

## CLASSICAL CONDITIONING

It was a Russian *physiologist* (a person who studies the workings of the body) named Ivan Pavlov (1849–1936) who pioneered the empirical study of the basic principles of a particular kind of learning (Pavlov, 1906, 1926). Studying the digestive system in his dogs, Pavlov had built a device that would accurately measure the amount of saliva produced by the dogs when they were fed a measured amount of food. Normally, when food is placed in the mouth of any animal, the salivary glands automatically start releasing saliva to help with chewing and digestion. This is a normal **reflex**—an unlearned, involuntary response that is not under personal control or choice—one of many that occur in both animals and humans. The food causes a particular reaction, the salivation. A *stimulus* can be defined as any object, event, or experience that causes a *response*, the reaction of an organism. In the case of Pavlov’s dogs, the food is the stimulus and salivation is the response. Pavlov soon discovered that his dogs began salivating when they weren’t supposed to be salivating. Some dogs would start salivating when they saw the lab assistant bringing their food, others when they heard the clatter of the food bowl from the kitchen, and still others when it was the time of day they were usually fed. Switching his focus, Pavlov spent the rest of his career studying what eventually he termed **classical conditioning**, learning to elicit an involuntary reflex response to a stimulus other than the original, natural stimulus that normally produces the reflex.

### ELEMENTS OF CLASSICAL CONDITIONING

Pavlov eventually identified several key elements that must be present and experienced in a particular way for conditioning to take place.

**UNCONDITIONED STIMULUS:** The original, naturally occurring stimulus mentioned in the preceding paragraph is called the **unconditioned stimulus (UCS)**. The term *unconditioned* means “unlearned.” This is the stimulus that ordinarily leads to the reflex response. In the case of Pavlov’s dogs, the food is the unconditioned stimulus.

**UNCONDITIONED RESPONSE:** The reflex response to the unconditioned stimulus is called the **unconditioned response (UCR)** for much the same reason. It is unlearned and occurs because of genetic “wiring” in the nervous system. For example, in Pavlov’s experiment, the salivation to the food is the UCR (unconditioned response).

**CONDITIONED STIMULUS:** Pavlov determined that almost any kind of stimulus could become associated with the unconditioned stimulus (UCS) if it is paired with the UCS often enough. In his original study, the sight of the food dish itself became a stimulus for salivation *before* the food was given to the dogs. Every time they got food (to which they reflexively salivated), they saw the dish. At this point, the dish was called a **neutral stimulus (NS)** because it had no effect on salivation. After learning being paired with the food so many times, the dish came to produce the same salivation response, although a somewhat weaker one, as did the food itself. When a previously neutral stimulus, through repeated pairing with the unconditioned stimulus, begins to cause the same kind of reflexive response, learning has occurred. The neutral stimulus can now be called a **conditioned stimulus (CS)**. (*Unconditioned* means “unlearned,” and, as mentioned earlier, *conditioned* means “learned.”)

**CONDITIONED RESPONSE:** The response that is given to the CS (conditioned stimulus) is not usually quite as strong as the original unconditioned response (UCR), but it is essentially the same response. However, because it comes as a response to the conditioned stimulus (CS), it is called the **conditioned response (CR)**.

### **PAVLOV'S EXPERIMENT**

*How did Pavlov study conditioning?* To begin, he rang a bell. At first, the bell was a neutral stimulus (the dogs did not respond to it by salivating). Immediately after Pavlov rang the bell, he placed meat powder on the dog's tongue, which caused reflex salivation. This sequence was repeated a number of times: bell, meat powder, salivation; bell, meat powder, salivation. Eventually (as conditioning took place), the dogs began to salivate when they heard the bell. By association, the bell, which before had no effect, began to evoke the same response that food did. This was shown by sometimes ringing the bell alone. Then the dog salivated, even though no food had been placed in its mouth.

### **STIMULUS GENERALIZATION AND DISCRIMINATION**

Pavlov did find that similar sounds would produce a similar conditioned response from his dogs. He and other researchers found that the strength of the response to similar sounds was not as strong as it was to the original one, but the more similar the other sound was to the original sound (be it a metronome or any other kind of sound), the more similar the strength of the response was (Siegel, 1969). The tendency to respond to a stimulus that is similar to the original conditioned stimulus is called **stimulus generalization**. For example, a person who reacts with anxiety to the sound of a dentist's drill might react with some slight anxiety to a similar-sounding machine, such as an electric coffee grinder.

Of course, Pavlov did not give the dogs any food after the similar ticking sound. They only got food following the correct CS. It didn't take long for the dogs to stop responding (generalizing) to the "fake" ticking sounds altogether. Because only the real CS was followed with food, they learned to tell the difference, or to *discriminate*, between the fake ticking and the CS ticking, a process called **stimulus discrimination**. Stimulus discrimination occurs when an organism learns to respond to different stimuli in different ways. For example, although the sound of the coffee grinder might produce a little anxiety in the dental-drill-hating person, after a few uses that sound will no longer produce anxiety because it isn't associated with dental pain.

### **EXTINCTION AND SPONTANEOUS RECOVERY**

What would have happened if Pavlov had stopped giving the dogs food after the real CS? Pavlov did try just that, and the dogs gradually stopped salivating to the sound of the ticking. When the metronome's ticking (CS or conditioned stimulus) was repeatedly presented in the absence of the UCS (unconditioned stimulus or food, in this case), the salivation (CR or conditioned response) "died out" in a process called **extinction**.

The term *extinction* is a little unfortunate in that it seems to mean that the original conditioned response is totally gone, dead, never coming back, just like the dinosaurs. Remember the definition of learning is any relatively *permanent* change in behavior. The fact is that once

people learn something, it's almost impossible to "unlearn" it. People can learn new things that replace it or lose their way to it in memory, but it's still there. In the case of classical conditioning, this is easily demonstrated.

After extinguishing the conditioned salivation response in his dogs, Pavlov waited a few weeks, putting the conditioned stimulus (e.g., the metronome) away. There were no more training sessions and the dogs were not exposed to the metronome's ticking in that time at all. But when Pavlov took the metronome back out and set it ticking, the dogs all began to salivate, although it was a fairly weak response and didn't last very long. This brief recovery of the conditioned response proves that the CR is "still in there" somewhere (remember, learning is *relatively permanent*). It is just suppressed or inhibited by the lack of an association with the unconditioned stimulus of food (which is no longer reinforcing or strengthening the CR). As time passes, this inhibition weakens, especially if the original conditioned stimulus has not been present for a while. In **spontaneous recovery** the conditioned response can briefly reappear when the original CS returns, although the response is usually weak and short lived.

### **HIGHER-ORDER CONDITIONING**

Another concept in classical conditioning is **higher-order conditioning**. This occurs when a strong conditioned stimulus is paired with a neutral stimulus. The strong CS can actually play the part of a UCS, and the previously neutral stimulus becomes a *second* conditioned stimulus. For example, let's revisit the point when Pavlov has conditioned his dogs to salivate at the sound of the metronome. What would happen if just before Pavlov turned on the metronome, he snapped his fingers? The sequence would now be "snap-ticking-salivation," or "NS-CS-CR" ("neutral stimulus/conditioned stimulus/conditioned response"). If this happens enough times, the finger snap will eventually also produce a salivation response. The finger snap becomes associated with the ticking through the same process that the ticking became associated with the food originally and is now another conditioned stimulus. Of course, the food (UCS) would have to be presented every now and then to maintain the original conditioned response to the metronome's ticking. Without the UCS, the higher-order conditioning would be difficult to maintain and would gradually fade away.