

Recent and upcoming developments

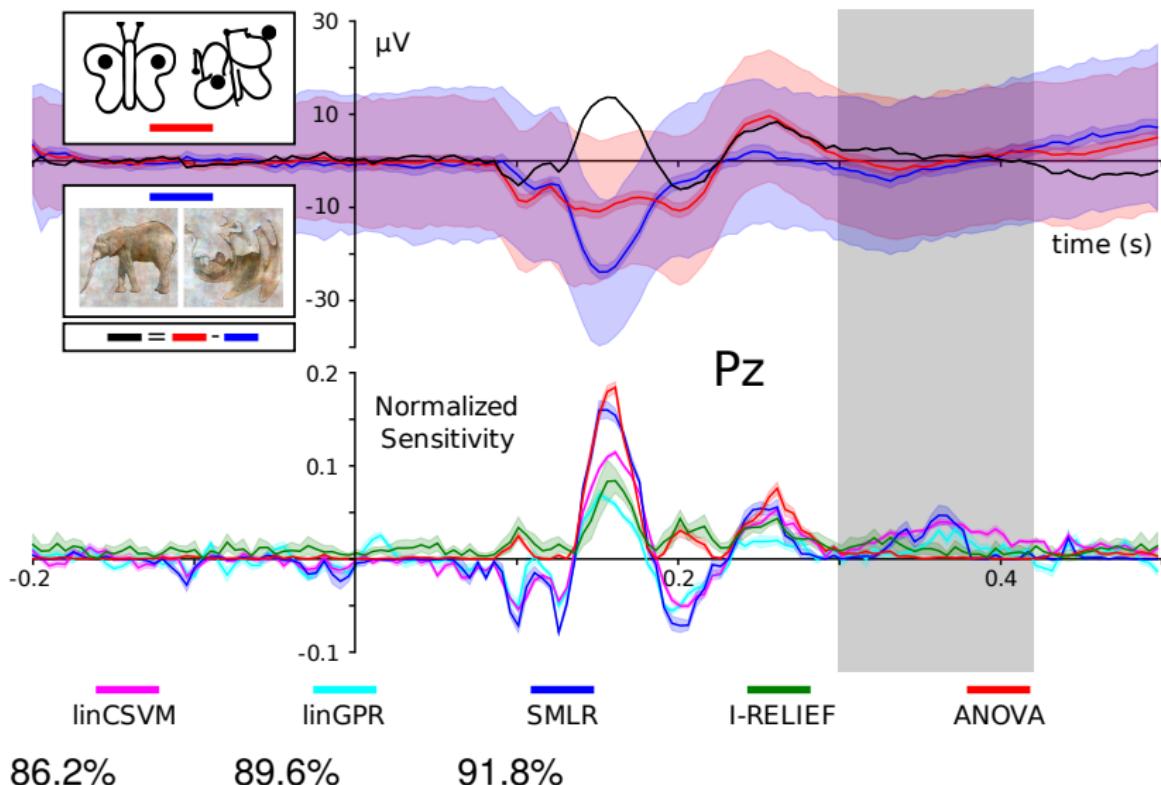
Michael Hanke & Yaroslav Halchenko

University of Magdeburg, Germany
Dartmouth College, USA

Delmenhorst 2014

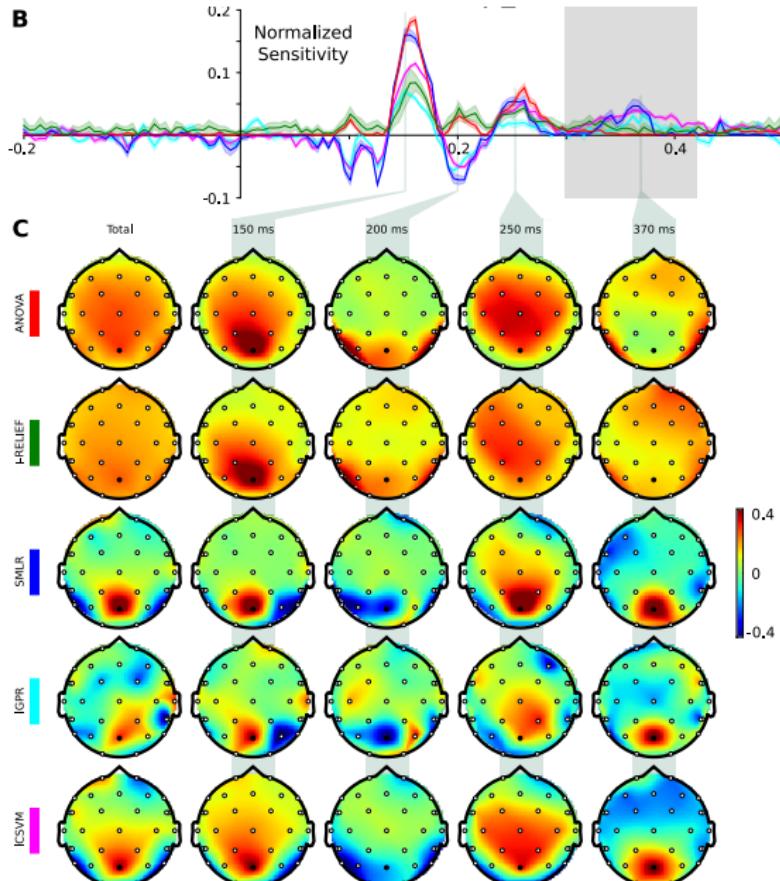
Modality agnostic sensitivity analysis

Modality-independent: EEG

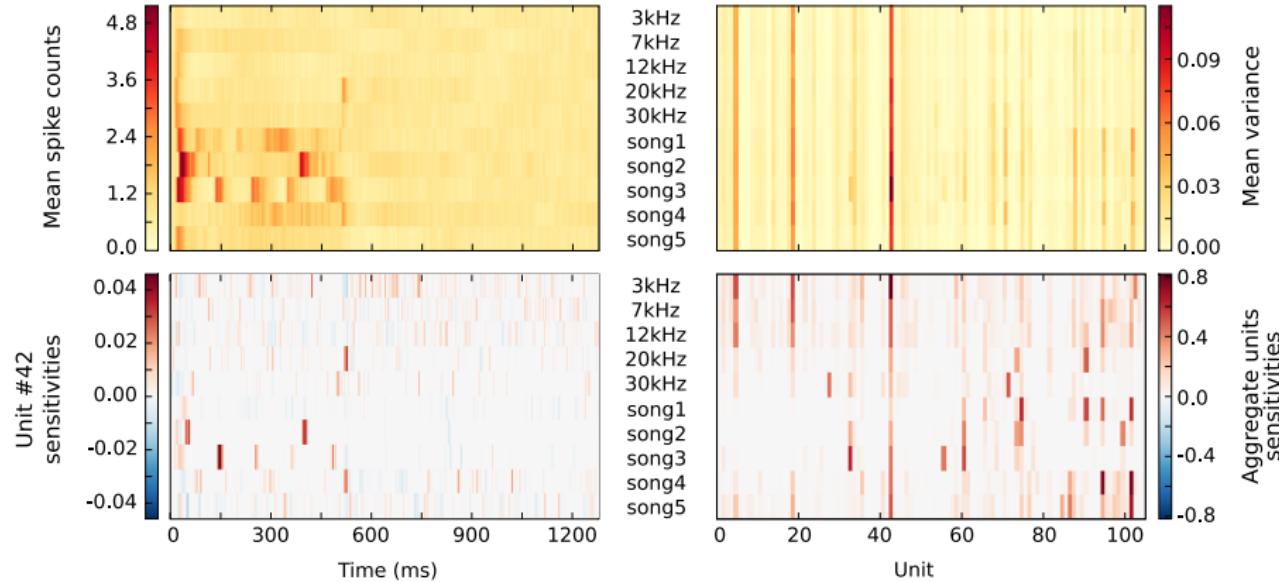


Hanke et al. (2009) (Daten: Fründ et al., 2008)

