



MRC Cognition
and Brain
Sciences Unit



UNIVERSITY OF
CAMBRIDGE

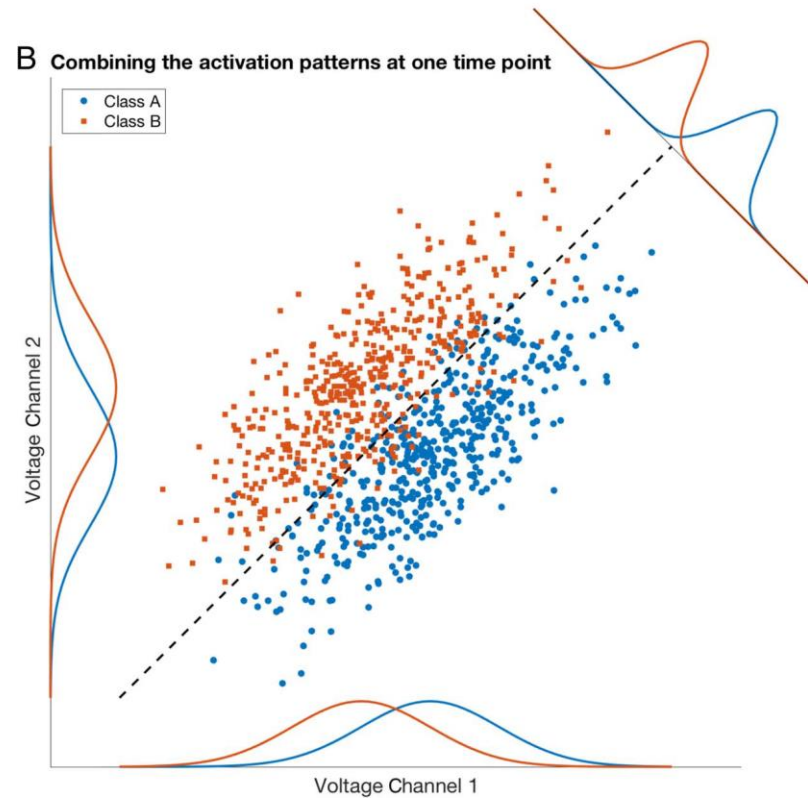
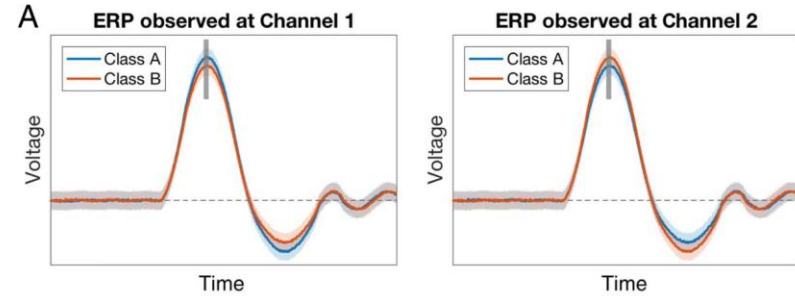
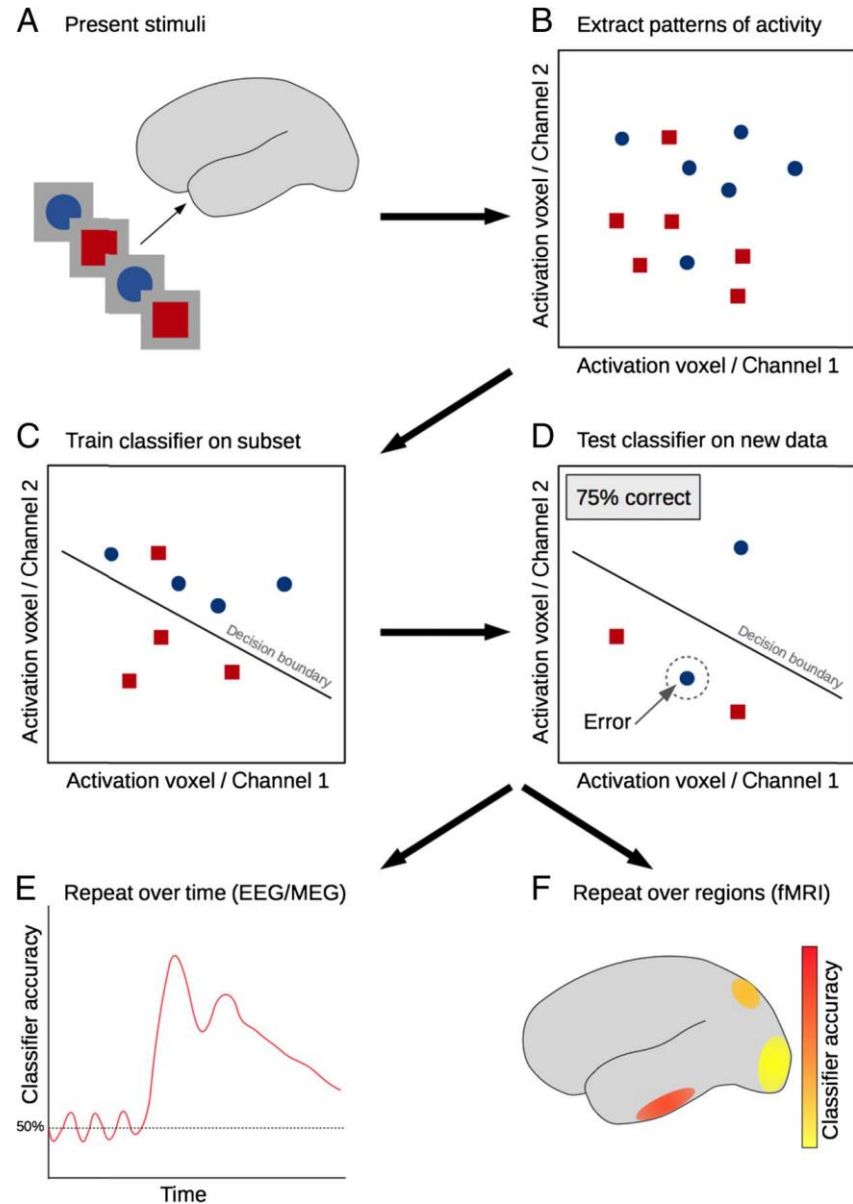
EEG/MEG 4: MVPA and RSA with EEG/MEG

