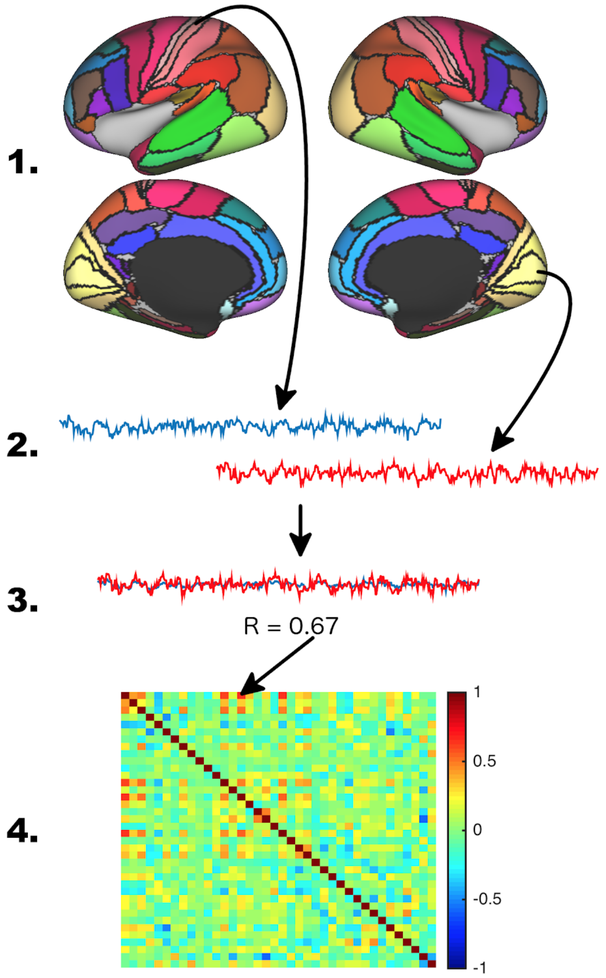
Network modeling analysis

- Resting state preprocessing
- Node definition and edge calculation
- Group analysis and challenges
- Comparison of resting state methods

