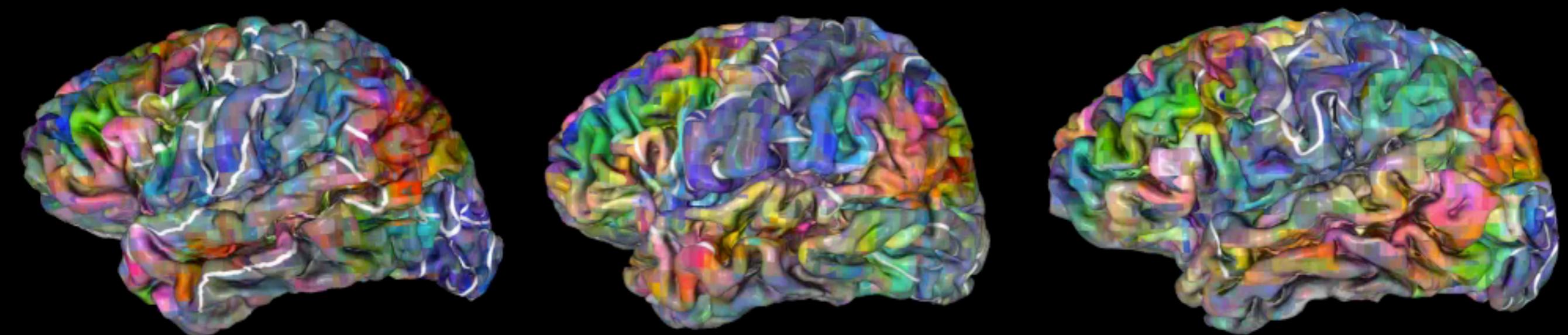


NEURO DATA ANALYSIS IN PYTHON (NEU 337)

Prof. Alexander Huth
8/29/2018

NEURO DATA ANALYSIS IN PYTHON



BACKGROUND

- * What do you need to know for this class?
(not that much don't worry about it)

TOPICS

- * What are you going to learn in this class?
 - * Python (*numpy, matplotlib, etc.*)
 - * Statistical methods (*hypothesis tests, bootstraps*)
 - * Timeseries analysis (*spectrogram, filtering*)
 - * (Un-)Supervised learning methods (*regression, clustering, etc.*)

MATERIALS

- * Two free(!) books
 - * <https://www.inferentialthinking.com/>
 - * [https://jakevdp.github.io/
PythonDataScienceHandbook/](https://jakevdp.github.io/PythonDataScienceHandbook/)

MATERIALS

- * Lecture slides will be posted on the course website

<https://github.com/alexhuth/ndap-fa2018>

SYLLABUS

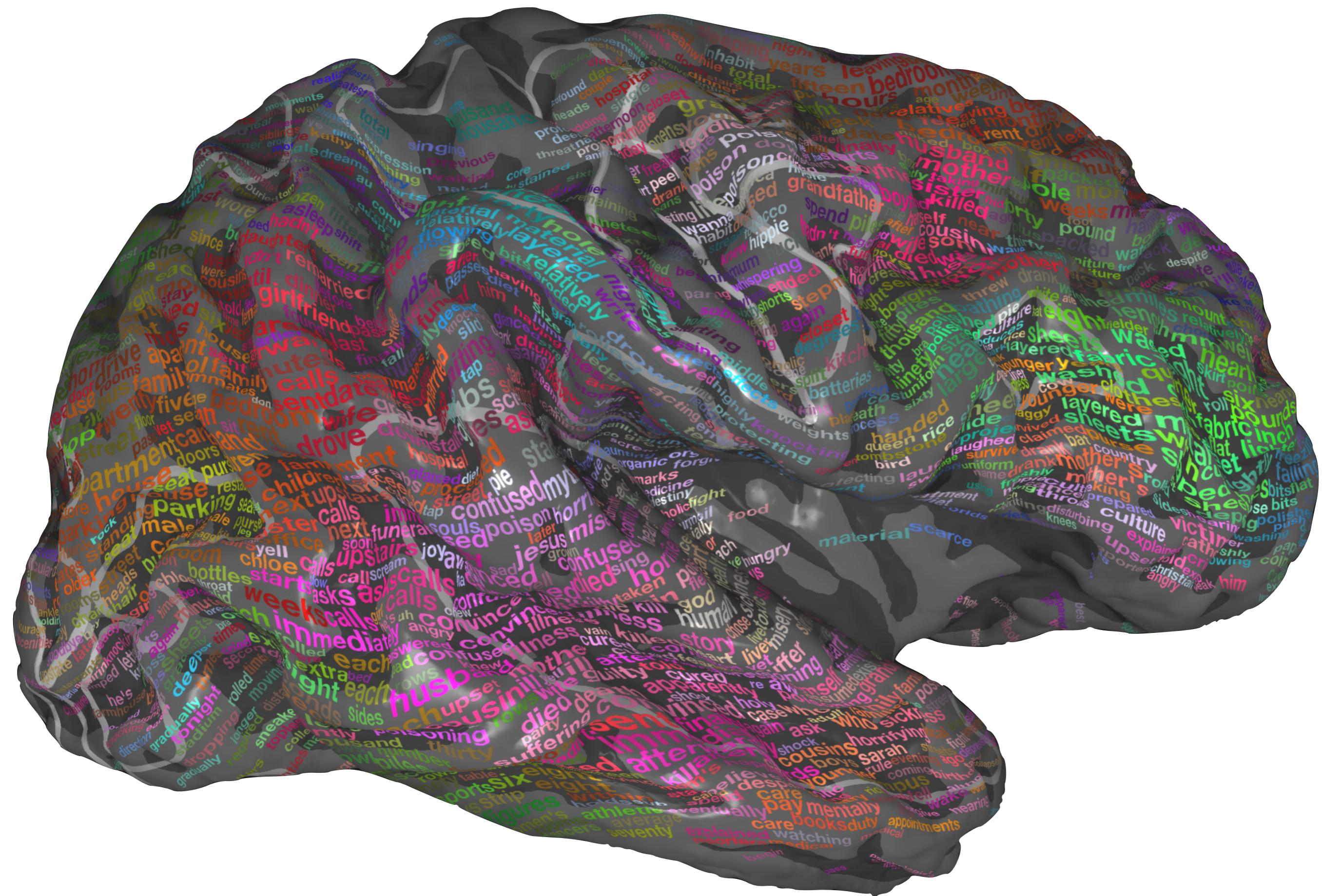
- * <https://github.com/alexhuth/ndap-fa2018>

FORMAT

- * 7 homeworks (60% of grade)
- * final exam (30% of grade)
- * class participation (10% of grade)

