NST IB Psychology

Emotion and motivation – 2

Concepts of motivation; psychological mechanisms for action

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Department of Experimental Psychology

Thursday 4, Saturday 6, Tuesday 9 March 2004; 11am
Physiology Lecture Theatre 3
Kubrick (1999): ‘Eyes Wide Shut’
Demme (2001): ‘Blow’
Theories of motivation
Maslow’s ‘hierarchy of needs’ — not very helpful

- **Self-actualisation**
  - Realising one’s full potential ‘becoming everything one is capable of becoming’.

- **Aesthetic needs**
  - Beauty — in art and nature — symmetry, balance, order, form.

- **Cognitive needs**
  - Knowledge and understanding, curiosity, exploration, need for meaning and predictability.

- **Esteem needs**
  - The esteem and respect of others, and self-esteem and self-respect. A sense of competence.

- **Love and belongingness**
  - Receiving and giving love, affection, trust and acceptance.
  - Affiliating, being part of a group (family, friends, work).

- **Safety needs**
  - Protection from potentially dangerous objects or situations, (e.g. the elements, physical illness).
  - The threat is both physical and psychological (e.g. ‘fear of the unknown’).
  - Importance of routine and familiarity.

- **Physiological needs**
  - Food, drink, oxygen, temperature regulation, elimination, rest, activity, sex.
Manigault (1909) ‘The Rocket’
Behaviourism: positive and negative reinforcement

*e.g. Skinner (1938)*
Behaviourism: avoiding circularity

response R → outcome O

If the animal performs the response, is there an “O drive”?

**Potentially circular argument:** the animal performs response R because it’s motivated by O-drive – and we know that O-drive exists because it performs response R…

**Even worse:** does the animal perform R because it *likes* performing R? Can explain any behaviour this way.

**Skinner (1938):** define reinforcers by their effects on behaviour. (Can’t then say that behaviour alters as a consequence of reinforcement, because that would be circular.)

*Positive reinforcers* are those things that strengthen preceding responses; *negative reinforcers* are those things whose removal strengthens previous responses.
Motivational states as hidden explanatory variables (1)

*Richter (1927), wheel-running in a female rat*
Motivational states as hidden explanatory variables (2)

- hours of water deprivation
- feeding dry food
- hypertonic saline injection
- angiotensin II injection
- work performed to obtain water
- volume of water drunk
- speed of drinking
- quinine required to stop drinking
Motivational states, drives, homeostasis

Hull (1943): events that reduce ‘drives’ are reinforcing.

Homeostasis (a term coined by Cannon).
Negative feedback.
Homeostasis in action? Sham drinking

Rolls & Rolls (1982)
Rodents that eat all the pies

Left: rat with ventromedial hypothalamic lesion; above: mice with leptin or leptin-receptor deficiency

Hetherington & Ranson (1939); Coleman & Hummel (1969)
Humans with leptin deficiency get a bit chunky, too (1)

8 year-old girl.
1.37 m tall (75th centile).
86 kg. BMI of 46.
Mobility severely impaired.

BMI = body mass index = mass in kg / (height in m)².
20–25 normal; >25 obese.

(And another picture of the mice.)

Montague et al. (1997)
Humans with leptin deficiency (2)

Before treatment with recombinant leptin

After treatment with recombinant leptin

Not all motivation is obviously homeostatic
What’s reinforcing?
What’s reinforcing?

Premack (1963); Hundt & Premack (1953)
Development of theories of reinforcement

Given a free choice, animals perform some behaviours a lot (with high probability) and others seldom (low probability).

Premack’s principle (1963): high-probability behaviours reinforce low-probability behaviours (e.g. if you normally drink more than you run, you’ll run in order to be allowed to drink, and vice versa).

Timberlake & Allison (1974): deprived behaviours reinforce less-deprived behaviours (e.g. if you’re drinking less than you normally would, you’ll do other things in order to be able to drink more).

Hundt & Premack (1953): the same behaviour can be both a positive and a negative reinforcer!
Electrical intracranial self-stimulation (ICSS)

The mind is its own place, and in itself, can make heaven of Hell, and a hell of Heaven.

(Olds & Milner 1954)

(Satan, in John Milton’s Paradise Lost, book 1, ll. 254–5)
Remote-controlled rats (and a cocaine sniffer rat)


Talwar et al. (2002). Nature 417: 37
Psychological basis of instrumental conditioning
Complex behaviour can be unlearned…

The greylag goose. Hard to catch (hence “wild goose chase”).

On the right, a female rolling an egg towards its nest.

Lorenz (1939); Tinbergen (1948)
… and we talked about Pavlovian conditioning last time.
Instrumental versus Pavlovian conditioning

Pavlovian (classical) conditioning

Experimenter arranges a contingency between two stimuli (CS and US), independent of the animal’s behaviour.

