

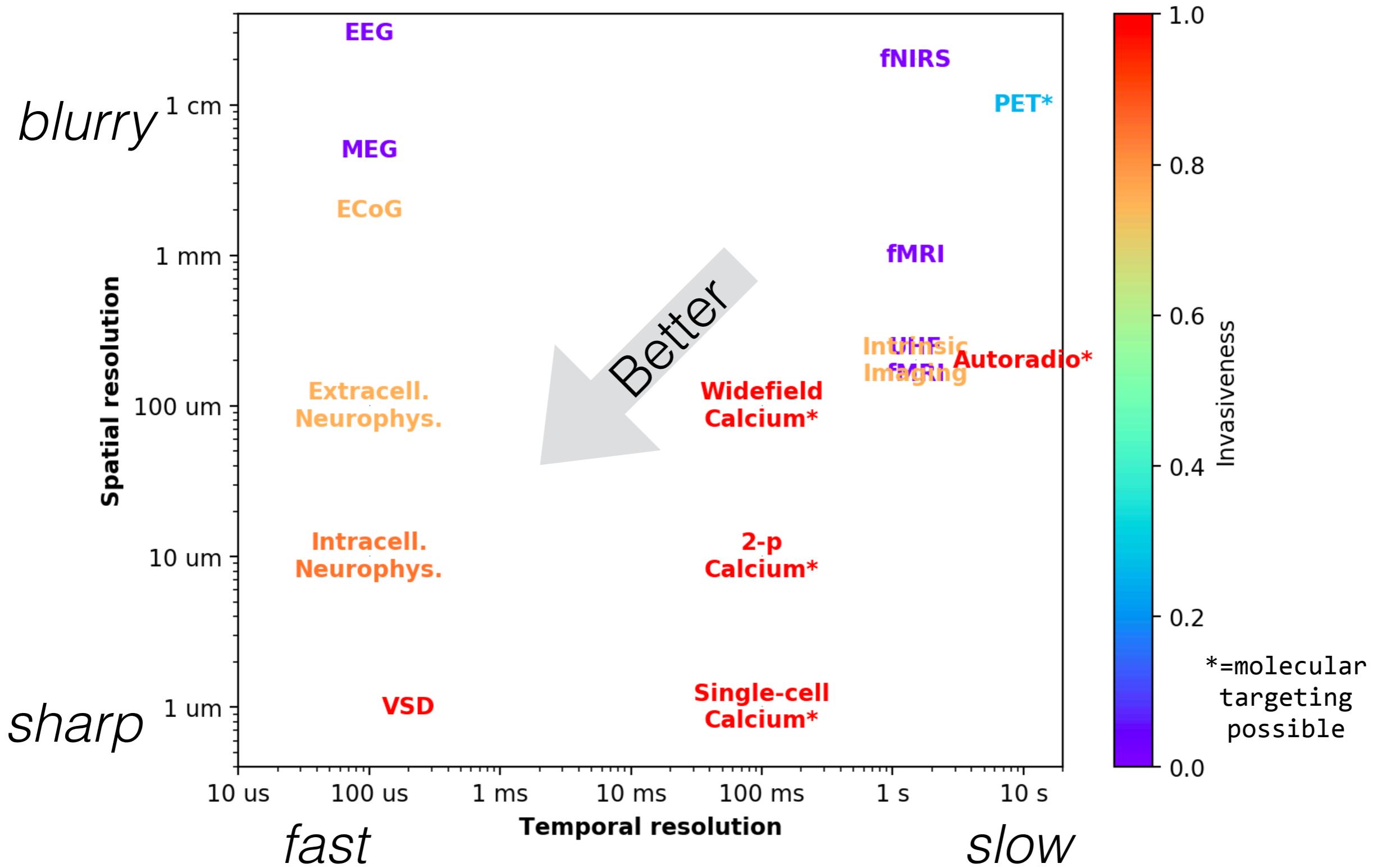
EXPERIMENTAL DESIGN

Prof. Alexander Huth
2/11/2020

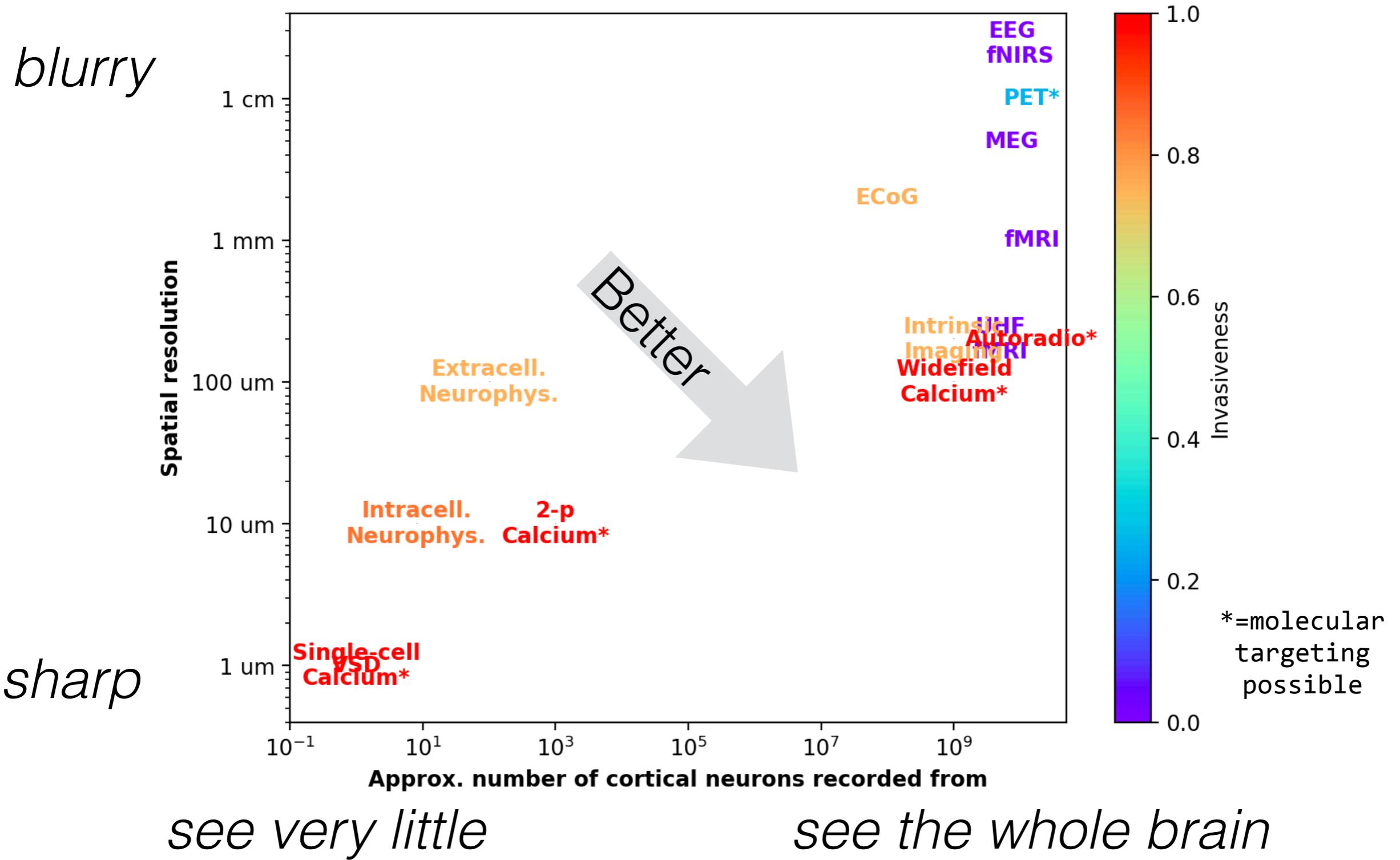
LAST TIME

- * methods for measuring brain activity

NEURO METHODS



NEURO METHODS

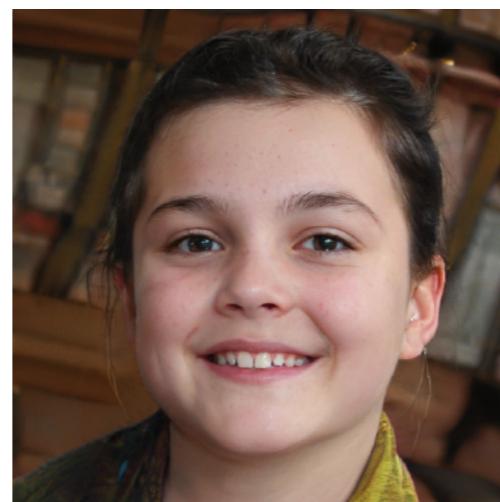


TODAY

