Classical appetitive conditioning in the pigeon

Nicholas Longo, Suzanne Klempay and M. E. Bitterman

BRYN MAWR COLLEGE

Abstract

Pigeons were trained in an appetitive conditioning situation (CS paired with the presentation of food). The CS-US interval was 1 sec. for one group and 10 sec. for another. Stabilimetric measures of anticipatory activity showed better conditioning at the longer interval.

Problem

Interest in broadening the phyletic base of research on classical conditioning has led us to explore a phenomenon of appetitive conditioning in the pigeon which has been known for at least 40 years (Razran, 1933): a signal paired with the presentation of food may soon come to evoke anticipatory activity which can be detected stabilimetrically. We describe here an improved technique for the study of this phenomenon and some illustrative first results on the role of the CS-US interval.

Method

A ventilated picnic chest is divided into two compartments by an opaque Plexiglas partition. S's compartment is about 11 in. long, 11 in. wide, and 13 in. high. The floor of the compartment is a spring-mounted platform, to one end of which is fixed a thin rod that runs through a hole in the partition into the needle-holder of a crystal phonograph cartridge on the other side. The cartridge is mounted on its edge in a shielding enclosure fixed to the bottom of the chest. To S, the partition displays two house lights (7.5 w Christmas tree bulbs) and a feeding tray of clear Plexiglas into which an ounce or so of mixed grain can be discharged from a hopper by the action of a solenoid; hopper and solenoid are mounted behind the partition. Below the feeder-tray is a feeder light (a 7.5 w Christmas tree bulb) which illuminates the tray as the grain is discharged. The CS is compound: offset of the house lights and onset of a buzzer. When the scheduled CS-US interval has elapsed, the feeder solenoid is activated and the feeder light flashes briefly, whereupon the house lights are turned on again and the buzzer is turned off. To measure S's activity during the CS-US interval and during control periods of no stimulation, the output of the phonograph cartridge, suitably amplified and integrated,¹ is used to drive a relay which in turn operates a printing counter or (when the temporal distribution of response is of interest) an event recorder. The graphic records closely resemble those made by Pavlov (1927, facing p. 32), each pip representing a unit of activity rather than a drop of saliva. All the events

of the experiment are programmed automatically. Two Ss, each in a separate chamber, are studied concurrently.

In the present experiment, 20 experimentally naive, but thoroughly tamed White Carneaux cocks were studied. After their body weights had been reduced gradually to 85% of prefeeding levels, the Ss were fed for several successive days from the trays of the conditioning chambers. Then the experiment proper was begun. There were 10 reinforced trials per day with a mean intertrial interval of 15 min. (varying from 7-22 min.). One group of 10 Ss had nine training trials on which the CS-US interval was 1 sec., and one test trial (its position in the daily series varying systematically from S to S and from day to day) on which the CS-US interval was 40 sec. A second group of 10 Ss was treated in exactly the same way, except that the CS-US interval on the nine training trials was 10 sec. The two groups were compared in terms of response to the CS on the 40 sec. test trials, during which graphic records were made. Graphic records of response also were made during 40 sec. control periods of no stimulation which provided estimates of basal activity. One basal activity measurement was made for each S in each experimental session, the point at which it was made in the session varying from S to S and from day to day. Training continued for 16 days.

Results

Mean response to the CS in the 10 sec. group increased in negatively accelerated fashion, reaching asymptote by Day 11 or 12. Response to the CS increased somewhat in the 1 sec. group, as did the basal level of activity in both groups.

Fig. 1. Response to the CS on 40 sec. test trials and during 40 sec. periods of no stimulation (ACT) in groups trained with CS-US intervals of 1 or 10 sec.

¹ A circuit diagram will be provided on request.

For the 10 sec. group, there was a marked difference between level of response to the CS and level of basal activity, but in the 1 sec. group there was no such difference. These relationships may be seen in Fig. 1, which shows mean magnitudes of response in successive 5 sec. segments of the 40 sec. test trials (CS) and the 40 sec. periods of no stimulation (ACT). The curves are based on the pooled data of the last five days (Days 12-16) of the experiment, during which time the level of response was quite constant from day to day. No elaborate statistical tests are required to show the effect of CS-US interval. For the 1 sec. group, the distributions of ACT and CS scores overlapped extensively, with mean ACT slightly higher than mean CS. For the 10 sec. group, there was no overlapping at all; each of the 10 Ss had higher CS than ACT scores. Furthermore, there was no overlap in the distributions of CS scores for the two groups.

Discussion

Better conditioning with a CS-US interval of 10 sec. as compared with 1 sec. is not what we should have been led to expect by the familiar textbook generalization, based primarily on work with mammals, that level of conditioning declines as the CS-US interval increases beyond an optimal value of about half a second. Nor are the results in accord with those of recent experiments on avoidance conditioning in the goldfish which yield a function that is essentially flat over intervals from 1-30 sec. (Behrend and Bitterman, 1962, 1964). Whether these discrepancies are due to species, or method, or both cannot, of course, be said until the two variables are unconfounded. A possibility to be considered carefully is that much of the activity that develops in the appetitive situation is instrumental in character--a product of adventitious reinforcement (Skinner, 1948)--the 10 sec. interval af-

fording more opportunity than the 1 sec. interval for its development. That general activity of the kind measured in this experiment can be brought under instrumental control has already been demonstrated (Graf and Bitterman, 1962). In any case, the diversity of outcome which is now beginning to appear in experiments on the CS-US interval suggests that more attention must be given to parameters such as species and method.

Summary

Two groups of pigeons were trained in an appetitive conditioning situation, the CS being paired with the presentation of food. For one group, the CS-US interval was 1 sec; for another, it was 10 sec. Stabilimetric measures of activity made during 40-sec. control periods of no stimulation showed better conditioning at the longer interval. Response to the CS in the 1 sec. group did not exceed the basal level of activity.

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Acknowledgment

This work was supported by Contract Nonr 2829(01) with the Office of Naval Research.