

Learning and Motivation

1. Basic biological processes

• Learning = an enduring change within an organism brought about by an experience that makes a change in behaviour possible

-Enduring: changes are relatively stable

-Experience: history of practice, previous trials

• How can learning and performance differ?

-Learning doesn't equal performance.

-Changes in performance do not always reflect changes in learning.

-Although performance is affected by learning, it also depends on opportunity, motivation and sensory and motor capabilities.

• Learning is not: (Factors that affect behaviour but not constitute learning)

▪ Reflex = Automatic and usually very fast, innate physical response

-Changes in behaviour are not brought about by experience → Learning is not required

Eliciting stimuli	Corresponding response
Air puff	Eye blink
Food	Salivation
Movement	Eye turn
Knee tap	Knee jerk
Baby's check	Head turn
Pain	Withdrawal

-Sensory nerves detect stimuli and message is passed through the spinal cord to the motor nerves to stimulate muscles (reflex arc)

▪ Instinct = Behavioural sequence made up of units which are largely genetically determined and are typical of all members of a species

-Changes in behaviour are genetic → Learning is not required

-Innate and occur "automatically" in response to particular stimuli without any prior learning

-It is evolutionarily developed and essential for the survival of the species

-Tend to be only triggered in certain motivational states

-Difference between reflex and instinct is in complexity, not type – Involve several muscle systems (entire sequence not a reflex response) and last longer

-Example: Mating rituals

▪ Maturation = Changes that take place in your body and in your behaviour as you age

-Changes in behaviour are brought about by aging → Learning is not required

-Acquisition of skill from bodily capacity not experience

-Example: baby 'learning' to walk – babies want to walk (kicking legs into the air) but can't because of the body

▪ Fatigue = Transient state of discomfort and loss of efficiency as a normal reaction to emotional strain, physical exertion, boredom or lack of rest which may lead to physical inability to perform a learned response

-Changes in behaviour are not stable/ enduring → No evidence for lack of learning

• Use of animals

-Simpler conditions

-Easily controlled

-Less expensive

-Can monitor background: every single stimulus it's been exposed to in its life can be monitored

-Wider scope (deprivation, stress, aversive events)

-We don't assume animals are like people. We look for similarity between animals and humans in relevant features for the problem of interest

• **Habituation** = Decreased responding produced by repeated stimulation

-E.g. Rat jumps less with each presentation of a loud noise then promptly ignores it; a kid looks at a pattern to orient himself then spends less time looking at the pattern;

-Habituation is not fatigue: fatigue occurs when muscles become incapacitated so the organism can no longer perform the response

-Habituation is not sensory adaptation: sense organs become temporarily insensitive to stimulation (bright light or loud noise); the rat stops being startled not because it damaged its ears and went deaf

▪ Habituation is stimulus specific

-E.g. Salivation to lemon vs. lime: one becomes habituated to lemon and salivates no more (NOT because there is no saliva left) but once given lime, one salivates again → habituation only occurred for ONE specific stimulus

▪ Habituation is response specific

-E.g. Looking and listening to someone making an announcement: one first looks at and listens to the announcer then one spends less time looking at the announcer → only ONE specific looking response has been habituated not the listening response (NOT because you are blind or deaf)

▪ Disorders in habituation

-In people with no mental illness, the neural response in the hippocampus decreases with repeated presentations of pictures of emotional or neutral faces → Habituation of hippocampus

-People with schizophrenia have impaired habituation. Their responses to faces remain fairly high, with no difference between early and late phase.

-Impaired habituation in people with schizophrenia compared to people with no mental illness

-Diagnosing mental illnesses is often very difficult. Early detection facilitates treatment and often leads to better outcomes

-Diagnostic test assesses habituation to stimuli and compare to sample of people known to have no mental illness

-This allows detection before the presence of symptoms

• **Sensitisation** = Increased responding produced by repeated stimulation

-E.g. Rat runs more in response to the same amount of cocaine when they are pre-exposed to cocaine; background noise results in more vigorous startle reactions to a tone

• Habituation and sensitisation are needed to help us sort out what stimuli to ignore and what to respond to, to organise and focus our behaviour in a world of meaningless stimuli

2. Classical conditioning

• Classical conditioning

Despite not seeing the food, seeing the lab assistant brought on the dog's biological reflex of salivation. Food was then paired with a cue (bell) and ringing the bell alone could cause the reflex.

▪ Pavlovian terminology

-Unconditioned stimulus (US) = Stimulus that unconditionally evokes a response = Food

-Unconditioned response (UR) = Response evoked by the US (no learning required) = Salivation

-Conditioned stimulus (CS) = Stimulus that evokes a response because it has been paired with US = Bell

-Conditioned response (CR) = Response evoked by the CS with absence of US (conditional upon learning the previous US-CS pairing) = Salivation

▪ Examples

1) Appetitive (pleasant, useful):

-Eye-blink conditioning

-Food preferences

-Place preferences (room with cocaine)

2) Aversive (unpleasant, useless)

-Conditioned fear

-Anticipatory nausea (nausea rolls before nauseating agent is injected for chemotherapy)

- Conditioned taste aversions
- Place avoidance (room with electric shocks)

-Watson: All behaviour is determined by experiences from external environment by learning. Emotion can be conditioned too, not just biological reflexes.