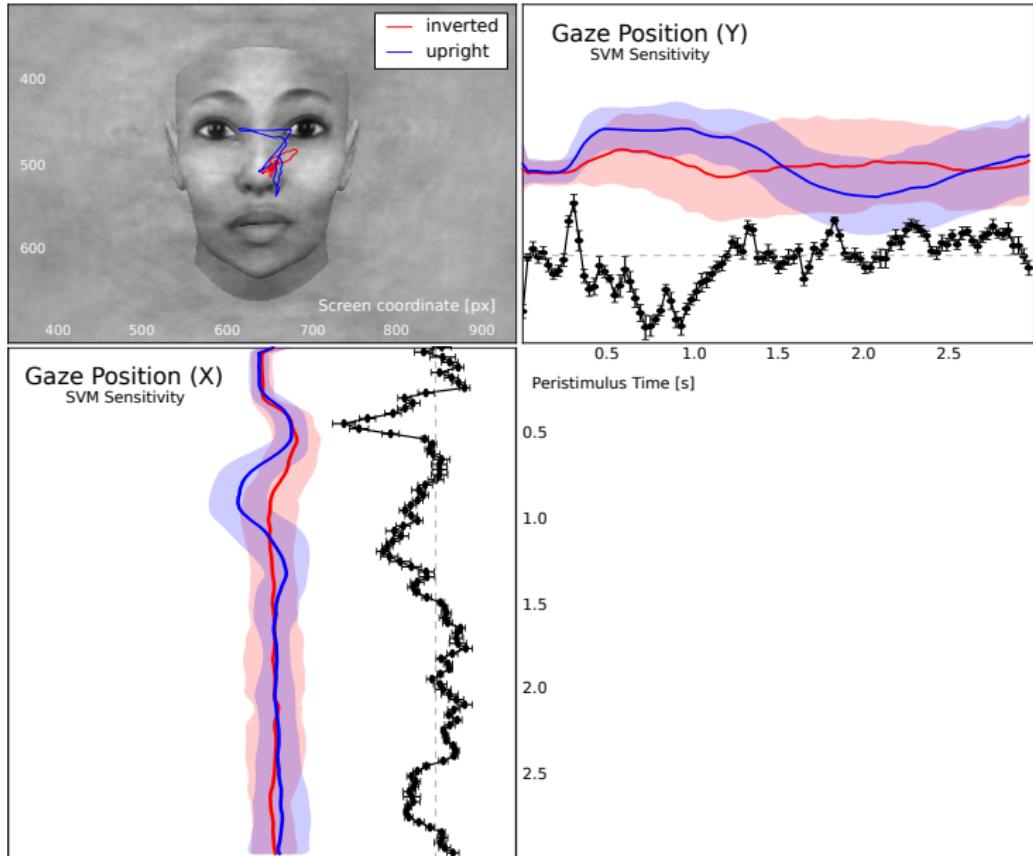
Modality-independent: EEG Temporal Profile



