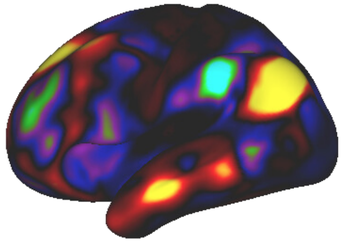
Network modeling analysis

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

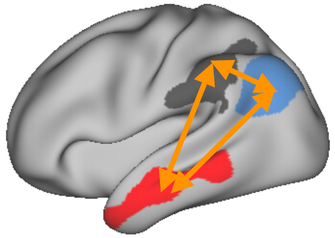
Overview of resting state methods

Voxel-based



- Seed-based correlation analysis
- Independent component analysis
- Amplitude of low frequency fluctuations
- Regional homogeneity

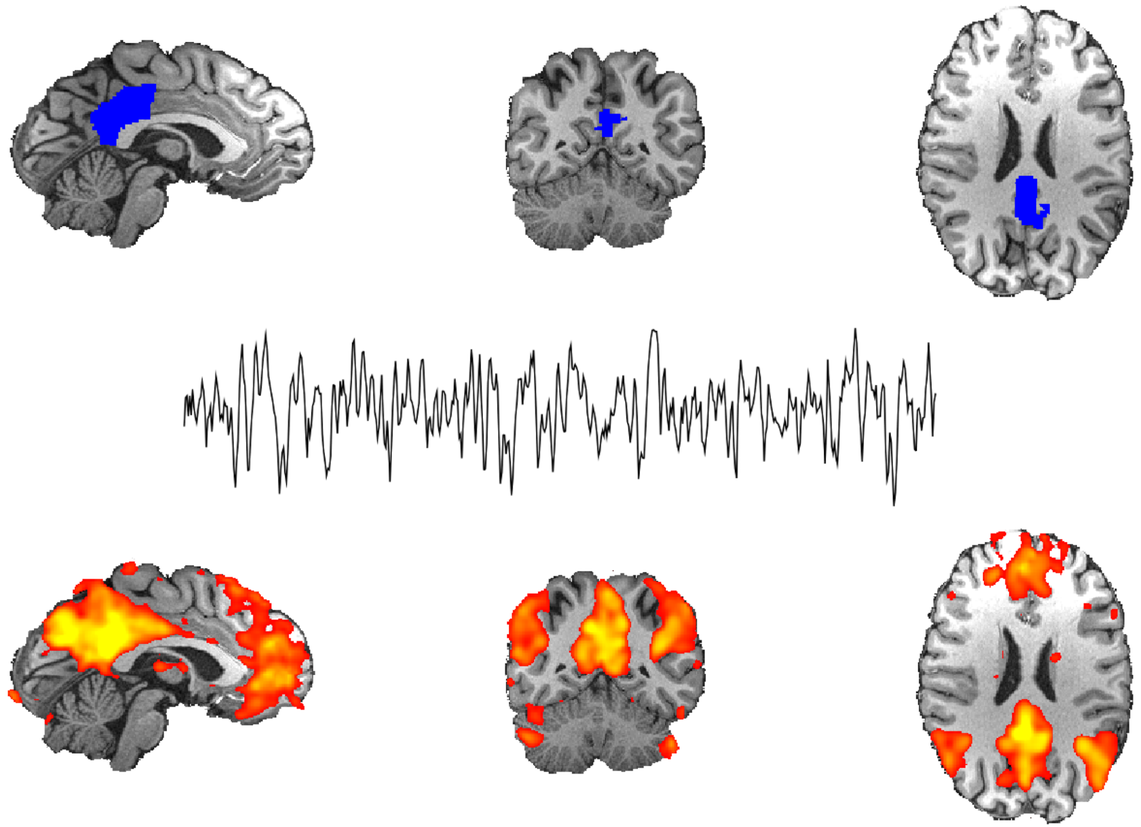
Node-based



- Network modelling analysis
- Graph theory analysis
- Dynamic causal modelling
- Non-stationary methods

