PSYC1022: The Psychology of Addiction

Topic 5: Associative learning II

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Outline:

- Instrumental (operant) conditioning
  - Thorndike's Law of Effect
  - B.F. Skinner
  - Experimental procedures
  - Schedules of reinforcement
  - Types of Instrumental conditioning
- Pavlovian-Instrumental interactions
- Application to addiction

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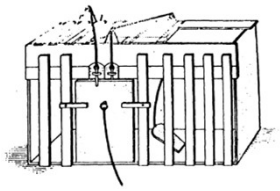
Instrumental (Operant) Conditioning

Instrumental (operant) conditioning is concerned with how new voluntary actions are acquired to achieve desired outcomes.



Edward Thorndike: established the field of instrumental conditioning. Interested in the process of insight in problem solving.

- believed that learning to solve a problem involved a flash of insight where the solution suddenly pops into consciousness.
- Studied how cats learned to escape from a puzzle box.
- Thorndike would put the cat in the box, close the door, then place a piece of food just outside where the cat could see it, but not obtain it without first escaping.
- Thorndike recorded how long it took for the cat to pull the string, open the door, & get the food.
- Later he would return the cat to the box & repeat the process.

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Instrumental Conditioning

- Performance shows a pattern of trial & error learning (red line represents insight learning)
- Thorndike theorized that the satisfying consequences of getting the food increased the probability of whatever response the cat was making just before it got the food.
  - When first in the box, the cat did many things with no success
  - On each trial, the behaviours that immediately preceded the food became more & more frequent.
  - As trials went on, behaviours that occurred just before the consequence of food occurred, were carried out more frequently
- Result: the time needed to get out of the box decreased gradually across trials
  - only behaviours the cat made in the box were those that opened the door & let the cat out to eat.

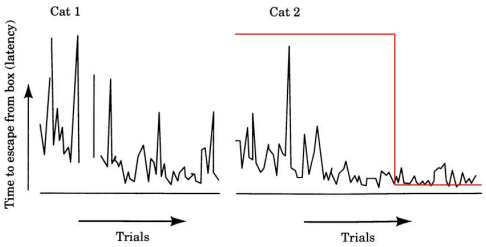

FIGURE 2.8 These two curves show the performances of two cats in Thorndike's box. [From E. L. Thorndike, *Animal Intelligence* (New York: Macmillan, 1911).]

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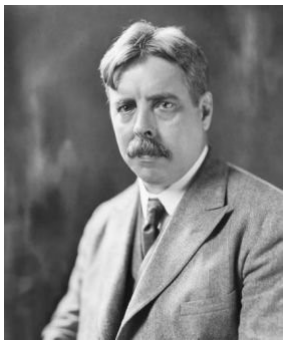
Instrumental Conditioning

- These observations led Thorndike to articulate his 'law of effect' (1911):

"Of several responses made to the same situation, those which are accompanied or closely followed by satisfaction to the animal … will, other things being equal, be more firmly connected with the situation …; those which are accompanied or closely followed by discomfort will … have their connections with the situations weakened … The greater the satisfaction or discomfort, the greater the strengthening or weakening of the bond."

Video: Thorndike's "Law of Effect"



Edward Thorndike 1874-1949

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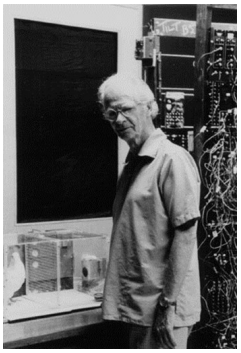
Instrumental Conditioning

B.F. Skinner: invented the 'Skinner box' (Operant chamber)

- under computer control which enables a variety of reinforcers (e.g. food, water, sexual partner) to be administered & responses (lever presses, chain pulls, wheel spinning) to be recorded.
- "A hungry rat is placed in a semi-soundproof box. For several days bits of food are occasionally delivered into a tray by an automatic dispenser. The rat soon goes to the tray immediately upon hearing the sound of the dispenser. A small horizontal section of a lever protruding from the wall has been resting in its lowest position, but it is now raised slightly so that when the rat touches it, it moves downward. In doing so it closes an electric circuit and operates the food dispenser. Immediately after eating the delivered food the rat begins to press the lever fairly rapidly. The behaviour has been strengthened or reinforced by a single consequence"(Skinner 1938)



B.F. Skinner 1904-1990

Rat in a Skinner Box learning an Instrumental Response (lever pressing) for a reward (food).

