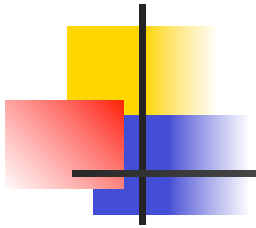
The Frontal Lobes

- 1930's & 40's : Frontal Lobes subserved "abstract attitude, foresight, and intellectual synthesis"
  - Brickner, 1936; Goldstein
- 1940's & 50's: Prefrontal cortex lacks functional significance
  - Hebb, 1945
- Frontal Lobes as the 'Final Frontier' in neuropsychology
  - Stuss and Levine, 2002
- The cognitive architecture of the frontal lobes has remained one of the great enigmas of neuropsychology
  - Cato et al. 2004



- Considerable agreement in the literature of a functional frontal lobe dissociation
- Dorsal = Cognitive
- Ventral = Affective*

Cognitive (Dorsal)

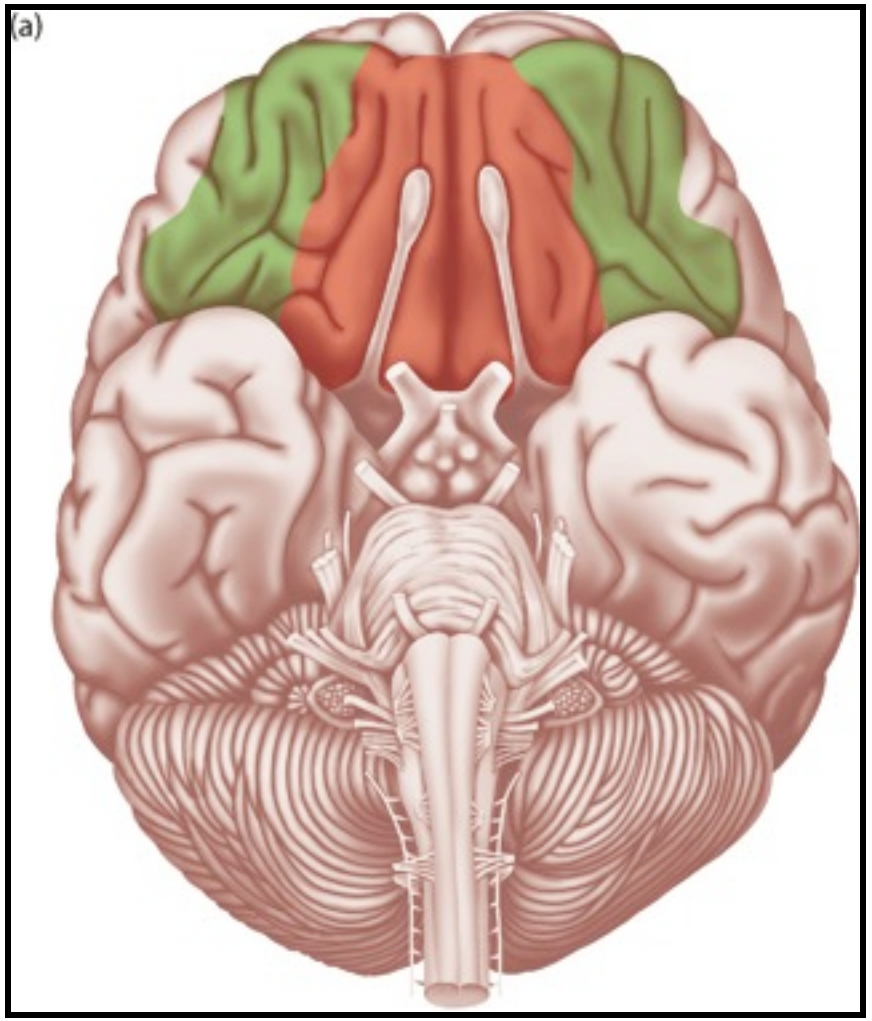
- Maintaining and shifting attention
- Mental flexibility
- Abstract thinking
- Feedback utilization
- Inhibition of response
- Motivation/initiative
- Creativity
- Concentration
- Working memory

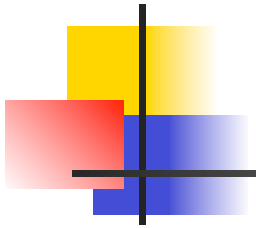
Affective (Ventral)

- Behaviour regulation
- Processing emotions and reward
- Emotional decoding
- Learning of reward associations (& reversing)
- Social inhibition (impulse control)
- Primary reinforcers (food, sex, social affiliation)

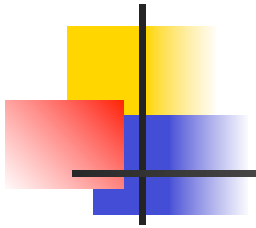
Orbitofrontal Cortex

- What do you think would happen if a person sustained localized damage to the OFC?





- Socially indiscriminate
- Socially isolated
- Difficulty initiating tasks
- Difficulty terminating tasks/perseveration
- Impaired parenting
- Blunted emotions
- Hypersexuality
- Dietary Change
- Poor decision making (unstructured situations)
- Inability to regulate behaviour according to internal goals (SRD)
- Low motivation
- Highly distractible
- Uncreative



- OFC lesion patients → representations required to guide and produce an action are brought into working memory, but they are stripped of emotional content
- A patient may still mull over problems, albeit in an impersonal manner
- A patient may be aware of the death of a close relative and understand the finality of it, but he is divested of the emotional pain that accompanies the loss

