Recent and upcoming developments

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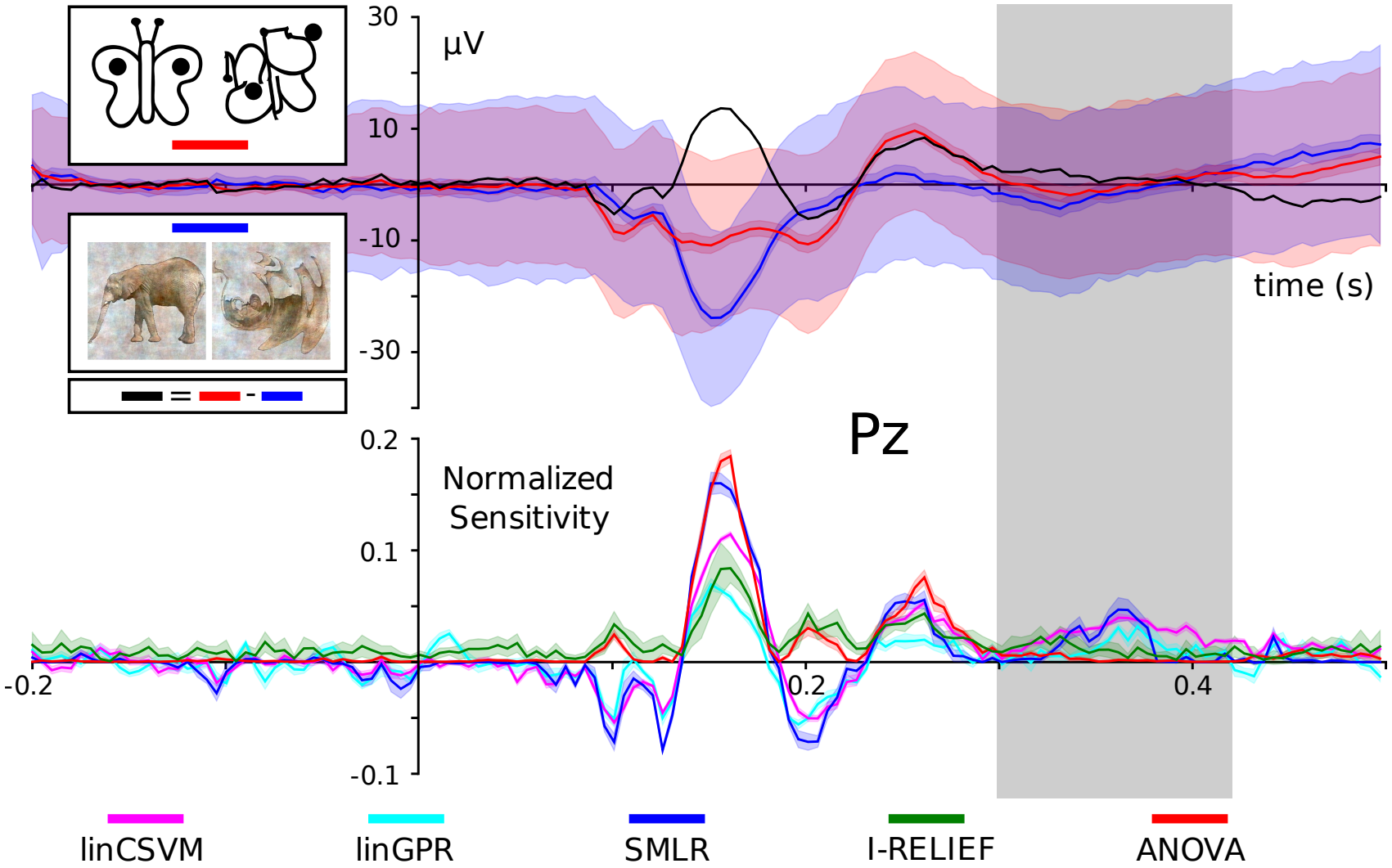
Delmenhorst 2014

