MRC Cognition and Brain Sciences Unit

UNIVERSITY OF CAMBRIDGE

EEG/MEG 5:

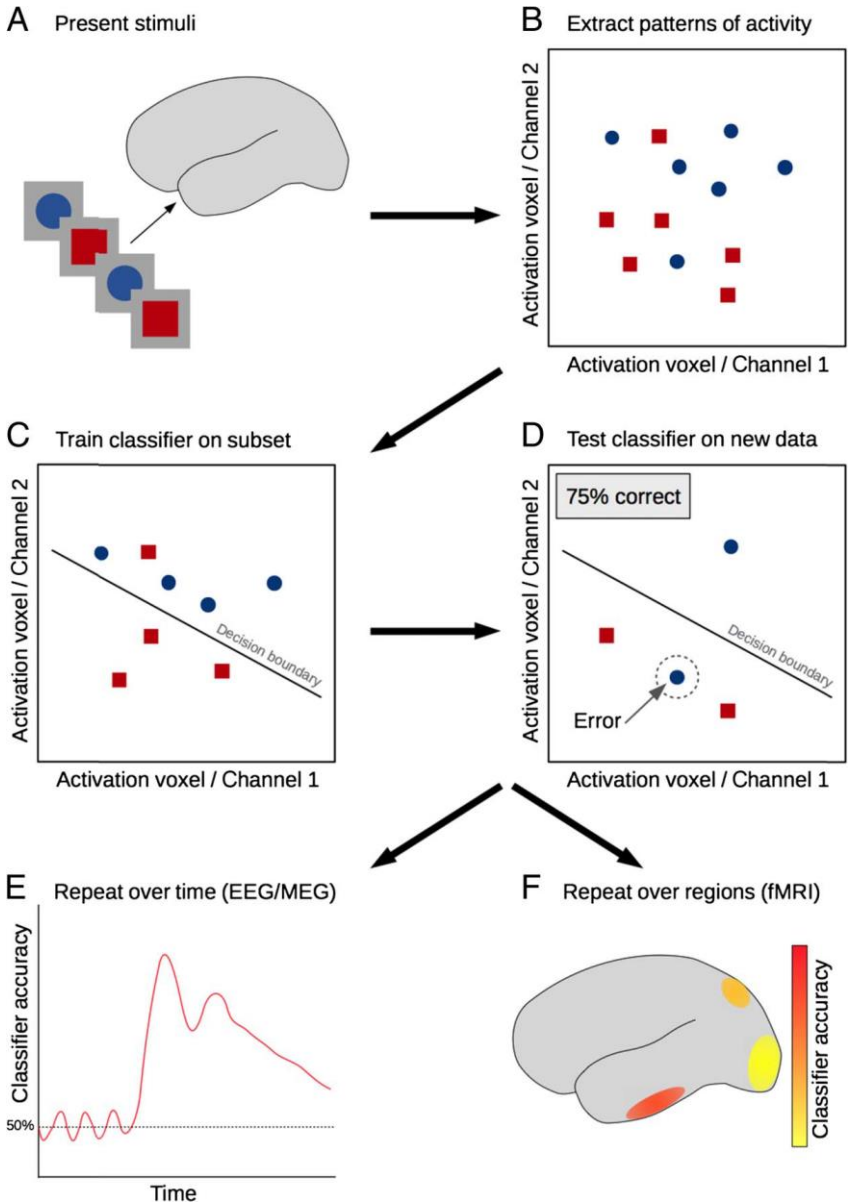
MVPA and RSA with EEG/MEG

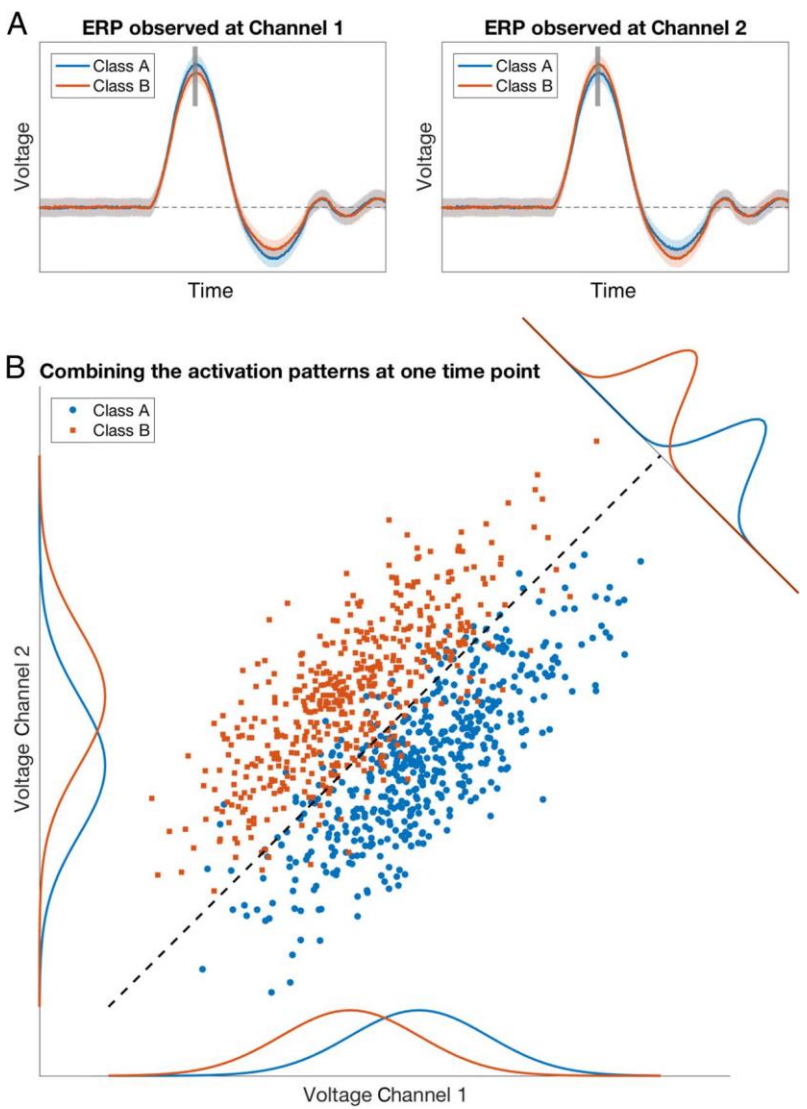
Olaf Hauk

olaf.hauk@mrc-cbu.cam.ac.uk

COGNESTIC 2023

Decoding Information Over Time





Tutorial: Grootswagers et al., JoCN 2017, https://pubmed.ncbi.nlm.nih.gov/27779910/

