

# 2a. Learning - Classical & Operant Conditioning

**Conditioning: The process of learning associations between stimuli in the environment (one event) and a behavioural response (another event).**

**Two main types of conditioning:**

1. Classical conditioning – we learn two events go together after we experience them occurring together on a number of occasions.
2. Operant conditioning – we learn by forming a three-way association between a specific stimulus, a response and the consequence of the response.

**Five key elements are used to describe the process of classical conditioning:**

- The neutral stimulus (NS)
- the unconditioned stimulus (UCS)
- the unconditioned response (UCR)
- the conditioned stimulus (CS)
- the conditioned response (CR)

## **Classical conditioning**

**Before conditioning:**

NS = Doesn't have a response e.g. bell

UCS = Stimuli that produces an involuntary response e.g. eating wizz fizz

UCR = Salivating in response to wizz fizz

**During conditioning:**

NS (bell) + UCS (wizz fizz) = UCR (salivating)

## **After conditioning:**

CS (bell) will not produce CR (salivating)

## **Key processes of classical conditioning:**

- **Acquisition: the overall process during which an organism learns to associate two events (the CS and the UCS).**
  - During acquisition, the presentations of the CS and the UCS occur close together in time and always in the same sequence.
  - The duration of the acquisition stage is usually measured by the number of trials it takes for the CR to be acquired (learned).
- **Timing: a very short time between presentations of the two stimuli (CS and UCS) is most effective.**
  - Acquisition is often more rapid when the CS occurs and remains present until the UCS is presented.
  - The end of the acquisition stage is said to occur when the CS alone produces the CR. At this point, conditioning is said to have taken place.
- **Extinction: the gradual decrease in the strength or rate of a CR that occurs when the UCS is no longer presented.**
  - Extinction is said to have occurred when a CR no longer occurs following presentation of the CS.
  - E.g. Pavlov's dogs eventually ceased salivating (CR) in response to the bell (CS) when the UCS (food) was removed from the association.
- **Spontaneous recovery: the reappearance of a CR when the CS is presented, following a rest period (i.e. when no CS is presented) after the CR appears to have been extinguished.**
  - Extinction of a conditioned response is not always permanent.

- Spontaneous recovery does not always occur, and when it does it is often short-lived and weaker.
- **Stimulus generalisation is the tendency for another stimulus that is similar to the original CS to produce a response that is similar (but not necessarily identical) to the CR.**
  - E.g. In Pavlov's experiments, sounds similar to a bell could cause salivation.
  - Stimulus generalisation can have detrimental effects, e.g. non-threatening stimuli triggering a fear response.
- **Stimulus discrimination occurs when a person or animal responds to the CS only, but not to any other stimulus that is similar to the CS.**
  - E.g. Pavlov's dogs salivating to the sound of a bell but not the ring of a telephone.

### **Ethical considerations and Little Albert**

**Little Albert experiment:** J.B. Watson and Rosalie Rayner (1920)

- Watson wanted to demonstrate experimentally that humans undergo the same process in acquiring fears as animals do.
- Little Albert was conditioned to have a fear response to various stimuli which previously had not evoked fear such as a white rat, white rabbit, a dog and a coat.

### **Stimulus generalisation:**

After conditioning, Little Albert also showed strong fear reactions to:

- A white rabbit,
- A dog and
- A sealskin coat.
- He showed slightly weaker fear reactions to
- Cottonwool balls

- Santa Claus mask
- **Ethical values** such as research merit and integrity, beneficence, justice and respect for human beings, would all undoubtedly have been breached if they were in place at the time of the 'Little Albert' experiment.
- **Ethical principles** that may have been violated:
  - There is doubt as to whether Little Albert's mother gave informed consent.
  - Watson and Raynor did not stop the experiment when Little Albert showed severe anxiety and stress (withdrawal rights).
  - Little Albert was not de-conditioned to the various conditioned stimuli which evoked fear.
  - Little Albert may have experienced long-lasting harm.

**How to decondition Little Albert:**

- In classical conditioning, the individual is learning the association between the NS (CS) and UCS.
- In Little Albert's case, he has learned the white rat (CS) is a predictor of a loud noise (UCS) that will follow. He cries because he anticipates the loud noise when he sees the rat. This acquisition of learning occurred because the CS and UCS were paired together over multiple trials.
- Usually, we would expect that enough presentations of the CS in the absence of the UCS will lead to the extinction of the learning that they should be associated with each other. In Little Albert's case, extinction has not occurred.

