LEARNING:
OPERANT CONDITIONING

Operant conditioning includes the study of how environmental factors influence behavior. These factors include *discriminative stimuli*, which signal that a response may now be reinforced; *reinforcers*, which increase the frequency of the response they follow; and *schedules of reinforcement*, which are rules for the delivery of reinforcers. In this lab you will use animals in your activity, but these principles are also applicable to human behavior.

General Method

Subjects:

Three female albino rats approximately 90 days old. One is a naïve rat. One goes to the food cup when the click occurs. One has learned to lever press.

Apparatus:

Three equivalent operant chambers, each equipped with a lever, food cup, and lights. These are connected to a computer that notes responses and controls food delivery. A hand button is at the end of a long cord. Lights can be illuminated red and/or green and a button below those lights, which change which light, is illuminated.

Procedure:

Overview: Rats will be placed individually into conditioning chambers, which are located in different rooms. Different procedures will be followed for each rat. The red and green lights tell you which training procedure the equipment is set up to do. Pressing the button below the lights moves them from one training activity to another and changes the lights. The naïve rat will be magazine trained (the RED light should be on). The rat that goes to the food cup is magazine trained and will be trained to press the lever (the GREEN light should be on). The rat that is lever pressing will be exposed to a schedule of reinforcement (both the RED AND GREEN lights should be on). You are free to move from room to room and observe and/or assist with the procedures.

Experiment A – Magazine training

Procedure:

The naive rat: The first step in teaching a rat to press a lever is to teach it to go get the reinforcer when it is delivered. If you don't do this, then when you see a response you want to increase in frequency and deliver a reinforcer, that rat will not go to the food cup to receive the reinforcer, so the response won't increase in frequency. What's important is the rat's experiences, not your intentions.

When the food pellet is delivered, by your pressing the hand button, a click occurs. You will train the rat to go to the food cup when the click occurs. Before you start training, deliver a pellet when the rat is away from the lever. Time the latency from when the click occurred to when the rat grabbed the pellet. Do this three times. These are

a measure of how well the click influences the rat's going to the cup with little training. These will be compared to latencies recorded after training.

Now training begins. Deliver food pellets randomly, about one every 30 seconds. If you notice the rat is beginning to do the same thing over and over (except going to the cup when the click occurs) then stop giving the rat a pellet following that activity. Never give a pellet if the head/nose of the rat is in or within an inch of the food cup. Also do not deliver a pellet if the rat is grooming or 'vigorously' sniffing between the bars on the floor of the chamber. When the rat is reliably going to the food cup when the click occurs, time and record the next 5 latencies. If these latencies are short, less than 3 sec., Press the button below the red and green lights once to move to turn on the GREEN light and start lever-press shaping. Follow the instructions in B, below.

Results:

You want to determine whether the click became a discriminative stimulus, influencing the rat to go to the food cup. Calculate the mean latency for the first five recorded latencies, and the last five latencies. Long latencies indicate little influence by the click, short latencies indicate strong influence by the click.

First three latencies:	Last five latencies:
1. _____	1. _____
2. _____	2. _____
3. _____	3. _____
	4. _____
	5. _____
SUM _____	_____
Mean = Sum/3 = _____	Mean = sum/5= _____

Discussion

Discriminative stimuli signal that reinforcers are available. Did you established the click as a discriminative stimulus for going to the food cup. Compare the mean of the first five latencies with the mean of the last five latencies. Which is larger? What does that mean? Discriminative stimuli are very common in complex human behavior. List five discriminative stimuli in your life.

Experiment B

In this segment a rat that was magazine trained will be shaped to press the lever.

Procedure:

If you did not just magazine train you rat, check that he is trained by putting the RED light on an making the click randomly every 30 or so sec. If the rat reliably goes to the food cup (within 3 sec), he is trained and start shaping. Other wise continue presenting the click until the rat reliably goes to the cup when the click occurs.

Shaping: This rat's behavior is already influenced by the click, demonstrating that the click is a discriminative stimulus. Next you want the rat to acquire a new response, pressing the lever. To do this you will use a procedure called shaping by the method of successive approximations. This means you will reinforce responses that remotely resemble lever pressing. As this response increases in frequency, the criterion for reinforcement changes slightly to a response more closely resembling lever pressing. You continue to change the criterion for reinforcement as the rat learns to emit each response. In a short period of time the rat will begin pressing the lever.

Before you begin shaping, first observe the rat for 5 minutes, counting the number of lever presses. Later you will count the number of lever presses after the shaping procedure to see if the number of lever presses increased. Then you begin shaping. Specifically, reinforce (give the rat a food pellet by pressing the hand button) a response the rat can emit but does so only occasionally, such as facing the lever. When the rat is frequently facing the lever change the criterion to being close the lever,

then one paw off the floor,
then one paw near the lever,
then one paw touching the top of the lever,
then both paws touching the top of the lever,
then slight lever presses,
then complete lever presses.

