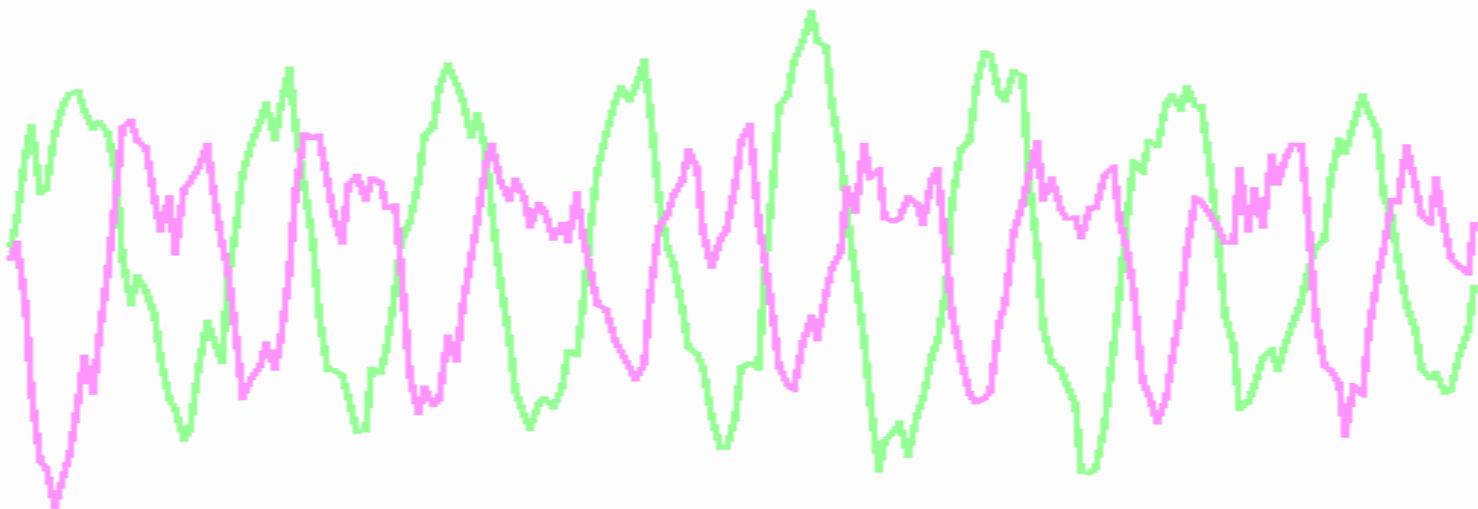


# Context-dependent changes in large-scale brain functional networks

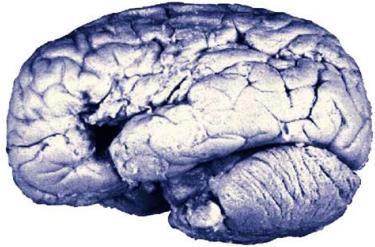


Alex Fornito

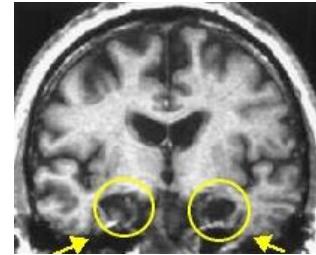
Monash Clinical and Imaging Neuroscience

School of Psychological Sciences &  
Monash Biomedical Imaging  
Monash University

email: [alex.fornito@monash.edu](mailto:alex.fornito@monash.edu)



Broca's Leborgne (aka Tan)