Modality agnostic

sensitivity analysis

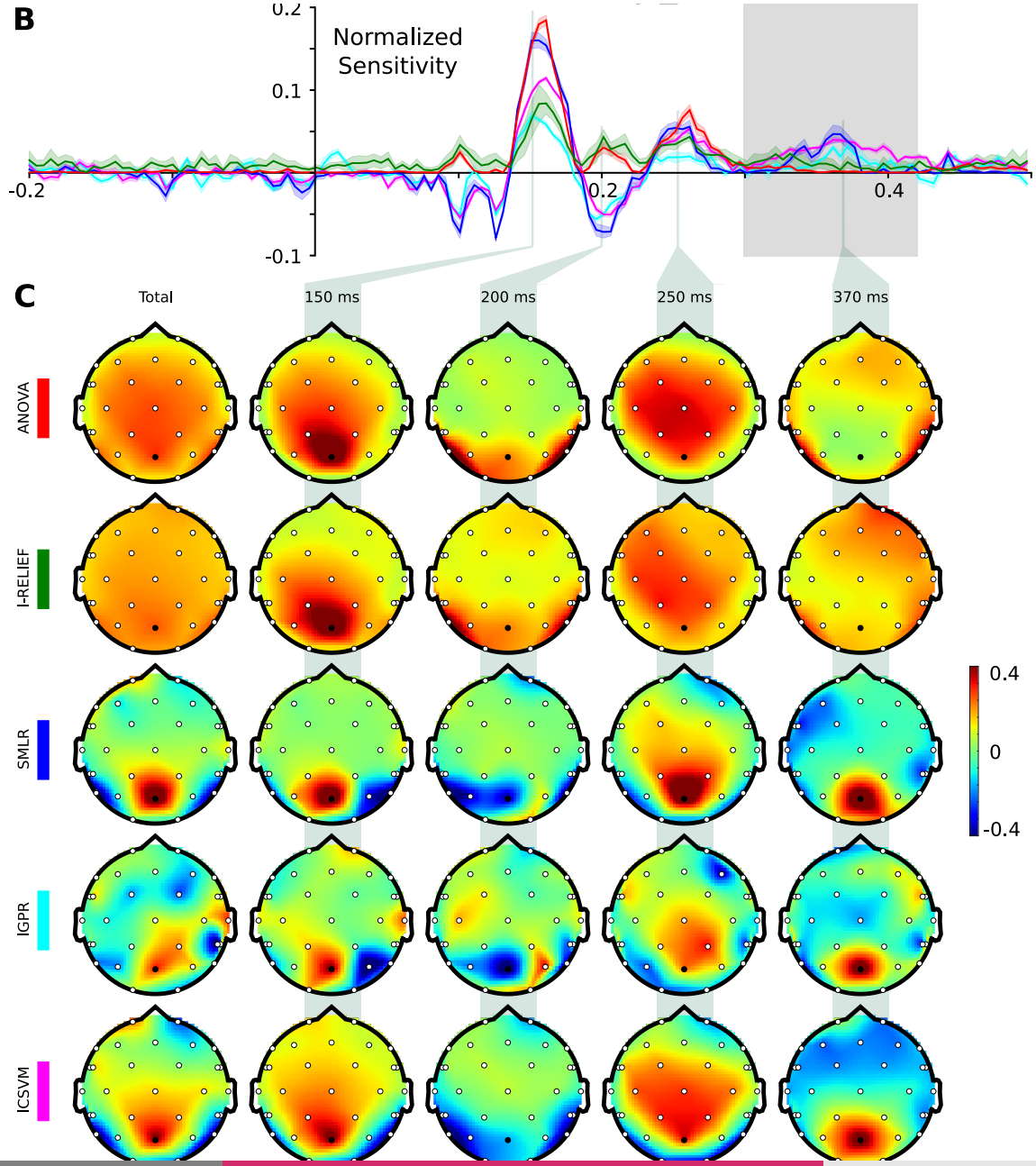
Modality-independent: EEG



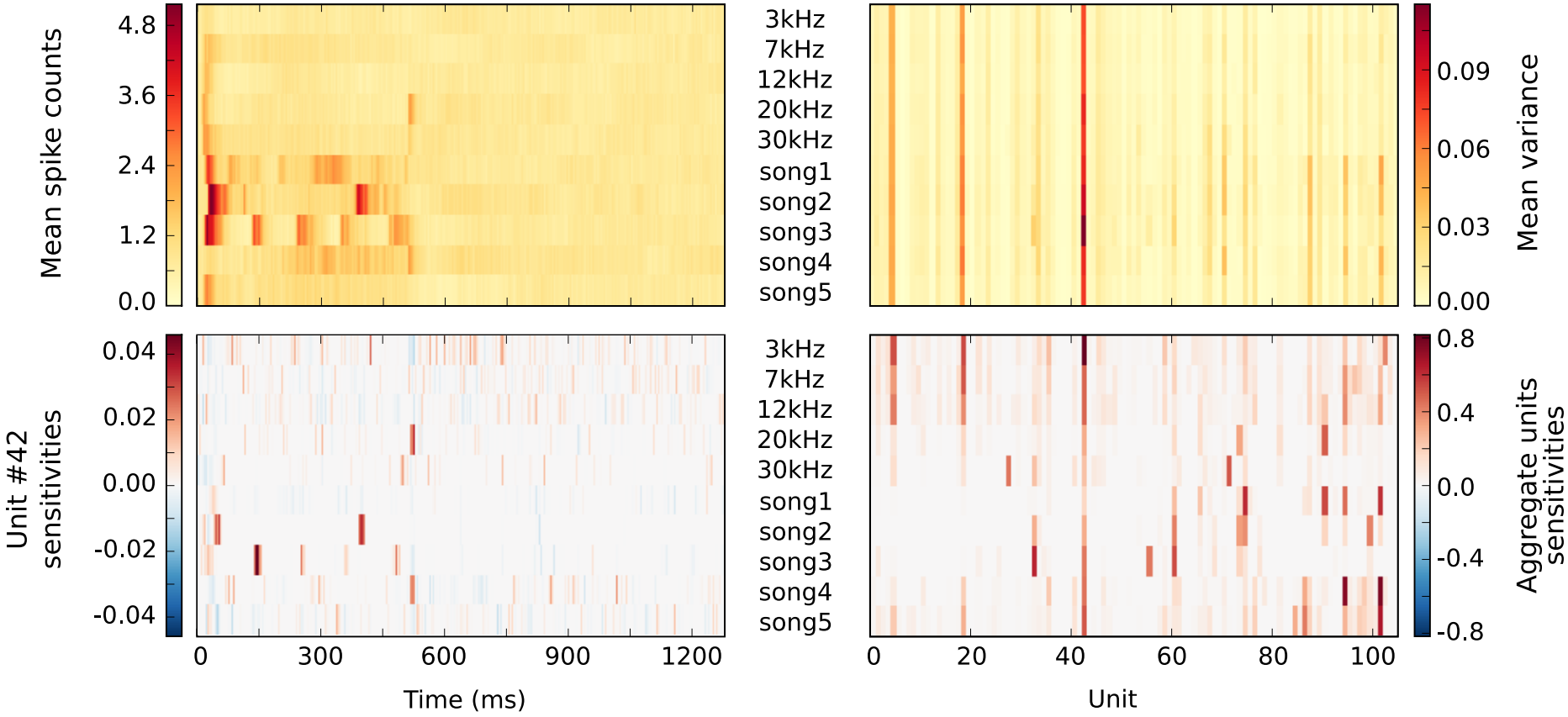
86.2% 89.6% 91.8%

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

Modality-independent: EEG Temporal Profile

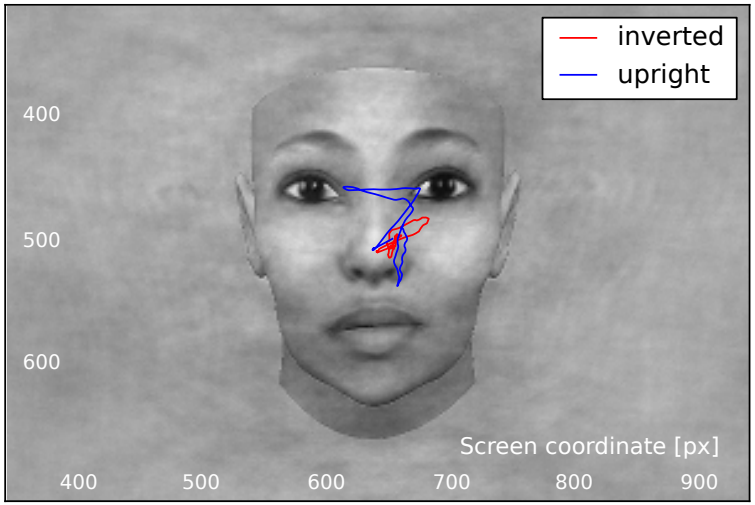


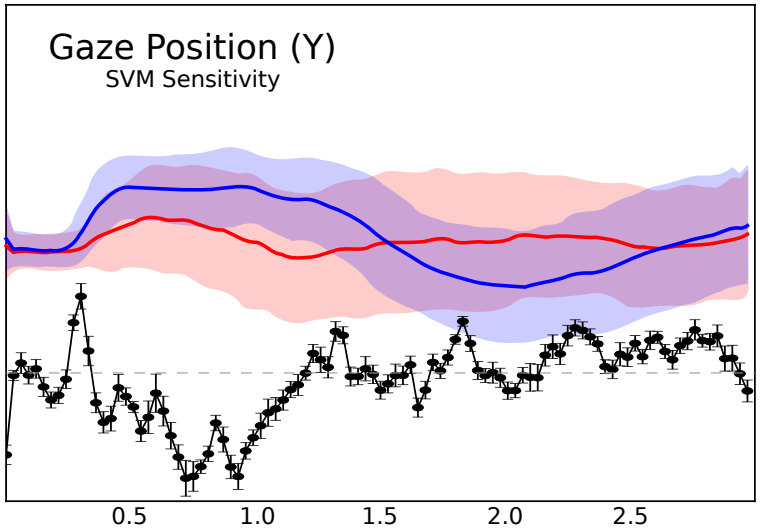
Modality-independent: Spikes

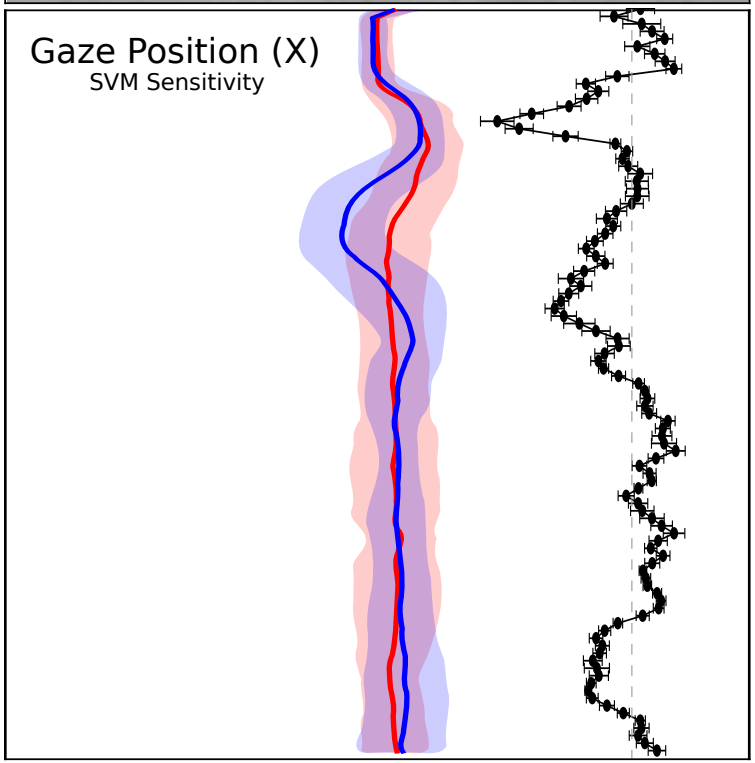


Hanke et al. (2009)

Modality-independent: Eye movements



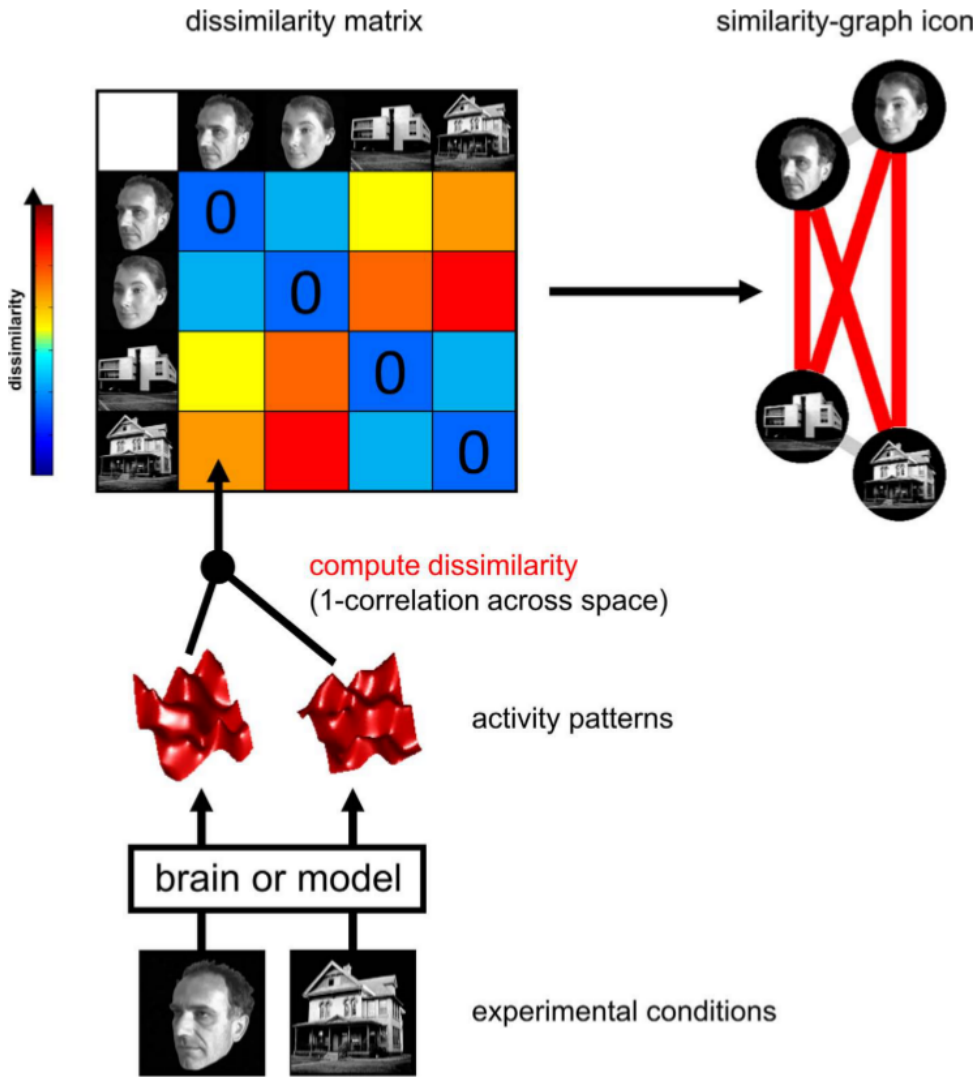




Similarity structure analysis

2nd-order isomorphism

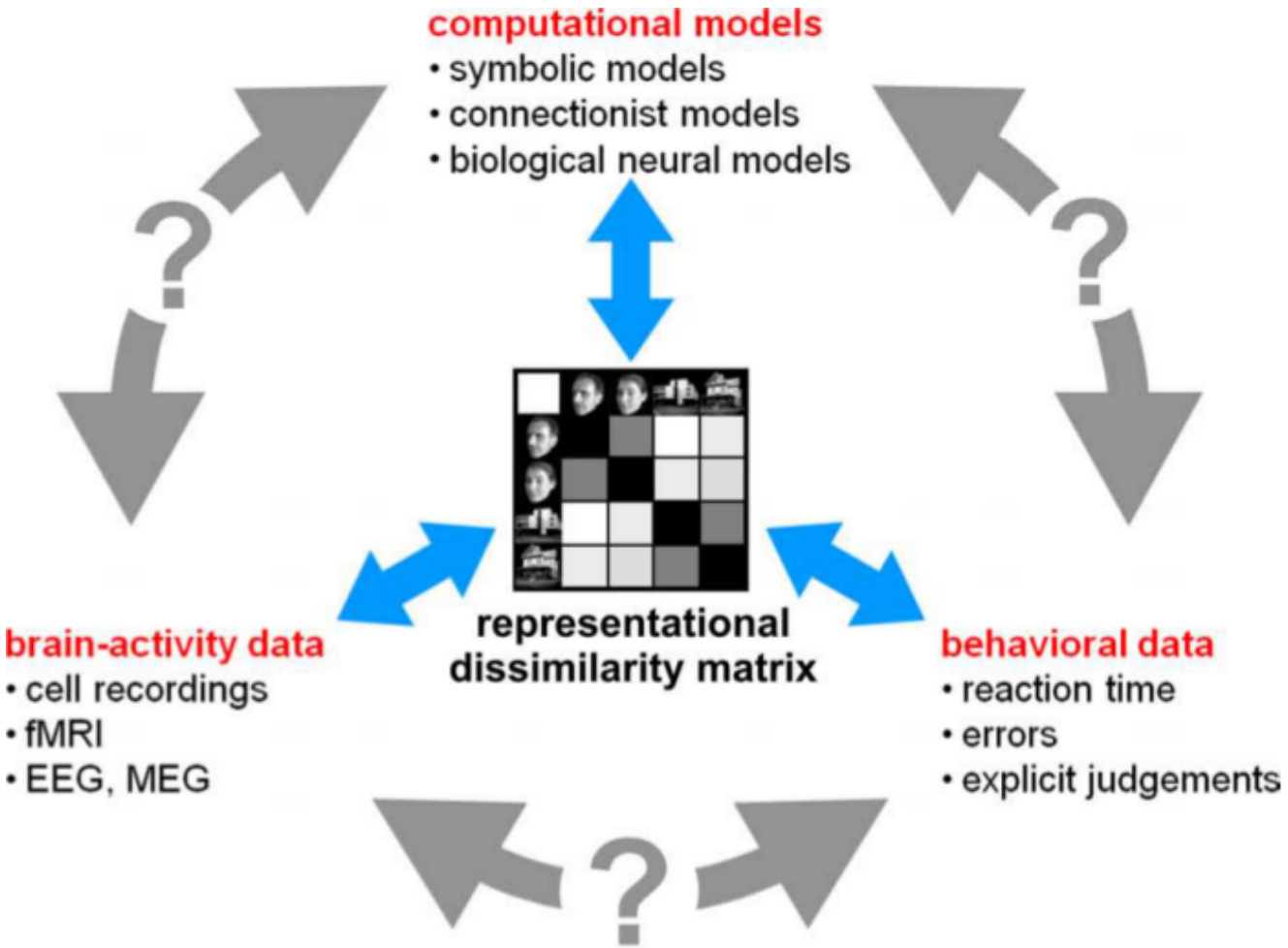
similarity of similarity structure



Kriegeskorte et al., Frontiers in Systems Neuroscience, 2008

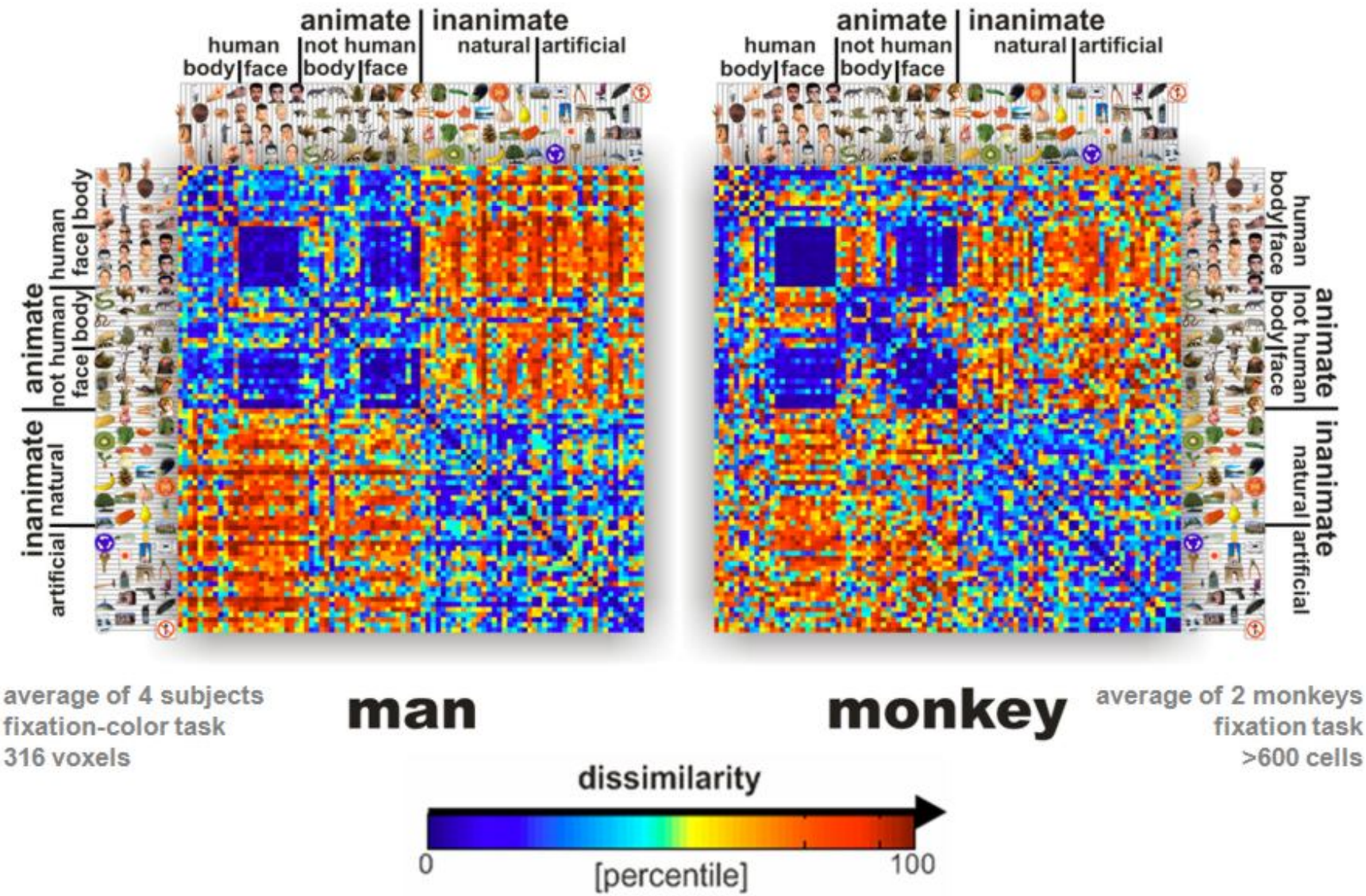
2nd-order isomorphism

similarity of similarity structure



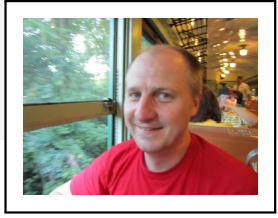
Kriegeskorte et al., Frontiers in Systems Neuroscience, 2008