-Little Albert: Babies have no fear of fire or animals. By repetitively playing a loud sound when showing an animal, the baby had conditioned fear when seeing the animal.

- Second order conditioning

-CS1-CS2 pairing: Condition a second CS with first CS (no US-CS2 pairing)

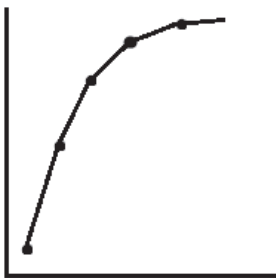
-CS2 in absence of US and CS1 can cause CR

-E.g. when bell is rung, light is turned on too. Light is never paired with food. After classical conditioning, light alone can cause salivation

- Factors that affect classical conditioning

1) Frequency = Number of US and CS pairing presented = Amount of learning

-More CS-US → Stronger CR → More learning

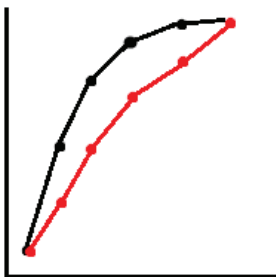


-Rate of learning decreases

-Asymptotic level of responding: Negatively accelerating form of the CR strength – CR gets stronger by smaller and smaller amounts each trial until it hits a maximum limit (asymptote)

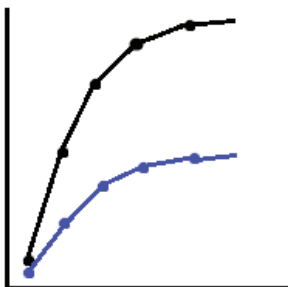
2) Salience/ Intensity

a) More intense CS → Faster learning



-If salience of CS is low, it delays the rate of learning and it takes longer to get to learning

b) More intense US → Stronger CR → Greater amount of learning



-Stronger US leads to more learning (higher shock, more vigorous startle)

3) Contiguity/ Timing = Time distance between onset of CS and US

-Closer CS and US occur together → Better learning

-Longer delay → Weaker learning (one cannot pick up the pairing/ relationship they should be learning about)

-CS and US too close → Weaker learning (tiny delay is needed)

4) Contingency

-E.g. A's allergic reaction was only present when consuming gluten. The response is fully contingent upon eating gluten. B's allergic reaction was present when eating gluten and prawns. Gluten-allergy contingency may be a result of prawn-allergy contingency.

-US must occur when CS isn't presented

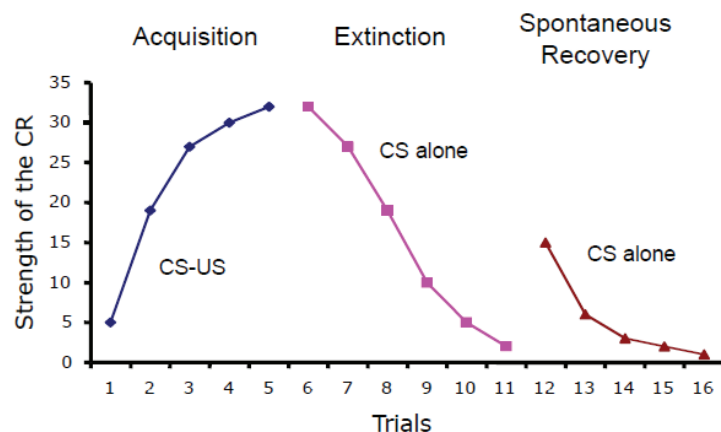
-Need two pieces of information:

-What is the probability that the US follows the CS?

-What is the probability that the US occurs anyway?

-Learning about the causal, structural and predictive relations between events and stimuli

• **Extinction** = Repeated CS alone presentations following acquisition resulting in a reduction in the CR
= Reversing the learning process



-Spontaneous recovery: extinction cannot completely eradicate learning – If the participant is allowed a period of rest after extinction and then the CS is presented, the CR sometimes reappears

▪ Uses of classical conditioning

-Advertisement – pairing something desirable with the product

-Phobia – exposure with happy stimuli for systematic desensitization

3. Instrumental learning

• Thorndike's Law of Effect

-Experiment: Cat is locked in puzzle box. Cat makes the 'right' response. The door opens. Cat can eat.

-Thorndike measured the time for cat to escape from puzzle box and observed progressive improvement over many trials

-It was based on trial and error, not 'sudden insight' into the mechanism of the door. The subjects accidentally find out the response from random exploring and the likelihood of that same behaviour increases (=learning).

-**Law of Effect**: What a human or animal does is strongly influenced by the immediate consequences of such behaviour in the past

-“Of several responses made to the same situation, those that are accompanied or closely followed by satisfaction to the animal will, other things being equal, be more firmly connected with the situation, so that, when it recurs, they will be more likely to recur”

▪ Tripartite Contingency – ABC

-Antecedent: The stimulus controlling behaviour

-Behaviour: What is the Response being reinforced?

-Consequence: What is the immediate outcome of a behaviour?

• Skinner

• The difference between discrete trial and free operant procedures

1) Discrete trial procedure:

-Measures objective dependent variables e.g. 'time' and 'error'

-Measures one discrete response trial

- When subject can respond is constrained
- One response and/or one reinforcer per trial
- Handling gives subjects stress

2) Free operant procedure

-Rat placed in Skinner Box. Rat makes 'right' response. Rat gets food. Rat can make the 'right' response anytime, however many times it wants.