PROFESSOR

- * Me! Alex Huth
- * Office hours: MW 1:30-3:00pm @ NHB 3.134



NATURAL LANGUAGE EXPERIMENT

Language fMRI data

2.5h narrative stories from

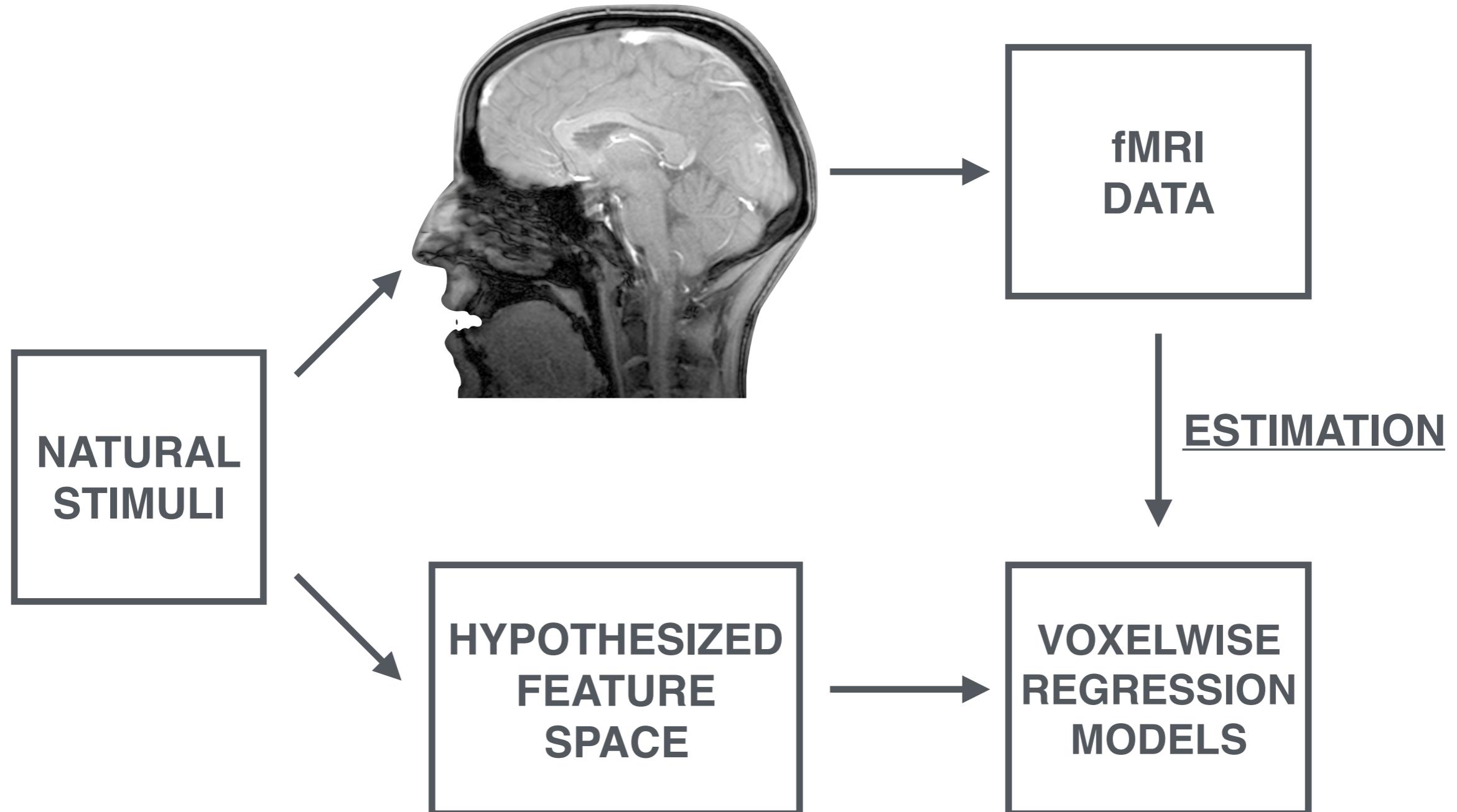
The Moth Radio Hour



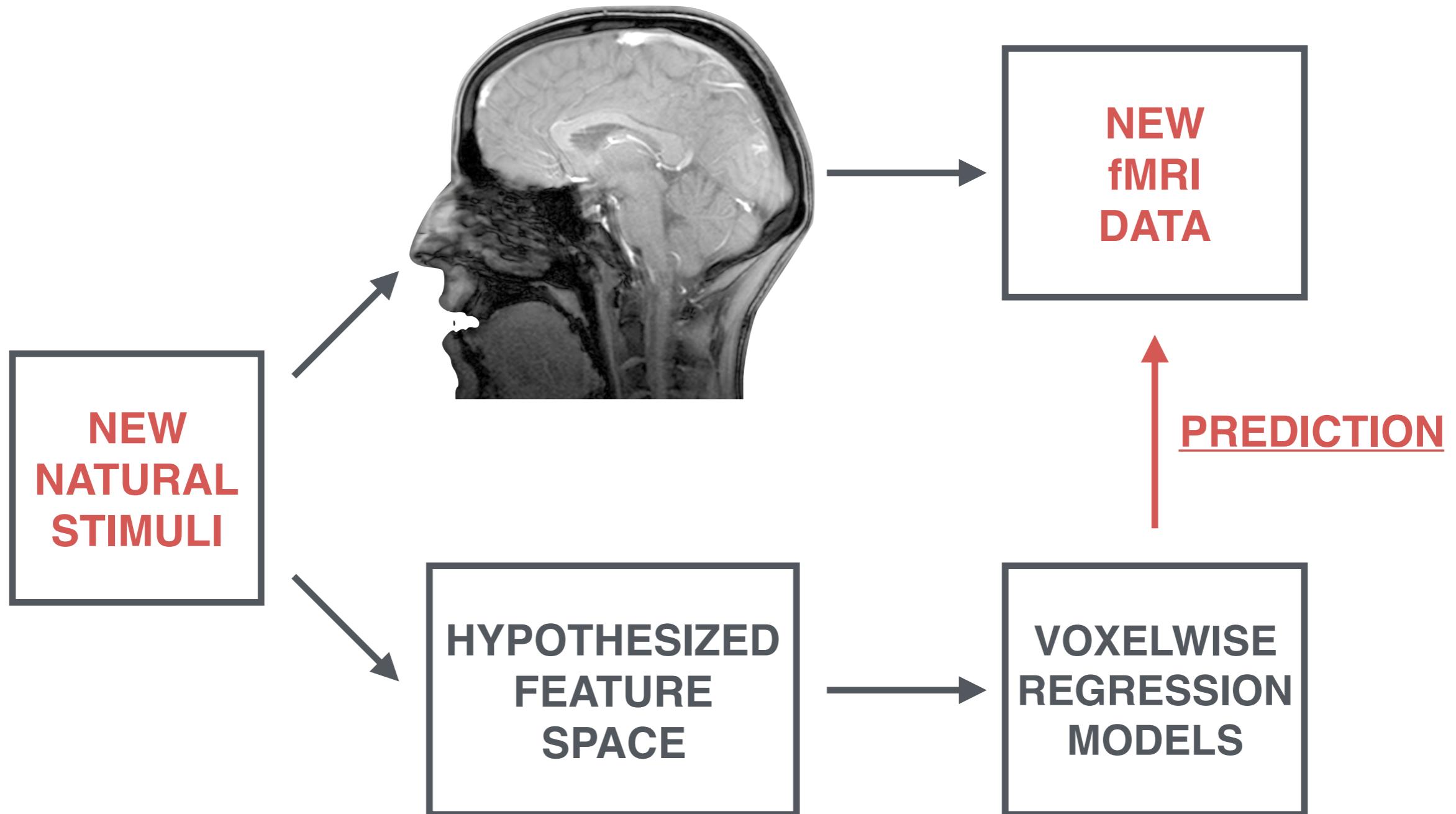
*...she was removing photographs
from the walls and placing them in
little piles around the house..."*