Why Pro-Con Lists work poorly…

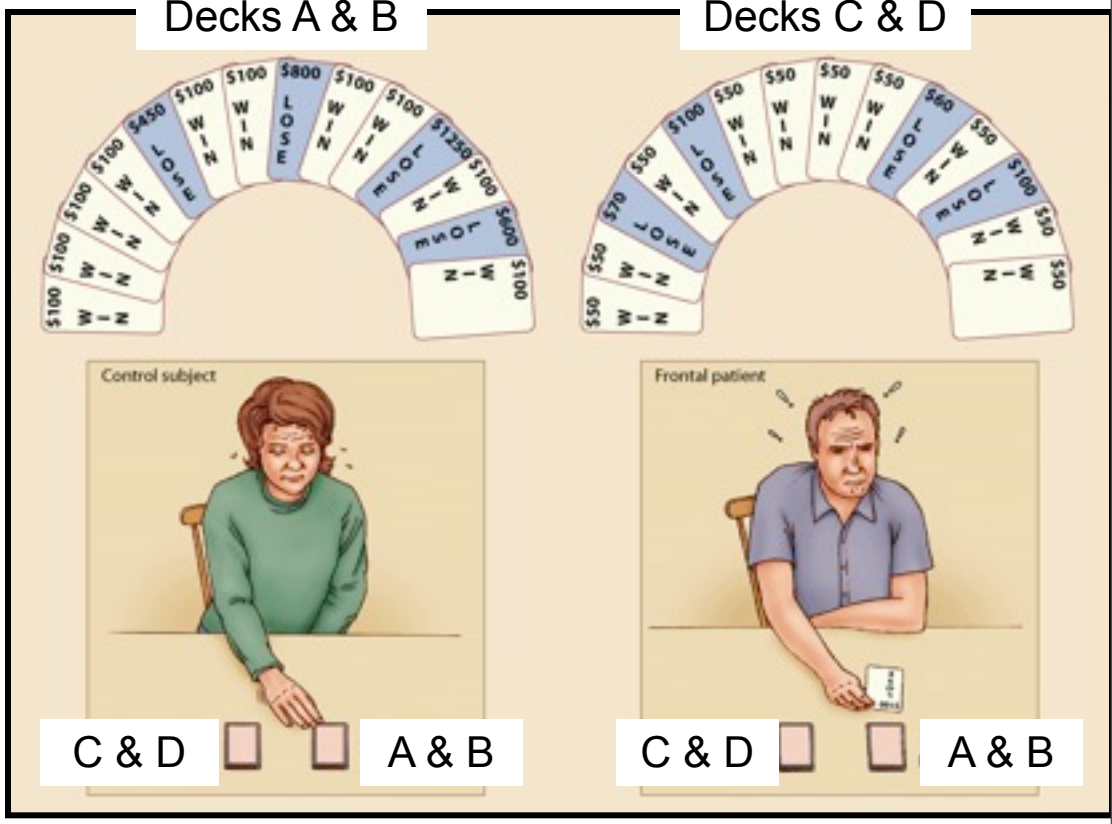
- Emotion influences everyday "rational" decision making (Antonio Damasio)
- Emotional evaluation guides reasoning
- "Gut Feelings"
- Persuasion: Rona vs. statistics

Somatic Marker Hypothesis

- Sensory information activates the VPFC
- Causes autonomic arousal
- Creates nonconscious bias that serves to facilitate cognitive (conscious) evaluation of the situation

Bechara et al. (1997)

- OFC is important for emotional responding
- Are emotional responses necessary for appropriate decision making?
- Gambling task that simulates real-life decision making



Bechara et al. (1997)

- Control Results:
  - Chose advantageously before they realized which strategy was best
  - Developed anticipatory SCR even before they figured out the strategy
- VMPFC Patient Results:
  - Chose disadvantageous even when they knew correct strategy
  - Never developed anticipatory SCR (even when they did realize the choices were risky)

Bechara et al. (1997)

- Study suggested that non-conscious biases guide behaviour before conscious knowledge
- Without biases, overt knowledge is not sufficient to ensure advantageous behaviour

The Pre-Frontal Cortex (PFC)

Richard Davidson

Mind and Life Institute: studies on long-term effects of meditation

Key outcomes:

1) people can permanently adjust their neuroanatomy;

2) people can make themselves much happier and emotionally stable than previously believed;

3) people can affect even low-level processes (e.g., startle, primary emotional responses)

Neural Plasticity

The brain changes continuously

“Our brains’ connections are refined and retuned with every experience of our lives.”

Only recently have we begun to appreciate our brains’ incredible ‘plasticity’ – or, ability to change.

Neural Plasticity

Plasticity is amazing, but the limits are unknown.

Certainly, age is a factor: e.g., v. young children with severe epilepsy → "radical hemispherectomy" → mostly normal functioning!

Current huge questions concern the OUTER LIMITS to which people can learn to manipulate their own neural functioning, and the benefits gained. Practical questions concern how to create a more brain-healthy society.

Brain areas can even recruit systems normally devoted to other tasks.

e.g., cut off a finger → that part of the sensory cortex will start to receive signals from the other fingers → enhanced sensitivity

e.g., if blind → the sensory cortex corresponding to the Braille-reading finger expands; sense of touch starts to get processed by the visual cortex

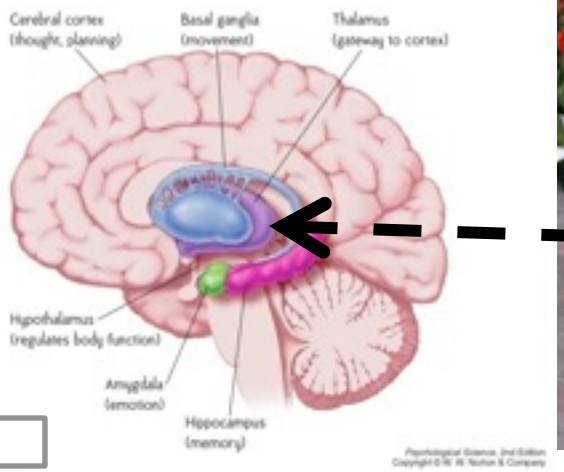
In essence, this is how our sensorimotor cortices evolved in the first place.