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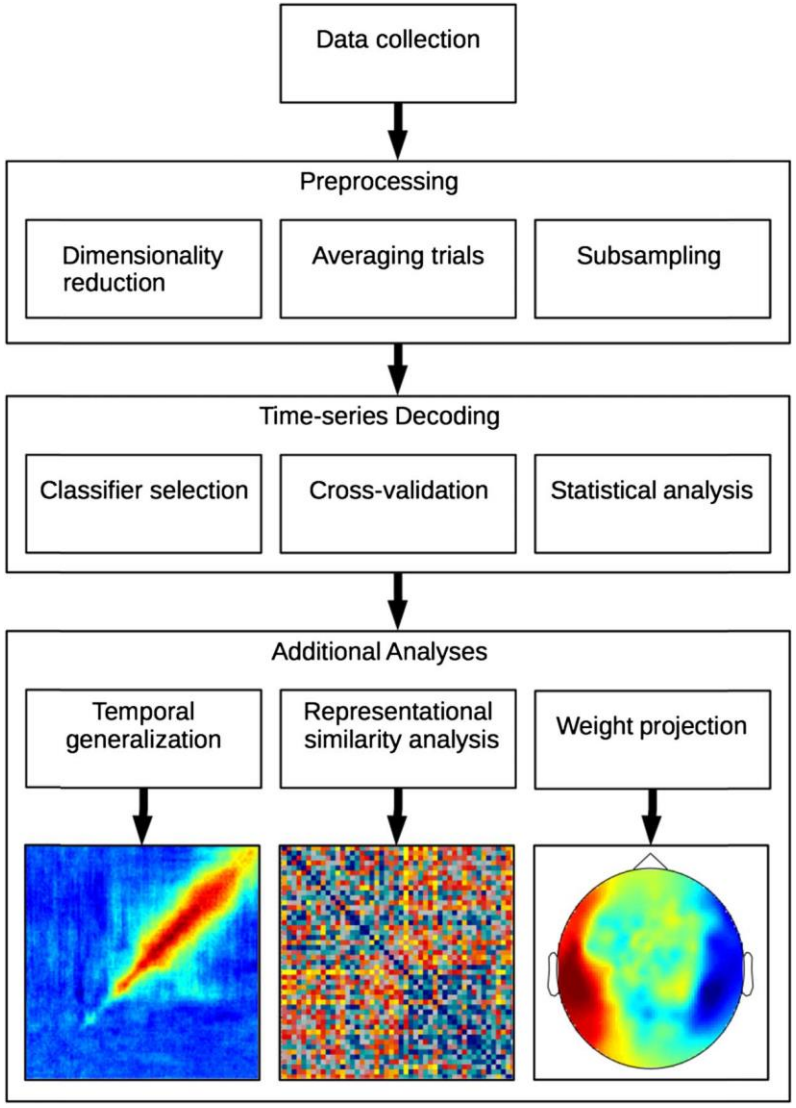

Tutorial: Grootswagers et al., JoCN 2017,
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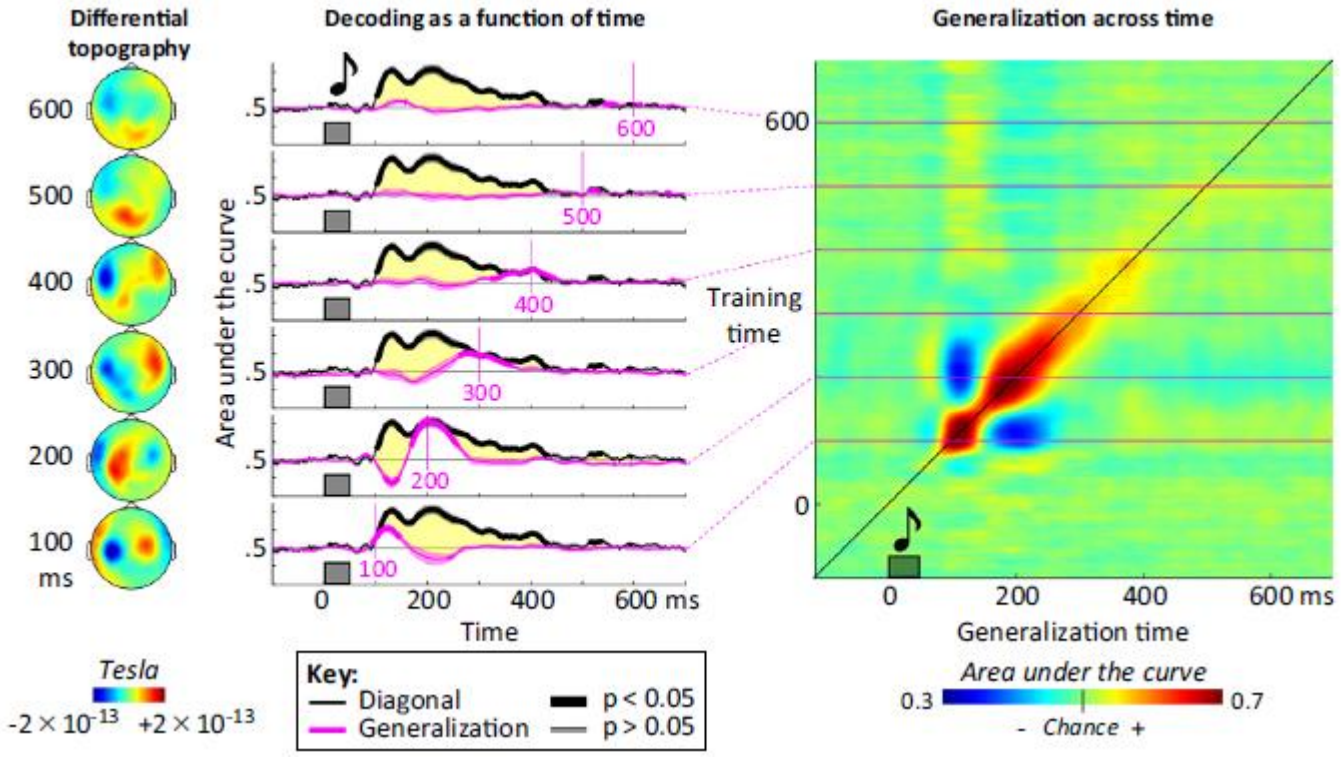


King & Dehaene, TICS 2014
https://pubmed.ncbi.nlm.nih.gov/27779910/

How Can We Combine Measurement Modalities?

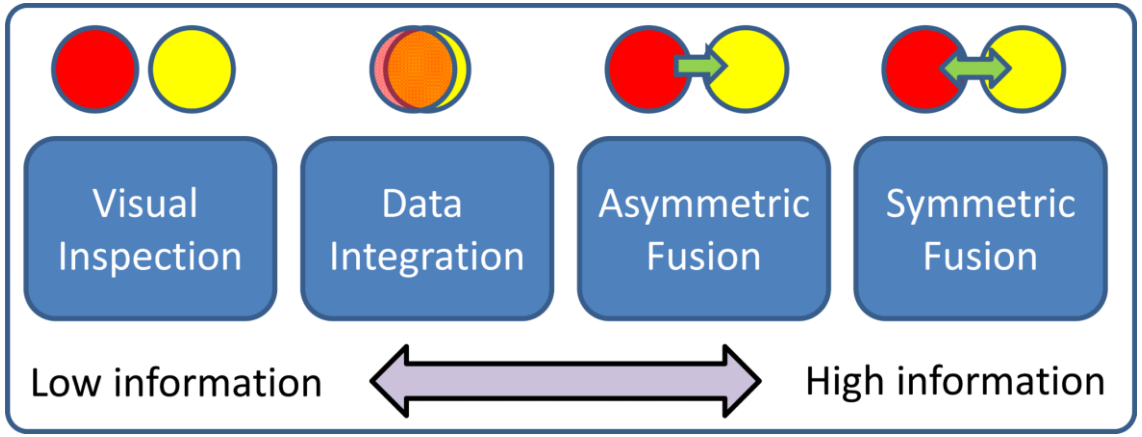
“Converging Evidence”:
Compare results from different modalities, determine commonalities and differences.