Seed-based correlation

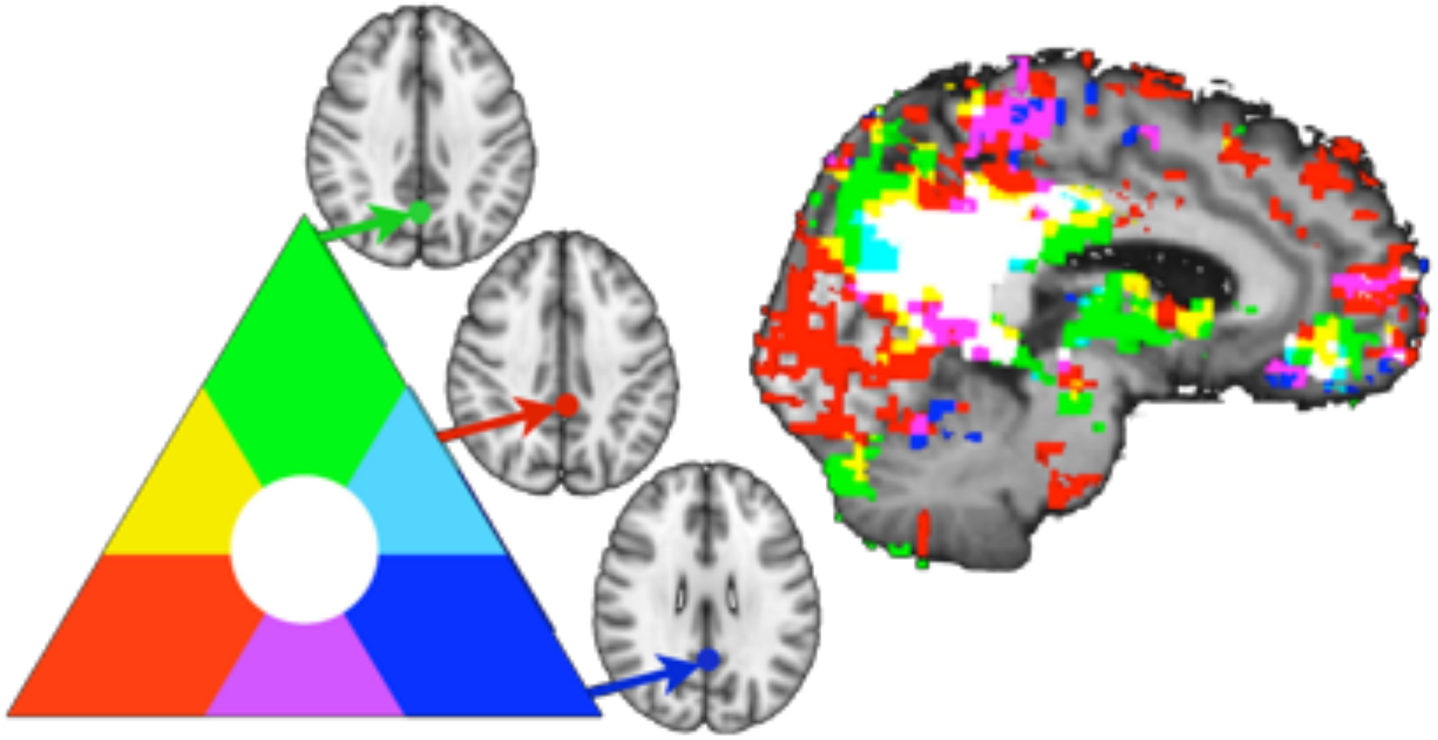
- Easy to interpret
- No correspondence problem
- Seed-selection bias
- Only models seed-effect (ignoring complex structure & noise)



Bijsterbosch et al (2017)