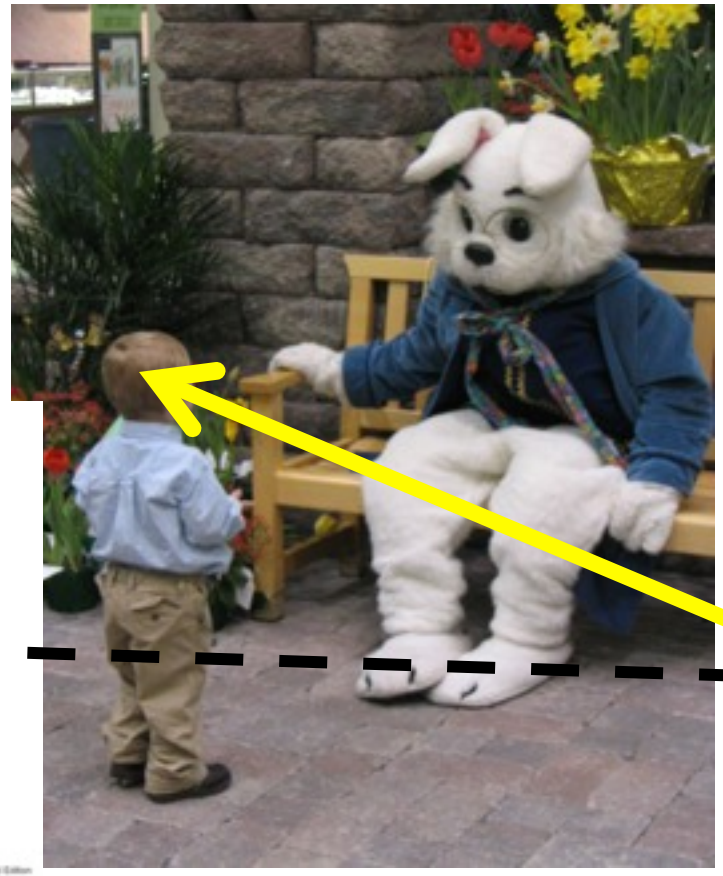
Step 1: Reality

Step 2: Sensory receptors

Step 3:

Transduction: physical energy of stimulus is converted to electrical energy, which is sent in pulses to the brain





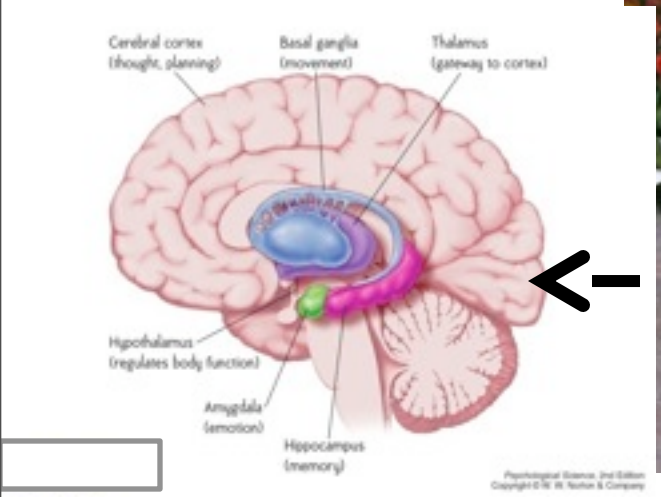
Step 1: Reality

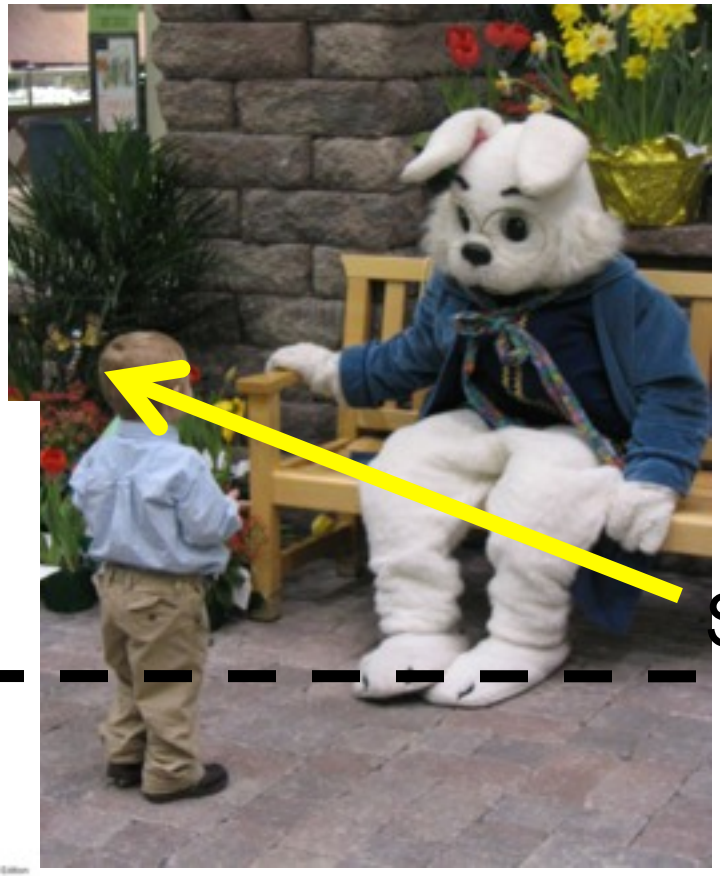
Step 2: Sensory receptors

Step 3: Transduction

Step 4:

Thalamus: the sensory-message switchboard operator, which figures out where to send it next...





