目前MRI與MEG研究國際趨勢、討論課題與成果分享

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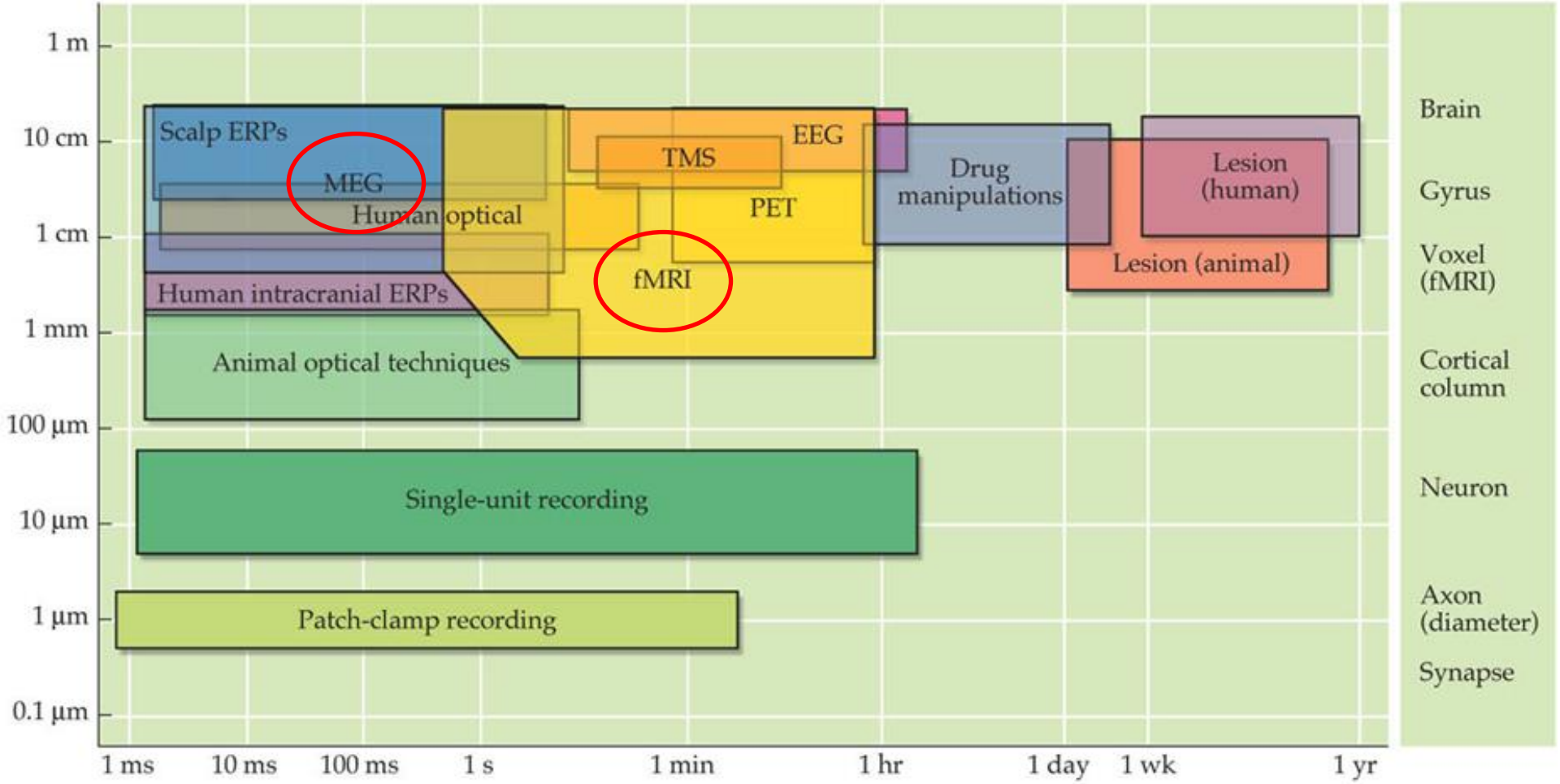
Overview