ORIGINAL CONDITIONING	DE CONDITIONING
NS — White rat UCS — Loud noise UCR - Fear CS — White rat	NS — White rat UCS — Soothing massage or calming music UCR — Feeling soothed/calmed

CR - Fear	CS — White rat CR — Feeling soothed/calmed
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If white rat is too strong a stimulus then a systematic desensitisation approach could be adopted:

- Start with something less fearful (like the white cotton wool) and gradually build up to the more fearful Stimuli like the white rabbit and finally the white rat

### Elements of Operant conditioning

**Operant conditioning (AKA instrumental conditioning): a type of learning whereby the consequences of an action determine the likelihood that it will be performed again in the future.**

- An organism will tend to repeat a behaviour (operant) that has desirable consequences (such as receiving a treat), or that will enable it to avoid undesirable consequences (such as being given detention).
- Organisms will tend not to repeat a behaviour that has undesirable consequences (such as disapproval or a fine).
- An operant is any response (or set of responses) that acts ('operates') on the environment to produce some kind of consequence.

### Three-phase model: The ABC's of behaviour

**The Antecedent (A): the stimulus (object or event) that precedes a particular response, signals the probable consequence for the response and therefore influences the occurrence of the response.**

- Must be present for a particular response to occur
- Enables the organism to predict the likely outcome of a response.
- Sometimes referred to as the discriminative stimulus.

**The Behaviour (B): voluntary response that occurs in the presence of the antecedent.**

- Behaviour you're trying to reward or punish.
- Involves activity that has an effect on the environment in the form of a consequence that follows it.
  - e.g. pressing the 'receive' button on your phone in response to your phone ringing (the A)

**The Consequence (C): the environmental event that occurs immediately after the response and determines whether or not the response will occur.**

- e.g. Pressing the 'receive' button (the B) when the phone rings (the A) so you can talk to your friend (the consequence)
  - Compare this to the response of singing to your phone when it rings. As this does not lead to the desired consequence it is a response that is unlikely to occur again.

**Nature of the consequence:**

- A response that is followed by a reward strengthens the response and makes it more likely to occur again, whereas a response followed by punishment weakens the response and makes it less likely to occur again.
- Whether the consequence is considered a reward or punishment depends on the individual

**Examples:**

Antecedent	Behaviour	Consequence
The environment stimulus that precedes an operant response	The action that can have an effect on the environment	The environmental stimulus or event that follows the operant response

Petrol gauge almost empty	Fill car with petrol	Avoid running out of petrol (negative reinforcement: more likely to fill petrol to avoid empty fuel tank)
Skinner's box Puzzle box	Pushing on lever to open door	Escape and get food (positive reinforcement- more likely to push on lever again)

**Reinforcement: is said to occur when a stimulus (object or event) strengthens or increases the frequency or likelihood of a response that it follows.**

- Learning through operant conditioning occurs as a result of the consequences of behaviour.
- This may involve using a positive stimulus or removing a negative stimulus to subsequently strengthen or increase the frequency or likelihood of a preceding response or operant.
- An essential feature of reinforcement is that it is only used after the desired or correct response is made.

**Reinforcer: any stimulus (object or event) that strengthens or increases the frequency or likelihood of a response that it follows.**

- The term 'reinforcer' is often used interchangeably with the term 'reward'.

**Positive reinforcement:**

- **A positive reinforcer: a stimulus that strengthens or increases the frequency or likelihood of a desired response by providing a satisfying consequence.**
- Giving something positive so that a behaviour is repeated.
- Positive reinforcement occurs from giving or applying a positive reinforcer *after* the desired response has been made.
  - E.g. Thanking a friend for doing you a favour. If this reinforces the likelihood of your friend doing you another favour then 'thanking' can be considered a positive reinforcer.

#### **Negative reinforcement:**

- **A negative reinforcer: any unpleasant or aversive stimulus that, when removed or avoided, strengthens or increases the frequency or likelihood of a desired response.**
- Taking away something unpleasant, leading to a higher likelihood of repeating the behaviour.
- Negative reinforcement is the removal or avoidance of an unpleasant stimulus. It has the effect of increasing the likelihood of a response being repeated and thereby strengthening the response.
  - E.g. pressing a button to avoid an electric shock or remove the sound of a loud/painful alarm

#### **Positive vs negative reinforcement:**

- The important distinction between positive (+) and negative (-) reinforcement is that positive reinforcers are *given* and negative reinforcers are *removed* or *avoided*.
- However, because both procedures lead to desirable or satisfying consequences, each procedure strengthens (reinforces) the behaviour that produced the consequence.