Step 1: Reality

Step 2: Sensory receptors

Step 3: Transduction

Step 4: Thalamus

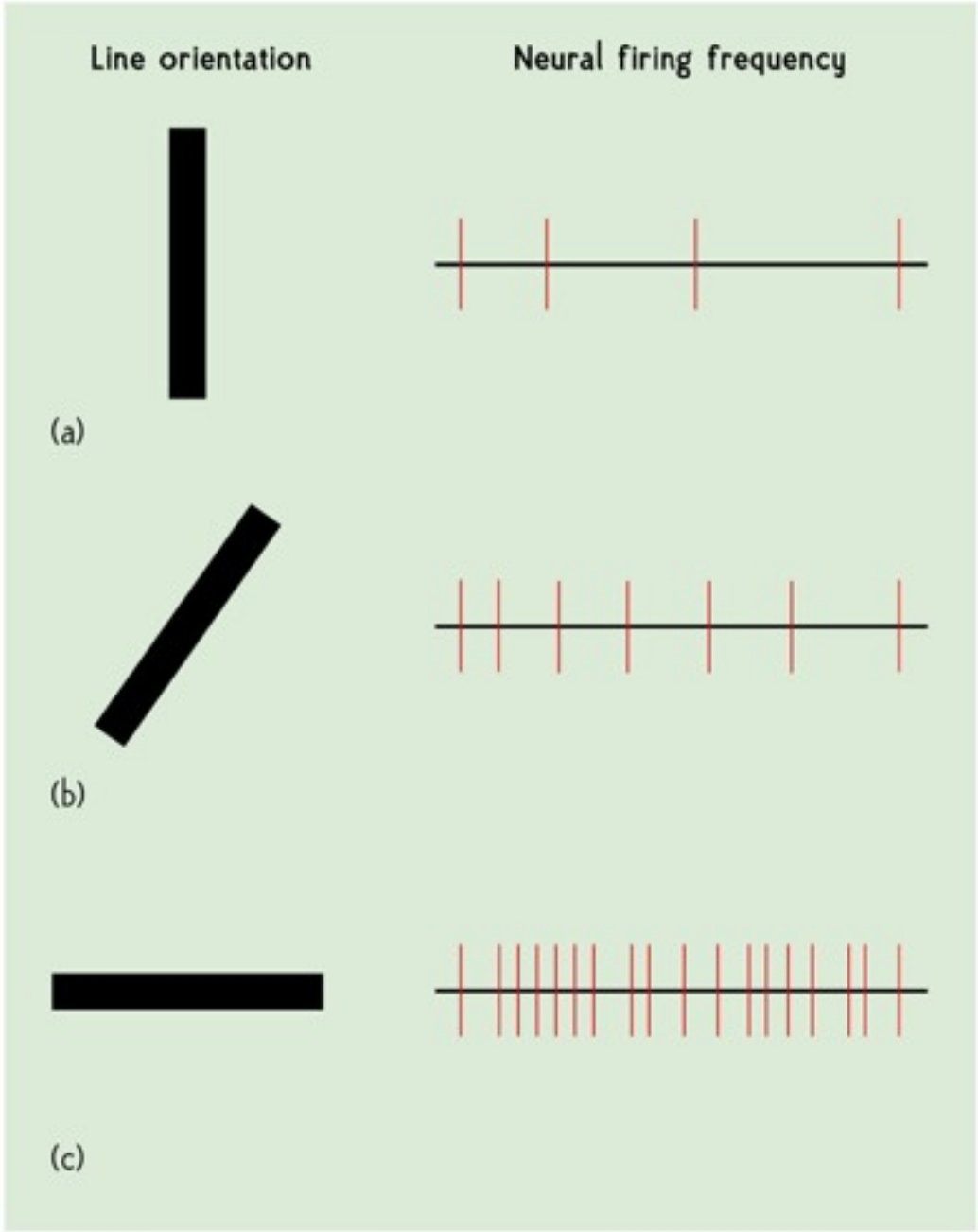
Step 5: Primary sensory cortex: initial processing of information occurs

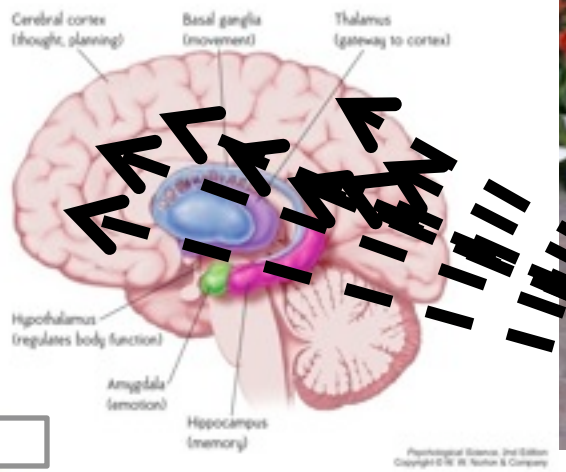
Hierarchical Processing

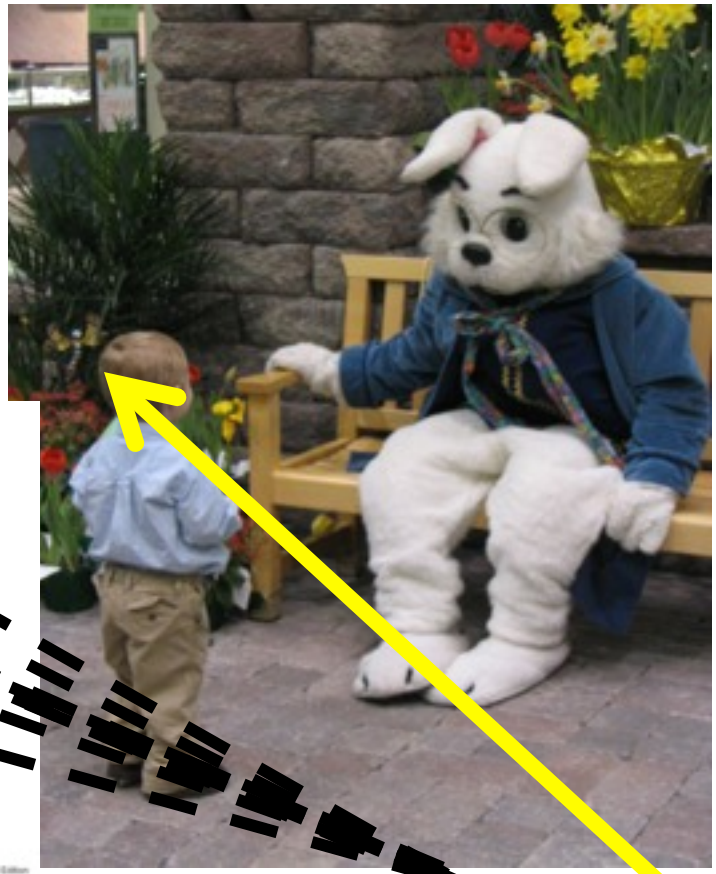
Processing of visual information occurs in a series of steps, from initial coarse processing of relatively basic features (e.g., line orientation, colour, movement), to more complex processing (e.g., face and object recognition, 3-dimensional space)

Hubel & Wiesel (1963) examined the firing rate of single cells in the primary visual cortex

- many were specialized to respond to particular features: “primitives”