Shaping is somewhat of an art, so you can only be given general guidelines. Rats are individuals, so you need to vary the specifics of shaping to the individual needs of the rat. Some rats will "skip" some steps noted above. That's OK, follow the lead of your rat. The rat should be getting between 1 and 4 reinforcers per minute. When the rat is getting 4 or so reinforcers per minute, he has learned to emit the response you are reinforcing, so change the criterion to something more closely resembling lever pressing. If the frequency of reinforcement drops to fewer than 1 or so per minute the criterion may be too difficult for your rat. Change the criterion to something easier, possibly the former criterion. Whoever is shaping lever pressing need to deliver the reinforcer immediately – when the response meets the criterion. If you wait to decide, or get a consensus from students in the room, the rat will be doing something else when the pellet is delivered. This will reinforcer a response other than the response you want strengthened.

When this rat is reliably lever-pressing, count the number of lever presses for 5 minutes. Then we move to a schedule of reinforcement by pressing the button below the lights, turning on both the RED AND GREEN lights. Go to lever-pressing rat in Experiment C, below.

Results:

Calculate the mean responses per minute for the first five minutes of training, and the last 5 minutes of training. To do this, divide the total number of responses in each period by 5.

First five minutes:

Total responses = _____. Mean responses per minute= total responses / 5= _____.
Lst five minutes:
Total responses = _____. Mean responses per minute= total responses / 5= _____.

Discussion

If the rate of lever pressing is higher after training than before training, then you taught your rat to lever press. Compare the mean response rate before training began with the mean response rate at the end of training. Which is larger? What does that mean? How many reinforcers were required to shape this response? How many did you think it would take? What responses have you learned by a shaping procedure? At first you may think none, but we have all learned lots of responses as a result of a shaping procedure; consider motor skills and learning to pronounce words in a foreign language.

Experiment C

In this segment a rat that was trained to press the lever will now have its lever pressing reinforced only occasionally. We will use a fixed ratio schedule (rule) of reinforcement. In this reinforcers are delivered following a certain number of responses.

Procedure:

Not every lever press will be reinforced (rarely in complex human behavior is every response reinforced). This rat's response will be reinforced on a ratio schedule of reinforcement. On ratio schedules, the critical factor determining the delivery of reinforcement is the number of responses the rat emits. The apparatus is now set to reinforce the first lever press after the hand button is pressed. Initially a schedule of continuous reinforcement is used. In this schedule each lever press is reinforced. To accomplish this, press the hand button after each response to arrange the next reinforcer. Each time the rat presses the lever a food pellet will be delivered. Time the latency from the delivery of a pellet to the next lever press. Do this for the first 5 lever presses. Save this data fromj a comparison with data collected later. After 40 or so reinforcers (food pellets), the response requirement will be increased to 2 responses (called a Fixed Ratio 2 schedule). To do this, press the button after one lever press. The next lever press will be reinforced. After the next response, which is not reinforced, again press the hand button, and the next lever press will be reinforced. Repeat this until 40 or so reinforcers have been delivered. If the rat is generally focusing its behavior to the lever, go to the next step; other wise stay with FR 2 until he is generally focusing its behavior at the lever. Generally focused means 'trying' to press the lever, pushing it in one way or another, or sniffing or biting the lever. Short breaks from the lever are OK. If your rat makes one press and then walks from the lever, its behavior is not focused on the lever.

Next we will increase the response requirement to 3 responses (Fixed Ratio 3 schedule). After two lever presses, press the hand button. Repeat this for 40 or so reinforcers. Go to the next step only if the rats is generally focusing it behavior to the lever.

Next we will increase the response requirement to 4 responses (fixed ratio 4). After three lever presses, press the hand button. Repeat this for 60 or so reinforcers.

Next we will increase the response requirement to 6 responses (FR 6). After five lever presses, press the hand button. Advance to larger ratios is steps of 2 responses when at least 40 reinforcer were delivered at a particular ratio and when the rats behavior is generally focused to the lever.

The data we will collect is the latency from the delivery of the reinforcer to the next lever press. With a stopwatch, start timing when the click occurs, indicating a food pellet was delivered. Stop timing when the rat next presses the lever. If the first schedule you use is continuous reinforcement, each lever press delivers a food pellet, simplify data collection by recording the total time it takes to make the first 5 lever presses. The mean latency is the time for the first press to the last divided by the number of presses. At the end of the lab record the latency from the click to the next lever press for the last 5 reinforcers.

Results:

Calculate the mean latency for the first five latencies, and the last five latencies.

First five latencies:	Last five latencies:
1. _____	1. _____
2. _____	2. _____
3. _____	3. _____
4. _____	4. _____
5. _____	5. _____
SUM _____	_____
Mean = Sum/5 = _____	Mean = Sum / 5= _____

Discussion

~~Lever pressing rat:~~ Compare the mean of the first five latencies with the last five latencies. Which is larger? Did the latency to the first response following a reinforcer increase with the greater response requirement of fixed ratio schedules? Typically this occurs. Fixed ratio schedules (or close approximations) are common in human behavior. Can you think of any examples of human behavior that is reinforced on a fixed ratio. It could be your own behavior or that of someone else's.