•Instrumental conditioning = The behaviour/ response is instrumental in determining the consequences

- The response serves as a means for obtaining a pleasant or aversive stimulus
- In classical conditioning, stimuli are presented regardless of what the person does. In instrumental conditioning, you wait for the spontaneous generation of behaviour to reinforce
- A particular behaviour or response (R) leads to a particular outcome with reinforcement value (Rft or SR) in the presence of given stimulus (S). It is these consequences of a response that determine the likelihood of the response being repeated in similar situations (i.e. when S is again present).
- Learning = the probability of repeating the behaviour increases
- The likelihood that a behaviour will increase or decrease is determined by:
 - The nature of the events that follow (appetitive/ aversive)
 - Whether the behaviour produces or terminates these events

•Different types of instrumental conditioning

- Bar pressing in rats
- Dog opening the door
- Pigeon looking over the left shoulder
- Gambling

•The difference between instrumental and classical conditioning

- Pavlov: The subject has no control over events, but responds to them
- Thorndike/Skinner: The subject has to respond to control the outcome

•Shaping

=Principle of successive approximation

- Reinforce behaviours that are closer and closer to a target behaviour
- Gradually make the conditions of reinforcement more stringent, more precise (reinforcement is harder)
- Can generate entirely novel behaviours

•Superstitious behaviour = behaving according to one's false assumption of a pattern of reward (when there is none)

•Reinforcement

▪Reinforcers

- Primary reinforcers = Intrinsically valued rewards e.g. giving a dog food
- Secondary reinforcers = Acquire their reinforcing properties through experience e.g. classical conditioning pairing of clicker with food so the dog hears the clicker and knows food will be rewarded soon
- Social reinforcement e.g. praise
- Attention e.g. attention reinforces the crying behaviour of babies

▪Response-consequence contingencies

The consequence	Appetitive	Aversive
R produces consequences	Positive reinforcement: R increases R produces appetitive outcome	Positive punishment: R decreases R produces aversive outcome
R terminates consequences	Negative punishment (Omission): R decreases R terminates appetitive outcome e.g. sending a kid to room	Negative reinforcement (Escape/ Avoid): R increases R terminates aversive outcome e.g. rat in shuttle box

▪Negative reinforcement

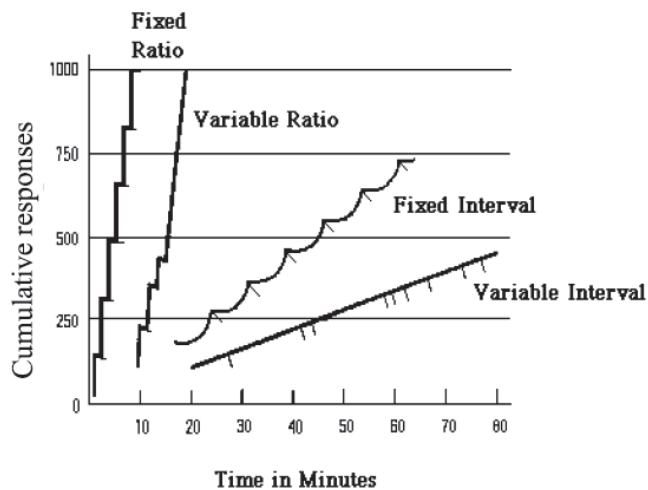
- A barrier divides the shuttle box – one half has a grid floor. A warning signal comes on, followed by a mild foot shock through the grid floor. The subject can escape the shock by leaping over the barrier to the safe area.
- The subject soon learns to jump over the barrier when the warning signal comes on, and avoids the shock altogether.
- Escape = Turning off some currently occurring aversive event
- Avoidance = Preventing some aversive event from occurring

•Different schedules of reinforcement

- The way reinforcement is carried out is more important than the amount of reinforcement given

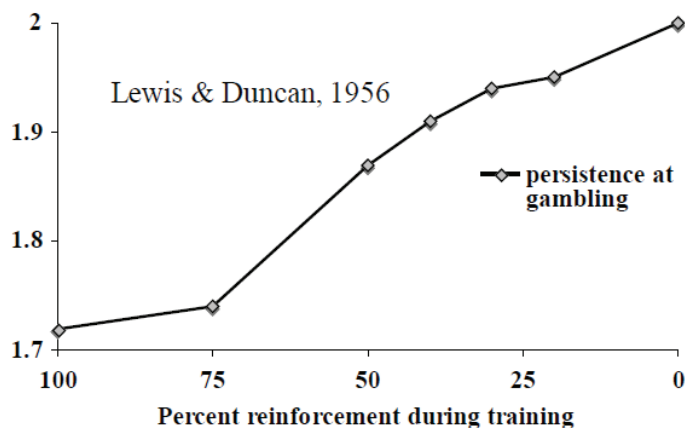
▪Contiguity and contingency

	Fixed	Variable
Ratio (Responses) =Ratio of Response: Outcome	Piecework in factories	Playing a slot machine
Interval (Time period) =Number of outcome per time interval	Watching the clock at work (fixed quitting time)	Surfers waiting for a big wave



- Fixed ratio: Fast and steady growth of responses as you're immediately rewarded for each response
- Variable ratio: Response peaks as you are not rewarded immediately and can't predict the ratio
- Fixed interval: Response increasing nearing the outcome as you expect when it is coming
- Variable interval: Slow but consistent response as you don't know when the outcome is coming