(f)MRI vs. MEG

Current trends

(f)MRI vs. MEG


1 m
10 cm
1 cm
1 mm
100 µm
10 µm
1 µm
0.1 µm
1 ms
10 ms
100 ms
1 s
1 min
1 hr
1 day
1 wk
1 yr
Scalp ERPs
MEG
Human optical
Human intracranial ERPs
Animal optical techniques
EEG
TMS
PET
fMRI
Drug manipulations
Lesion (human)
Lesion (animal)
Single-unit recording
Patch-clamp recording
Brain
Gyrus
Voxel (fMRI)
Cortical column
Neuron
Axon (diameter)
Synapse

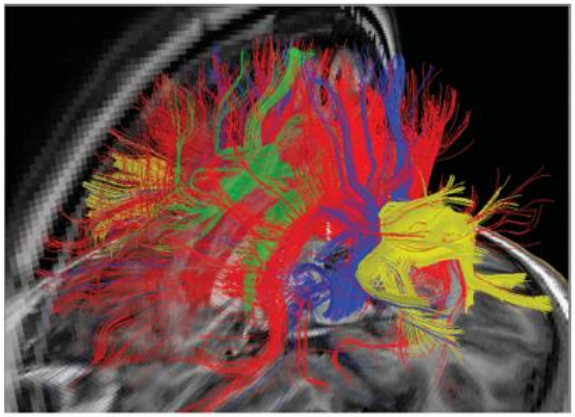
(f)MRI vs. MEG

- **(f)MRI**: where
  - Structures
    - Gray matter
    - White matter
  - Functions (indirect)
    - Functional localisations or mappings
    - Functional connectivity
      - Task positive
      - Resting state
    - Effective connectivity

- **MEG**: when and where
  - Functions (relative direct)
    - Event-related effects
    - Neural communications
      - Brain oscillations
    - Source localisations
      - Functional localisations
      - Functional and effective connectivity

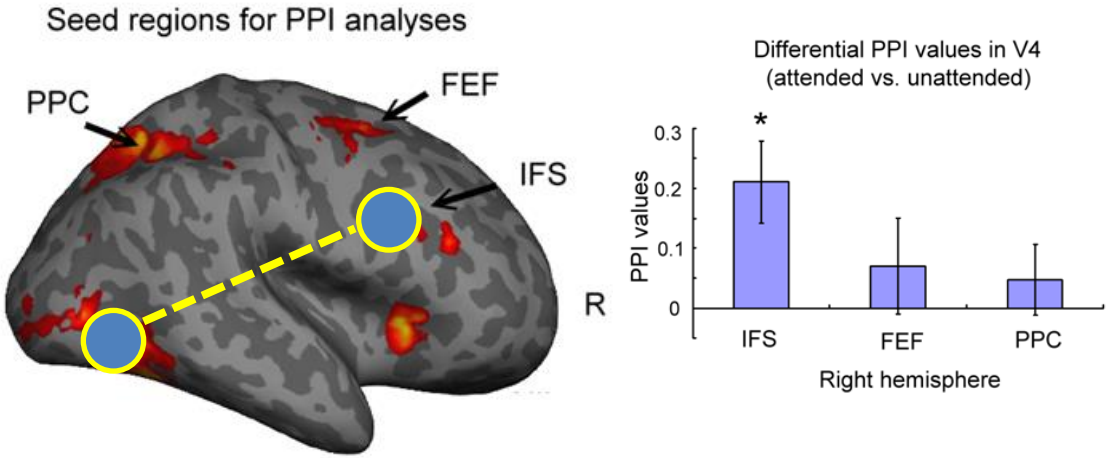
(f)MRI

Diffusion MRI



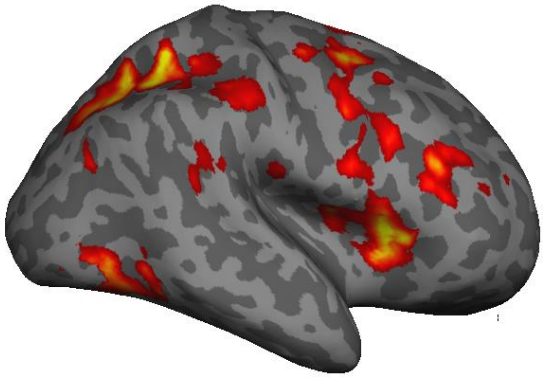
Cho, et al., 2013, J. Neurosci. Neuroeng

