

NEURAL COMPUTATION

Prof. Alexander Huth

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TODAY

- * Paper presentation: “Broca and Wernicke are Dead”
- * Finish brain activity methods
- * Experimental design
 - * Goal
 - * Deductive approach

SOURCES OF SIGNAL

- * Electric fields
- * Calcium concentration
- * Metabolism (e.g. glucose uptake)
- * Blood oxygen level dependent (**BOLD**)

FMRI: Functional Magnetic Resonance Imaging



Advantages

Good spatial resolution (~ 3 mm)

Inherently 3D

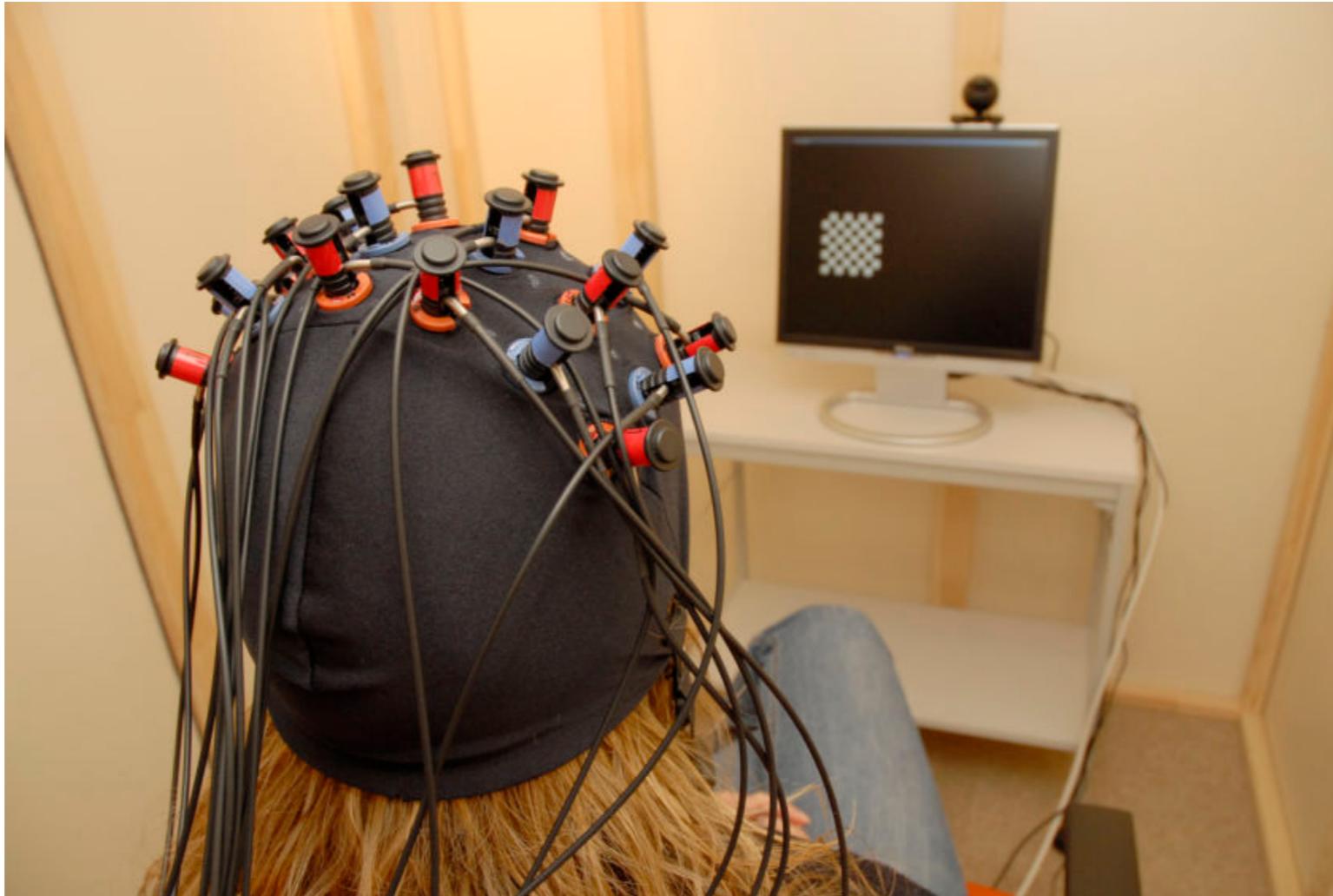
Disadvantages

Very expensive & complicated

Poor temporal resolution (> 1 s)