Step 1: Reality

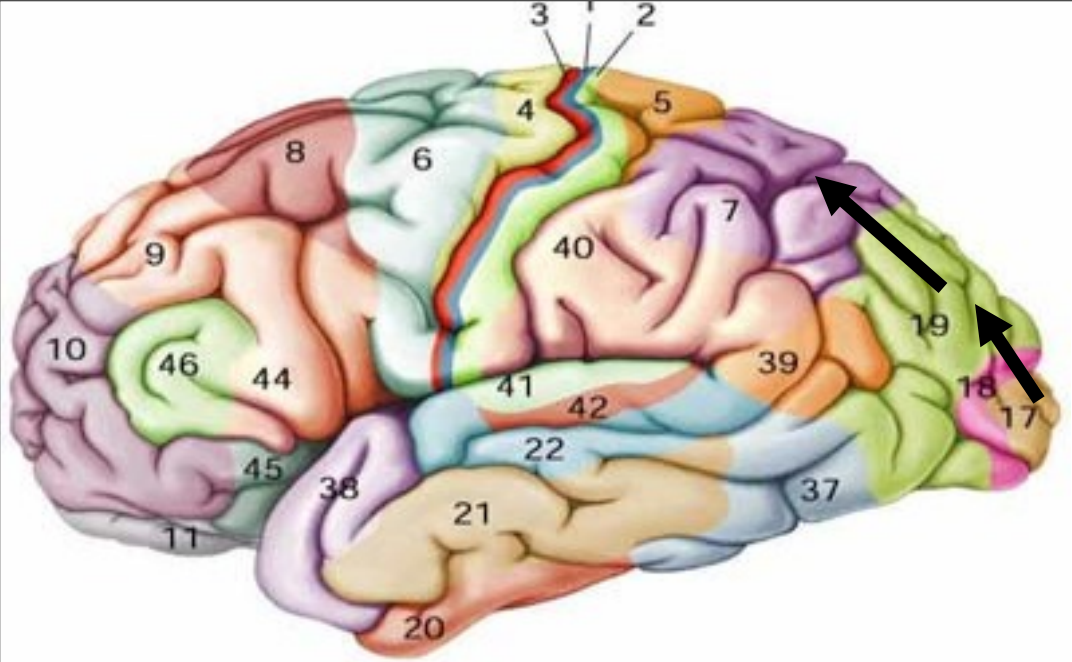
Step 2: Sensory receptors

Step 3: Transduction

Step 4: Thalamus

Step 5: Primary sensory cortex

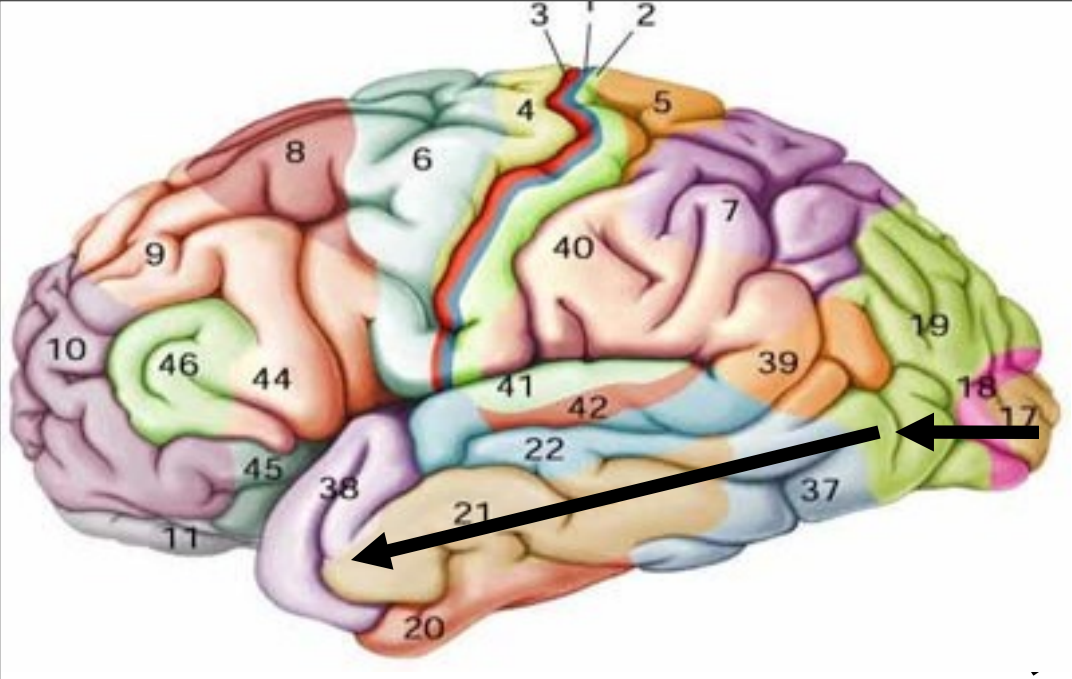
Step 6: Further processing in many other brain areas, linked to higher level cognitive & perceptual tasks: e.g., the "what" & "where" pathways



WHERE?

dorsal pathway → superior ventral lobes → parietal lobes; processes spatial location

“The .... thing .... is right in front of me!”



WHAT?

- ventral pathway → inferior temporal lobes; specializes in object recognition

"It's....um.....a giant rabbit?"

Step 7: Deciding & Acting

Many other brain areas (involving memory, planning, motivation, self-control, etc.) then decide what do, and tell our motor cortex to communicate the appropriate actions to muscles in the body....

What we learn from cats

In a gradual, bidirectional process of brain-environment adaptation, experience teaches our brains how to perceive reality, giving us knowledge about what the world looks like.

We then use this knowledge to guide how we construct perceptions.

What knowledge does the brain use to guide perception?

1) chronic habits of the mind → highly accessible pieces of information

What knowledge does the brain use to guide perception?

2) whatever is currently (or very recently) on your mind → the particular knowledge structures that are “activated” and can guide information processing

Top-down processing

the various ‘rules’ the brain uses to construct representations of the world

NOTE: these are functional almost all the time! Which is of course why our brains have automatized them so universally

Top-down processing: Context

Many illusions occur as a result of misleading contextual cues (or simply no contextual cues), which our brains rely heavily upon to make proper inferences about what they see.

Vokey and Read (1985)

Studied participants' ability to comprehend messages played backwards.

- 98.9% accuracy on judging the sex of the speaker
- 78.5% accuracy on judging if the speaker was the same across audio clips
- 46.7% accuracy on judging if the clip is English, French, or German (chance = 33.3%)

But these are simple judgements; not comprehension.