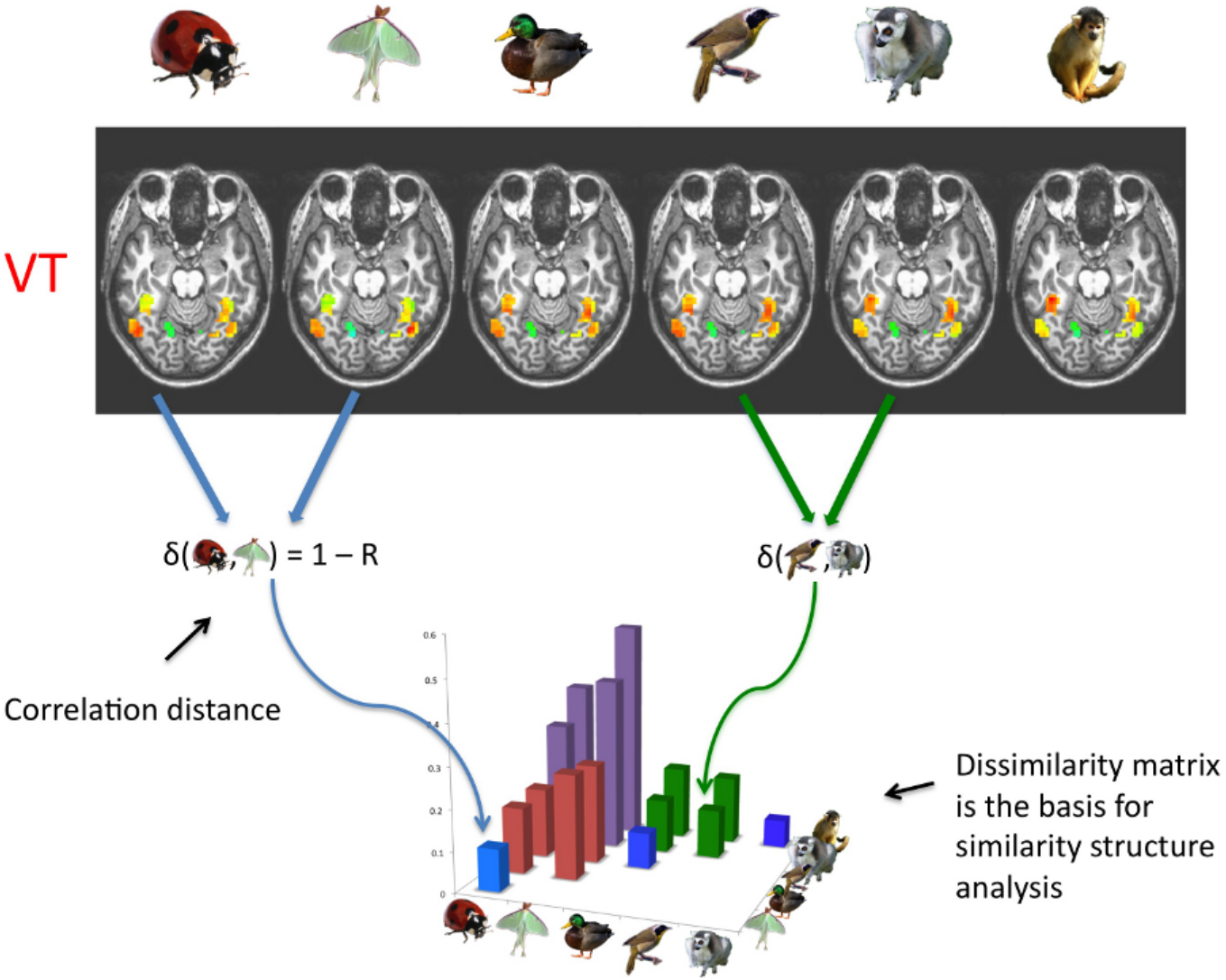
Representational spaces across species



Kriegeskorte et al., COSYNE, 2008

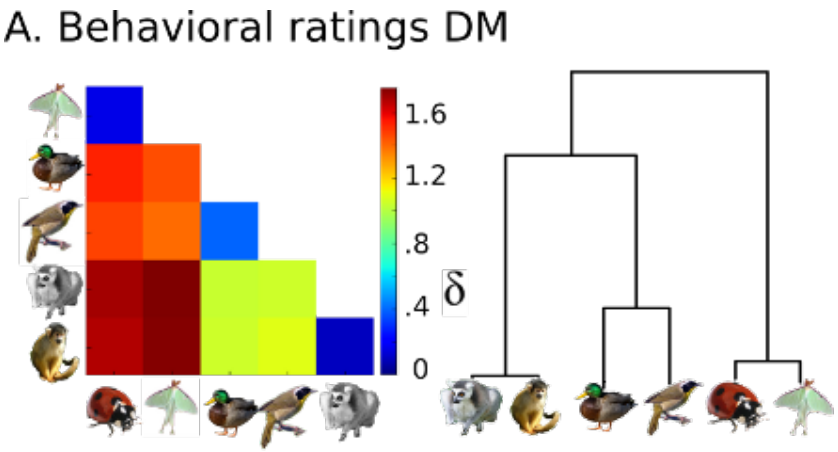
Similarity Analyses

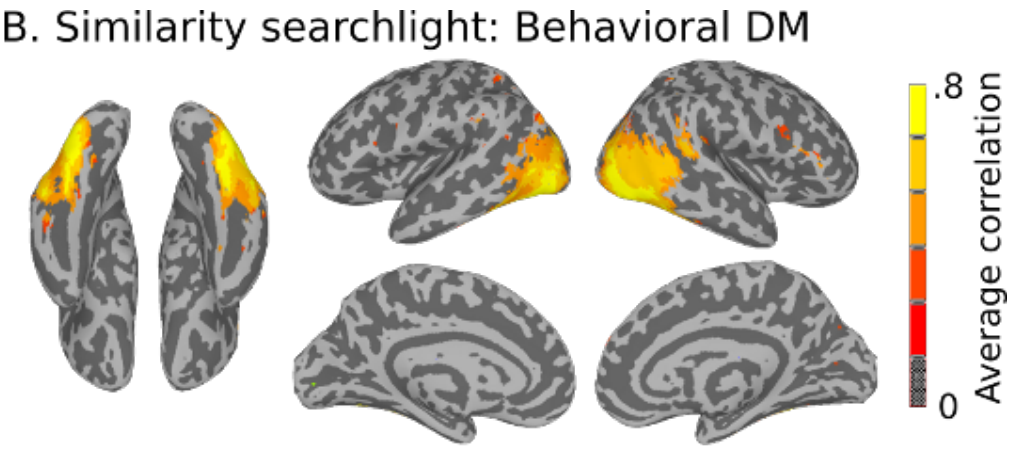


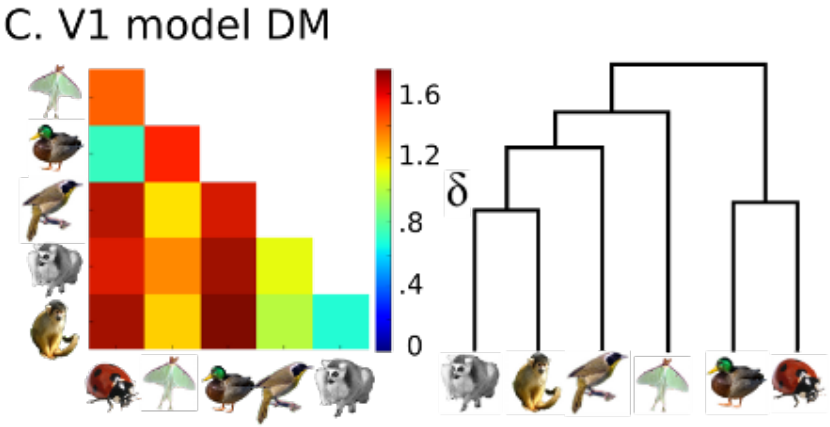


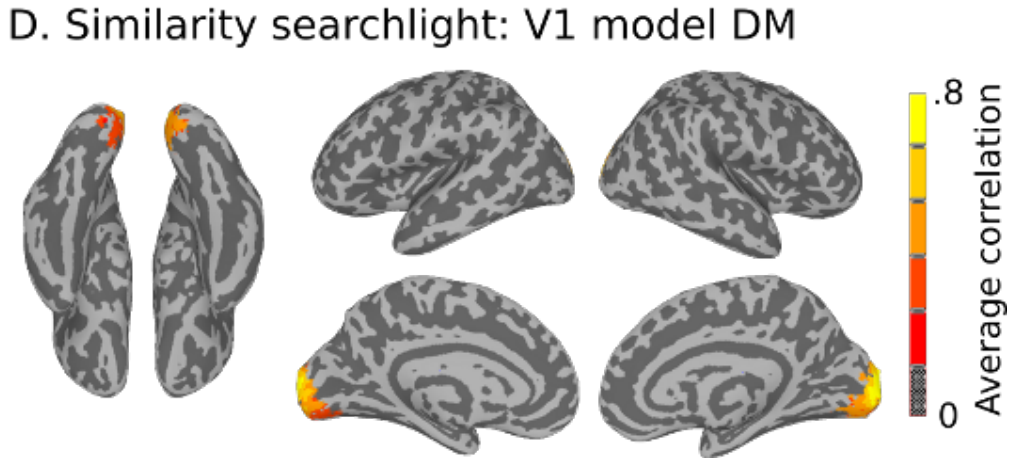
Connolly et al. (2012)

Similarity Analyses: V1 vs behavioral models



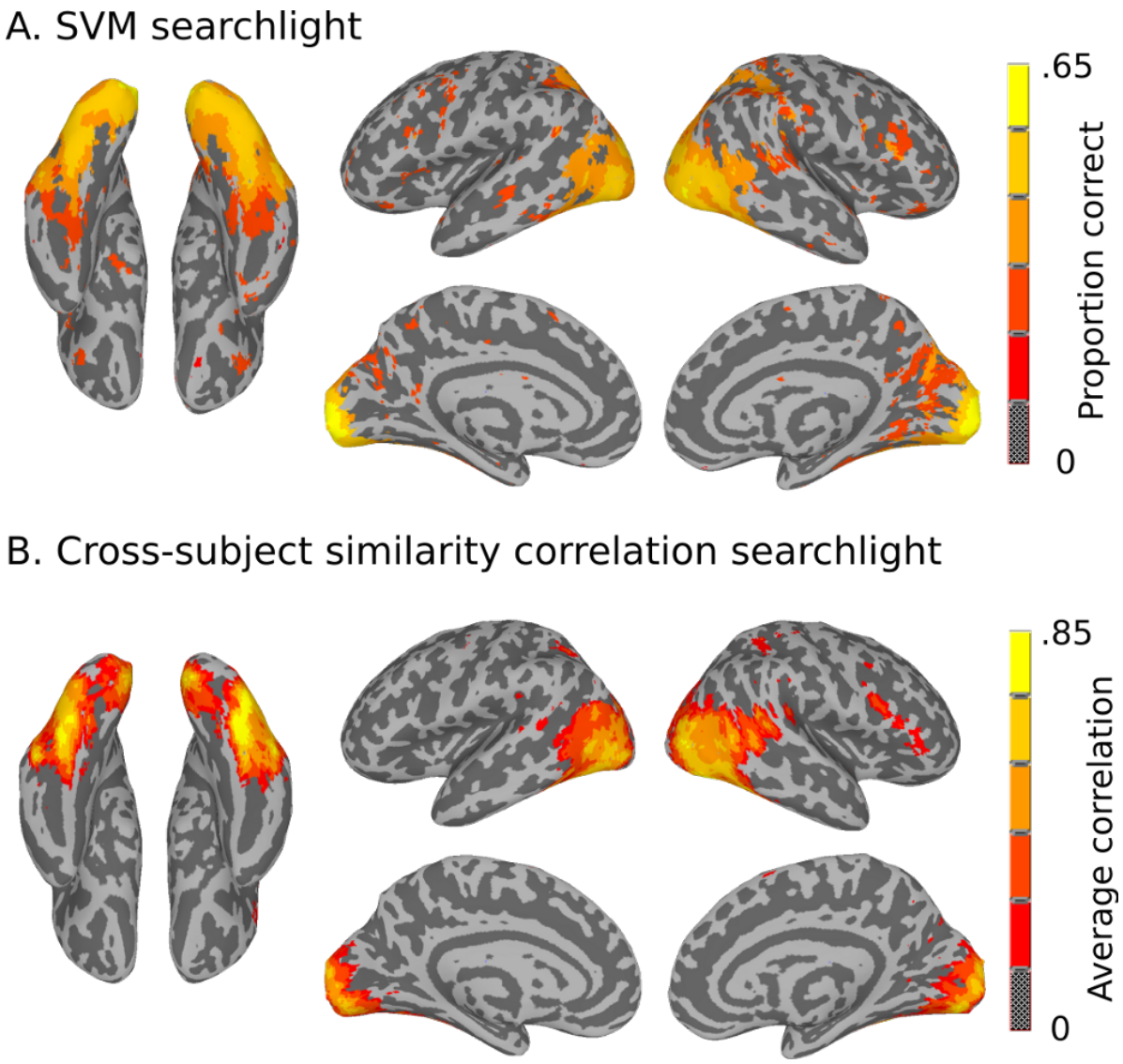






Connolly et al. (2012)

