



The Thoughtful Animal

What Is Classical Conditioning? (And Why Does It Matter?)

By Jason G. Goldman on January 11, 2012



Classical conditioning is one of those introductory psychology terms that gets thrown around. Many people have a general idea that it is one of the most basic forms of associative learning, and people often know that Ivan Pavlov's 1927 experiment with dogs has something to do with it, but that is often where it ends.

Classical Conditioning, Explained

The most important thing to remember is that classical conditioning involves *automatic or reflexive responses*, and not voluntary behavior (that's operant conditioning, and that is a [different post](#)). What does this mean? For one thing, that means that the only responses that can be elicited out of a classical conditioning paradigm are ones that rely on responses that are naturally made by the animal (or human) that is being trained. Also, it means that the response you hope to elicit must occur below the level of conscious awareness - for example, salivation, nausea, increased or decreased heartrate, pupil dilation or constriction, or even a reflexive motor response (such as recoiling from a painful stimulus). In other words, these sorts of responses are *involuntary*.

The basic classical conditioning procedure goes like this: a *neutral* stimulus is paired with an *unconditional* stimulus (UCS). The neutral stimulus can be anything, as long as it does not provoke any sort of response in the organism. On the other hand, the unconditional stimulus is something that reliably results in a natural response. For example, if you shine a light into a human eye, the pupil will automatically constrict (you can actually see this happen if you watch your eyes in a mirror as you turn on and off a light). Pavlov called this the "unconditional response." (UCR)

As soon as the neutral stimulus is presented with the UCS, it becomes a *conditional* stimulus (CS). If the CS and UCS always occur together, then the two stimuli would become associated over time. The response that was initially produced in response to the UCS would also be produced in response to the CS, even if it was presented alone. Pavlov called this the "conditional response." (CR)

To make this a bit more concrete, we'll use Pavlov's dogs as an example. Before learning took place, the dogs would reliably salivate (UCR) when given meat powder (UCS), but they gave no response to the ringing of a bell (neutral). Then Pavlov would always ring a bell just before he would present the dogs with some meat powder. Pretty soon, the dogs began to associate the sound of the bell with the impending presence of meat powder. As a result, they would begin to salivate (CR) as soon as they heard the bell (CS), even if it was *not* immediately followed by the meat powder

(UCS). In other words, they learned that the bell was a reliable predictor of meat powder. In this way, Pavlov was able to elicit an *involuntary, automatic, reflexive response* to a previously neutral stimulus.

Note that most English-language textbooks use the terms "unconditioned stimulus," "unconditioned response," and so on. This is due to a translation error from Pavlov's Russian to English. The better translation would be "conditional."

Want an infographic? Of course you do:

Pavlov's Dogs



by Jason G. Goldman

BEFORE LEARNING:



MEAT (UCS)



SALIVATION (UCR)



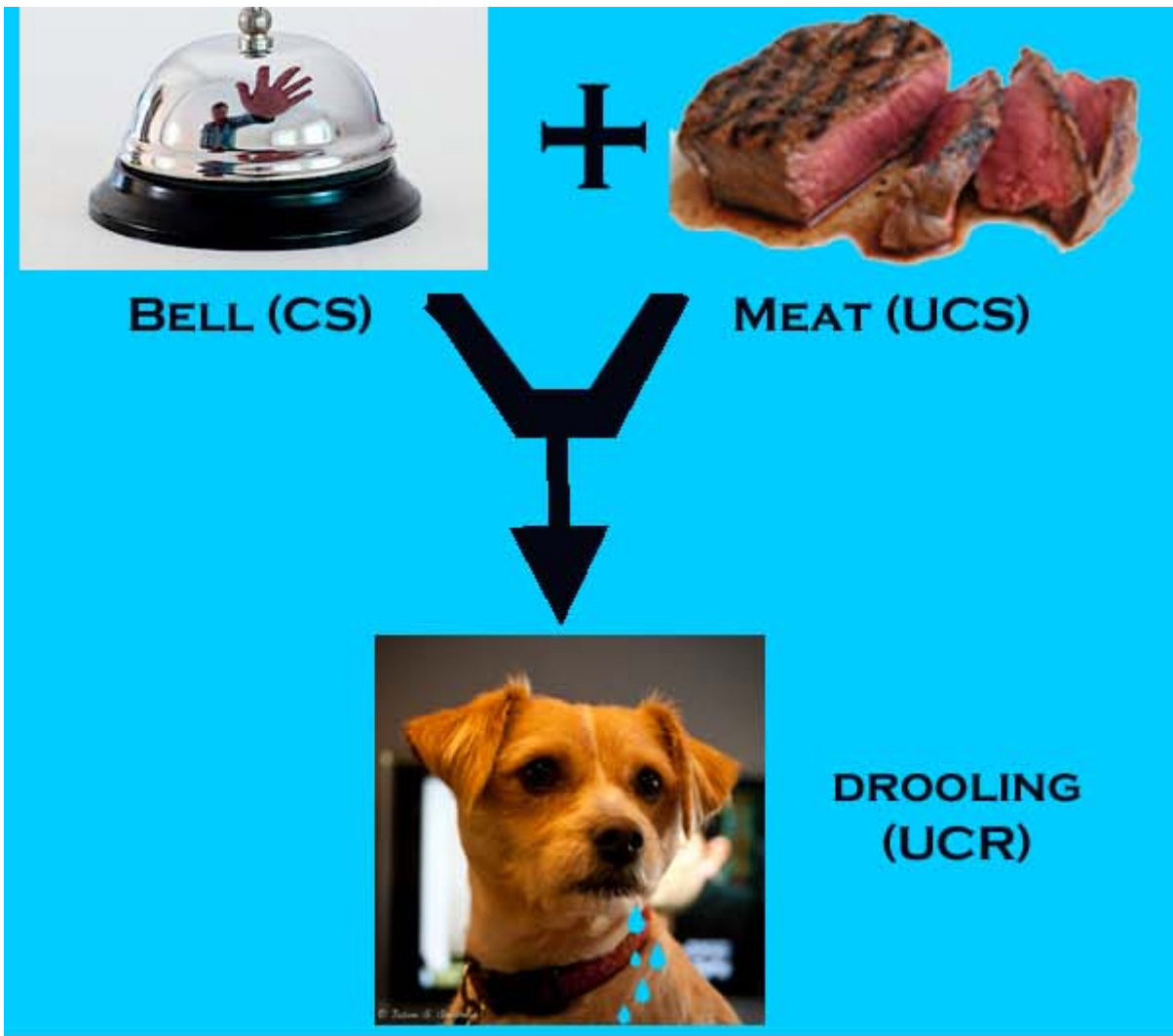
BELL (NEUTRAL)