**Punishment: the delivery of an unpleasant consequence following a response, or the removal of a pleasant consequence following a response.**

- Giving them something unpleasant that makes them less likely to produce a behaviour.
- Has the same unpleasant quality as a negative reinforcer, but unlike a negative reinforcer, the punishment is given or applied, whereas the negative reinforcer is prevented or avoided.
  - E.g. Receiving a speeding fine or getting a low mark on your SAC
- The consequence or outcome of punishment is the opposite to removal of a negative reinforcer.
- When closely associated with a response, punishment weakens the response or decreases the probability of that response occurring again over time.
  - E.g. if the consequence of not studying before a SAC is a poor grade then the poor grade acts as a punishment to decrease the probability of you not studying before a SAC again.

**Positive punishment/punishment: involves the presentation (or introduction) of a stimulus and thereby decreasing (or weakening) the likelihood of a response occurring again.**

- E.g. A scolding from your teacher (the punishment) for turning up late to class (the response).

**Negative punishment/response cost: involves the removal or loss of a stimulus and thereby decreasing (or weakening) the likelihood of a response occurring again.**

- E.g. Taking your phone off you (punishment) for using it in class (the response).
- Taking away something pleasant leads to behaviour being less likely to be reproduced.
  - Since negative punishment involves taking a stimulus away as a consequence of a particular response, it is often referred to as a response cost.

- **A response cost: involves removal of any valued stimulus, whether or not it causes the behaviour.**
  - e.g. Taking your phone off you for having it out in class = negative punishment
  - e.g. Taking money off you for speeding = response cost
    - Money is a valued stimulus. It doesn't cause your speeding but will be taken away from you (in the form of a speeding fine) as a consequence of your speeding. The speeding fine is the response cost.

### **Skinner's experiments:**

- In his study of operant conditioning, Burrhus Frederick Skinner (1904-1990) designed a chamber, referred to as the Skinner Box.
- This box allowed an animal to move around a little and the box was installed with a device to deliver food or water. The animal was required to perform specific responses in order to obtain reinforcement (food/water).
- Rats in the Skinner box had to learn to obtain food by operating on their environment within the box.
  
- The Skinner box, was used in the classic experiment in 1938 to demonstrate operant conditioning. A hungry rat was placed in the Skinner Box.
  1. As the rat was exploring its environment, it accidentally pressed the lever which delivered a pellet of food.
  2. The rat continued exploring its environment and once again pressed the lever. Again the rat was rewarded with a pellet of food.
  3. Soon the rat only performed behaviour which produced food.
  4. The rat learned that the receipt of food was dependent on pressing the lever.

- The Skinner Box made it possible to experiment with different types of reinforcement and rats (later pigeons) could be taught specific responses using the principles of operant conditioning.

### **B. F. Skinner:**

- Skinner believed there was no need to search for internal agents (factors within an organism) to explain changes in behaviour.
- Behaviour can be understood in terms of environmental, or external, influences without any consideration of internal mental processes.

In 1st experiment:

Antecedent: rat being hungry

Behaviour: rat pressed the lever

Consequence: being rewarded with food

In 2nd experiment:

Antecedent: being electrocuted

Behaviour: pressing the lever

Consequence: negative stimulus taken away (negative reinforcement)

### **Key processes of operant conditioning**

#### **Acquisition: the establishment of a response through reinforcement.**

- The speed with which the response is established depends on which schedule of reinforcement is used.
- The types of behaviours acquired through operant conditioning are usually more complex than the reflexive involuntary responses that became learned responses in classical conditioning.

**Extinction: the gradual decrease in the strength or rate of a conditioned (learned) response following consistent non-reinforcement of the response.**

- Extinction is said to have occurred when a conditioned response is no longer present.
- In classical conditioning, extinction takes place over a period when the unconditioned stimulus (UCS) is withdrawn or is no longer present, but with operant conditioning, extinction also occurs over time, but after reinforcement is no longer given.
  - Depending on whether continuous or partial reinforcement is used, the response rate can actually increase in the initial phase of extinction after reinforcement is stopped.
  - Extinction is less likely to occur when partial reinforcement is used; that is, when reinforcement does not regularly follow every correct response.
  - The uncertainty of the reinforcement leads to a greater tendency for the response to continue.
- Extinction is often not permanent in both operant and classical conditioning.

**Spontaneous recovery: after the apparent extinction of a conditioned response, spontaneous recovery can occur and the organism will once again show the response in the absence of any reinforcement.**

- The response is likely to be weaker and will probably not last very long.

**Stimulus generalisation: occurs when the correct response is made to another stimulus that is similar (but not necessarily identical) to the stimulus that was present when the conditioned response was reinforced.**

- This response usually occurs at a reduced level (frequency or strength).