Olaf Hauk

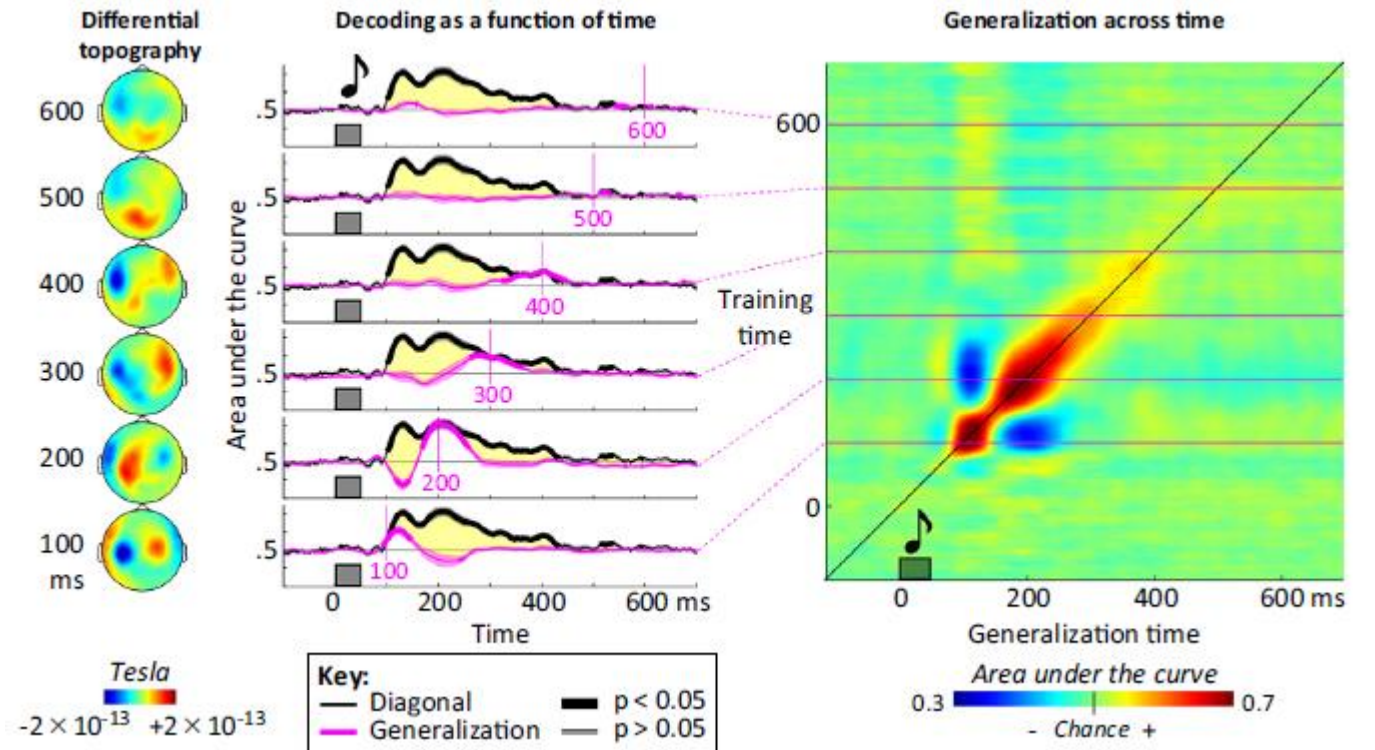
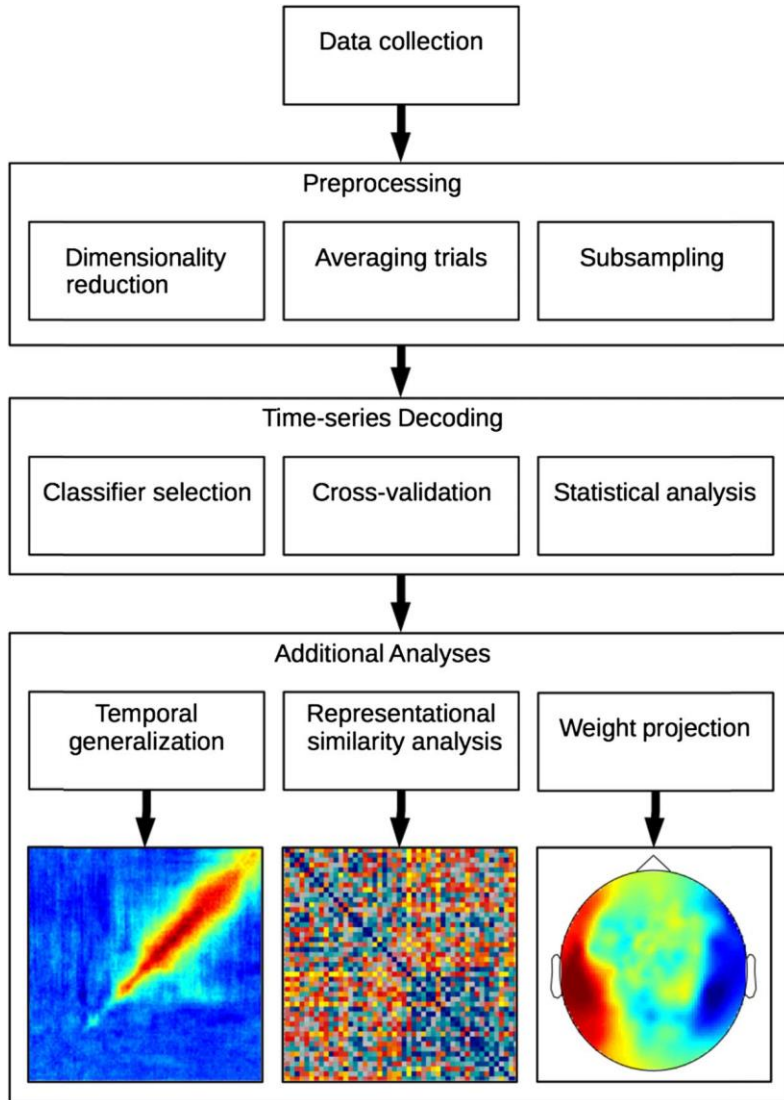
olaf.hauk@mrc-cbu.cam.ac.uk

COGNESTIC 2022

Decoding Information Over Time



Decoding Information Over Time



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)

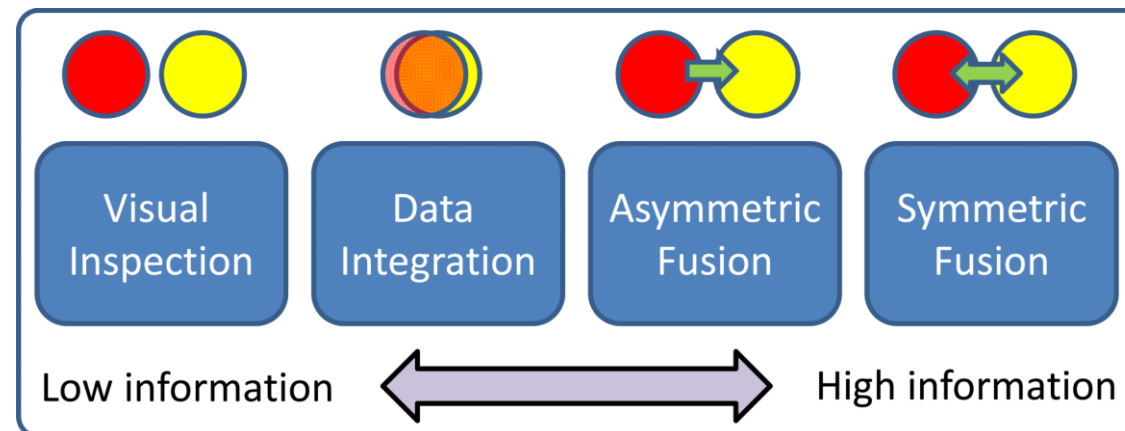
“Neural Modelling” (“Symmetric Fusion”):

Use of a common neural model that accounts for signals in all modalities.