Vokey and Read (1985)

Comprehension study:

- Nursery rhymes
- Christian passages (23rd psalm)
- Satanic messages
- Pornographic statements
- Advertising messages

Accuracy = 19.4% (chance = 20%)

‘Twas Brillig and the Slithy Toves

Would participants hear what they were told to hear?

- Stimuli: Lewis Carroll’s Jabberwocky and the 23rd Psalm
- Experimenters “identified” a number of potential phrases:
  - “Saw a girl with a weasel in her mouth”
  - “I saw Satan”

84.6% of participants said they heard the phrases.

Learning

early 1900s – a resistance to the dominant paradigms in psychology of the day: introspection & Freudian psychoanalysis

Psychologists started to try to make psychology more scientific, experimental. They began to focus only on **observable** aspects of human experience → focus on **behaviour**

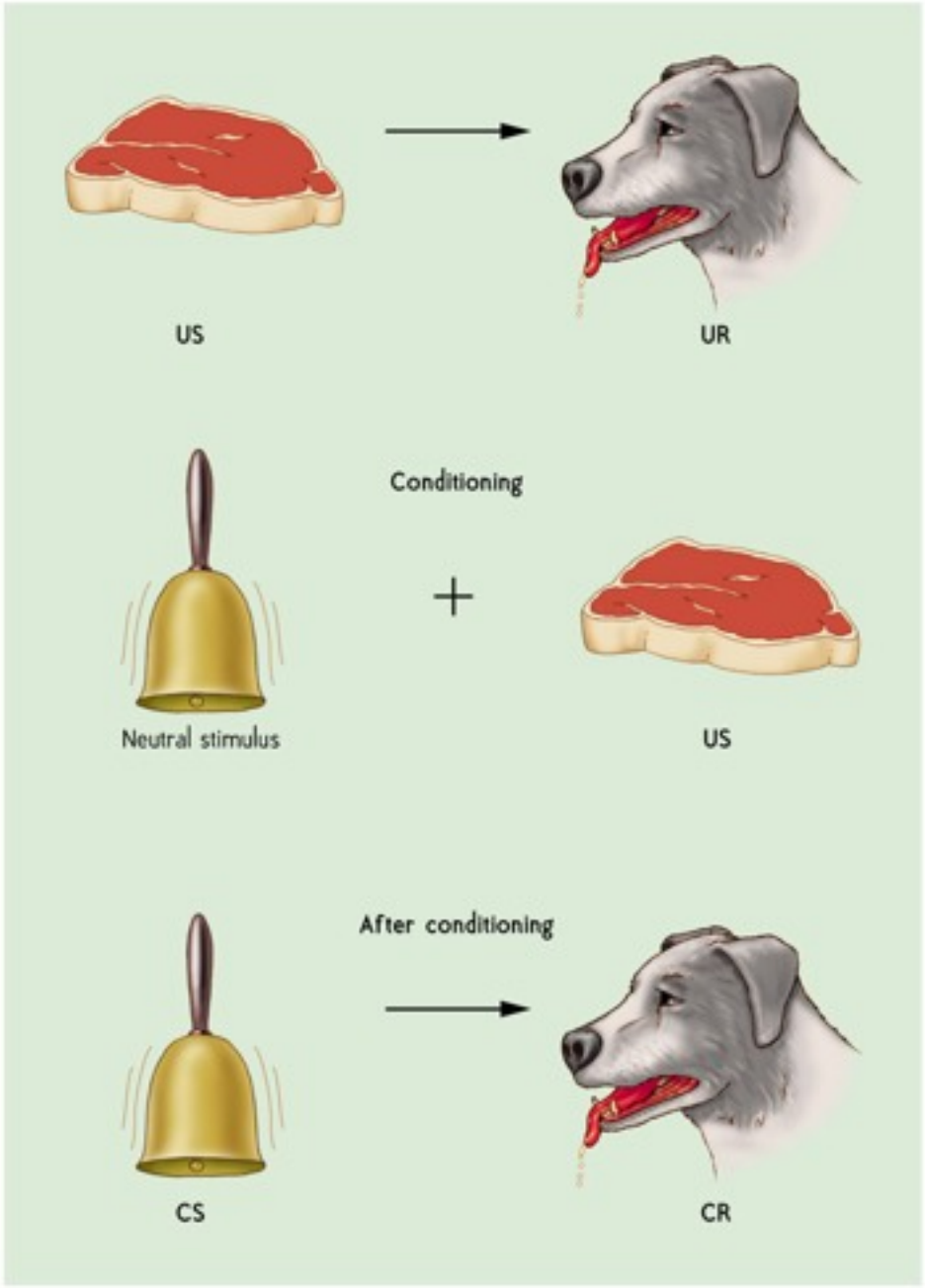
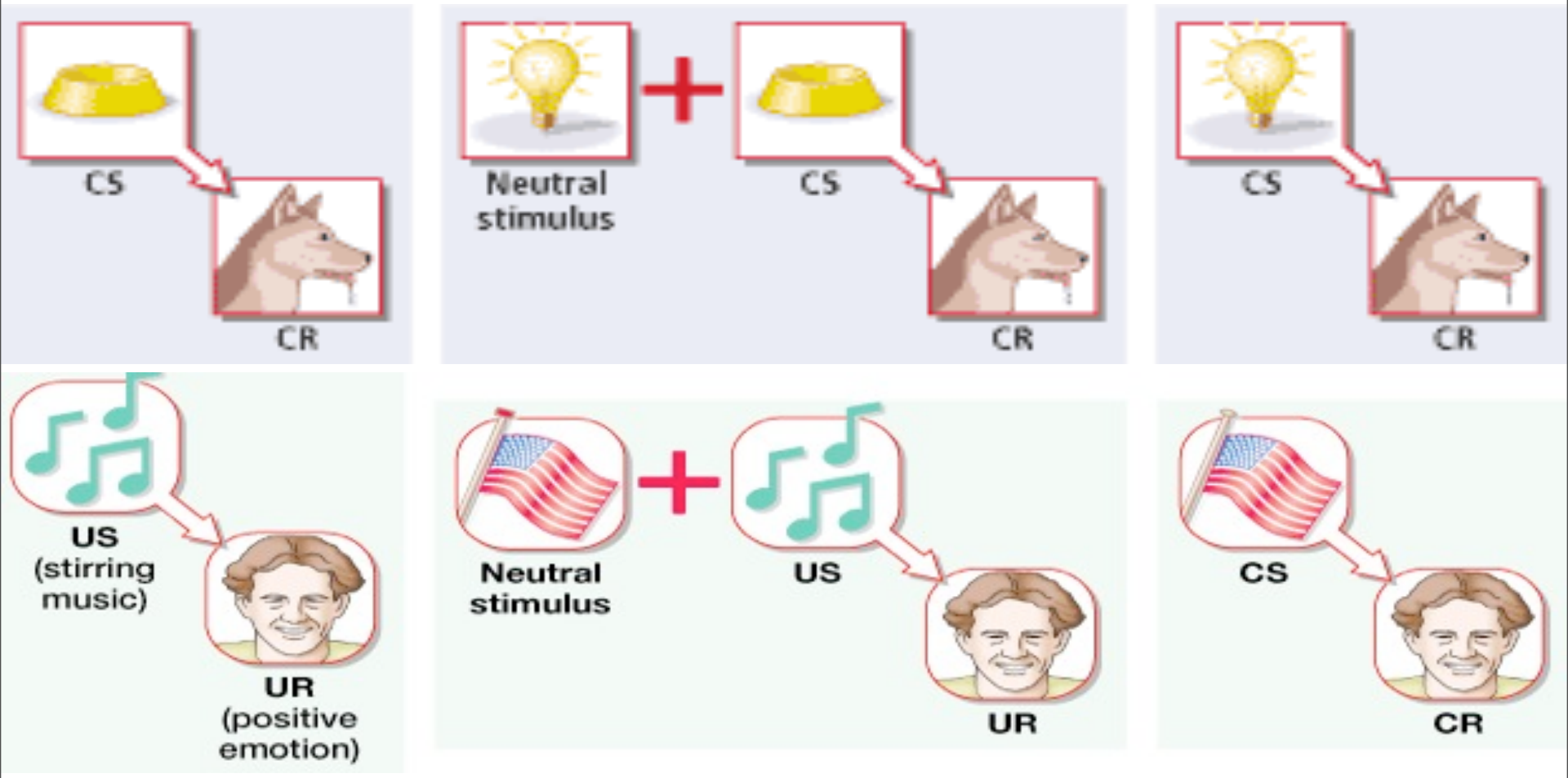