▪Extinction



- The less reliably a response is reinforced, the more persistent it is during extinction
- Gamblers have variable interval reinforcement
- The gambling response is harder to extinguish because the gambler experienced 'extinction' as a part of learning when gambling

▪Analysis of drug abuse – The spiral from drug use to drug abuse

- Positive reinforcement – Drug use produces instant pleasure
- Negative reinforcement – Drug use terminates aversive withdrawal symptoms
- Goal directed/ habit?
- Treat with punishment? Extinction? Omission?
- Role of habituation, classical conditioning, discrimination learning, social learning, etc

4. Stimulus control

1) Classical conditioning:

When a conditioned stimulus (CS) is paired with an unconditioned stimulus (US), it comes to elicit a conditioned response (CR).

2) Instrumental conditioning:

In the presence of a discriminative stimulus (Sd), a response (R) is followed by a reinforcer (Sr) or punisher (Sav).

•A discriminative stimulus is a stimulus when present increases the occurrence of an operant response because of its previous association with reinforcement; one discriminates between closely related stimuli and responds positively only in the presence of that stimulus.

E.g. A person sees an "open" sign on a shop door and walks into the store to buy something. The sign on the door is a discriminative stimulus because it tells the person when it is appropriate to make an instrumental response (buying items from the store)

Q) But how do variations in the eliciting stimuli (CS, Sd) affect conditioned performance?

1) Classical conditioning

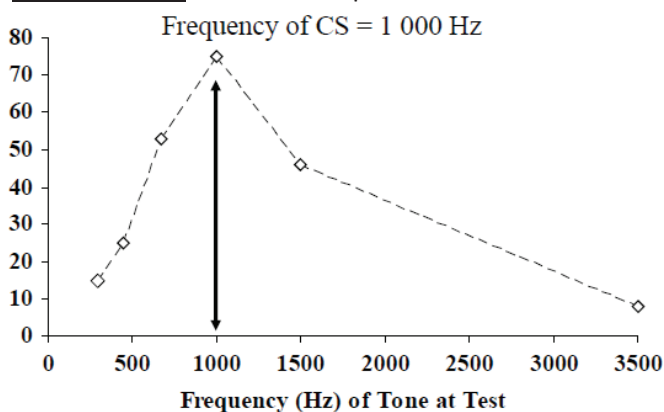
▪Watson & Little Albert

- Paired a white rat (CS) with a loud noise (US) and demonstrated that fears and phobias can be acquired through conditioning
- Little Albert generalised to similar stimuli i.e. anything white or fluffy

▪Razran (1939)

- Paired words (CS) with lemon juice (US) in students for salivation (CR)
- Trained CSs: Style, Urn, Freeze, Surf and tested response to:
 - Semantically related words: Fashion, Vase, Chill, Wave
 - Phonetically related words: Stile, Earn, Frieze, Serf
- Most CRs to words that are semantically related
- More generalisation from the meaning rather than the physical similarity of stimuli
- Suggests ability to categorise with higher order thinking

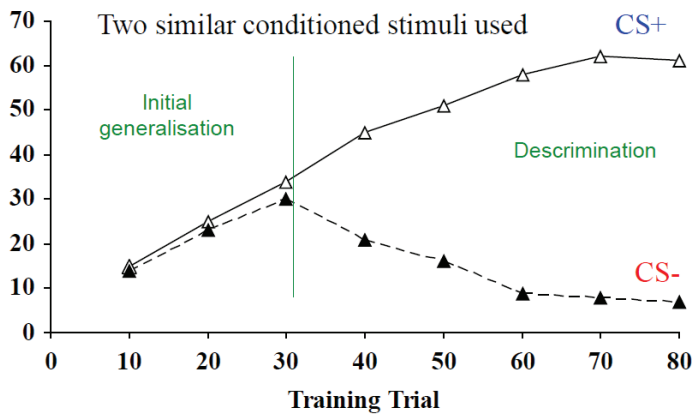
•Generalisation: Conditioned performance occurs in the presence of stimuli similar to the original CS



▪Discrimination studies

- CS1 (1000 Hz tone) was paired with electrical shock (US) to give rats startling
- CS2 (900 Hz tone) was not paired with electrical shock
- After trials, the rat stopped responding to the CS2

•**Discrimination:** Learning to differentiate between two CS's



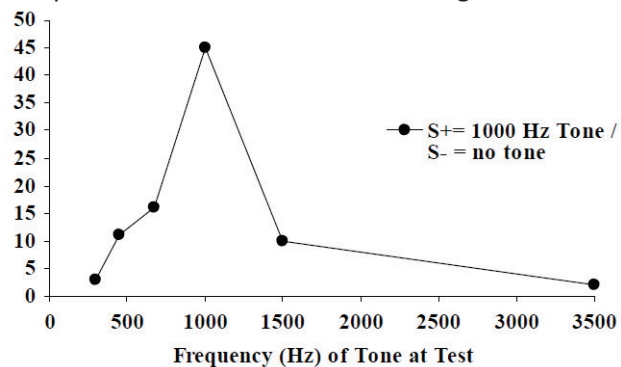
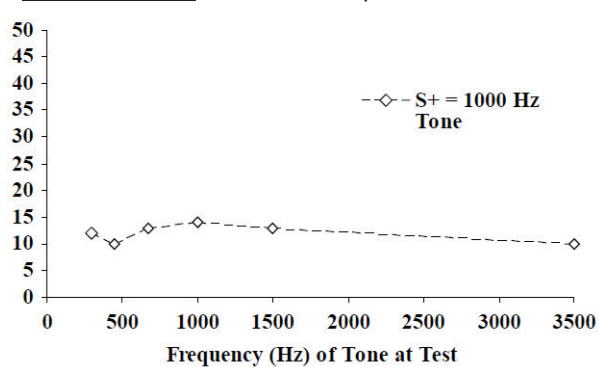
2) Instrumental conditioning