Seed-selection bias

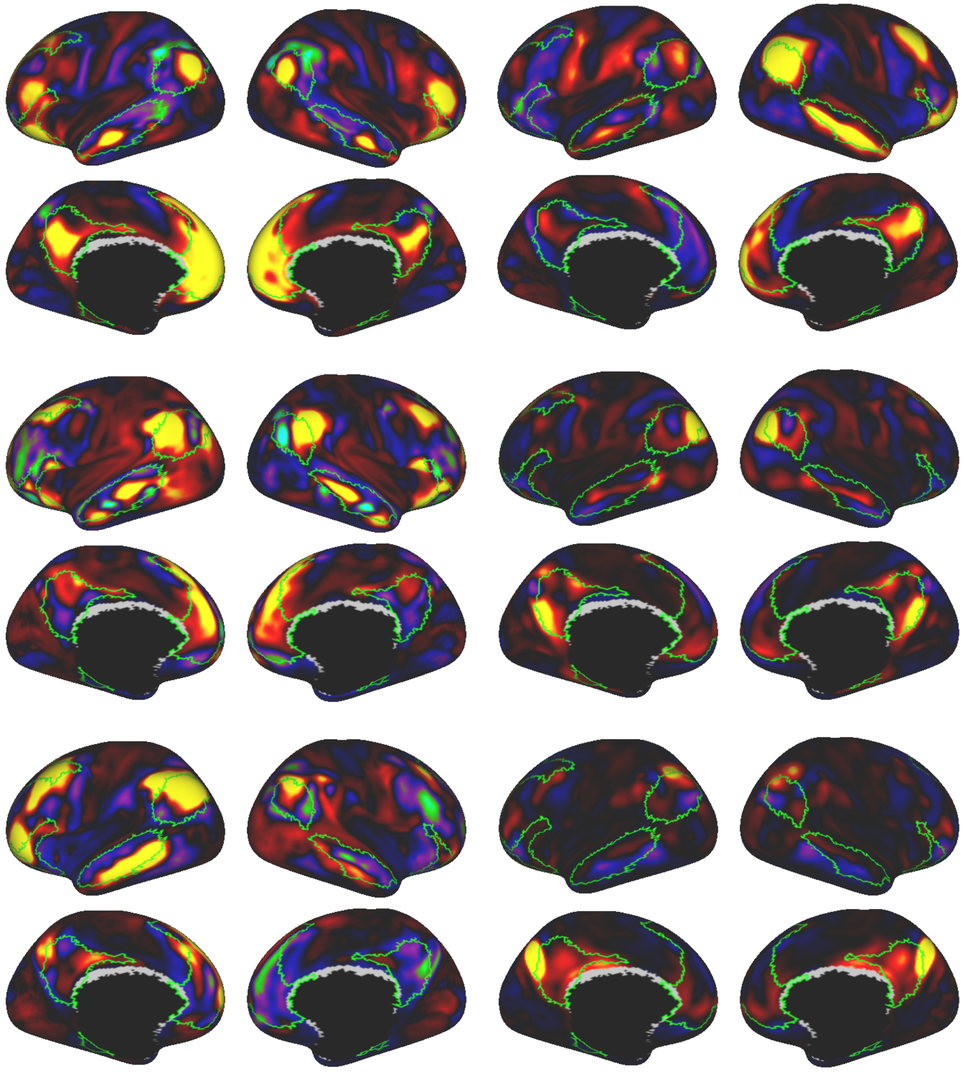
Seed-based correlation results are strongly influenced by small changes is seed location



Cole et al (2010)

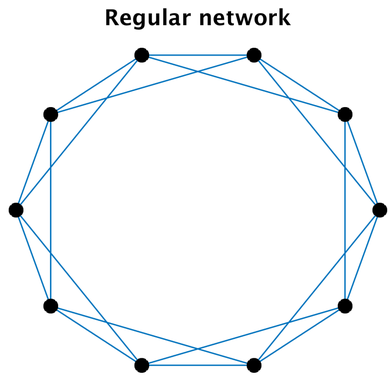
ICA

- Multivariate: decompose full dataset
- Test for shape & amplitude
- Can be hard to interpret
- No control over decomposition (may not get breakdown you want)

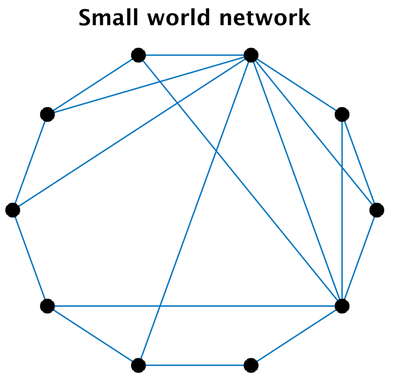


Graph theory

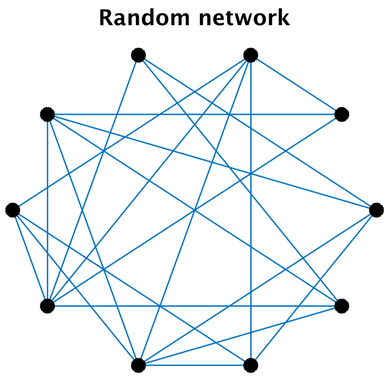
- Simple summary measures (derived from network matrix)
- Network matrix often binarised
- Difficult to meaningfully interpret (abstract and far removed from data)