(NO RESPONSE)

TRAINING:





TESTING:



BELL (CS)



DROOLING (CR)

Images: All dog photos copyright Jason G. Goldman

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Bell: <http://www.flickr.com/photos/fcstpauli/5998938270>
Meat: <http://www.fotopedia.com/items/flickr-3182238046>

Real-world Examples of Classical Conditioning

Classical conditioning can help us understand how some forms of **addiction**, or drug dependence, work. For example, the repeated use of a drug could cause the body to compensate for it, in an effort to counterbalance the effects of the drug. This causes the user to require more of the substance in order to get the equivalent effect (this is called *tolerance*). However, the development of tolerance also takes into account other environmental variables (the conditional variables) - this is called the *situational specificity of tolerance*. For example, alcohol tends to taste a certain way, and when alcohol is consumed in the usual way, the body responds in an effort to counteract the effect. But, if the alcohol is delivered in a novel way (such as in Four Loko), the individual could overdose. This effect has also been observed among those who have become tolerant to otherwise lethal amounts of opiates: they may experience an overdose if they take their typical dose in an atypical setting. These results have been found in species ranging from rats and mice to humans.

In these examples, it's the environmental context (conditional stimuli) that prompts the body to prepare for the drug (the conditional response). But if the conditional stimuli are absent, the body is not able to adequately prepare itself for the drug, and bad things could happen.

Another example of classical conditioning is known as the **appetizer effect**. If there are otherwise neutral stimuli that consistently predict a meal, they could cause people to become hungry, because those stimuli induce involuntary changes in the body, as a preparation for digestion. There's a reason it's called the "dinner bell," after all.

Classical conditioning is also being used in **wildlife conservation efforts**! At Extinction Countdown, John Platt pointed out last month that taste aversion, which is a form of classical conditioning, is being used to keep lions from preying on cattle. This should, in turn, prevent farmers from killing the lions.

Given and his team of researchers gave eight of the cats meals of beef treated with the deworming agent thiabendazole in doses large enough to make them temporarily sick to their stomachs. “It basically causes a bad case of indigestion,” WildiZe founder Eli Weiss told The Aspen Times.

After a few meals of treated beef, the lions were once again offered untreated meat. Seven of the eight refused to eat it, while an eighth actually refused to eat at all for a short period.

In this example, the meat is actually the neutral stimulus, when paired with the deworming agent (UCS). The unconditional response is the feeling of being sick. Thus, the feeling of being sick (CR) was associated with the beef (CS), resulting in aversion to beef.

Finally, following a conversation on twitter recently, cartoonist Joseph Hewitt pointed out another example of classical conditioning:



Can you think of other real-world examples of classical conditioning? Leave them in the comments!

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Jason G. Goldman is a science journalist based in Los Angeles. He has written about animal behavior, wildlife biology, conservation, and ecology for *Scientific American*, *Los Angeles* magazine, *The Washington Post*, *The Guardian*, the BBC, *Conservation* magazine, and elsewhere. He contributes to *Scientific American's* "60-Second Science" podcast, and is co-editor of *Science Blogging: The Essential Guide* (Yale University Press). He enjoys sharing his wildlife knowledge on television and on the radio, and often speaks to the public about wildlife and science communication.

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