Does not measure neural activity

NIRS: Near-infrared spectroscopy



Neuper & Pfurtscheller, 2010

Advantages

Relatively simple and cheap

Inherently 2D

Disadvantages

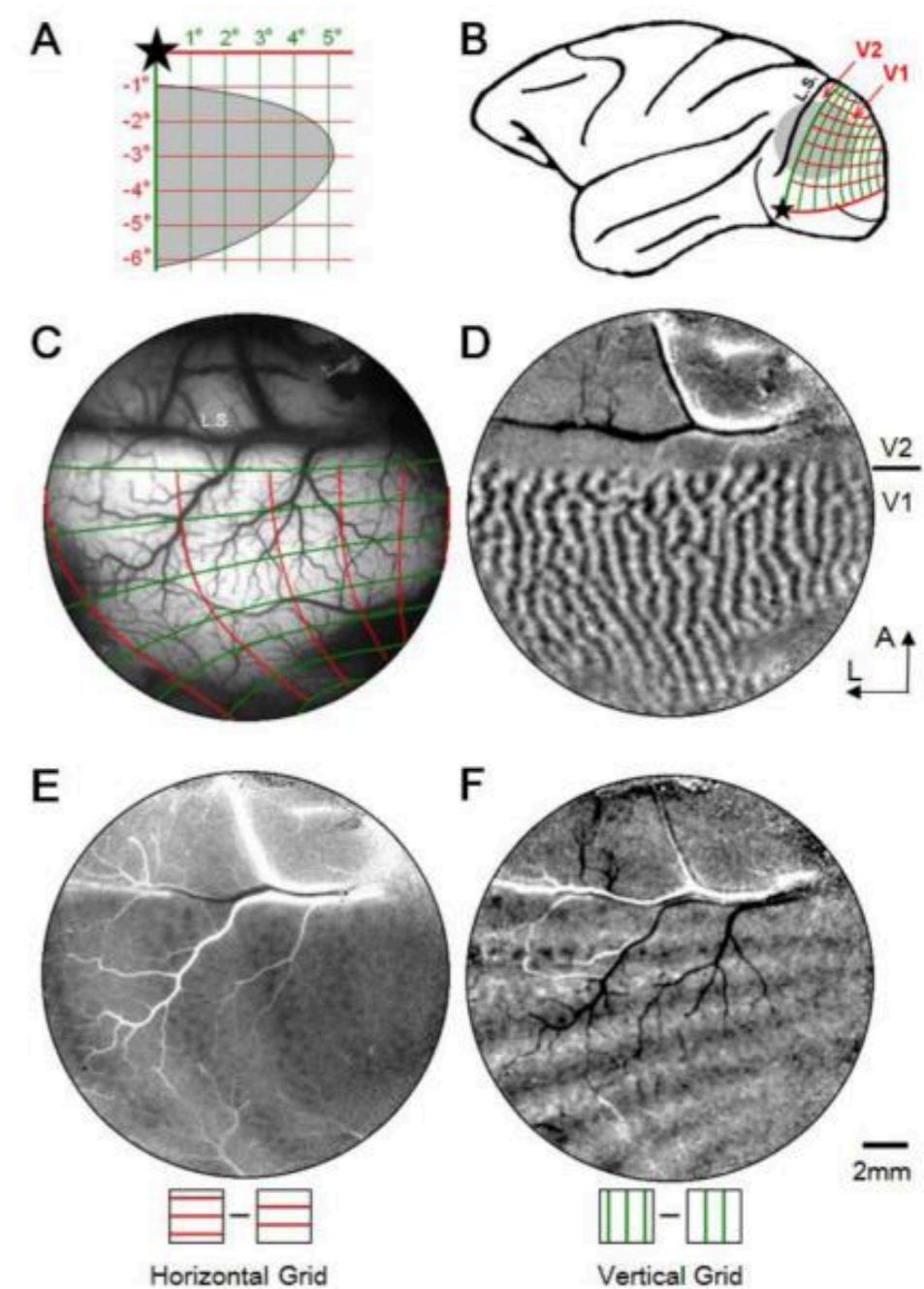
Poor signal quality

Bad spatial resolution (> 3 cm)