Node-based methods



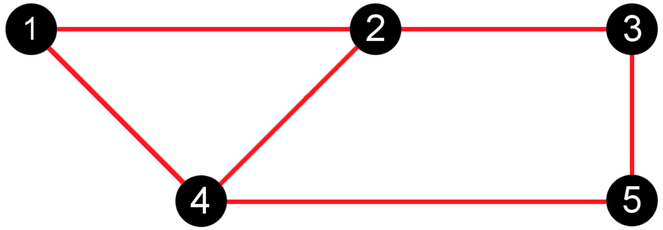
Node definition

Timeseries extraction

Edge calculation

Network matrix

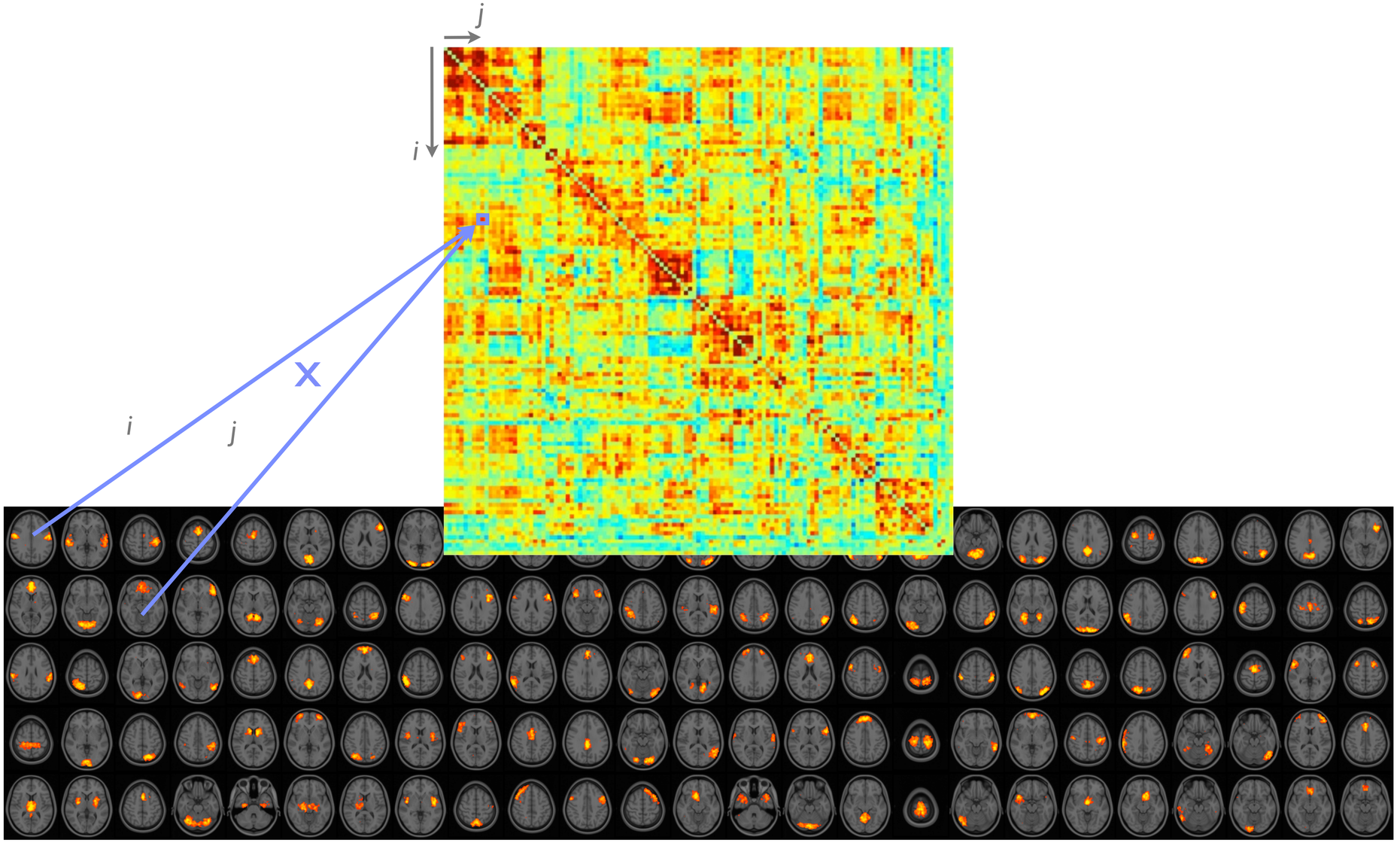
Group analysis



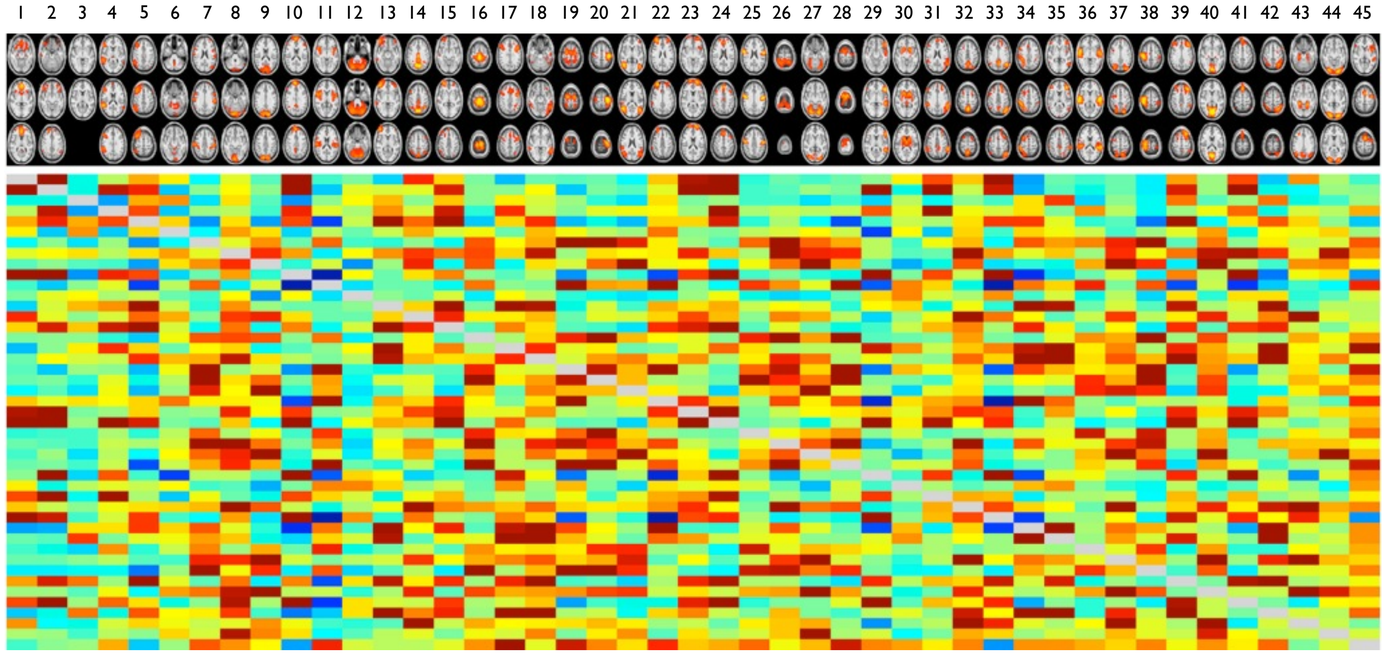
Bijsterbosch et al (2017)

