Course website:
http://www.christofflab.ca/psych260/

Labs will be held in MSRC 1
MATH/STATS RESOURCE CENTRE
6357 AGRICULTURAL ROAD

Methods of Studying the Brain

Hypothetical Experiment

• Hypothesis: TV watching leads to increased arithmetic skills.

• Two labs: ALPHA and BETA conducted separate experiments and published results
LAB ALPHA: Article A

Subjects were run through a fMRI scanner while performing sessions of both TV watching and tasks related to arithmetic ability. Activity was found to be localized in temporal lobe in both activities. Results are shown on the side.

LAB BETA: Article B

Subjects were run through a fMRI scanner while performing sessions of both TV watching and tasks related to arithmetic ability. Activity was found to be localized in temporal lobe in both activities. Results are shown on the side.

Which article is more conclusive?

- Article A
  
  or
  
  Article B

?
The Brain as a pop star

- People are more likely to believe a scientific argument if it is accompanied by a brain picture
- The public is irresistibly drawn to anything brain-related
- On the other extreme, some people completely reject the relevance of brain research to psychology

Two extreme (and easy) attitudes

- An uncritical and immediate fascination with anything brain-related
- An overly critical dismissal of anything brain-related

- Instead, maintaining a position in between these two extremes is much more difficult
  - it requires knowledge and critical ability
  - is nevertheless what we need to develop
Methods for Observing Neural Activity

- EEG (Electroencephalography)
- MEG (Magnetoencephalography)
- PET (Positron Emission Tomography)
- fMRI (functional Magnetic Resonance Imaging)
- TMS (Transcranial Magnetic Stimulation)

EEG - Electroencephalography
EEG

- Measure of electrical activity in brain
- Multiple repeated measurements necessary
- ERP (event related potential) hidden in background
- Signal averaging
EEG results

PET
Positron Emission Tomography

- Measures activity, not structure
- Radioactive tracer injected into blood
  - Not metabolized
- Subject performs a task of interest after the injection
Method of cognitive subtraction

fMRI
Functional Magnetic Resonance Imaging

MRI
- Emission of Hydrogen atoms by radio-frequency waves
- High spatial resolution
- 2D or 3D images
- Used for structural analysis
Psychology 260, Kalina Christoff

**fMRI**

- Structural + functional imaging
- Functional based on BOLD signals
  - Activity = increase blood oxygen

**fMRI – measures the BOLD**

(blood oxygenation level dependent signal)

- The vascular system supplies blood containing oxyhemoglobin to active regions of the brain
- The influx of oxygenated blood to regions that are active reduces the local concentration of deoxyhemoglobin which increases BOLD signals
Static magnetic fields

Units:
- Tesla - SI Unit of magnetic flux density
- Gauss - old measure
- 1 Tesla = 10,000 Gauss

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<th>Controlled zone</th>
<th>Fridge magnet</th>
<th>Loudspeaker</th>
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<td>Gauss (G)</td>
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Artefacts

- Metal objects distort magnetic field and give rise to image artefacts

fMRI vs. PET

- **Advantages of PET**
  - Chemical specificity
  - Not subject to magnetic artifacts
  - Better understood
  - Quiet -- verbal responses allowed
  - Motion not as devastating to analysis

- **Advantages of fMRI**
  - Cheaper, more accessible
  - Better spatial and temporal resolution
  - Noninvasive (repeated experiments possible)
  - Can collect both structural and functional images
Studying the brain through examining single cells

Brodman's areas
Cytoarchitectonic classification

Cell typology (cytoarchitectonics)
Cytoarchitectonic differences

Source: Petrides & Pandya (1994)

Brodmann’s Areas

- Based on cytoarchitecture
  - Arrangement of cell bodies in cortex

abstract vs concrete thought
Cellular Recording

- Invasive
  - Intracellular
    - Recording within membrane of single cell
- Extra cellular
  - Records electrical disturbance of surrounding cells

Resolution

- **Temporal Resolution**: precision of measurement with respect to time
- **Spatial Resolution**: precision of measurement with respect to space