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Instrumental Conditioning

Video: Schedules of reinforcement

Demonstrated when the animal acquires a new response/action (i.e. lever pressing) to obtain an outcome. An outcome may be receiving a reward (food) or avoiding an aversive event (electric shock).

- Outcomes *reinforce* (strengthen) the behaviours that caused them to occur

Schedules of reinforcement: refer to the programmed relationship between the response & the outcome.

- the outcome can be available upon making a response after a certain period of time (interval) or given a particular number of responses (ratio)
  - the value of the interval or ratio may be fixed at a single value (1) or variable across a range of values (20). For example, a light switch changes the state of the bulb (illumination) on a fixed ratio 1 schedule- a single response (flicking the light switch) is required to cause the outcome (illumination).

	Interval	Ratio
Fixed	**Fixed-interval schedule (FI).** The first response after a fixed period of time since the last reward is reinforced.	**Fixed-ratio schedule (FR).** Every n^{th} response is reinforced.
Variable	**Variable-interval schedule (VI).** The first response after a variable time period since the last reward is reinforced.	**Variable-ratio schedule (VR).** On average every n^{th} response is reinforced.

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Types of Instrumental Conditioning

Positive Reinforcement: where a response which produces a positively valued/appetitive outcome (e.g. food, water, sex) increases in frequency.

- Child receives a piece of chocolate (reward) because they did their homework
  - Child increases likelihood of doing their homework in the future

Negative reinforcement: where a response which avoids/terminates an aversive event/outcome (e.g. shock, air puff) increases in frequency.

- Child is being bullied at school (aversive event) so they "skip" school
  - Child increases skipping/wagging school behaviour to avoid being bullied

Punishment: where a response which produces an aversive event/outcome (e.g. shock, air puff) decreases in frequency.

- Child has broken a window (response) & must pay to have it repaired (aversive event)
  - Child will avoid games that will potentially result in the window being broken again

Negative punishment/Omission/Response Cost: Where a response which avoids/terminates an appetitive reward/outcome (e.g. food, water, sex) decreases in frequency.

- Child misbehaves at school (response) so parents confiscate the games console (appetitive event/stimulus)
  - Child is reluctant to misbehave again at school

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Types of Instrumental Conditioning

	Increase behaviour	Decrease behaviour
Add something	**Positive Reinforcement**	**Punishment**
Remove something	**Negative Reinforcement**	**Negative Punishment**

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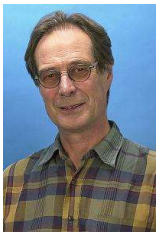
Instrumental Conditioning

Does the animal possess knowledge of the causal relationship between the response (lever press) & the outcome (food)? Do they undertake the response voluntarily based upon their expectation concerning the current value of the outcome?

- Tony Dickinson: Outcome devaluation procedure



Tony Dickinson

Instrumental Training

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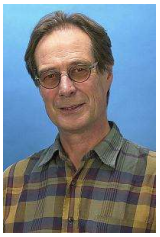
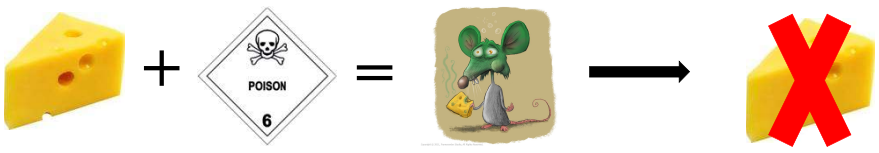
Instrumental Conditioning