Group Analysis

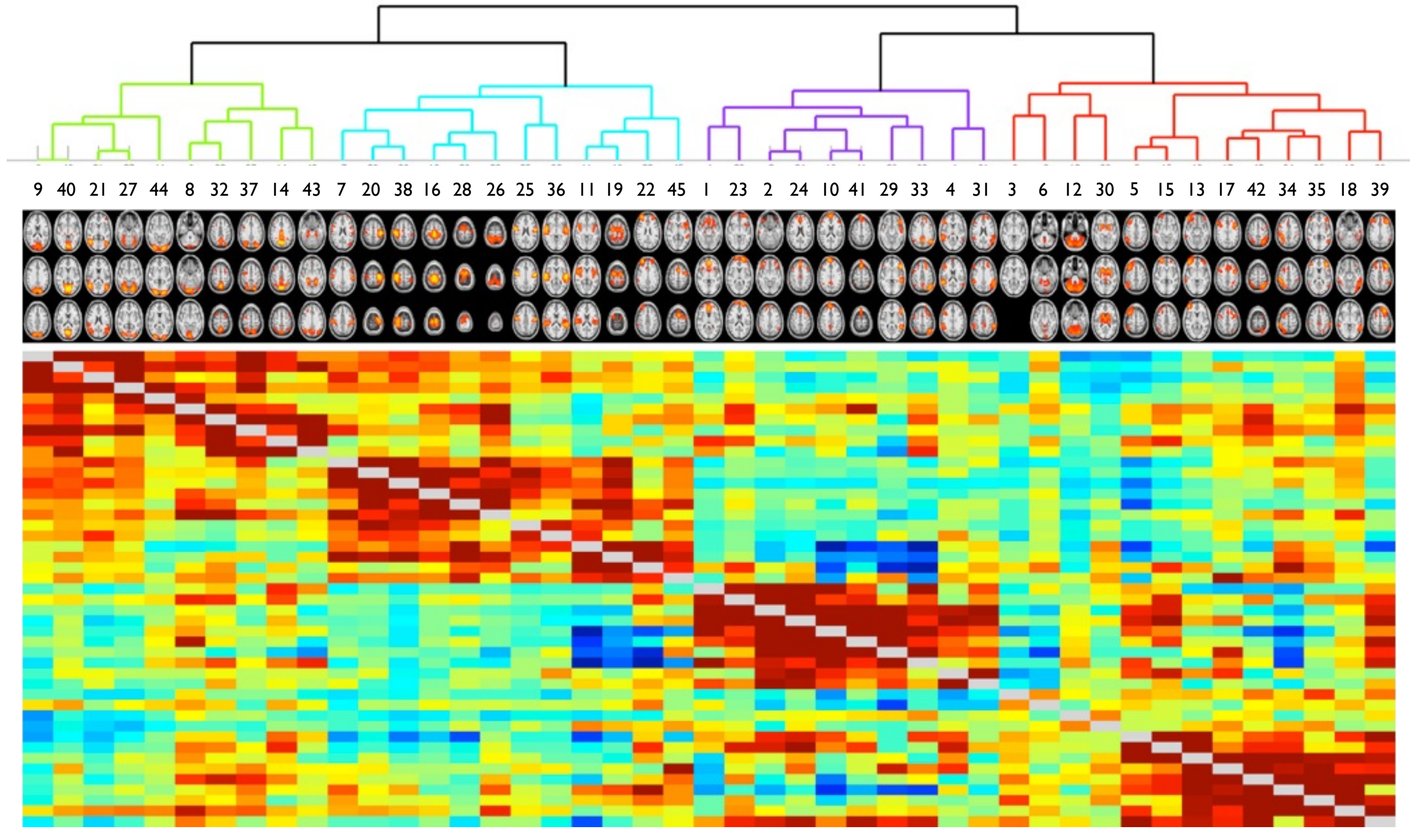
Building a network matrix



Network matrix

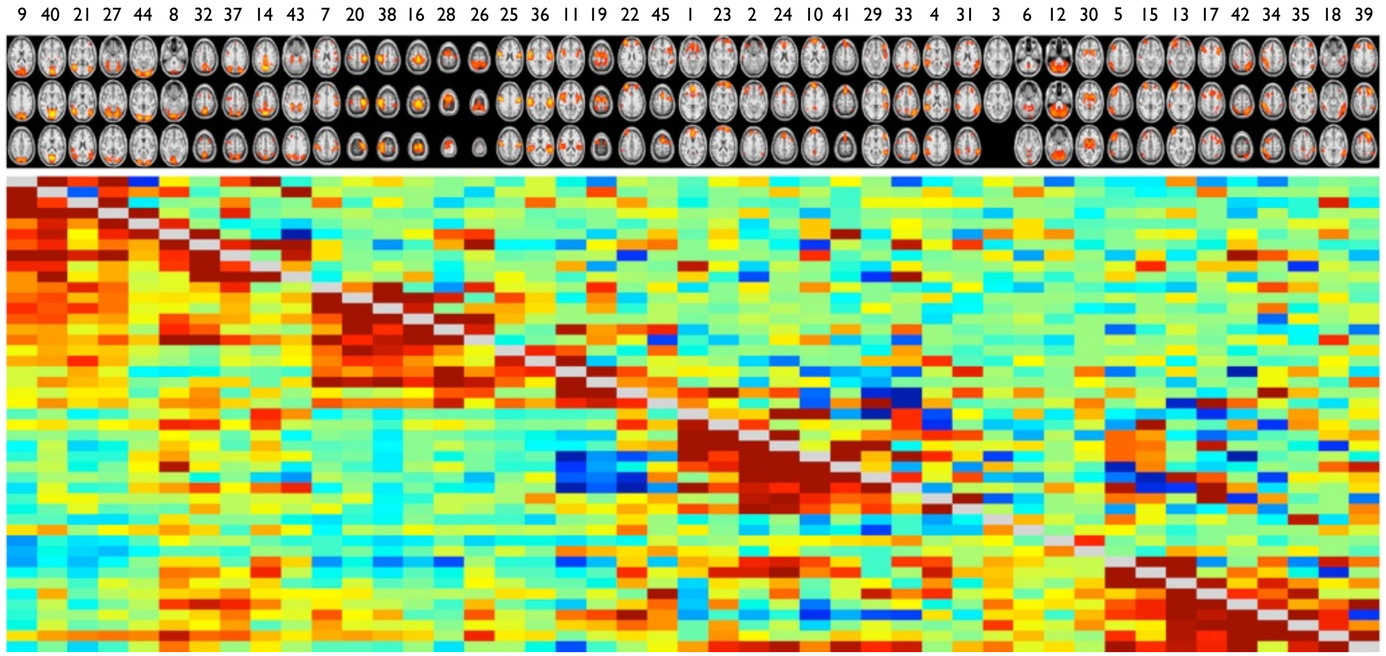


Hierarchical clustering



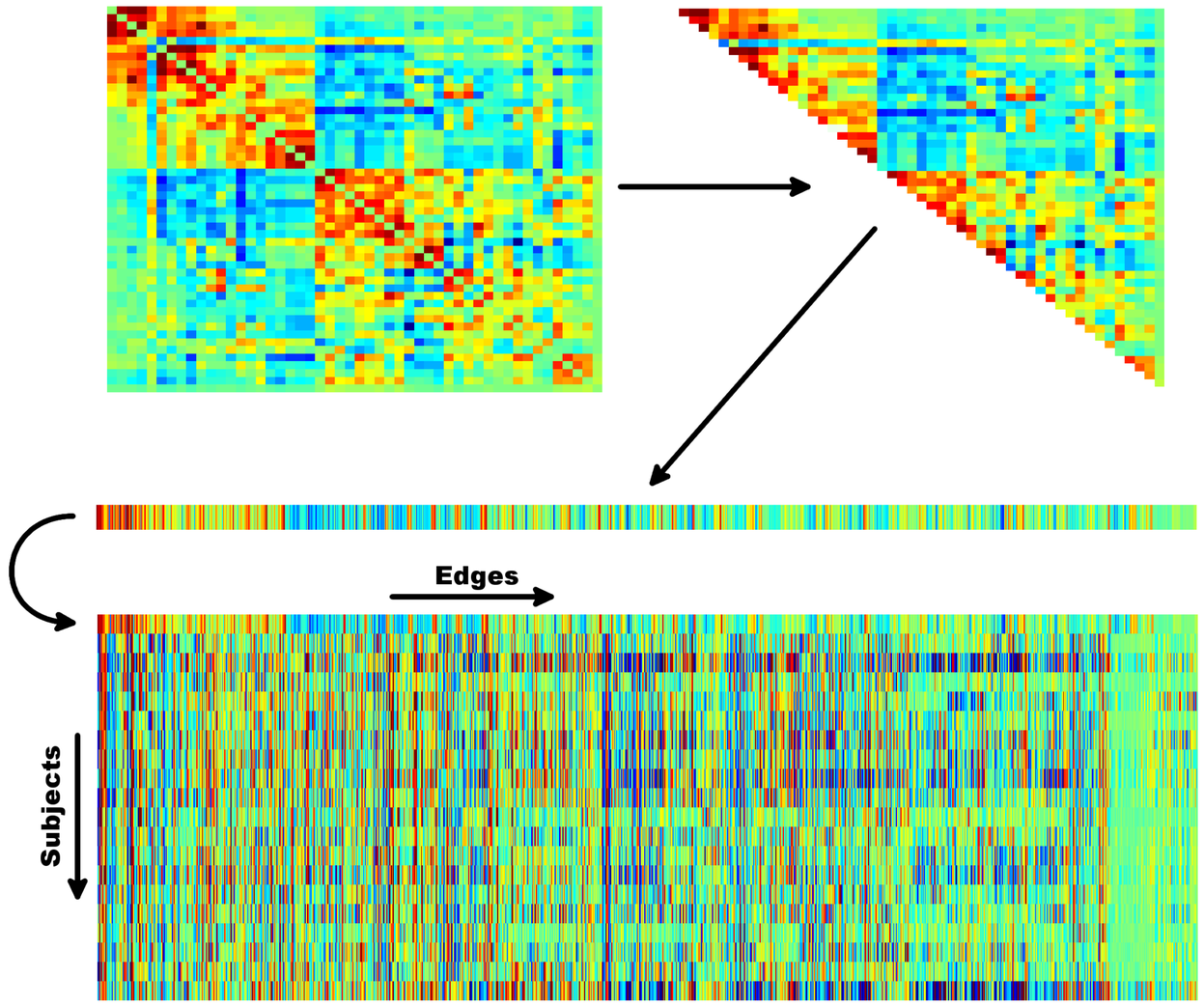
Partial correlation is sparser than full

Full correlation matrix



Partial correlation matrix