“(Asymmetric) Fusion”:
Use one modality as a constraint for another.
(e.g. EEG->fMRI, fMRI->EEG/MEG)

“Neural Modelling” (“Symmetric Fusion”):
Use of a common neural model that accounts for signals in all modalities.
(e.g. EEG<->MEG)

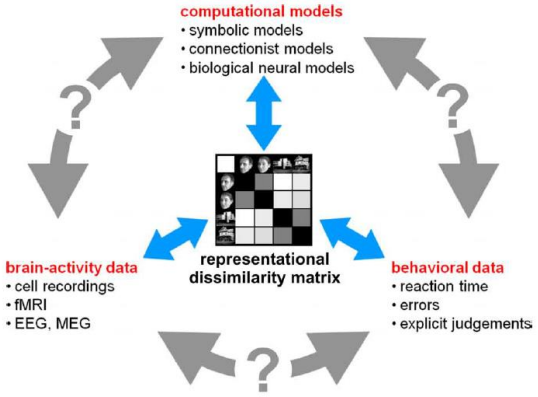
e.g. Horwitz&Poeppel, HBM 2002; Henson et al., HBM 2010

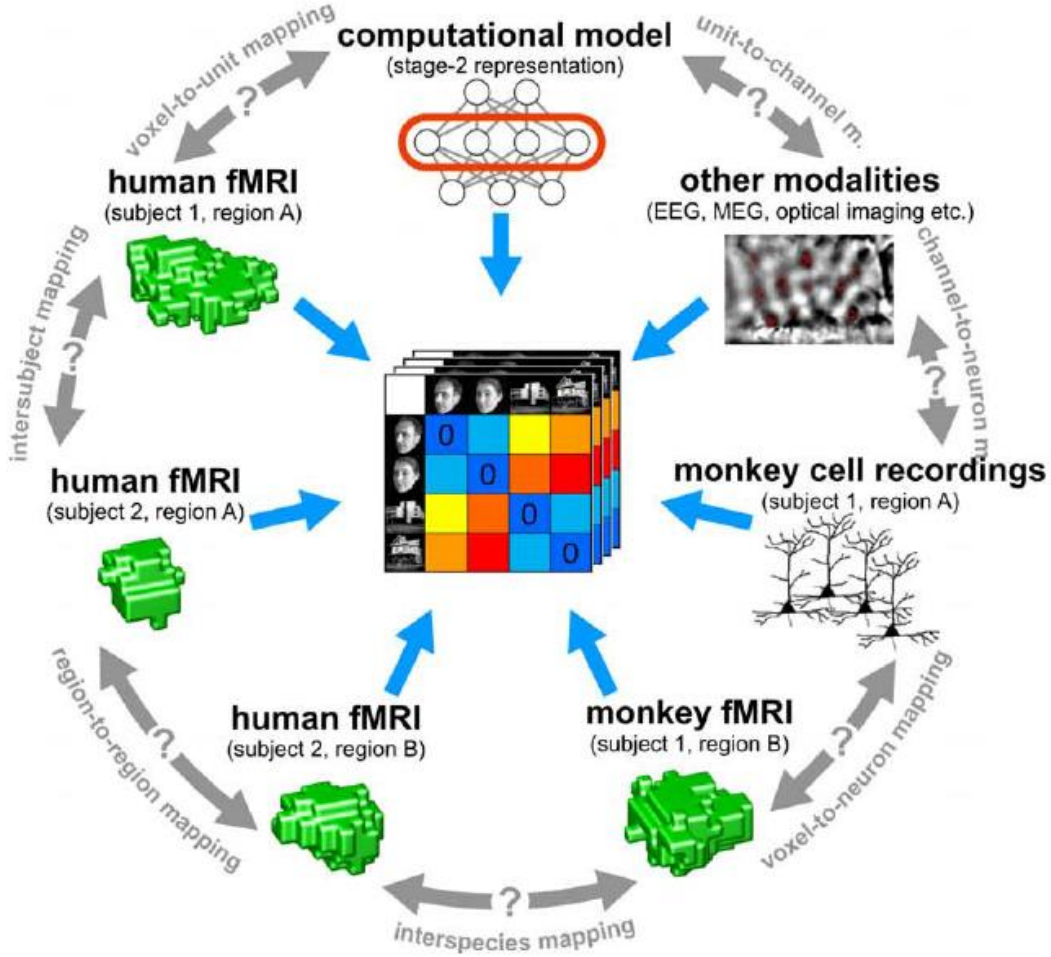
Each of these options poses different challenges with respect to modelling assumptions and complexity.



Calhoun & Sui, Biol Psych Cogn Nsc 2017

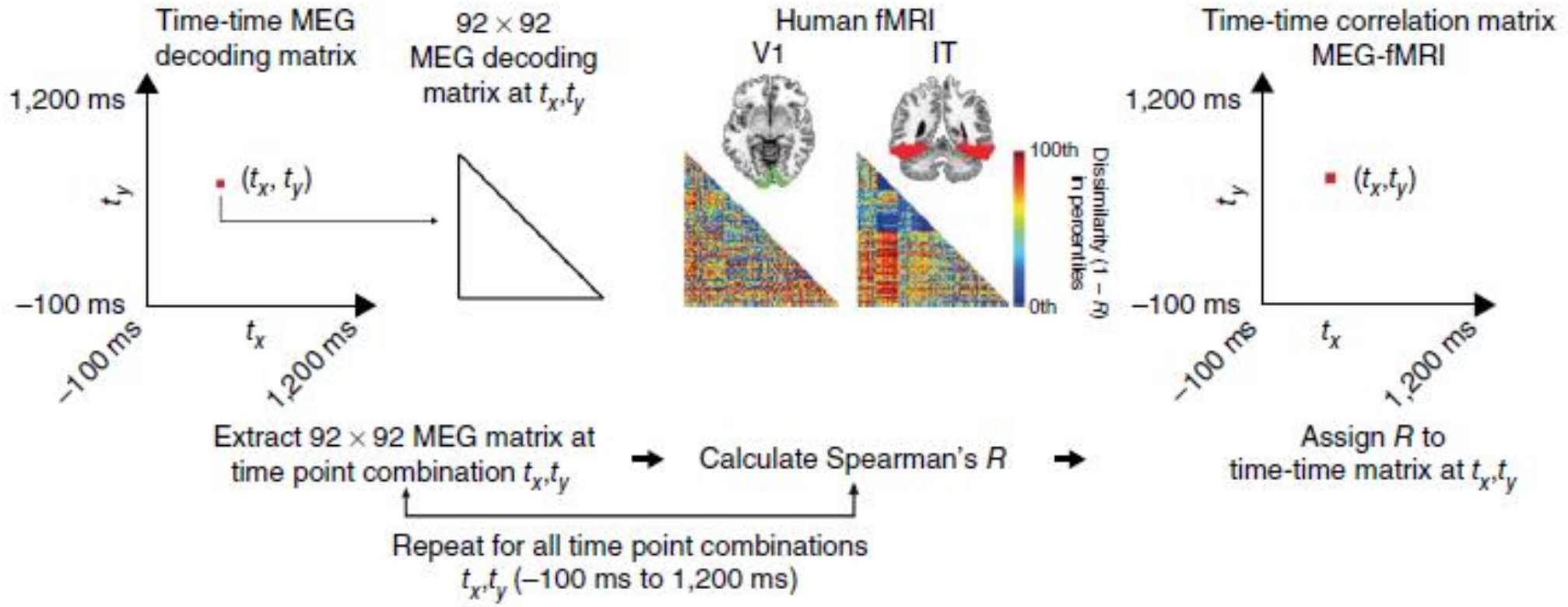
Comparing Representational Dissimilarity Across Neuroimaging Methods





Kriegeskorte et al., Front Syst Nsc 2008, https://www.frontiersin.org/articles/10.3389/neuro.06.004.2008/full
Laakso & Cottrell, Philosph Psychol 2000, https://philpapers.org/rec/LAACAC