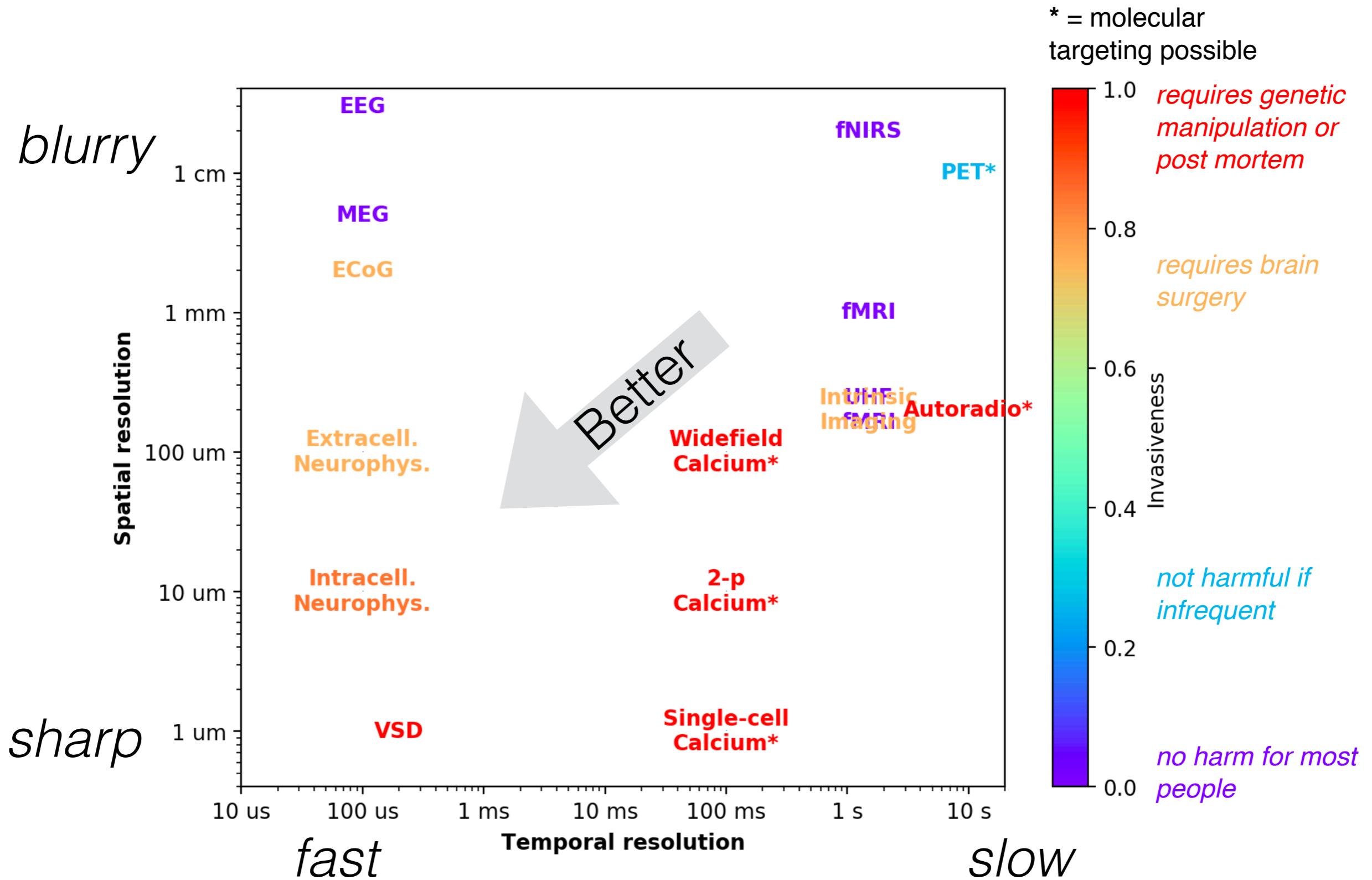
Doesn't measure neural activity

INTRINSIC SIGNAL IMAGING

- * Oxygenated and deoxygenated blood reflect & absorb different wavelengths of light
- * If you can see the brain:
 - * Shine IR light of the right wavelength
 - * Record reflectance