Group analysis



- Calculate network matrix for each subject
- Combine all network matrices into one
- Perform group-level comparisons:
  - Univariate tests for each edge (GLM)
  - Multivariate prediction methods (SVM)

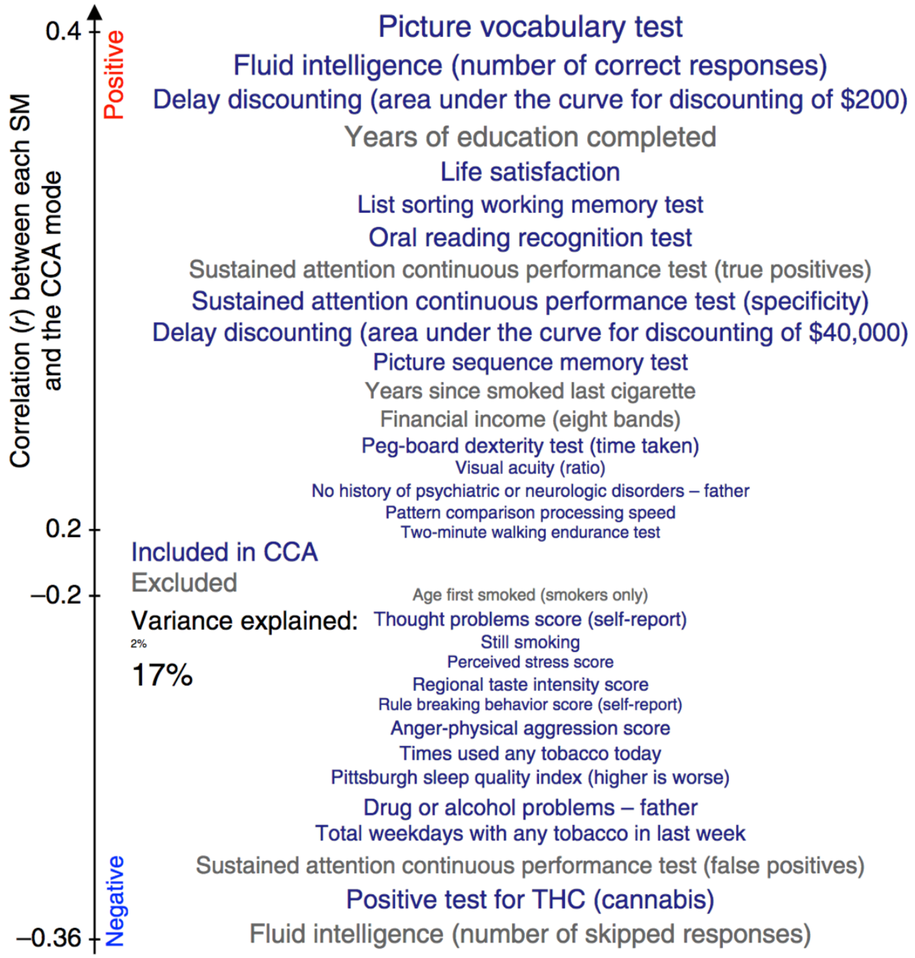
Bijsterbosch et al (2017)

