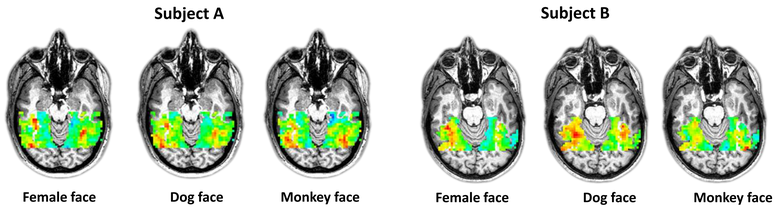
In search of a **common representational space** for decoding:

comparing anatomical alignment, functional voxel matching, and hyperalignment

J. Swaroop Guntupalli and James V. Haxby *Dept. of Psychological & Brain Sciences, Dartmouth College, Hanover, NH, USA*

INTRODUCTION

- Multivariate pattern (MVP) analysis[1] reveals the information content in the patterns of brain activity.
- Features are difficult to align across subjects, therefore MVP models are usually subject-specific.



Functional alignment

- Functional alignment[2] aligns fine-scale brain structure based on functional patterns.
- We compare the anatomical alignment, the functional voxel matching, and the hyperalignment by decoding information content across-subjects

METHODS – Imaging

- Ten healthy young subjects participated in two fMRI studies:
  - On one day, they watched the movie Raiders of the Lost Ark.
  - On a different day they viewed static pictures of four categories of faces (human females, human males, monkeys, and dogs) and three categories of objects (houses, chairs, and shoes) in a block design.
- We used voxels from anatomically defined ventral temporal (VT).

METHODS - Alignment

- For **anatomical alignment**, we aligned subjects into standard **Talairach** brain.
- For **functional alignment**, we treat the voxel response patterns during the movie as vectors in high-dimensional feature space.
- **Voxel matching** uses the Hungarian algorithm to match voxels between subjects.
- H**yperalignment** uses the Procrustean transformation to align one subject's trajectory of time-point vectors to another subject's trajectory.
- **Hyperalignment aligns neural representational feature spaces** in contrast with other two methods which align voxels across subjects.

METHODS - Between Subject Classification

I. Face & object categories

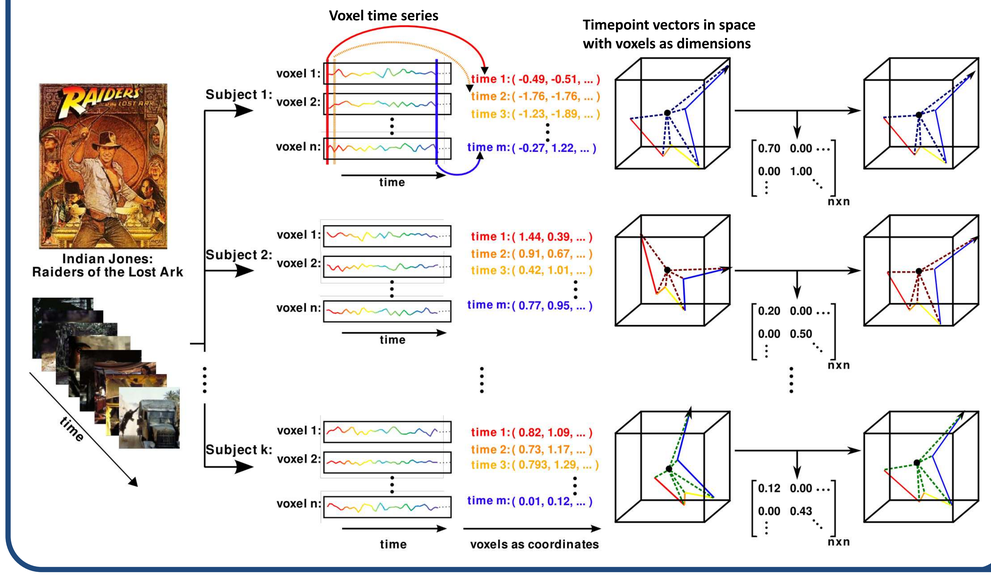
We derived the alignment parameters using movie data and applied them to the faces and objects study data. We classified the categories of blocks from each subject based on models from other subjects' data.