CS typically neutral (no unlearned response).
US typically biologically relevant (unlearned response: UR).

Animal’s behaviour is observed. Does it learn to respond to the CS?

Instrumental (operant) conditioning

Experimenter arranges a contingency between an aspect of the animal’s behaviour (e.g. pressing a lever) and some stimulus.

Stimulus typically biologically relevant (e.g. food).

Animal’s behaviour is observed. Does the probability of that behaviour change?
Instrumental conditioning: some responses can be goal-directed

Bidirectional control:
1. When buzzer sounds, turn head \textbf{left} in order to receive carrot (delivered straight ahead).
2. Now, new situation: when buzzer sounds, must turn head \textbf{right} in order to receive carrot.

Behaviour changes. Stimulus–outcome (buzzer–carrot) Pavlovian relationship constant; difference is due to behaviour–outcome (instrumental) relationship. \textit{Grindley (1932). Also rats pressing levers (Bolles et al., 1980)}.

Omission schedule:
• Tone (CS) $\rightarrow$ food (US), \textbf{except} that if the dog salivates (CR), it loses the food.

Dog continues to salivate: this response is under Pavlovian, not instrumental, control.

\textit{Sheffield (1965)}
Animals work for reinforcement for several reasons, including...

good-directed action

declarative memories

food

lever

press lever

food is nice

leaver-pressing causes food

nice

after Dickinson (1980)

stimulus–response habit

procedural memory

lever

press lever
Train rats to press a lever for food A. Give them food B for free.

Poison either food A (group P) or food B (group U).

Test responding in extinction (no food).

If their lever-pressing is goal-directed and they represent the value of the goal, then group P should press less than group U.

They do.

Adams & Dickinson (1981)
The story so far… (1)
Learning the ‘incentive value’ of foods

<table>
<thead>
<tr>
<th>Stage</th>
<th>Devalued</th>
<th>Comparison</th>
<th>Controls</th>
<th>Change in devalued group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training</td>
<td>$L \rightarrow \text{food}$</td>
<td>$L \rightarrow \text{food}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Devaluation</td>
<td>$\text{food} \rightarrow \text{LiCl}$</td>
<td>$\text{food}$</td>
<td></td>
<td>hedonic change</td>
</tr>
<tr>
<td>Test 1</td>
<td>$L$</td>
<td>$=$</td>
<td>$L$</td>
<td></td>
</tr>
<tr>
<td>Re-exposure</td>
<td>$\text{food}$</td>
<td>$\text{food}$</td>
<td></td>
<td>incentive learning</td>
</tr>
<tr>
<td>Test 2</td>
<td>$L$</td>
<td>$&lt;$</td>
<td>$L$</td>
<td></td>
</tr>
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</table>

$L = \text{lever}$

$\text{LiCl} = \text{lithium chloride}$

*Balleine & Dickinson (1991)*
Learning that food’s value depends on your hunger

<table>
<thead>
<tr>
<th>Train hungry</th>
<th>Incentive learning</th>
<th>Test while sated</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Learning group</strong></td>
<td>L → food</td>
<td>sated: food</td>
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<td></td>
<td>hungry: food</td>
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<td><strong>Test while sated</strong></td>
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<td>Have learned that food is less worthwhile when they’re sated</td>
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**Controls**

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Based on Balleine (1992)
‘Hedonic’ taste reactivity patterns (1)

Hominoids:  Apes & Humans
Mid-face Aversion  (bitter)  Midface ‘Smile’  (sweet)

Eye squinch & nose wrinkle  Elevation & relaxation

Berridge (2000)
‘Hedonic’ taste reactivity patterns (2)

‘Universal hedonic reaction’ — tongue protrusion to sweet substances

Berridge (2000)
‘Hedonic’ taste reactivity patterns (3)

‘Universal aversive reaction’ — gaping to bitter substances

Berridge (2000)
‘Hedonic’ taste reactivity patterns (4): they can alter

**Human Infant**

<table>
<thead>
<tr>
<th></th>
<th>Hedonic</th>
<th>Aversive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sucrose  (Sweet)</td>
<td><img src="image1" alt="Graph" /></td>
<td><img src="image2" alt="Graph" /></td>
</tr>
<tr>
<td>Water</td>
<td><img src="image3" alt="Graph" /></td>
<td><img src="image4" alt="Graph" /></td>
</tr>
<tr>
<td>Citric   (Sour)</td>
<td><img src="image5" alt="Graph" /></td>
<td><img src="image6" alt="Graph" /></td>
</tr>
<tr>
<td>Quinine (Bitter)</td>
<td><img src="image7" alt="Graph" /></td>
<td><img src="image8" alt="Graph" /></td>
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**Rat**