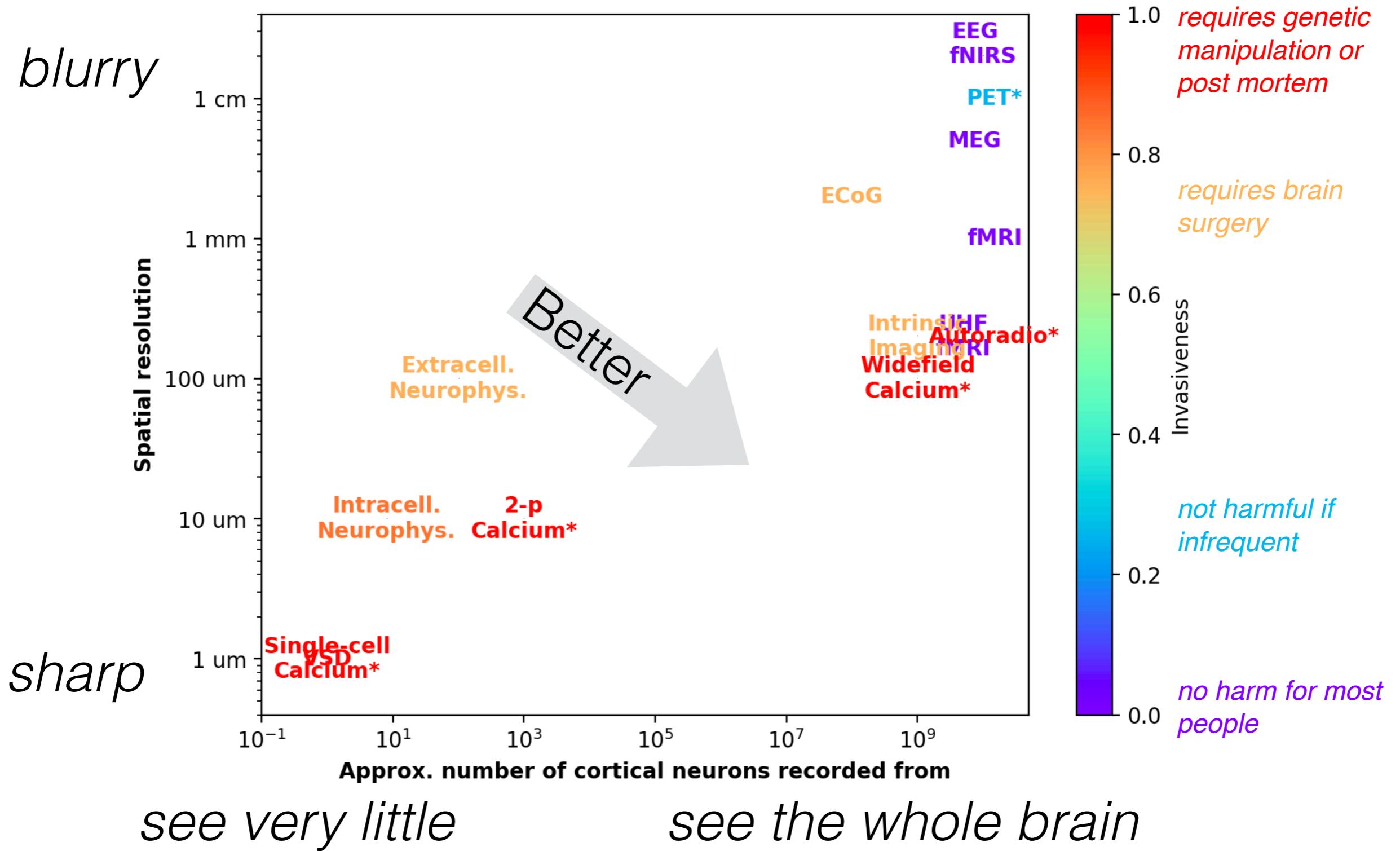


NEURO METHODS



NEURO METHODS

* = molecular targeting possible

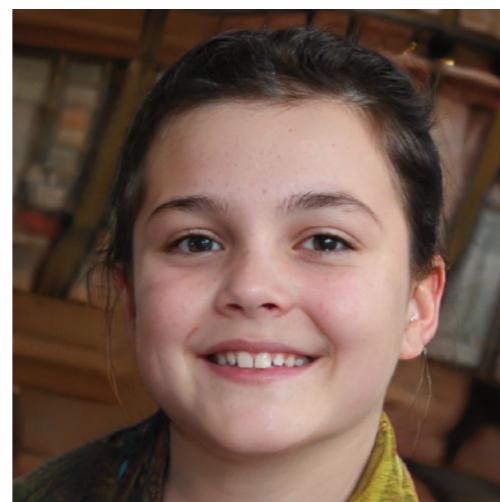


**THERE IS NO PERFECT
METHOD FOR MEASURING
NEURAL ACTIVITY**

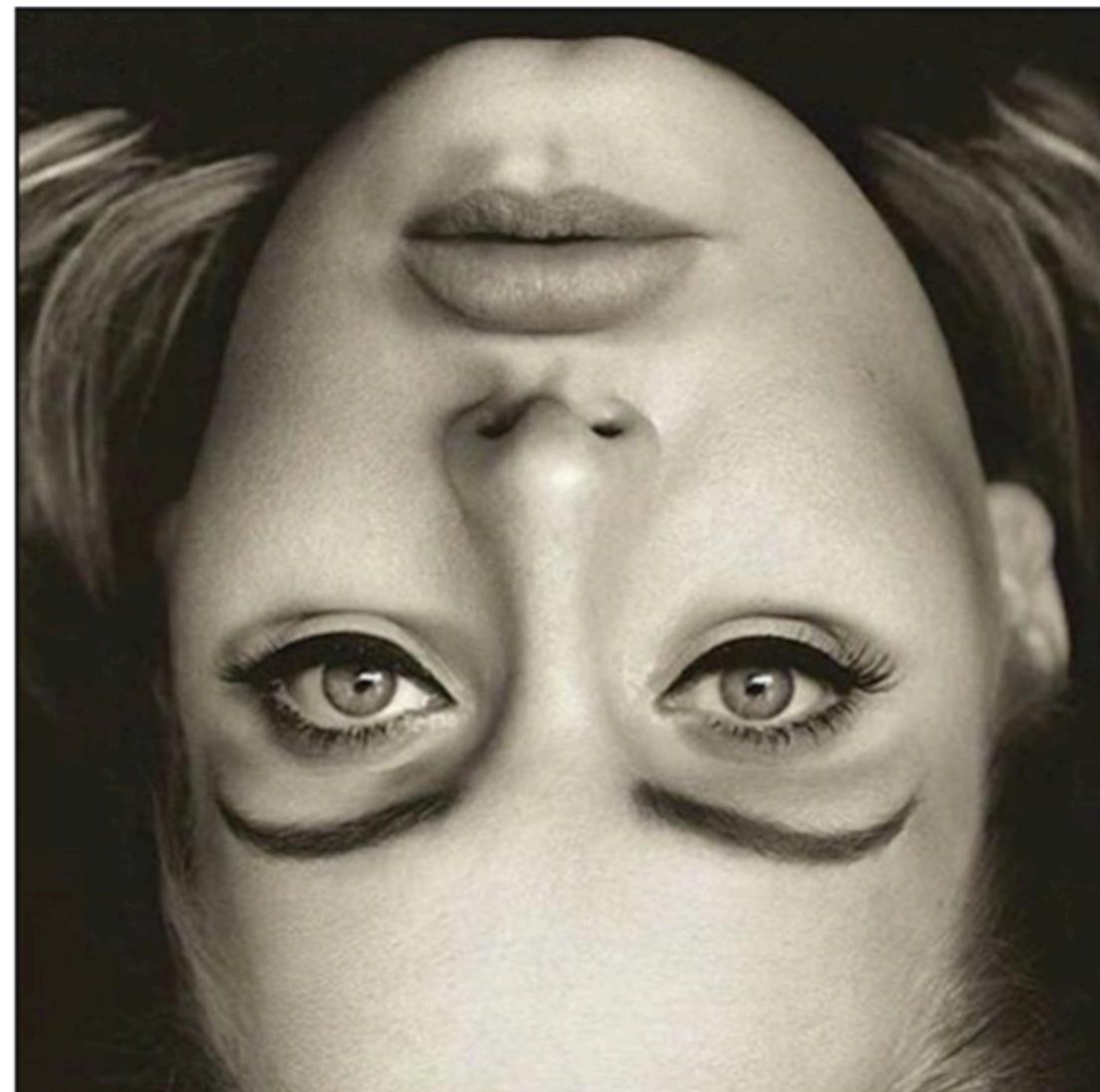
EXPERIMENTAL DESIGN

GOAL?

