Classical Pavlovian Conditioning

Assistant --> Food

Conditioned stimulus (CS) --> Unconditioned stimulus (US)

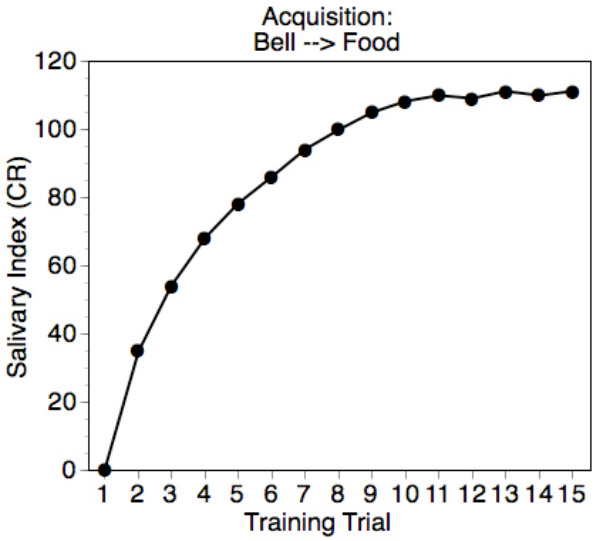
CS acquires value only if it is paired with the US; generate response after having been paired with the US.

US normally elicits a response (salivation) by itself, unconditionally

Acquisition of a CR   

Training: Bell (CS) is repeatedly followed by food (US).

After a few trials, the bell starts to elicit the salivation conditioned response (CR) by itself *before* food is delivered.



CS Center → US Center

Claimed that this concept was equivalent to the psychological concept of **associations**.

This is a Stimulus-Stimulus (S-S) theory, i.e., Pavlov assumed the representations of the two stimuli, the CS and the US, would become associated (e.g., bell-food).

Contrary to the Stimulus-Response (S-R) theory many American behaviourists favoured at the time: They assumed the CS would become directly associated with the CR (e.g., bell-salivation).

Preparedness

Seligman (1971): Certain associations are formed more readily than others (we are more likely to develop a phobia of spiders rather than a phobia of cars). Seligman argued this is the result of evolution.

So **learning is not entirely driven by experience,** certain aspects seem to be innate…

e.g. you're more scared of snakes than of cars even though you're now more likely to die from a car accident. We're scared because our ancestors were scared of wild animals and died from getting bitten, cars didn't exist. BUT this is only an argument, there's not actual proof. Could just be a circular argument.

John Garcia's experiments on *taste aversion conditioning*:

Expose animal to a taste → induce nausea (LiCl, or radiation)

CS (taste) → US (nausea)

One of the most powerful conditioning procedures: an aversion to the taste develops after only one pairing of the taste with nausea.

Very powerful pairing.

Rats learned to associate *Food with Nausea* and *Tone with Shock* faster. Hence, certain combinations of stimuli are learnt more readily than others.

B. F. Skinner and Operant/Instrumental Conditioning

Operant conditioning: Learn to associate an action with a consequence.

Action 1 => reward

Action 2 => no reward

Over time, the animal will perform action 1 more frequently than action 2. Hence, the environment (the consequences of the animal's actions) will 'shape' the animal's behavior.

Classical Conditioning

CS → US

Bell → Food

Notice that the animal is *not* required to make a response in order for the US to occur. In fact, it has no control over the occurrence of food, the experimenter determines when food will be delivered.

Learn relationships between events that happen in one's environment.

Whether the animal salivates or not doesn't chance whether the food is delivered or not.

Operant (or Instrumental) Conditioning

Learn that a behaviour will be followed by an US:

Operant Response → US

Press Lever → Food

In order for food to occur, the animal must perform the operant response. Hence, the animal controls the delivery of food.

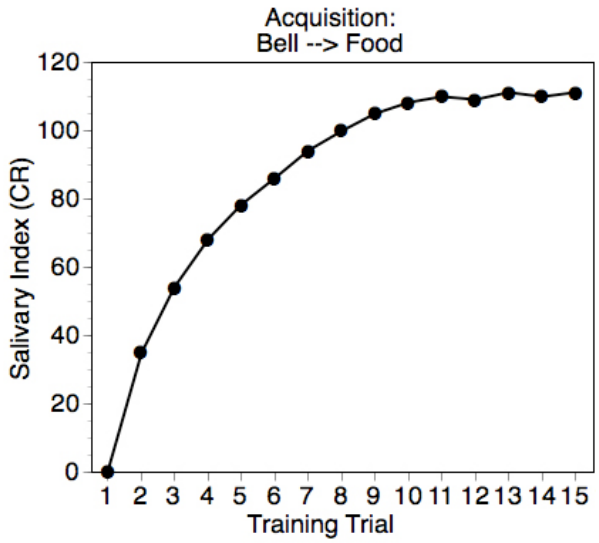
Learn the consequences (good or bad outcomes) that follow one's behaviour.

HULL-SPENCER MODEL

Acquisition of a CR   

Training: Bell (CS) is repeatedly followed by food (US).

After a few trials, the bell starts to elicit the salivation conditioned response (CR) by itself *before* food is delivered.



This is a typical learning curve.

Notice that the CR increases abruptly on the first few trials, and does not change much on the last few trials. This suggests that **large changes in the CS-US (bell-food) association happen only early on**, when the animal is still surprised by the occurrence of the food US. Then it reaches a plateau.

The extent to which the US wasn't expected = surprise

$$\Delta V_{A(t)} = k(\lambda - V_{A(t-1)})$$

Change in the strength of the A-US association on trial *t*.

Learning rate parameter (speed of learning)

Actual Outcome
$\lambda = 1$ if US is present.
$\lambda = 0$ if US is absent.

Expected Outcome = Associative strength that A has acquired up until trial *t*.

Trial 1: A → US

Start with $V_A = 0$

Assume k = 0.2 (k can take on any value between 0 and 1)

Calculate the change in the A-US association:

$\Delta V_{A(1)} = .2(1 - 0) = 0.2$ (US is completely unexpected)

Update the associative strength of A:

$V_{A(1)} = V_{A(0)} + \Delta V_{A(1)}$

$V_{A(1)} = 0 + 0.2 = 0.2$

So A has gone from zero associative strength to 0.2 after one pairing with the US.

Trial 2: A → US

Start with $V_A = 0.2$ (US is expected)

$\Delta V_{A(2)} = .2(1 - 0.2) = 0.16$

Update the associative strength of A:

$V_{A(2)} = V_{A(1)} + \Delta V_{A(2)}$

$V_{A(2)} = 0.2 + 0.16 = 0.36$

Learning reaches asymptote: $V_A = \lambda = 1$

$$\Delta V_A = k(\lambda - V_A) = 0$$

The model generates a learning curve that is *negatively accelerated* (learning slows down).

This is a realistic learning curve.