Cognitive Brain Imaging Lab

Session 1:
Lab overview

Graduate TA: Andrew Bauer

01/13/16

Basic logistics

- Office: Baker 327B (Andrew), 327K (Zach)
- E-mail: bauera@cmu.edu (Andrew)
  zanderso@andrew.cmu.edu (Zach)
- Office hours: By appointment, or stop by office
- Lab in 332P
  - Wednesday, 9:00-9:50pm
  - Baker Hall 332P (computer lab)
  - Code to access computer lab wing outside normal hours: **5406***
  - (NOTE: You cannot stay in the computer lab past midnight)

Graded assessment

- Lab material is worth **15-20%** of your final class grade

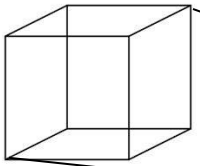
- Quizzes (3, equally weighted) **(20%)**
- Assignments (i.e. lab write-ups) (6, *not* equally weighted) **(80%)**

Upon successful completion of this lab course, you should be able to…

- Process raw fMRI data in preparation for statistical data analysis;

- Visualize brain activation to discover which brain regions are active, or inactive, in a given cognitive or behavioral task

FMRI detects changes in blood flow within volumetric pixels (voxels)

1 x 

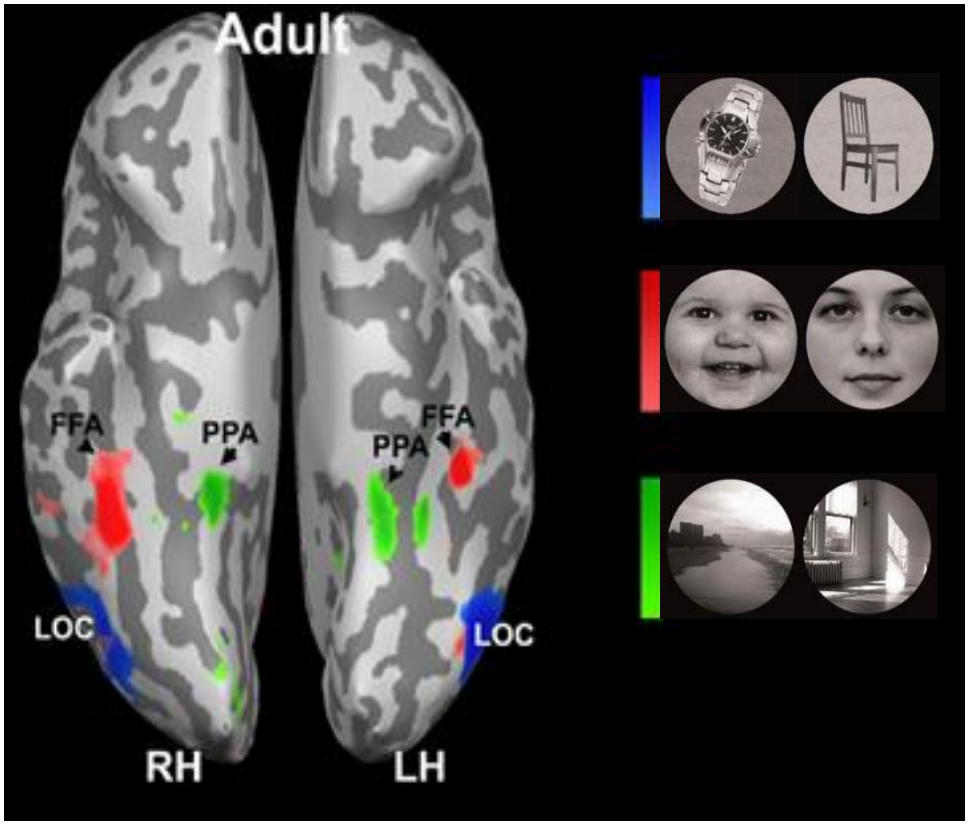
= hundreds of

thousands of neurons

Visualizing brain activation during behavior/thought

- *Map* behavior or thought →brain areas

- Standard analysis: average the signal ("smooth") over different voxels to improve the signal-to-noise ratio