Similarity Analyses: Cross-subject agreement



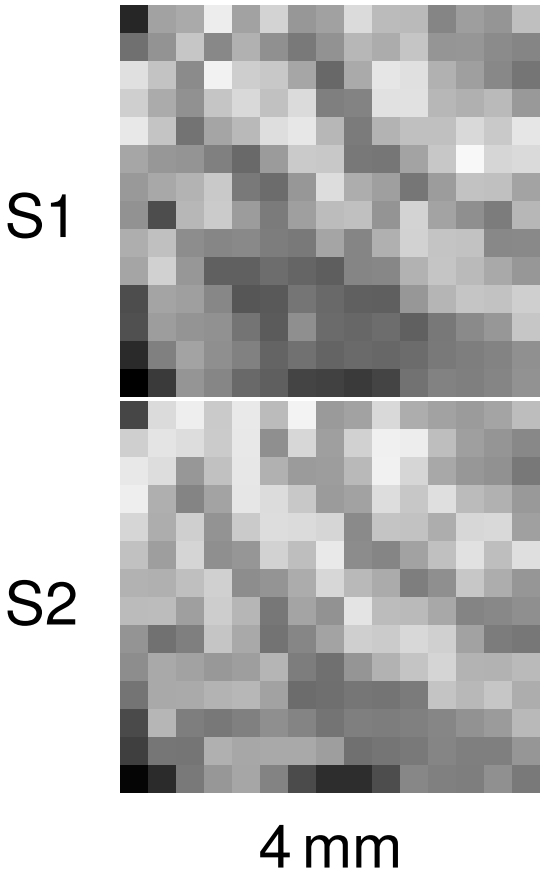
Connolly et al. (2012)

Take Home

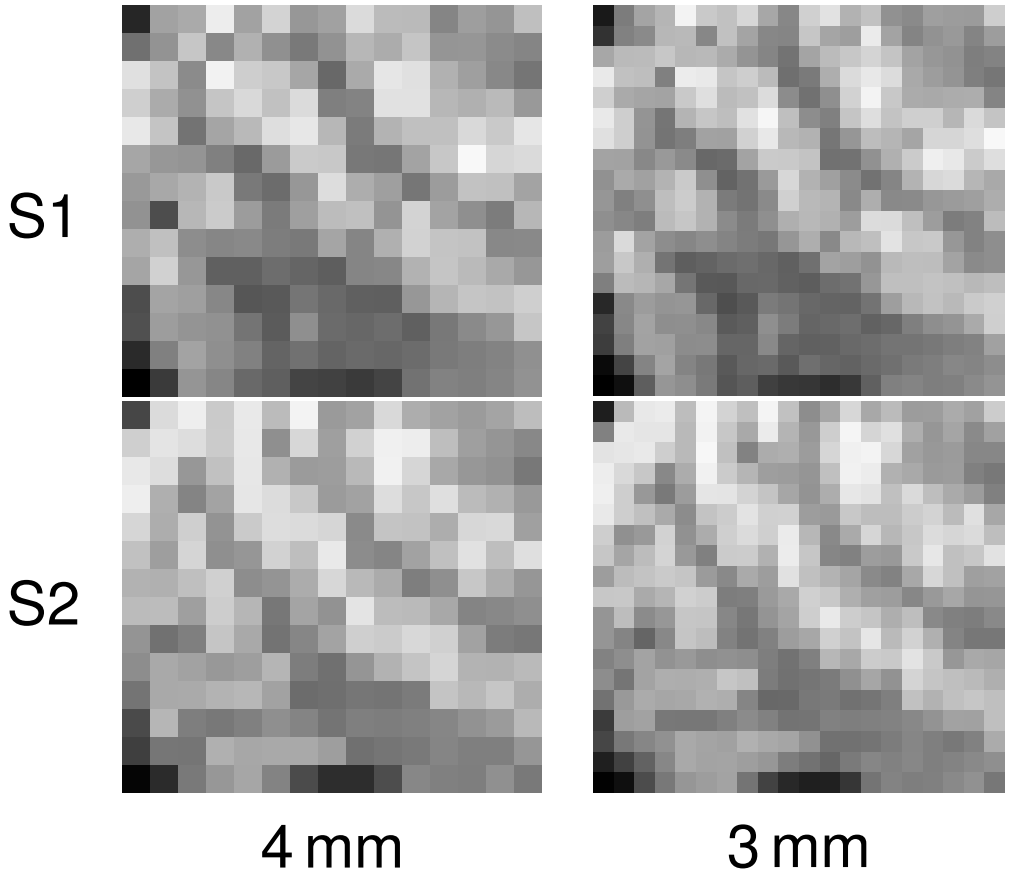
Similarity structure analysis works with **any kind of model** and **across data modalities**

But if 2nd-order is not enough?

Localization – the end is near!



Localization – the end is near!



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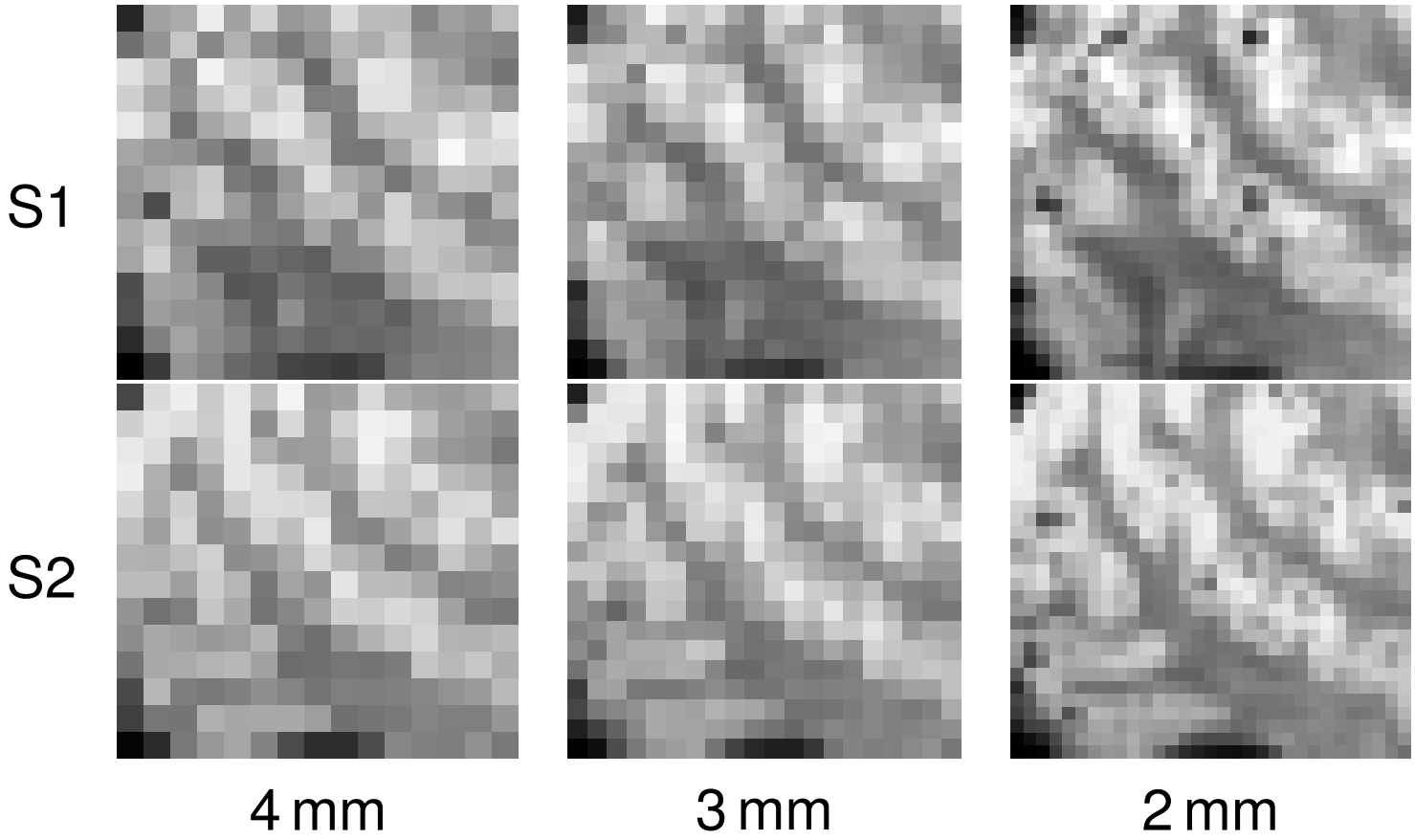

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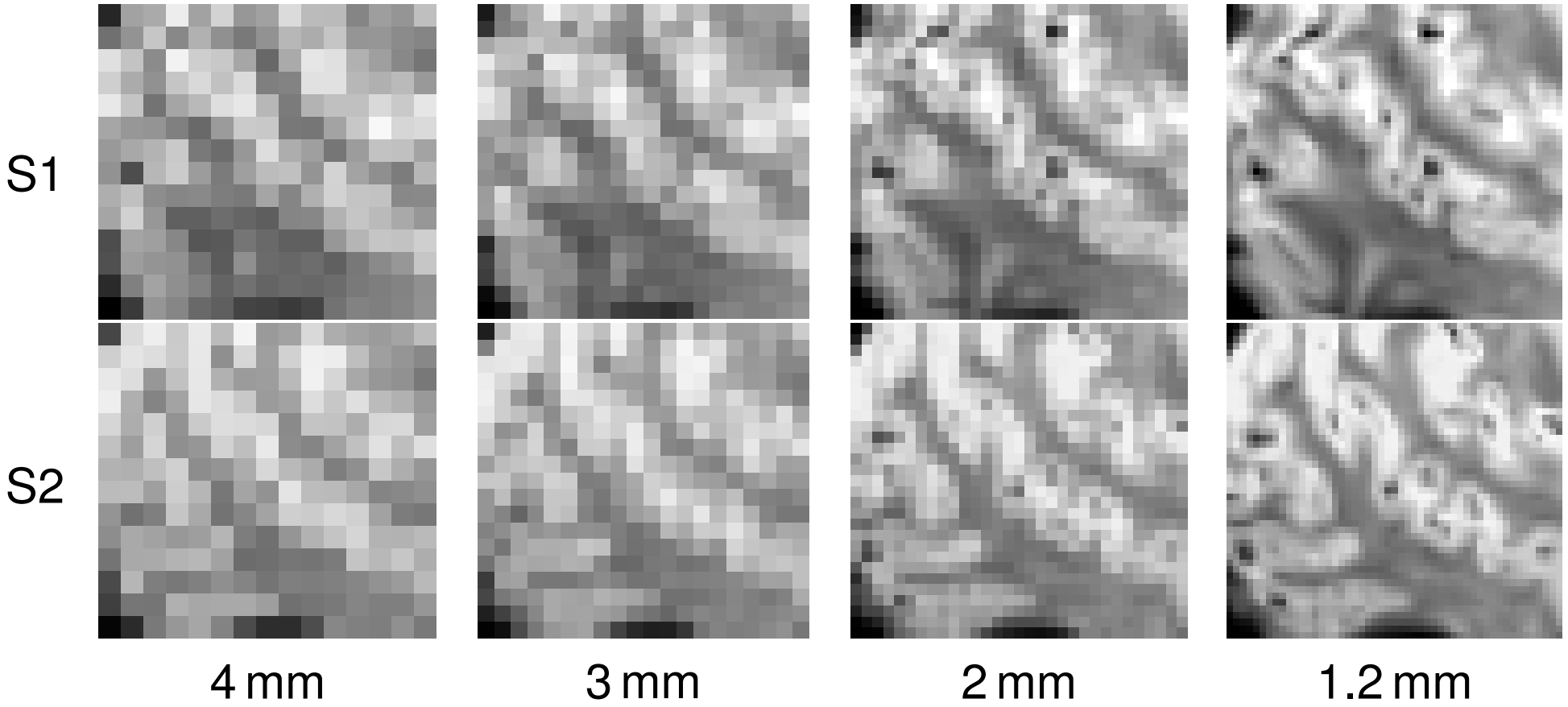
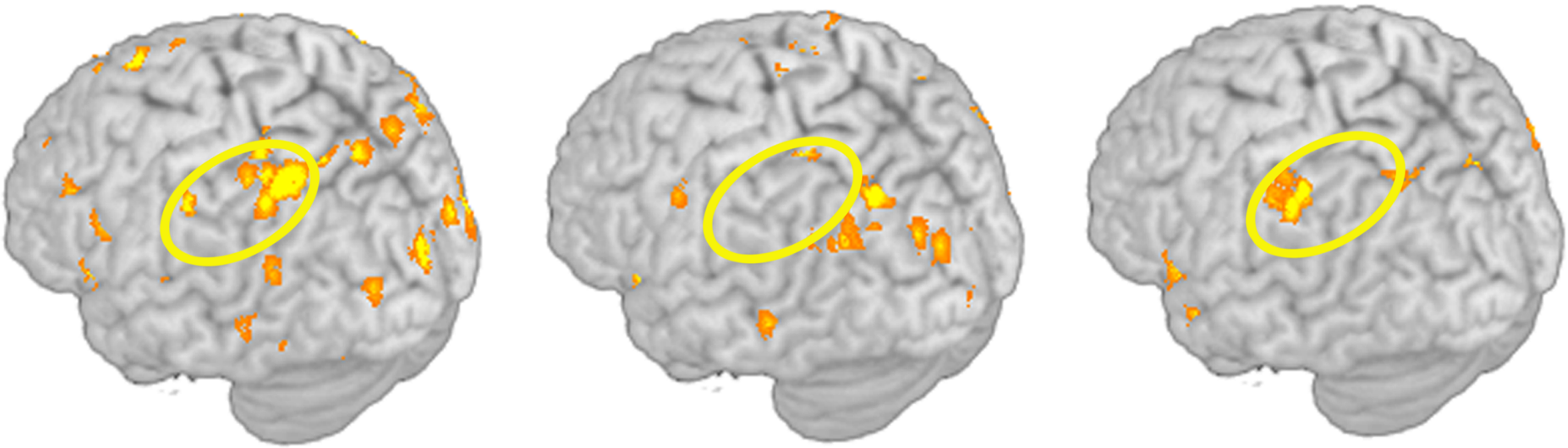