Tony Dickinson

Outcome Devaluation



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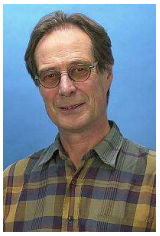
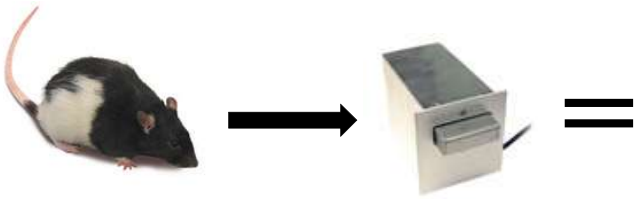
Instrumental Conditioning



Tony Dickinson

Test



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Instrumental Conditioning

- Following the devaluation procedure, rats reduced lever pressing for the devalued outcome
  - rats expected the lever press response to produce the food outcome & because their desire for that food had been devalued, they volunteered not to lever press.
- Thus, instrumental action is voluntarily selected based upon animals' knowledge of the causal relationship between the response & the outcome (belief), combined with knowledge of the current value of the outcome (desire)

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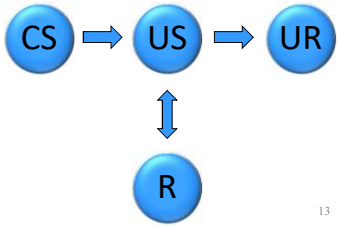
Pavlovian-Instrumental interactions

Pavlovian conditioning: learning about *predictive* relationships between CS and US, enabling organisms to anticipate the US from the CS.

Instrumental conditioning: learning about the *causal* relationship between responses & outcomes enabling voluntary action to be undertaken in anticipation of obtaining that outcome (US).

Pavlovian-Instrumental Transfer (PIT): Pavlovian CSs not only elicit reflexes (URs), but also voluntary instrumental responses (R) directed at the same US with which a CS is paired.

- Pavlovian training: the rat learns that a CS (sound) predicts a food US (cheese).
- Instrumental training: rat learns that an instrumental response (R) produces the same food outcome (US).
- PIT stage: presenting the CS causes the rat to increase the lever pressing response (R) for food.
  - These data indicate that the CS retrieved an expectation of the food US, which in turn activated the voluntary instrumental response (R) directed at obtaining that food.



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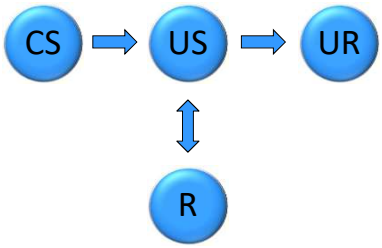
Application to addiction

- US: drug effect (e.g. "high")
- CS: drug related cues (e.g. pub/bar, drug-use tools, packaging, injecting rooms)
- Pavlovian conditioning: the drug cue CS comes to elicit a cascade of physiological reflexes in anticipation/expectation of taking the drug.
- "Instrumental" drug-seeking behaviour (e.g. walking to the pub or dealers house, ordering & handing over money) is regarded as voluntary instrumental behavior & is acquired because it ultimately leads to the drug effect (the outcome or US).
- PIT: drug cues (CS) retrieve an expectation of the drug effect (US) & can not only elicit involuntary reflexes (UR), but can also elicit voluntary instrumental responses (R) which lead to the drug & ultimately, consumption.



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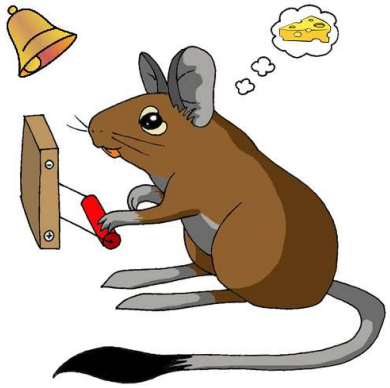
Summary

- Understanding of Pavlovian conditioning:
  - Background, experimental procedures, application to Hebb's rule and subsequent findings of Rescorla (US representation)
- Understanding of Instrumental conditioning:
  - Background, experimental procedures, types of instrumental learning and schedules of reinforcement.
- Knowledge of how these principles can be applied to understanding addiction.



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