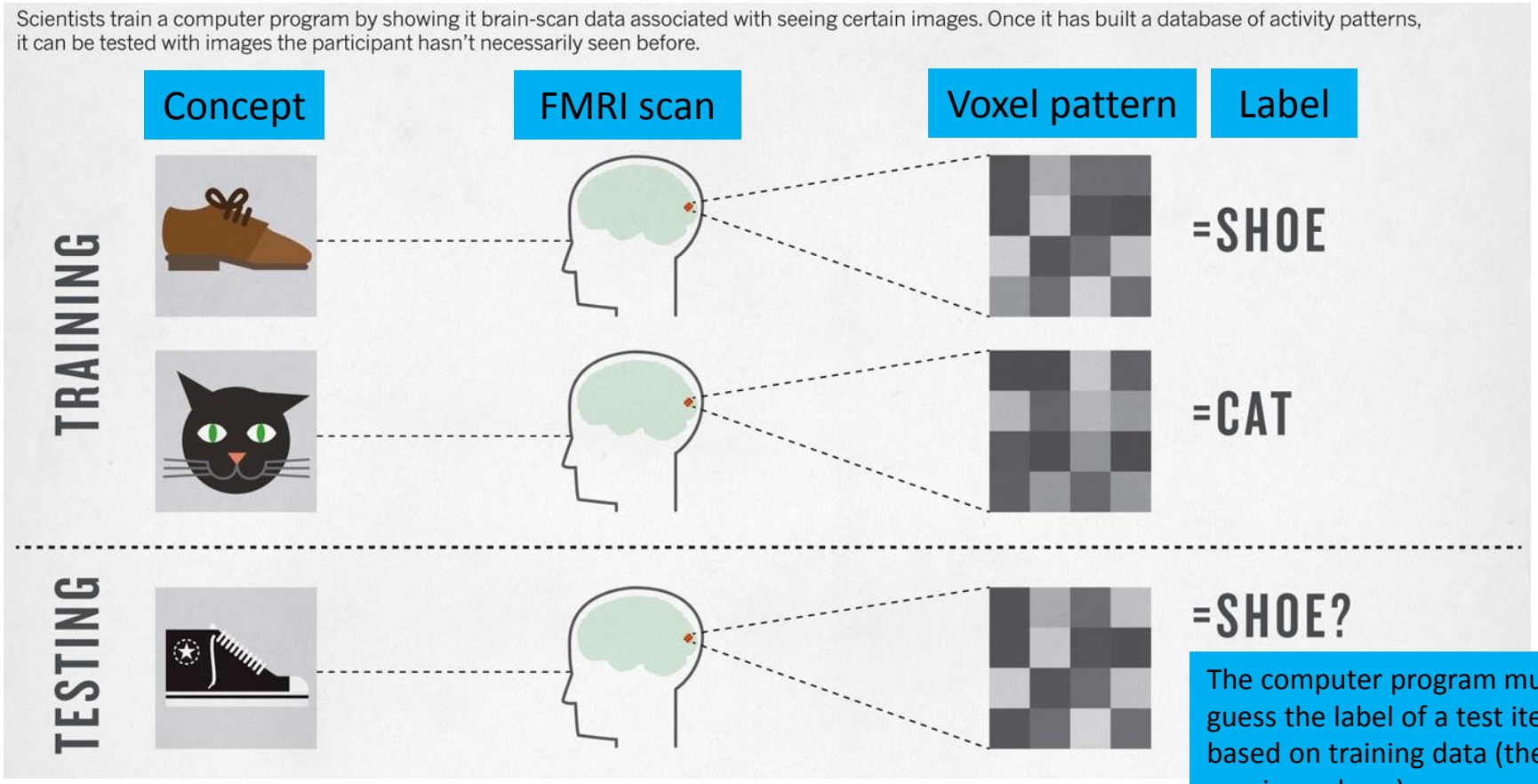


Upon successful completion of this lab course, you should be able to…

- Process raw fMRI data in preparation for statistical data analysis;
- Visualize brain activation to discover which brain regions are active, or inactive, in a given cognitive or behavioral task;
- *Conduct "mind-reading" to infer what a person is thinking about based on distributed brain activation patterns*

“Mind-reading”/multivariate pattern analysis

- Detects patterns of brain activation – no averaging/smoothing over voxels
- Is a more sensitive tool of brain mapping than standard data analysis



The computer program must guess the label of a test item based on training data (the previous phase)