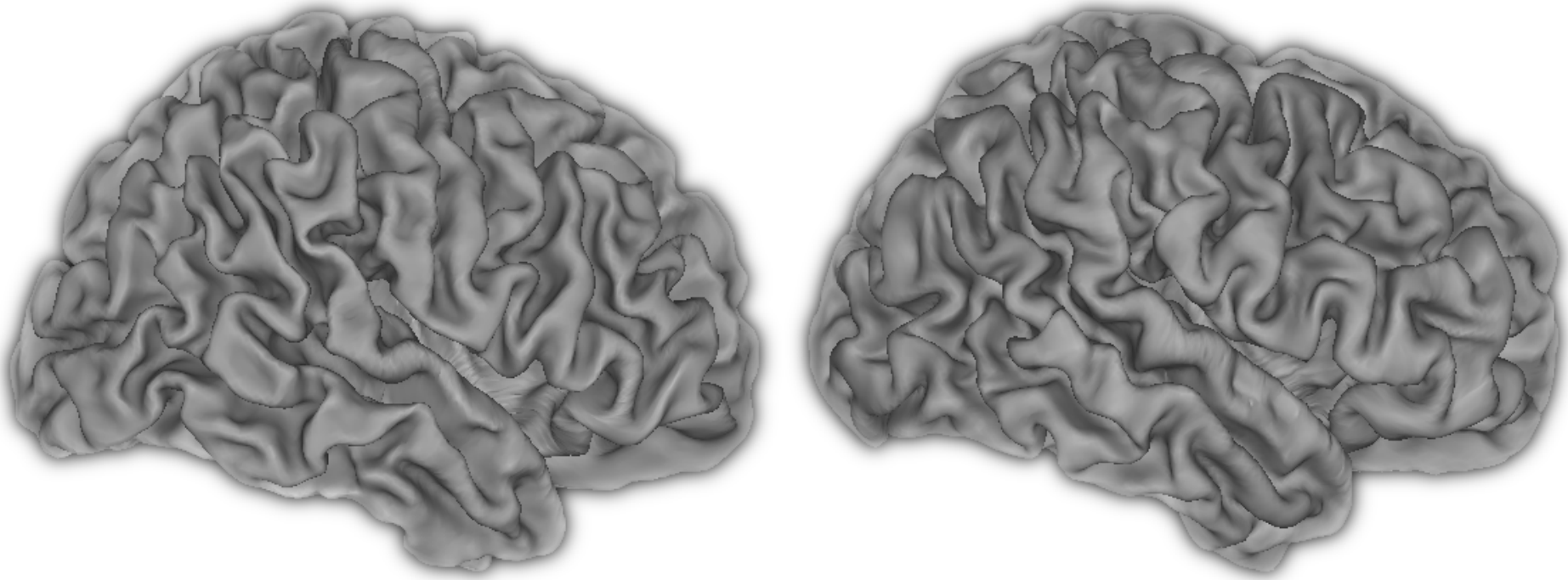
Idiosyncratic vs. common patterns



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

Mitchell et al. (2008)

"'Hardware"' alignment is no longer good enough



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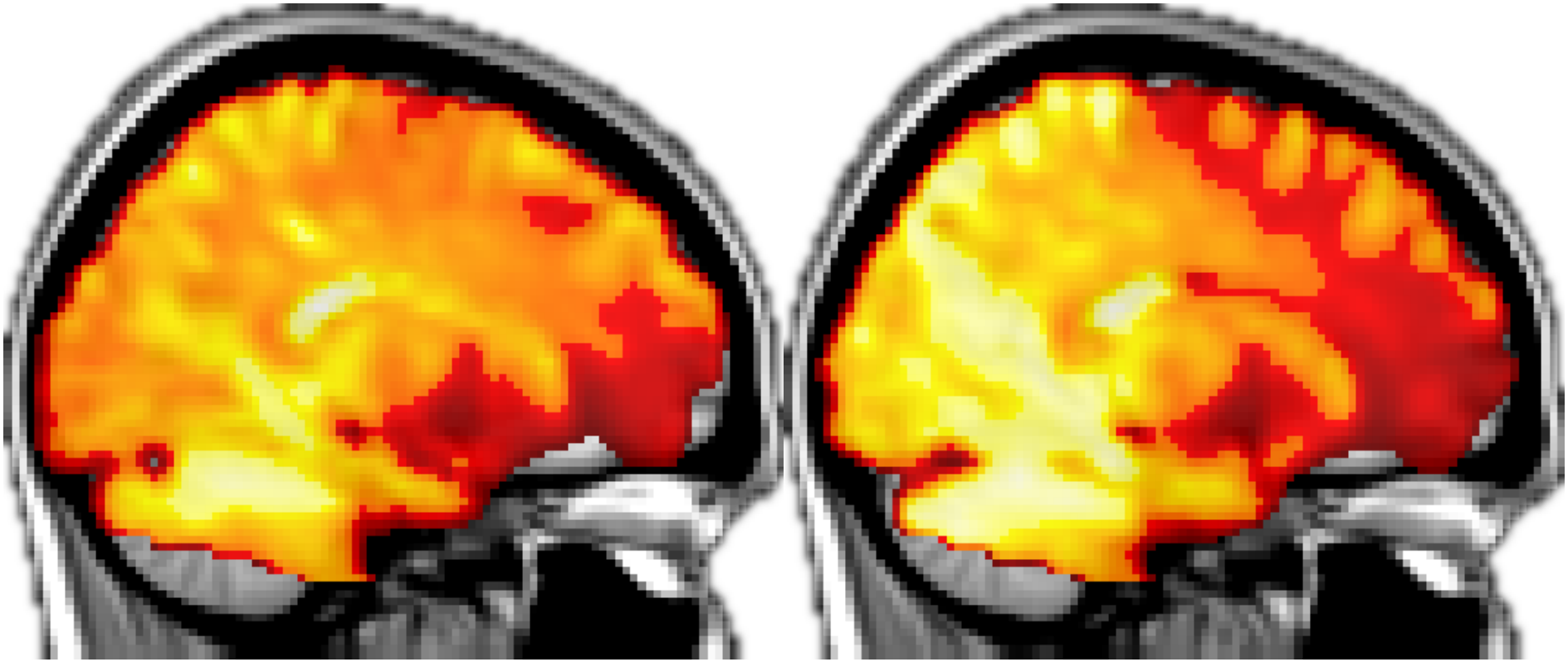
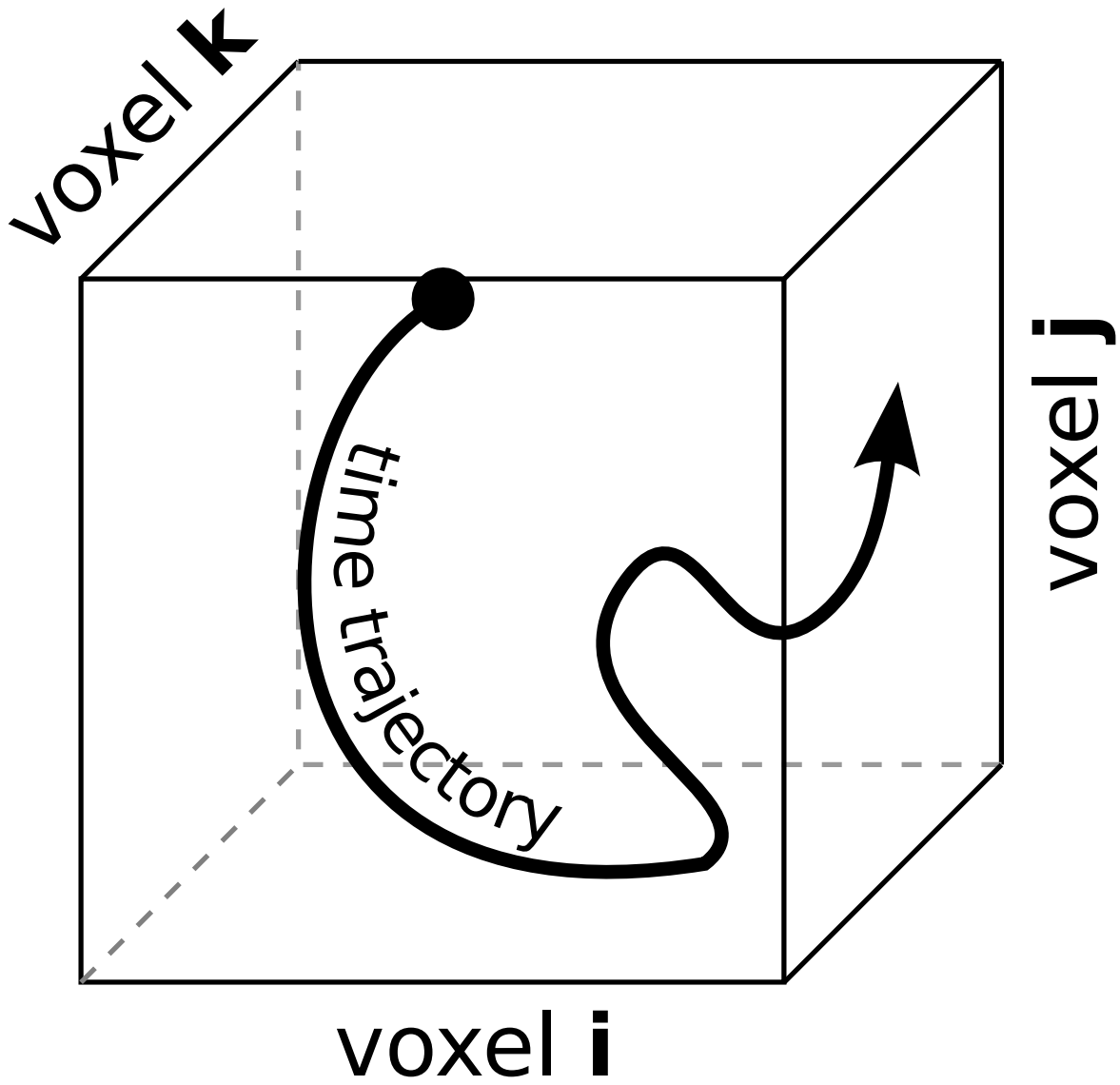
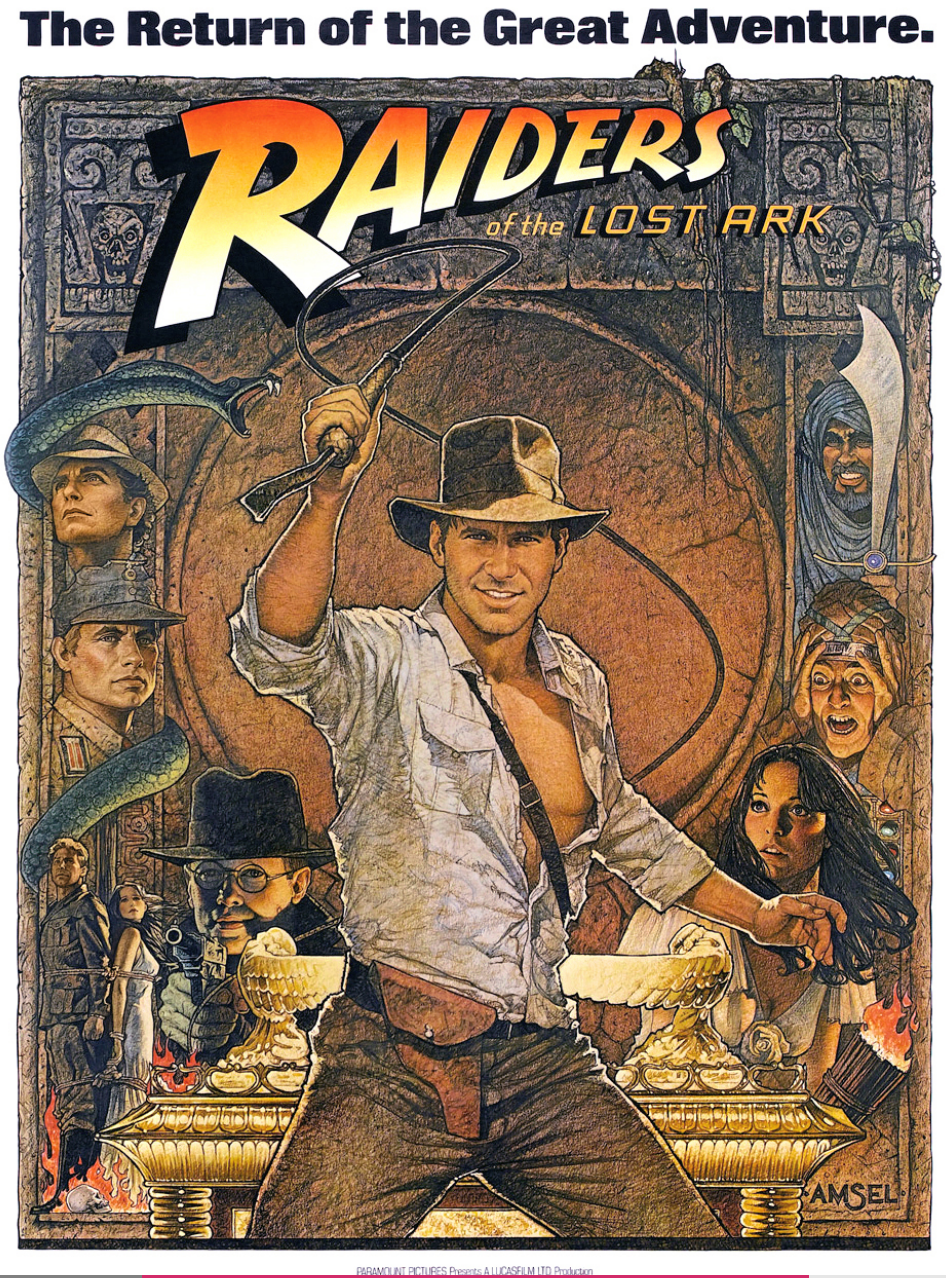