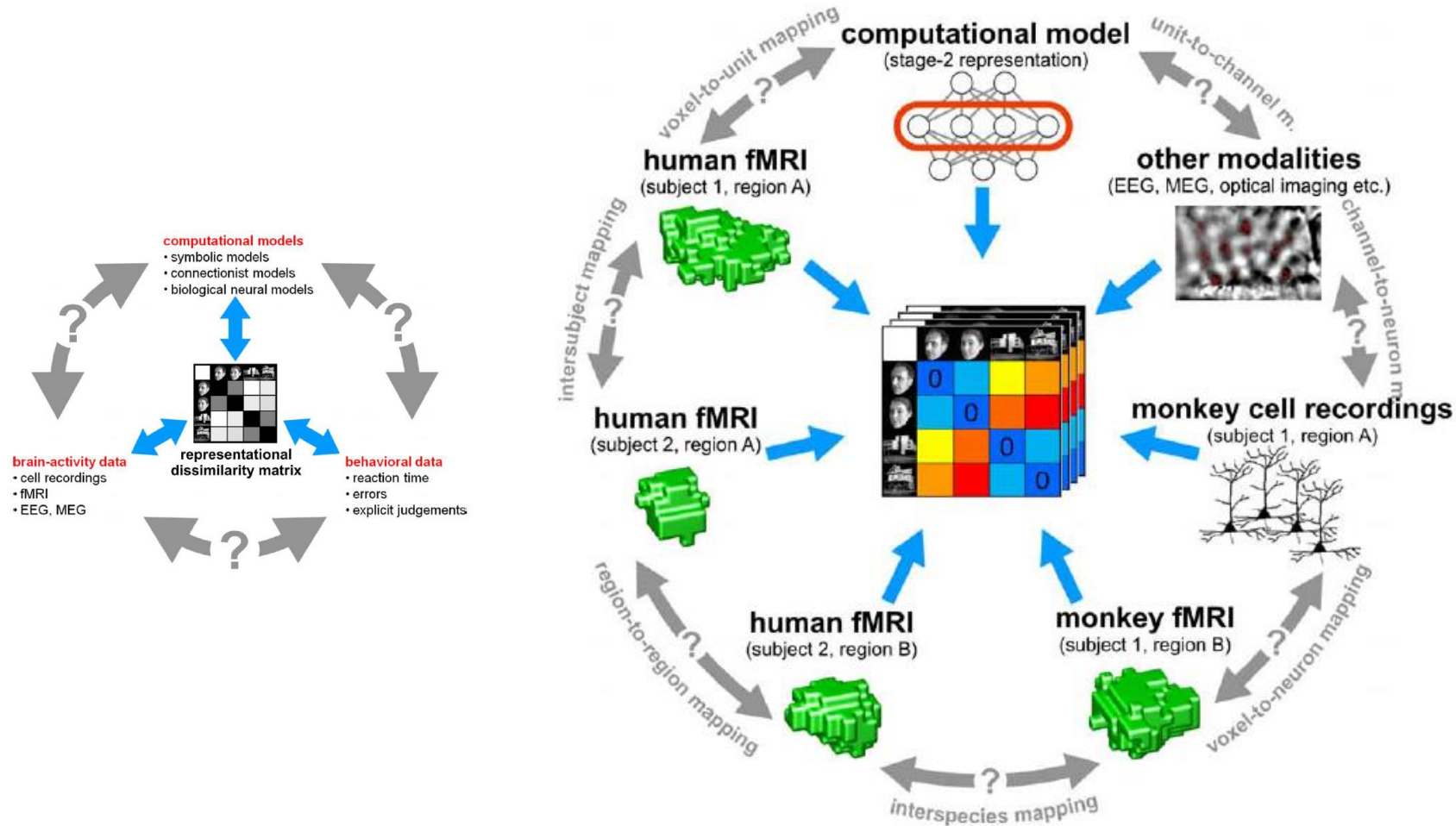
(e.g. EEG<->MEG)

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

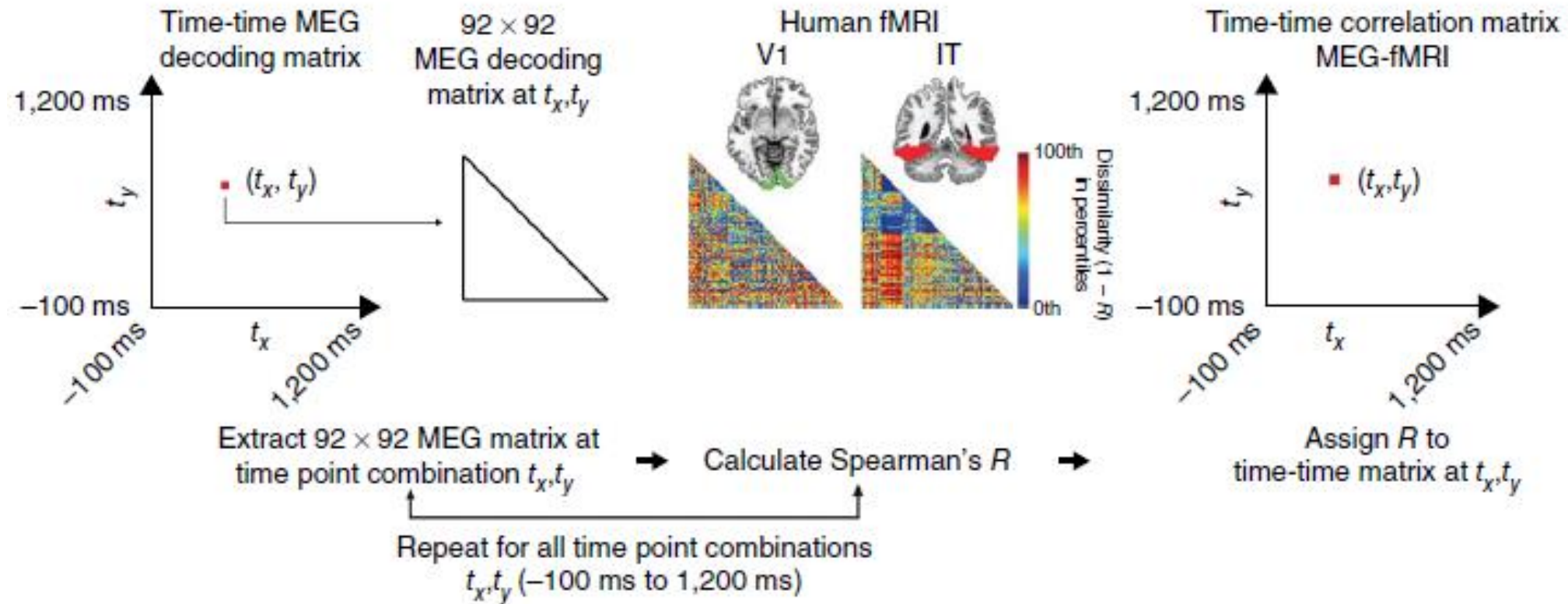
Each of these options poses different challenges with respect to modelling assumptions and complexity.