- * Suppose there is a neural circuit that we want to understand
- * *Example: The human face processing network*



FACE PROCESSING



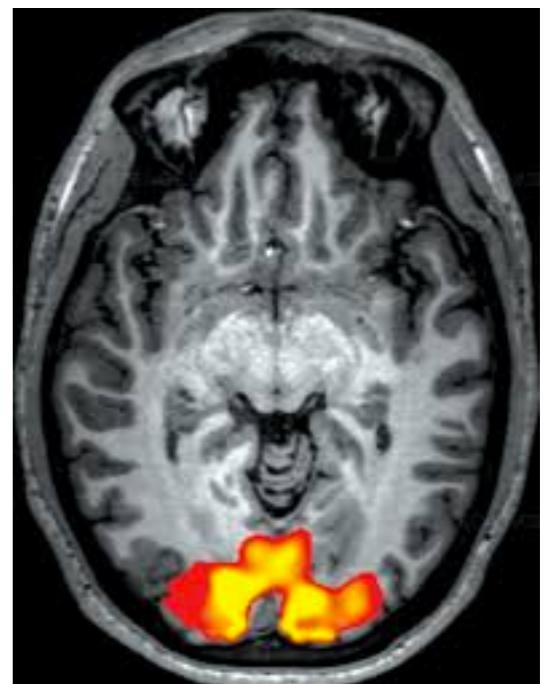
GOAL?

- * *Example: The human face processing network*
 - * **What questions do we want to ask?**
 - * **What experiments can we do to answer those questions?**
 - * **What would success look like?**

LOCALIZATION

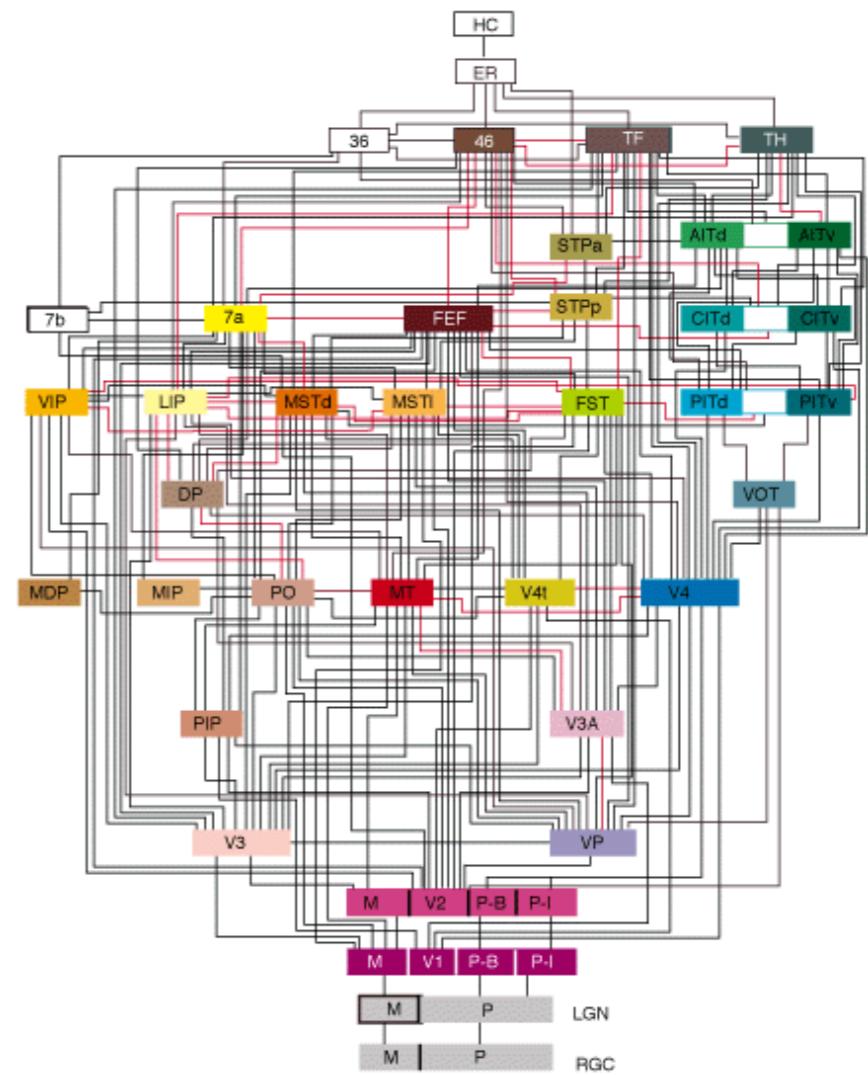
- * One experiment we could do:
 - * record brain activity while subjects look at pictures of faces
- * What's the problem here?

Result:



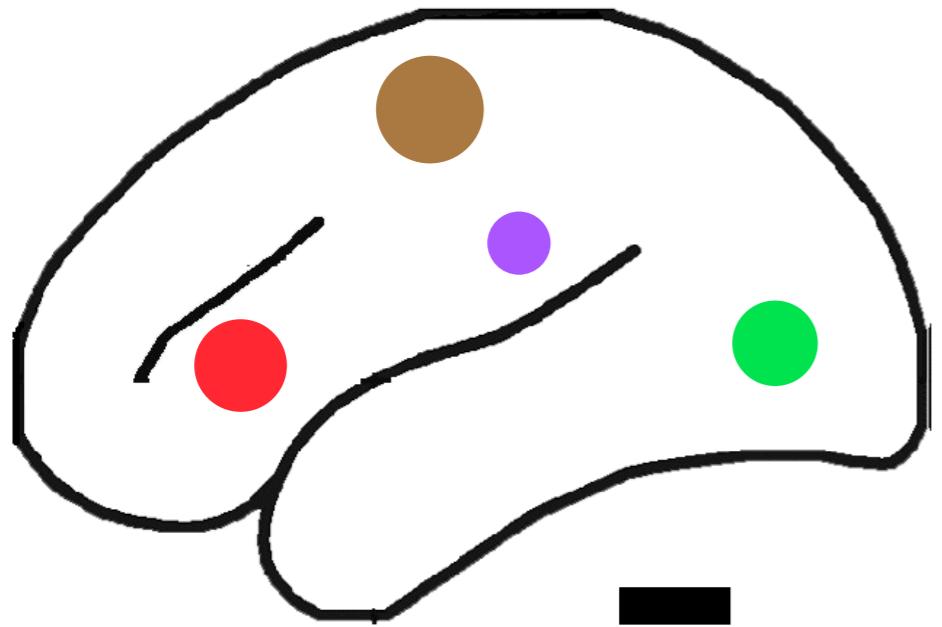
LOCALIZATION

- * Looking at faces causes many parts of the visual system to become active
- * But which parts are specific to faces?

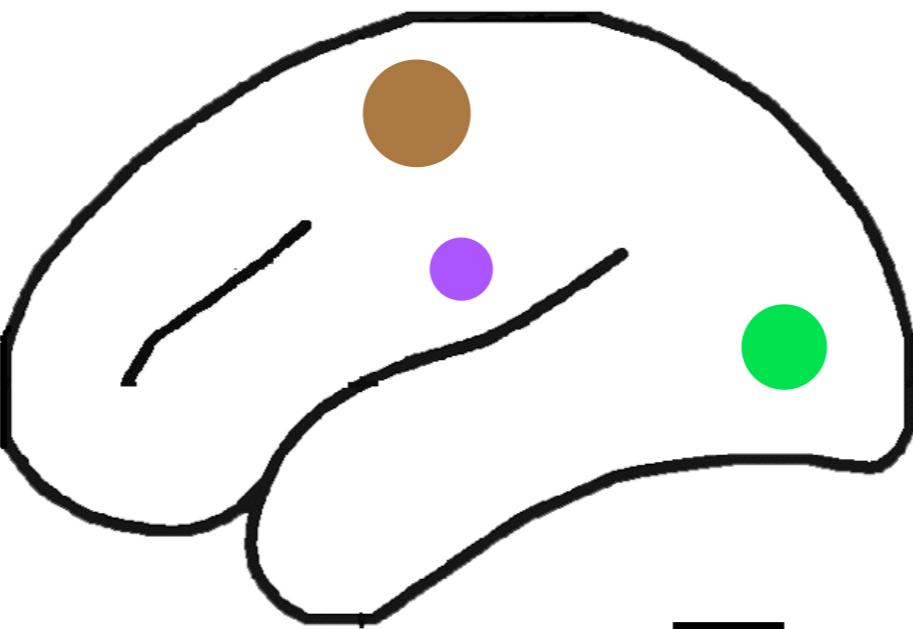


DEDUCTIVE APPROACH

- * the “**contrast method**”
aka “**localizer method**”
aka “**subtraction method**”
- * Subtract response in **control condition** from response in **experimental condition**
- * Use some **statistical method** to determine whether difference in response is **significant**