Modality-independent: Spikes



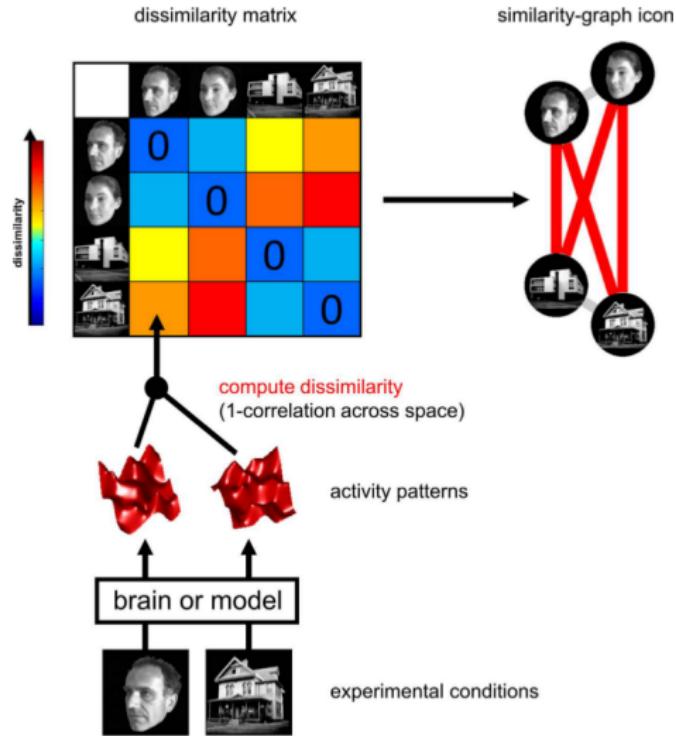
Modality-independent: Eye movements



Similarity structure analysis

2nd-order isomorphism

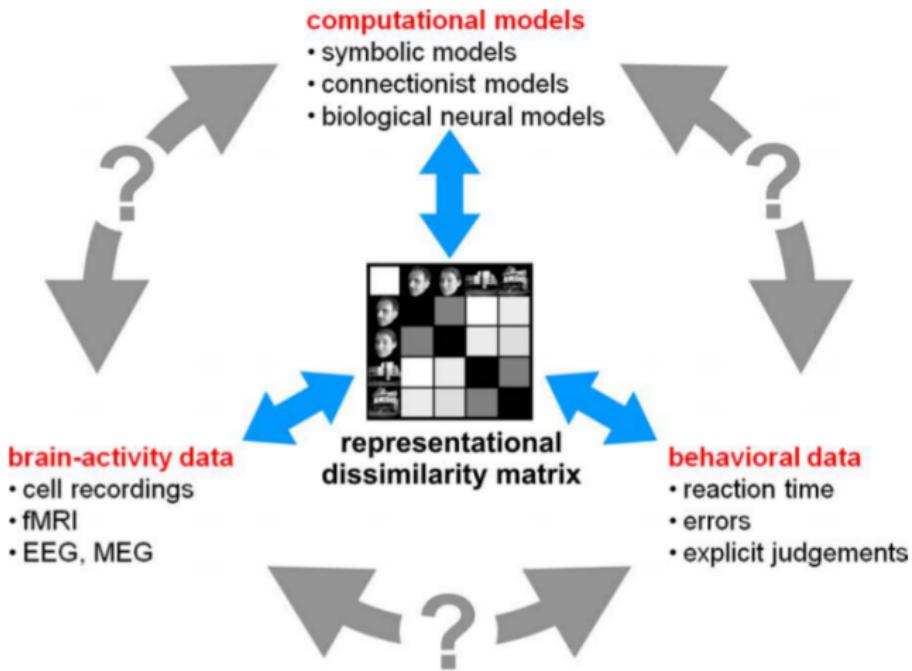
similarity of similarity structure



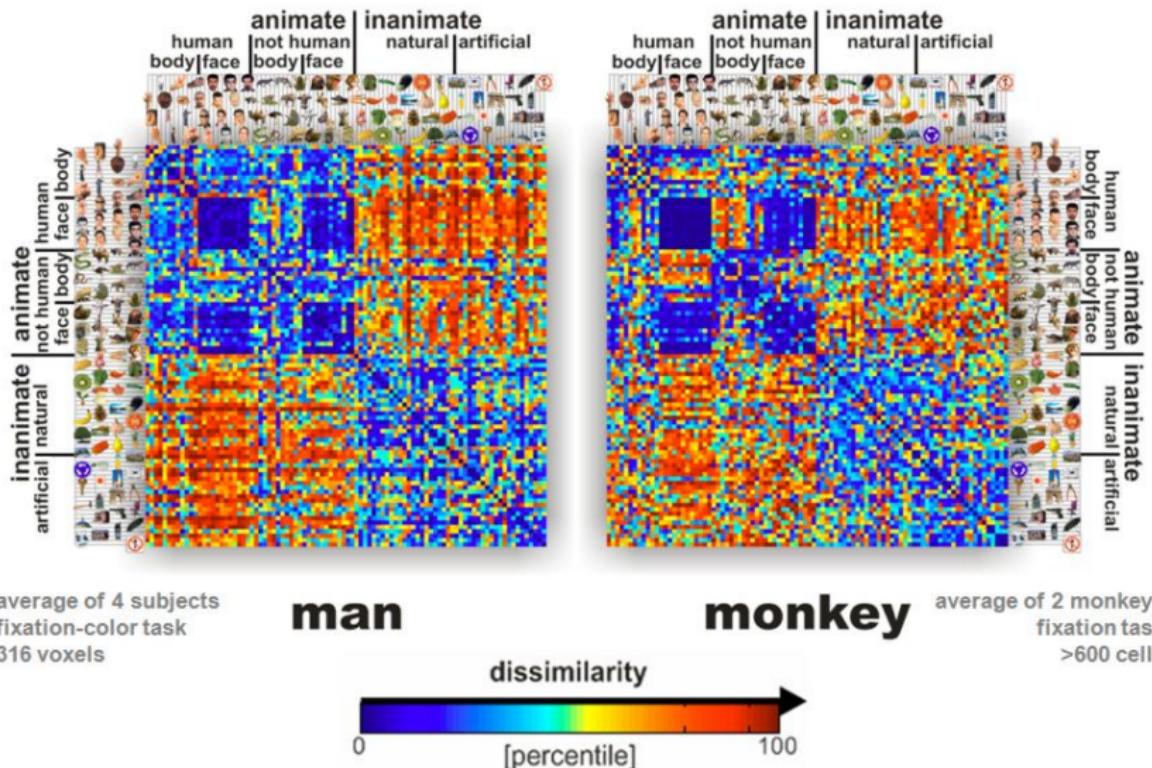
Kriegeskorte et al., Frontiers in Systems Neuroscience, 2008

2nd-order isomorphism

similarity of similarity structure

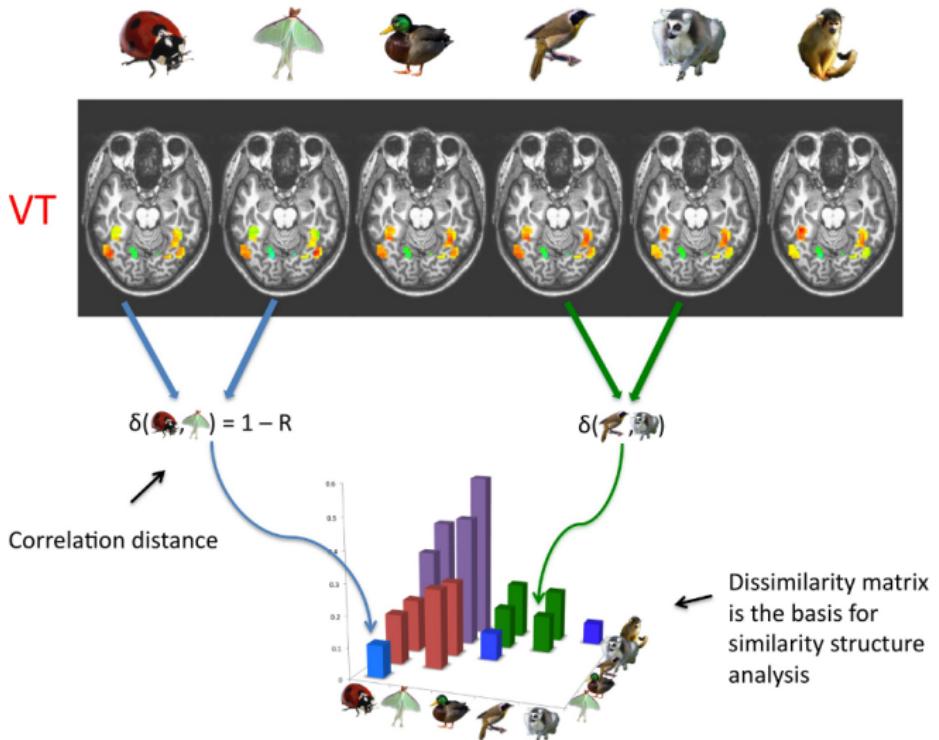


Representational spaces across species



Kriegeskorte et al., COSYNE, 2008

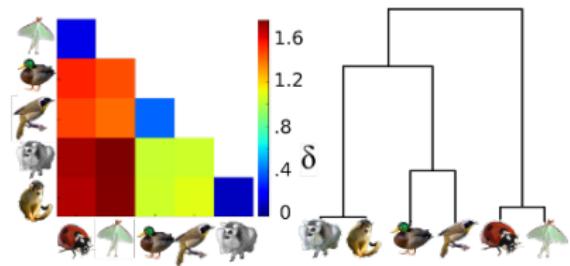
Similarity Analyses



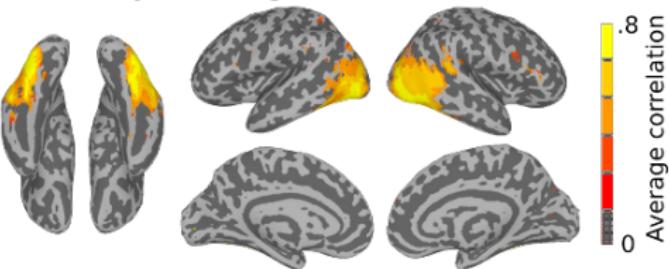
Connolly et al. (2012)

Similarity Analyses: V1 vs behavioral models

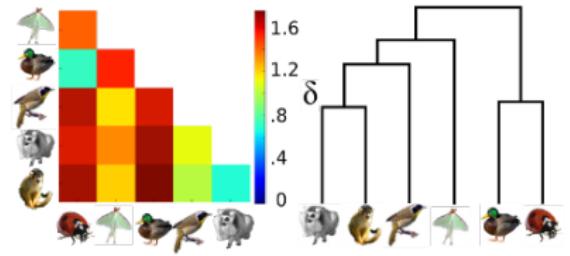
A. Behavioral ratings DM



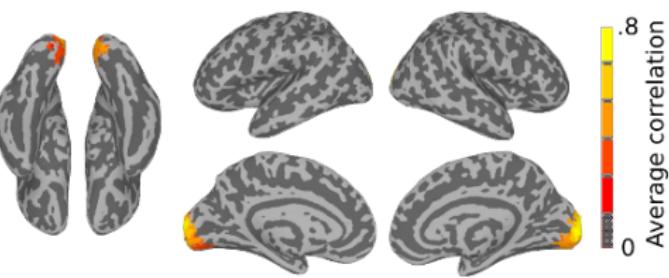
B. Similarity searchlight: Behavioral DM