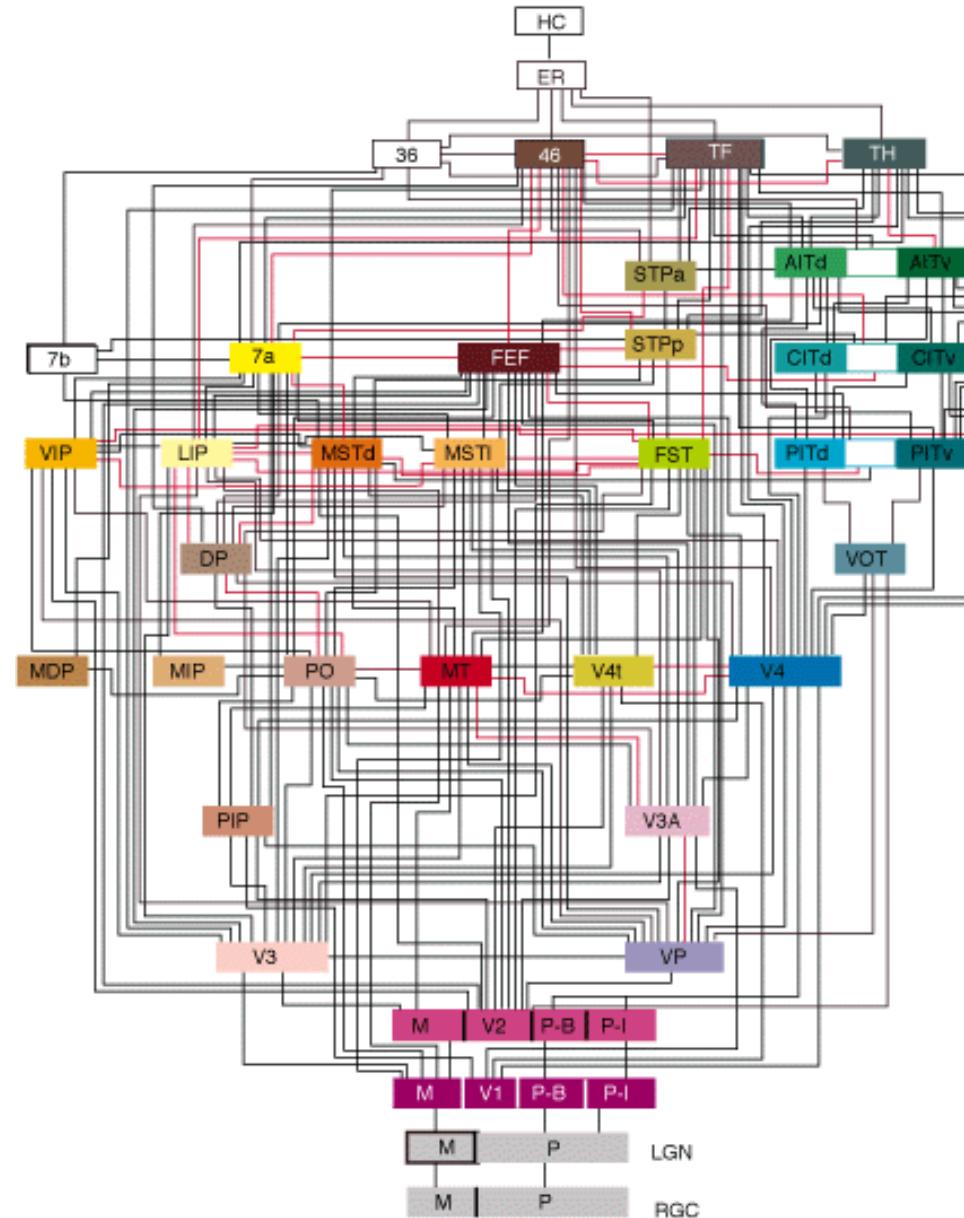
Scoville & Milner's HM



Harlow's  
Phineas Gage

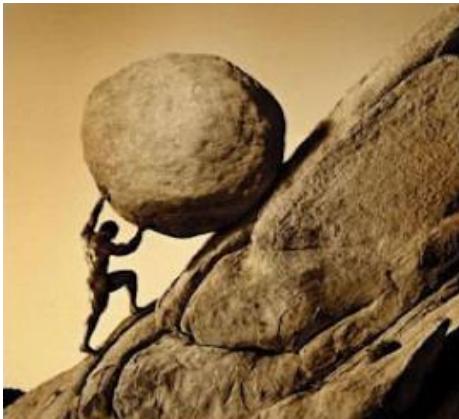


# the substrate of integration



# classes of functional connectivity

## task-related



## resting-state



### Potential causes of correlated activity

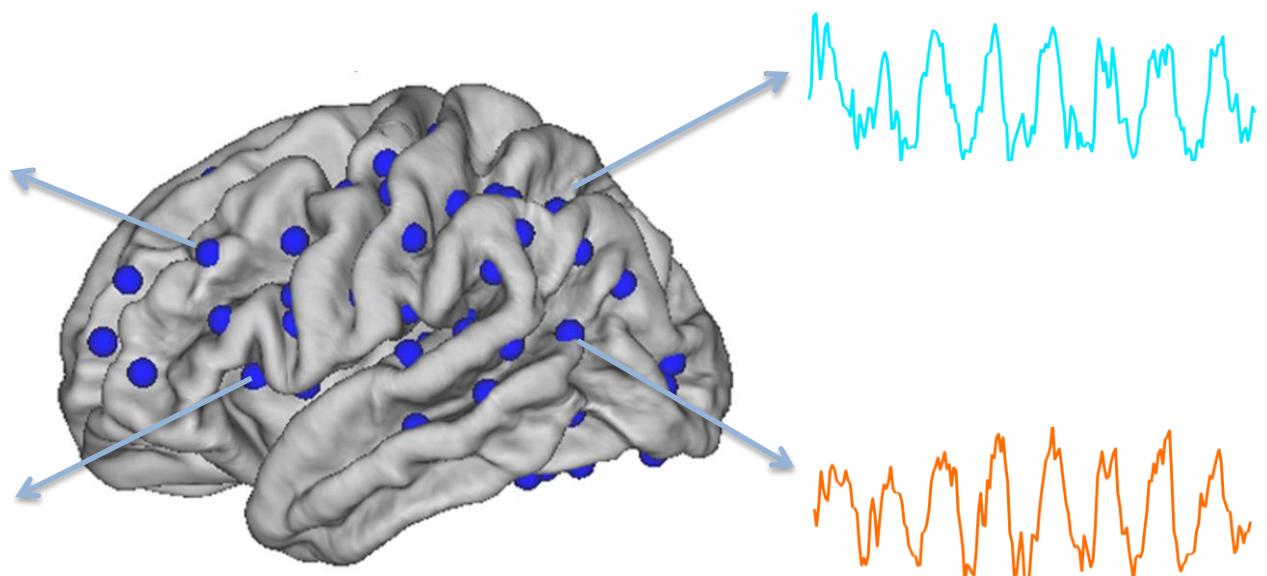
during task:

Coactivation  
Independent activation without communication

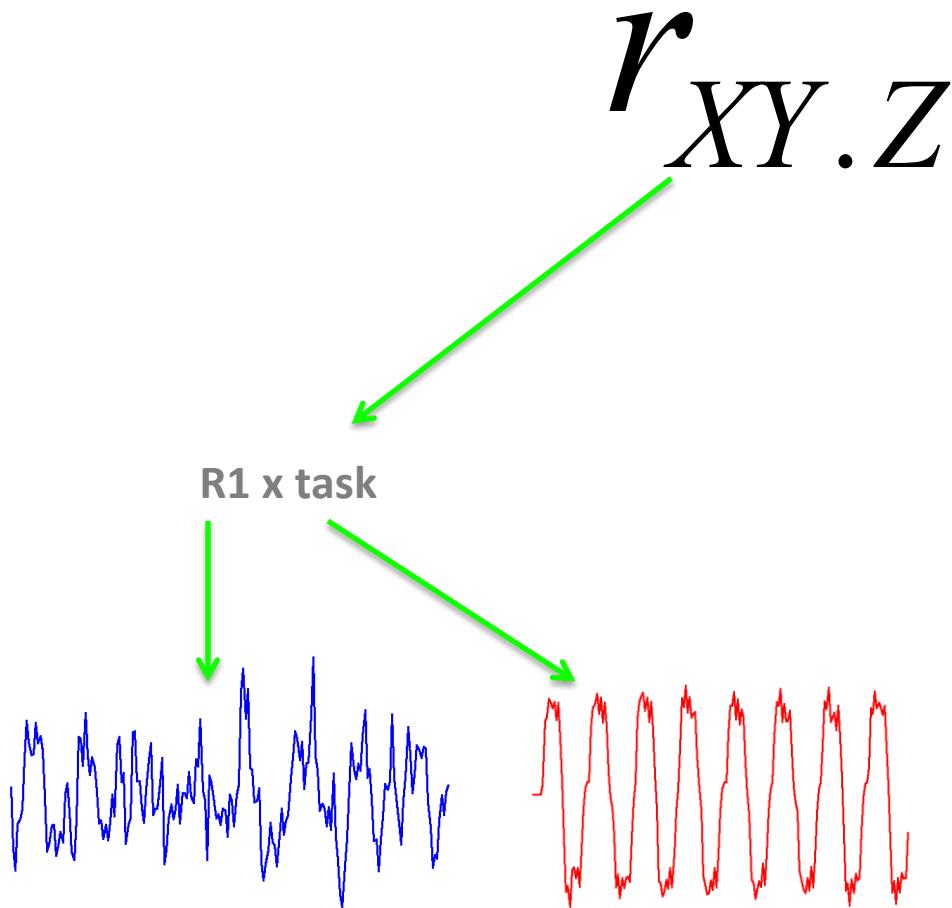
Noise

e.g., physiological, scanner  
Intrinsic (task-unrelated) connectivity  
e.g., spontaneous dynamics, anatomy, neuromodulation

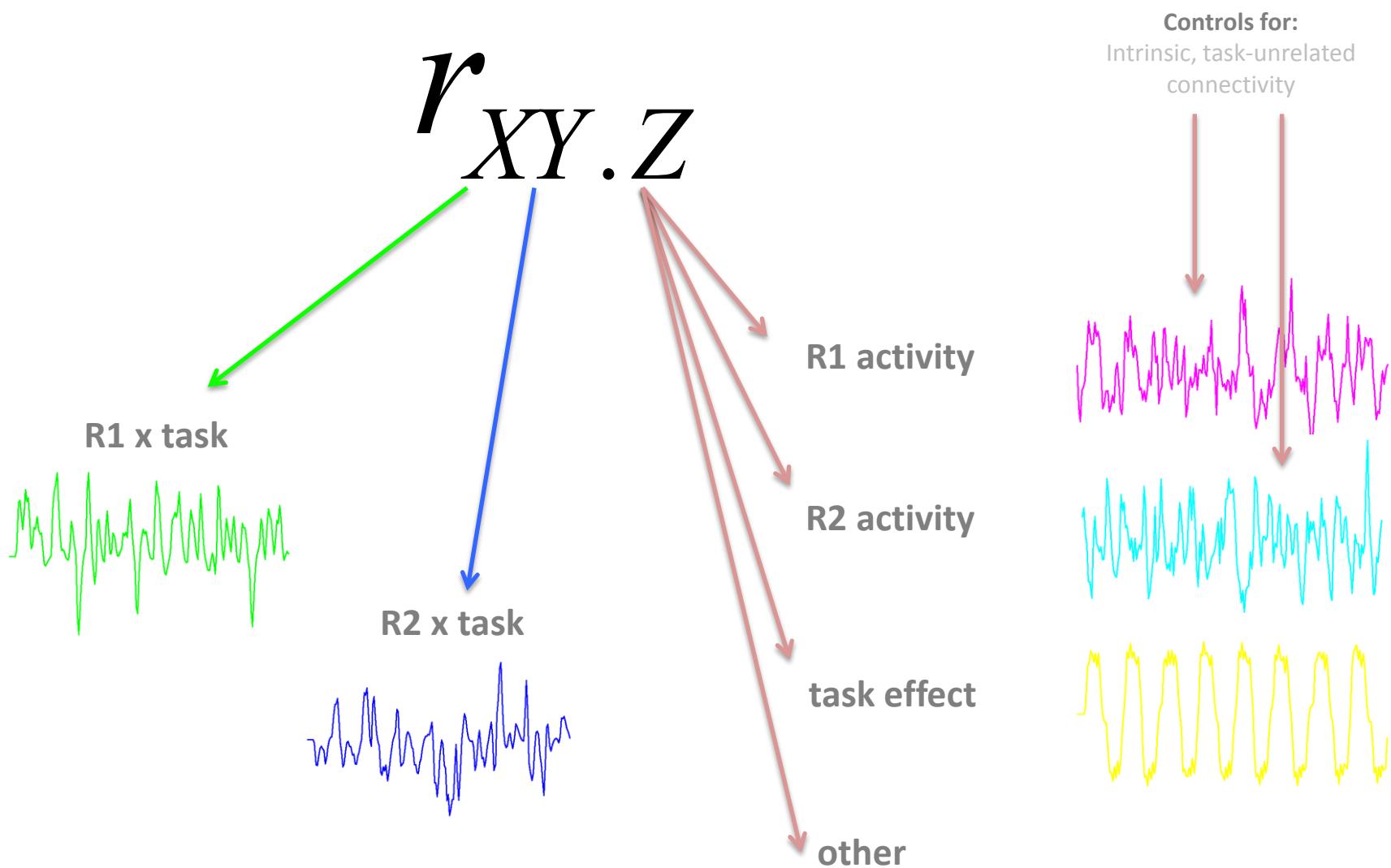
Task-related connectivity  
Context-dependent modulations of connectivity