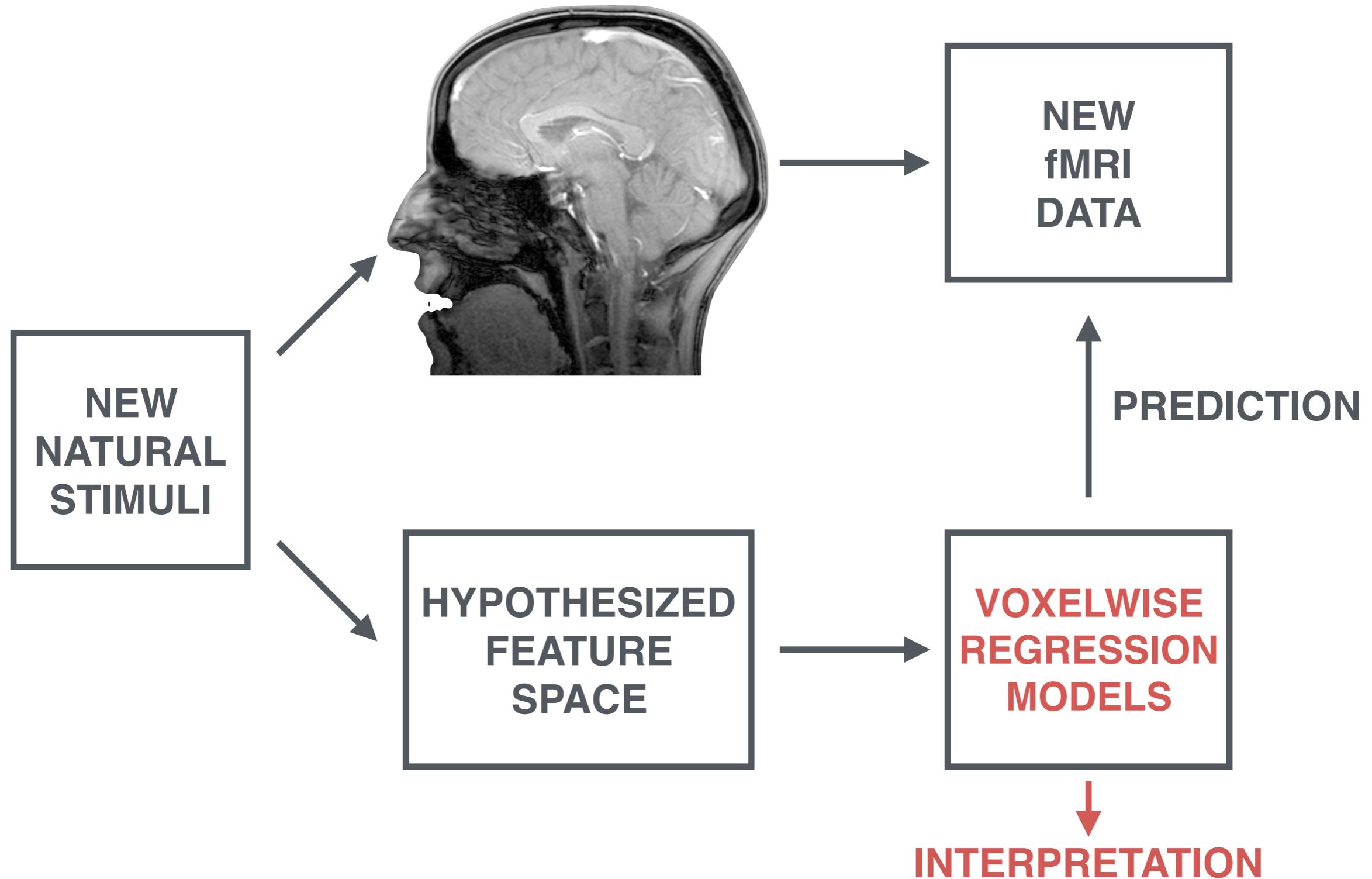
VOXELWISE MODELING



VOXELWISE MODELING



VOXELWISE MODELING



VOXELWISE MODELING

SIMPLEST MODEL:

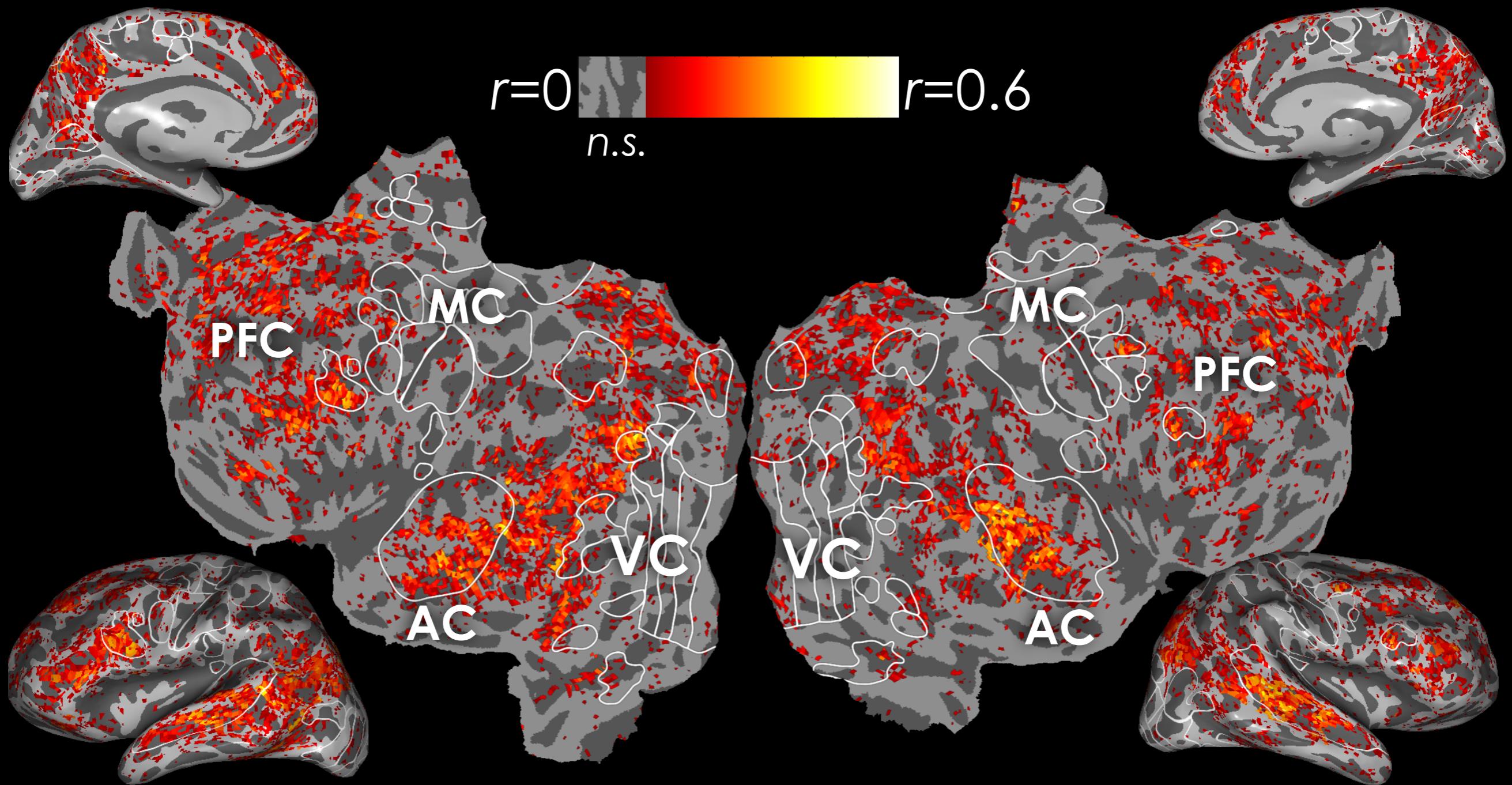
each voxel responds (some amount) to each word