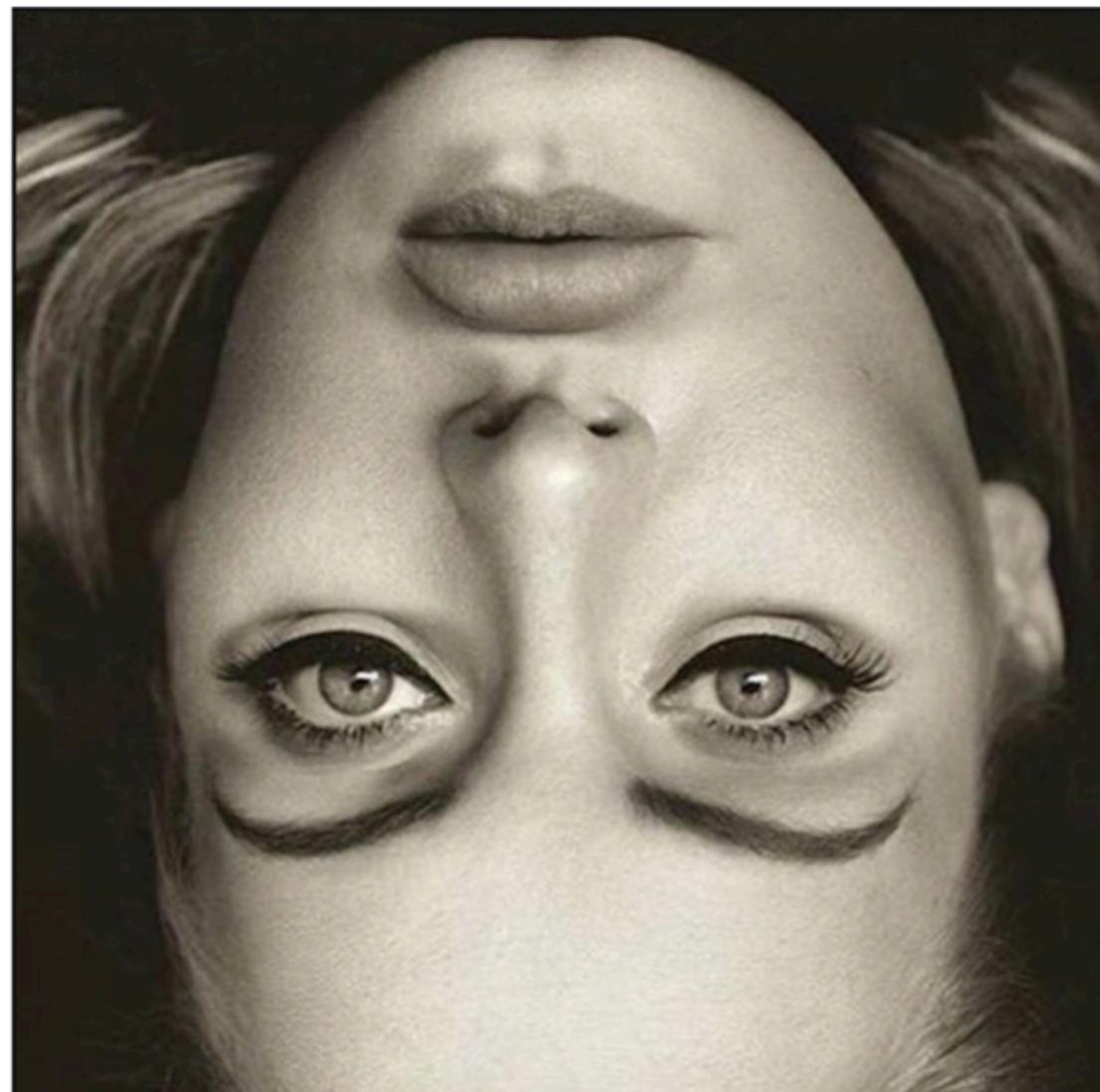
- * Experimental design
 - * Goal
 - * Deductive approach
 - * Inductive approach
 - * Natural stimuli

GOAL?

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



FACE PROCESSING



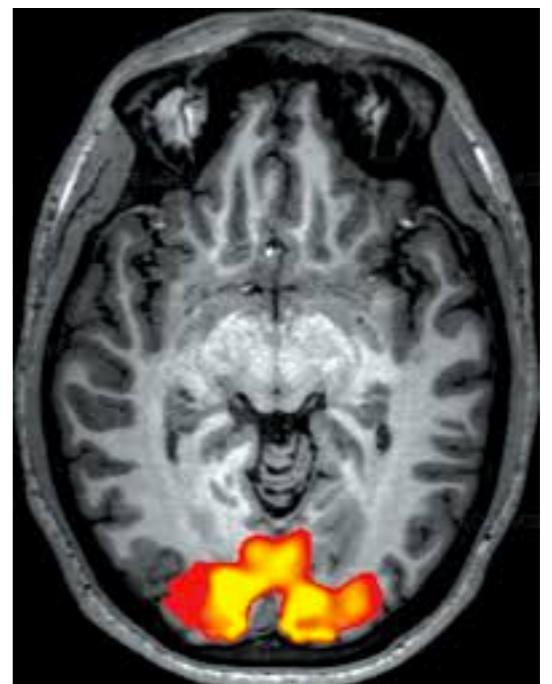
GOAL?