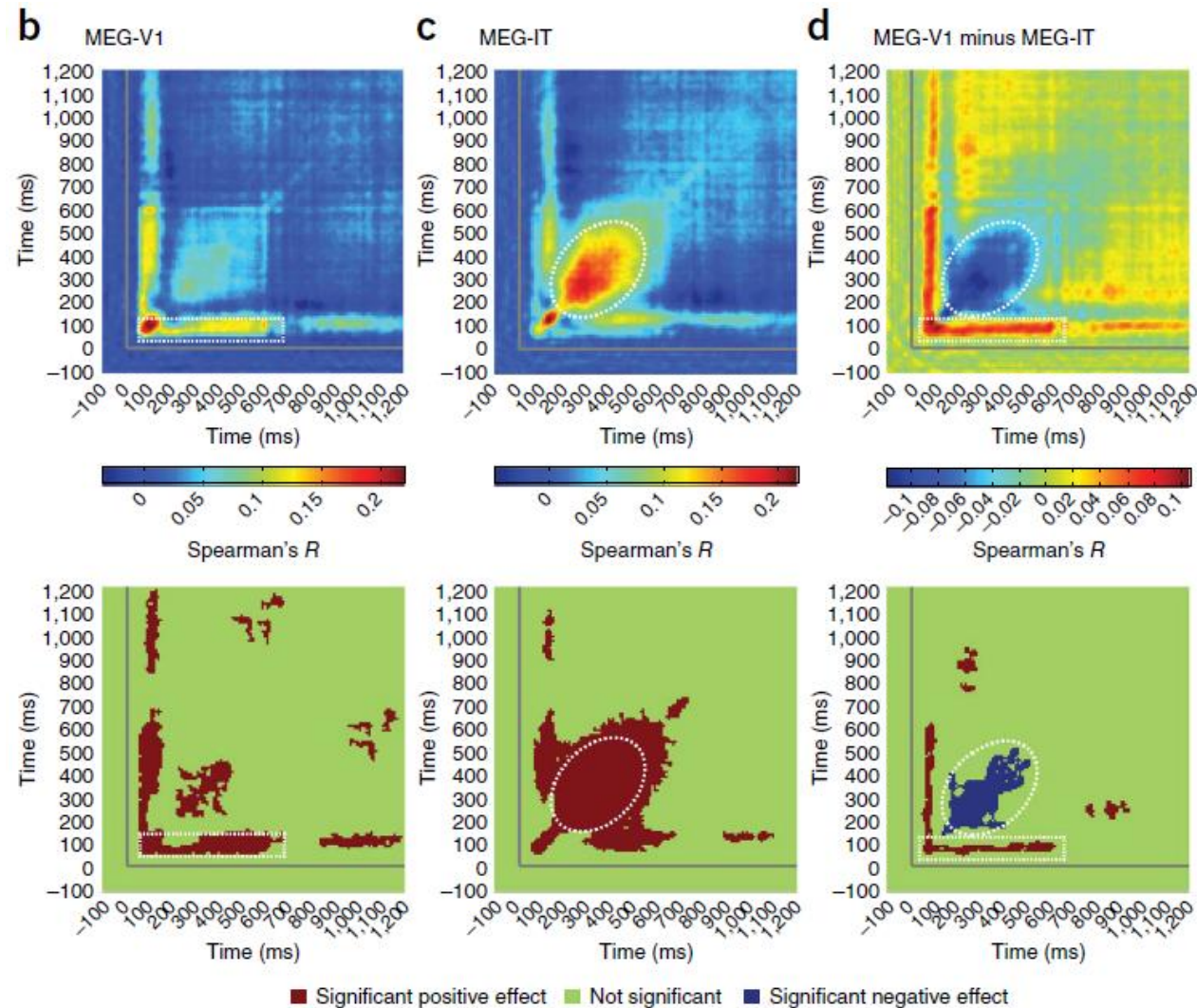
Comparing Representational Dissimilarity Across Neuroimaging Methods



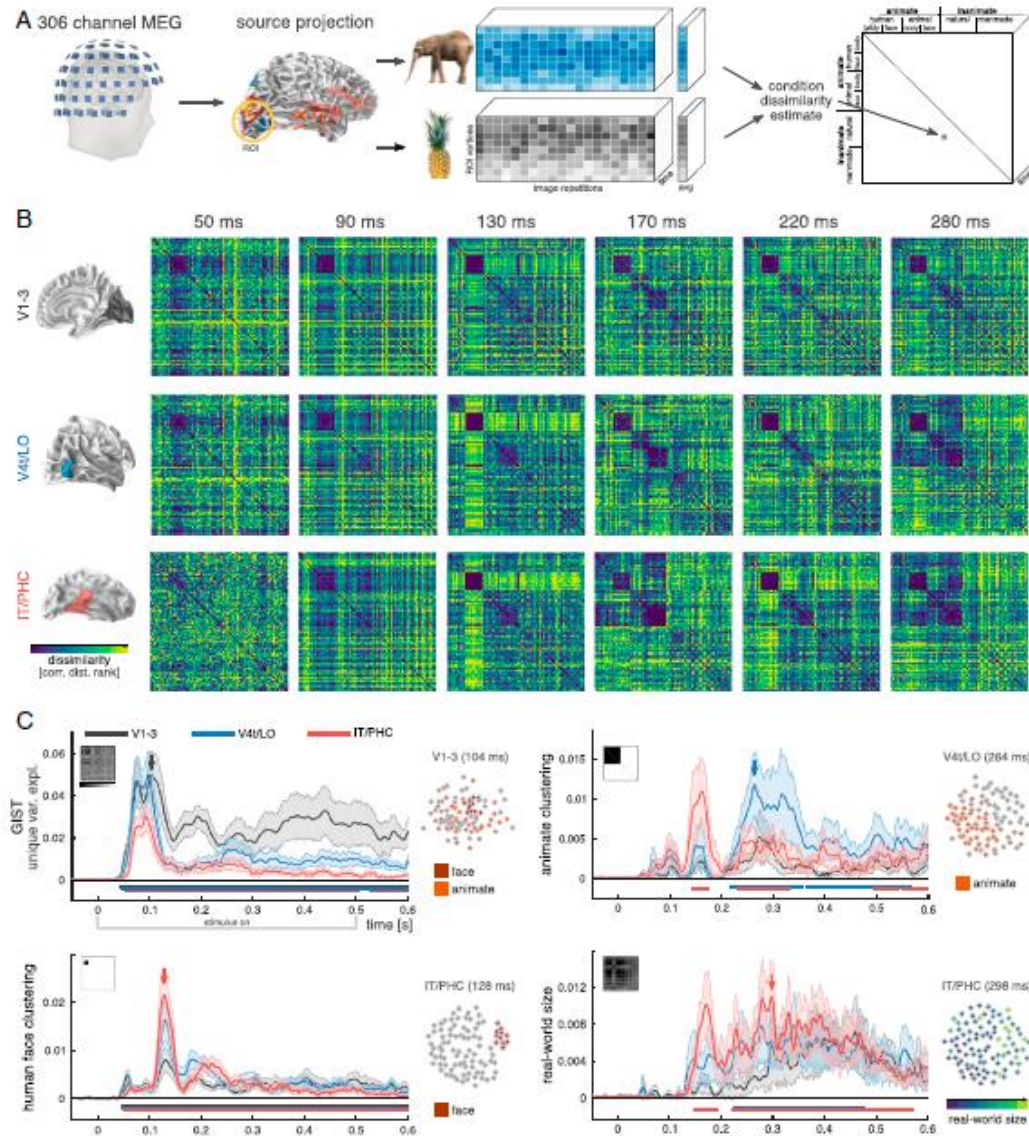
Comparing Representational Dissimilarity Across Neuroimaging Methods