Comparing Representational Dissimilarity Across Neuroimaging Methods



Cichy et al., Nat Nsc 2014, https://pubmed.ncbi.nlm.nih.gov/24464044/

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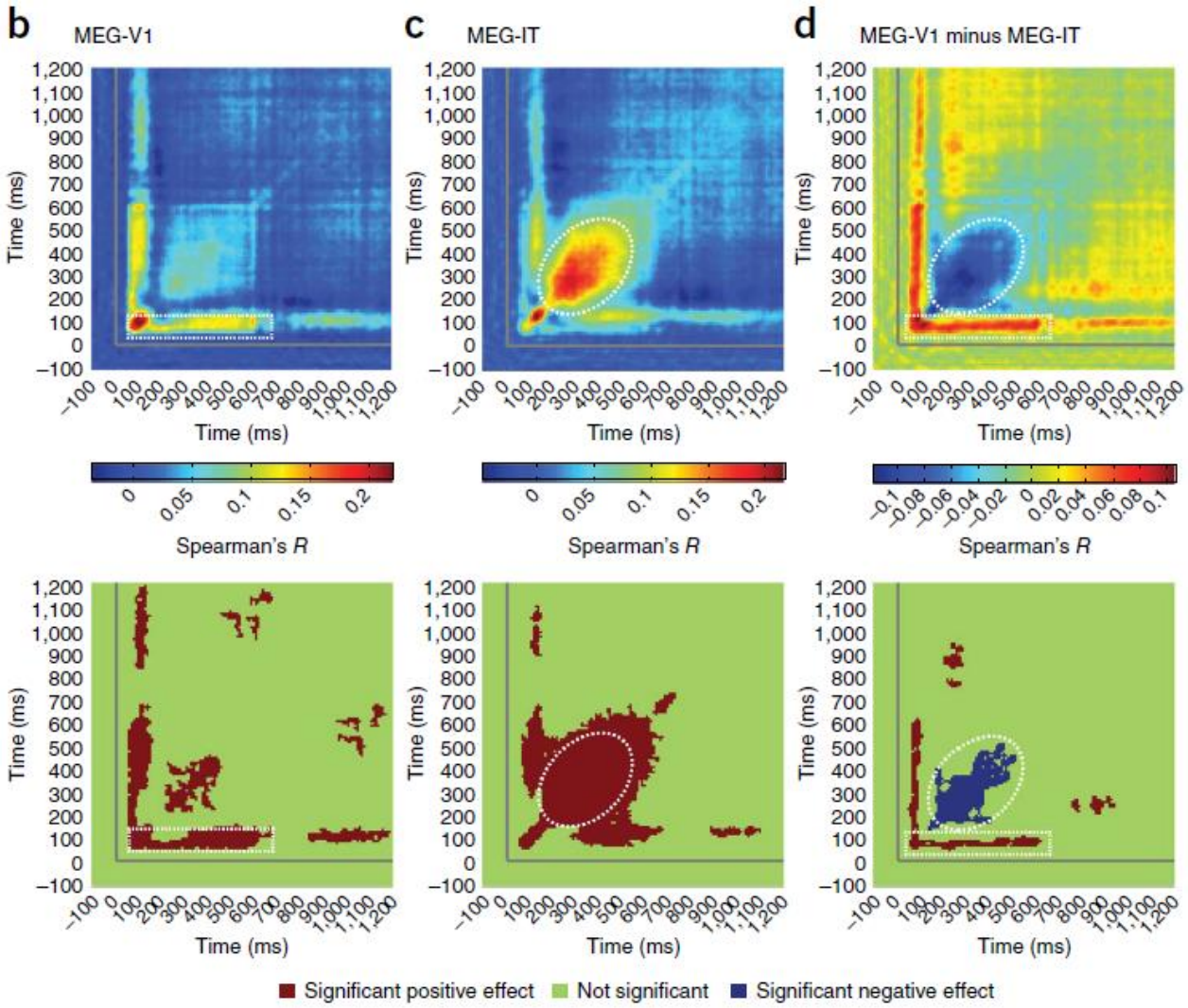
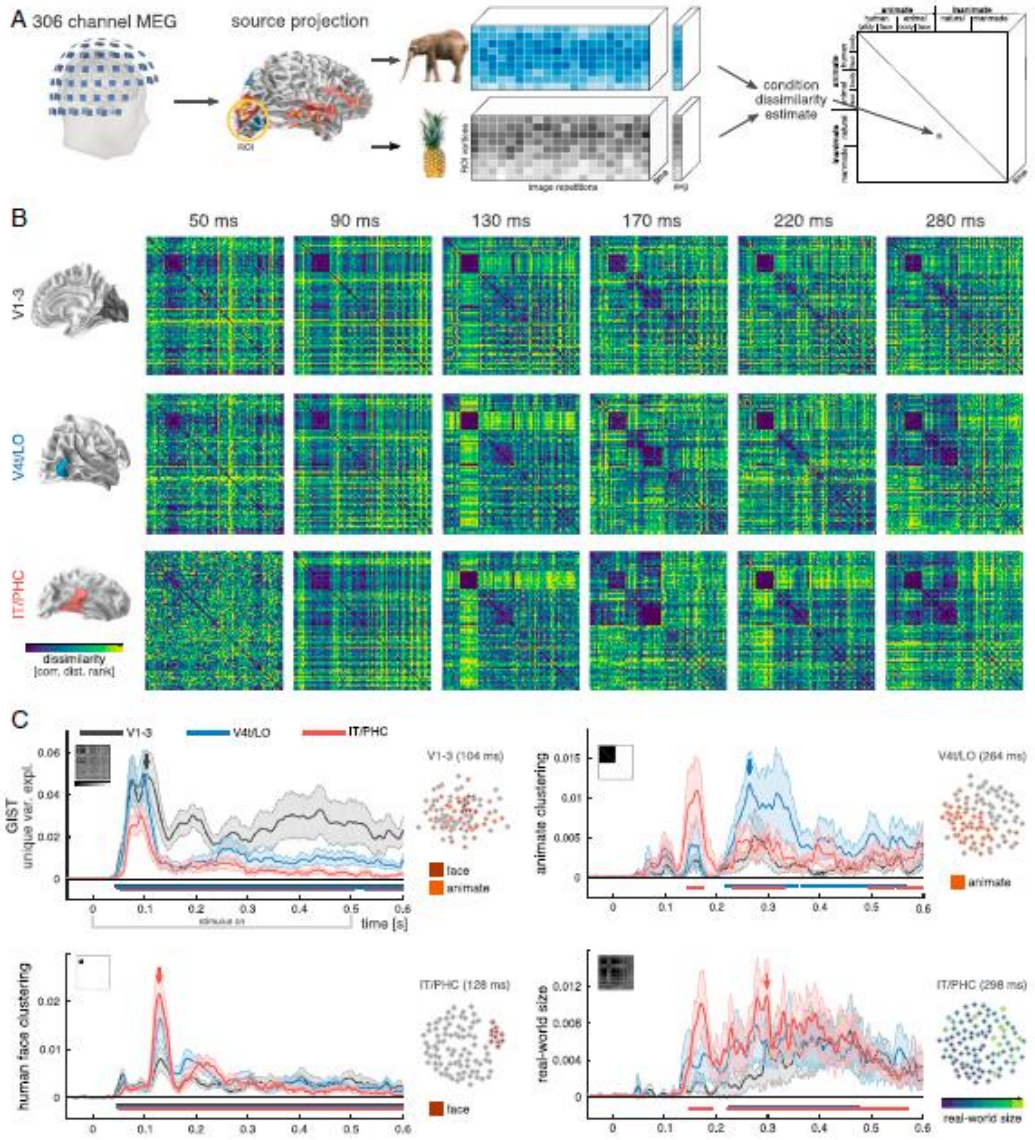
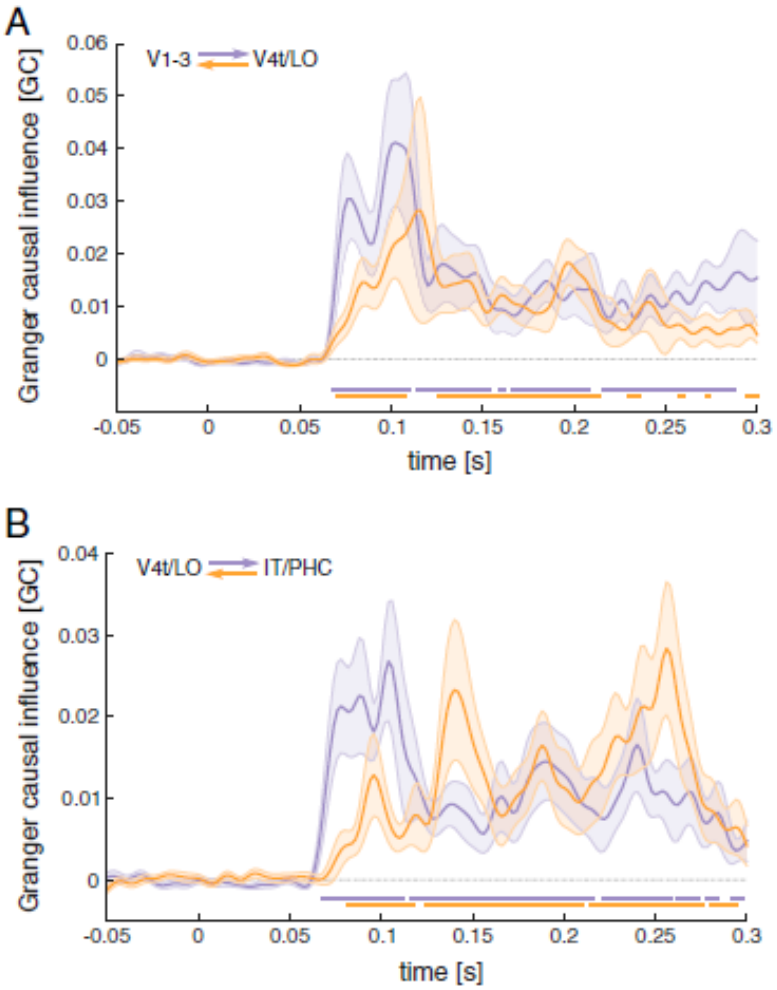