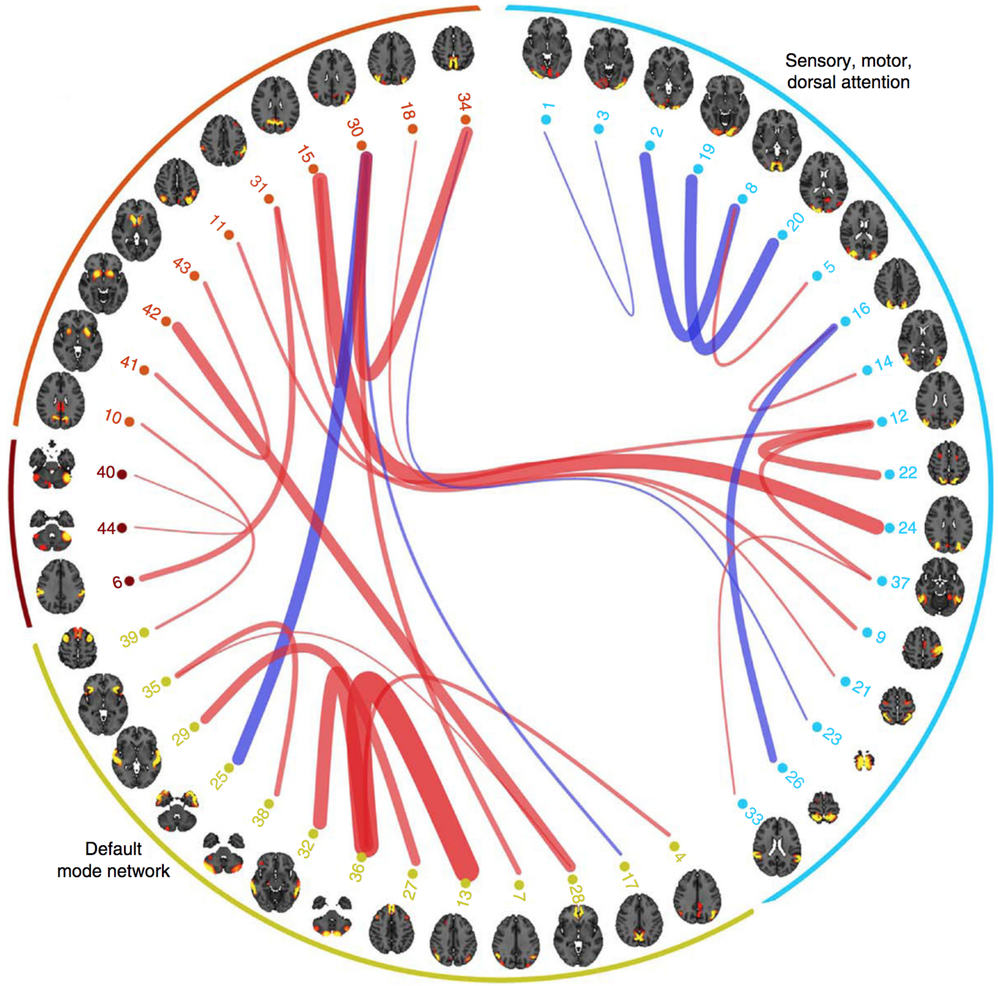
FSLnets

- Currently uses Matlab or Octave
- Therefore this practical will be a bit different from other practicals
- More information and download here: https://fsl.fmrib.ox.ac.uk/fsl/fslwiki/FSLNets