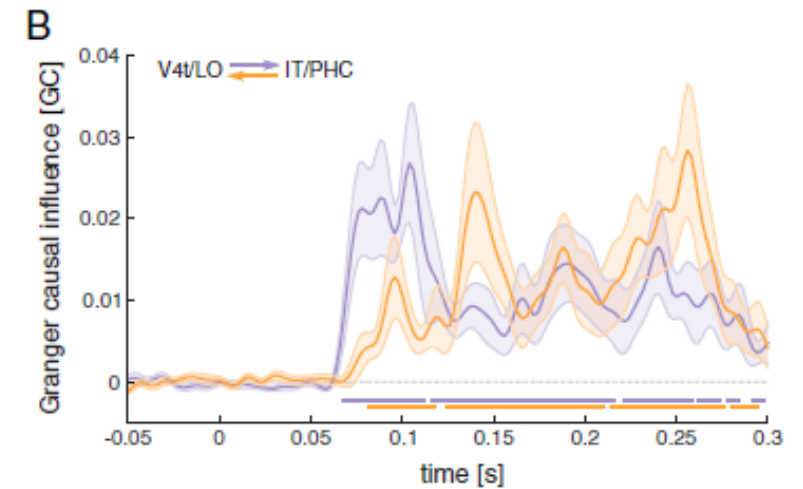
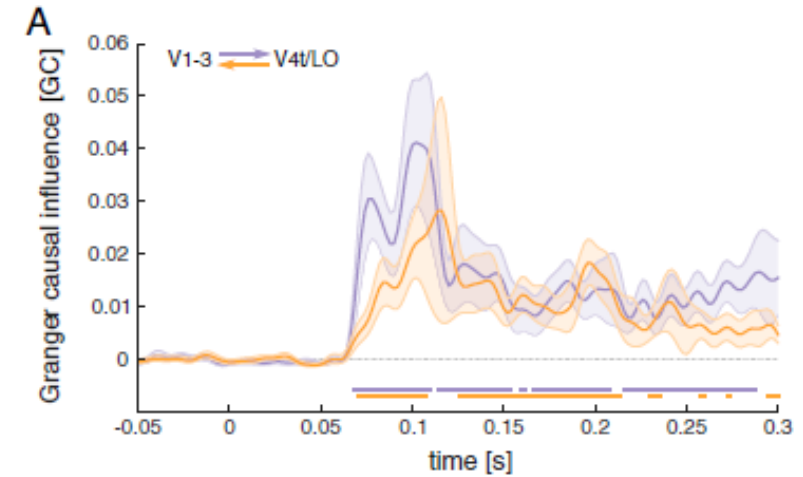
Comparing Representational Dissimilarity Across Neuroimaging Methods



Decoding Information Over Time And Space



RSA Granger Analysis of Information Flow

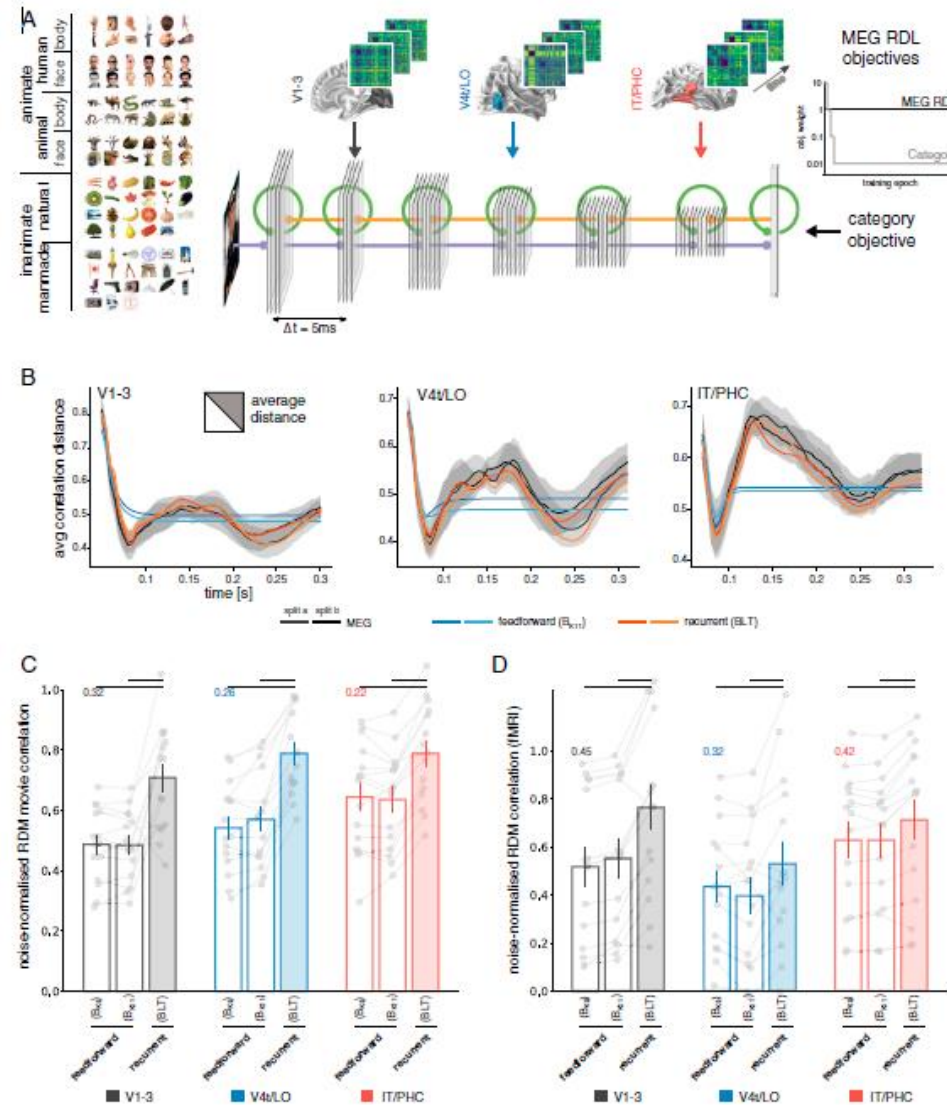


Kietzmann et al., PNAS 2019, <https://www.pnas.org/doi/10.1073/pnas.1905544116>

Also: Goddard et al. 2018: <https://pubmed.ncbi.nlm.nih.gov/26806290/>,

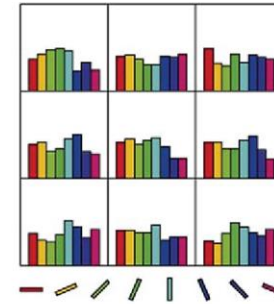
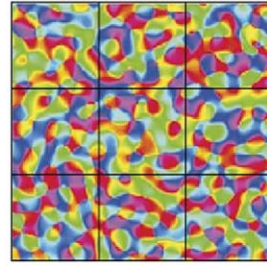
Karimi-Rouzbahani et al. 2022: <https://www.frontiersin.org/articles/10.3389/fnins.2022.755988/full>

Comparing Real With Artificial Neural Networks

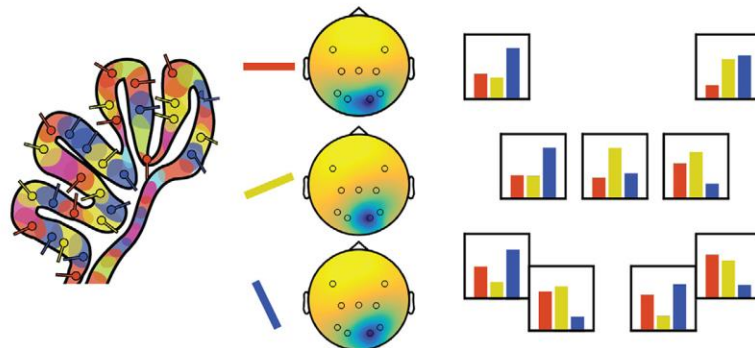
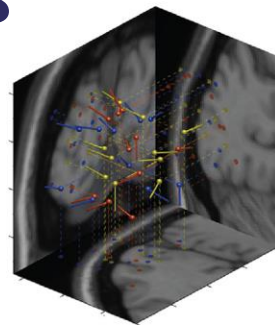
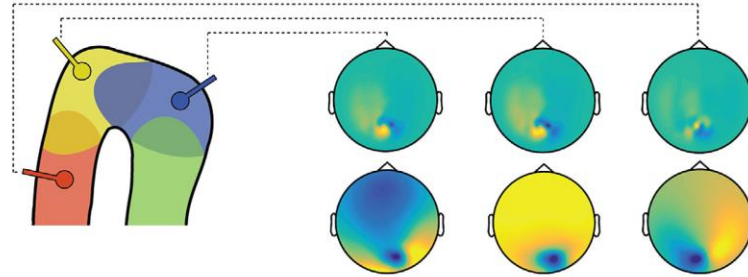
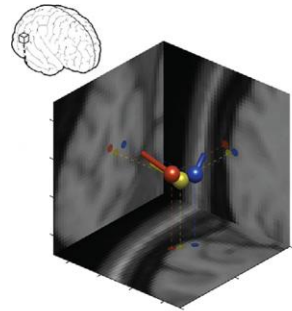


