VERTICAL JUMPING AND SIGNED AVOIDANCE

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This paper reports an experiment intended to demonstrate that the vertical jumping response can be learned using a signaled-avoidance technique. A photoelectric cell system was used to record the response. Twenty female rats, divided equally into two groups, were exposed to intertrial intervals of either 15 or 40 s. Subjects had to achieve three successive criteria of acquisition: 3, 5, and 10 consecutive avoidance responses. Results showed that both groups learned the avoidance response, requiring increasingly larger numbers of trials as the acquisition criteria increased. No significant effect of intertrial interval was observed.

Key words: avoidance learning, intertrial interval, vertical jumping response, rat

The type of response required in either signaled or nonsignaled avoidance learning influences its acquisition, maintenance, and extinction (Bolles, 1972; Mackintosh, 1974). The acquisition, maintenance, and extinction of avoidance responses in many cases seem to be directly related to the degree of situational change resulting from the response. One-way running responses (Theios, Lynch, & Lowe, 1966) and the response of jumping onto a platform (Baum, 1965), which require movements from one environment to another, are quickly acquired, stably maintained, and difficult to extinguish. Two-way avoidance (Brush, 1962), which requires that subjects return to environments correlated with shock, may provide only a moderate degree of situational change and appears to be acquired and maintained at more moderate rates and is less rapidly extinguished than one-way or jump-up responses. Finally, responses that produce only a moderate environmental change, such as nondiscriminated lever-press avoidance (Fantino, Sharp, & Cole, 1966) are only very slowly acquired, relatively more unstable, and quick to extinguish.

Some authors (e.g., Masterson, Whipple, & Benner, 1972, in their study of the jump-into-air avoidance response) suggest that these difficulties stem from the necessity of providing a "safe" place (i.e., one negatively correlated with shock delivery). The suggestion that access to a safe place can facilitate the acquisition of an avoidance response has been demonstrated in other studies (e.g., Baron, DeWaard, & Lipson, 1977). However, the relation between safety or shock-free periods with the

biological relevance, evolutionary heritage, or type or response required remains unresolved (Dunham, 1977).

In the present experiment, a modification of the jumping response used by Masterson et al. (1972) was developed in order to improve its recording accuracy. Masterson et al. measured the response visually, a jump being counted if the subject was not touching the floor grid at a given moment. A more objective measurement can be obtained using an array of photoelectric cells that can be interrupted only if the subject jumps, thus automatically recording the response. However, the existence of the photoelectric cells at a distance of 25 cm provides some directionality to the jumping (vertical jumping response).

Using the Sidman avoidance procedure, we have obtained successful and stable learning with this vertical jumping response (Cándido, Catena, & Maldonado, 1984; Catena & Maldonado, 1983) comparable to that obtained with the two-way response (Riess & Farrar, 1972). The present experiment evaluated whether the vertical jumping response can be learned under a signaled-avoidance procedure.

METHOD

Subjects

Subjects were 20 female Wistar rats from the University of Granada's stocks. They were between 90 and 120 days old at the start of the experiment, and were kept in the laboratory colony at a constant 20 °C in a 12:12 hr light/dark cycle. The experimental sessions took place during the light phase.

Fig. 1. Number of trials for each subject as a function of ITIs of 15 s (●—●) and 40 s (▽—▽) and the acquisition criteria (3, 5, and 10 consecutive avoidance responses).

Apparatus

The experimental apparatus consisted of a modified rat operant conditioning unit, made of four walls: two opposing walls, 31 cm high by 28 cm long, were of transparent plastic; the other walls, 31 cm high by 23.5 cm long, were of opaque plastic and aluminum, respectively. The floor was formed by a grid of 19 stainless steel rods 4 mm in diameter and positioned 2 cm center-to-center. The grids were connected in series to a LETICA® shock-source module designed to produce continuous scrambled current between 0 and 3.5 mA. Five photoelectric cells were mounted at 5-cm intervals 25 cm above the grid floor, beginning 5 cm from the aluminum wall. Corresponding lights (5 mm in diameter) were mounted on the opposite wall. Lights and cells formed an electrical circuit connected to a response recorder. A vertical jump interrupted the circuit and recorded a response. The warning buzzer (producing 88 dB at 24 V) was installed in the center of the aluminum wall at a height of 2.5 cm. The

Skinner box was placed in a sound-attenuating box 70 cm long, 53.5 cm high, and 46 cm wide that was provided with an air extractor to make a background noise of 70 dB. Avoidance and escape latencies were resolved to 0.1 s.

