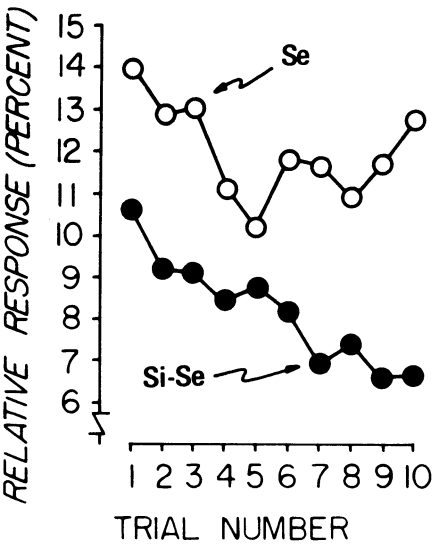

Figure 1. Relative response amplitudes to the eliciting stimulus presented alone (Se) or preceded by a light flash (Si-Se) on each of the 10 trials of the experiment. On any one trial number, half of the subjects received Se and half Si-Se. Each point in the graph is based on a subgroup of eight subjects, each subgroup appearing five times along each curve.

Figure 1), whereas inhibition was present in the human on the first trial. The instructions given the human subjects, their understanding of the experimental apparatus, and perhaps their general apprehension about experimental situations may have been sufficient to produce a facilitative state functionally similar to that which developed in the rat only following the imposition of one or more intense noise bursts.

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