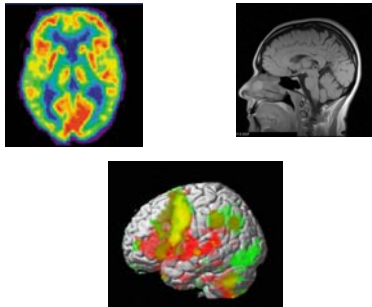


Methods of Studying the Brain

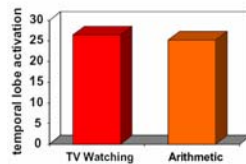


Hypothetical Experiment

- Hypothesis: TV watching leads to increased arithmetic skills.
- Two labs: ALPHA and BETA conducted separate experiments and published results

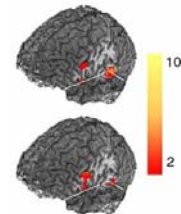
LAB ALPHA: Article A

Subjects were run through an 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.



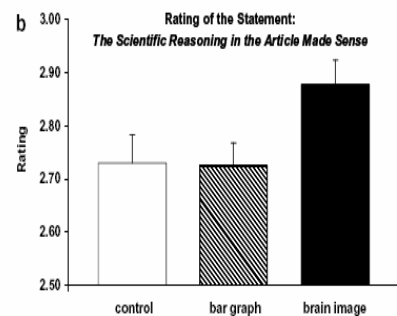
LAB BETA: Article B

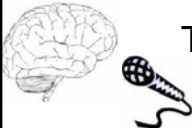
Subjects were run through an fMRI scanner while performing sessions of both TV watching and tasks related to arithmetic ability. Activity was found to be localized in temporal lobe in both activities. Results are shown on the side.



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

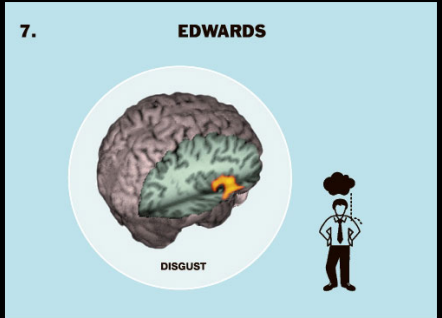
- An uncritical and immediate fascination with anything brain-related
- An overly critical dismissal of anything brain-related
- Instead, maintaining a position in between these two extremes is much more difficult
 - it requires knowledge and critical ability
 - is nevertheless what we need to develop

The New York Times

Subjects who had an unfavorable view of John Edwards responded to pictures of him with feelings of disgust, evidenced by increased activity in the insula, a brain area associated with negative emotions.

This Is Your Brain on Politics

7. EDWARDS



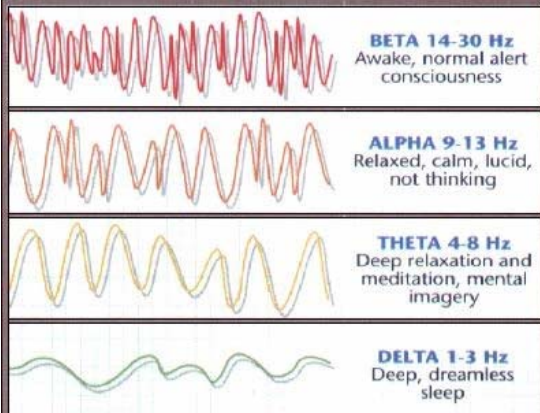

DISGUST

<http://www.nytimes.com/2007/11/11/opinion/11freedman.htm>

Methods for Observing Neural Activity

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

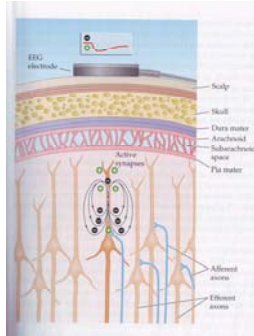
EEG - Electroencephalography



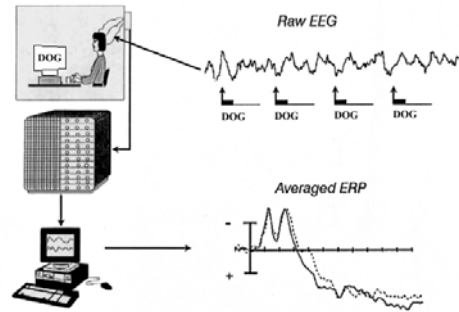
BETA 14-30 Hz Awake, normal alert consciousness
ALPHA 9-13 Hz Relaxed, calm, lucid, not thinking
THETA 4-8 Hz Deep relaxation and meditation, mental imagery
DELTA 1-3 Hz Deep, dreamless sleep