C. V1 model DM

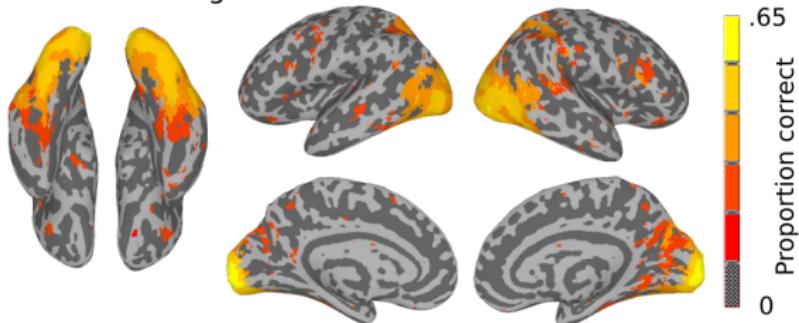


D. Similarity searchlight: V1 model DM

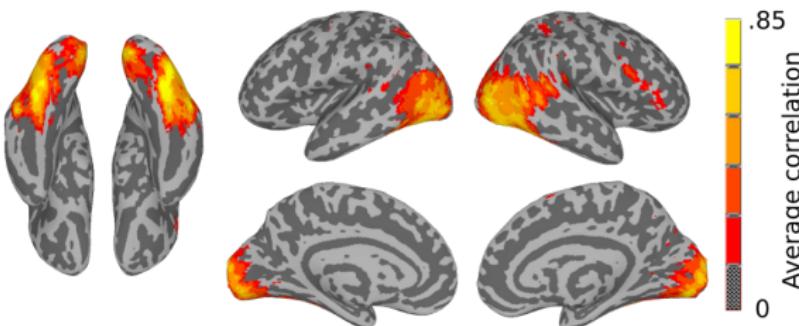


Similarity Analyses: Cross-subject agreement

A. SVM searchlight



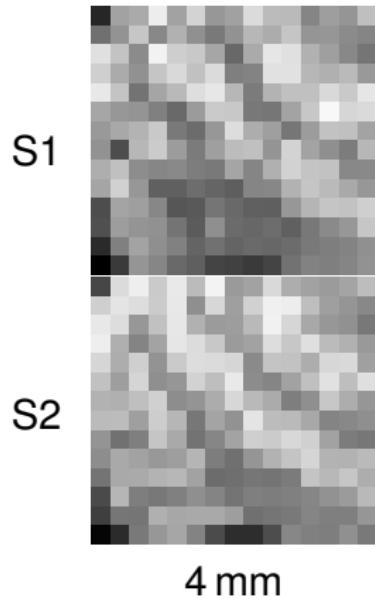
B. Cross-subject similarity correlation searchlight



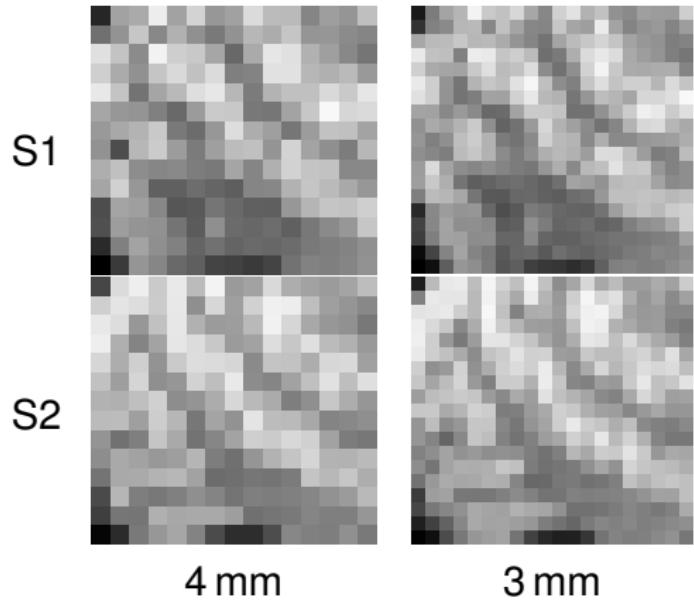
Similarity structure analysis works
with **any kind of model** and
across data modalities

But if 2nd-order is not enough?

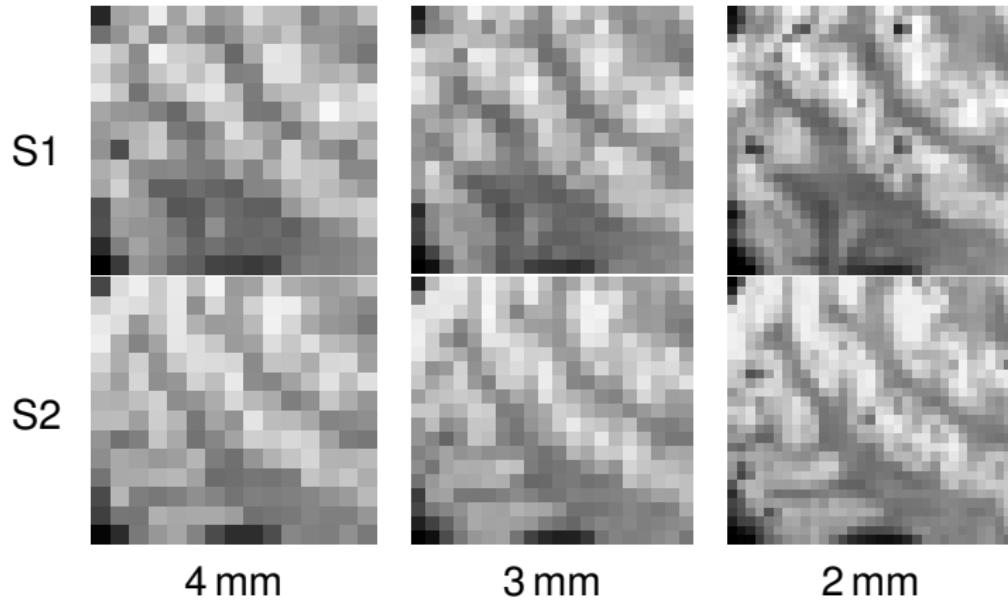
Localization – the end is near!



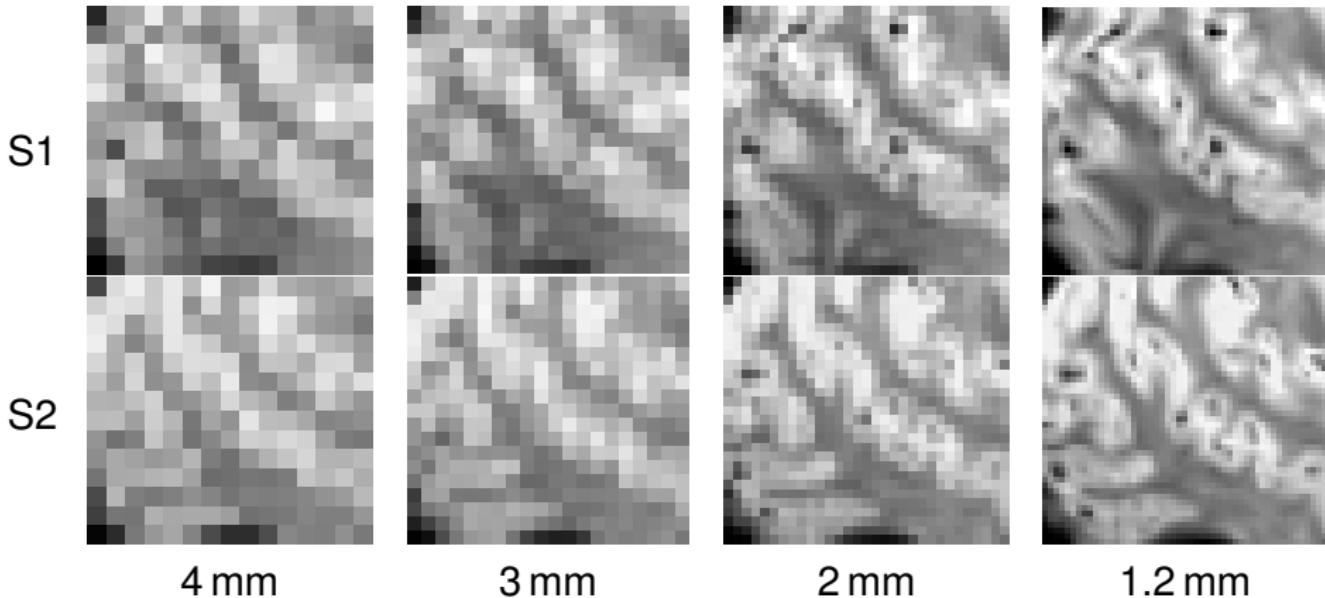
Localization – the end is near!