Functional connectivity

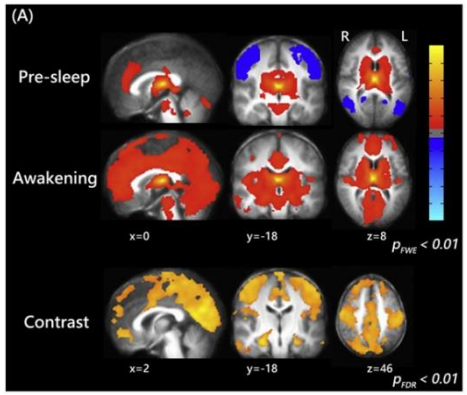


Kuo, et al., 2014, Journal of Cognitive Neuroscience

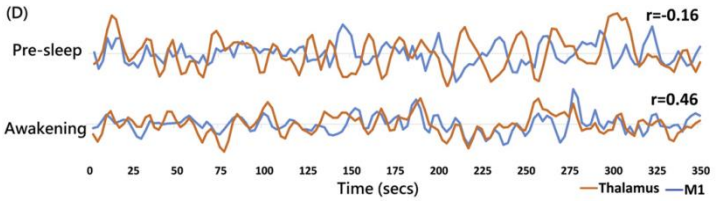
Functional mappings



Kuo, under revision



Resting-state connectivity



Tsai, et al., 2014, NeuroImage

(f)MRI vs. MEG

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  - Structures
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- **MEG**: when and where
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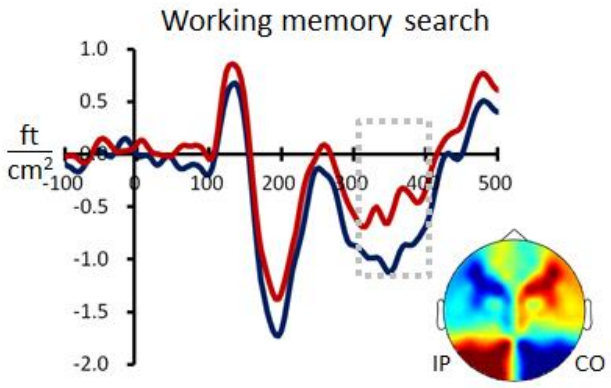
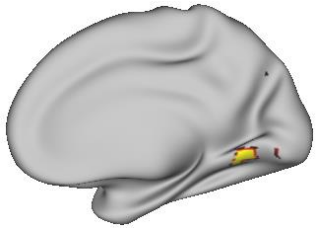
      - Functional localisations
      - Functional and effective connectivity

MEG

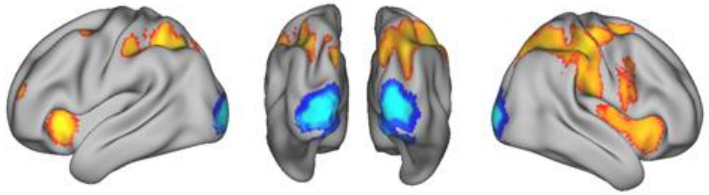
Event-related magnetic fields (ERMF)