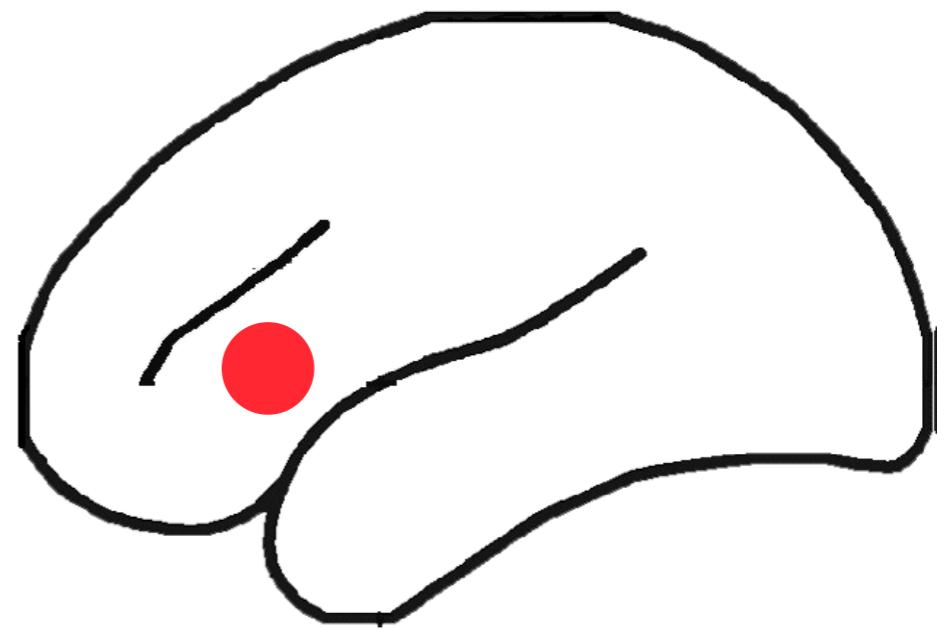


Task



Control

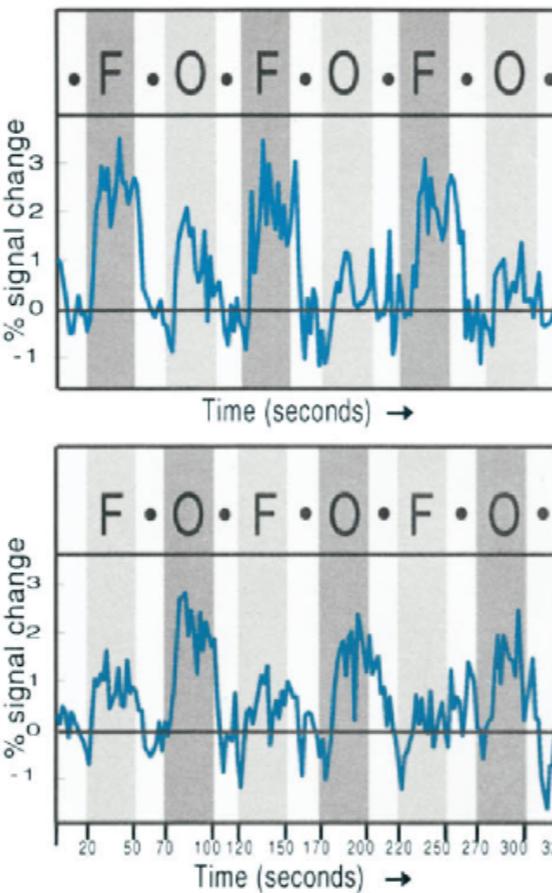
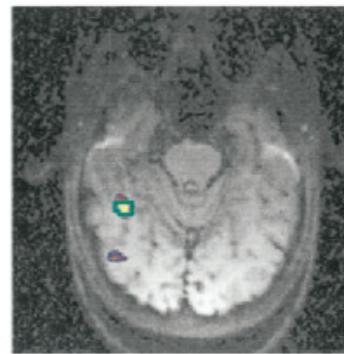
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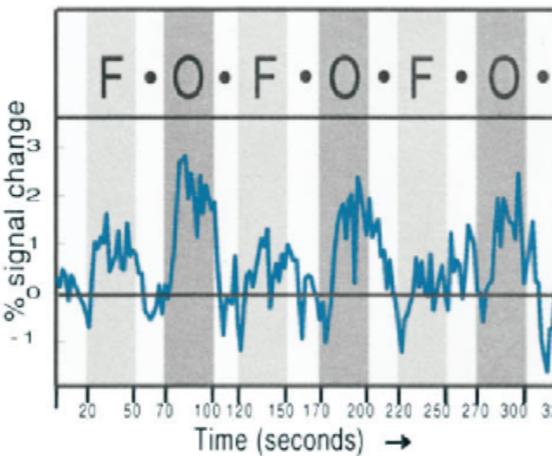
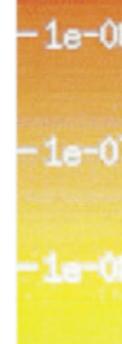
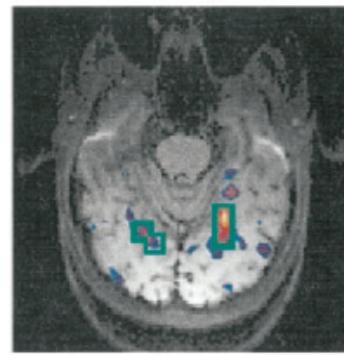
Difference

Functional localizer for the fusiform face area

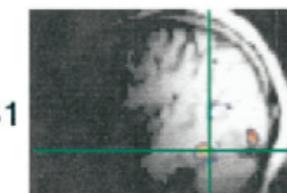
1a. Faces > Objects



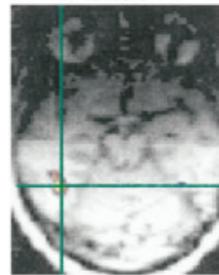
1b. Objects > Faces



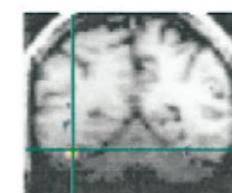
Sagittal



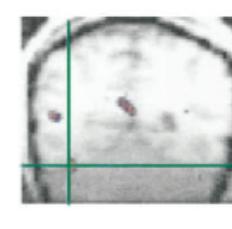
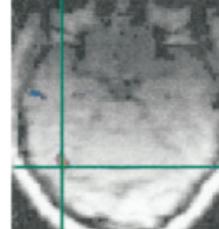
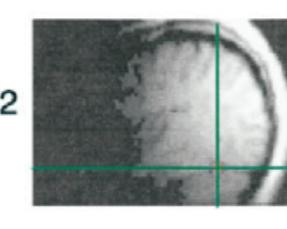
Axial



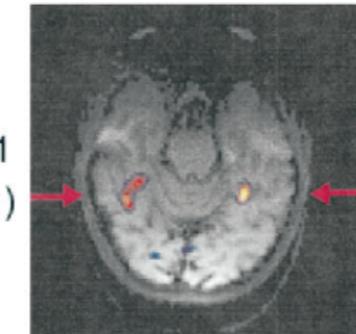
Coronal



S2



S11
(Lh)



S12
(Lh)