FIGURE 6.4

Higher-Order Conditioning

A neutral stimulus can become a conditioned stimulus by being paired with an already established CS



Classical Conditioning in Real Life

- Conditioning plays a big role in our emotional responses to objects, people, symbols, events, and places.

- ....and advertisers pull our strings all the time by associating their products with images that we associate with desire, cool, sex, power, excitement

John B. Watson

“eureka!” ..... 10 years later .....

1913 – begins to publish his perspective on Behaviourism through Psych Review: “Psychology as the Behaviorist Views It”

“Psychology as the behaviorist views it is a **purely objective** natural science. Its theoretical goal is the **prediction and control** of behavior. Introspection forms no essential part of its methods ... “

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"The behaviorist, in his attempts to get a unitary scheme of animal response, recognizes no dividing line between man and brute. The behavior of man, with all of its refinement and complexity, forms only a part of the behaviorist's total scheme of investigation."

Watson & the Rise of Behaviourism

thought that the conditioned reflex was a model that would account for a wide variety of phenomena.....even emotions!

studied babies, and identified 3 unconditioned emotional responses: rage, fear, love

Watson & the Rise of Behaviourism

he believed that all other complex emotional experiences were CRs, built on the foundation of these three URs.

Little Albert...

Behaviourism

behaviourists challenged our basic understanding of the world, and championed a view of people as stimulus-response machines

they also solidified within psychology a strong paradigm based on experimental methods, quantitative analysis, and “objective” measurement

