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NOTES

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3. Flow diagrams and preliminary software for the Linc computer are available on request from the authors.
4. Due to the flexibility of electromechanical relay and timer panels, detailed wiring diagrams are not presented. The authors' arrangement is available upon request.

The effect of pressurized air in establishing discriminative response suppression in stump-tailed macaques¹

JOEL KAPLAN and CHARLES REBERT, STANFORD RESEARCH INSTITUTE, Menlo Park, California 94025

Pressurized air was repeatedly associated with one of two frequencies of flashing light during performance of a VI 30-sec positive reinforcement schedule by stump-tailed monkeys. As revealed by the relative suppression of bar presses to each of the two visual stimuli, the Ss learned to discriminate between the different flicker frequencies. However, they also showed signs of adapting to the airblast during the course of training, and its location had to be changed in order to maintain discriminative suppression.

Pressurized air (PA) has been shown to be an effective aversive stimulus in modifying the behavior of rats (Kaplan, 1968; Ray, 1966a, b), cats (Ray, 1966c), and squirrel monkeys (Polidora & Boyer, 1967). In the few experiments in which PA was used as an aversive stimulus, its effect was measured mainly in "active" avoidance tasks. Polidora and Boyer (1967) found that acquisition and extinction of shuttle-avoidance behavior by squirrel monkeys were more rapid with PA than with electric foot shock. They concluded that PA facilitated avoidance learning because it produced less disruptive effects than shock did early in training. However, the fact that the extinction of the response to PA was also more rapid suggests that PA was actually less aversive than foot shock and that it did not produce as strong a conditioned emotional response. Therefore, it might be expected that Ss would adapt to the repeated presentation of unavoidable PA, indicating that PA would not be an effective aversive stimulus in learning paradigms that involve repeated association of conditioned and unconditioned stimuli, e.g., conditioned suppression paradigm. In the present experiment, PA was repeatedly associated with one of two visual stimuli, and the acquisition and extinction of discrimination performance was determined by the relative suppression of responses in the presence of each stimulus.

METHOD

Two experimentally naive, adult, female stump-tailed macaques (*Macaca speciosa*), weighing 6-7 kg, were trained to bar-press for 0.5 cc of grape juice on a VI 30-sec reinforcement schedule while restrained in a primate chair. After their response rates stabilized, a strobe light, driven by a Grass Model PS-2 photostimulator, was used to present 10-sec trials at either 15 flashes/sec (CS-15) or 60 flashes/sec (CS-60). Ten trials at each frequency were randomly ordered and presented during each daily session, with an average intertrial interval of 2 min. After the Ss habituated to the visual stimuli (determined by the lack of suppression of bar presses during visual stimulation), a 1-sec period of PA at 50 lb/in.² immediately followed each CS-15 trial. The 1-sec airblast was delivered through a 15-ga hypodermic needle located 1 in. to the side of the S's head and aimed at the area behind the right ear. As the Ss adapted to the PA during the course of discrimination training, the hypodermic needle was moved to a different location 2 in. in front of the S and aimed at the nose. The relative amount of discrimination between CS-15 and CS-60 was measured by comparing the average number of bar presses during these trials with the number of presses during the 10-sec interval immediately preceding the onset of CS (pre-CS). Since bar-pressing rates during the pre-CS-15 and pre-CS-60 intervals were not different, the average number of pre-CS bar presses was obtained by combining both pre-CS conditions. Discrimination training was terminated when the number of bar presses during CS-60 reached 90% of those made during the pre-CS interval in three successive sessions. Four extinction sessions were then presented in which the airblast was removed from the CS-15 trials. CS trials, intertrial intervals, positive reinforcement, and airblasts were controlled automatically with appropriate timers, solenoids, and pulse generators. A Grass Model 5 polygraph was used to record bar presses and pre-CS and CS intervals during each session.

RESULTS AND DISCUSSION

Both Ss learned to discriminate between the 15/sec flashing

Fig. 1. Changes in bar-pressing performance during training and extinction of a discriminative response suppression task. During training a 1-sec airblast followed a visual stimulus of 15 flashes/sec (CS-15) but not one of 60 flashes/sec (CS-60). The pre-CS period was of the same duration as the CS periods and immediately preceded CS onset.

light that was associated with airblast and the 60/sec flashing light that was not, as shown by the significant difference in suppression of bar presses between these two conditions in the last three training sessions (t test, $p < .001$), and the lack of difference between the CS-60 and pre-CS conditions in these same sessions (Fig. 1). However, each S showed definite signs of adapting to the airblast during the course of training. Suppression of bar presses during CS-15 was greatly attenuated in Session 7 for one animal and in Session 9 for the other. When the position of the tubing through which PA was delivered was then moved to a different location, bar-pressing suppression during CS-15 recurred. Complete extinction of response suppression followed removal of airblast from CS-15 trials.

These results show that PA can be used as an effective aversive stimulus in learning situations where conditioned and unconditioned stimuli are repeatedly paired, although it is possible that learning will be masked by adaptation to the PA. In the present experiment, the Ss began to show poor discrimination behavior as they adapted to the airblast aimed at the side of the head. However, they displayed successful discrimination performance as soon as the airblast was changed to a different location on the face. Whether or not the Ss would have fully adapted to this new location cannot be answered by the present experiment, although they did show somewhat less suppression during CS-15 trials on the last few training sessions (see Fig. 1).

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NOTE

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