Examples

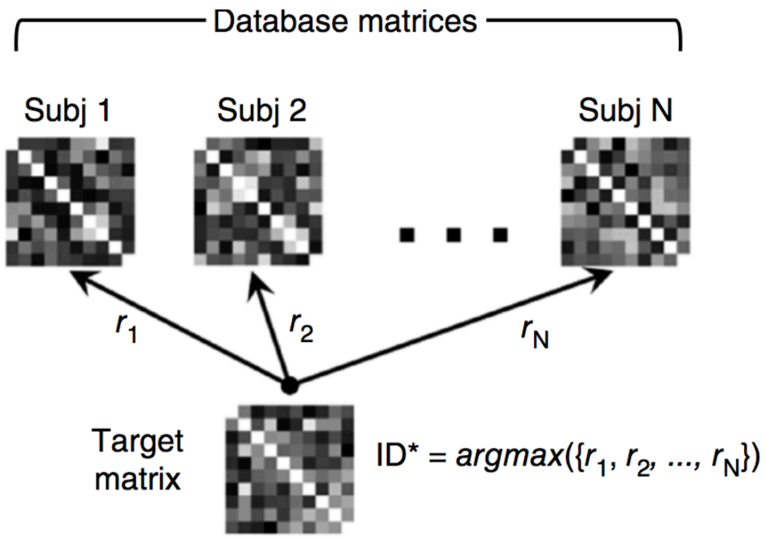
Example: positive-negative mode

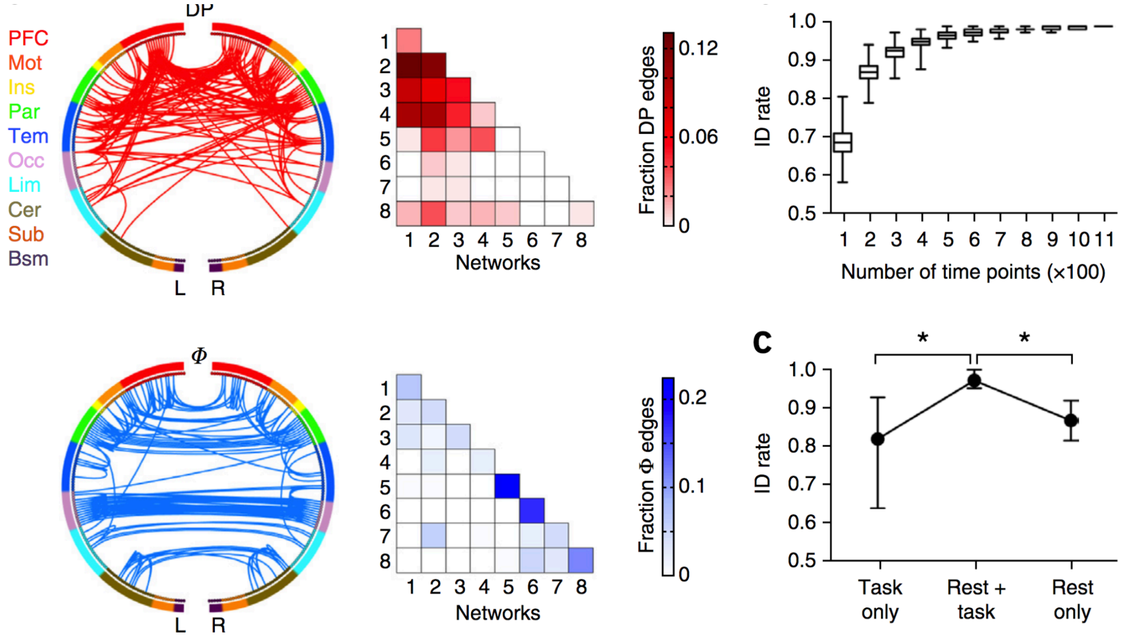




Smith et al (2015)

Example: connectivity fingerprint

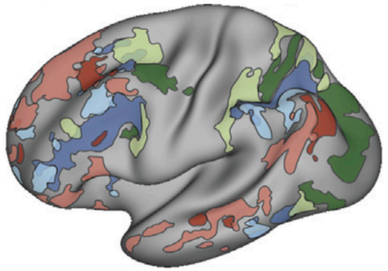


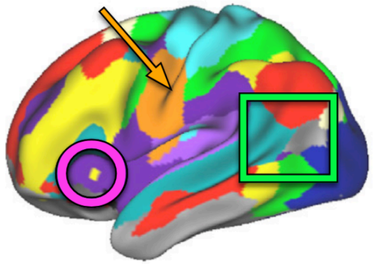


Finn et al (2015)

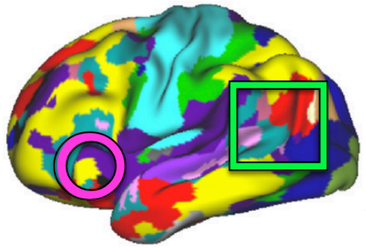
Challenges

Between-subject variability





Group



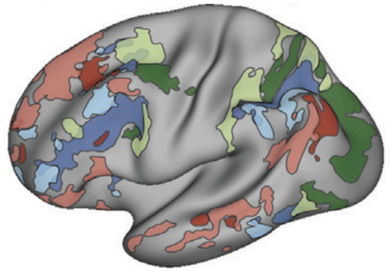
Subject

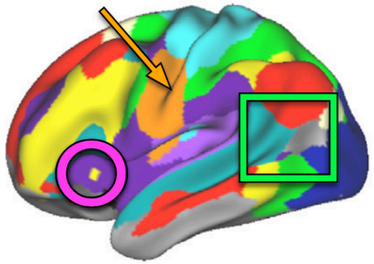
Subject-specific node estimation:

- Dual regression
- PROFUMO (all-in-one)
- Classifier
- Task-based activation mapping

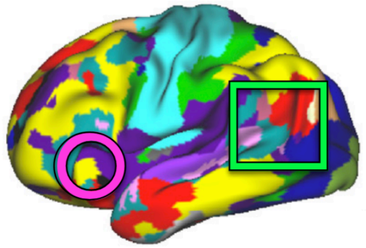
Braga et al (2017), Laumann et al (2015), Nickerson et al (2017), Harrison et al (2020), Hacket er al (2013)