EEG

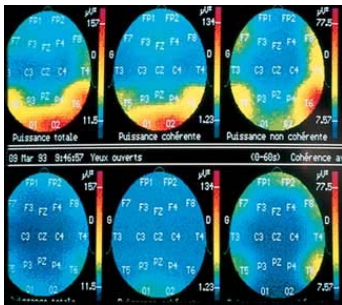
- Measure of electrical activity in brain
- Multiple repeated measurements necessary
- ERP (event related potential) hidden in background
- Signal averaging



Event-Related Potential Technique



EEG results

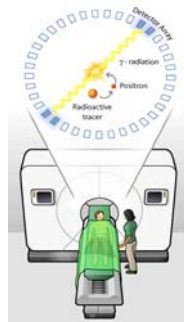


PET Positron Emission Tomography

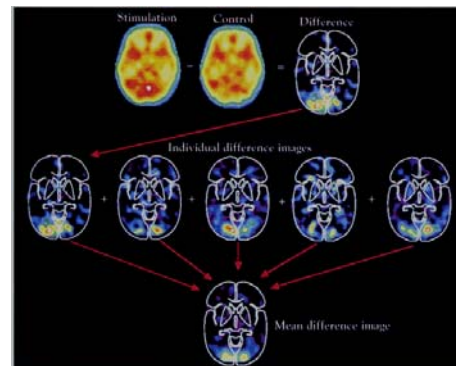


PET

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

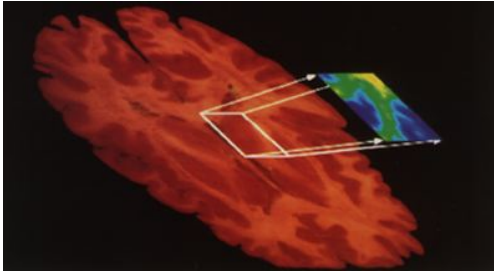


Method of cognitive subtraction



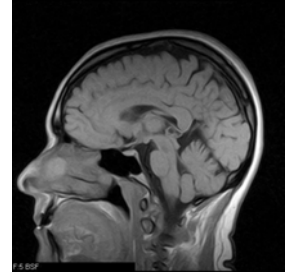
fMRI

Functional Magnetic Resonance Imaging



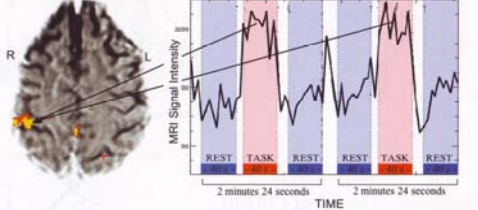
MRI

- Emission of Hydrogen atoms by radio-frequency waves
- High spatial resolution
- 2D or 3D images
- Used for structural analysis



fMRI SHOWS THE ACTIVITY OF THE BRAIN

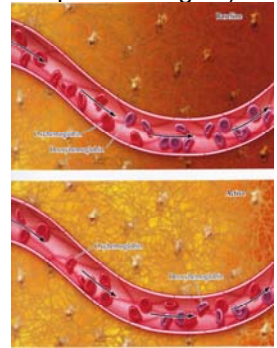
Left Hand - Touch



- 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

Source	Field Strength (G)	Field Strength (T)
Earth	0.6G	0.06mT
Controlled zone	5G	0.5mT
Fridge magnet	20G	2mT
Loudspeaker	50G	5mT
MRI system	30,000G	3T