- * *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

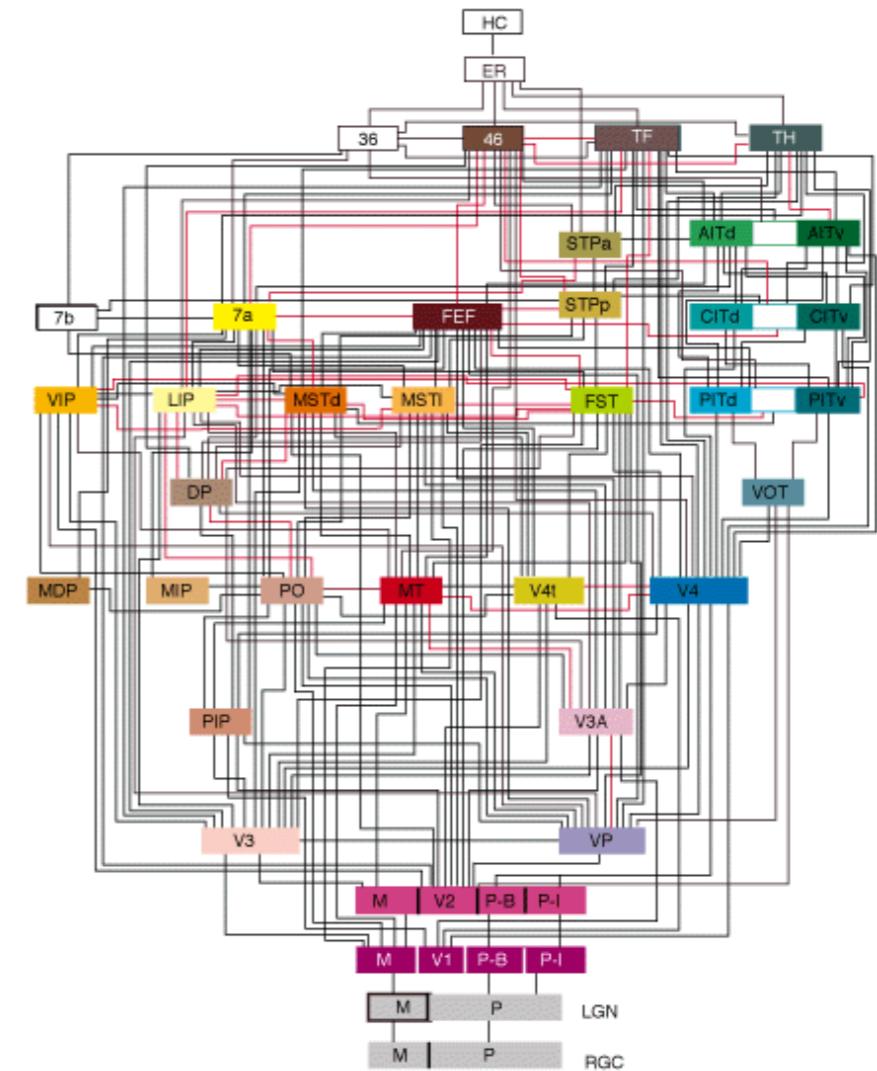
- * One experiment we could do:
 - * record brain activity while subjects look at pictures of faces
- * What's the problem here?

Result:



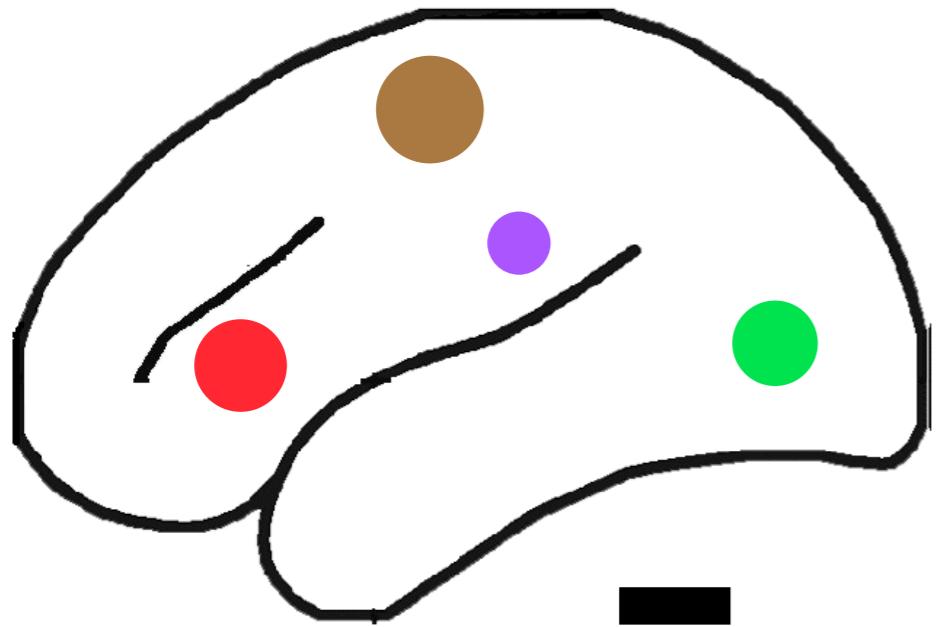
LOCALIZATION

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

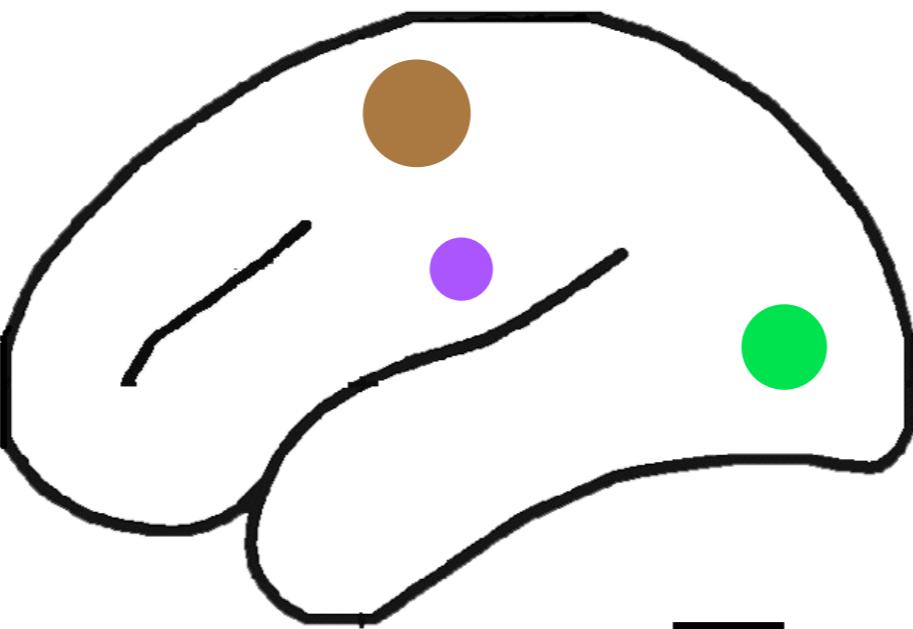


DEDUCTIVE APPROACH

- * 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**

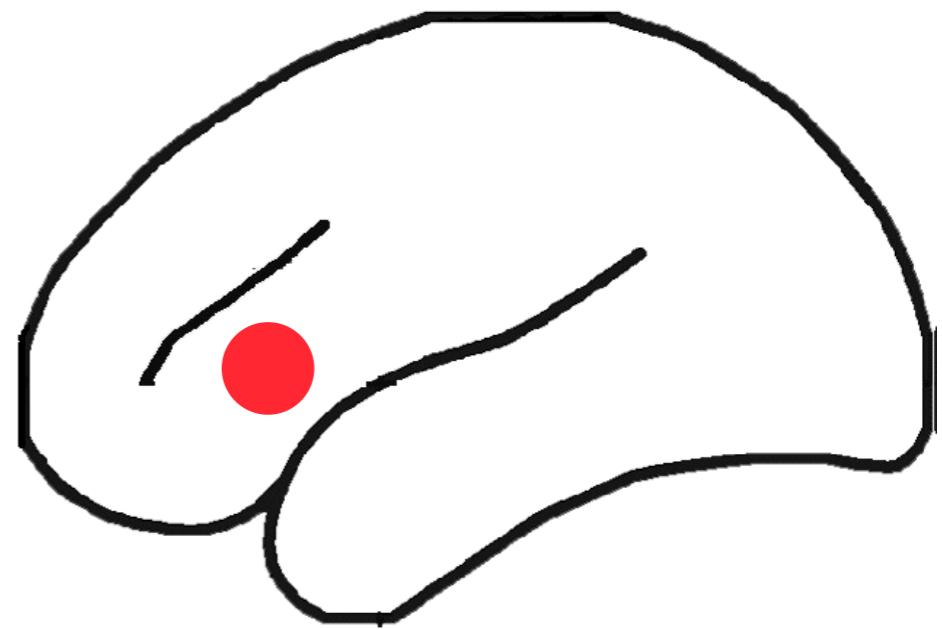


Task



Control

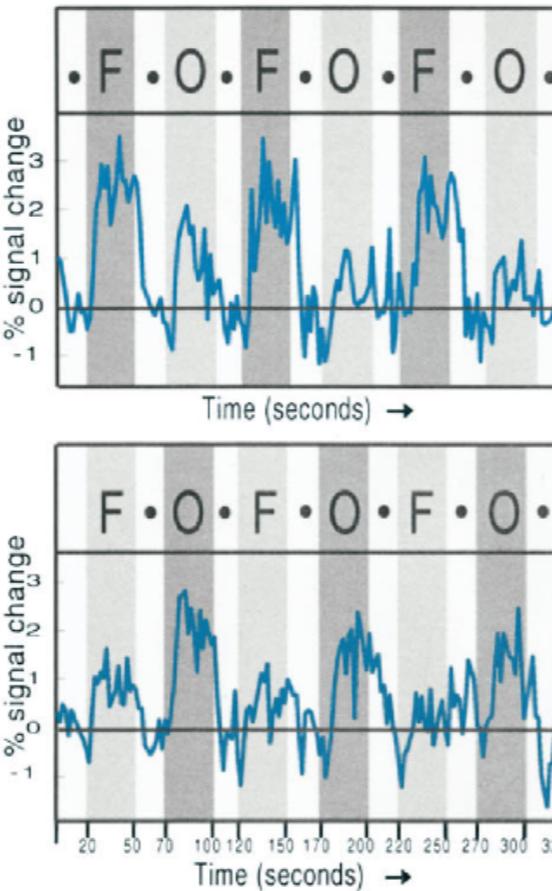
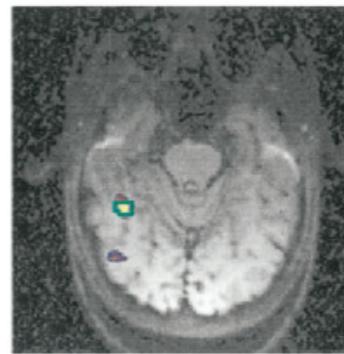
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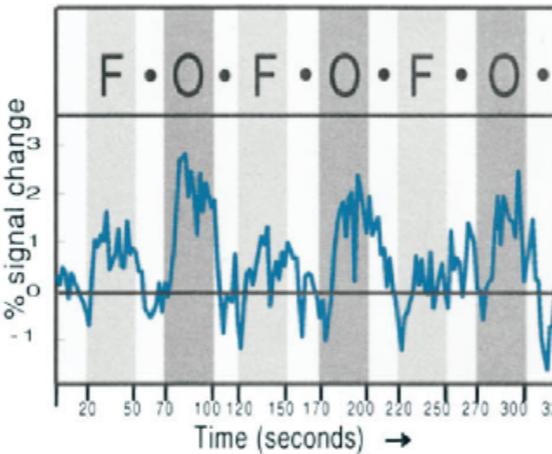
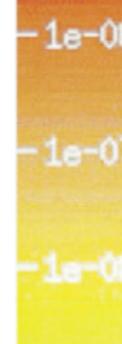
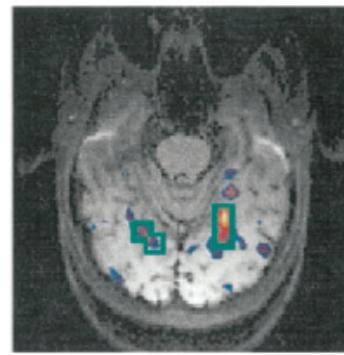
Difference