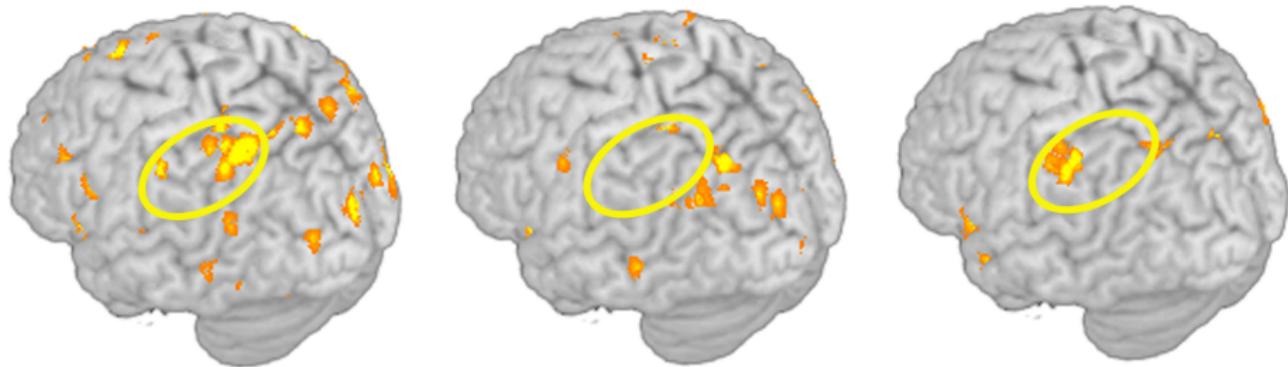
Localization – the end is near!



Localization – the end is near!

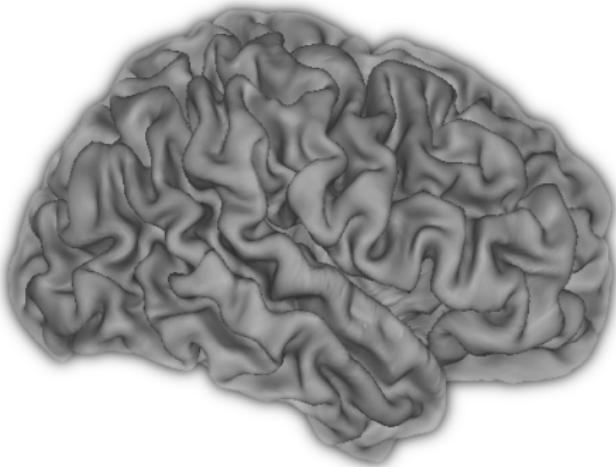
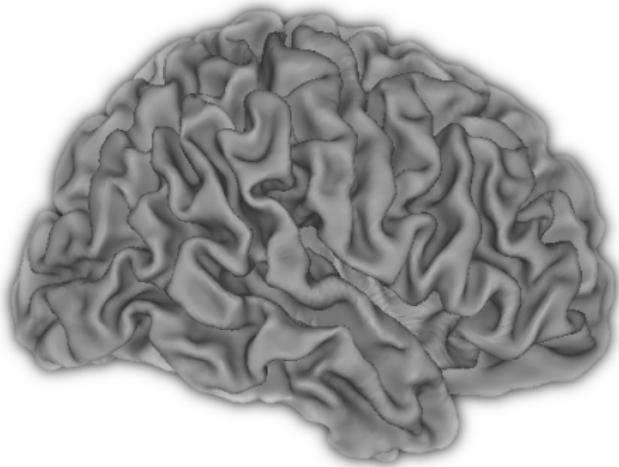


Idiosyncratic vs. common patterns

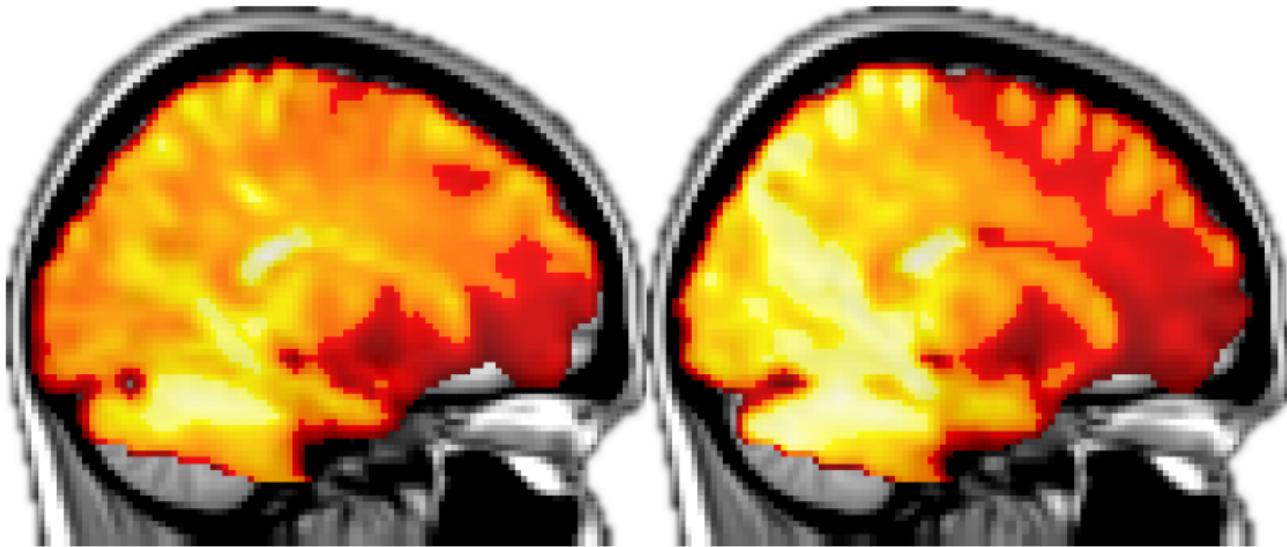


Diagnostic voxels for distinguishing perception of tools and dwellings – three different brains