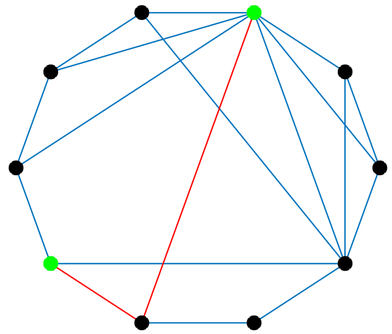
Regular network



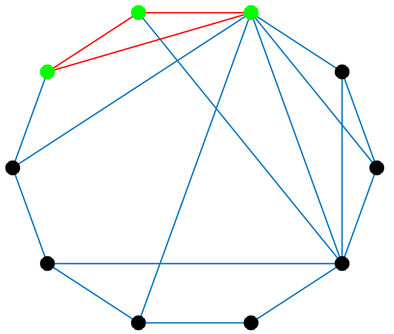
Small world network



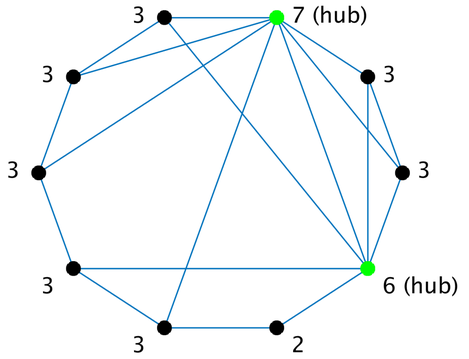
Random network



Minimum path length



Clustering coefficient

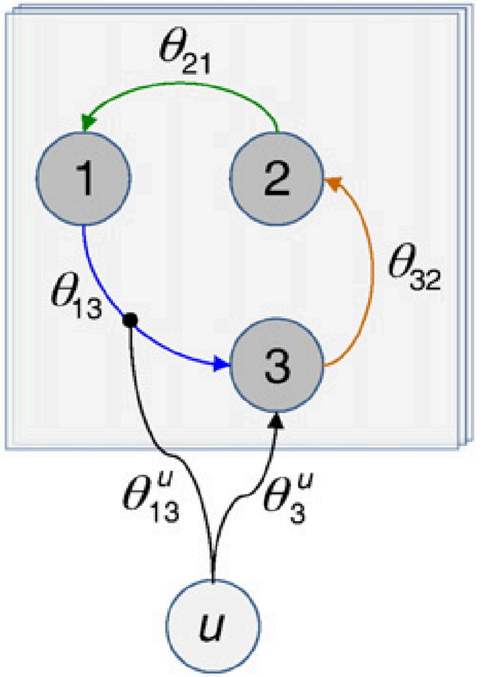


Degree and hubs

Rubinov et al (2010)