Reality and Measurement

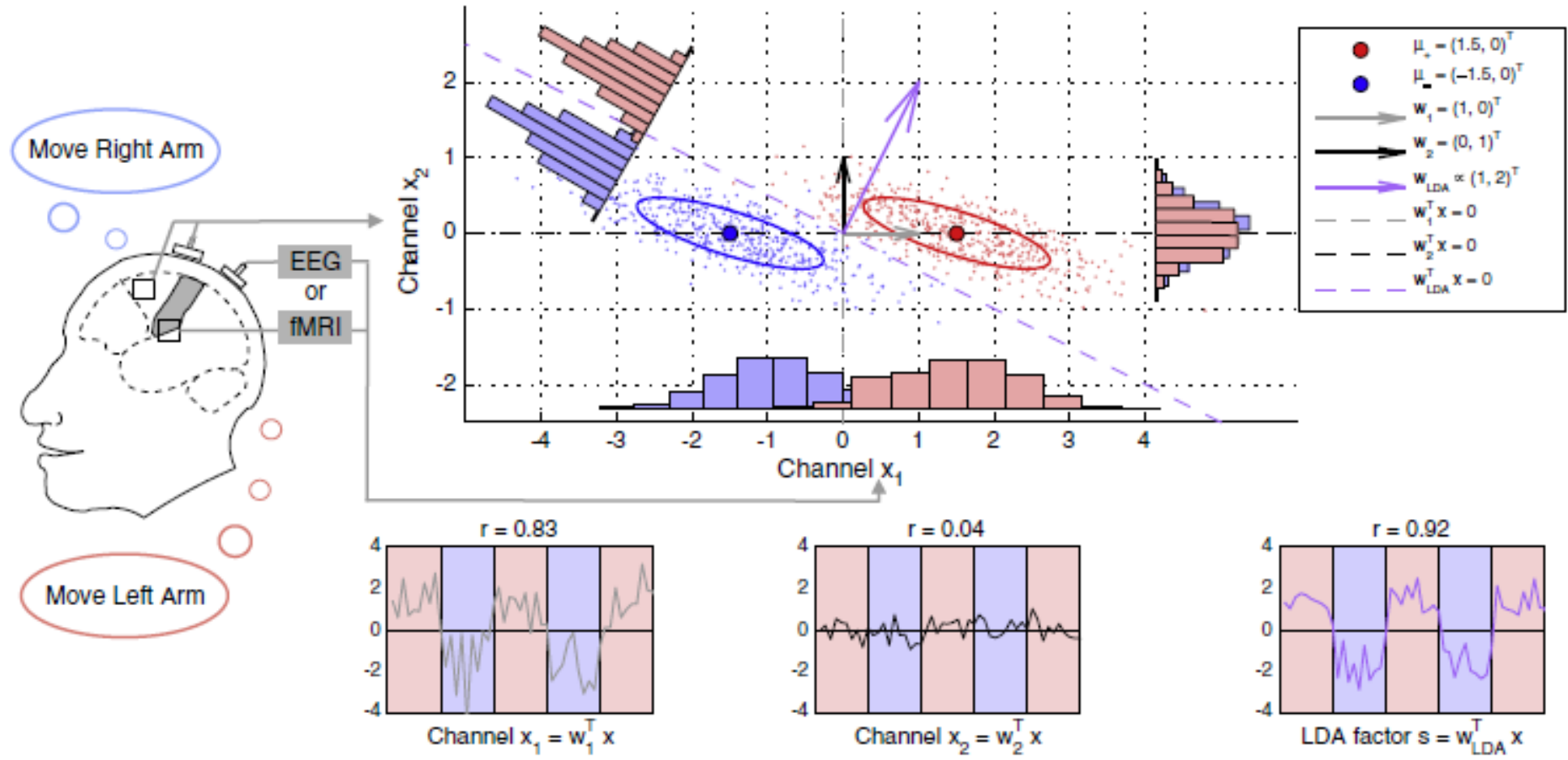
fMRI



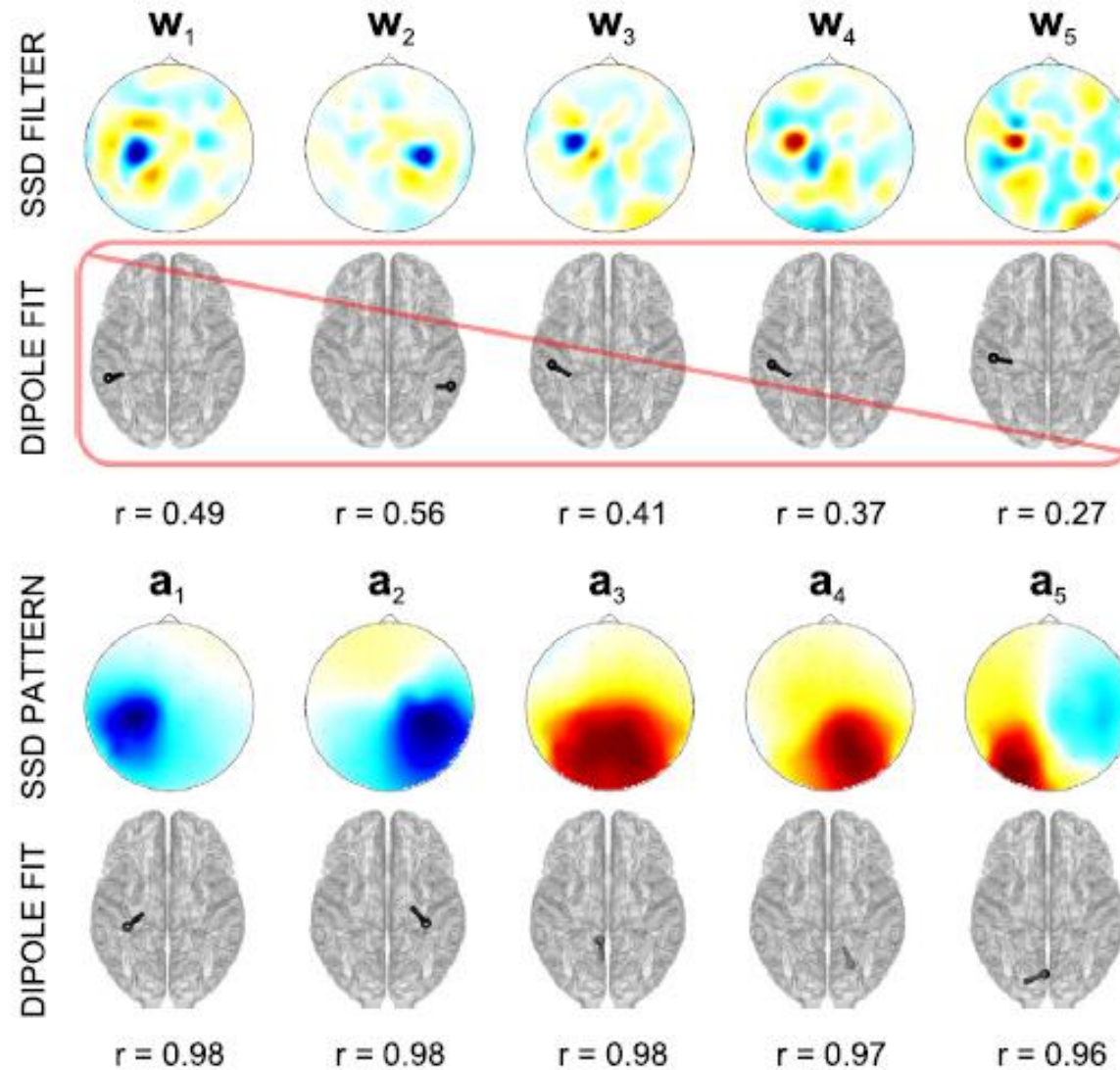
EEG/MEG:
Orientation matters



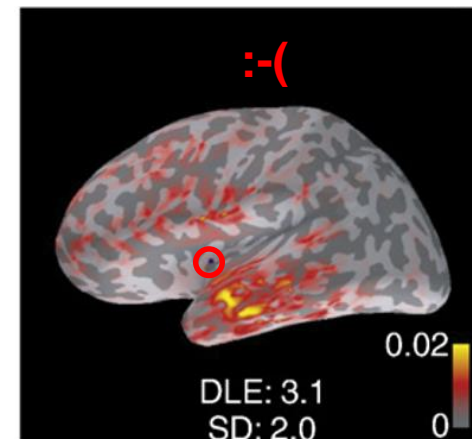
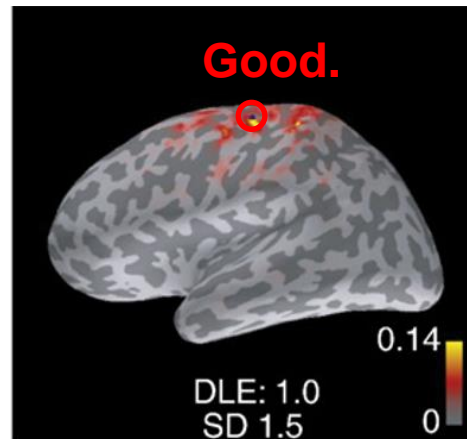
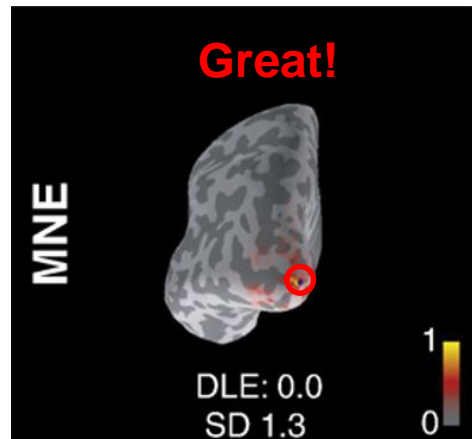