Cichy et al., Nat Nsc 2014, https://pubmed.ncbi.nlm.nih.gov/24464044/

Decoding Information Over Time And Space

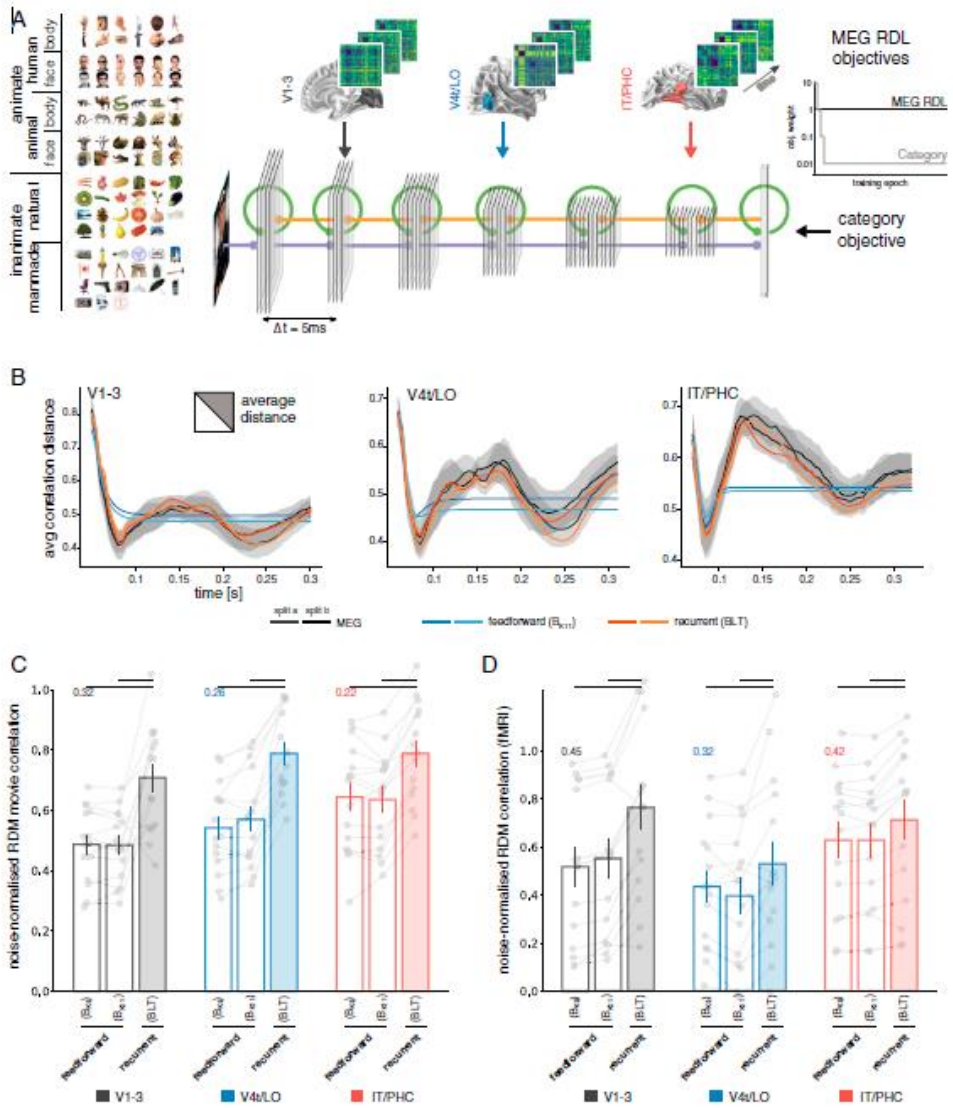


RSA Granger Analysis of Information Flow



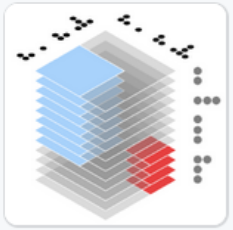
Kietzmann et al., PNAS 2019, https://www.pnas.org/doi/10.1073/pnas.1905544116
Also: Goddard et al. 2018: https://pubmed.ncbi.nlm.nih.gov/26806290/,
Karimi-Rouzbahani et al. 2022: https://www.frontiersin.org/articles/10.3389/fnins.2022.755988/full

Comparing Real With Artificial Neural Networks



Kietzmann et al., PNAS 2019
https://www.pnas.org/doi/10.1073/pnas.1905544116

RSA Toolbox(es)



RSA development group

Development of the Toolbox for Representational Similarity Analysis

Overview | Repositories 3 | Projects | Packages | People 8

Popular repositories

rsatoolbox — Public

Python library for Representational Similarity Analysis

Python 130 33

rsatoolbox_matlab — Public

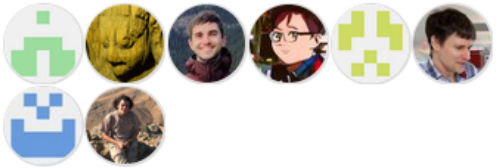
A Matlab toolbox for representational similarity analysis