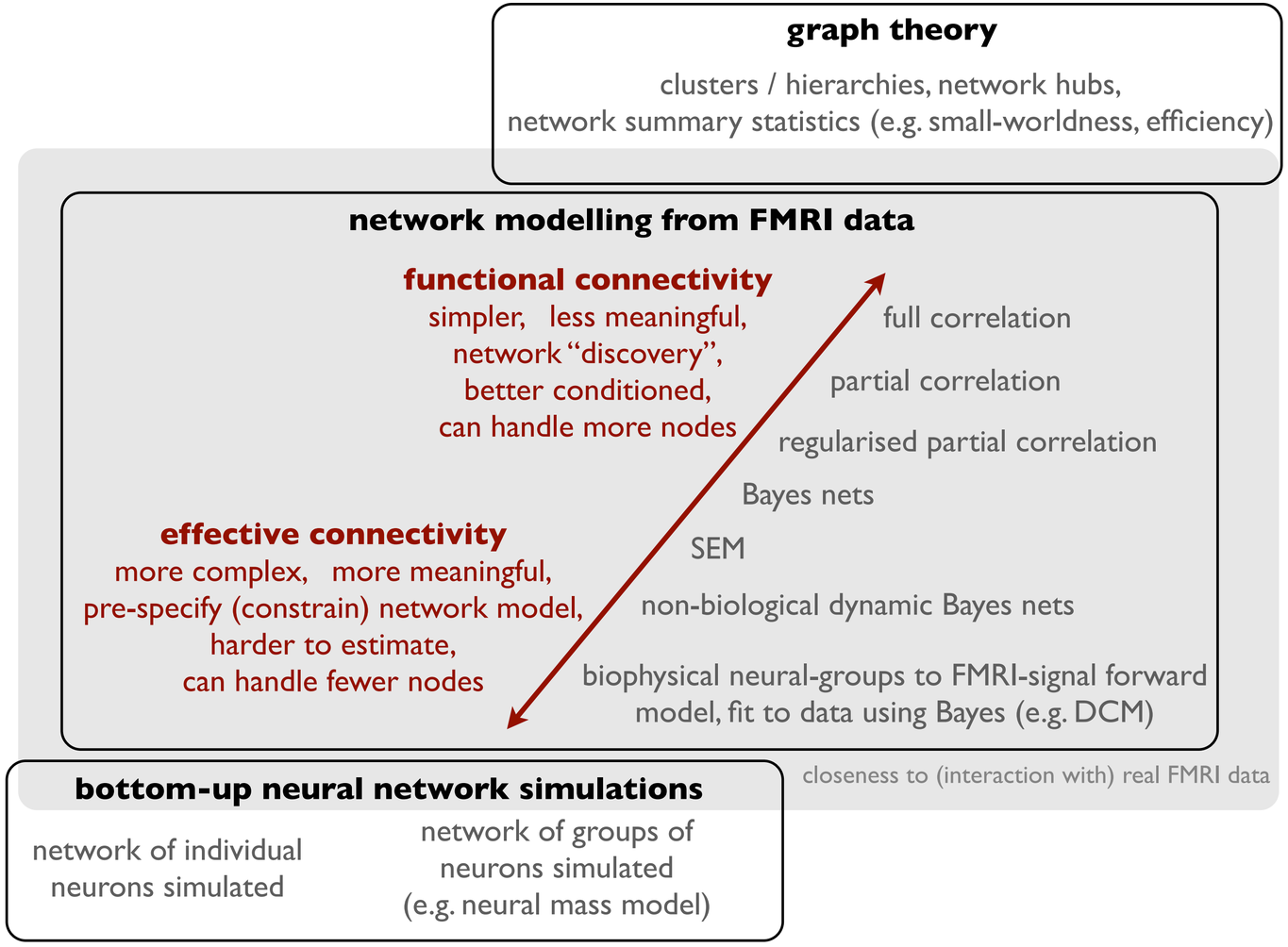
Dynamic causal modelling

- Directional interpretation (effective connectivity)
- Biophysical model
- Assumes HRF homogeneity
- Limited model comparisons