Functional localizer for the fusiform face area

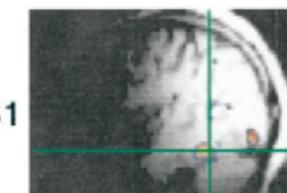
1a. Faces > Objects



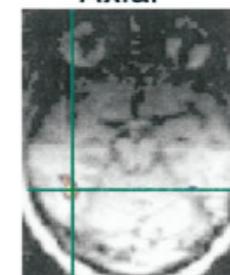
1b. Objects > Faces



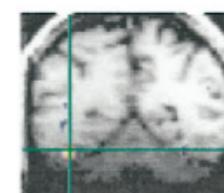
Sagittal



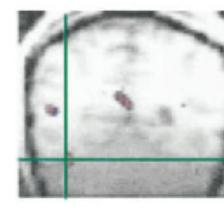
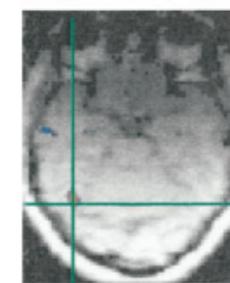
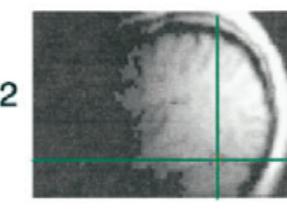
Axial



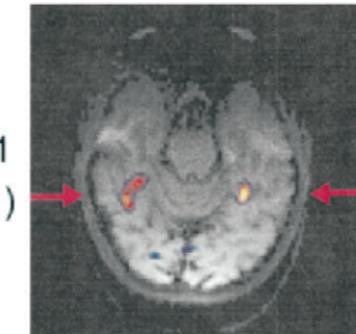
Coronal



S2



S11
(Lh)



S12
(Lh)

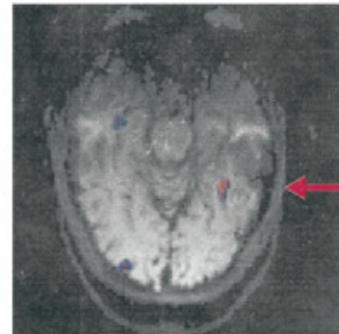
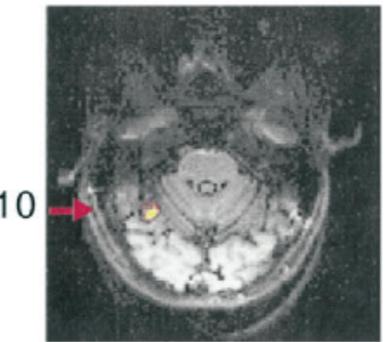
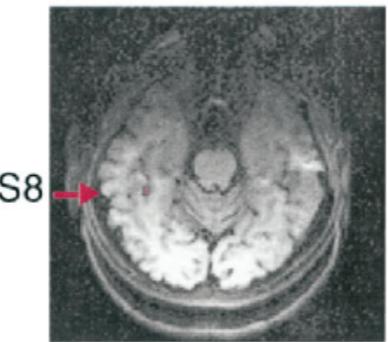
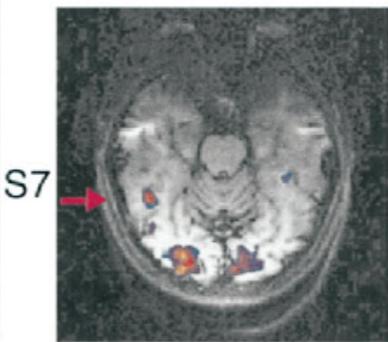
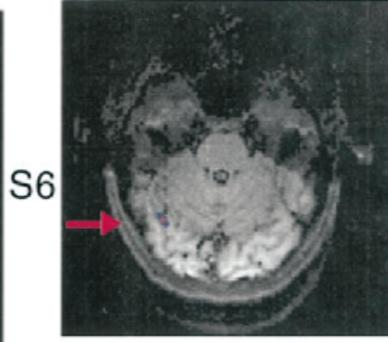
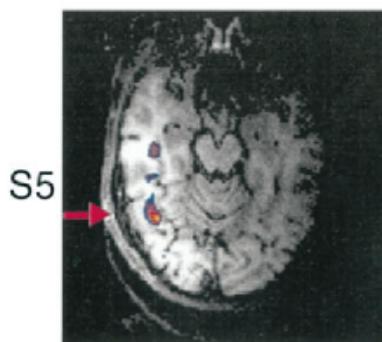
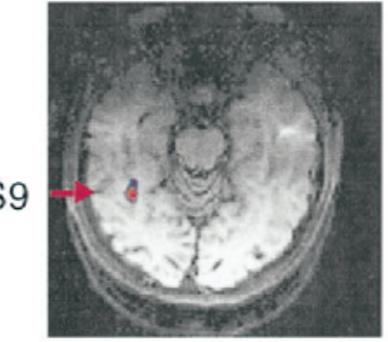
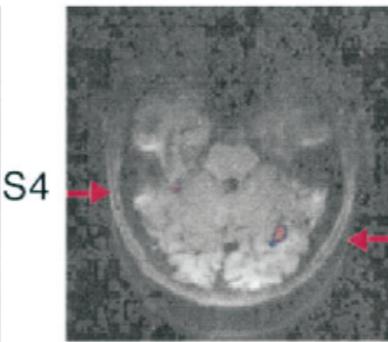
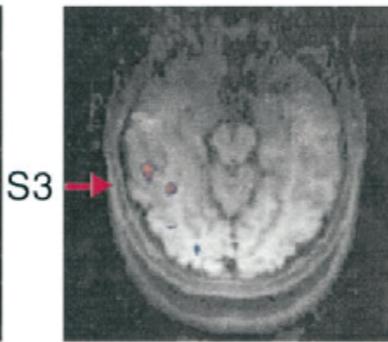
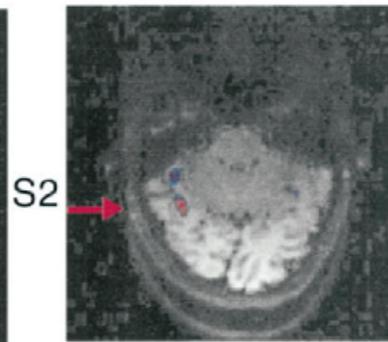
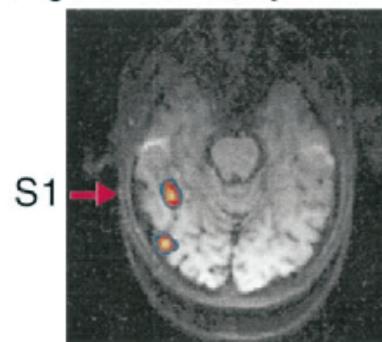
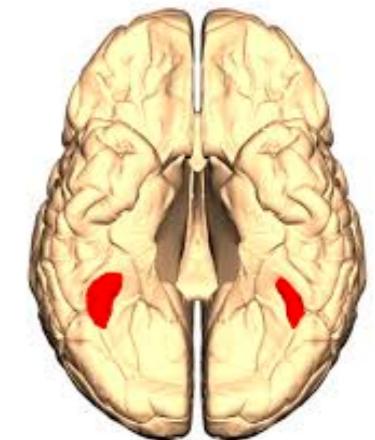


Fig 2. 12 Subjects



LOCALIZATION



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

LIMITS OF DEDUCTION

- * Each experiment is designed to a small number of hypotheses
- * What if truth doesn't clean map onto these hypotheses?
- * What if the result doesn't generalize?