Between-subject variability





Group



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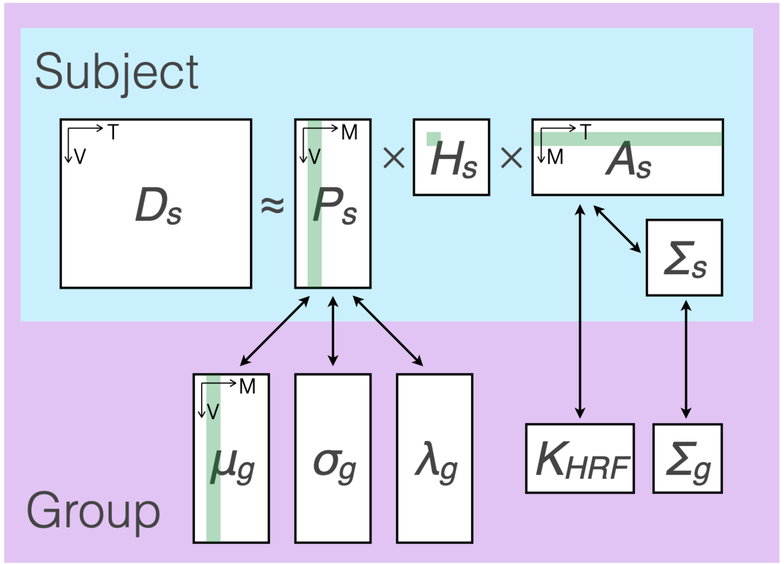
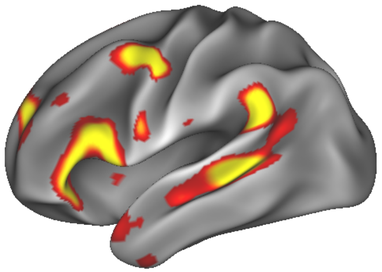
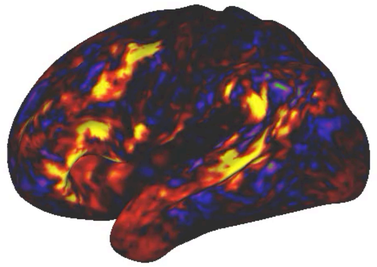




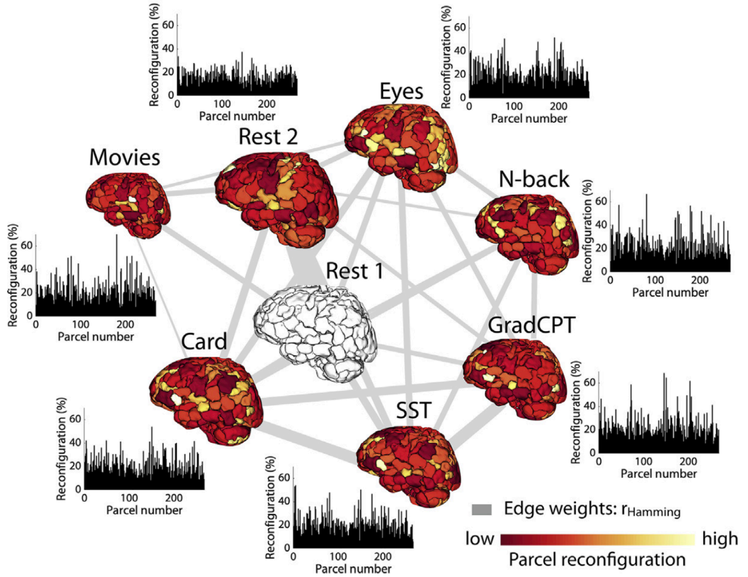


Braga et al (2017), *Laumann et al (2015)*, *Nickerson et al (2017)*, *Harrison et al (2020)*, *Hacket er al (2013)*