Wanted: functional alignment of brain states

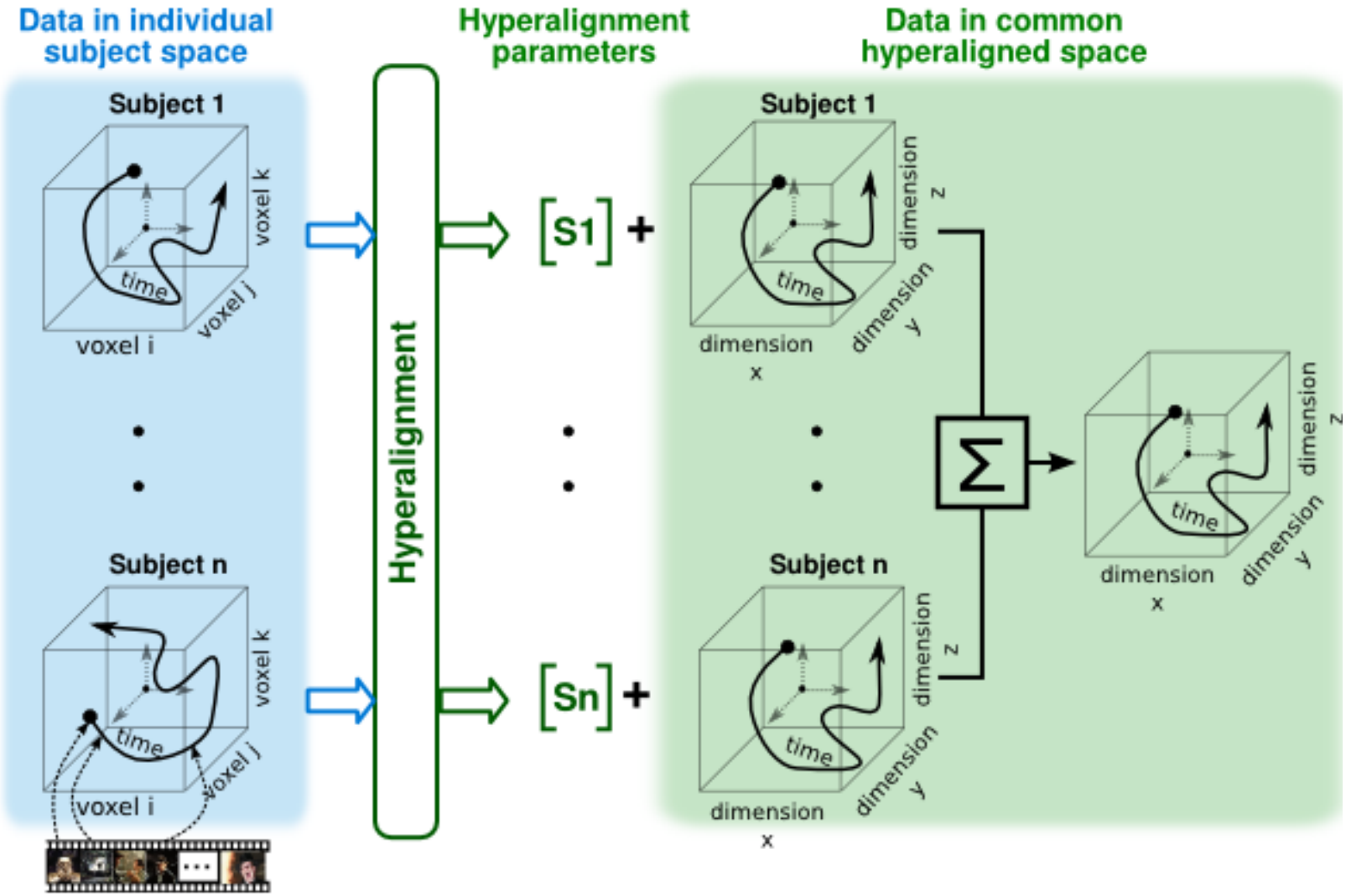
Brain state – re-conceptualize alignment!



Brain state calibration: rich, "'natural"' stimulation

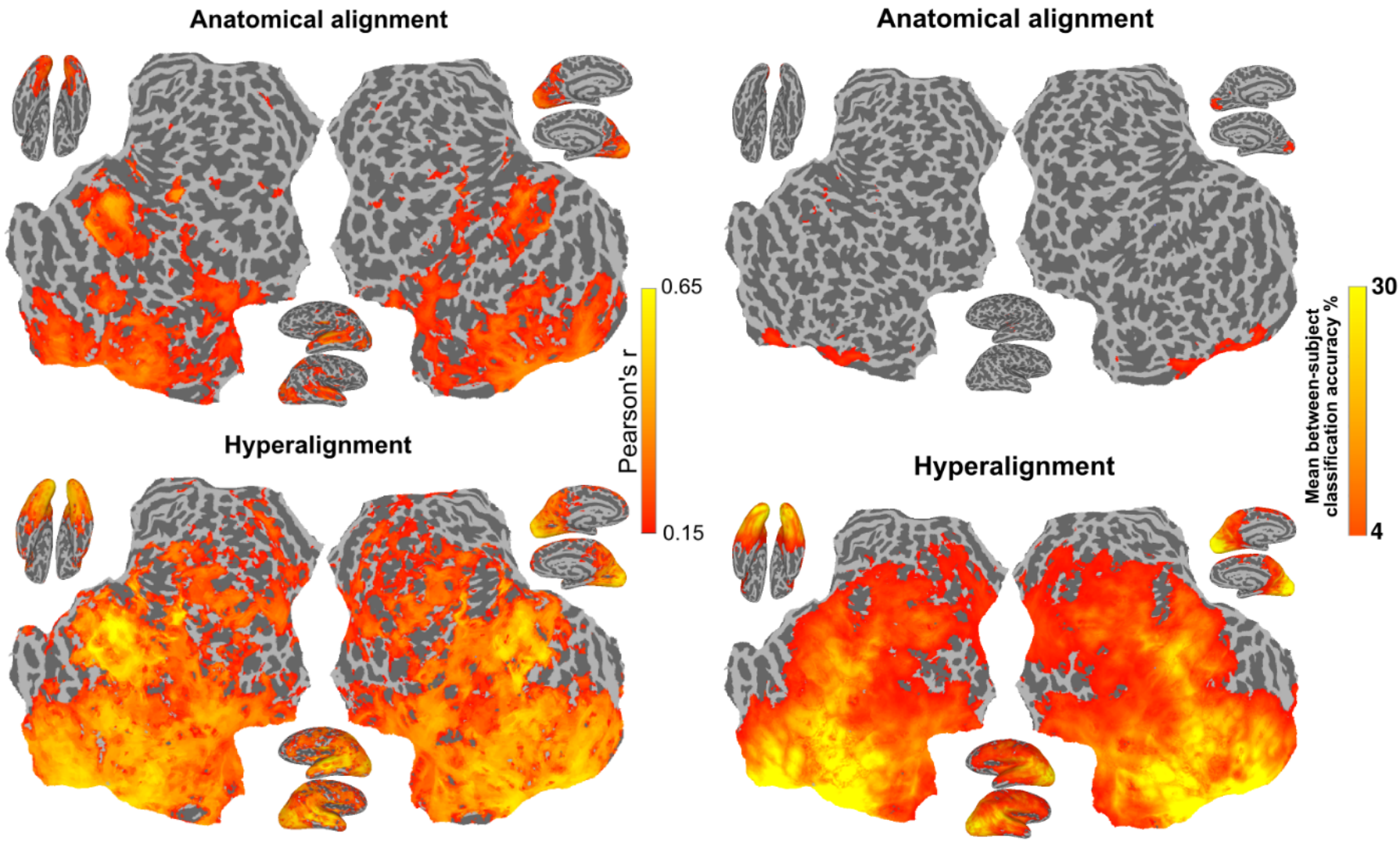


Hyperalignment: common feature space



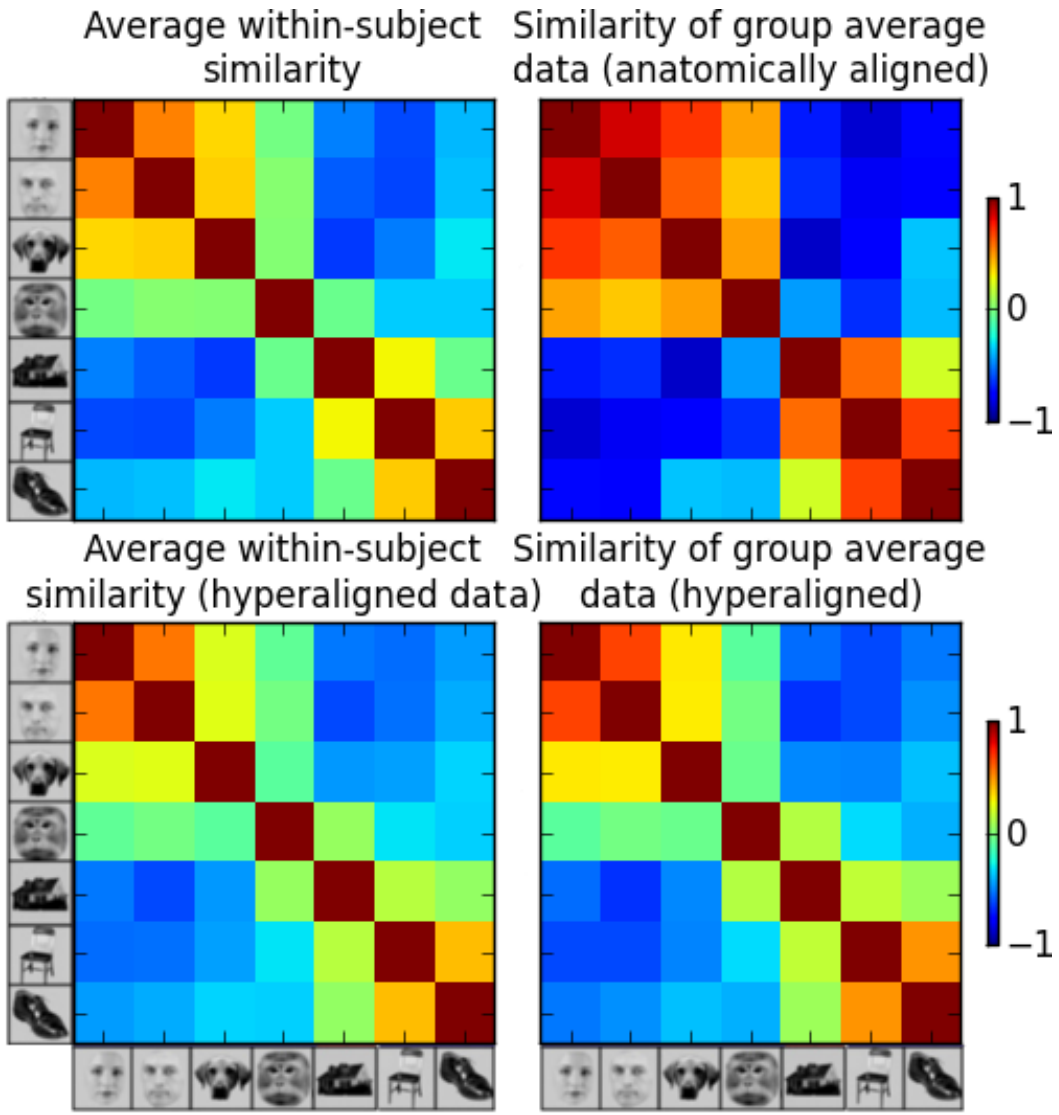
Haxby et al., Neuron, 2011; `http://www.pymvpa.org`