•Thorndike claimed that the likelihood of a response was due to two factors:

1. Whether the response was followed by a pleasant or unpleasant event (reinforcement)
2. Whether cues that were present when the response was reinforced or punished are still present

Instrumental behaviour only becomes controlled by the situational cues if and only if these cues signal whether the response is going to be reinforced or not.

•**Generalisation:** Conditioned performance occurs in the presence of cues similar to the original Sd

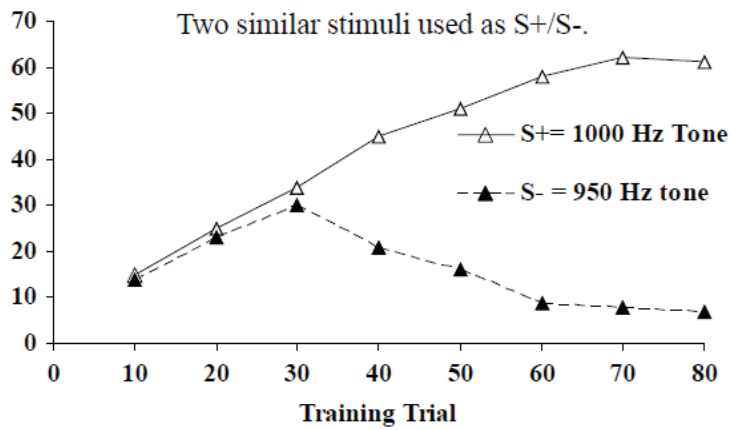


-Tone is paired with food upon pecking

-If the tone is always played, the tone does not signal whether the response is going to be reinforced or not. This is not a discriminative stimulus. Hence, the instrumental behaviour is not controlled and the pigeon pecks at every frequency of the tone.

-If upon the tone, the pigeon pecks, it is reinforced with food. If there is no tone, there is no food upon pecking. This becomes a discriminative stimulus, signalling the pigeon whether the instrumental behaviour will be reinforced or not. Hence, the behaviour is controlled and the pigeon can generalise. The pigeon will peck at tones that have similar frequencies to the Sd and not peck when the frequency gets further away.

•**Discrimination:** Learning to respond only (or differently) when the presence of a cue signals that the response will be reinforced, i.e. for S+ but not S-

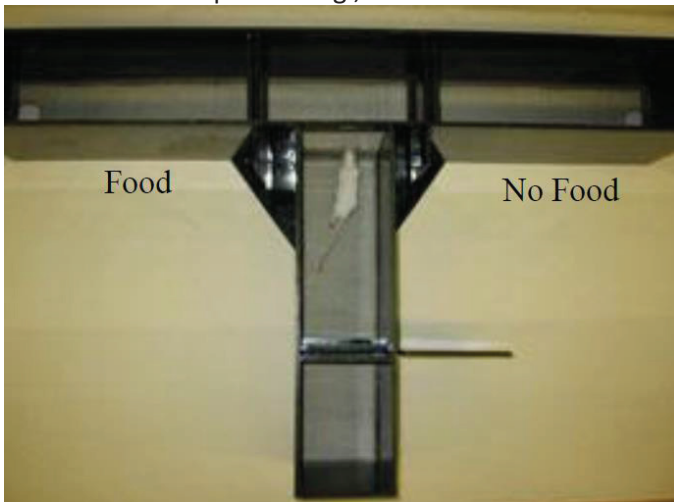


- Herrnstein et al. (1976)

- Discrimination learning can be produced with realistic stimuli (more naturalistic study)
- Pigeons learned to peck if people were present within the images
- Pigeons can discriminate with leaf shapes, water/no water, tree/no tree, specific person
- Pigeons can also discriminate with things not normally encountered e.g. fish/ no fish