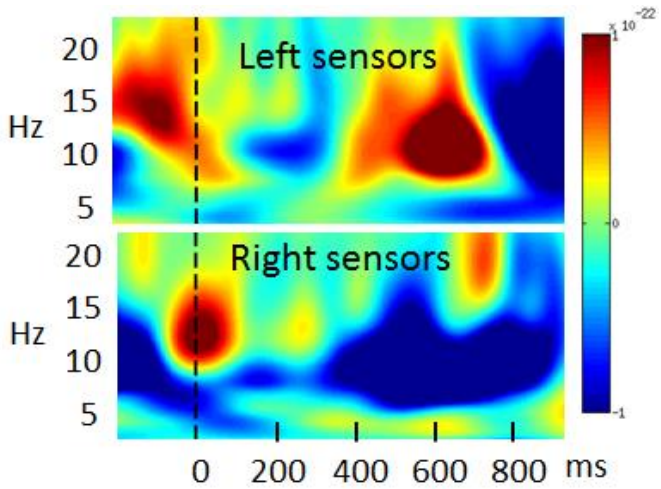
Neural origins for ERMF

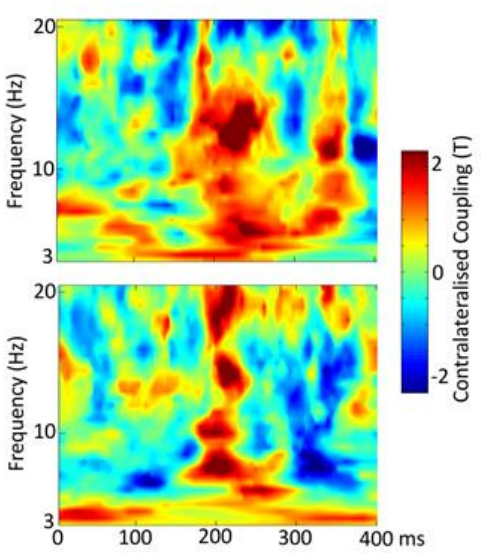


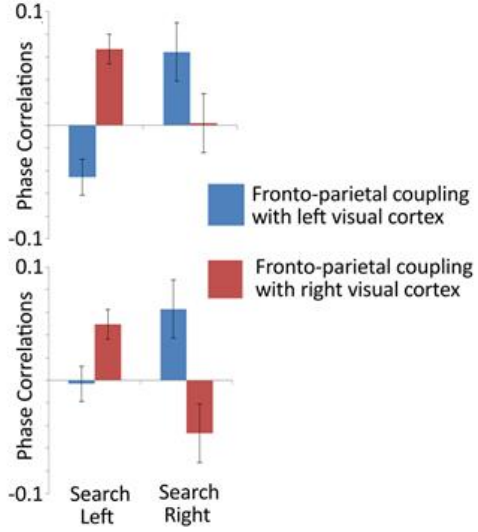
Frontoparietal – visual phase synchronisation