INDUCTIVE APPROACH

- * **Measure** brain responses to a wide variety of stimuli
- * **Build** model to predict responses based on stimuli
- * **Test** whether model generalizes to different stimuli
- * **Use** model to answer questions about brain

NATURAL STIMULI

THIS:

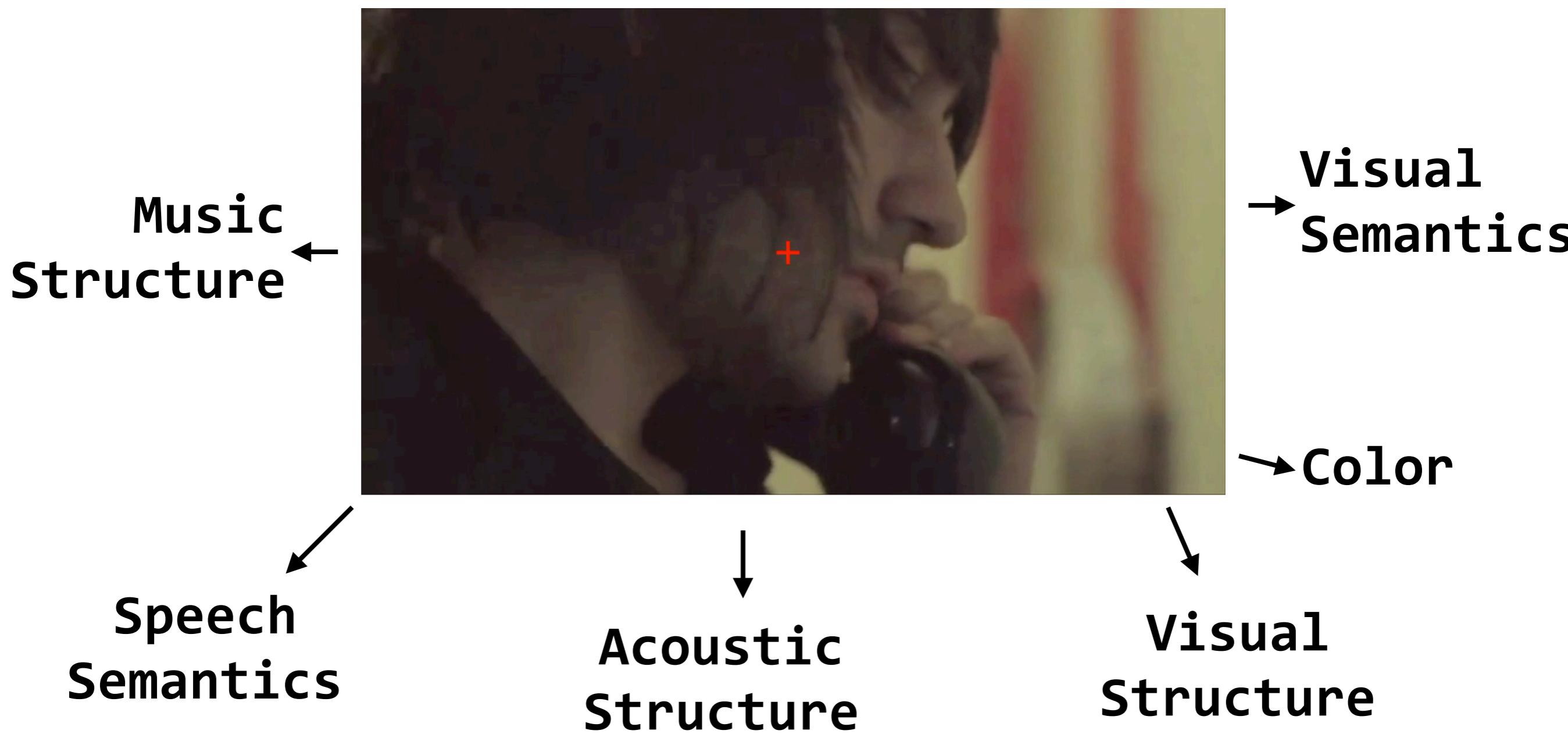


NOT THIS:

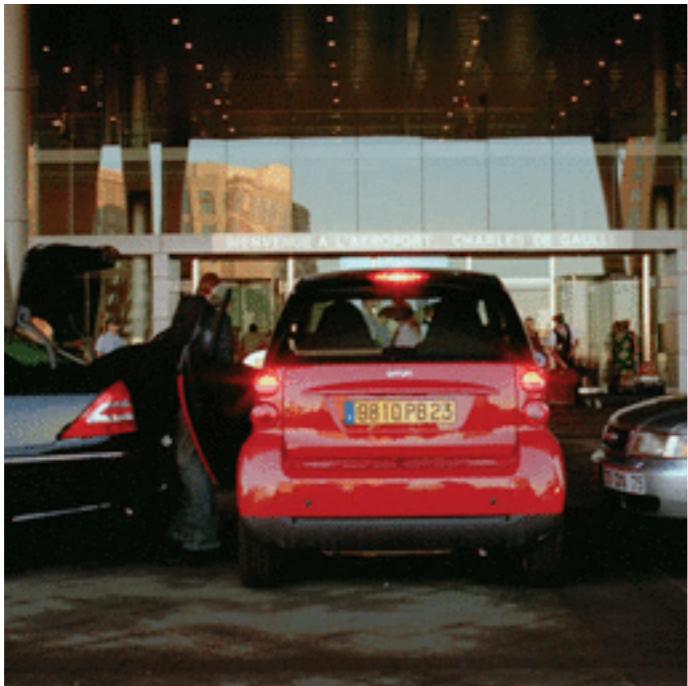
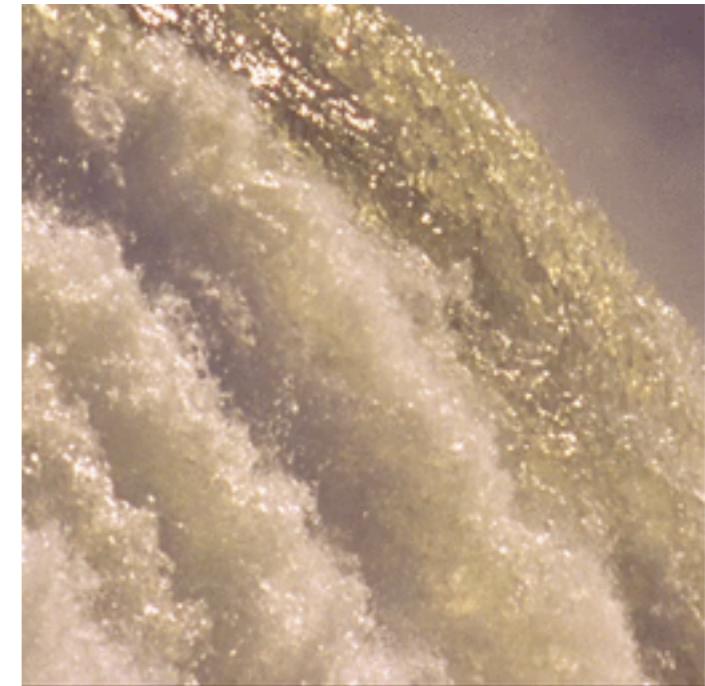
chairs