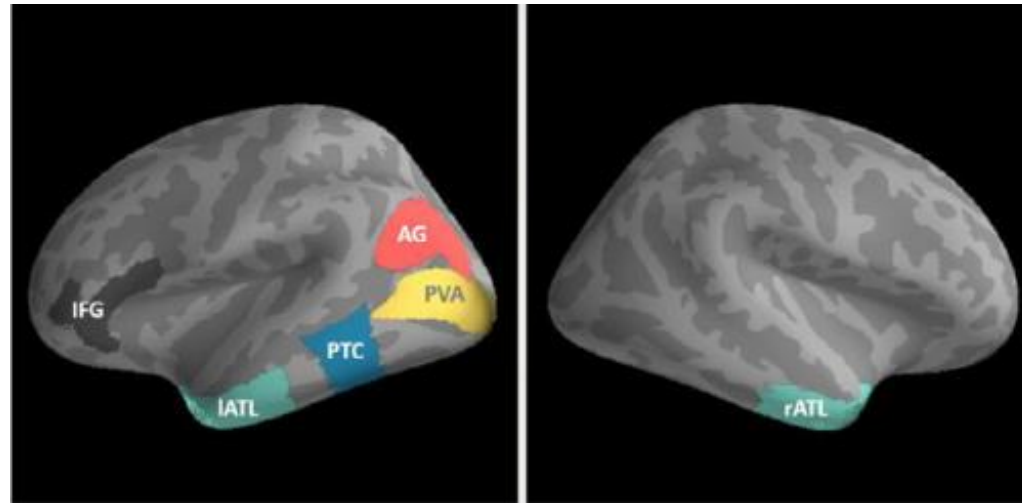
Interpreting Weight Vectors



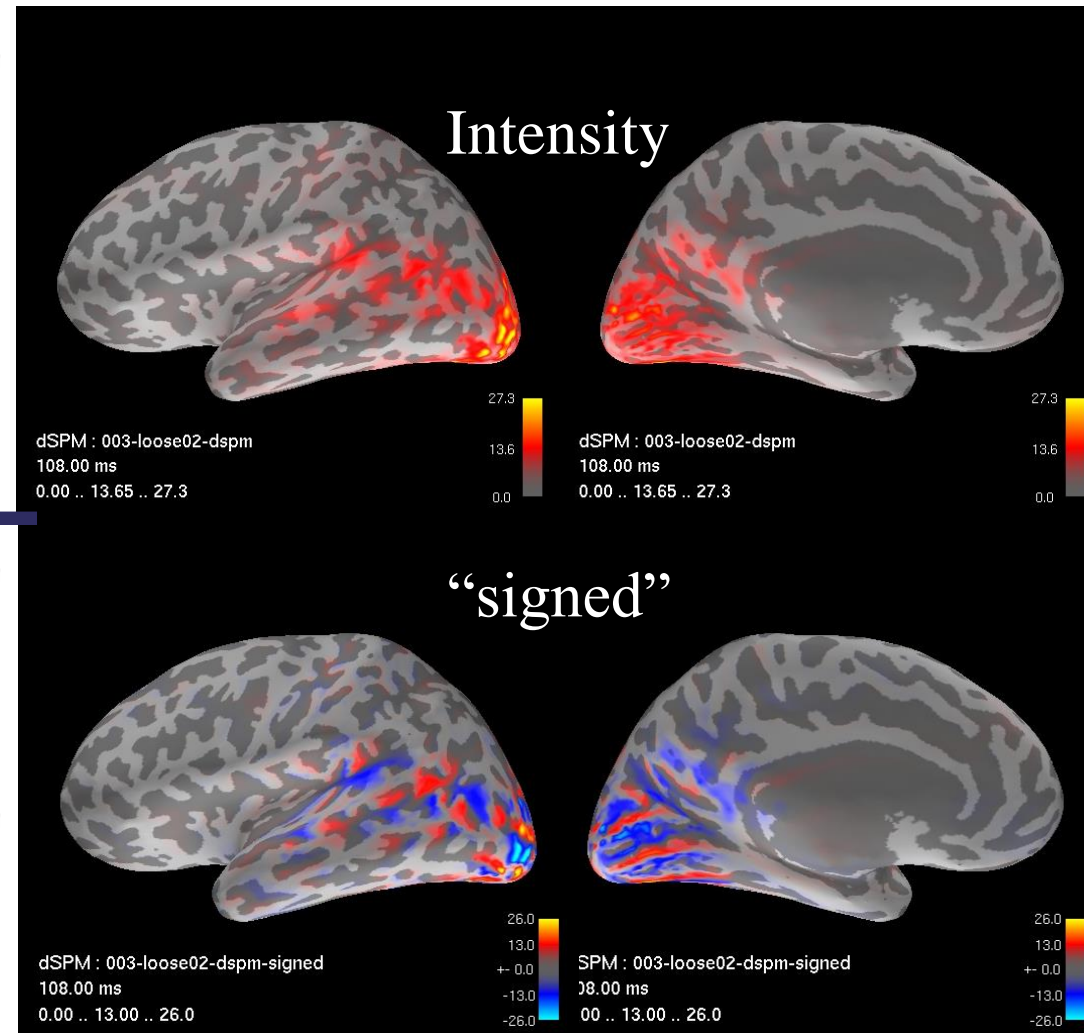
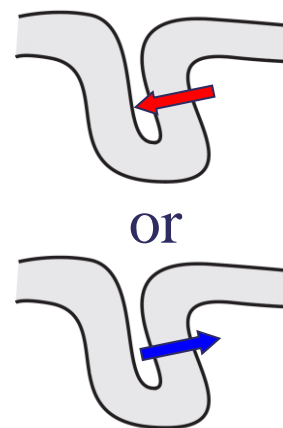
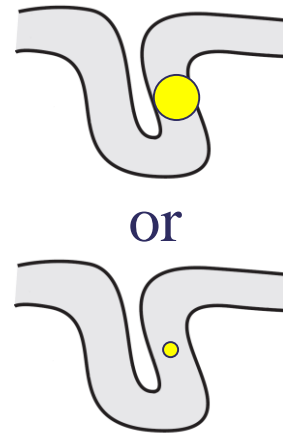
Perform Source Estimation On Patterns, Not Filter Weights