Procedure

The subjects were put into the chamber 5 min before the trials began. A trial consisted of a warning signal followed 5 s later by a 2-mA electric shock. Both continued for 30 s or until the subject interrupted the photoelectric circuit by jumping. Half the subjects were exposed randomly to an intertrial interval (ITI) of 15 s, the others to a 40-s ITI.

The dependent variable was the number of trials to satisfy each of three acquisition criteria. The criteria were either 3, 5, or 10 consecutive avoidance responses (CARs). The trial beginning a consecutive sequence was used, rather than the one terminating it, so that the different criteria need not force a greater number of trials. That is, subjects could meet more than one criterion within one sequence (e.g., by emitting seven consecutive responses). In this case acquisition scores would be the same for both criteria and would equal the trial initiating the sequence of consecutive responses.

Training lasted until the rat reached the acquisition criteria or 100 trials had occurred. If the 10 CARs criterion was not reached in a single session, an additional session was given 24 hr later. Two rats of the 40-s ITI group were excluded because they did not acquire the criterion within 200 trials and were replaced.

RESULTS

Figure 1 shows the number of trials required to reach the three acquisition criteria. Increasing the criteria monotonically increased trials to criterion. The 40-s ITI group required more trials at each criterion to acquire responding ($M = 35.0, 48.6,$ and 67.4 trials, respectively, to reach 3, 5, and 10 CARs) than the 15-s ITI group ($M = 16.4, 33.1,$ and 54.5 trials).

The scores obtained for the dependent variable were treated statistically by a 2×3 ANOVA, the first factor being the two groups and the second repeated-measures factor, the three acquisition criteria. Statistical significance level

was set at .05 ($p < .05$). The results showed that only the criteria acquisition factor had a statistically significant effect, $F(2, 36) = 16.231$. Groups did not differ in the number of trials to criterion. Trend analysis of the criteria acquisition factor demonstrated the existence of a marked linear component, $F_{\text{linear}}(1, 18) = 16.23$, which confirms the trend to use greater numbers of trials to reach successive criteria.

DISCUSSION

These results support our main aim, which was to demonstrate that vertical jumping could be learned as an avoidance response using a signaled avoidance task, having previously shown that it could be learned using a non-signaled, Sidman avoidance task (Cándido et al., 1984; Catena & Maldonado, 1983).

Because our subjects were not removed to another safe place after the response, we conclude that the interoceptive and exteroceptive stimuli provoked by the response are, in fact, sufficient for the acquisition and maintenance of an avoidance response, either signaled or nonsignaled. Whether this response has unique characteristics with respect to its relationship to shock (e.g., jumping away from the shock source) or with respect to the evolutionary heritage of the species cannot be answered in the present study.

It also seems that our manipulation of the ITI did not have a statistically significant effect on avoidance learning using this type of response. There was a tendency, however, for the group with the longer ITI (40 s) to need more trials to reach the various criteria of acquisition. It is noteworthy that when using responses involving little contextual change (such as bar pressing) the effect of the ITI is the opposite to what it is in tasks that do involve great contextual and situational changes (e.g., one-way). In other words, the latter improve as the ITI increases, whereas the former deteriorate (Cole & Fantino, 1966; Pearl, 1963). Other types of avoidance responses, such as wheel-turning, are also better at short ITIs (Anderson & Nakamura, 1964). Our results also support this tendency, but do not reach a statistically significant level.

In short, vertical jumping is a reliable technique in avoidance learning. This is confirmed by the results of the present study and by its use as a sensitive baseline (Sidman avoidance)

in the study of such varied behavioral phenomena as feedback effects (Cándido, 1987), relationships between classical and instrumental conditioning (Catena & Maldonado, 1983), and learned helplessness (Cubero & Maldonado, in press).

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