Oscillations in alpha frequency band

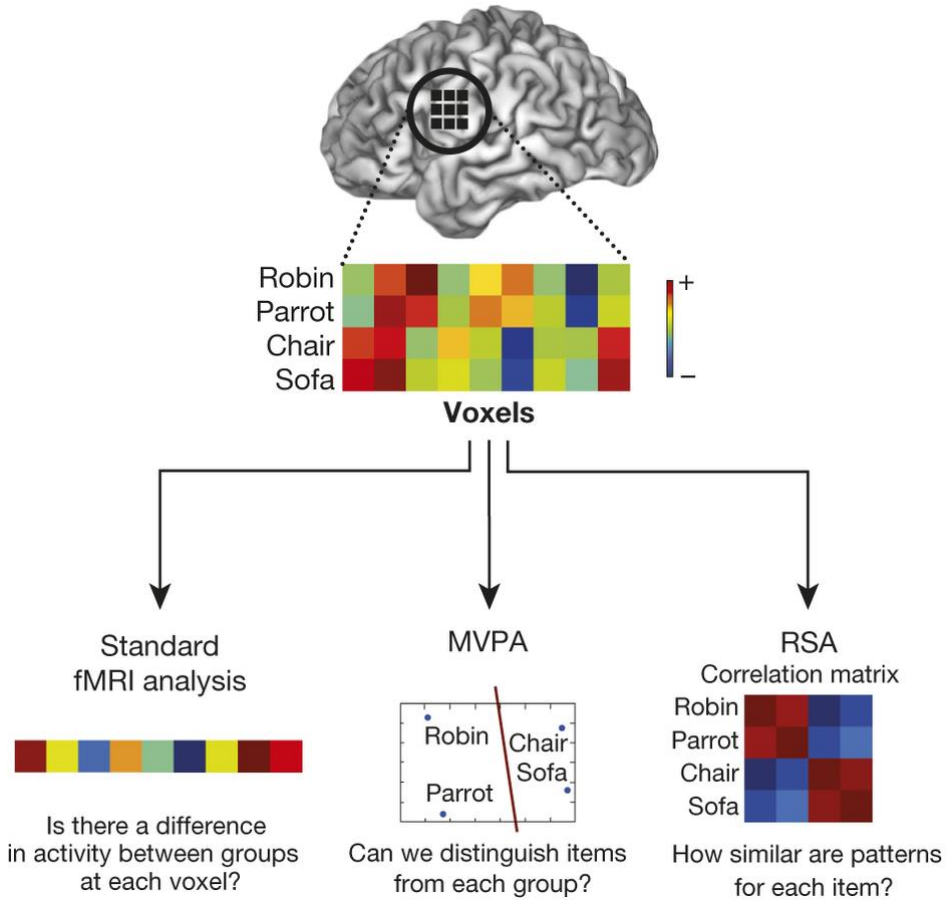




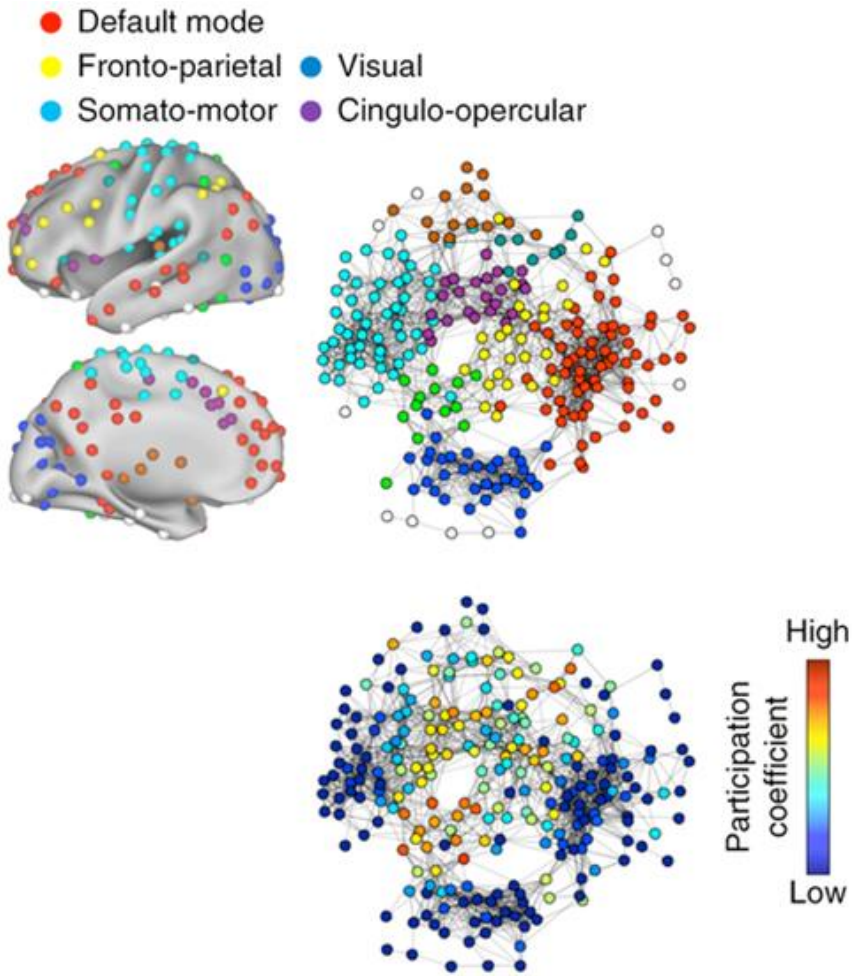


Kuo, under revision

Current trends: machine learning, decoding, connectivity, and network