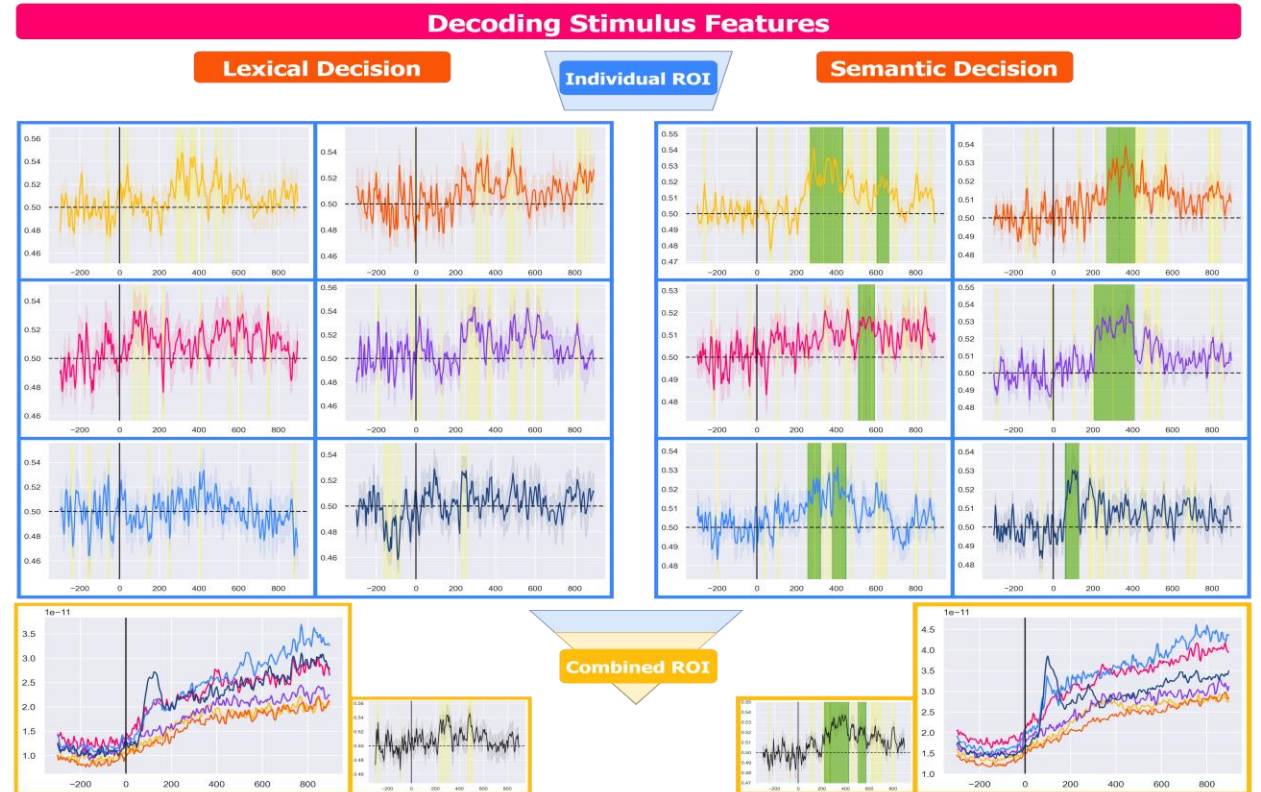
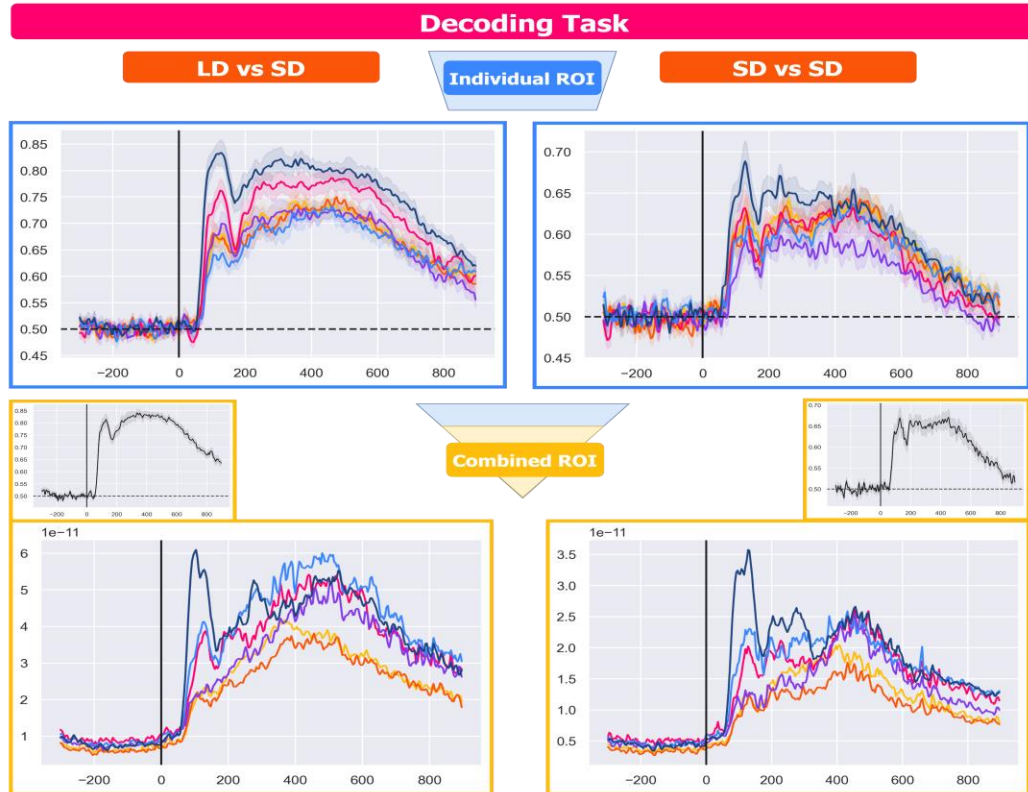
Back to Basics: Where/What to Decode From



Signed Source Estimates Contain More Information For Decoding



Back to Basics: Where/What to Decode From



■ IATL
 ■ rATL
 ■ AG
 ■ PTC
 ■ IFG
 ■ PVA
 — chance
 ■ $p < 0.05$ (corrected)

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



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Thank you

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