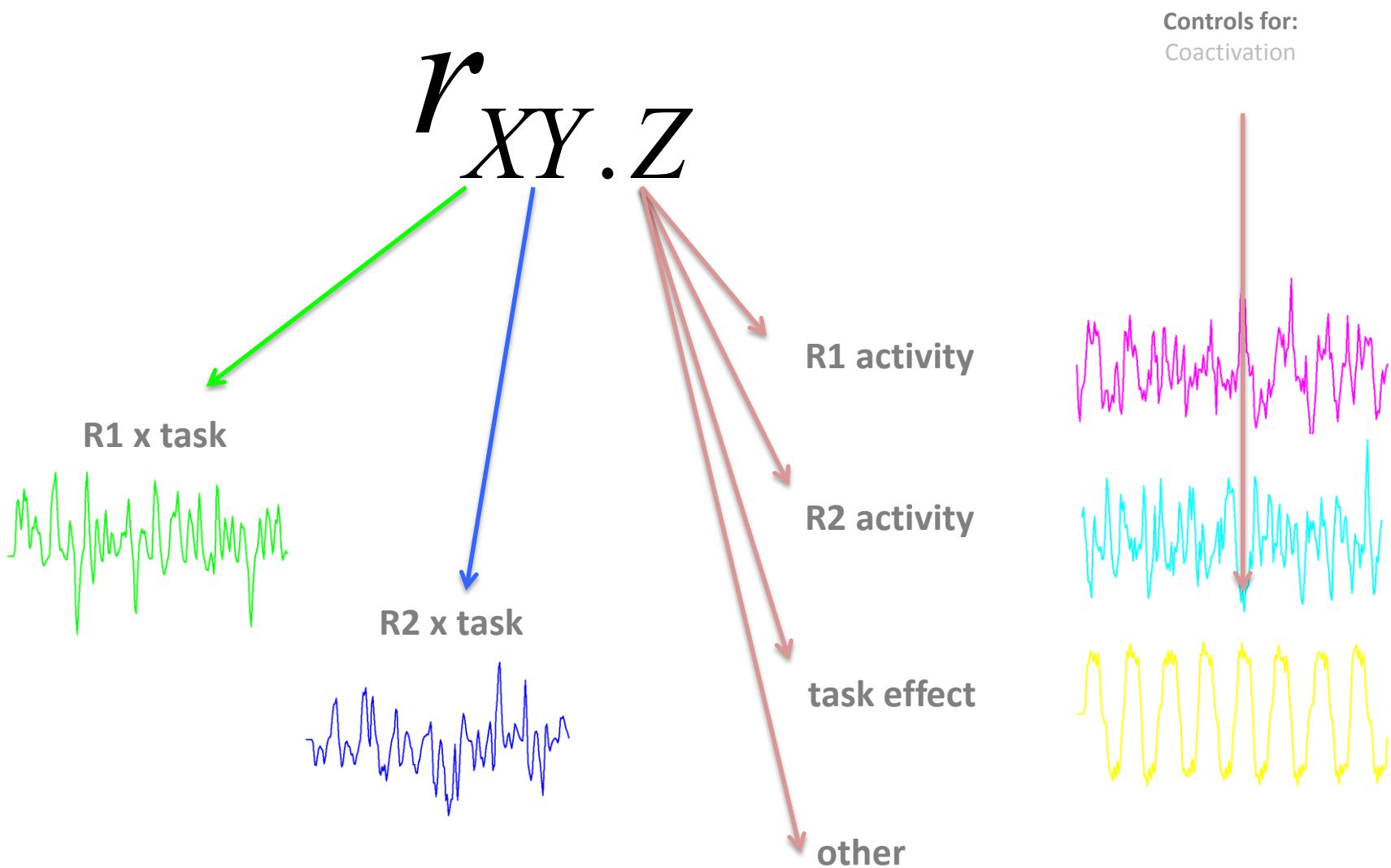
## cPPI: correlational psychophysiological interactions



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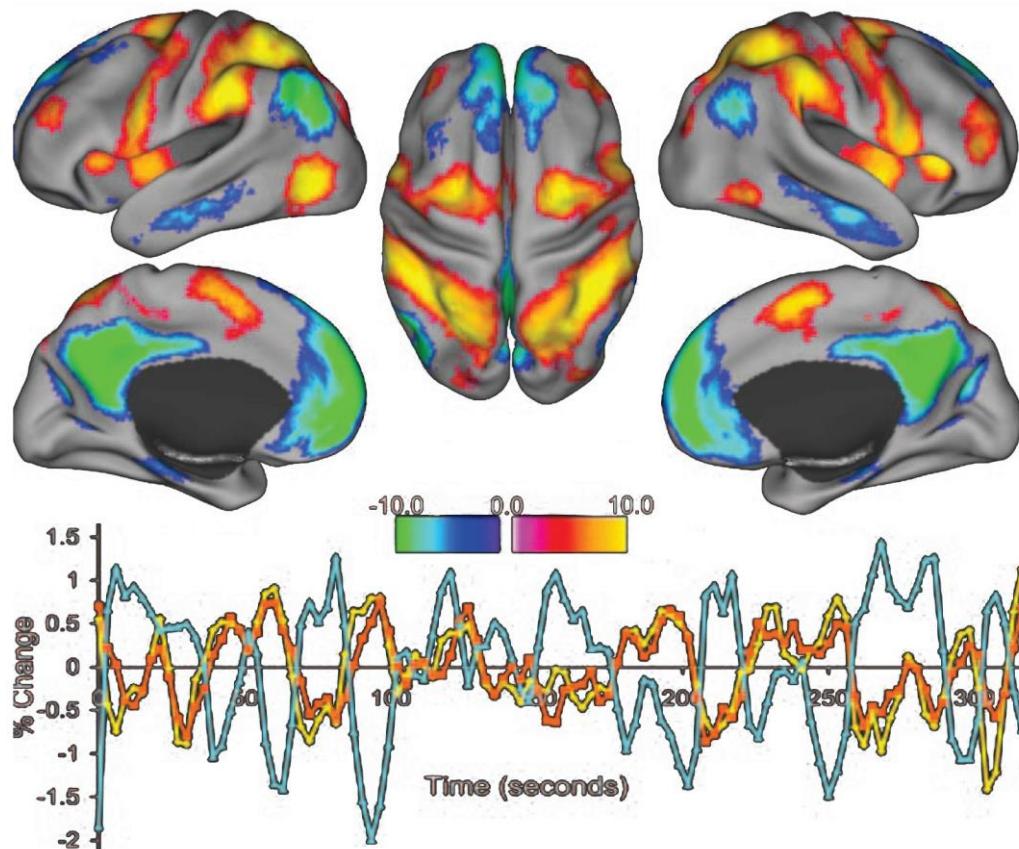


# The human brain is intrinsically organized into dynamic, anticorrelated functional networks

Michael D. Fox<sup>\*†</sup>, Abraham Z. Snyder<sup>\*‡</sup>, Justin L. Vincent<sup>\*</sup>, Maurizio Corbetta<sup>§</sup>, David C. Van Essen<sup>§</sup>, and Marcus E. Raichle<sup>\*§¶</sup>

