Heart-rate conditioning to a pure tone in the guinea pig*

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Classical aversive conditioning of heart rate to a pure tone stimulus in the guinea pig was demonstrated. The CR (a decrease in heart rate) was easily established within 20 trials and appears to be both stable over time and under strict stimulus control. A nonpaired control group showed no indications of conditioning and, in fact, had a small increase in heart rate to the CS.

Although the guinea pig is widely used as a S in physiological experiments, its use in research situations requiring a behavioral response has remained limited (Dutch & Brown, 1968, 1969). The difficulties encountered in training these animals to the more common behavioral procedures, such as barpress shock avoidance, may well be the reason (Webster & Walsh, 1968). A technique which does not require the "cooperation" of the animal, using a response which is easily established and which appears to be both stable over time and under strict stimulus control, is described.

Ten naive guinea pigs weighing between 350 and 750 g were used. All animals were tested using the Pryer reflex response to insure that they were not deaf.

APPARATUS

Animals were restrained in a small squeeze cage which could be adjusted to hold them securely without compromising respiration during an experimental session. The cage was located in an IAC double-walled sound chamber. The acoustic stimulus was presented via an AR 4x speaker located approximately 1 ft from the animal's head. The guinea pig's electrocardiogram (EKG) was recorded on a Grass polygraph from a double thickness of stainless steel wire (00-ga) electrodes sutured through the skin. A three-electrode recording system was used. The electrodes were implanted under Nembutal (sodium pentobarbital) anesthesia at least 1 day prior to the start of conditioning. CS onset and offset were recorded on a second channel of the polygraph. Heart beats were counted manually from the EKG record and converted to heart rate (HR) in beats/minute.

The UCS was a 5-sec 2.5-mA shock from a Grason-Stadler Model 700 shock generator delivered through two of the EKG electrodes, one on each side of the thoracic cavity.

The CS was a 1-kHz tone of 10 sec duration generated by an audio-oscillator and presented at approximately a 0-dB sound-pressure level (re: 1 dyne/cm²). Events occurring within a trial were timed and controlled by Grason-Stadler solid-state logic modules. All lights in the sound chamber were extinguished during a session.

PROCEDURE

Prior to any experimental treatment, all animals were given 2½ h to adapt to the restraining device and acoustic chamber. This long period was necessary to bring basal HR within normal limits (Mikishora, 1968).

A single trial for an experimental animal ran as follows: 10-sec pre-CS period (EKG recorded during this time), 10-sec CS period (EKG also recorded), and 5-sec UCS period (no EKG recorded). Intertrial intervals varied randomly from 120 to 185 sec (M = 147.5 sec).

The control group (five animals) was given unpaired presentations of the CS and UCS. Inter-UCS intervals were equal to those in the experimental condition, and a CS was randomly presented between

consecutive UCSs. All CS-UCS time configurations except CS-UCS overlap were permitted.

Experimental animals received a total of 320 trials over 6 days in a sequence as indicated in Fig. 1. Control animals were given 150 trials in 3 days, with distribution also indicated in Fig. 1.

RESULTS AND DISCUSSION

Heart rate was computed for the final 5 sec of the pre-CS period and the final 5 sec of the CS period. The mean HR change (CS minus pre-CS) in beats/minute for experimental (CS and UCS paired) and control (CS and UCS unpaired) groups is given in Fig. 1. Also provided are variance measures (± 1 SD) for each group.

The CR is quickly established within 20 trials and appears to remain stable over a long period of time. With the cessation of the UCS (extinction), the response disappears quickly, but some sensitization to the stimulus is evidenced by the elevation of the CR in Trial Block 17 (CS only) relative to that in Trial Block 16 (extinction).

Note that the mean change in HR for the control group is generally positive (CS rate > pre-CS rate), while that for the experimental group is negative. A comparable difference in the direction of the CR and UCR in HR conditioning has been reported for rats (Fitzgerald & Teyler, 1970) and humans (Wood & Obrist, 1964).

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Fig. 1. Mean CS minus pre-CS heart-rate changes for experimental (paired) and control (unpaired) groups. Also given are variance measures (± 1 SD) for each group. N = 5 in each group.

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