$$R(t) = \sum_{i=0}^N \beta_i W_i(t)$$

$$\hat{\beta} = \operatorname{argmax}_{\beta} P(R|\beta, W)$$

likelihood

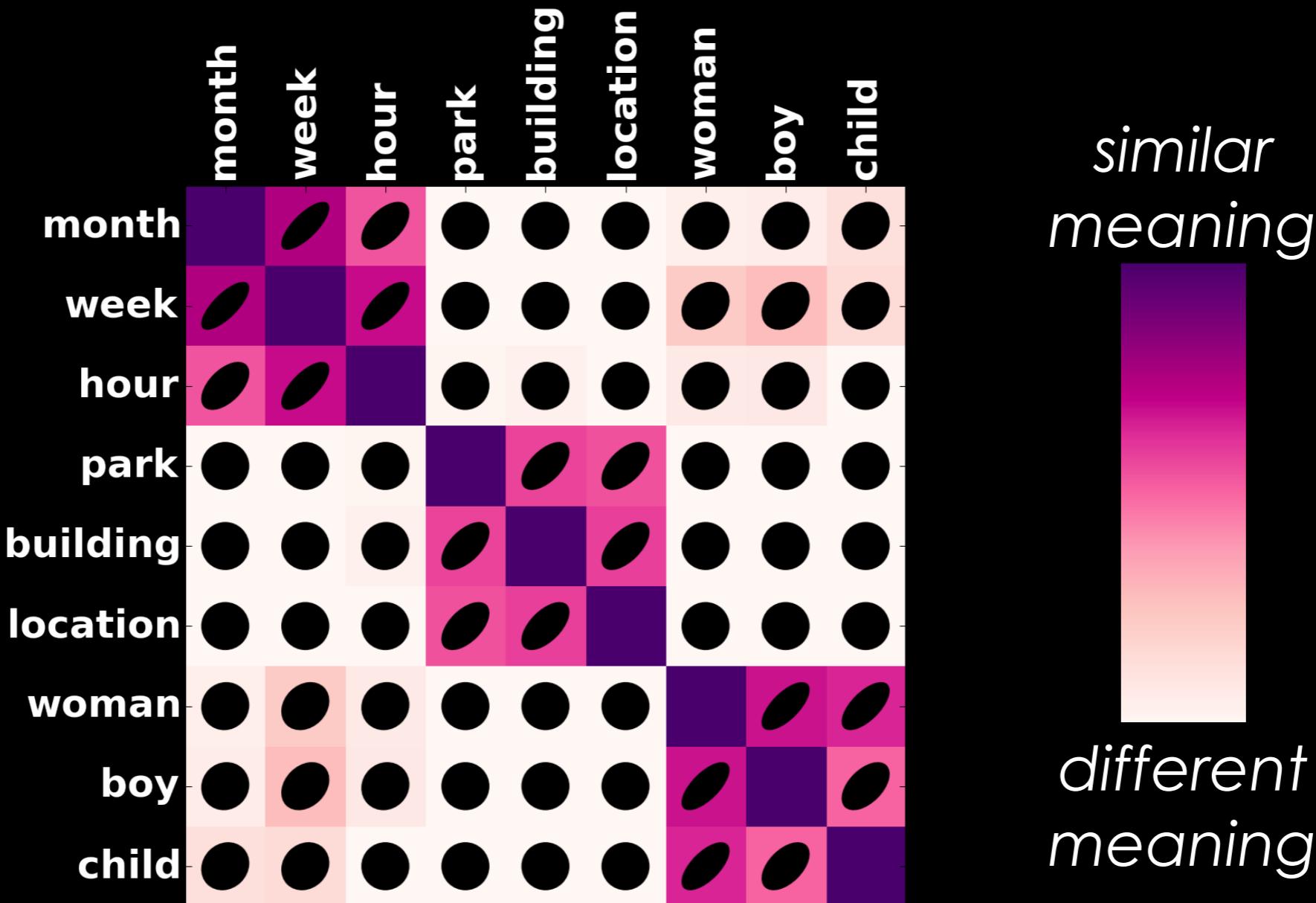
WORD MODEL PERFORMANCE: KINDA BAD



SEMANTIC PRIOR

IMPROVED MODEL:

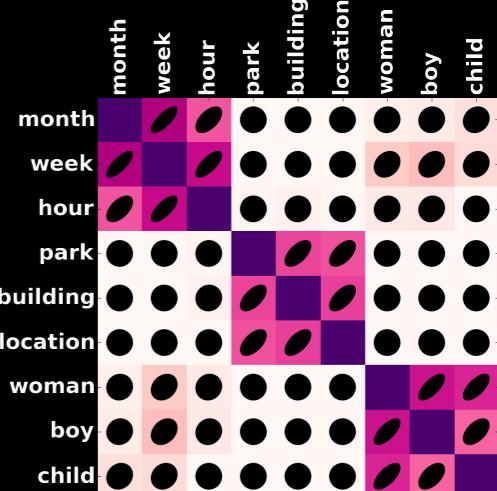
similar responses to words with similar meanings