Hyperalignment: movie brain state group-similarity



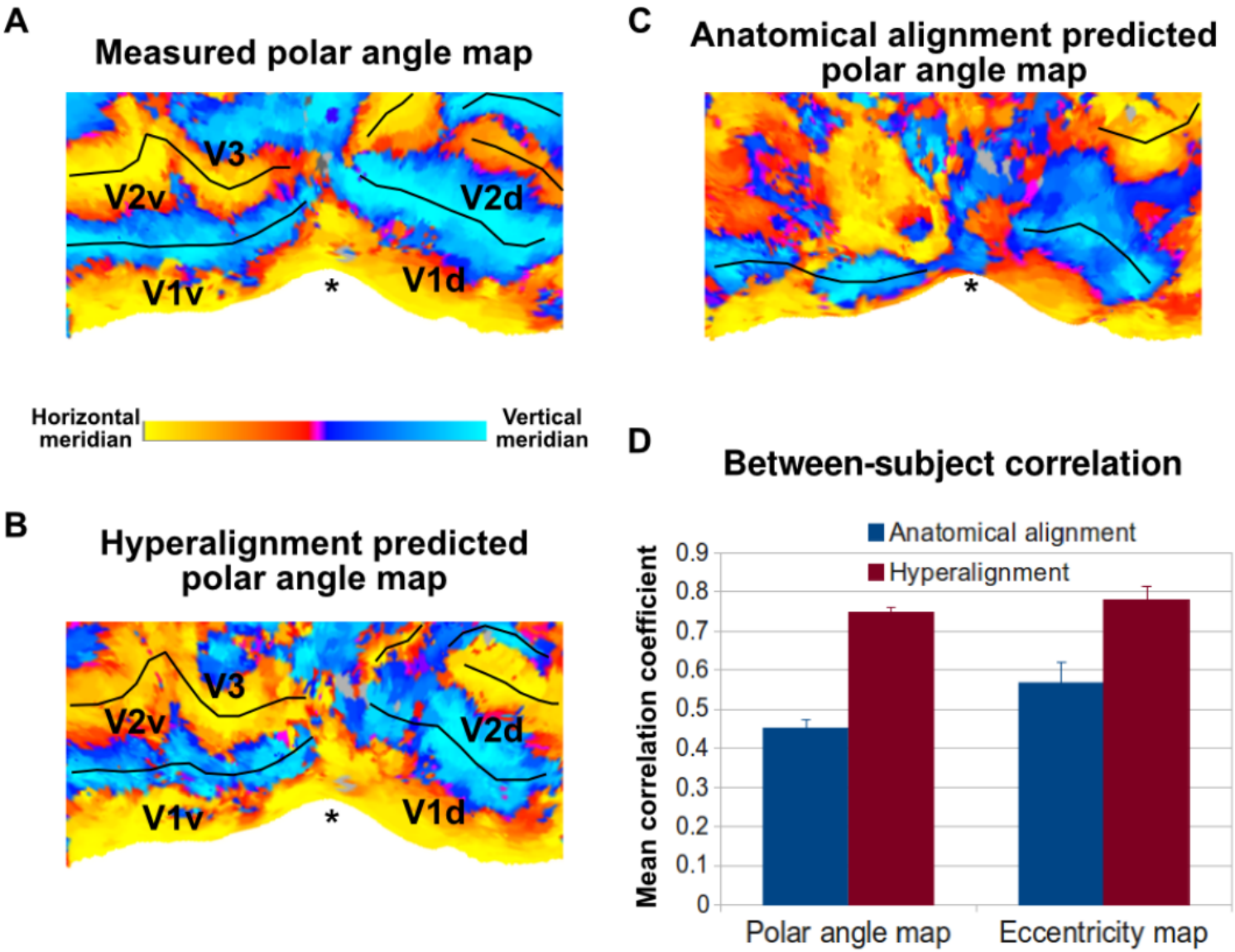
Guntupalli & Haxby, OHBM, 2013

Hyperalignment: ventral visual pathway



Haxby et al., Neuron, 2011

Hyperalignment: retinotopic maps



Guntupalli & Haxby, OHBM, 2013

General applicability?

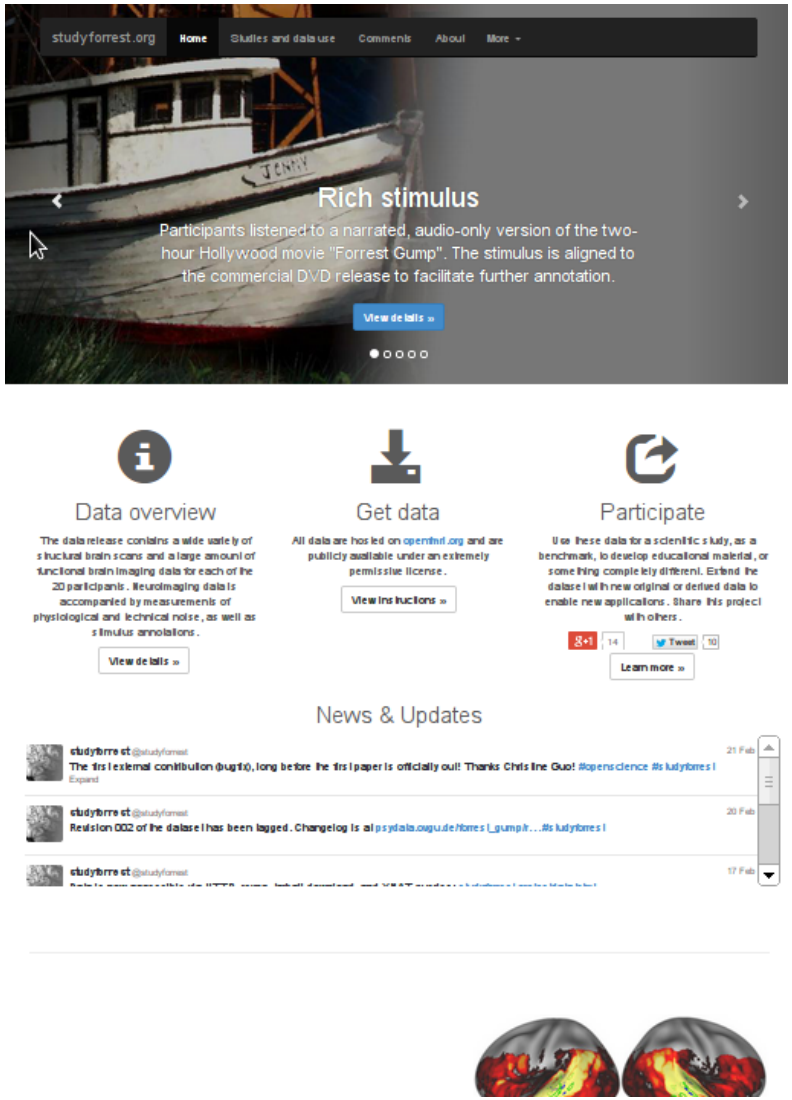
Investigate auditory representational spaces

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

www.studyforrest.org

355 GB of data published first!

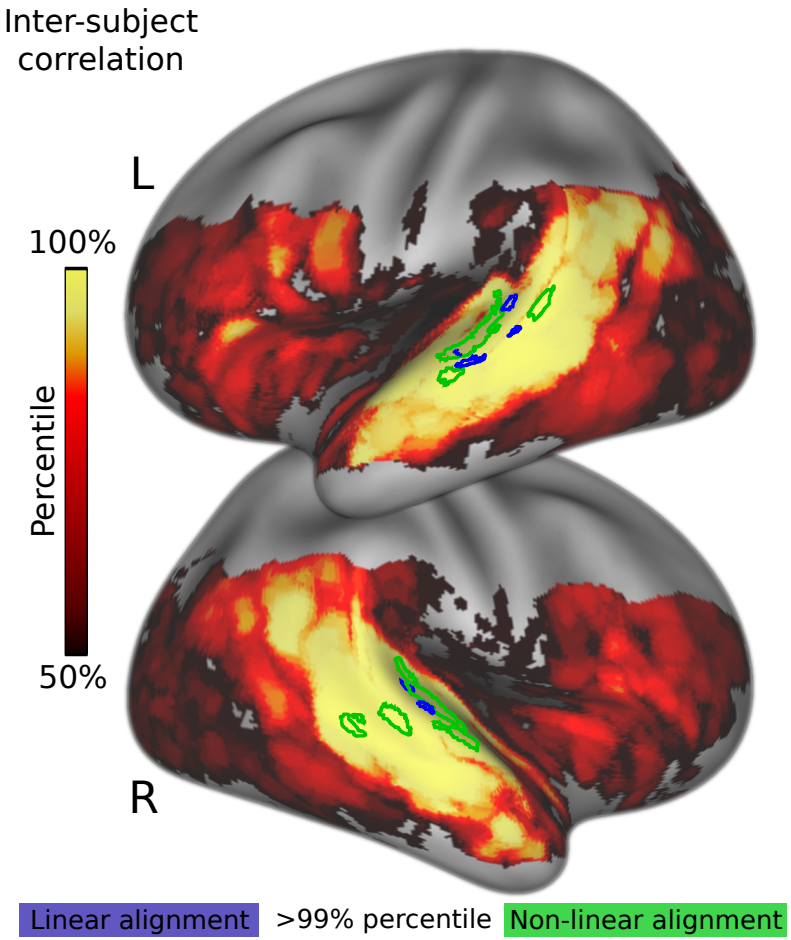
- 20 participants (plus phantom)
- 2 hours of 7-Tesla fMRI (2 s TR, 1.4 mm)
- Simultaneous physiological data (respiratory, cardiac)
- 0.7 mm T1w, T2w
- Arteriography, venography
- DTI
- Movie annotations



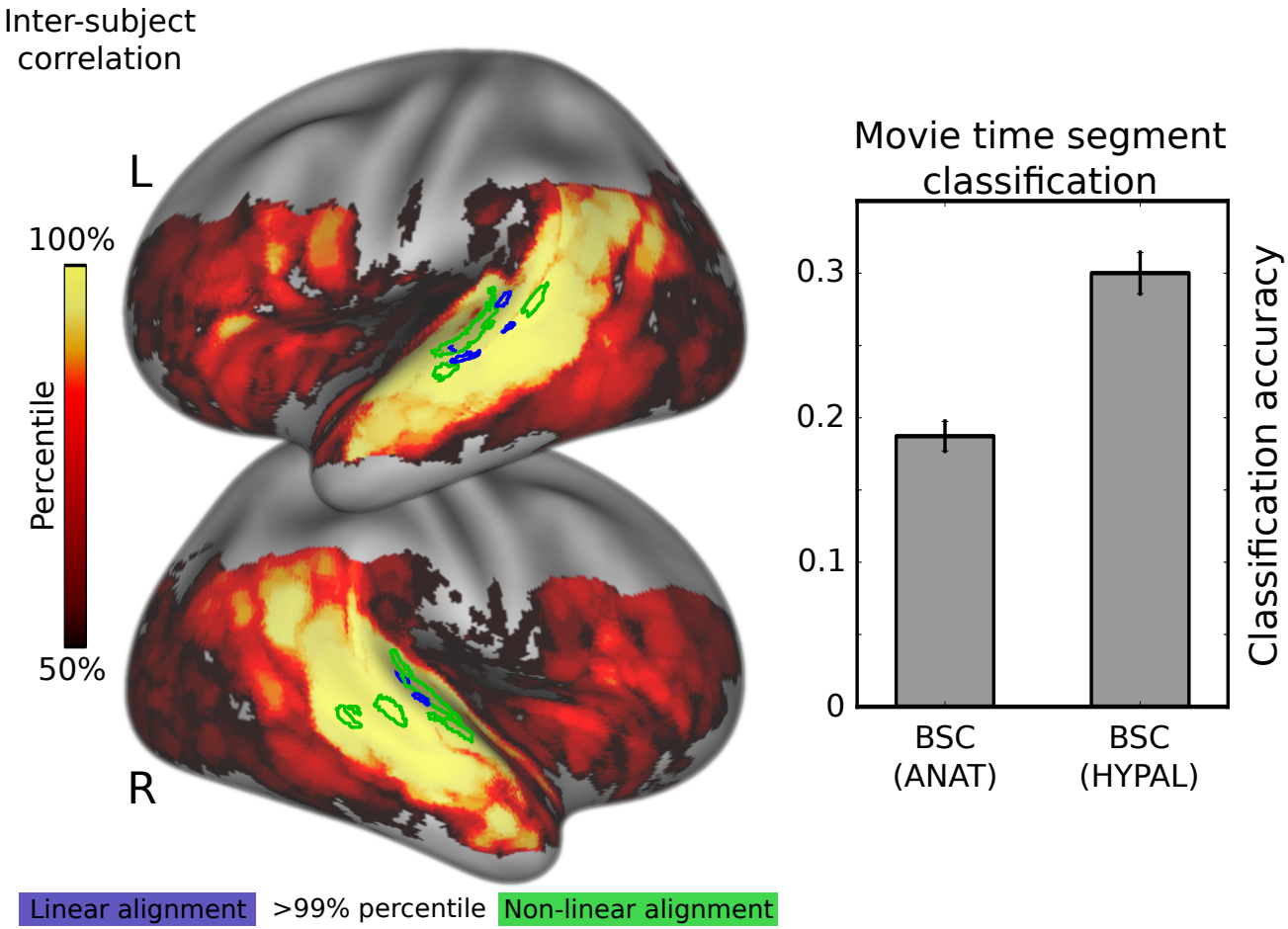
Most comprehensive public dataset on natural language processing