MATLAB 38 49

rsaModelComparison — Public

MATLAB 1 2

People



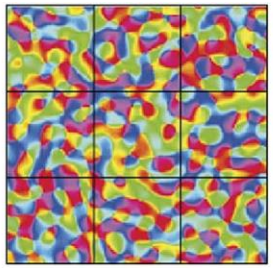
Top languages

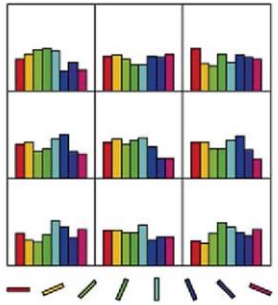
MATLAB Python

https://github.com/rsagroup

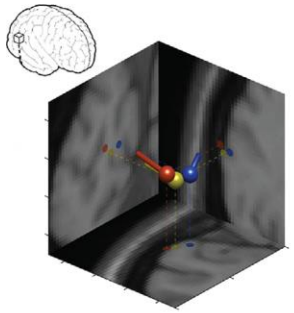
Reality and Measurement

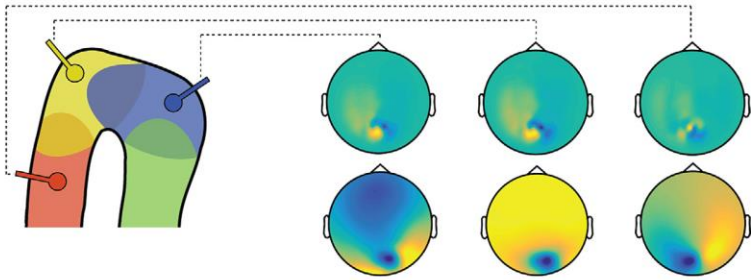
fMRI

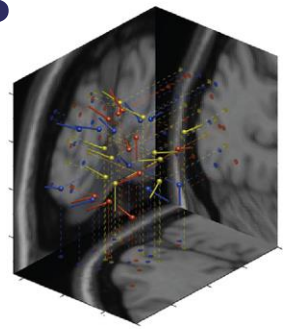


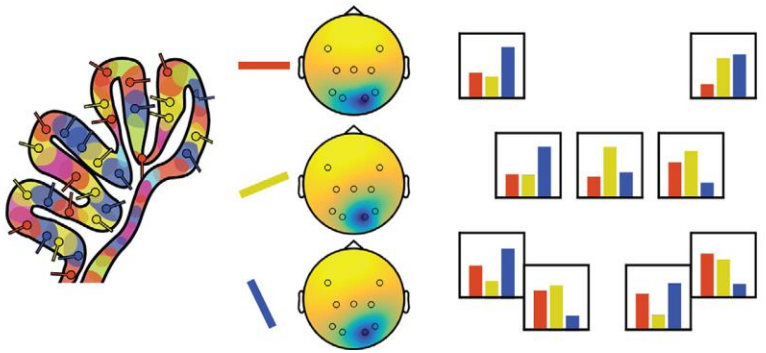


EEG/MEG:
Orientation matters



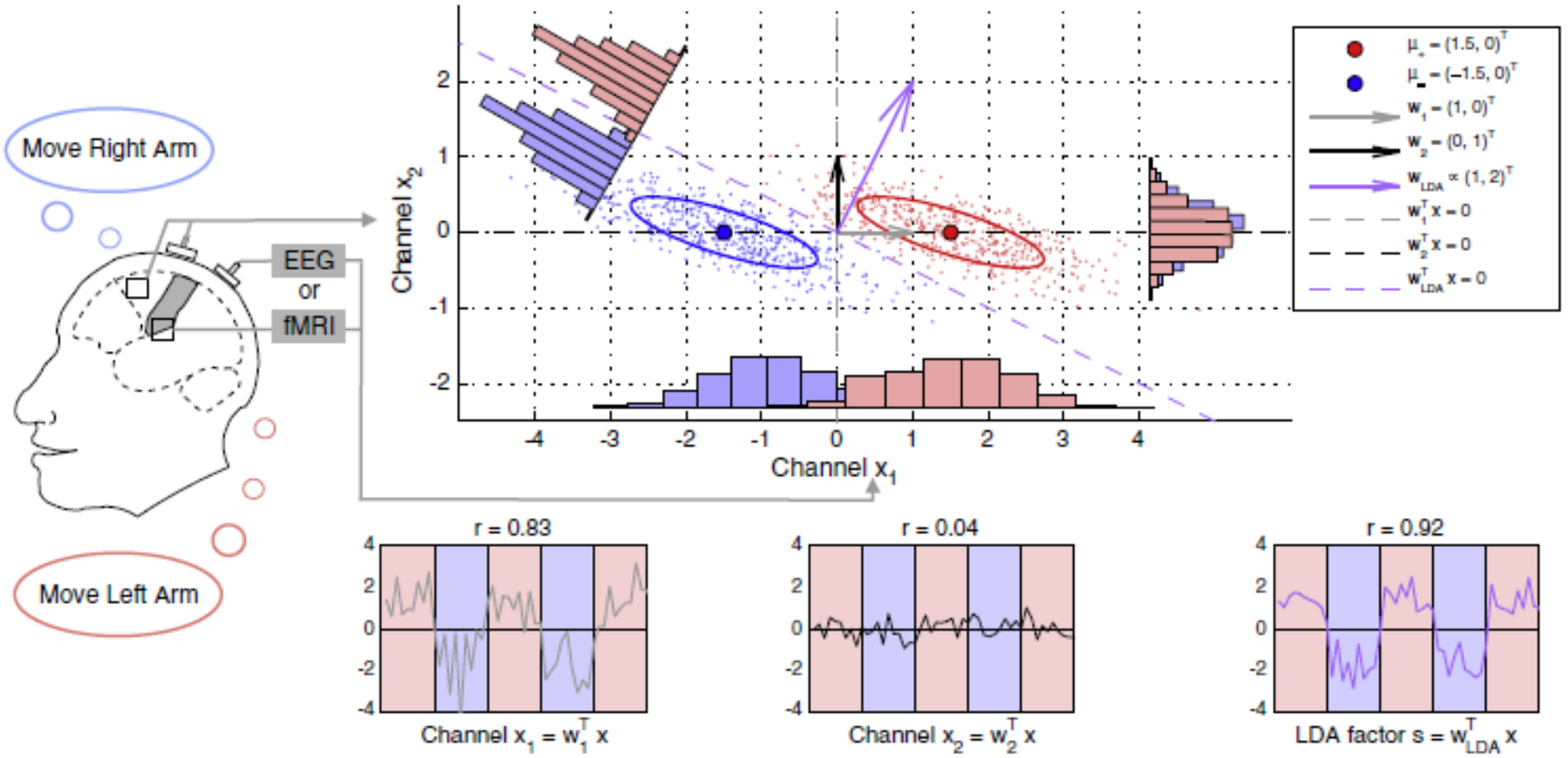






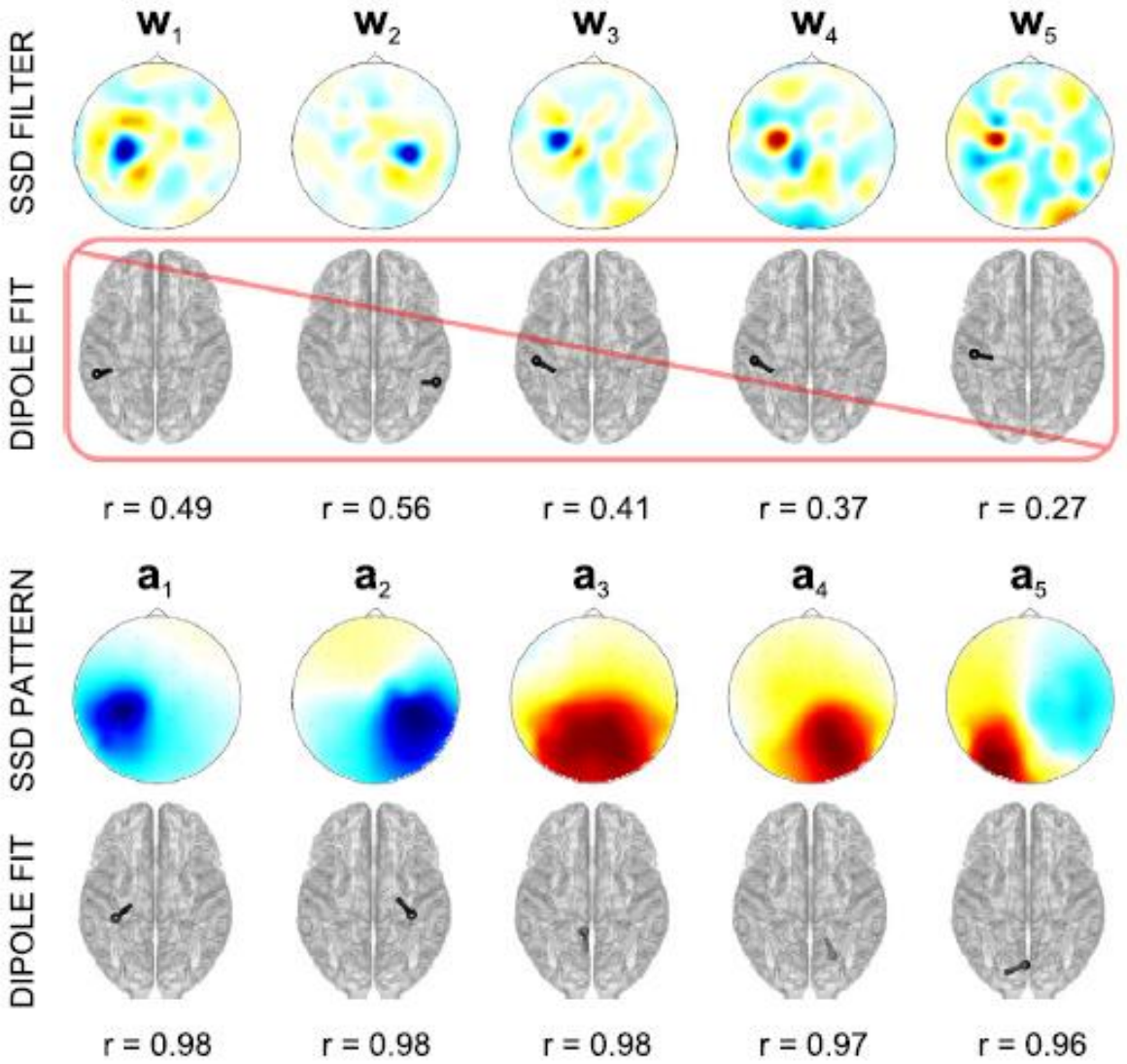
Stokes et al., TICS 2015
https://pubmed.ncbi.nlm.nih.gov/26440122/

Interpreting Weight Vectors



Haufe et al., Neuroimage 2014
https://www.sciencedirect.com/science/article/pii/S1053811913010914