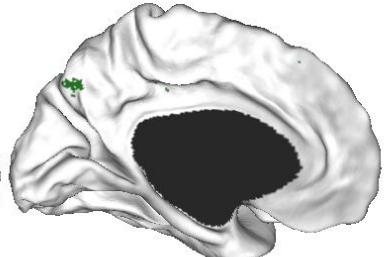
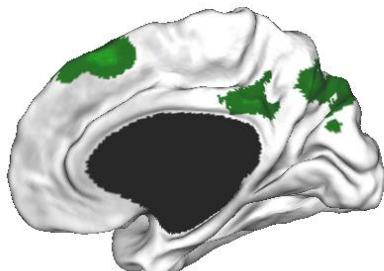
Departments of <sup>\*</sup>Radiology, <sup>‡</sup>Neurology, <sup>§</sup>Anatomy and Neurobiology, and <sup>¶</sup>Biomedical Engineering, Washington University, St. Louis, MO 63110

Contributed by Marcus E. Raichle, May 19, 2005

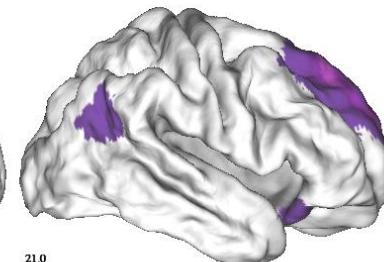
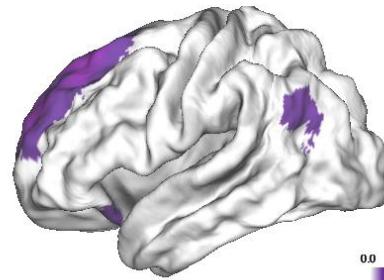
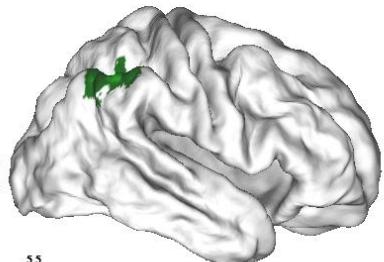
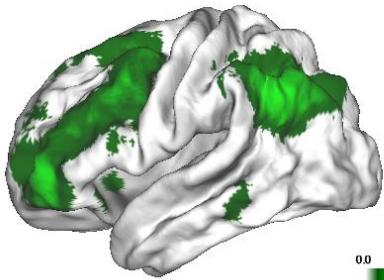
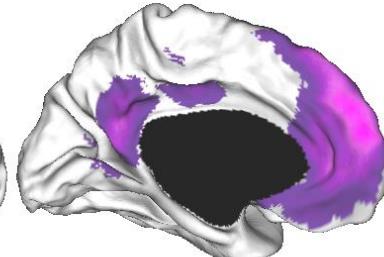
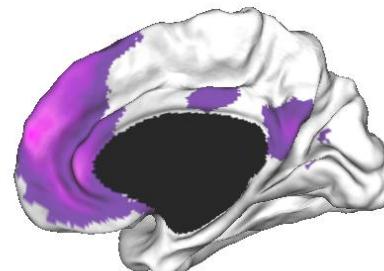


**contextual recollection**

RIGHT FRONTO-PARIETAL NETWORK  
(RFPN)



DEFAULT MODE NETWORK  
(DMN)

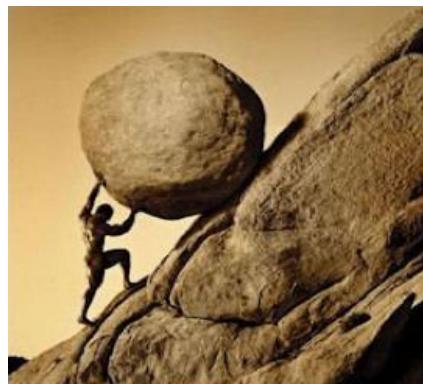


0.0 5.5

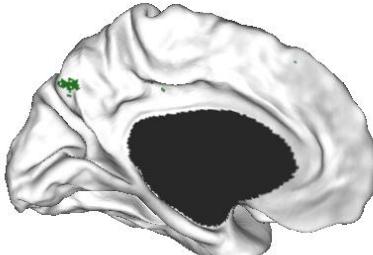
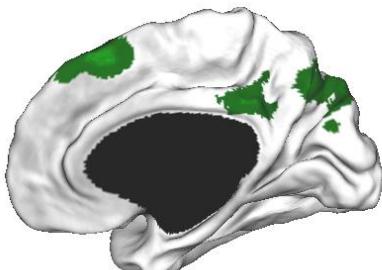
0.0 21.0

task-related

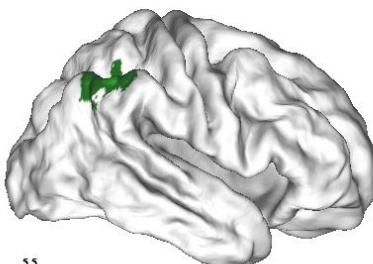
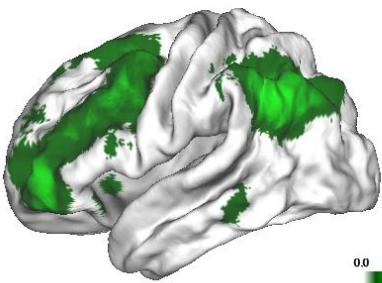
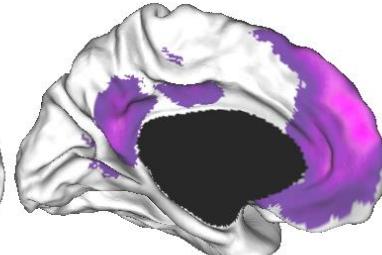
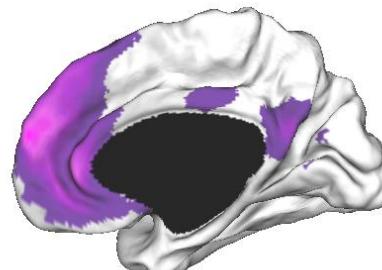
task-unrelated