II. Movie time segments

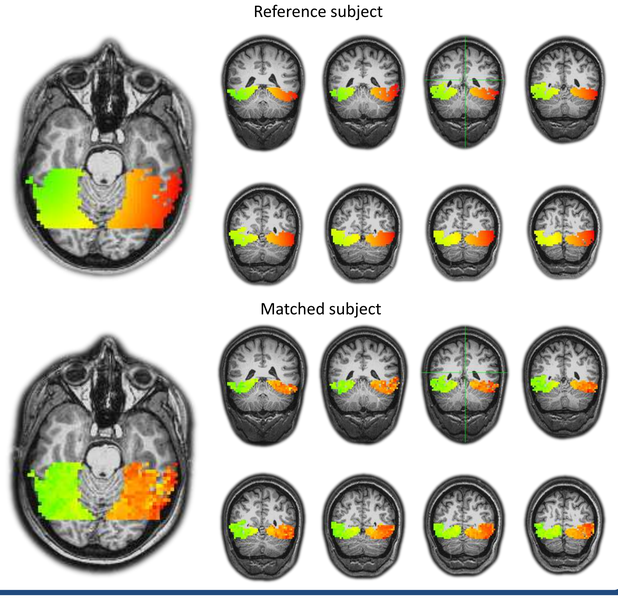
We derived the hyperalignment parameters from one session of the movie study and applied the parameters to data from the other session. We classified time segments in the other half of the movie for each subject using other subjects' data.

Hyperalignment

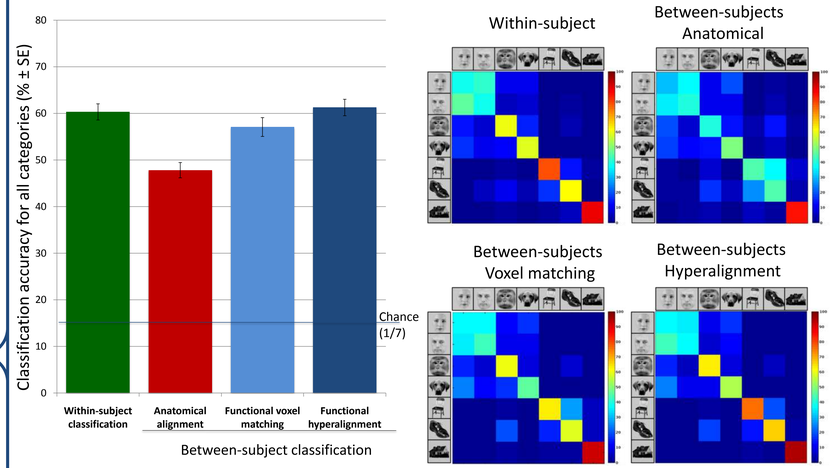
Schematic figure showing the derivation of hyperalignment parameters from the movie data



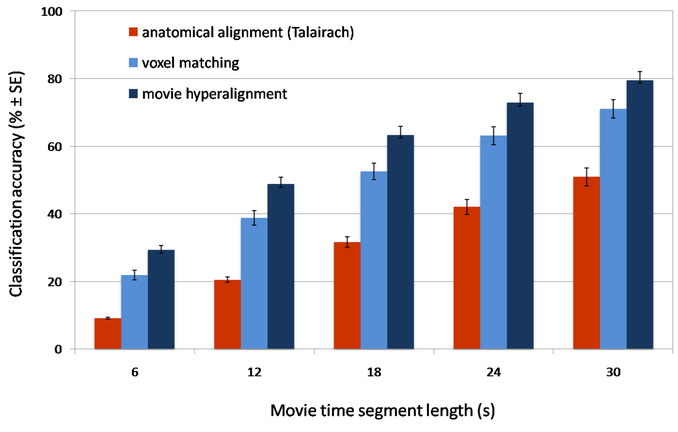
Functional voxel matching



Analysis I: Classification of faces and objects categories in VT cortex



Analysis II: Movie time-segment classification in VT cortex



CONCLUSIONS

- **Functional alignment** methods are **better than anatomical alignment**.
- **Hyperalignment** derived models of neural codes at least as good as individually-tailored models, indicating that this method **reveals a higher level of commonality** than anticipated.

.

References

1. Haxby, J.V., Gobbini, M.I., Furey, M.L., Ishai, A., Schouten, J.L., Pietrini, P. Distributed and overlapping representations of faces and objects in ventral temporal cortex. *Science* **293**, 2425-2430 (2001).
2. Sabuncu, M.R., Singer, B.D., Conroy, B., Bryan, R.E., Ramadge, P.J., Haxby J.V. Function-based intersubject alignment of human cortical anatomy. *Cereb. Cortex*, in press.

***Pretty brain pictures by Christine Looser**