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<th>Aversive</th>
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</thead>
<tbody>
<tr>
<td>CS^{-} (Safe sugar)</td>
<td><img src="image9" alt="Graph" /></td>
<td><img src="image10" alt="Graph" /></td>
</tr>
<tr>
<td>CS^{-} (Safe salt)</td>
<td><img src="image11" alt="Graph" /></td>
<td><img src="image12" alt="Graph" /></td>
</tr>
<tr>
<td>CS^{+} (Poison paired sugar)</td>
<td><img src="image13" alt="Graph" /></td>
<td><img src="image14" alt="Graph" /></td>
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*Berridge (2000)*
The story so far… (1)
Learning the ‘incentive value’ of heroin

Hutcheson et al. (2001)

Mean cycles of drug-seeking achieved

Experience during withdrawal

State during test

saline heroin  none heroin

withdrawal
Stimulus–response habits develop after extended training

Adams (1982)
Is alcohol-seeking more ‘habitual’ than goal-directed?

Dickinson et al. (2002) experiment 2, figure 6 redrawn
Companies may have learned from rat experiments!

Sucrose ‘fading’ procedure: from e.g.
- 20% sucrose
- 20% sucrose, 5% ethanol
- ...
- 5% sucrose, 10% ethanol
- ...
- 40% ethanol

Samson (1986), rats; 1995 saw introduction of alcopops to UK
The story so far… (3)

outcome (US)

$S^D$

instrumental action representations

lever-pressing

chain-pulling

instrumental contingency

motor responses

leaver-pressing

chain-pulling

locomotor approach

instrumental incentive value

nice

nasty

taste reactivity patterns

dependence on motivational state is not direct, but must be learned (incentive learning)

Key

information about motivational state (hunger, thirst…)

conditional performance

value judgement
Cues paired with reinforcement can also motivate

**Conditioned reinforcement**

*Training*

*Test*

**Pavlovian–instrumental transfer (PIT)**

*Training*

*Test*
Pavlovian–instrumental transfer depends on motivational state
(without the need for learning)

Dickinson (1986); Dickinson & Dawson (1987a, 1987b)
Environmental stimuli (cues and contexts) may become associated with the effects of drugs such as cocaine through Pavlovian conditioning. They become conditioned stimuli (CSs).

They may motivate an addict to seek out drugs — cue-induced (conditioned) craving.
Pavlovian–instrumental transfer? Supermarkets

Static advertising, of course, and advertising to children (works: e.g. Galst & White 1976 *Child Dev* 47:1089), but also auditory/visual stimuli:

“There is a phenomenon known as Pavlovian–instrumental transfer, which suggests that people can learn to associate different stimuli with similar outcomes. In the context of supermarkets, this can be applied to the use of Tesco TV, which is being established to provide offers and value propositions from Tesco, its partners and advertisers — where it can be of most value, in-store where many purchase decisions are made… 7 ‘zones’ were identified in-store where programming could be targeted to make the best use of ‘dwell time’ to create a positive effect for the customer and advertisers… [Grocery, Beers/Wines/Spirits, etc.]…The trial began in 3 stores and its impact was comprehensively researched with Tesco customers… proposed roll-out to 300 stores.”

Shopping and motivational state

Mela et al. (1996)
The story so far… (3)

- **outcome (US)**
  - $S^D$
    - instrumental action representations
      - lever-pressing
        - chain-pulling
      - instrumental contingency
  - instrumental outcome
    - sugar pellets
      - water
    - incentive learning
      - nice
        - nasty
      - dependence on motivational state is not direct, but must be learned (incentive learning)
  - instrumental incentive value
    - motor responses
      - lever-pressing
        - chain-pulling
        - locomotor approach
  - stimulus–response habit
    - CS
  - hedonic impact
    - nice
      - nasty
  - taste reactivity patterns

**Key**
- information about motivational state (hunger, thirst...)
- conditional performance
- value judgement
Summary

• Reinforcement must be defined carefully to avoid circular arguments. Theories (Skinner, Hull, Premack, Timberlake).

• Motivational states are internal ‘hidden’ variables that help to explain behaviour.

• Apparently goal-directed behaviour is complex; several representations/processes contribute. For example, an animal learning to respond for a reward encodes
  • the instrumental (action–outcome) contingency;
  • the value of the outcome as an instrumental goal;
  • the (dissociable) ‘hedonic’ value of the outcome;
  • direct stimulus–response ‘habits’;
  • … and is influenced by Pavlovian processes including conditioned reinforcement and Pavlovian–instrumental transfer.

• Motivational state affects several of these processes.