Perform Source Estimation On Patterns, Not Filter Weights



Haufe et al., Neuroimage 2014
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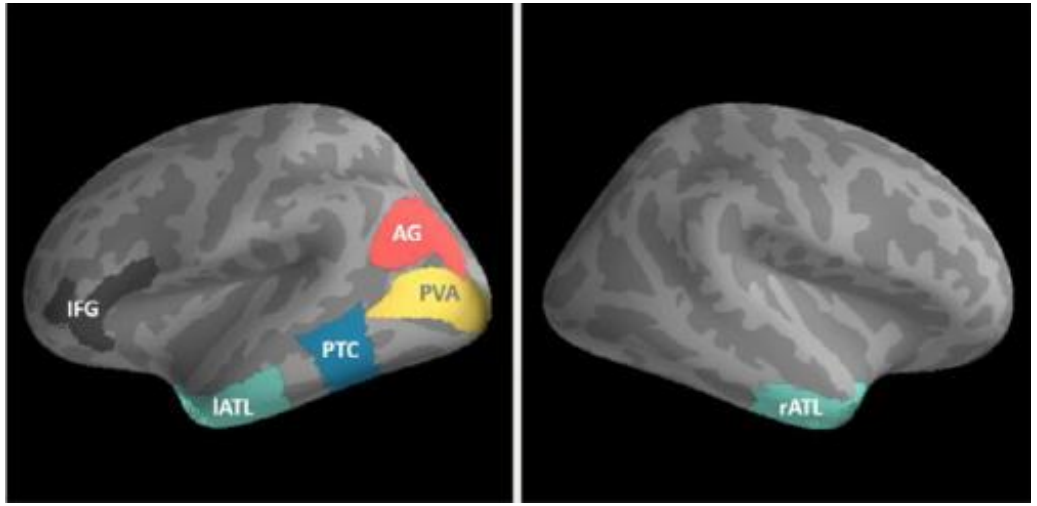
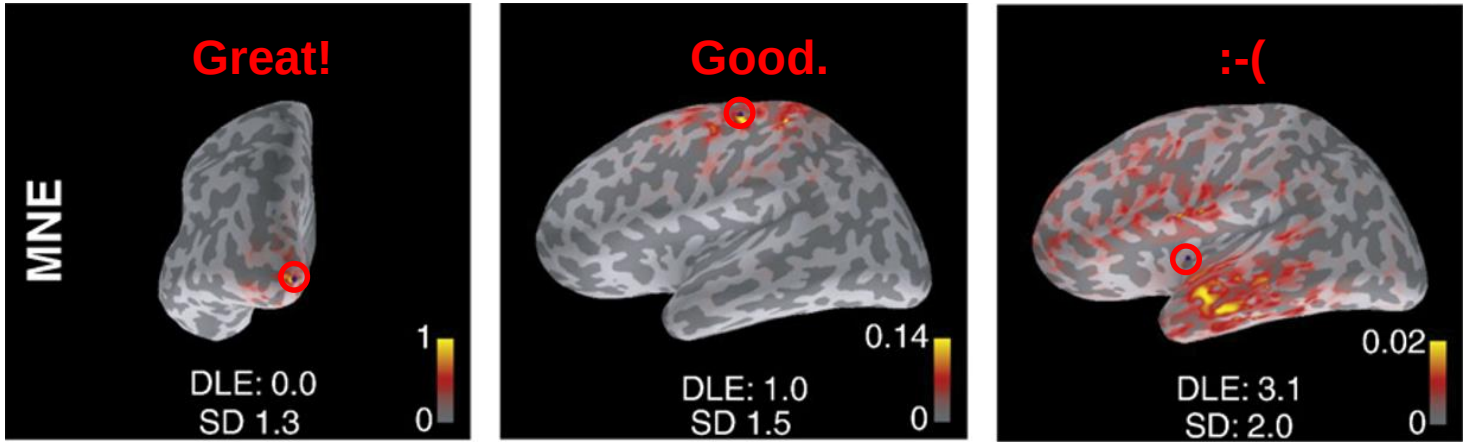
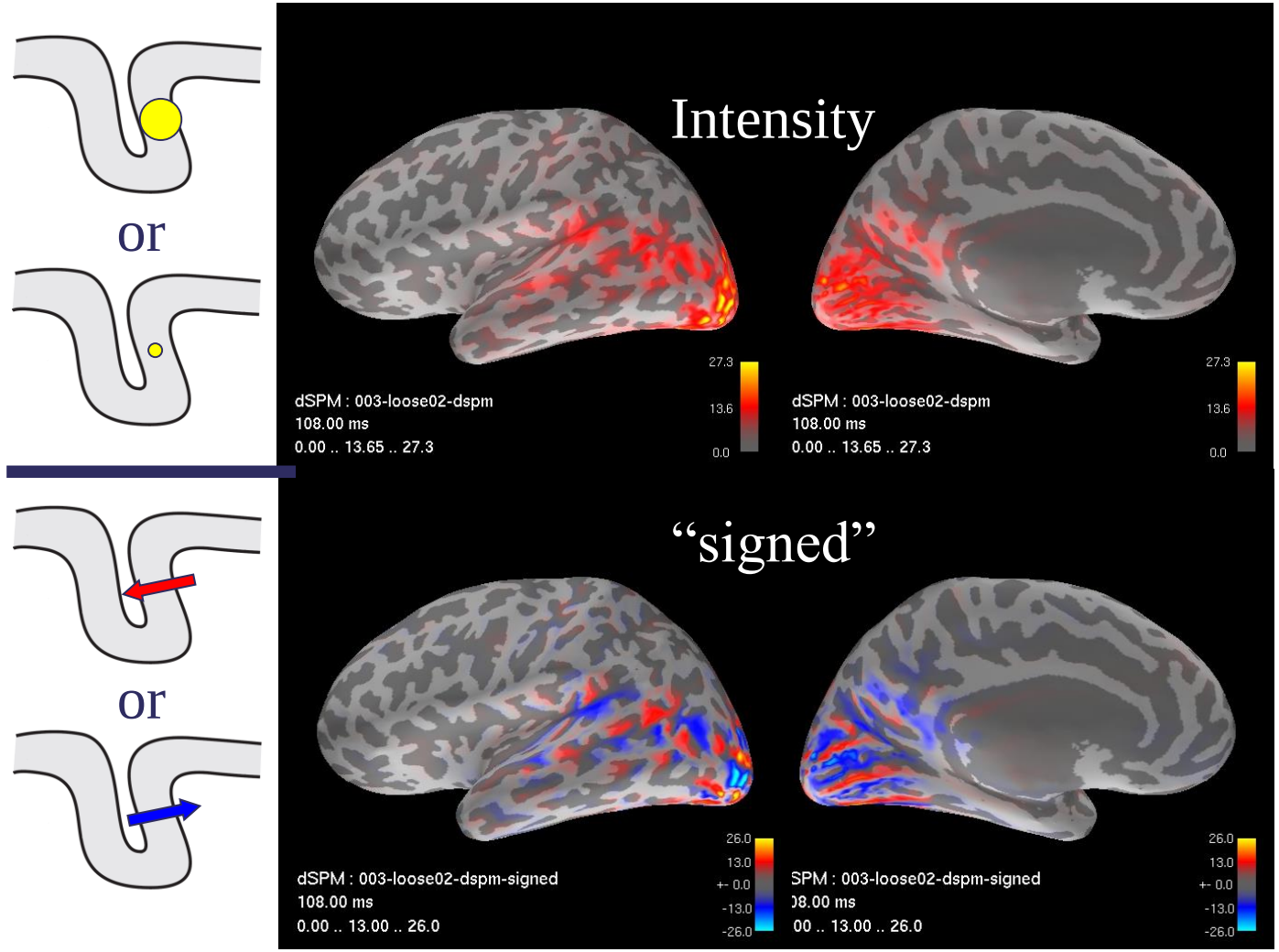
Back to Basics: Where/What to Decode From





Signed Source Estimates Contain More Information For Decoding



