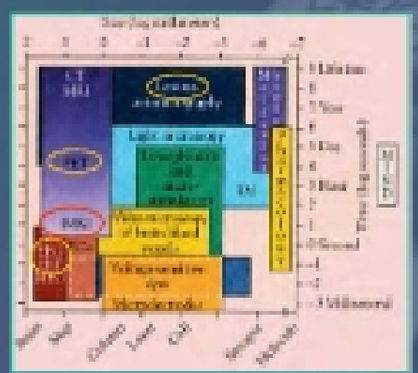
How to study the neural basis of human vision?

What should the ideal technique be like?

- High Temporal Resolution
- High Spatial Resolution
- Should cover a large extent of the brain
- Sensitive
- Safe

What techniques are available?

- Neuropsychology (Brain lesions)
- EEG, MEG
- PET
- fMRI



Brain Lesions

As a result of traumas, surgery, infarcts, or diseases

-Case of prosopagnosia

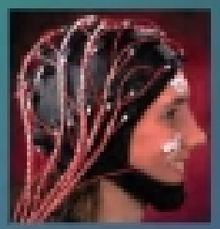
Main advantage: causality

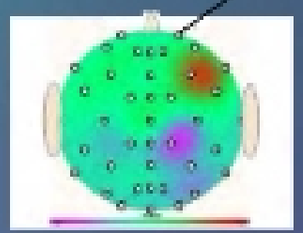
Disadvantages

- Necessity, but not sufficiency
- Specificity (multiple/extensive lesion may lead to more than one deficit)
- Plasticity (neural reorganization complicates interpretation)
- Rarity (only very few cases may exist)

EEG

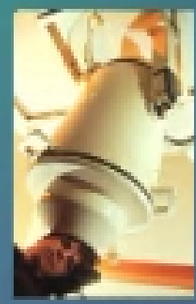
(Electro-EncephaloGraphy)





MEG

(Magneto-Encephalography)



EEG and MEG have great temporal resolution, but...

- Poor spatial localization/resolution
  (restricted mostly to cortex, issue of the inverse problem)
- Weak signal (need hundreds of trials)

Neuroimaging (PET, fMRI)

Provide an indirect link between neural activity and behavior:

The indirect link is Vascular response to neural activity

Your brain is like a muscle

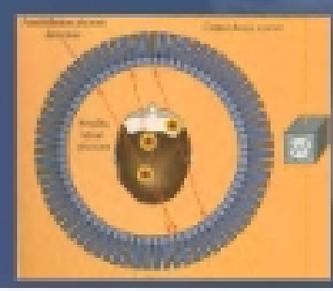
Dr. Fulton's own (1926)

PET

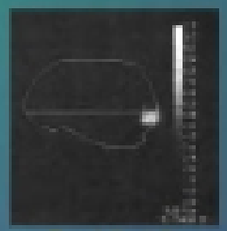
(Positron Emission Tomography)

Radio-isotope: O^{15}

(Bolus injection of H_2O^{15})



Results



Foveal stimulation

Peripheral stimulation

Fox et al. (1988)

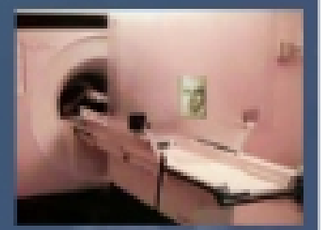
Advantage: has relatively good spatial resolution (order of cms)

Disadvantages

- Injection of Radioactive Isotopes
  - Cannot use same subject repeatedly
  - Needs to combine results from several subjects
  - No developmental studies
- Poor temporal resolution (40secs)!
- Expensive! (cyclotron)

fMRI

(functional magnetic resonance imaging)

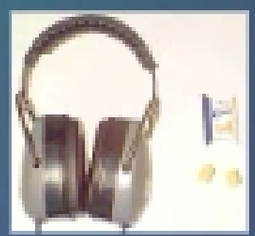


Advantages

- Harmless
  - Can use same subject repeatedly
  - Can look at single subject data (Individuality!)
    or can combine subjects together (population analysis)
  - Developmental studies allowed!
- Much better temporal resolution (about 1sec)
- Better spatial resolution (less than 1 cm)
- Much more accessible, affordable.
- Can get both anatomical and functional data in the same session

Some disadvantages

MRI is noisy...



...and magnetic!...

...and can be claustrophobic