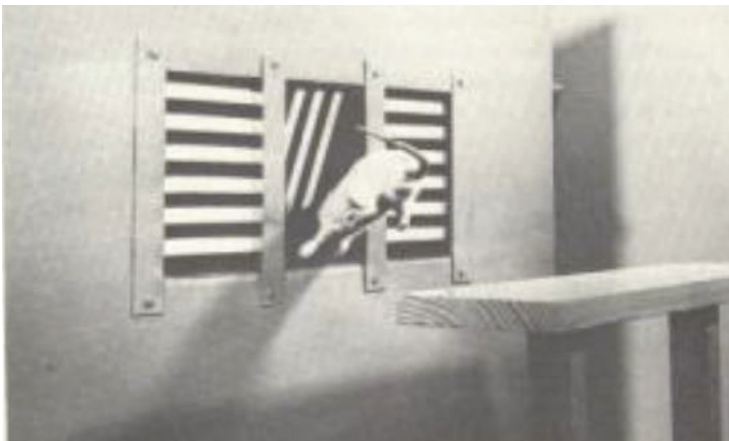
- Simultaneous discrimination

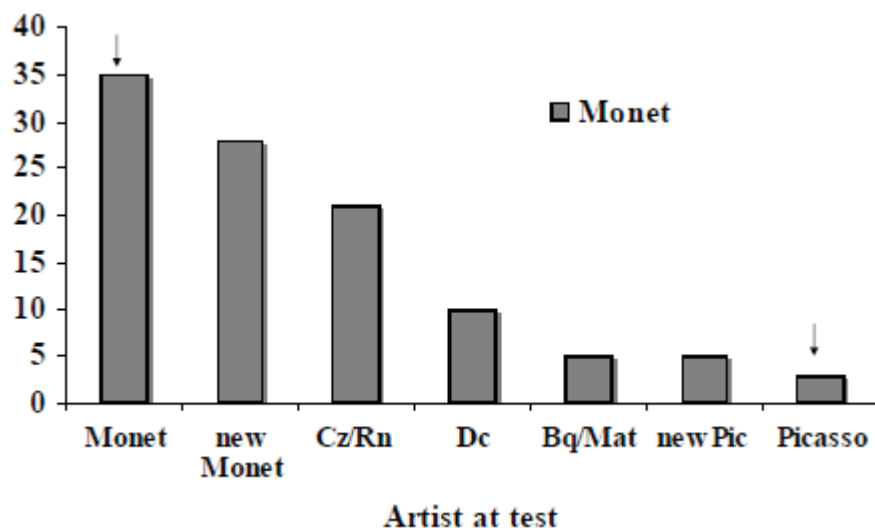
- Both S+ & S- are present e.g., a T-Maze



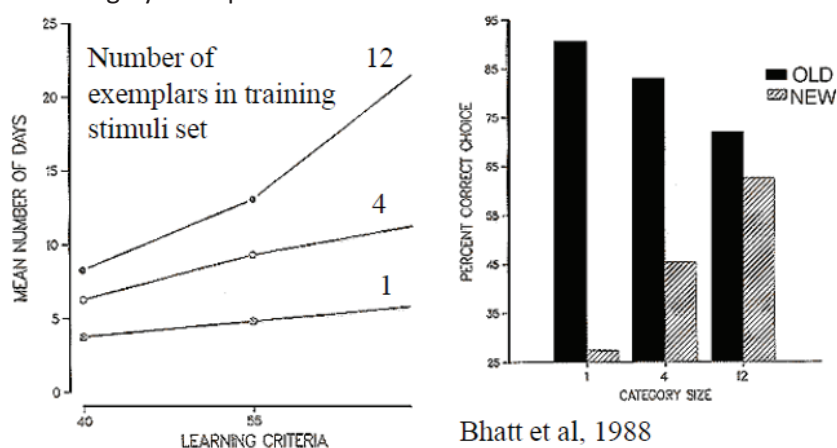
- Complex discriminations

- Reinforce correct choices made to stimuli based on categories:
 - ‘Same as’ & ‘Different to’,
 - Size,
 - Shape,
 - Number





• Learning by exemplar



Bhatt et al, 1988

-Pigeons were reinforced by sitting on a chair instead of a table.

-Pigeons were put in 3 groups:

- 1 type of chair and table
- 4 types of chair and table
- 12 types of chair and table

-Group A pigeons were good at responding to the training item but bad at responding to novel stimuli

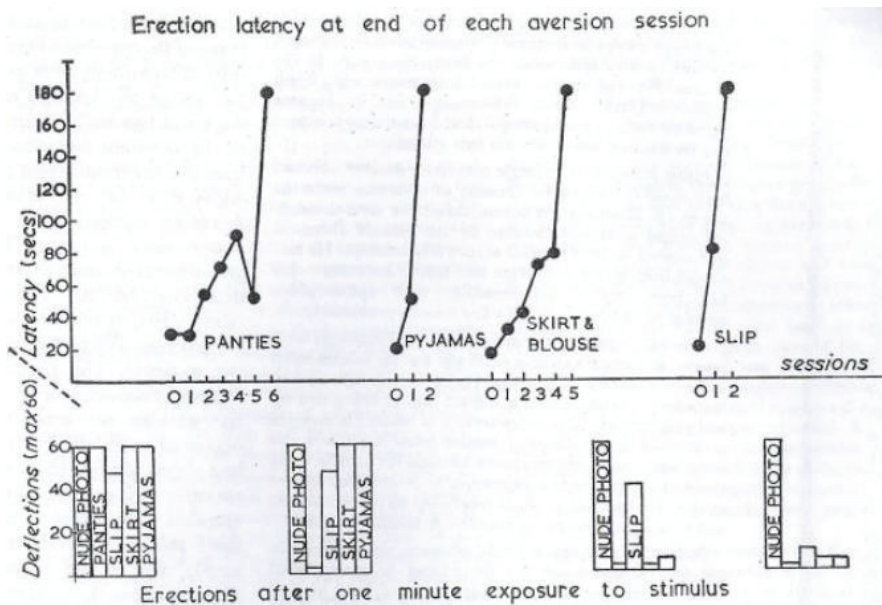
-Group B pigeons were not as good at responding to the old items but better than responding to new stimuli