Within-subject variability

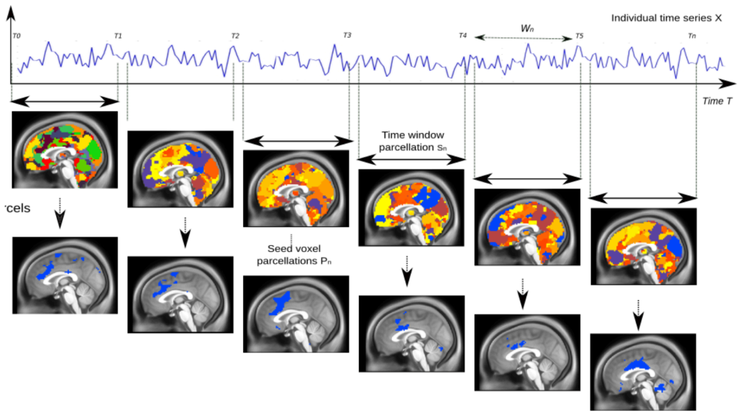
State-dependent changes

- Task demands
- Emotional state



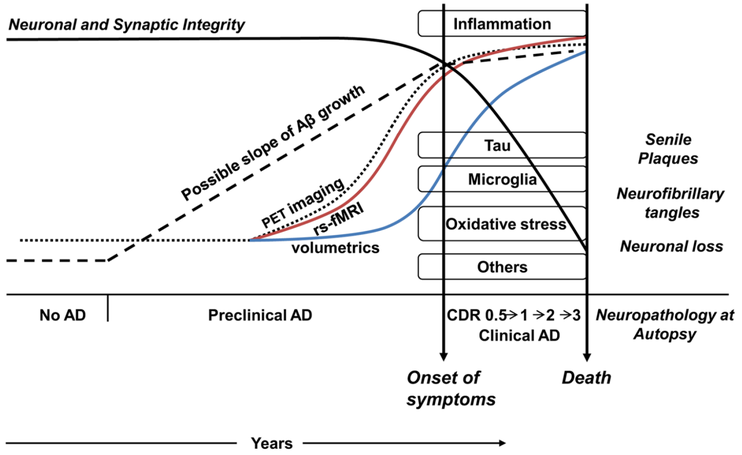
Within-scan dynamics

- Mind-wandering
- Arousal



Longitudinal trajectories

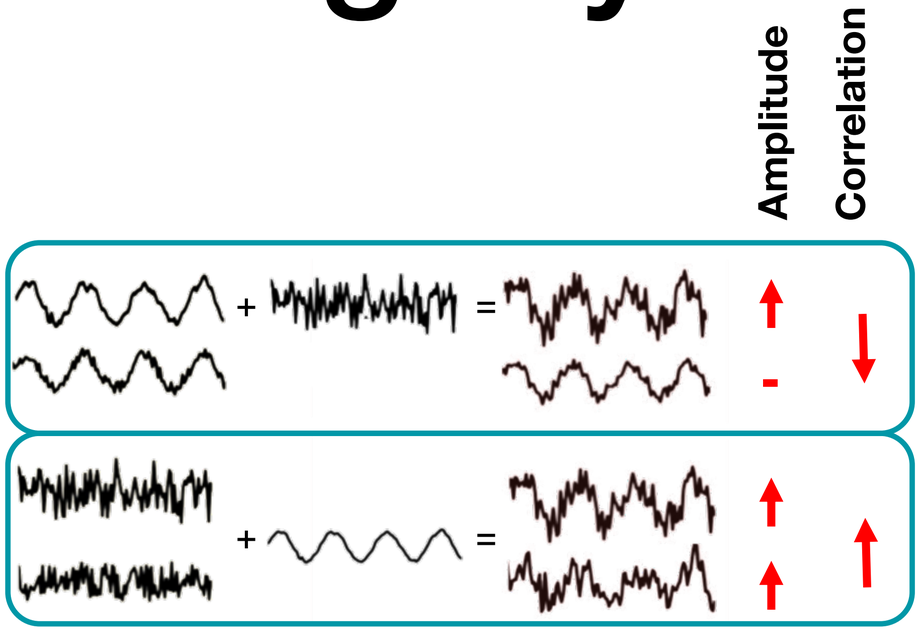
- Development/ Aging
- Disease progression



Salahi et al (2019), *Boukhdir et al (bioRxiv)*, *Sheline et al (2013)*

Representational ambiguity

- Correlation results may often not be driven by connectivity
- Amplitude changes can be seen as correlation changes
- Minor spatial changes in node shape/ location drive correlation



Duff et al (2018), Bijsterbosch et al (2018 & 2019)

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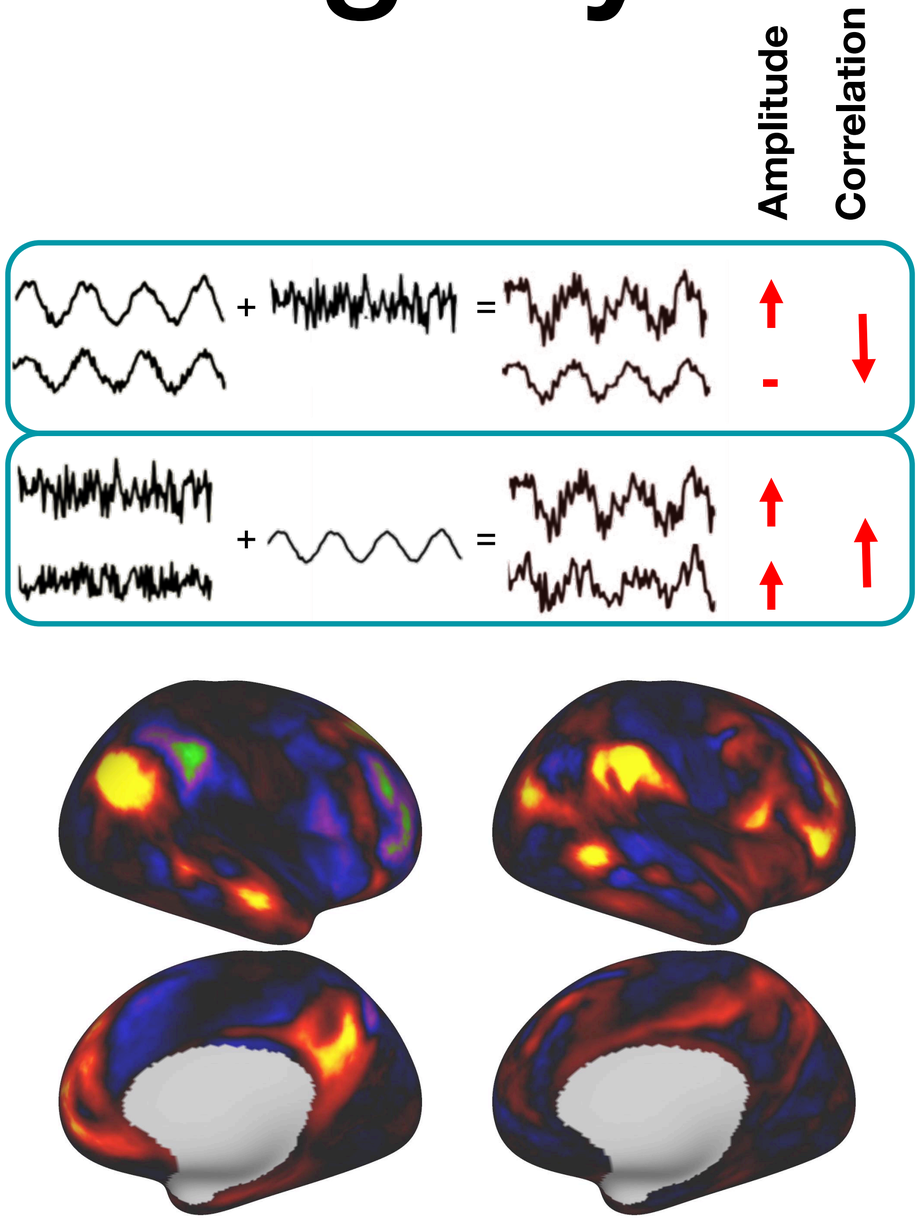

Duff et al (2018), Bijsterbosch et al (2018 & 2019)

Resources

- FSL mailing list
- Book (Amazon/ OUP)
- All references on the bottom of slides contain ‘clickable’ links