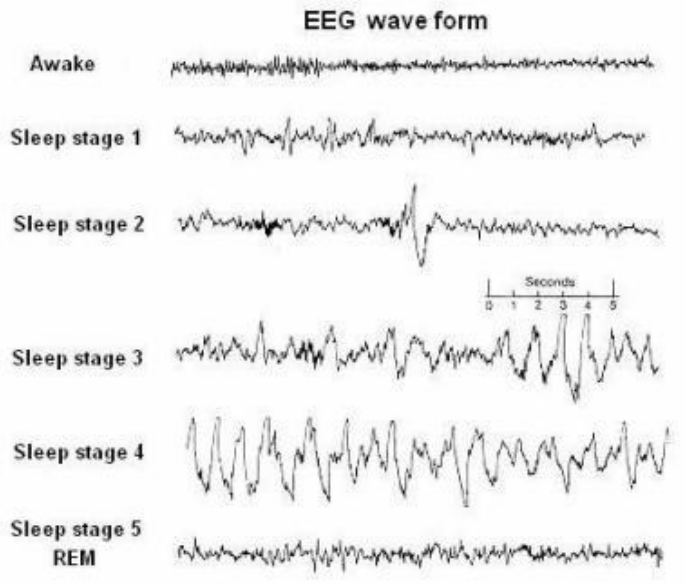


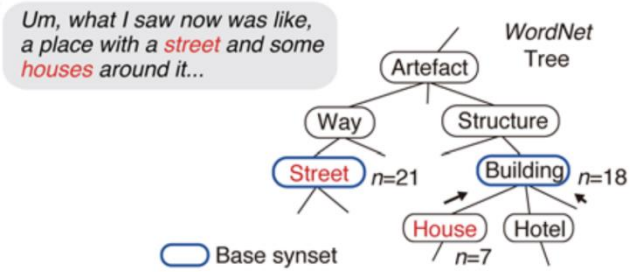
Poldrack, R. A., & Farah, M. J. (2015). Progress and challenges in probing the human brain. Nature, 526(7573), 371-379.