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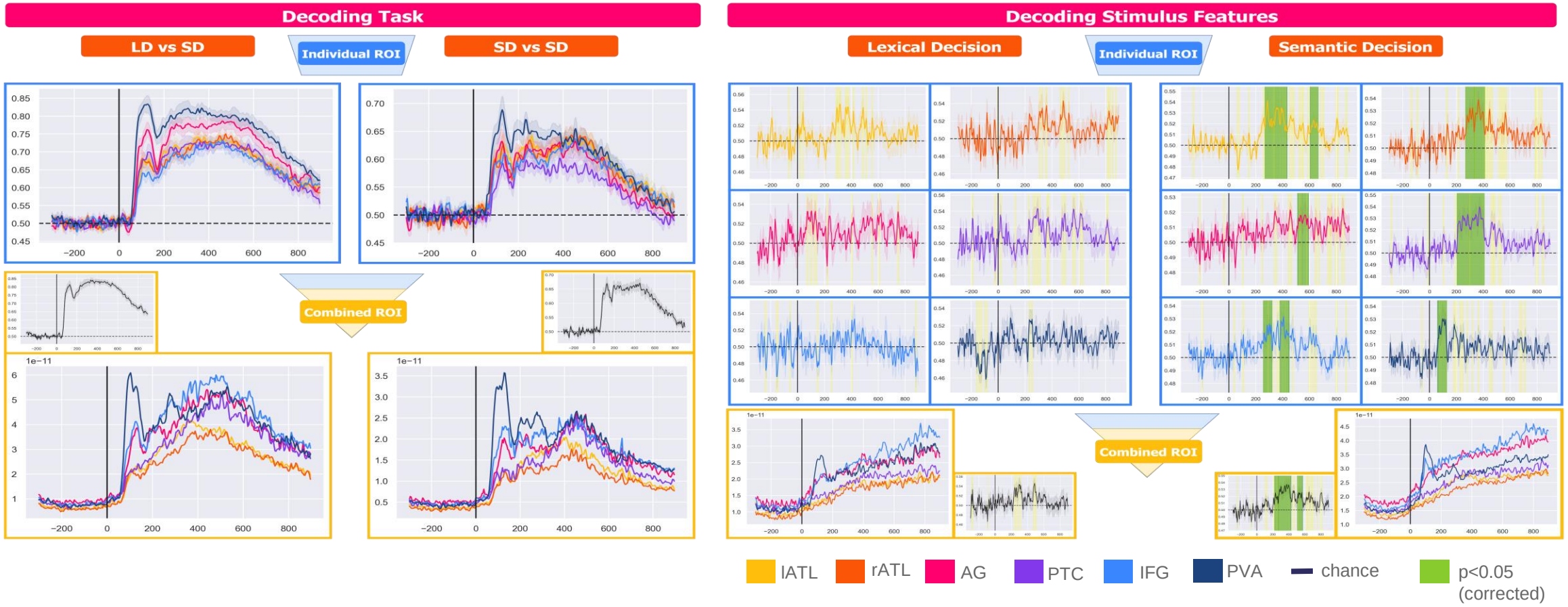

Different results whether you decode for individual ROIs or across combined ROIs.

Magnabosco et al., bioRxiv 2023, https://www.biorxiv.org/content/10.1101/2023.07.20.549326v2
Also: Cox & Rogers, JN 2021, https://pubmed.ncbi.nlm.nih.gov/33334868/

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Thank you