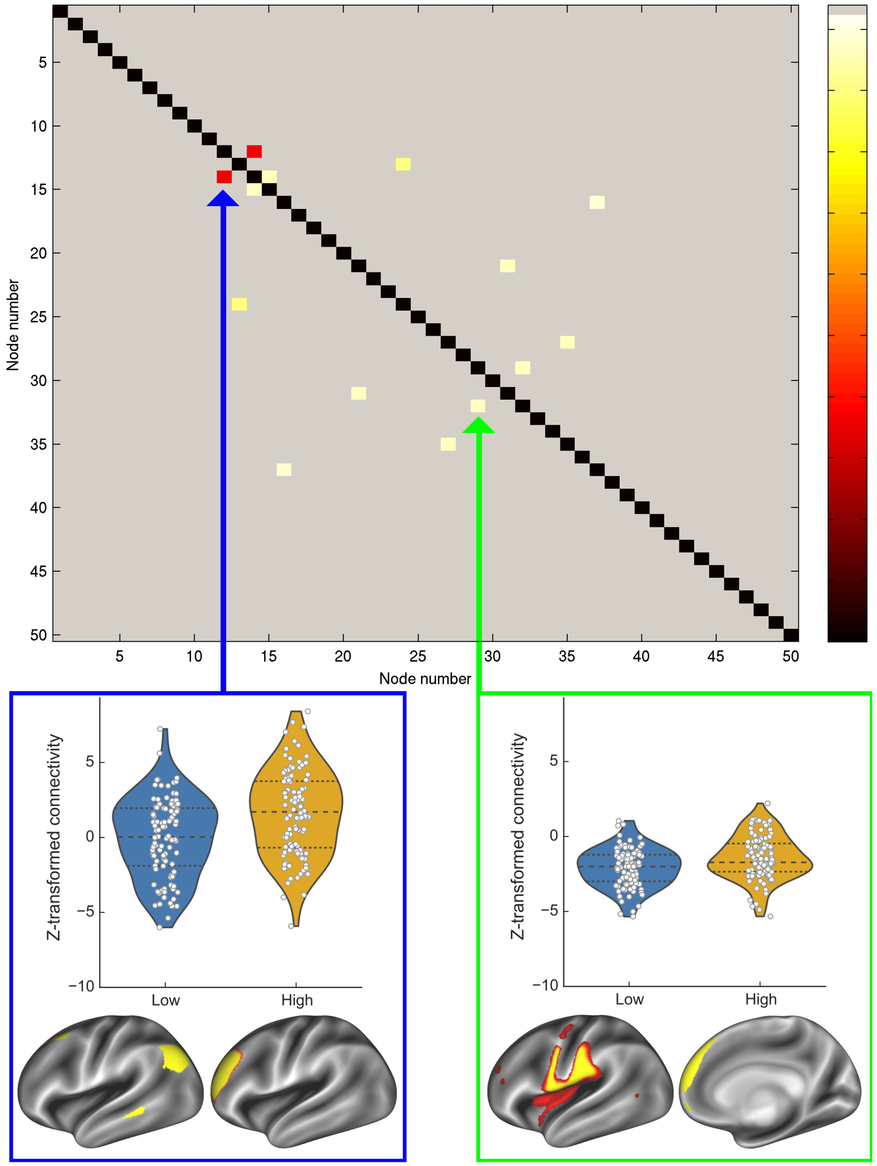
Daunizeau et al (2011)

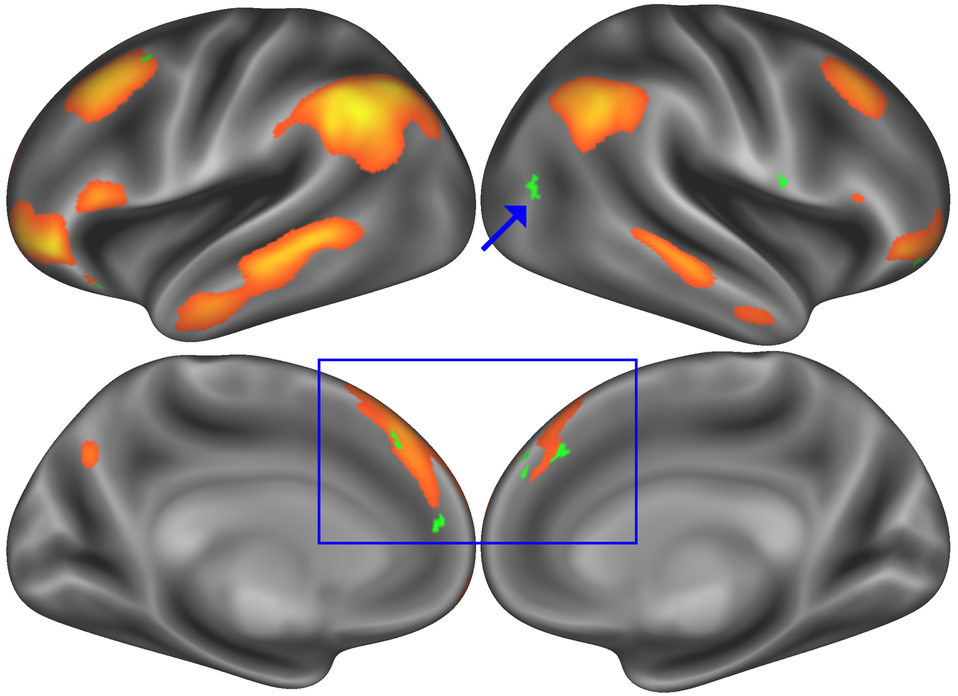
Overview of node-based methods



Smith et al (2013)