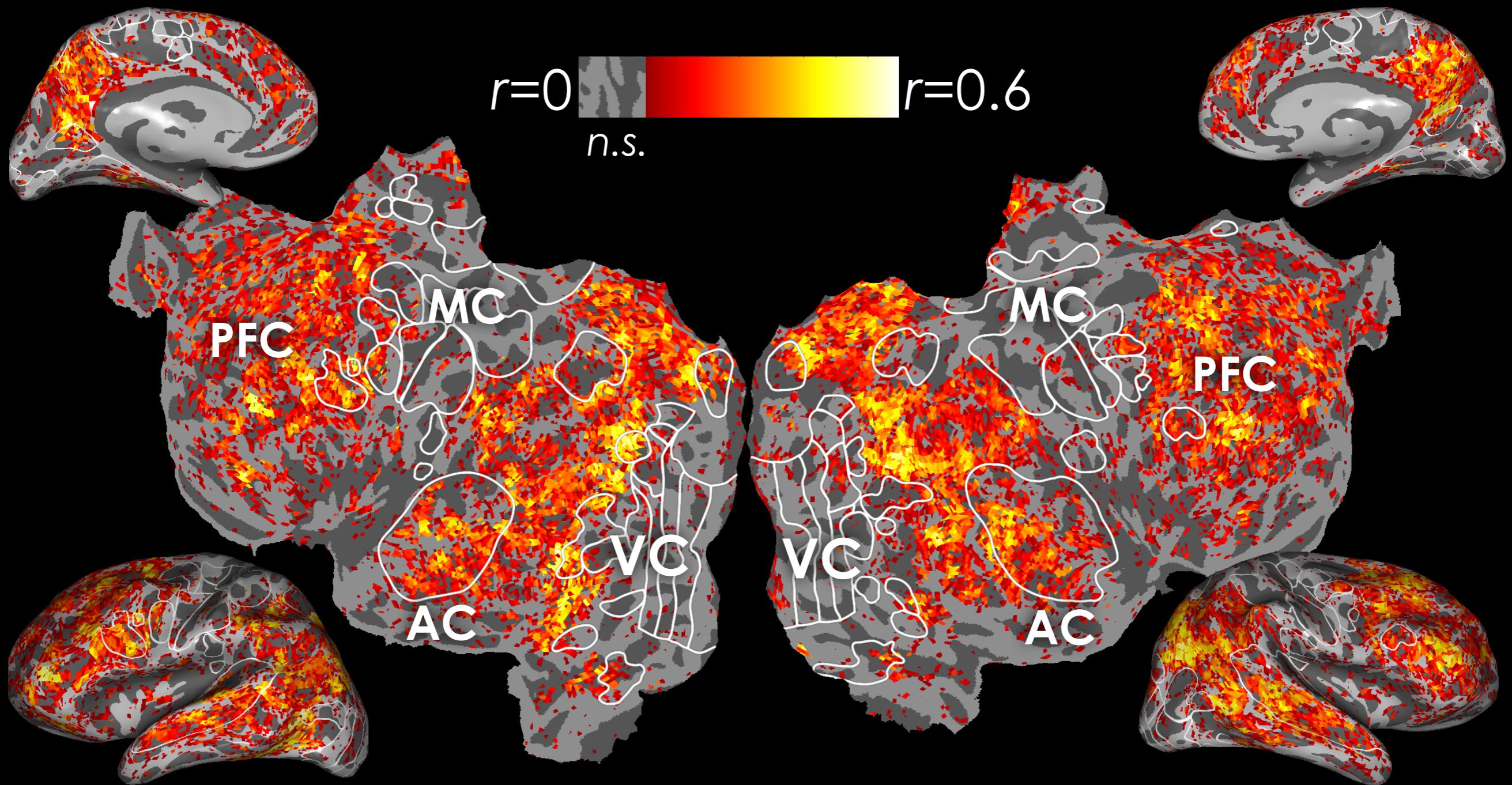
SEMANTIC PRIOR

IMPROVED MODEL:

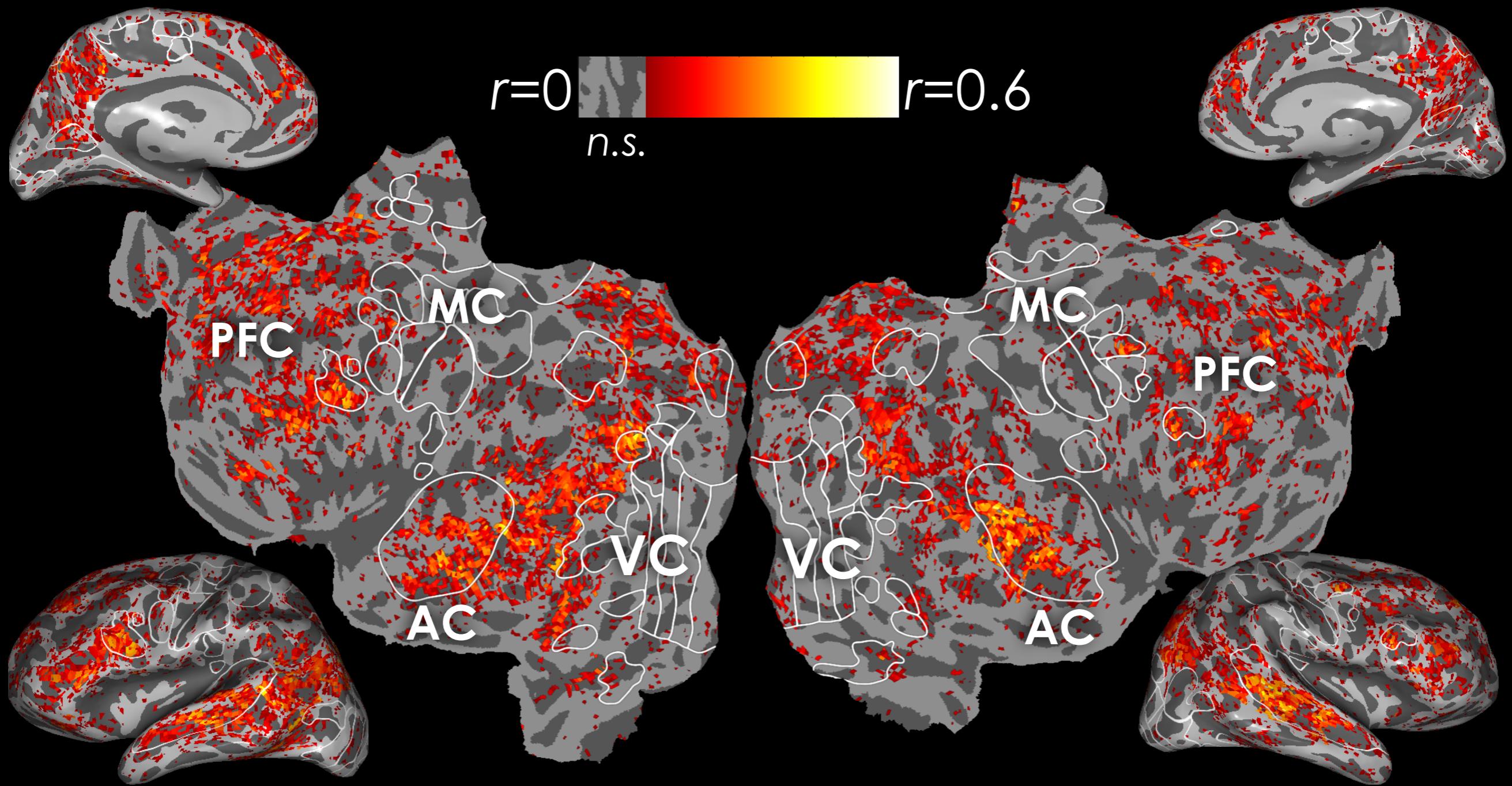
similar responses to words with similar meanings

