How to Investigate Brains

Dissection
Single cell recording
EEG: Electroencephalography
Psychological experiments on people with brain damage, e.g. HM, hemineglect
Brain scanning
Transcranial magnetic stimulation
Computational methods

Types of Brain Scans

- CAT: Computerized axial tomography.
- PET: Positron emission tomography.
- fMRI: Functional magnetic resonance imaging
- MEG: Magnetoencephalography
- NIRS: Near-infrared spectroscopy

fMRI

- The magnet realigns atoms and protons.
- Machine sends a radio pulse that causes atoms to release energy.
- A computer detects energy release and produces an image.
- Functional MRI measures brain function by measuring changes in blood volume.

Neurocomputational Models

- Theoretical neuroscience: emerging combination of neuroscience, psychology, and computer modelling.
- More realistic computer models:
  - Spiking neurons.
  - Large networks: 1000s with many connections.
  - Organized into brain areas.
How Brains Represent
- Neural populations represent inputs by patterns of firing that encode them.
- Pinker: “Brain cells fire in patterns.”
- Neural populations represent neural populations by encoding inputs from neural populations.

Discussion Question
- What are the benefits and limitations of using neuroscience to study the mind?

How Brains Compute
- Similar to connectionism: neurons linked by excitatory and inhibitory links.
- Molecules matter:
  - Individual cells can perform computations internally.
  - Neuronal signaling via synapses depends on many different kinds of chemical neurotransmitters. Drugs.
  - Long distance signaling takes place by hormones.
  - Brain chemicals have temporal as well as topographic effects: coordination and synchrony.

Key Points
- Neuroscience brings new methods, e.g. brain scanning to the investigation of mind.
- Experimental results can be explained using more neurally realistic computer models.

Emotions in Scientific Thinking
Theories of Emotion

- Cognitive appraisal
  - Emotions are judgments about situations.
- Somatic perception
  - Emotions are perceptions of bodily states.
- Unified (EMOCON)
  - Emotions are brain states that simultaneously represent cognitive appraisal and somatic perception.
- Emotions also have molecular and social aspects, e.g. love.

Discussion Question

- How important are emotions to human thinking?
- Can neuroscience explain emotions?

Emotions: Practical Applications

Critical thinking: Should we be non-emotional?

1. Yes: avoid distortions such as motivated inference, hate mongering.
2. No: emotions needed for motivation, reward assessment.

Politics
- fMRI being used to investigate reactions to candidates, e.g. amygdala, insula, striatum
- Drew Westen: Political Brain

Neuromarketing
- Design: make things beautiful and thus more useful
- Relationships: love, trust, oxytocin

Oatley: Cognitive functions of Emotions

- Happiness: subgoals being achieved.
- Sadness: failure of plan or loss of goal.
- Fear: self-preservation goal threatened.
- Anger: Active plan frustrated.
- Disgust: Gustatory goal violated.
Key points

- Emotions have both cognitive and somatic (physiological) aspects.
- Theoretical neuroscience is beginning to offer explanations of how brains produce emotions.