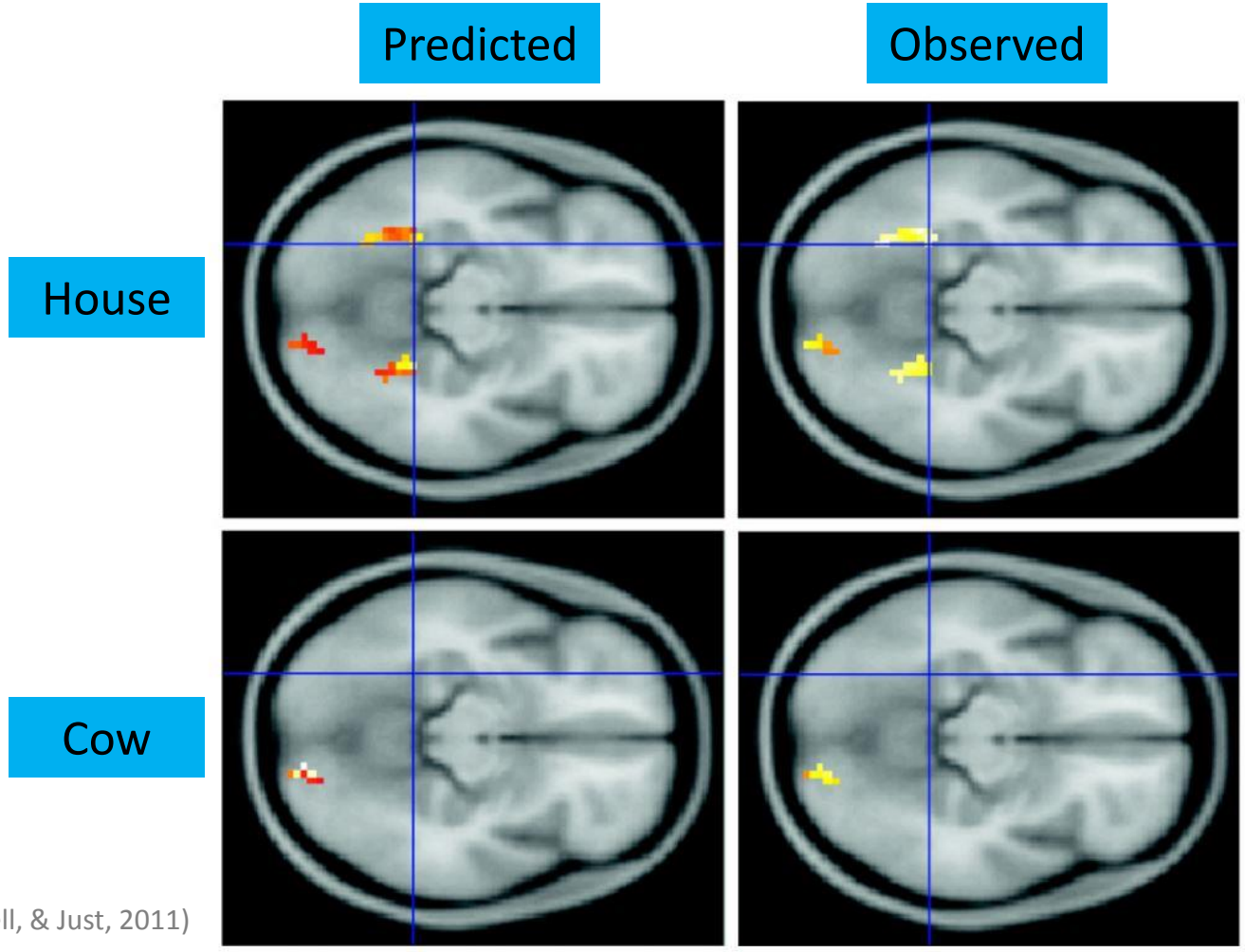
Upon successful completion of this lab course, you should be able to…

- Process raw fMRI data in preparation for statistical data analysis;
- Visualize brain activation to discover which brain regions are active, or inactive, in a given cognitive or behavioral task;
- Conduct "mind-reading" to infer what a person is thinking about based on distributed brain activation patterns;
- *Predict the brain activation pattern associated with thinking about a specific concept (the inverse of "mind-reading")*
  - If we can make precise predictions, then we might be on the right track to a solid scientific understanding