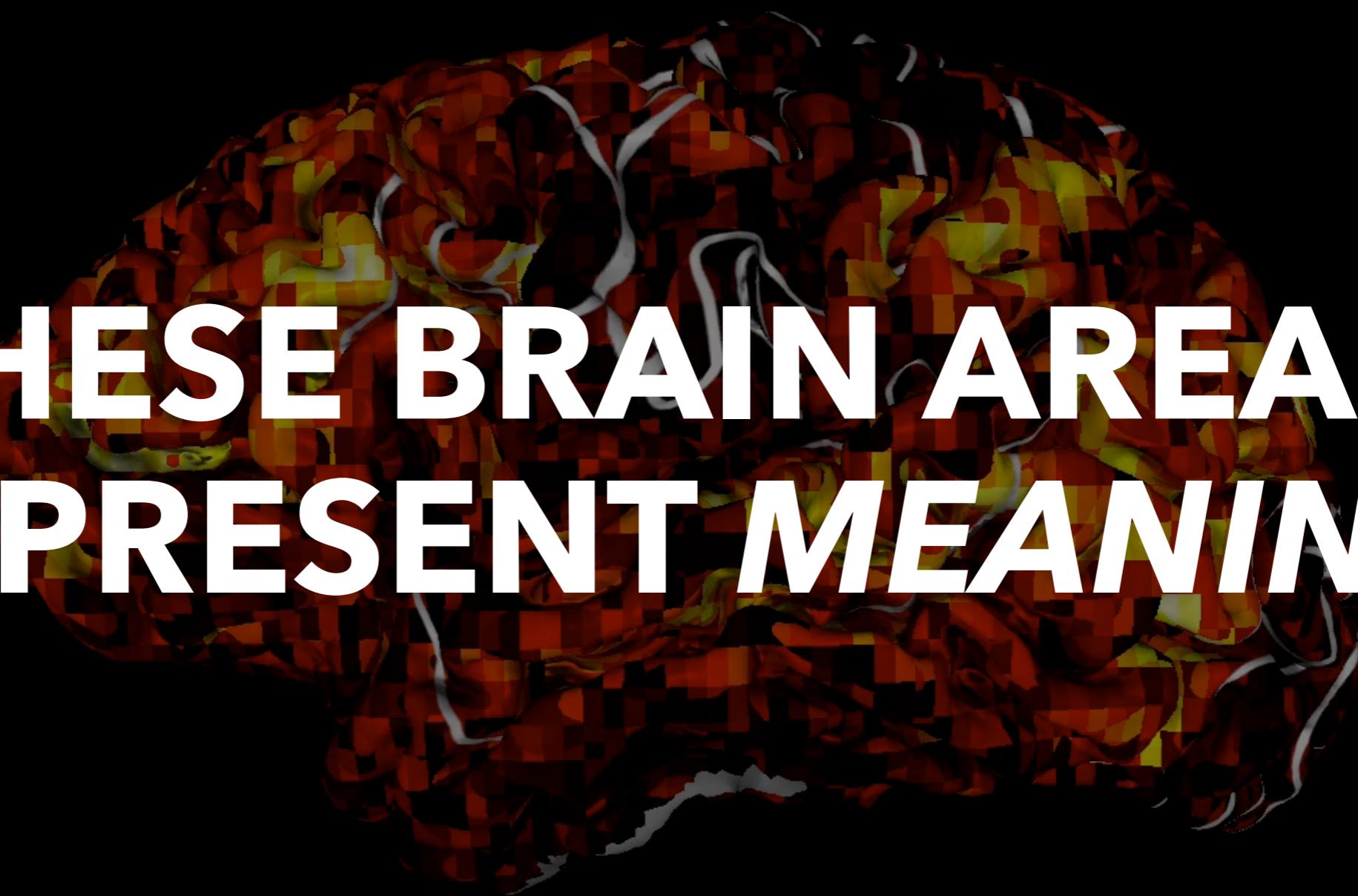


SEMANTIC MODEL PERFORMANCE: AWESOME



WORD MODEL PERFORMANCE: KINDA BAD





**THESE BRAIN AREAS
REPRESENT MEANING**

MODEL INTERPRETATION

*What information is represented
in each voxel?*

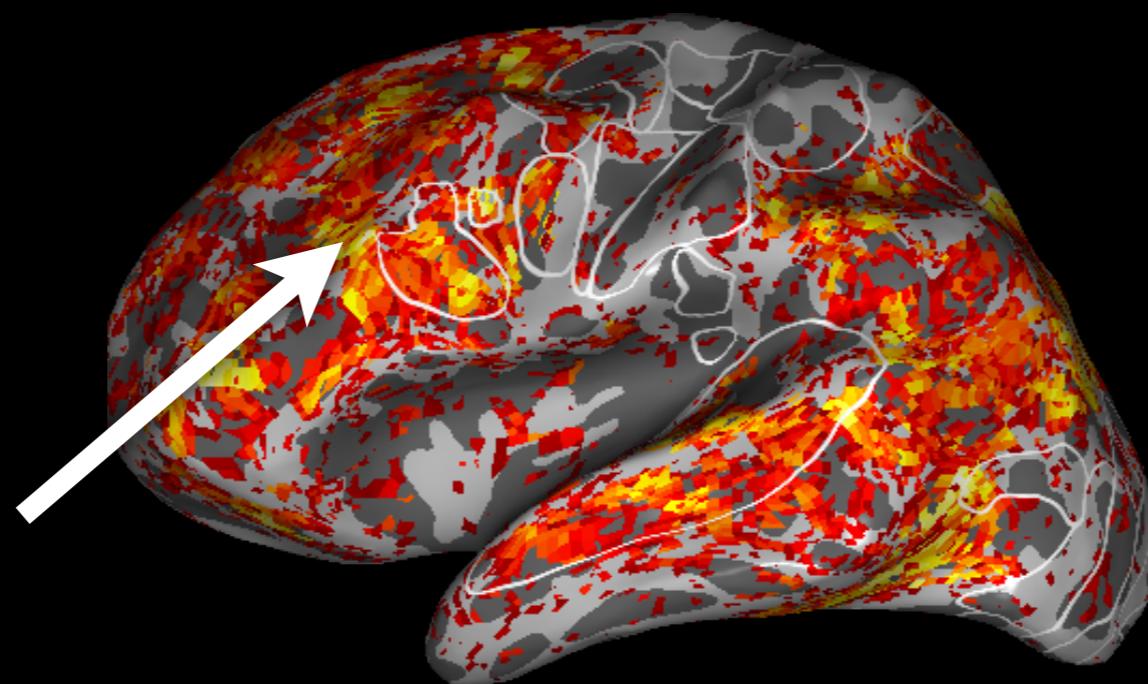
MODEL INTERPRETATION

emotions bible behaved thoroughly
advice counselor politician taught community
opinion political intellectual sir reasoned humor scientist kindly
politics religious singer biology dislike people's discussed
fellow appreciated culture educated arrogant rightly pope
encourage chaplain response colleagues offended polite moral recognize
argue enthusiasm remark understand

speed cliffs tower twenty-two destination landing aloft shaft
climb twice square stacked below each two maximum
dozen resulting nearest yards nearly miles eight
finishes circular month thirty-five single total metres upwards
mounted wreckage days excess canyon block passengers eleven pair mm
steep dome placed highest corners