”Hardware” alignment is no longer good enough

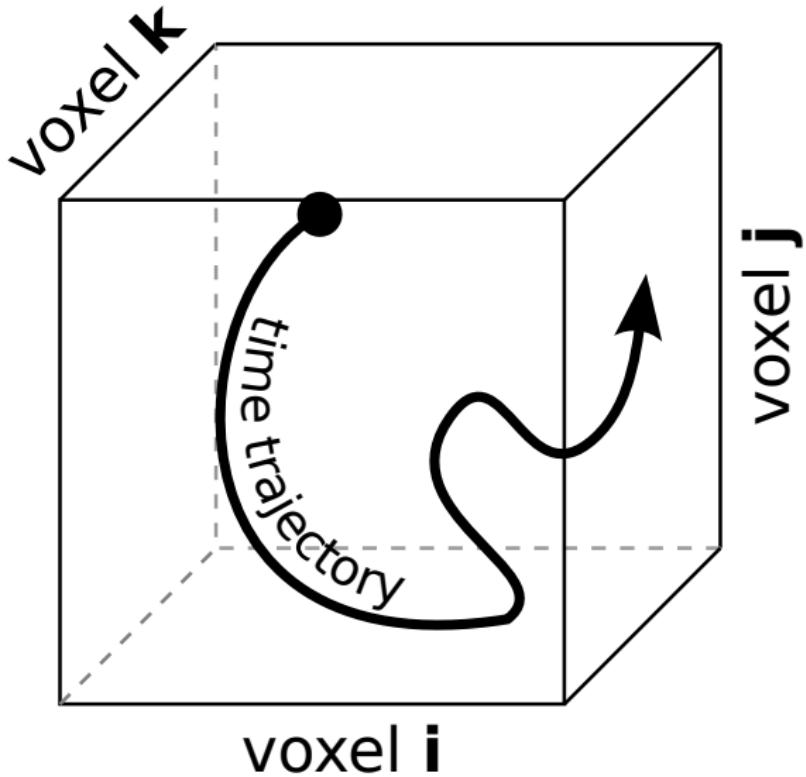


“Hardware” alignment is no longer good enough



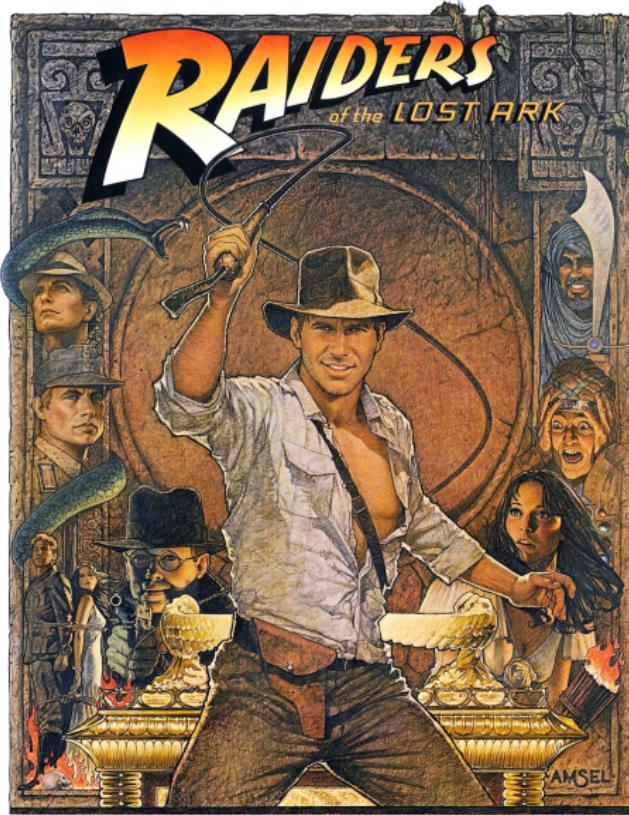
Wanted: functional alignment of brain states

Brain state – re-conceptualize alignment!

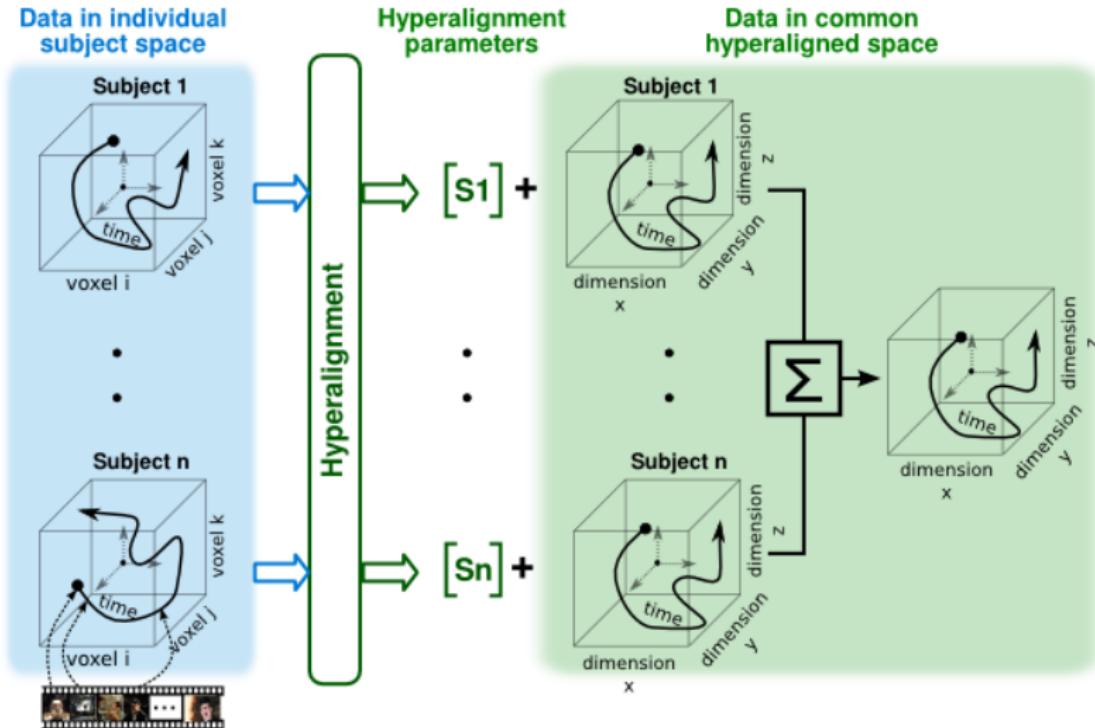


Brain state calibration: rich, “natural” stimulation

The Return of the Great Adventure.