Node-based versus voxel-based



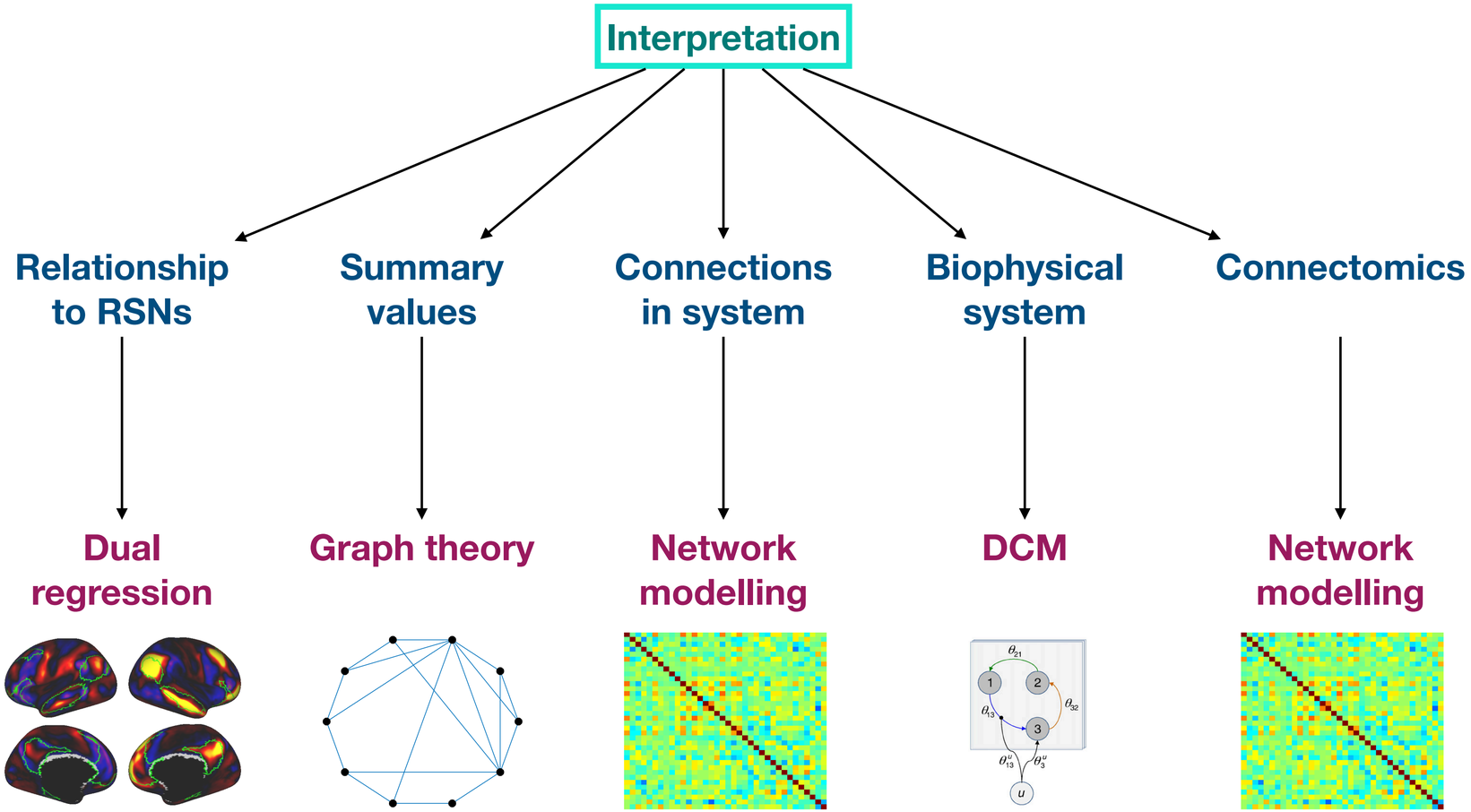


Bijsterbosch et al (2017)

Node-based versus voxel-based

- Node-based methods
  - Not sensitive to shape changes in connectivity patterns
  - Smaller multiple comparison correction problem
- Voxel-based methods
  - Seed-based correlation additionally tests for spatial (voxelwise shape) changes in connectivity patterns
  - Group ICA can test for shape and amplitude changes

Which method to chose?



Resources

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