Artefacts

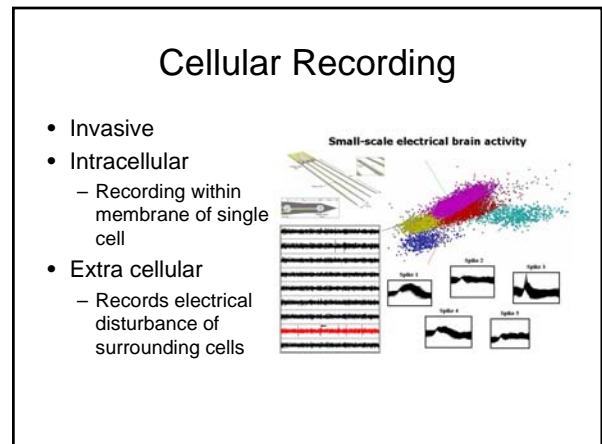
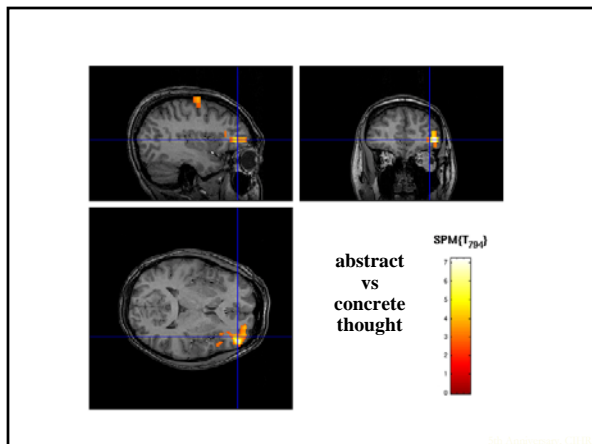
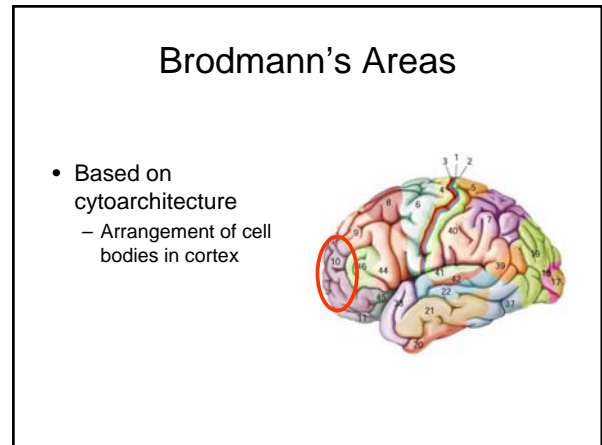
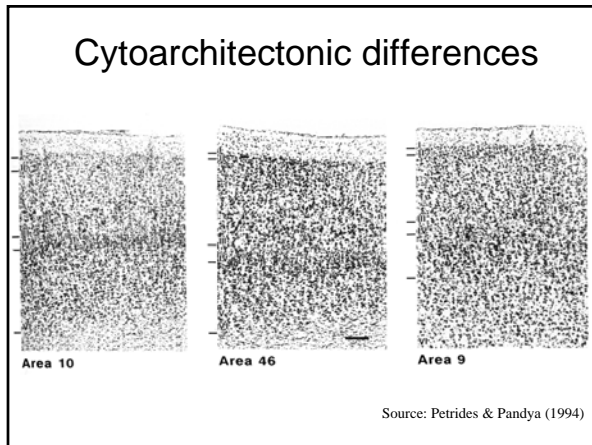
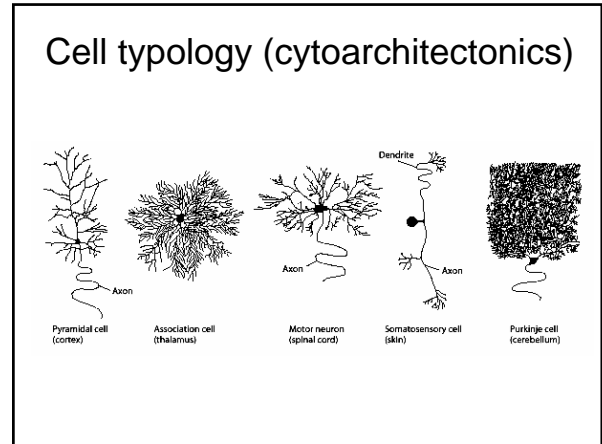
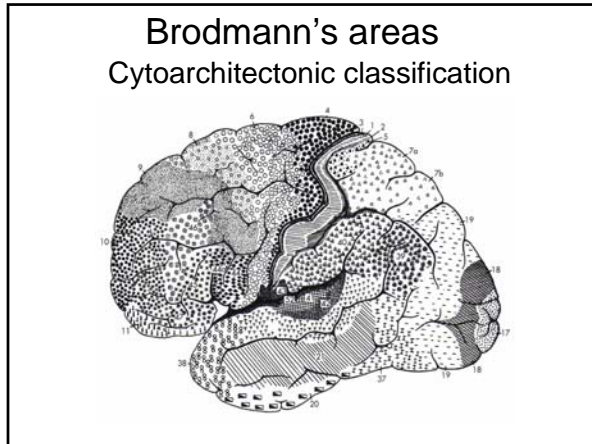
- Metal objects distort magnetic field and give rise to image artefacts

Hair grip Metal dental work

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



Resolution

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