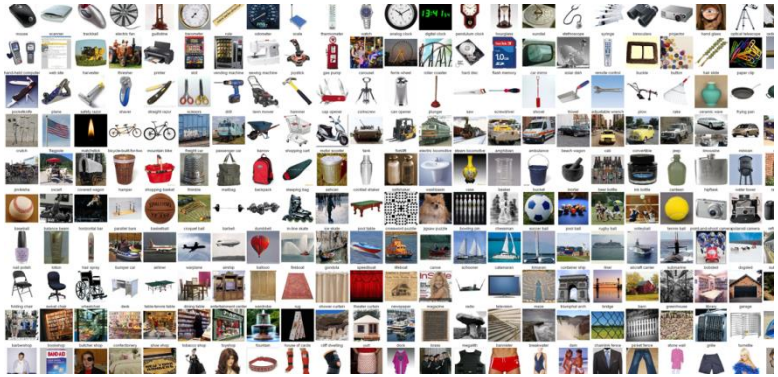


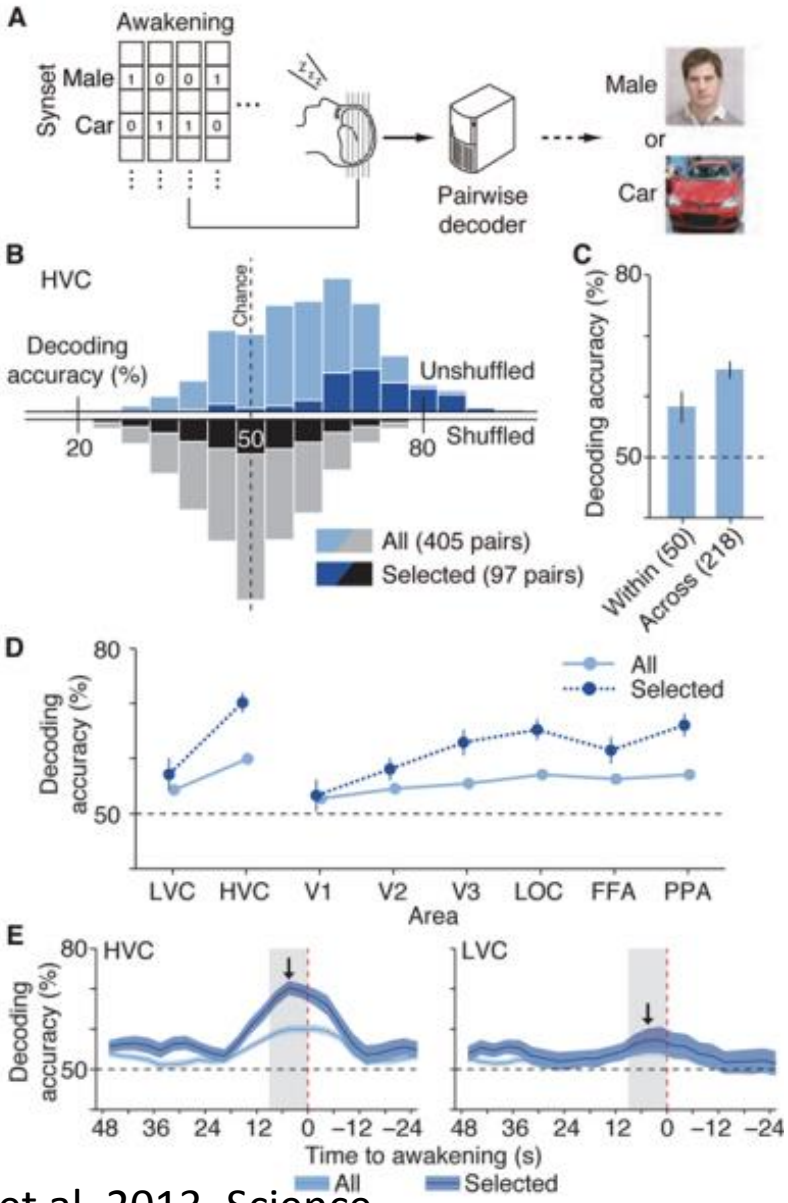
Sporns, O. (2014). Contributions and challenges for network models in cognitive neuroscience. Nature neuroscience, 17(5), 652-660.

