

## LABORATORY 10

### Operant Conditioning: Rats Pushing Levers

#### Purpose

- to introduce you to **operant conditioning techniques** in psychological research;
- to give you a chance to teach a (virtual) rat to press a lever and learn a discrimination;
- to illustrate what is meant by the terms **conditioning**, **extinction**, **discrimination**, and **reinforcement schedules**.

#### Introduction

This lab is designed to give you experience with operant, or instrumental, conditioning, one of the standard procedures for behavioral research with nonhuman animals. The term “operant conditioning” was invented by B.F. Skinner, who exerted tremendous influence on the laboratory study of animal behavior and who liked to invent new language (Skinner was an English major as an undergraduate).

In this lab, you will have a chance to become acquainted with some of the terms and phenomena of conditioning techniques. You will work with a simulation of an albino laboratory rat (*Rattus rattus*), and an operant conditioning chamber, or Skinner box. Your tasks will be to teach the rat to press a lever in the Skinner box, to examine the effects of a **schedule of reinforcement**, and to conduct some (auditory) **discrimination learning**.

The Skinner box is designed to provide a relatively controlled environment in which it is possible to present stimuli and provide reinforcement in a well-defined way. The box has Plexiglas sides and top to allow you to observe what the animal is doing. The grid floor is designed to be easy to clean. The front and back of the box are made of metal to provide support. The front end of the box holds the **food magazine**, the **lever** (or **manipulandum**), and the **discriminative stimulus**. The food magazine allows the rat access to a food pellet reinforcer, delivered through the chute behind the magazine. The lever is connected, mechanically and electrically, to the food delivery system, so that a press on the lever will deliver a reinforcer, on a schedule set by the experimenter. The discriminative stimulus provides a moderately loud sound in the cage and can be used to control when the rat presses the lever.

Skinner designed the Skinner box as a way of studying the behavior of organisms moving about relatively unconstrained in their environments. As part of his vision, he wanted to avoid using a **discrete trials** procedure, in which the experiment is divided into well-defined trial periods, separated by nontrial times. Instead, Skinner advocated using a **free operant** procedure, in which reinforcers could be delivered at any time, depending on the schedule of reinforcement. In this arrangement, there are no trials, hence it does not make sense to speak of “nontrial times”, either. To characterize performance when there are no trials, Skinner advocated using the **rate** of responding. The response rate measures how many responses are made in a given interval of time. Response rate is often displayed in the form of a cumulative record, which was another of Skinner’s inventions. This display shows the total responses made as a function of time.

**Procedure**

This lab will be done in a simulated environment, using Sniffy, the Virtual Rat. Each person should work alone with his or her own Sniffy. The lab will consist of a period of magazine training, a period of shaping, a period of acquisition on continuous reinforcement, then a period of shaping on an increasingly “lean” schedule. The final stage of the lab activity will be to teach the rat an auditory discrimination, such that it presses the lever only when a particular stimulus (in this case, a tone) is turned on.

The success of your efforts to teach your rat will depend in part on your application of the principles of operant conditioning. Sniffy will learn exactly what you teach him.

**Acquisition Training: Magazine Training**

The first step in the acquisition phase is to get the rat to associate the sound of the food magazine with food. This is accomplished by activating the food magazine at times that Sniffy is near the food hopper so that he eats the food in temporal proximity to the sound. The display includes a bar that shows the strength of the sound-food association. When the bar is at or close to its maximum strength, Sniffy is ready for shaping.

**Acquisition Training: Shaping**

This part of the acquisition phase is designed to get the rat pressing the lever. “Shaping” is the term for the process of providing reinforcement for behaviors that approximate the desired behavior. The idea is to gradually shape behavior to match a desired end state. To carry out the shaping process, you need to identify a set of behaviors that are rough approximations of your target behavior. For example, in order for the rat to press the lever, it has to be on the same side of the chamber as the lever rather than on the opposite side. Thus, you might give the rat a reinforcement or two just for being on the correct side of the chamber. As another example, the rat needs to orient toward the bar to press it, and you might reinforce orienting movements for a few occasions. You have to be careful not to give too many reinforcements for an approximate behavior, because the rat may come to make only the approximation; at the same time, you have to be careful to give enough reinforcements that the rat does not “give up”.