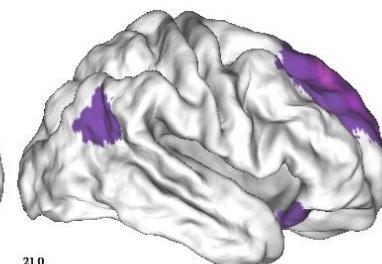
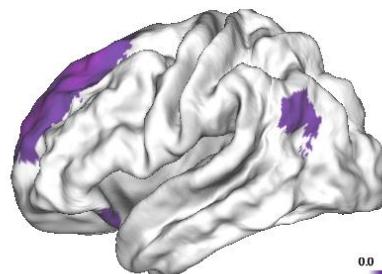
RIGHT FRONTO-PARIETAL NETWORK  
(RFPN)



DEFAULT MODE NETWORK  
(DMN)



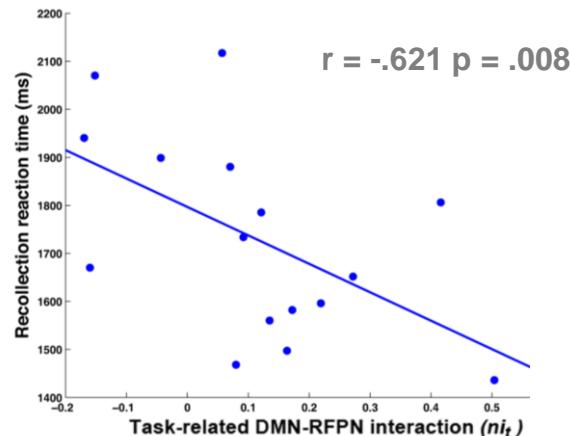
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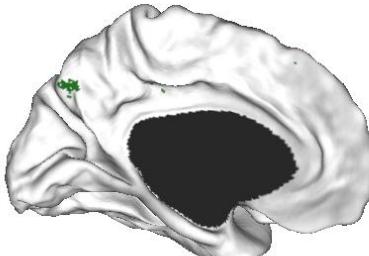
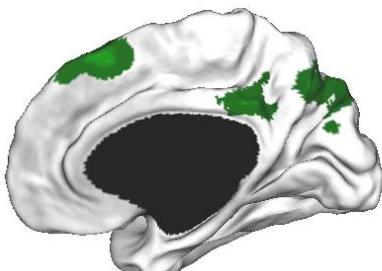
0.0 21.0

task-related

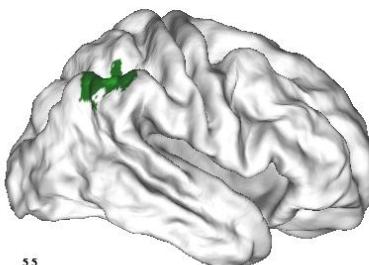
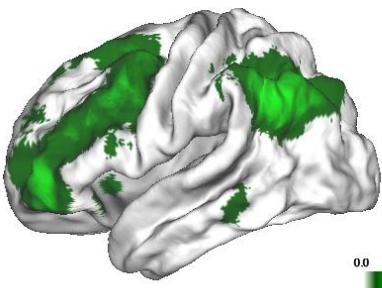
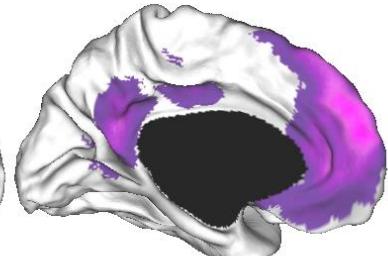
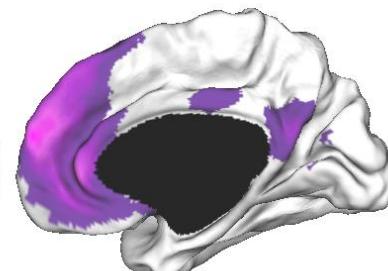
task-unrelated



RIGHT FRONTO-PARIETAL NETWORK  
(RFPN)



DEFAULT MODE NETWORK  
(DMN)

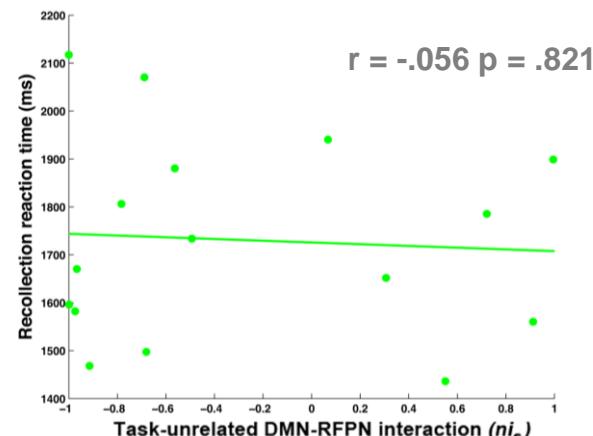
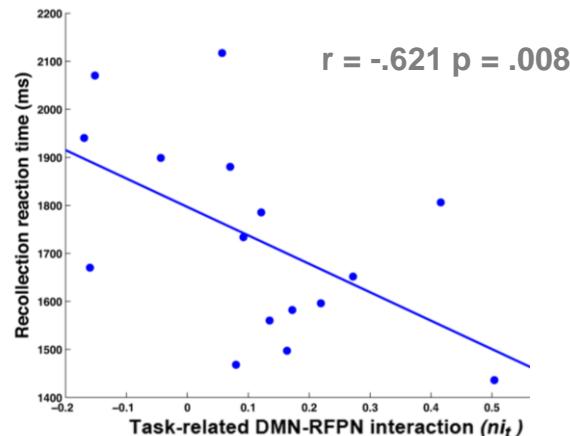