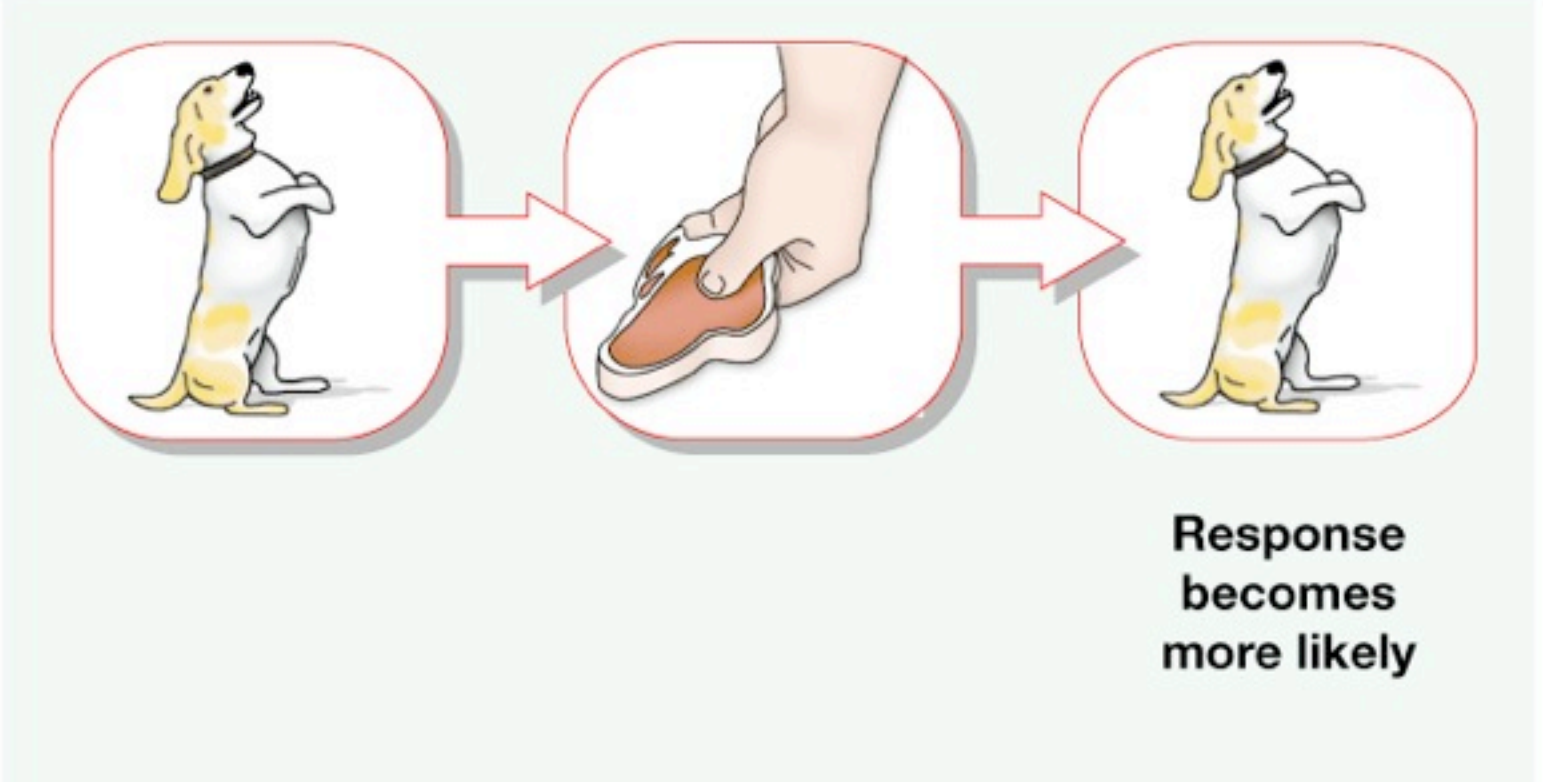
Operant Conditioning: Carrots & Sticks

classical conditioning: focus on **associations between stimuli**; target is largely passive

operant conditioning: focus on the **consequences of behaviour;** target is quite active, regulating her behaviour in order to meet hedonic needs (i.e., get pleasure, avoid pain)

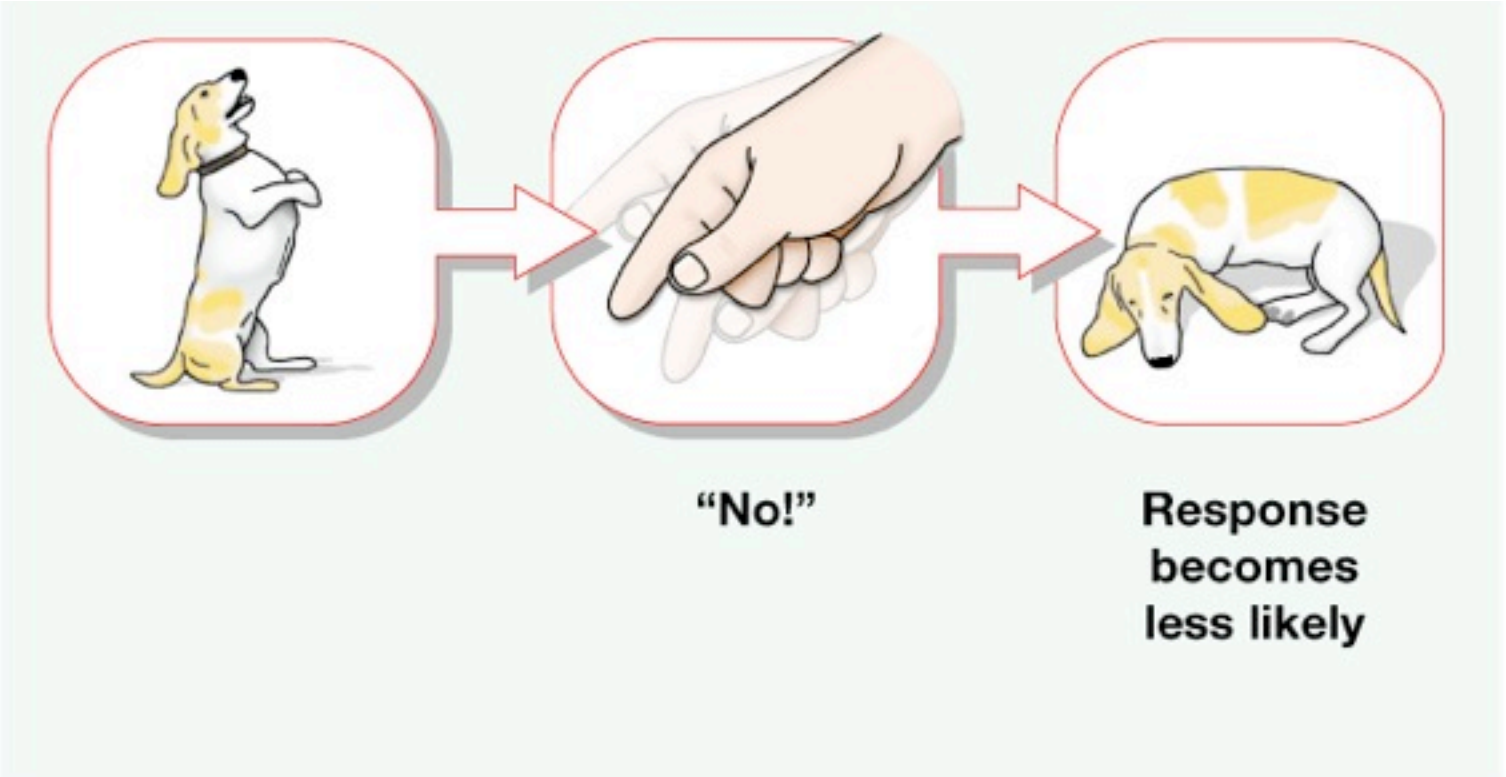
Consequences of Behaviour

- **Reinforcement** strengthens the response or makes it more likely to recur (positive vs. negative reinforcement)



Consequences of Behaviour

- **Punishment** weakens a response or makes it less likely to recur (positive vs. negative punishment)



Schedules of Reinforcement

Begin training a response with **continuous reinforcement** (acquisition is fast and easiest when reinforcement is continuous)

once a response is reliable,

it will be more resistant to extinction if it is rewarded on an **intermittent (partial) schedule of reinforcement,**

Reinforces only some responses, not all of them.