# Classical Conditioning

Classical conditioning is a type of conditioning discovered by Ivan Pavlov (1927). [1] It is also known as Pavlovian, respondent conditioning, Pavlovian reinforcement. Classical conditioning describes a behavioural response which is elicited when triggered by an otherwise neutral stimulus (the conditional stimulus), that has been linked to an unconditional stimulus, which normally evokes a clear, immediate and reflexive response.

### Examples

1. Classic example described as discovered by Pavlov:
   - Unconditioned stimulus: meat powder
   - Unconditioned (i.e.: reflex, innate) response: dogs begin to salivate
   - Conditioned (neutral) stimulus: the presence of the lab technician
   - When the conditioned and unconditioned stimulus are combined (occur simultaneously), that is when the lab technician was bringing the meat powder to the dogs, the dogs eventually **learned** that the lab technician is associated with food. Eventually, the mere *presence* of the lab technician (neutral, conditioned stimulus), evoked salivation by the dogs (a conditioned response).
2. Gill withdrawal reflex:
   - A conditioned reflex response is established by presenting a conditioned stimulus (CS), which itself elicits a little response, followed immediately by an unconditioned stimulus (UCS) which itself elicits a clear response.
   - After repeated pairing of the CS and USC, the CS delivered alone produces a clear response.
   - Classical conditioning occurs only if there is a predictable temporal relation between the CS and UCS.
3. In aplysia (a sea hare):
   - CS - stimulation of the mantle shelf is paired with UCS; stimulation of the tail, which alone produce an enlarged EPSP, later on an additional stimulation of the mantle shelf produce an enlarged EPSP.
   - The facilitatory action of serotonin released from interneurons by tail stimulation is enhanced if the mantle sensory afferent is active just before serotonin is released from the tail interneurons. Activity in the mantle afferent allows some calcium to enter the terminal, $Ca^{2+}$ in turn, acts through calmodulin to increase adenylate cyclase activity so that the serotonergic input due to tail stimulation produces more cAMP → $Ca^{2+}$ entry during action potential.
   - In the mantle sensory neuron, activated adenylate cyclase leads to cellular events associated with tail stimulation being more effective → coordinated activity in both the pre- and postsynaptic elements appears to strengthen (or facilitate) the synaptic effect.

### Role of receptors

G-protein-linked receptor can enable a transient signal to cause a persistent change in the electrical properties of a synapse and hence the behavior of the animal. The phosphorylation of $G_s$ channels represents a form of short-term memory, easily erased by the action of phosphoprotein phosphates (dephosphorylation of $G_s$ channels) and limited by the finite lifetime of the $G_s$-channel proteins. The mechanism of the long-term memory that follows repeated signal processing is not known, but it requires new RNA and protein synthesis and seems to involve changes in the structure as well as the chemistry of the presynaptic terminals. cAMP and A-kinase seem to mediate these changes too, presumably by phosphorylation other proteins which are able to alter the pattern of gene expression.

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### References


1. Pavlov, I.P. (1927/1960). *Conditional Reflexes*. New York: Dover Publications (the 1960 edition is an unaltered republication of the 1927 translation by Oxford University Press http://psychclassics.yorku.ca/Pavlov/).


### Sources

- Lecture Notes: Prof. MUDr. Jaroslav Pokorný DrSc.

## Bibliography


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- DESPOPOULOS, Agamnenon – SILBERNAGL, Stefan. *Color Atlas of Physiology.* 5. edition. Thieme, 2003. ISBN 3135450058.


## Further reading

- Classical Conditioning: http://en.wikipedia.org/wiki/Classical_conditioning