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

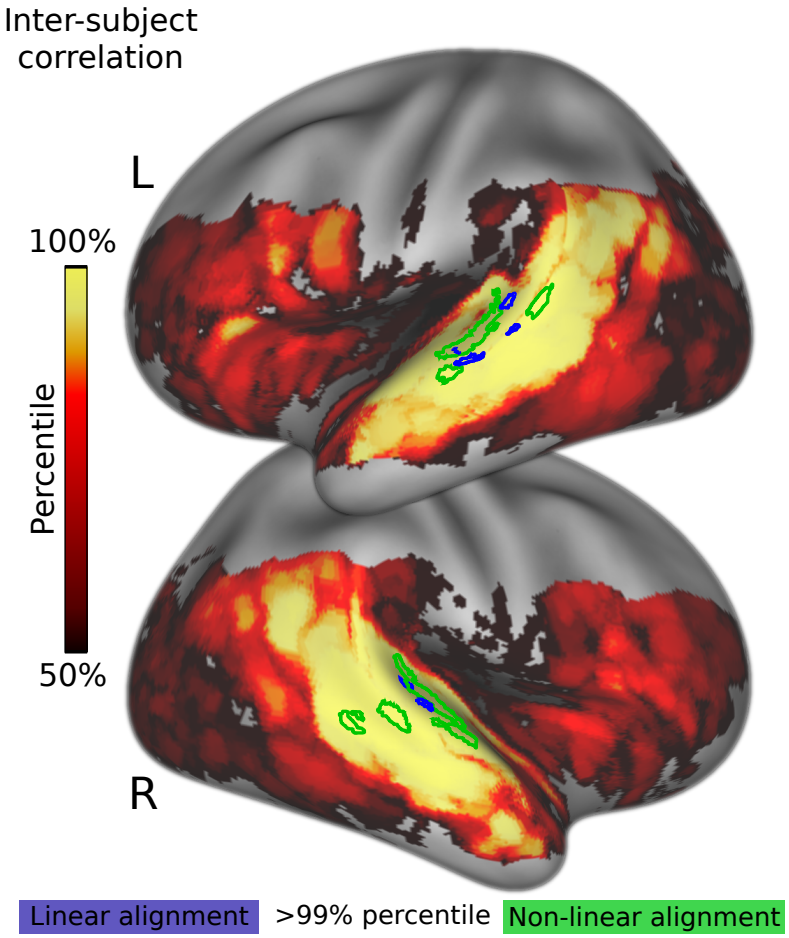
Preliminary results: auditory processing

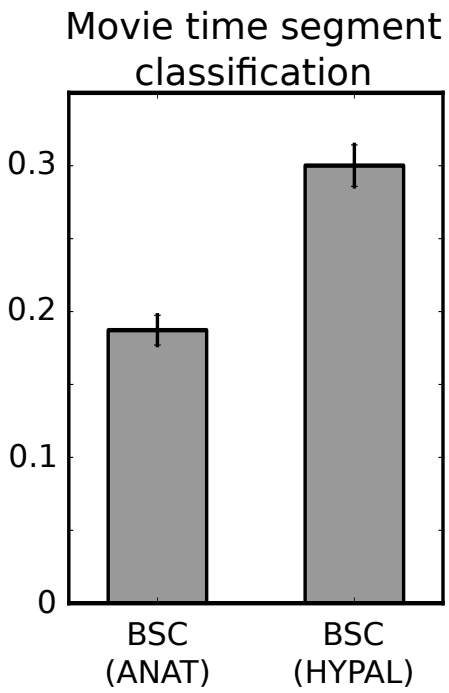


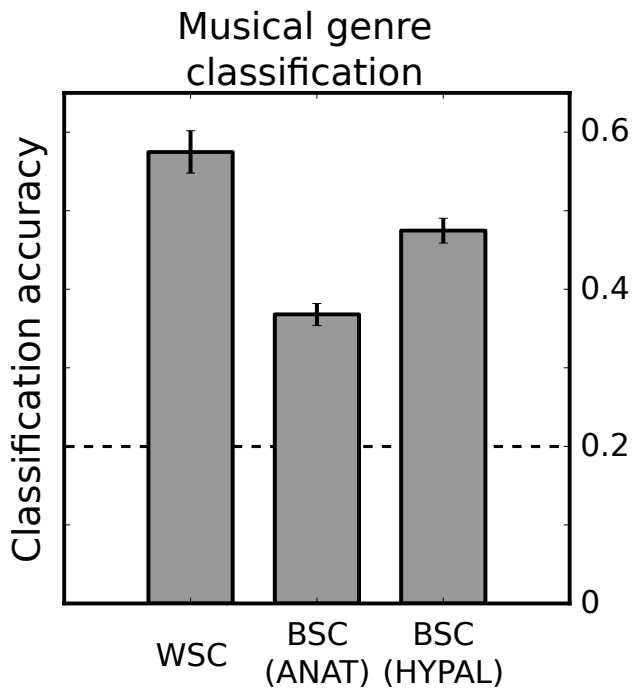
Preliminary results: auditory processing



Preliminary results: auditory processing

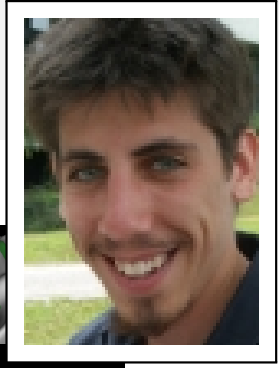


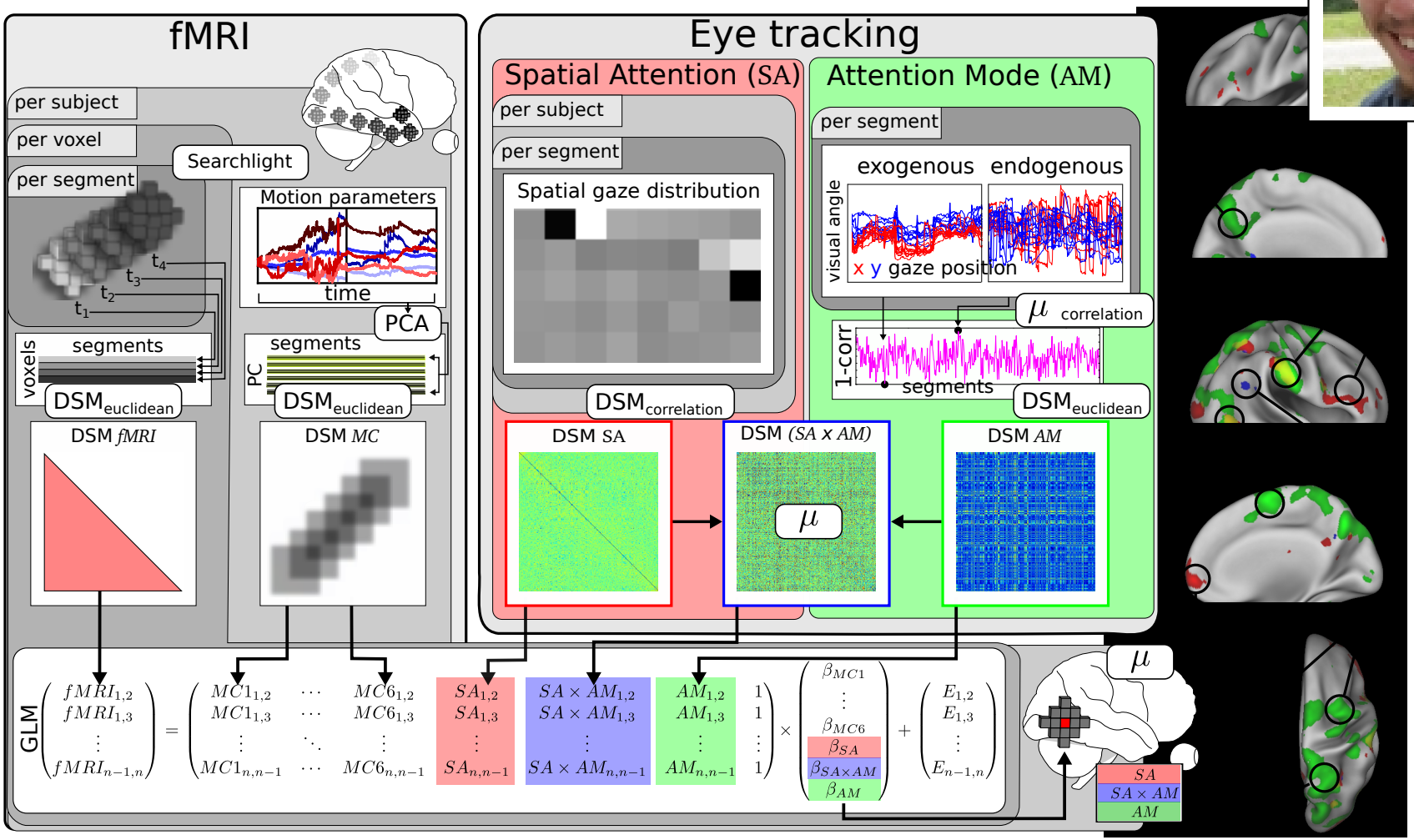




Multimodal analysis

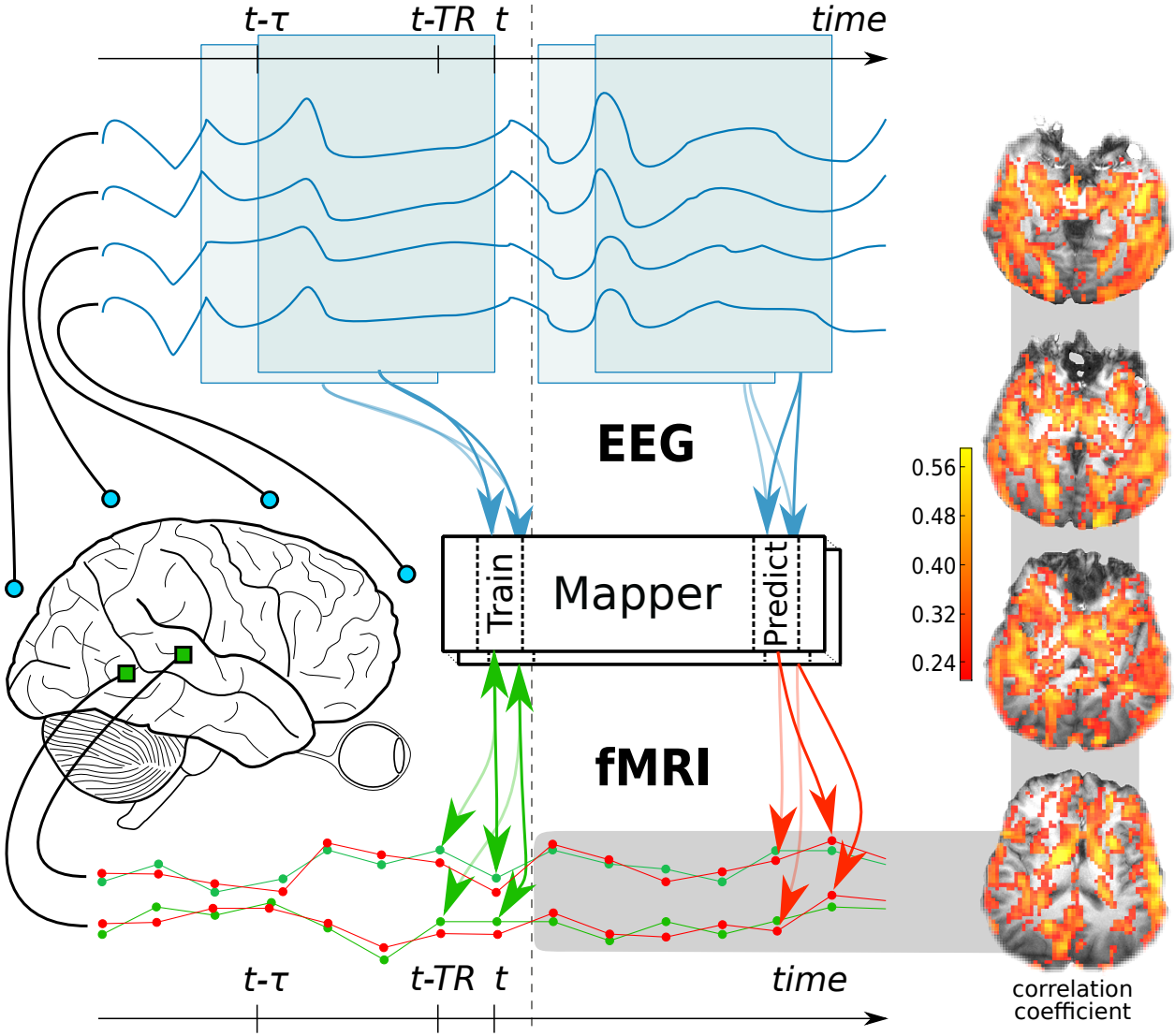
Visual attention





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.