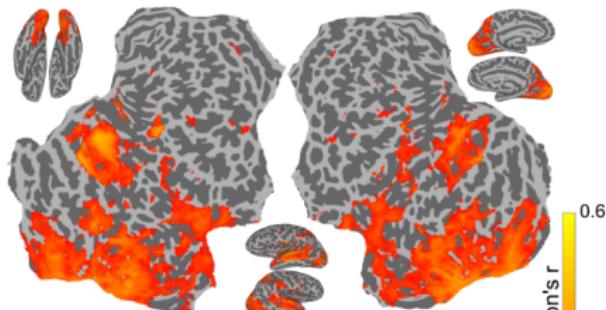


Hyperalignment: common feature space

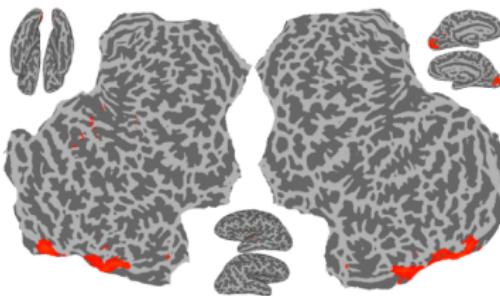


Hyperalignment: movie brain state group-similarity

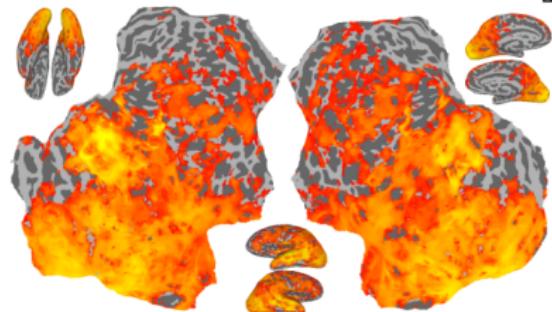
Anatomical alignment



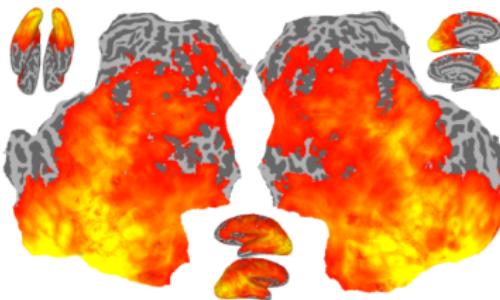
Anatomical alignment



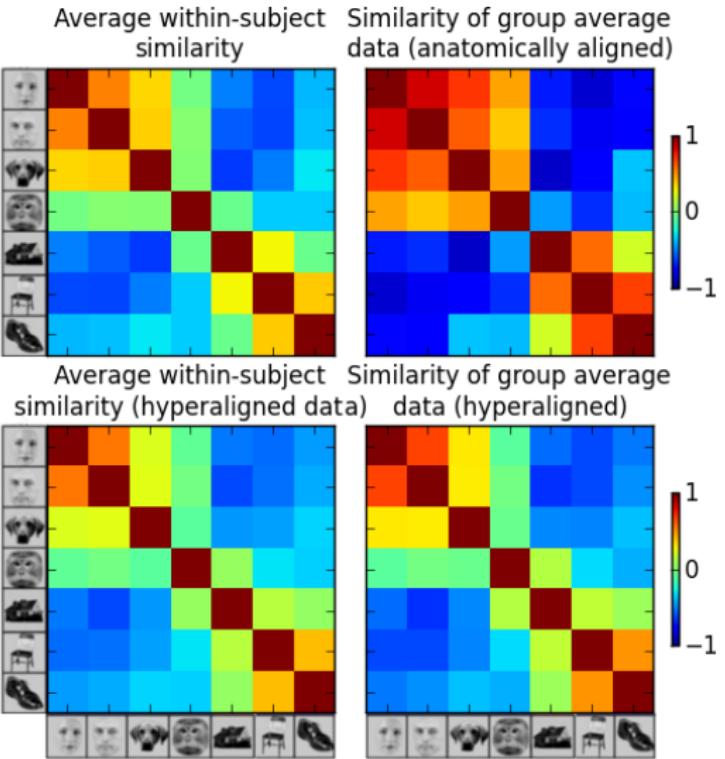
Hyperalignment



Hyperalignment



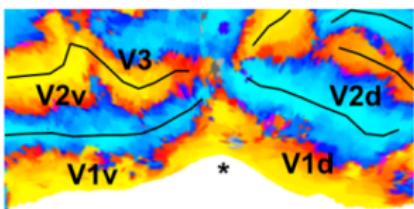
Hyperalignment: ventral visual pathway



Hyperalignment: retinotopic maps

A

Measured polar angle map

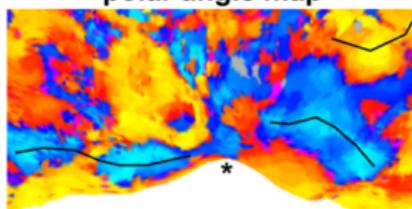


Horizontal
meridian

Vertical
meridian

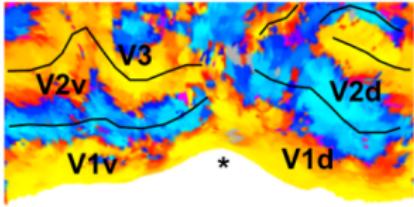
C

Anatomical alignment predicted polar angle map



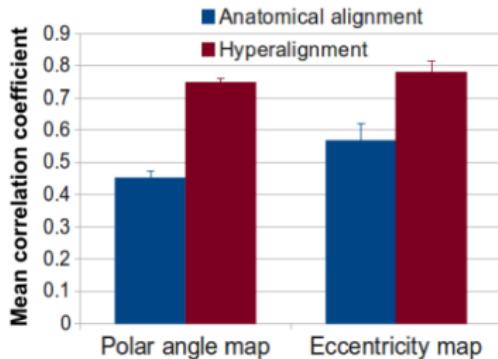
B

Hyperalignment predicted polar angle map



D

Between-subject correlation



General applicability?

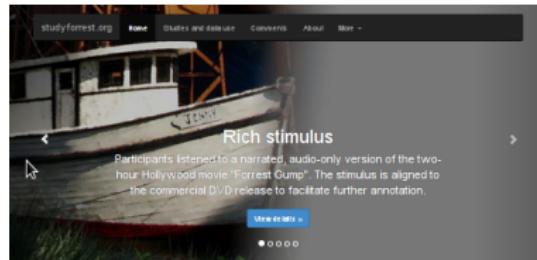
Investigate auditory representational spaces



- 2 h audio movie
- story narration
- verbal scene descriptions
- "shared memory"
- wide spectrum of music
- spans decades of "movie time"

355 GB of data published first!

- 20 participants (plus phantom)
- 2 hours of 7-Tesla fMRI (2 s TR, 1.4 mm)
- Simultaneous physiological data (respiratory, cardiac)
- 0.7 mm T1w, T2w
- Arteriography, venography
- DTI
- Movie annotations



Data overview

The dataset release contains a wide variety of structural brain scans and a large amount of functional brain scans. It includes the scans of 20 participants. Neuroimaging datasets accompanied by measurements of physiological and technical nature, as well as stimulus annotations.

[View the details](#)



Get data

All data are host on openneuro.org and are publicly available under an extremely permissive license.

[View the license](#)



Participate

Use these data for a scientific study, as a benchmark, to develop educational tools, or something else? We would like to know! Click the button below to share your original or derived work to enable new applications. Share this project with others.

[Get involved](#)

[Learn more](#)

News & Updates

- studyforrest et al.** [@openneuro](#) The test internal contribution (bugfix), long before the doi/paper is officially out! Thanks Chris! See you @Neuroscience in Kyoto! 1 day ago
- studyforrest et al.** [@openneuro](#) Revision 002 of the dataset has been tagged. Changes to [all participant datasets](#) (1 participant). 1 day ago
- studyforrest et al.** [@openneuro](#) 1 day ago

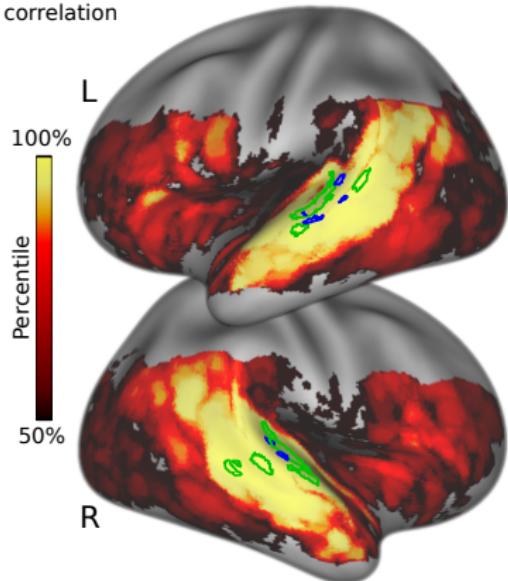


Most comprehensive public dataset on natural language processing

Hanke et al., Scientific Data, 2014 (promotion at nature.com in May)

Preliminary results: auditory processing

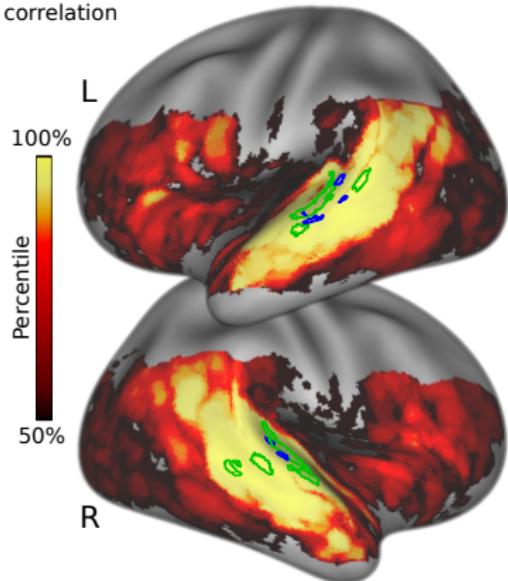
Inter-subject
correlation



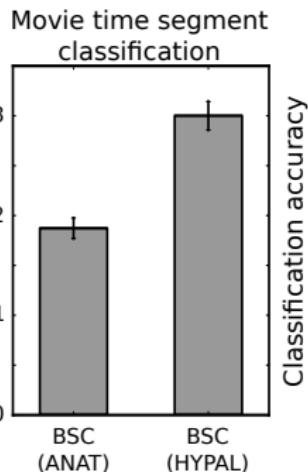
Linear alignment >99% percentile Non-linear alignment