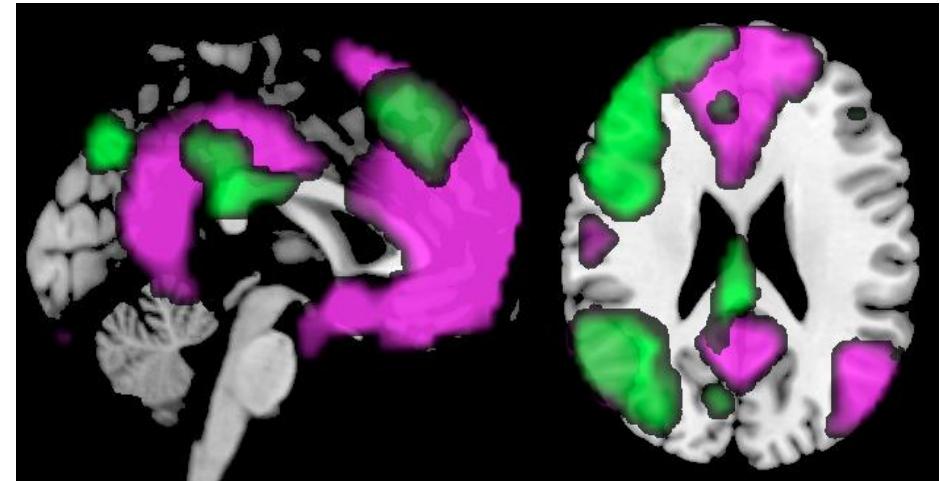
0.0 5.5

0.0 21.0

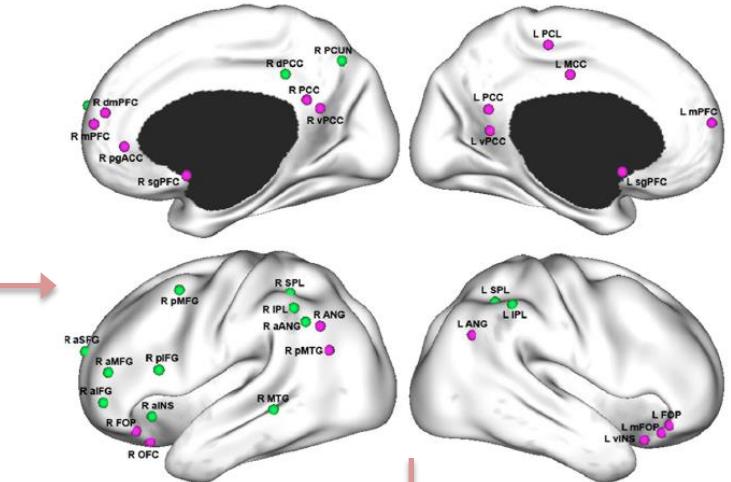
task-related

task-unrelated

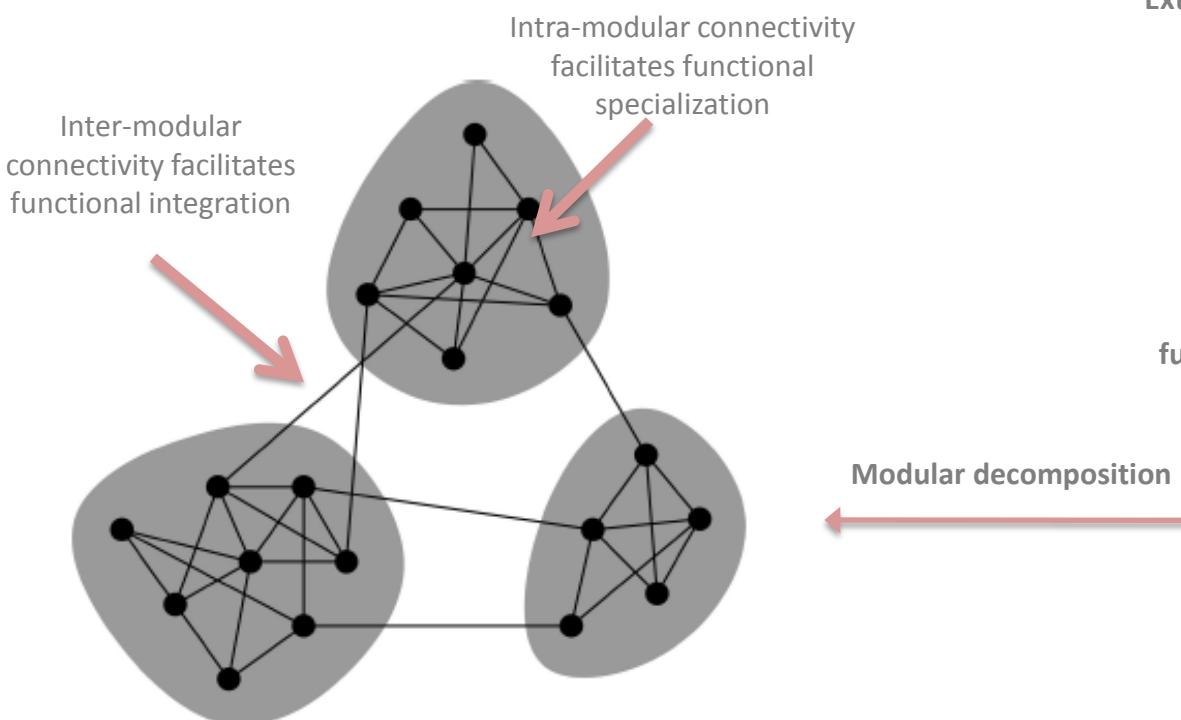




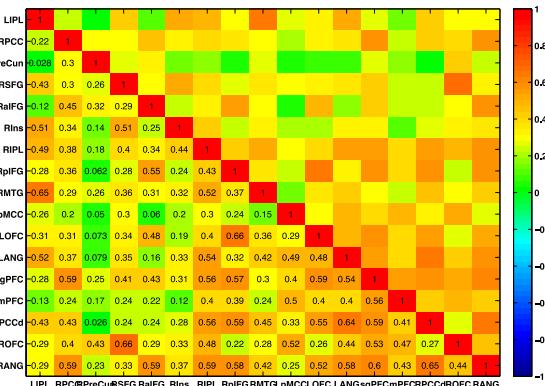
Define  
ROIs



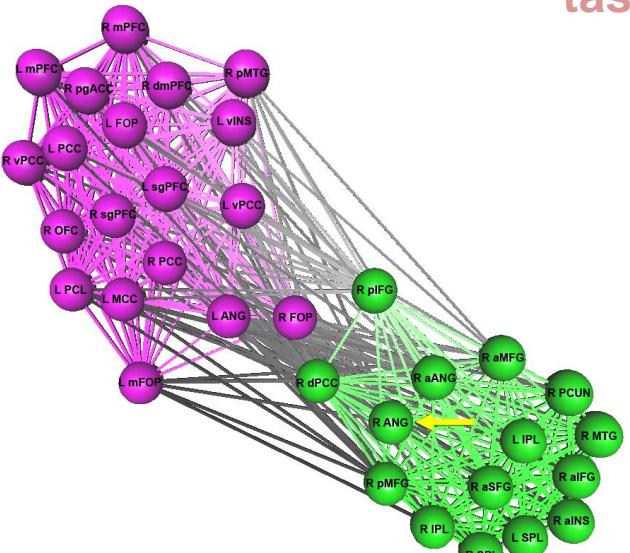