-Group C pigeons were not as good at responding to the old items but significantly better at generalising and discriminating stimuli

-More examples → Better categorisation → Better discrimination

• Punishment is very specific (NO generalisation but individually discriminated); you have to punish every single "unwanted" behaviour in order to eradicate it

(As a side note, punishment tends to be more short-lived than other types of learning)



-In getting rid of sexual fetishes, one piece of clothing is not generalising to the other pieces of clothing

Application: Stimulus control of studying

- Find a quiet spot to work (Sd);
- Only take in materials relevant to the goal (limit distractions, competing Rs);
- Initially, set modest targets then increase (shaping);
- Use appropriate reinforcers - a public declaration of goals and progress, a more pleasant activity;
- Leave place of study immediately if your attention wanders (stimulus control).

5. Social Learning

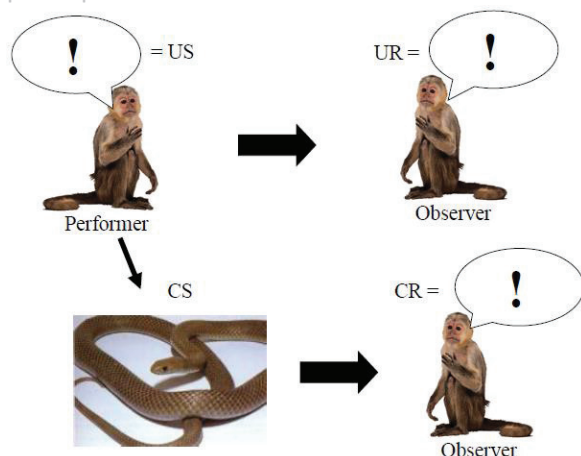
Q) Skinner/Watson (behaviourists) believed that all of our behaviours were determined by direct experience. BUT is direct experience necessary for learning to occur?

•Social learning

- Social learning occurs when an organism's responding is influenced by the observation of others, who are called models.
- You observe the relationship rather than directly experiencing the contingencies yourself.

•Observational conditioning

- Lab-raised monkeys are not normally afraid of snakes. If a lab-raised monkey sees a wild monkey act afraid of a snake, it will acquire a fear of snakes, although it initially had no trouble reaching for food near the snakes and had not watched an aversive consequence get paired with the snake. However another study showed that the fear of flowers was not learnt. This suggests that although fear of snakes is not predetermined but monkeys have predisposition to learn a fear of snakes.



- Instrumental Conditioning (Trial and error)

-A bird pecks the foil cover of the milk jar to get access to milk then many other birds copy it.

R = Pecking the lid

Rft = Access to milk

(Sd = milkman gone)

- Other social processes that affect learning – Social facilitation vs Social Learning

- Goal Enhancement: Getting access to some wanted goal might facilitate later trial and error learning, e.g. access to cream which is not usually readily available – the bird has not observed the other bird peck but it has tasted the milk through the opened bottle; it has seen the reward but does not know how to get it

- Stimulus Enhancement: Observe others and are often more likely approach places that they are, e.g. the milk bottles and hanging with other birds; it does not know the reward/ stimulus yet

- Increased Motivation to Act: Try more new things in the company of friends and parents – more motivation to act, more exploring, more chance of some consequence → more instrumental learning

- Contagious Behaviour: Mimicking an already established behaviour, e.g. yawning

→They don't constitute social learning as response-reinforcement contingency is unknown

→Empirical evidence is needed to prove that the occurrence is due to social learning

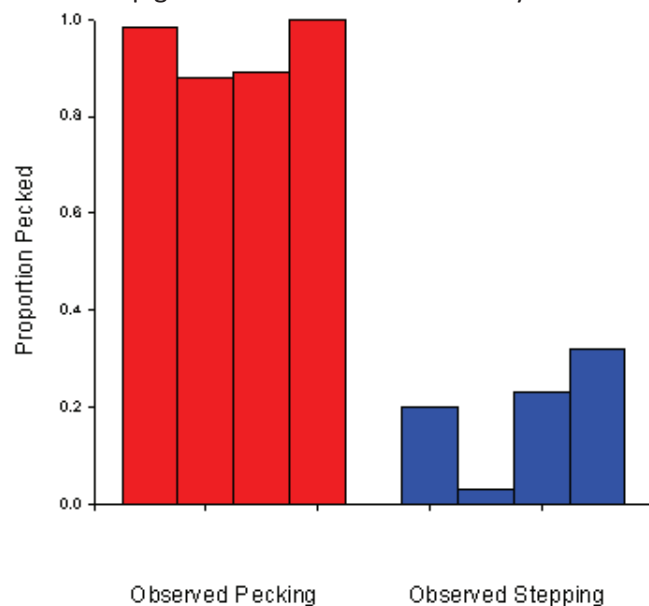
- Two-action test

-Pigeons are given demonstration on 2 types of instrumental responses:

a) Peck the lever to receive food

b) Step on the lever to receive food

-Observer pigeons demonstrated what they saw



- Capp et al (2005)