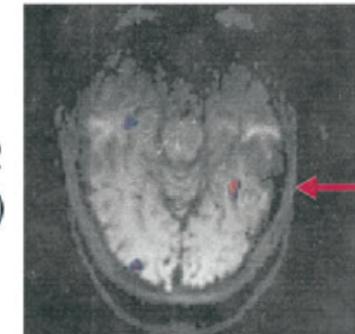
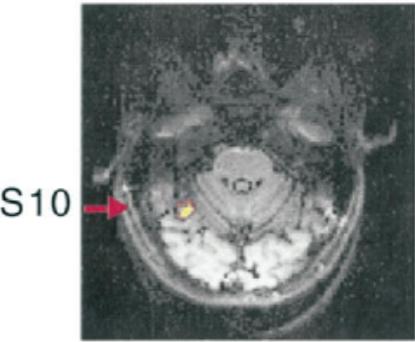
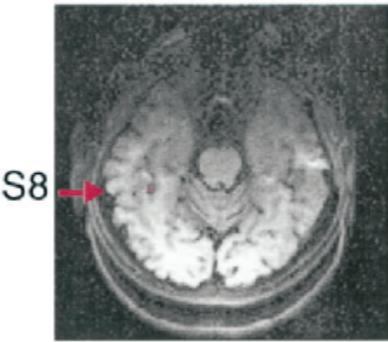
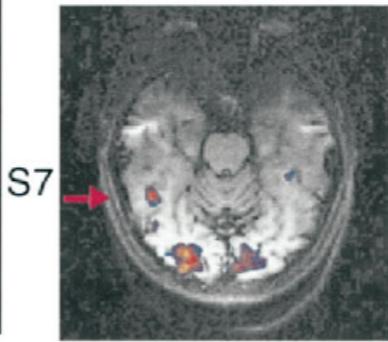
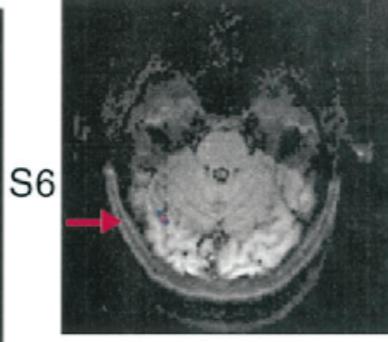
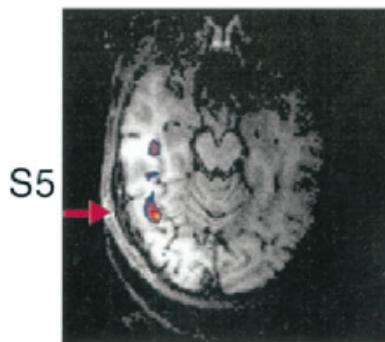
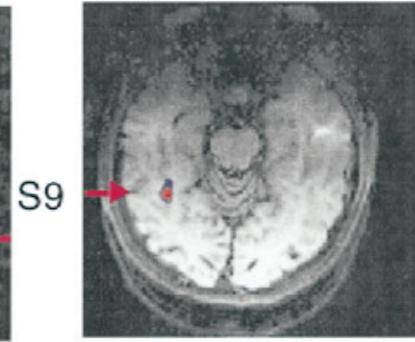
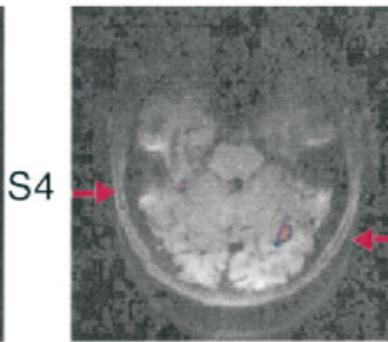
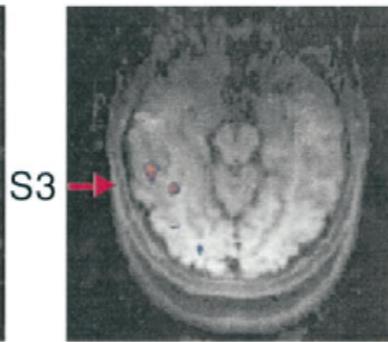
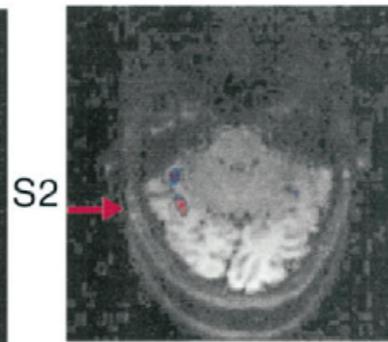
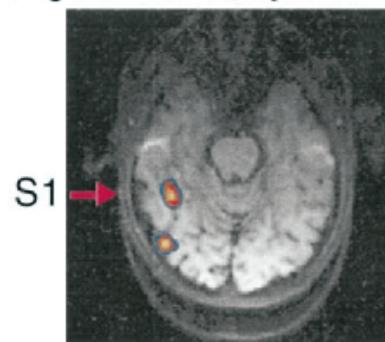
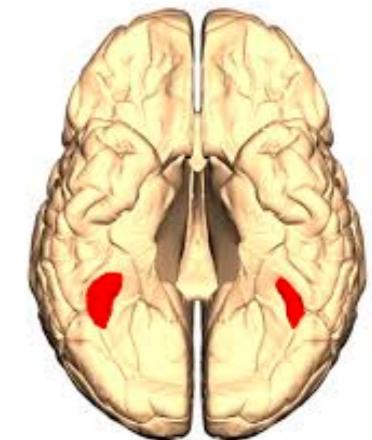


Fig 2. 12 Subjects



LOCALIZATION



- * What have we learned from finding the fusiform face area (FFA)?
- * What more do we want to know?