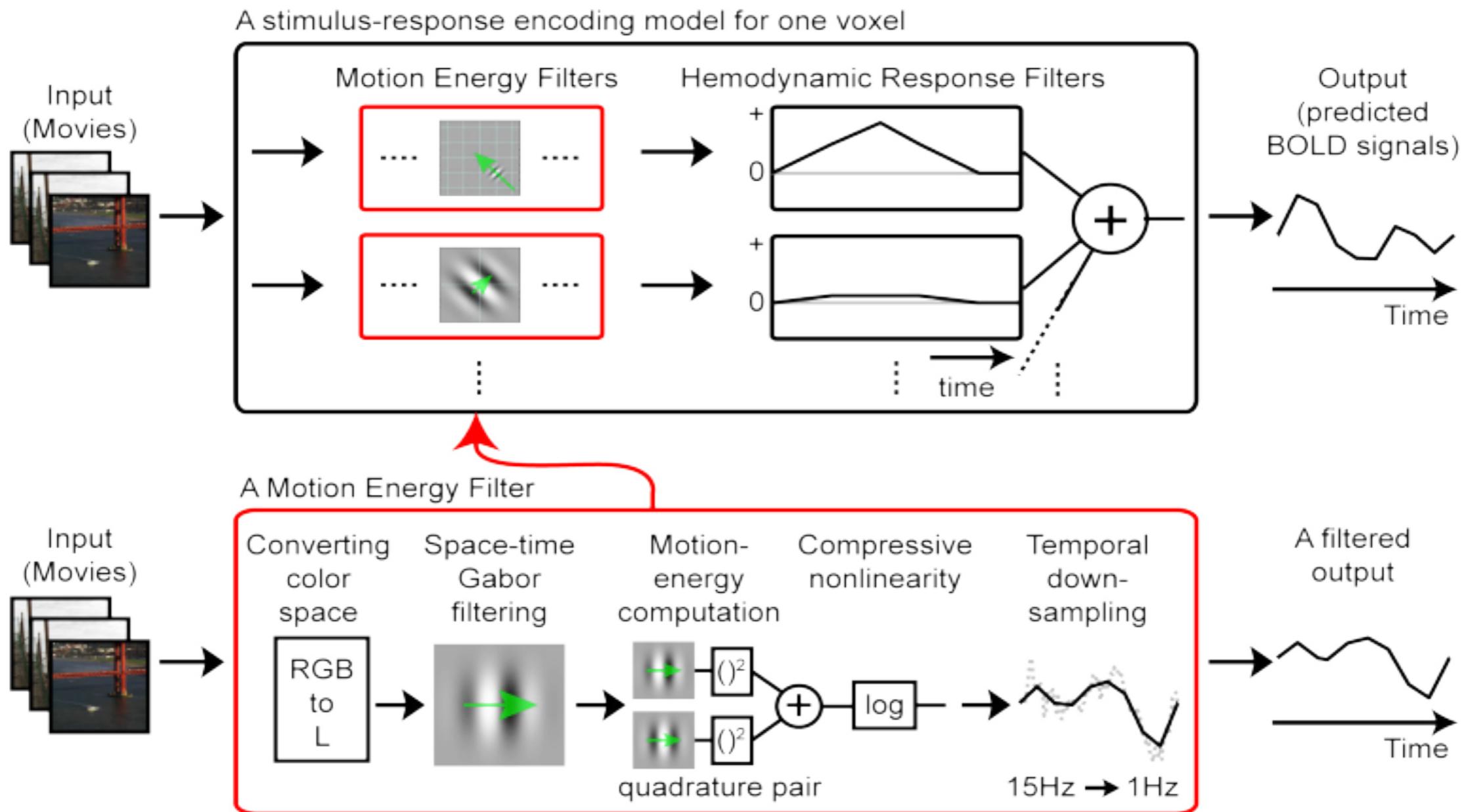
NATURAL STIMULI ANSWER MANY QUESTIONS



EXAMPLE: VIDEOS



EXAMPLE: VIDEOS



EXAMPLE: VIDEOS

Image

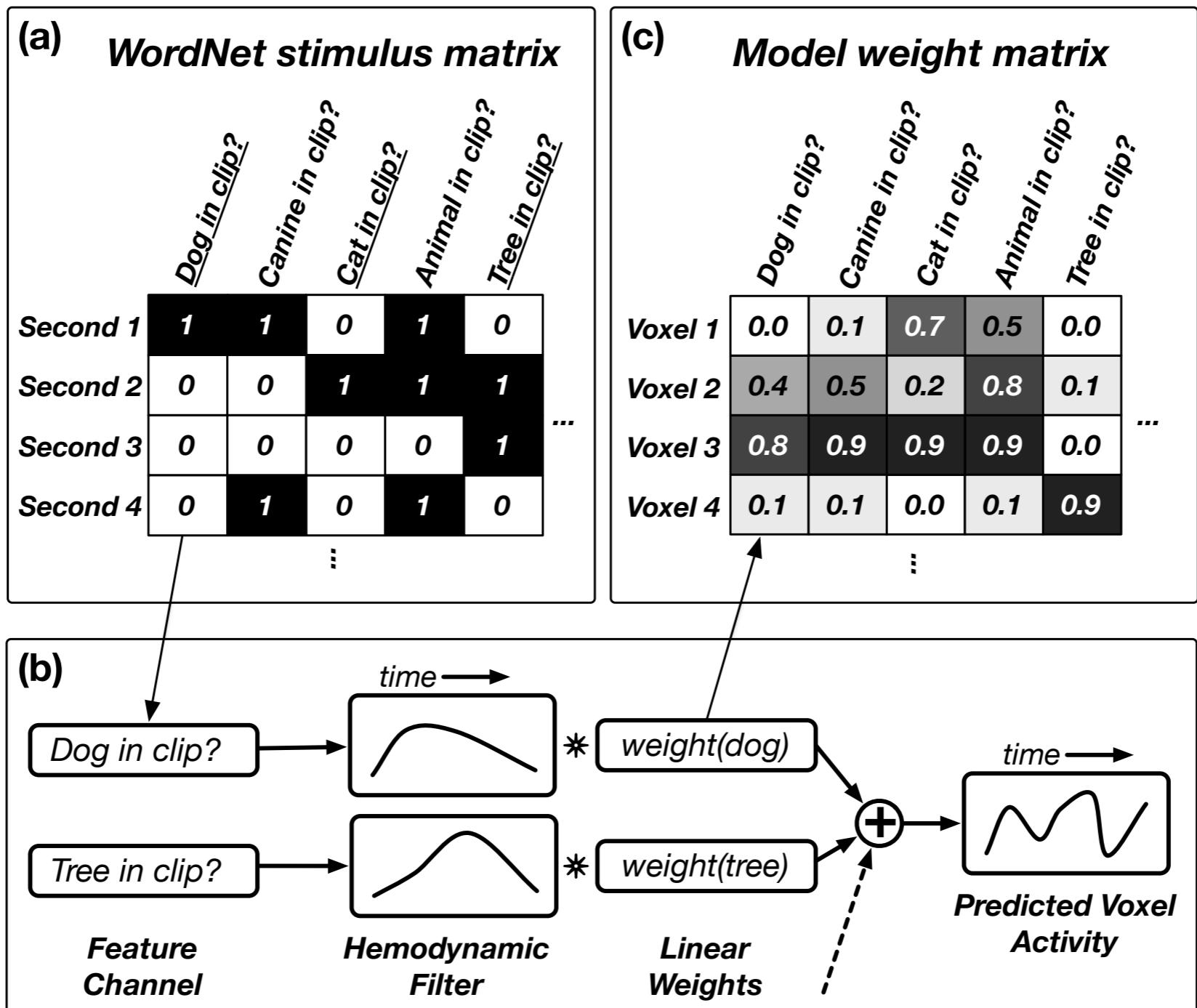


Presented movie

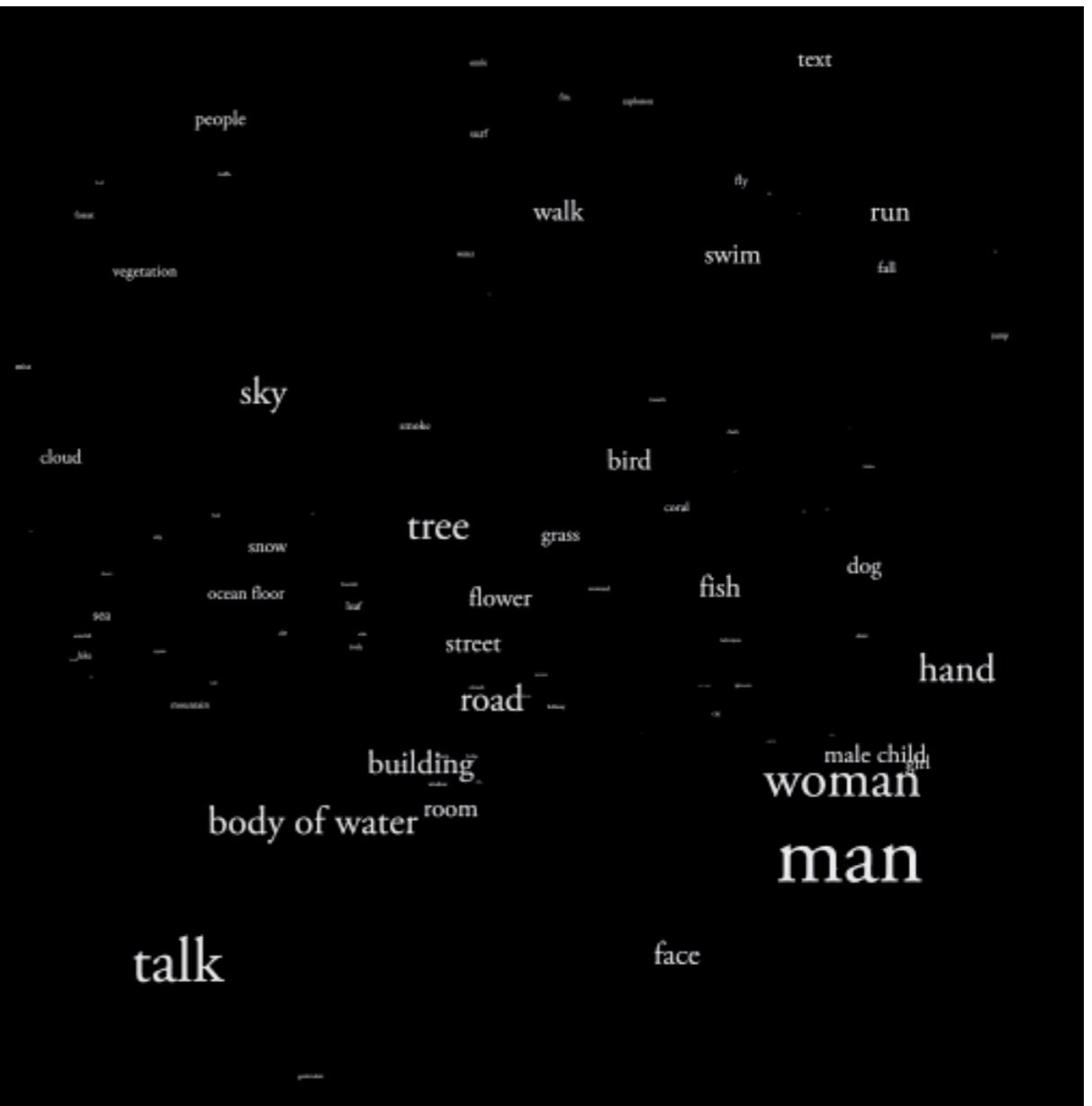
Decoded movie



EXAMPLE: VIDEOS 2



EXAMPLE: VIDEOS 2



NATURAL STIMULI: WHY NOT?

- variables of interest are *confounded* with other variables!
- variables of interest are *correlated* with each other!

CONFOUNDS?

- *Traditional, controlled experiment:*
 - Confounds are baked into design
 - Confounds can be perfectly correlated with design
- *Natural stimuli:*
 - Confounds are just *other variables*
 - If confounds are perfectly correlated in natural stimuli...

RECAP

- * Deductive, hypothesis-driven experiments are good at answering a few questions
- * Inductive, data-driven experiments are okay at answering many questions

NEXT TIME

- * System identification!