Lower response

Higher response



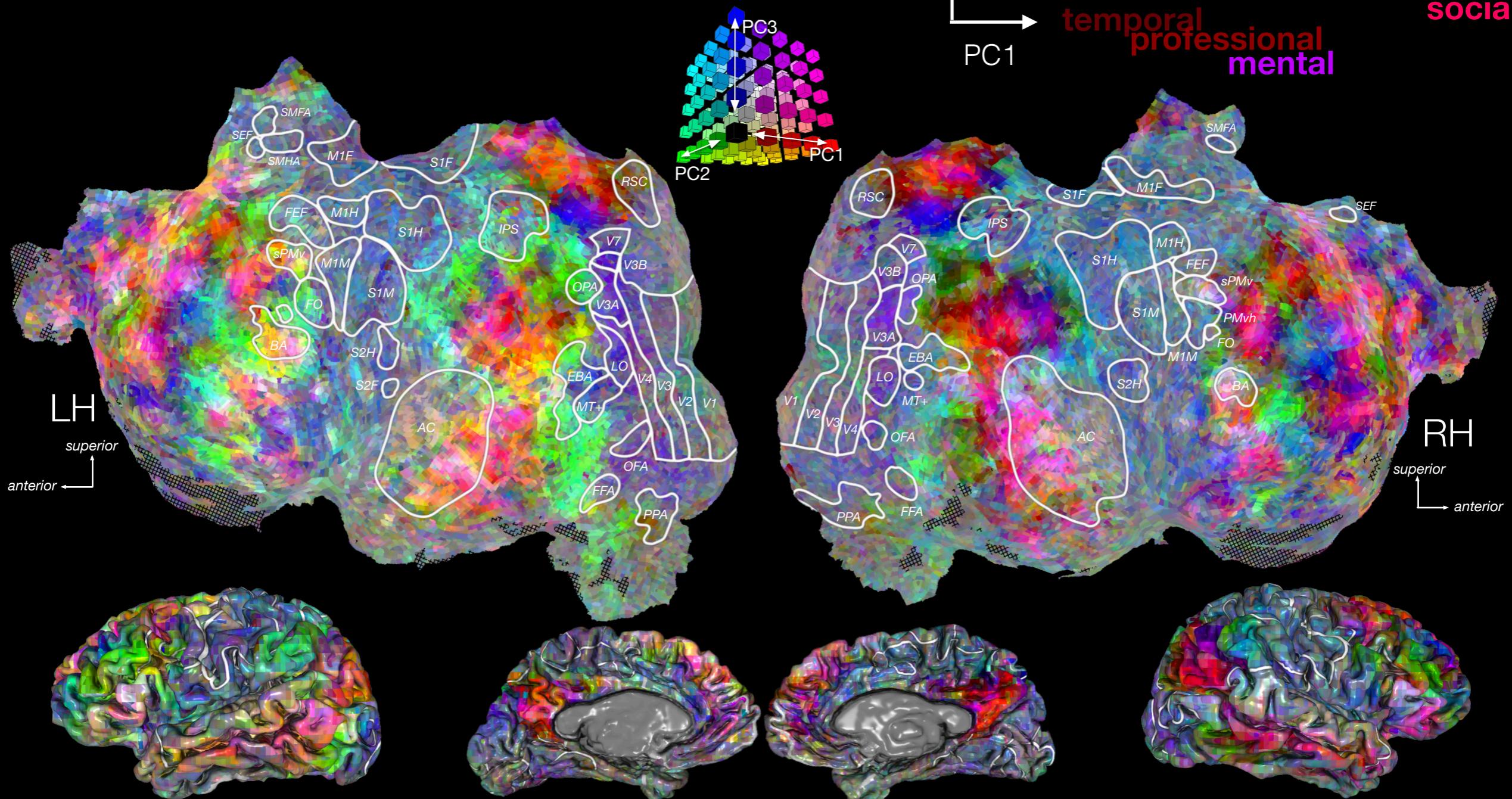
MODEL INTERPRETATION

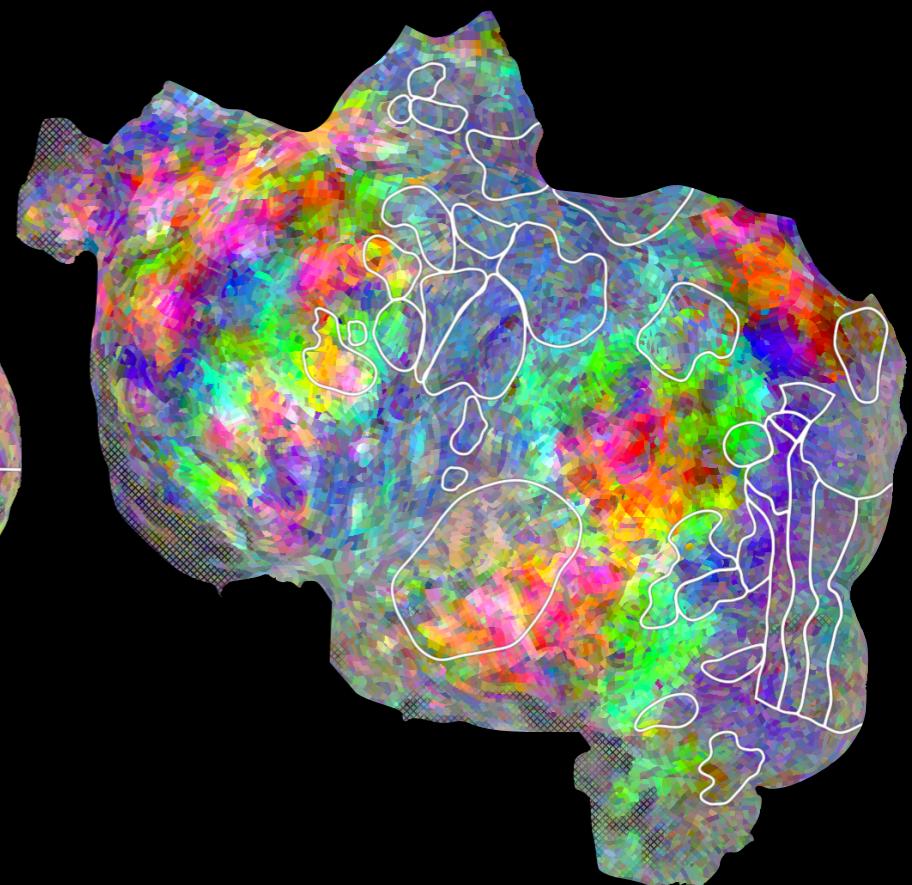
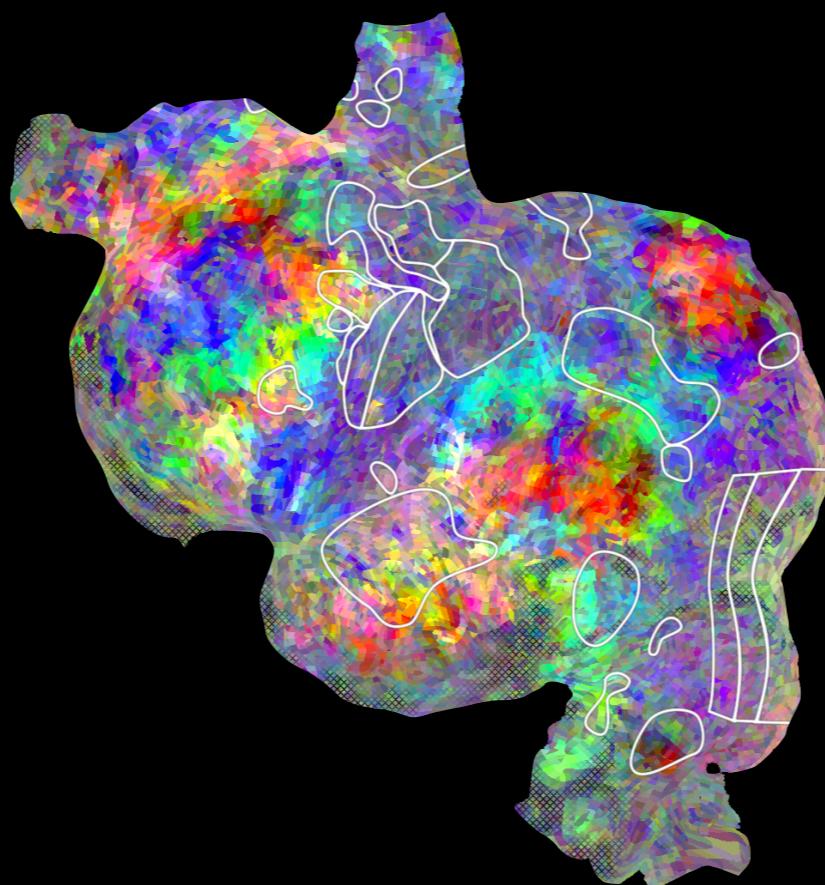
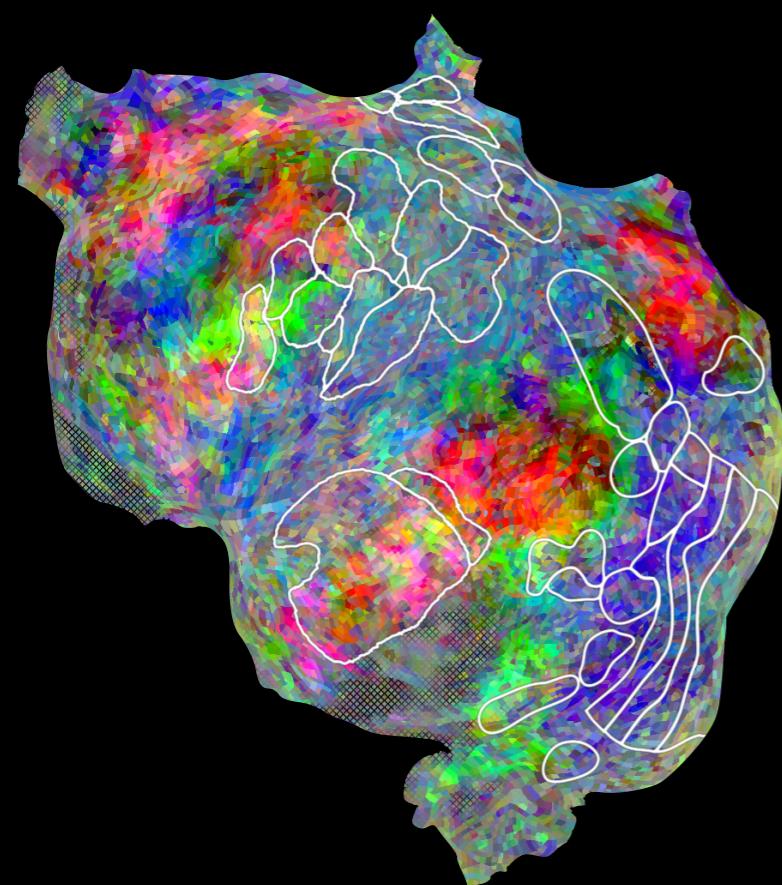
