Study 4: Pavlovian Conditioning 2

February 8, 1999

Abstract

In the first stage of this study, each rat will receive a continuation of last week's training. Then, the two stimuli will be presented sequentially in a second order conditioning procedure. As a change from last week's procedure, specific behavioral activity will be used as a measure of conditioning.

Second order Pavlovian conditioning has become an important topic in the last fifteen years. Although originally described by Pavlov (1927), it was regarded for many years as merely a weaker manifestation of first order conditioning processes. This view changed however, with an important article by Rizley and Rescorla (1972). They found that not only was second order conditioning a robust phenomenon, but that it also seemed to follow different conditioning principles. A good review of second order Pavlovian conditioning, and its use in the study of learning, is provided by Rescorla in a short book based upon lectures given here at the University of Alberta (Rescorla, 1980).

Holland and Rescorla (1975) used the conditioned activity paradigm to study second-order conditioning. For our study, we will replicate the features of this study, using the behavioral scoring procedure of Holland (1977) rather than the gross activity counts that we used last week.

Method

Subjects. Our Sprague-Dawley rats will serve as subjects.

Apparatus. We will be using the six custom-constructed chambers to condition our animals and the tone and light stimuli from our previous study.

Behavioral Coding. We will use Holland's behavioral coding categories. These are six nominal categories of the following behaviors:

Perambulate Change in position involving all four feet, including walking across chamber, circling and/or jumping suddenly to another position; often accompanied by sniffing.

Rear Standing on hind legs with both forepaws off the floor, usually (not always) stretching to full extent, forepaws usually (not always) on top of side walls of chamber, often pawing walls; may be accompanied by sniffing or slow side-to-side movement of head. Does not include grooming movements, even if performed while standing on hind legs.

Magazine Standing motionless in front of food magazine (the food cup) with nose or head within magazine, sometimes (rarely) gnawing on edges of magazine opening.

Head-jerk Short rapid horizontal and/or vertical movements of the head, usually oriented toward food magazine; hindquarters motionless. Infrequently occurring with rear: In those cases, only head-jerk scored.

Head-jerk/hind Head-jerk plus movement of hindquarters, either side-to-side or forward-backward. Simultaneous display of head-jerk and perambulate (rare) also scored as head-jerk/hind.

Other Grooming head, body, or tail; scratching; gnawing sides of chamber; lying motionless on floor; sniffing, when not accompanied by other behaviors.

Procedure. Each rat will be run for a session of 80 minutes. Because we will have six chambers, this will mean a single shift. During the first 32 minutes (Phase I), we will continue the training given the rats in Study Three. Then we will switch to a second-order conditioning phase (Phase II) for 48 minutes. Depending upon the results that we obtain with some of the rats that we have been testing the previous week, we may switch the US to a different type of food. We will discuss this change as necessary.

During Phase I, deliver 8 trials of the light and 8 trials of the tone according to the contingency used with your rat last week (e.g., if light was the CS^+ last week, continue to reinforce the light and nonreinforce the tone). Deliver a stimulus every two minutes, according to the sequence TTLL TLLT LTTL TTLL. Record for each half of the stimulus which of the above behaviors was the dominant behavior

during the interval. That is, you will have an observation for the first 5 seconds of the CS and the last five seconds.

During Phase II, deliver 16 second-order trials and 8 first-order trials. Each second-order trial consists of a ten-second presentation of the former CS^- followed by a ten-second presentation of the CS^+. Do not reinforce these trials with food. The first order trials consist of reinforced presentations of the CS^+ only. As in Phase I, deliver a trial every two minutes, according to the sequence FSSSSF SFFSSS FSSSSF SFSSSF, where S refers to a second-order trial and F refers to a first-order trial.

After the session, weigh and feed your rat.

Results

As in our previous study, we are interested in a change of behavior as a result of experience. Does the behavior to the second-order stimulus change as a result of pairings with the first order stimulus? An important question is whether the behavior controlled by the second-order stimulus is the same behavior as that controlled by the first. In this case, however, we have not a single measure of behavior, but, instead, we have six. Consequently, a "change" may mean a different behavioral profile.

To examine these questions, once again group your observations into blocks of four trials. This time, compute the percentage with which each behavior occurred during a block. (That is, with four stimuli in a block, and two observations per stimuli, you have eight observations; if "magazine behaviors" occurred three times out of the eight observations, magazine has a percentage of 38Plot this percentage as a function of the four blocks for both stimuli.

Because the CS^+ occurs on both first- and second-order trials, you have the opportunity to compare the behaviors on these two types of trials. Is there a difference?

Obtain the data from a team with the opposite relation between light and tone with food (i.e., if light was an CS^+ for your rat, get the data from a team for which light was the CS^-). Plot this rat in the same way.

Have you established evidence for second order conditioning? Do you think our study provides a sufficient control for nonassociative effects in second order conditioning?

REFERENCES

Holland, P. & Rescorla, R. A. (1975). Second-order conditioning with food unconditioned stimulus. Journal of Comparative and Physiological Psychology, **88**, 459–467.

Holland, P. C. (1977). Conditioned stimulus as a determinant of the form of the Pavlovian conditioned response. Journal of Experimental Psychology: Animal Behavior Processes, **3**, 77–104.

Pavlov, I. P. (1927). Conditioned reflexes. (G. V. Anrep, trans.). London: Oxford University Press.

Rescorla, R. A. (1980). Pavlovian second-order conditioning. Hilsdale, N. J.: Erlbaum.

Rizley, R. A. & Rescorla, R. A. (1972). Association in second-order conditioning and sensory preconditioning. Journal of Comparative and Physiological Psychology, **81**, 1–11.