CONDITIONED SUPPRESSION AS A TECHNIQUE FOR DETERMINATION OF AUDITORY SENSITIVITY IN PIGEONS*

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INTRODUCTION

The purpose of this experiment was to test the applicability of Hendricks (1966) modified conditioned suppression technique as a method for establishing auditory threshold in pigeons.

Conditioned suppression is an operant conditioning method which requires the animal to cease responding in the presence of a selected stimulus. Estes and Skinner (1941) first demonstrated that operant behavior may be suppressed by pairing a neutral stimulus with a brief unavoidable electric shock.

Mentzer (1963) showed that traditional methods such as the two key and four key forced choice methods and the “yes-no” method caused behavioral “habits” (such as single key perseveration) which interfered with the control of the subject.

Heise (1956) investigated auditory thresholds in pigeons using a method of limits which required the bird to respond with a burst of ten pecks in the presence of the auditory stimulus to receive reinforcement. He reported ambiguity in the interpretation of positive trials because the birds frequently made responses during silent intervals. Also, because of the method of reinforcement, it became increasingly difficult (as threshold was approached) to reinforce pecking without the fear of reinforcing subthreshold stimuli. In contrast, the Hendricks (1966) technique did not relate the reinforcement to the stimulus, but rather inserted the test trials within long intervals of a VI-2 minute schedule of reinforcement.

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METHOD

Subjects. Two white Carneaux pigeons were used as subjects. The birds were maintained at 80% of free-feeding body weight throughout the experiment and were housed in a quiet room away from all extraneous noises.

Apparatus. The experiment was carried out in a specially built pigeon box located in an IAC double wall sound room. The response key was a standard Harvard Pigeon Key which was illuminated. All responses were recorded on a cumulative recorder and electrical impulse counters.

The food hopper was operated remotely via pulleys and nylon cables by a solenoid located outside the sound room. The cue that the hopper was open was given by illuminating the hopper and increasing the intensity of the key light. All programming of experimental procedures was through electrical switching circuits located outside the sound room.

The auditory stimuli were puretone frequencies of 1, 2, and 4 ke/s delivered through an 8 inch General Electric 16 ohm extended range speaker mounted in the lid of the box. Calibration was maintained with an Allison Model 300 calibration unit.

The aversive stimulus (shock following auditory stimulus) was an ac shock delivered by internally implanted electrodes (Azrin, 1959). Resistance of 10,000 ohms was placed in series with the pigeon. The amount of shock required for suppression varied with each bird but an average of 25 v was found to be the level required to maintain suppression. Voltages as high as 100 v were necessary to first establish suppression.

Procedure. The subjects were first hopper trained using the method of approximation, reinforcing only "head-high" activity. Subsequently, the pigeon was progressively introduced to a VI-2 minute reinforcement schedule where baseline was established.

For measurement of the degree of suppression, the suppression ratio devised by Hoffman, Flesher, and Jensen (1963) was used. Ratios were computed as follows:

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\frac{\text{Pre-stimulus responses} - \text{per-stimulus responses}}{\text{Pre-stimulus responses}}
\]

The number of responses made during the 20 sec preceding onset of auditory stimulation was designated as "pre-stimulus" while "per-stimulus" responses represented responses made during the 20-sec auditory stimulation period of the stimulus response interval.

Upon the cessation of the stimulus, the shock was delivered with shock intensity equal to that of the stimulus intensity. Shock was shock present and was evident, subsequently following 60% of the trials.

The threshold for sound which yields a response in a block of 5 puffs was determined.

Figure 1 is a plot of the seven days of measurement of the cumulative result of stimulus suppression over time.

The initial shock was always in excess of the threshold of responding. Subsequent decreases in the magnitude of the shock did not diminish the degree of suppression but rather increased dramatically with repeated shock administrations.

Mean auditory suppression ratios are a definable function of the degree of suppression.
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All responses were false counters, lie and nylon cables cue that the hopper increasing the intensity procedures was through and room.

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trained using the method activity. Subsequently, the reinforcement schedule on the suppression ratio was used. Ratios were s responses 30 sec preceding onset of a plus” while “pre-stimulizing the 20-sec auditory stimulation period. According to this procedure, complete suppression is a suppression ratio of 1.0. If the pre-stimulus responses equal the per-stimulus responses the ratio is 0.00.

Upon the establishment of suppression the intensity of the auditory stimuli was reduced until threshold was reached. During this period an intermittent shock schedule was used in order to minimize problems associated with shocking the birds at intensities below threshold. In no instance was shock presented following a subthreshold stimuli. If suppression was evident, subsequent presentations were concluded with a brief shock following 60% of the trials as suggested by Hendricks (1966).

The threshold for hearing was defined as that intensity of the stimulus which yielded a suppression ratio below 0.50 on a minimum of 3 trials in a block of 5 presentations.

RESULTS

Figure 1 is a reproduction of a sample cumulative record made during the seven days of threshold investigation. The obvious lateral displacement of the cumulative baseline indicates suppression of responding as a result of stimulus presence. Evidence of suppression was apparent within the first two sessions of stimulus-shock presentations.

The initial presentations in each session during threshold trials (always in excess of 60 db SPL) were characterized by complete suppression of responding. Suppression was maintained at near threshold intensities and did not diminish over the seven days of threshold investigation. The degree of suppression followed closely from day to day and suppression increased dramatically with each 5 db (re SPL) step above threshold.

Mean auditory thresholds for the final three days for each bird at three frequencies are shown in Fig. 2. It can be seen that suppression ratios are a definite function of intensity in a constant and predictable curve.

In all psychophysical studies it is necessary to establish some sort of baseline of behavior that can be altered before stimulus controlled behavior may be assessed by comparison. This present study shows a time factor of only 50 days which indicates the short period of time required to carry a naive subject through to threshold assessment using the conditioned suppression technique. All but seven of these 50 days were spent reducing
Fig. 1. A reproduction of a segment of the cumulative record showing conditioned suppression. The arrows indicate presentation of the auditory stimulus.

Fig. 2. Mean thresholds for both subjects at 1, 2 and 4 ke's plotted as a function of stimulus intensity.

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Auditory threshold using a modified version of Dr. J. C. Smith.
the birds to 80% of free-feeding body weight and in shaping them to a stable response rate on a VI-2 minute schedule of reinforcement.

SUMMARY

Auditory thresholds were established for two white Carneaux pigeons using a modified version of the Estes-Skinner conditioned suppression paradigm.

The thresholds obtained "shadowed", and approached, the human threshold curve (re SPL) for the three frequencies investigated.

The efficiency of the technique was demonstrated by the short period of time required for training and threshold investigation.

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REFERENCES

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