

## LECTURE 4: CLASSICAL CONDITIONING BASICS

**A. General definition**

Classical (or Pavlovian) conditioning refers to any form of learning which results from a temporal relationship between two external events & which may be indicated either by a) some immediate change in behaviour (e.g. conditioned salivation), or b) the results of some subsequent test (e.g. as in sensory pre-conditioning or conditioned-inhibition).

Note: This is much broader than Pavlov's original concept of a conditioned reflex, since it incorporates 'behaviourally silent' learning & denies that an essential component is a 'reinforcer' or 'US' (i.e. biologically significant events which innately elicit reflexive responses). Examples of behaviourally silent classical conditioning:

**Example 1****Sensory preconditioning**

Stage	What is paired	What is tested	What is seen	What is learnt
1	Light + Tone	Light Tone	No change	????
2	Tone $\Rightarrow$ Shock	Tone	Increasing fear of Tone	Tone predicts unpleasant experience
3	Nothing	Light	Fear of light	Light & Tone MUST have been associated at Stage 1

**Example 2****Conditioned inhibition:**

Stage	What is paired	What is tested	What is seen	What is learnt
1	Clicker $\Rightarrow$ Food Light + Clicker $\Rightarrow$ No Food	Clicker - Food Light + Clicker - No Food	Salivation to Clicker on its own	Clicker predicts food, Light + Clicker doesn't
2	Tone $\Rightarrow$ Food	Tone	Increasing salivation to Tone	Tone predicts food
3		Light + Tone	No salivation	Light has generalised inhibitory properties

**B. Definition of basic phenomena**

**Acquisition:** CS $\Rightarrow$ US learning develops over repeated trials, following a negatively-accelerated curve.

**Extinction:** once acquired, the association is progressively lost if US no longer follows CS

**Spontaneous recovery:** once CS $\Rightarrow$ US association has been lost, subsequent experience of CS alone at a later time can lead to some response

**Temporal contiguity:** learning occurs best when CS onset precedes the US with no CS $\Rightarrow$ US interval (delay). Introducing an interval between CS and US (trace conditioning) reduces the CR, with the CR reducing progressively as the CS-US interval increases (a test of short-term memory). CS which follow the US do not form associations

**Stimulus generalisation;** once a response to one CS has been acquired, responses are seen to related CS

**Conditioned inhibition;** a CS can predict the absence of a US

**Latent inhibition (stimulus pre-exposure):** prior learning that CS $\Rightarrow$ no US inhibits subsequent learning of CS $\Rightarrow$ US associations

**Higher order conditioning:**

Note: All of these phenomena can be handled by Pavlov's conditioned reflex model, with the possible exception of inhibitory effects.

### C. Stimulus-Stimulus versus Stimulus-Response associations

Pavlov's "Principle of Stimulus Substitution" suggested that the CS came to elicit a representation of the US (Stimulus-Stimulus or S-S association). Other theorists (e.g. Skinner & Hull) generated Stimulus-Response (S-R) theories, so called because the Stimulus (CS) was believed to be associated directly with the response (UR). S-S theory implies an expectancy of a US following a CS, whereas S-R is more reflexive in its description of behaviour.

Is Classical Conditioning based on S-S or S-R associations? The answer is far from simple. Direct tests look at the effects of disrupting the US-UR link, since this should disrupt S-S associations while leaving CS-UR associations intact.

#### 1. US Devaluation

In this case, animals are trained with a CS-US relationship, & subsequently the value of the US is altered. If the connection is CS-UR, then altering the US should have no effect, whereas it should if the connection is CS-US-UR. One of the best studies is by Holland & Straub (See Tutorial 1), where hungry rats learned to approach a feeder in response to a noise (CS) which predicted food (US). The rats were subsequently made averse to the food, & then re-exposed to the noise. They showed less conditioned activity as a consequence of this aversion. This suggests S-S association.

#### 2. Sensory Preconditioning

The sensory preconditioning experiment described earlier in this lecture also suggests an S-S association, since one CS becomes associated with a second CS even though no UR is present. (e.g. Rizley & Rescorla, 1972)

#### 3. Second order conditioning

The following experiment, in contrast, provides evidence for S-R associations to form under some circumstances.

Group	First Order	Second Order	Extinction	Test
Experimental	Tone ⇒ Shock	Light ⇒ Tone	Tone	Light
Control	Tone ⇒ Shock	Light ⇒ Tone	-	Light

(After Rizley & Rescorla, 1972)

S-S theory would predict no response to the LIGHT CS by the Experimental group, since the Tone - Shock association has been removed. In fact, rats continued to respond to the LIGHT as before - no difference between groups was found at Test. Although this result has been replicated, other similar studies provide evidence for S-S encoding even with second-order conditioning

### Conclusion

Current theory sees conditioning very differently from the reflex accounts of the past. Learning is seen to develop through associations between internal representations of CS, US & CR & UR. The paradigms used in most learning experiments generally means that S-S associations are stronger than S-R ones. Thus sensory preconditioning provides evidence for S-S associations since no S-R association can form. With second-order conditioning, the S-S association of CSa & CSb is relatively weak, allowing the S-R association to become dominant. This combination of competing associations & expectancies reclassifies conditioning as a complex, sophisticated learning mechanism.