**Acquisition Training: Continuous Reinforcement**

This part of the acquisition phase is designed to get the rat to the point of pressing the lever consistently. In this phase, the rat should get a pellet every time it presses the lever. This phase of acquisition continues until the rat is pressing consistently.

**Acquisition Training: Partial Reinforcement**

This part of the acquisition phase is designed to get the rat on a partial reinforcement schedule. In this phase, your goal is to train the rat to press the lever 8 times for every pellet (an FR 8). However, in order to reach this goal, you will probably have to impose the schedule gradually. That is, once the rat is pressing consistently under CRF, shift to an FR2 or FR3 schedule, in which the rat gets a pellet only after making 2 or 3 presses. If the rat is performing

adequately on this schedule, shift to an FR4 or FR6 schedule. Finally, if the rat is performing adequately on this more demanding schedule, shift to an FR8 schedule.

To put Sniffy on an FR schedule, click on the **Experiment** tab in the Menu Bar, then select *Design Experiment*. In the window that opens, click on “Fixed” and “Response”, and set the number to “2”, then click on “OK”. Each time you want to change the FR requirement, you need to go to this window and change the number in the box.

### **Discrimination Training**

The discrimination training phase is designed to teach the rat to press the lever when a discriminative stimulus is present (the  $S^D$ , in this case a 1.0 kHz tone) and not press the lever when a different stimulus is present (the  $S^\Delta$ , in this case a 3.5 kHz tone). The basic procedure to accomplish this goal is to provide reinforcement for bar presses in the presence of  $S^D$  but not to provide reinforcement for bar presses in the presence of  $S^\Delta$ . To carry out the discrimination training, you will go through 10 cycles in which the  $S^D$  is on for 30 seconds, then turned off and the  $S^\Delta$  is on for 30 seconds. While the  $S^D$  is on, the rat will be given reinforcements on a fixed ratio schedule; while the  $S^\Delta$  is on, the rat will receive no reinforcement at all.

At the end of discrimination training, click on the **File** tab on the Menu Bar and Save the session on your clam account. After the session is saved, click on the window that has the cumulative record in it (this should be just below the window showing Sniffy), then click on the **File** tab again and select “Print Window”. This will print your cumulative record for the session, which you can use to answer your questions.

### **Data Analysis**

The object of your data analysis is to describe the behavior of the rat, based on what you saw during the training process and what is shown on your cumulative record.

A cumulative record is a graph that plots the total number of responses that have been made as time elapses. Cumulative records were one of Skinner’s inventions, and they provide an important window on the activity of organisms. There are a couple of features to note about a cumulative record. First, the graph never goes down; it only goes up, because the total number of responses does not diminish. However, as a practical matter, the printed record shows abrupt shifts downward. These occur when the recording pen reaches its upward limit, and then resets back to the beginning of the paper record. Think of these resets as being like carriage returns on a word processor. Second, the responses shift the line upward but are not individually marked.

Third, the occurrence of a reinforcer is indicated by a short slash. These slash marks provide a convenient way to see when responses are occurring.

### **Questions to Answer**

1. How did your rat come to press the lever? That is, what kinds of behavior did the rat exhibit before it pressed the lever consistently?

2. How high a ratio did your rat reach? Were there any systematic features of the rat's behavior while on the ratio schedule? How is this learning reflected in the cumulative record?
3. Did your rat learn the discrimination? How is the learning reflected in the cumulative record?

### **Lab Report**

Your report of this lab will consist of

- 1) a title page;
- 2) the cumulative records from all phases of the task;
- 3) your answers to the 3 sets of Questions to Answer.

In your report, be sure to explain the reasoning behind your conclusions.