Predictive voxel-wise modeling

- Predict the multi-voxel activation pattern of a concept…

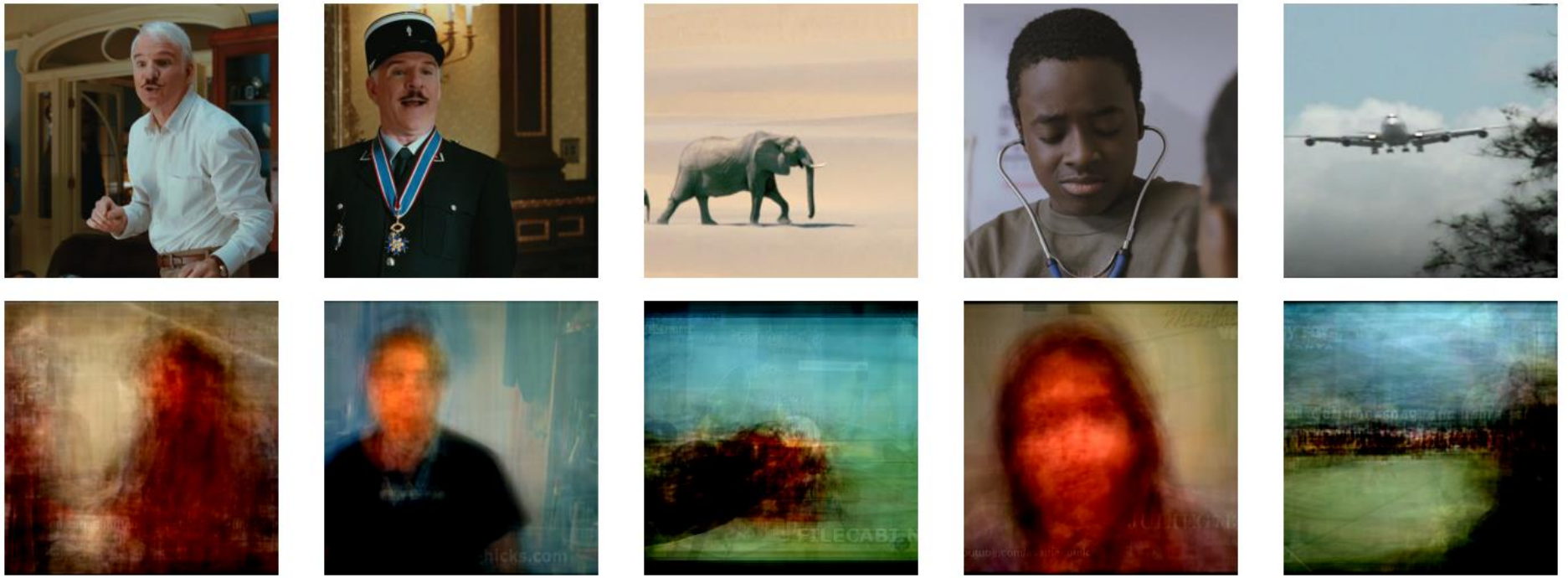
  based on how different voxels encode the properties that define the concept
  - E.g. ***house***: is warm, is made of wood or brick, etc.



(Chang, Mitchell, & Just, 2011)

Another example: predictive voxel-wise modeling in vision research

Real images seen in movie



(Image from Nishimoto et al., 2011)

Predicted images

Graded assessment cont.

- Quizzes (3): They take at most ten minutes to complete and are straightforward (two are on brain anatomy)

- Each lab session assignment (6)…

  - Involves some work at a computer and culminates in a fairly brief lab write-up

  - Is for the most part self-contained, meaning you will not be continually building on past work

Graded assessment cont.

- Each lab write-up due by beginning of the lab session of the due day, printed or as an e-mail attachment to me (bauera@cmu.edu)
  - See schedule in syllabus for due dates
  - I will remind you of due dates along the way
- ***Late submission policy:***
  - Lose 5% per day late
- You may work together to complete the assignments, but you must turn in write-ups that you yourself have written

Lastly…

- Please see the syllabus for more detailed information!

- Next lab (topic: *brain anatomy*)
  - No assignment due
  - No quiz