Decoding dreams with fMRI



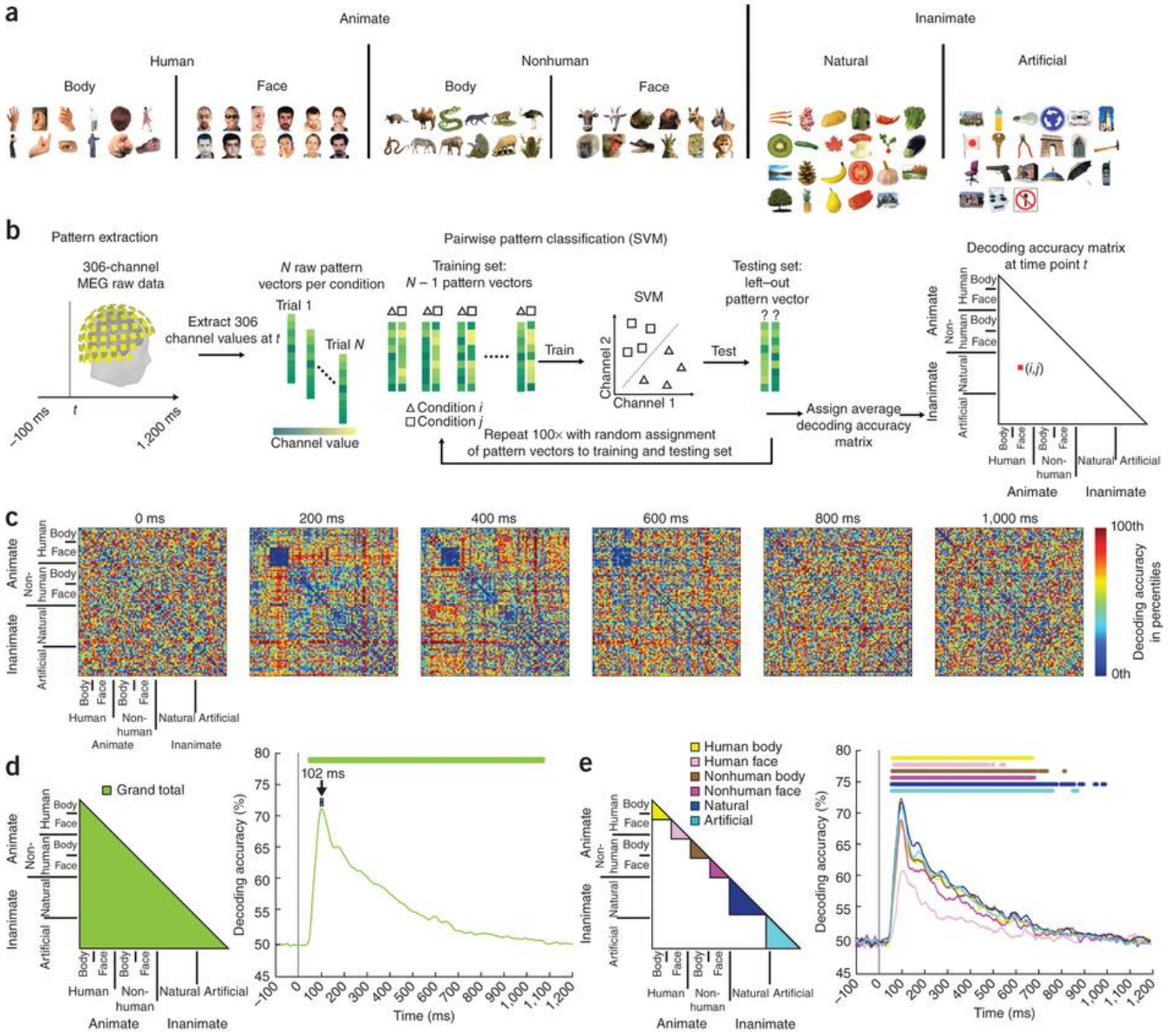






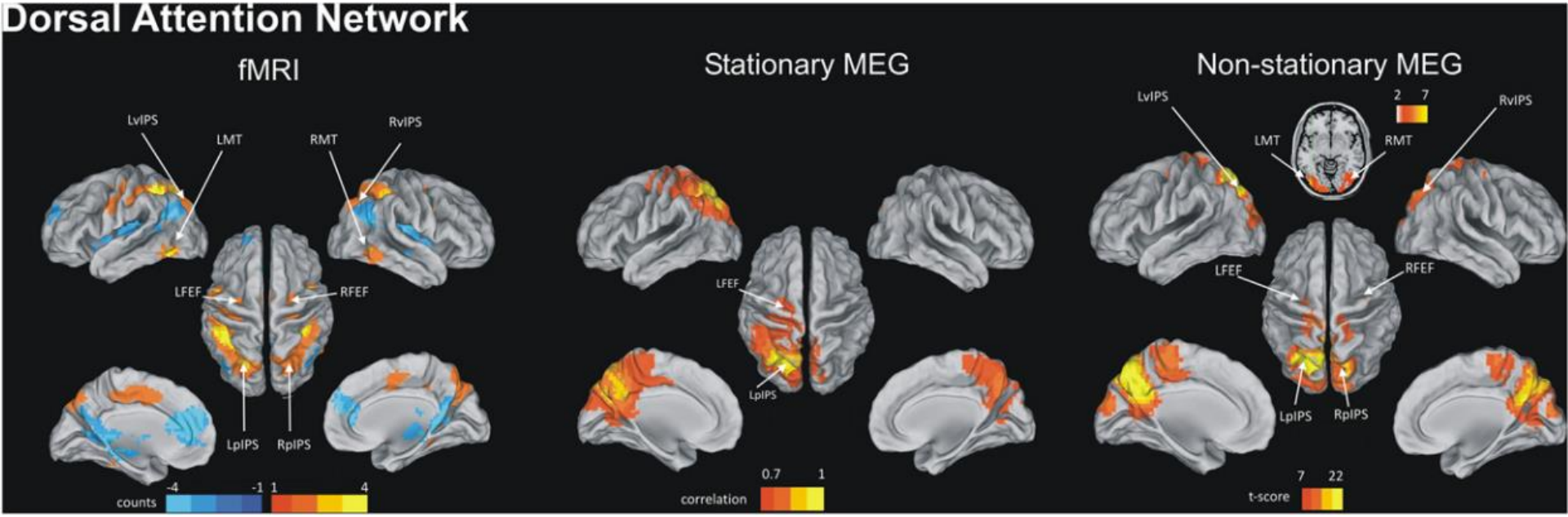
Horikawa et al. 2013, Science

Decoding of images from MEG signals



Cichy et al., 2014, Nature Neuroscience

fMRI & MEG: brain networks



HUMAN Connectome PROJECT

de Pasquale, F., Della Penna, S., Snyder, A. Z., Lewis, C., Mantini, D., Marzetti, L., ... & Corbetta, M. (2010). Temporal dynamics of spontaneous MEG activity in brain networks. *Proceedings of the National Academy of Sciences*, *107*(13), 6040-6045.

Current (or future) goals

- Basic knowledge for cognitive and neural representations
- Biomedical engineering – hardware and software
- Clinical diagnosis – e.g. epilepsy
- Brain machine interface

Thank you for your attention!

Q & A