**Stimulus discrimination: occurs when an organism makes the correct response to a stimulus and is reinforced, but does not respond to any other stimulus, even when stimuli are similar (but not identical).**

## Comparing the elements of classical and operant conditioning

- Classical conditioning as a three-phase process (before conditioning, during conditioning and after conditioning) that results in the involuntary association between a neutral stimulus and unconditioned stimulus to produce a conditioned response, including stimulus generalisation, stimulus discrimination, extinction and spontaneous recovery
- Operant conditioning as a three-phase model (antecedent, behaviour, consequence) involving reinforcers (positive and negative) and punishment (including response cost) that can be used to change voluntary behaviours, including stimulus generalisation, stimulus discrimination and spontaneous recovery

### Acquisition:

- In classical conditioning, the association of two stimuli, the CS and UCS, provides the basis of learning.
- In operant conditioning, the association is with an operant response to a stimulus and the consequence that follows the response, as described by three-phase model of  $A \rightarrow B \rightarrow C$ .

### Extinction:

- In classical conditioning, extinction takes place over a period when the UCS is withdrawn or is no longer present and the CS is repeatedly presented alone.
- In operant conditioning, extinction also occurs over time, but after reinforcement is no longer given.
- For instance, when Skinner stopped reinforcing his rats with food, their lever-pressing was eventually extinguished.

Similarity:

### Spontaneous recovery

- In both classical and operant conditioning, extinction can be interrupted by *spontaneous recovery*.
- Although not unique to conditioning, in both classical and operant conditioning *stimulus generalisation* and *stimulus discrimination* can occur.
- In addition, both types of conditioning are achieved as a result of the repeated association of two events that follow each other closely in time.

Difference:

- In operant conditioning the consequence of a response is a vital component of the learning process in that a behaviour becomes more or less likely, more or less frequent, or strengthened, depending on its consequence.
- In classical conditioning, the behaviour of the organism does not have any environmental consequences.

### Involuntary vs voluntary responses:

- Classical and operant conditioning involve different types of responses.
- In classical conditioning, the response is involuntary; an automatic reaction to something happening in the environment (such as the sight of food or the sound of a bell).
- Operant conditioning involves voluntary responses that are initiated by the organism (such as throwing a tantrum or doing homework), as well as involuntary responses.

### The role of the learner:

CLASSICAL CONDITIONING	OPERANT CONDITIONING
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<ul style="list-style-type: none"> <li>• In classical conditioning, the learner is a passive participant in the conditioning process.</li> <li>• The learner does not have to do anything for the CS or UCS to be presented.</li> <li>• The response made by the learner occurs automatically without them having to make any effort or actively do anything.</li> </ul>	<ul style="list-style-type: none"> <li>• The learner is an active participant in the learning process.</li> <li>• The learner must operate on the environment before reinforcement or punishment is received.</li> <li>• The learner is neither reinforced nor punished without performing the behaviour that produces the consequence.</li> </ul>
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**Timing of the stimulus and response:**

CLASSICAL CONDITIONING	OPERANT CONDITIONING
<ul style="list-style-type: none"> <li>• In classical conditioning, the response (e.g. salivation) depends on the presentation of the UCS (meat powder) occurring first.</li> <li>• The timing of the two stimuli (CS, then UCS) produces an association between them that conditions the learner to anticipate the UCS and respond to it even if it is not presented.</li> <li>• In classical conditioning the timing of the two stimuli (CS, then UCS) needs to be very close (ideally about half a</li> </ul>	<ul style="list-style-type: none"> <li>• In operant conditioning, the presentation of the reinforcer or punisher depends on the response occurring first.</li> <li>• The association that is conditioned is between the stimulus (i.e. the lever in a Skinner box) and the response (to push the lever). The response is either strengthened by reinforcement or weakened through punishment.</li> <li>• In operant conditioning, while learning generally occurs faster when the reinforcement or punishment occurs soon after the</li> </ul>

second) and the sequencing is vital—the CS must come before the UCS.	response (behaviour), there can be a considerable time difference between them (especially in humans).
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**The nature of the response:**

CLASSICAL CONDITIONING	OPERANT CONDITIONING
<ul style="list-style-type: none"> <li>• In classical conditioning, the response by the learner is usually a reflexive involuntary one (e.g. salivating or blinking).</li> <li>• The response is often one involving the action of the autonomic nervous system, and the association of the two stimuli is often not conscious or deliberate.</li> </ul>	<ul style="list-style-type: none"> <li>• In operant conditioning, the response by the learner is usually a voluntary one (e.g. pressing a lever, using an umbrella) but may also be involuntary.</li> <li>• The response may involve the autonomic nervous system but usually involves the central nervous system (e.g. the brain) and is conscious, intentional and often goal-directed.</li> </ul>