Preliminary results: auditory processing

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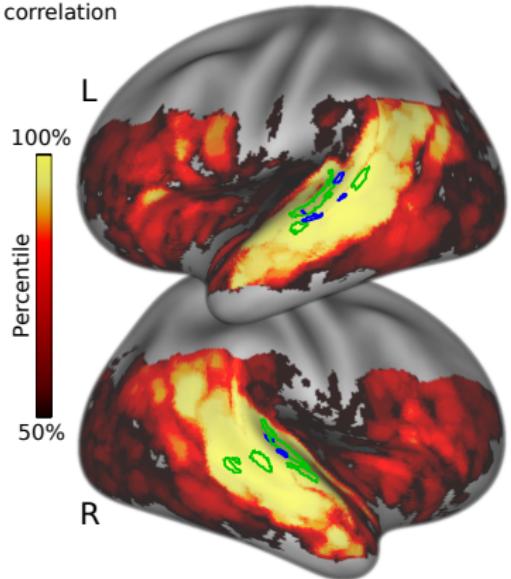


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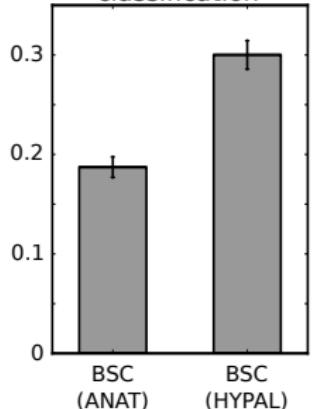
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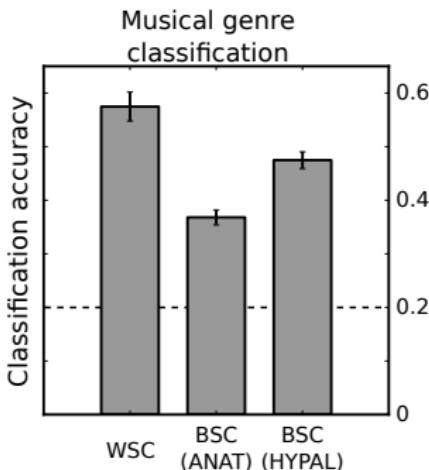


Linear alignment >99% percentile Non-linear alignment

Movie time segment
classification

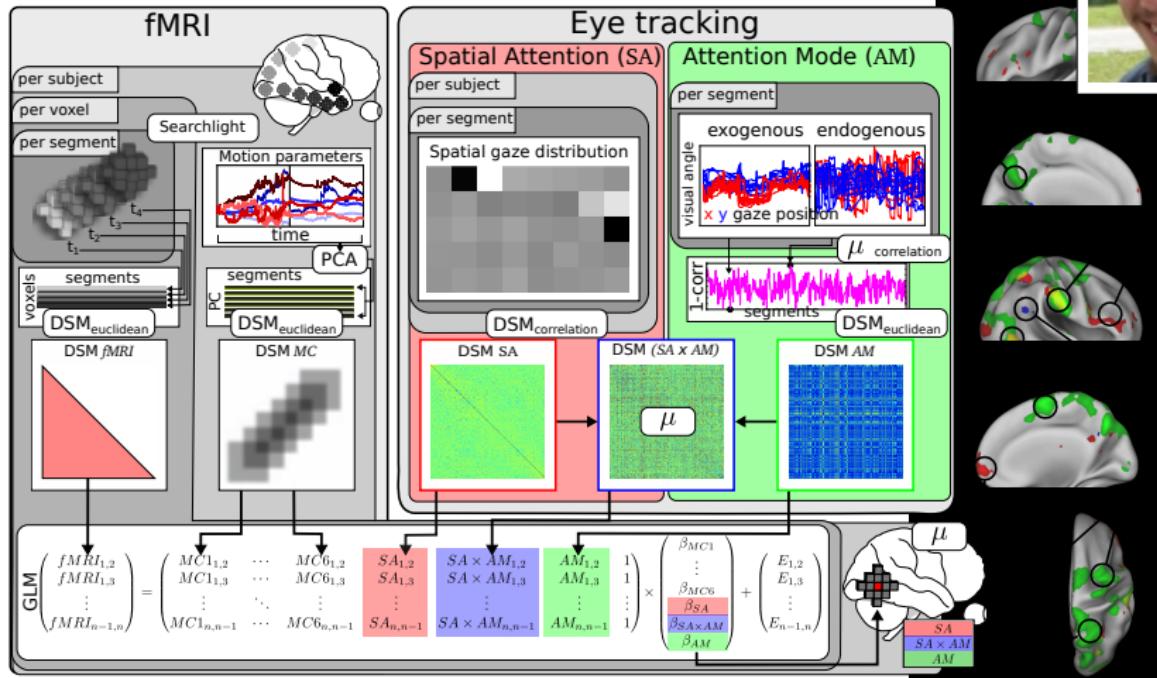


Musical genre
classification



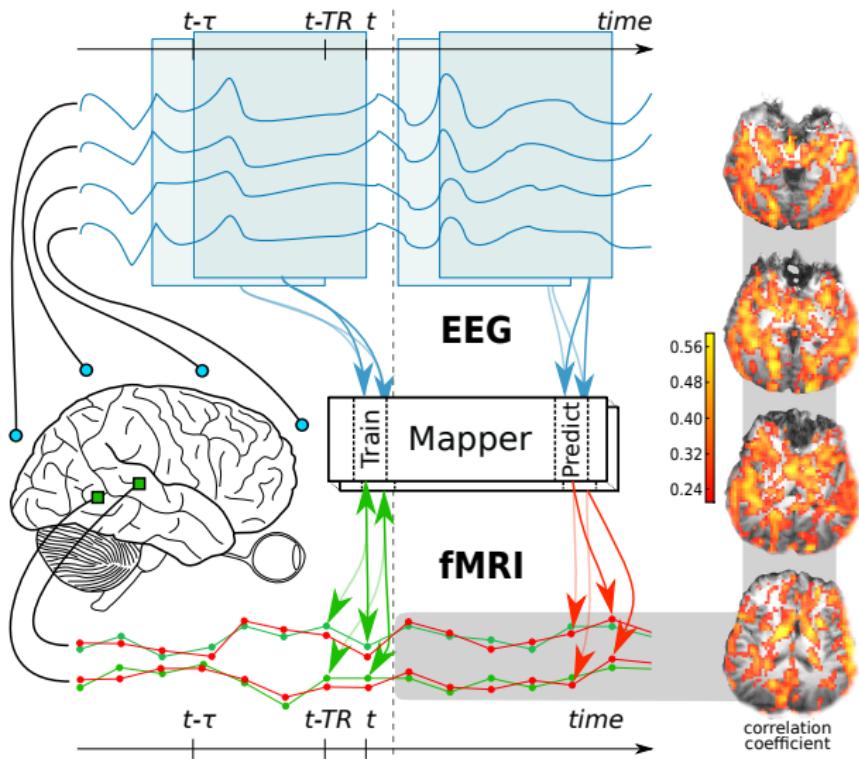
Multimodal analysis

Visual attention



Upcoming data acquisition: fMRI + eye-tracking during audio-visual Forrest Gump

EEG/fMRI



Halchenko, Y. O. and Hanke, M. (2010). Advancing Neuroimaging Research with Predictive Multivariate Pattern Analysis (MVPA). *The Neuromorphic Engineer*

References

- Connolly, A. C., Guntupalli, J. S., Gors, J., Hanke, M., Halchenko, Y. O., Wu, Y.-C., Abdi, H., and Haxby, J. V. (2012). Representation of biological classes in the human brain. *Journal of Neuroscience*, 32:2608–2618. PMC3532035.
- Halchenko, Y. O. and Hanke, M. (2010). Advancing Neuroimaging Research with Predictive Multivariate Pattern Analysis (MVPA). *The Neuromorphic Engineer*.
- Hanke, M., Halchenko, Y. O., Sederberg, P. B., Olivetti, E., Fründ, I., Rieger, J. W., Herrmann, C. S., Haxby, J. V., Hanson, S. J., and Pollmann, S. (2009). PyMVPA: A unifying approach to the analysis of neuroscientific data. *Frontiers in Neuroinformatics*, 3(3). PMC2638552.