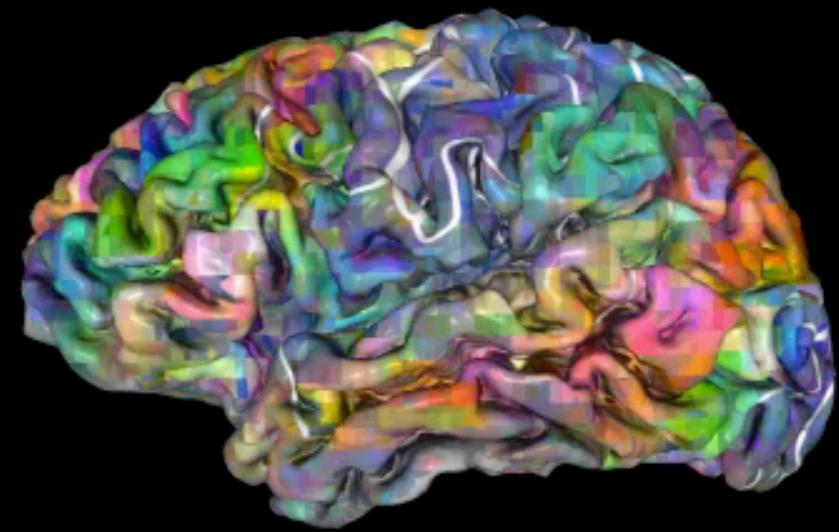
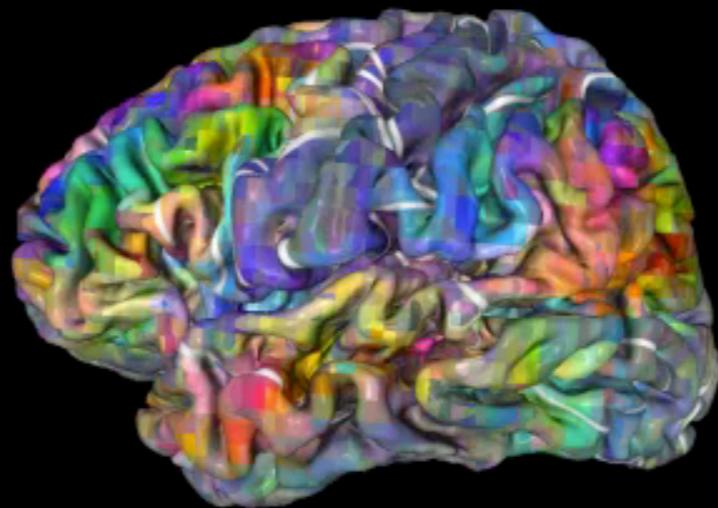
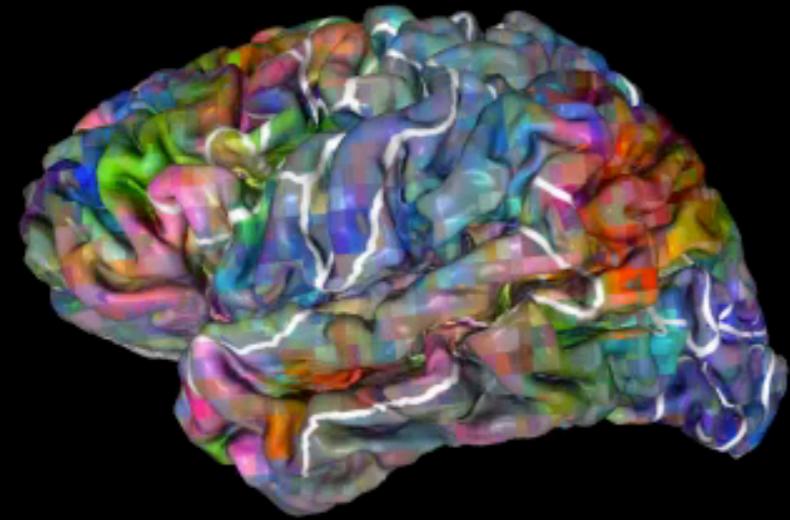
visual
tactile
abstract
numeric

locational

temporal
professional
mental

violent
communal
emotional
social





THAT'S ALL