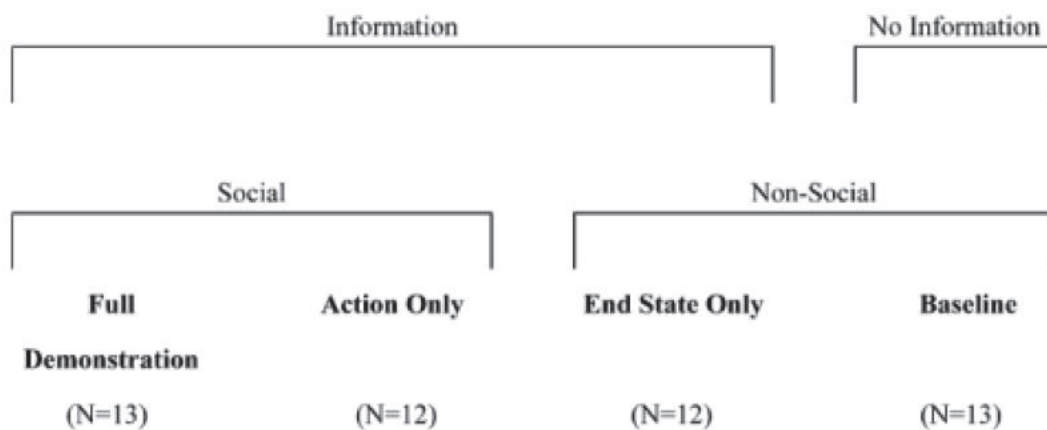
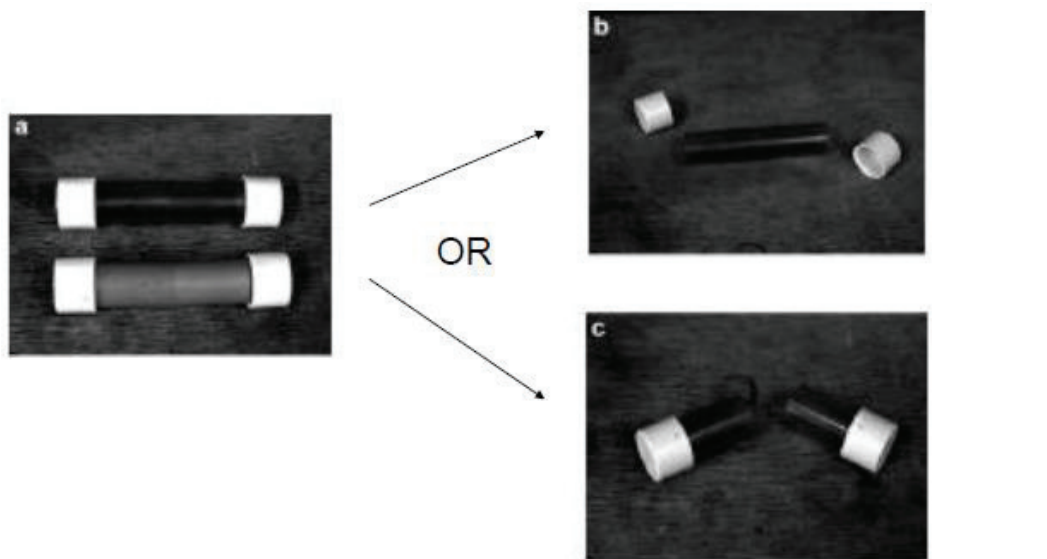
-Chimpanzees and young children are given a tube which can be opened in two ways. They are shown:

a) Full demonstration

b) Action only without the end state

c) A picture of the end state only

d) No information/ demonstration



a) Chimpanzee

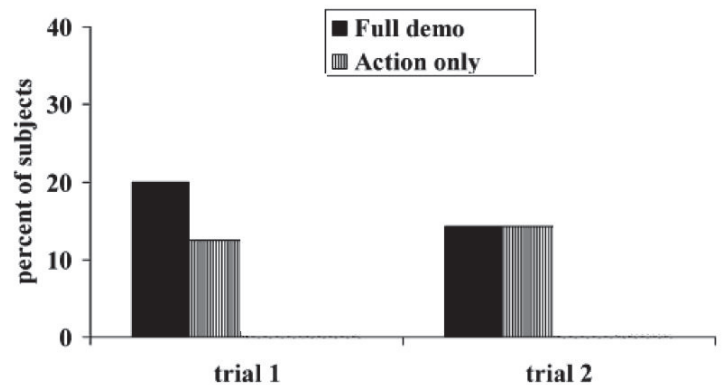
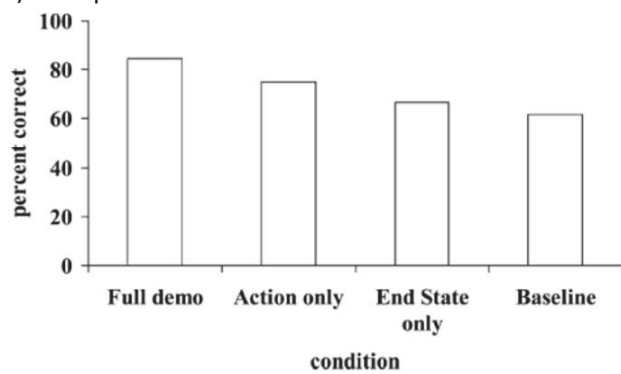


Fig. 3 Percentage of subjects who opened the tube across conditions

- Better learning when given more demonstration
- Only 20% of subjects copied the full demonstration

b) Child