Extract mean time series



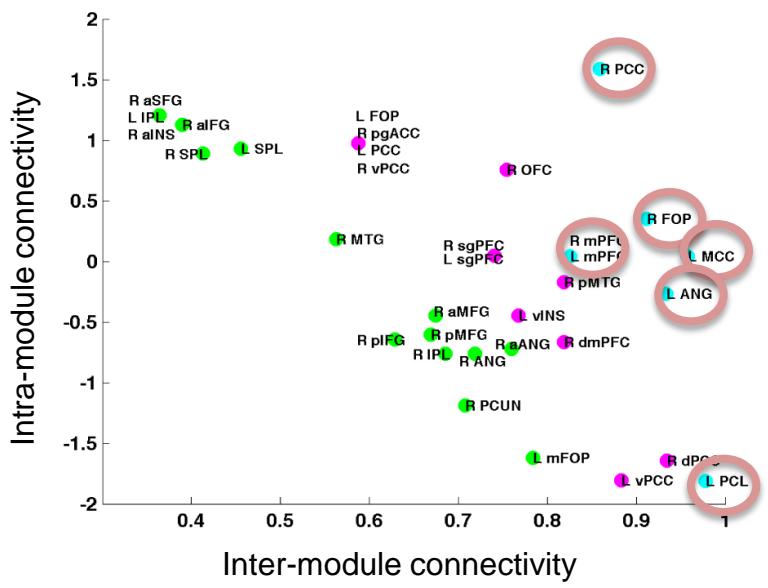
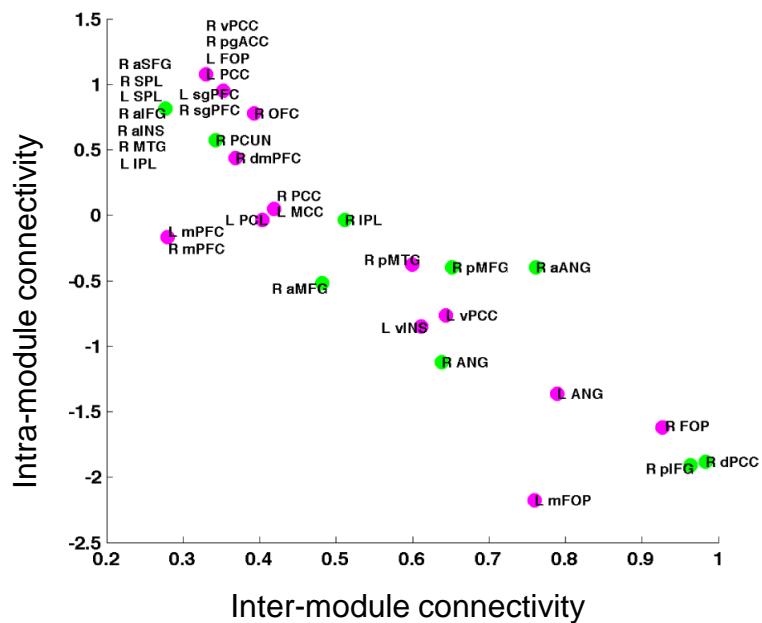
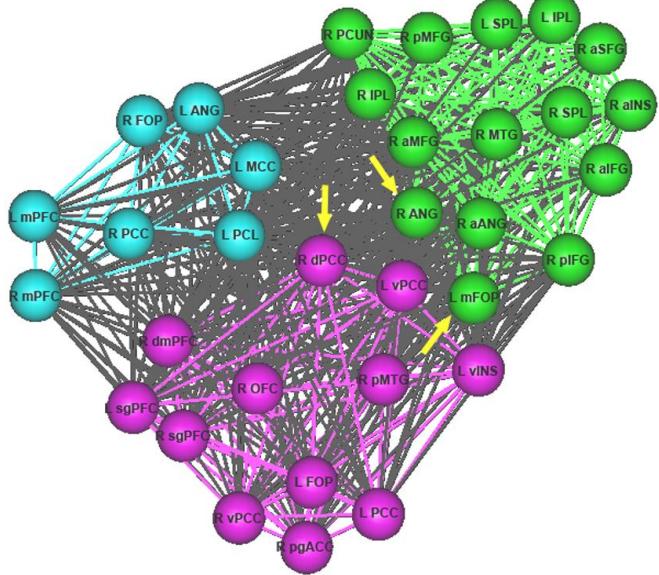
Compute pair-wise  
functional connectivity



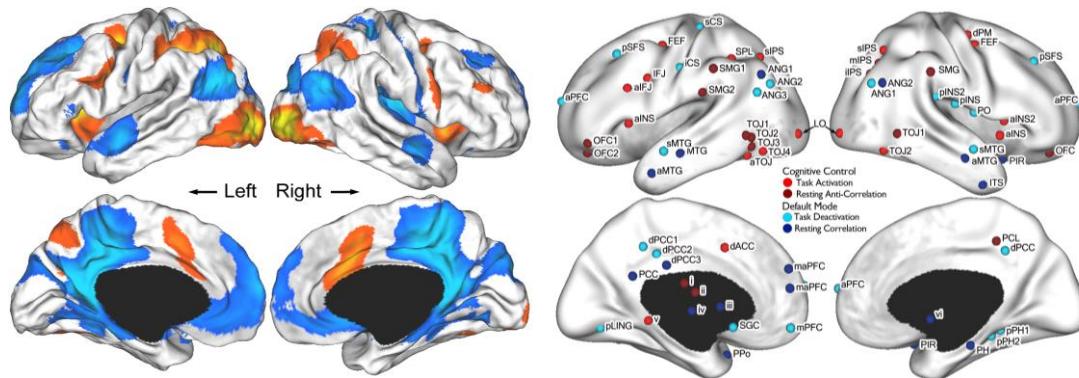
# task-unrelated



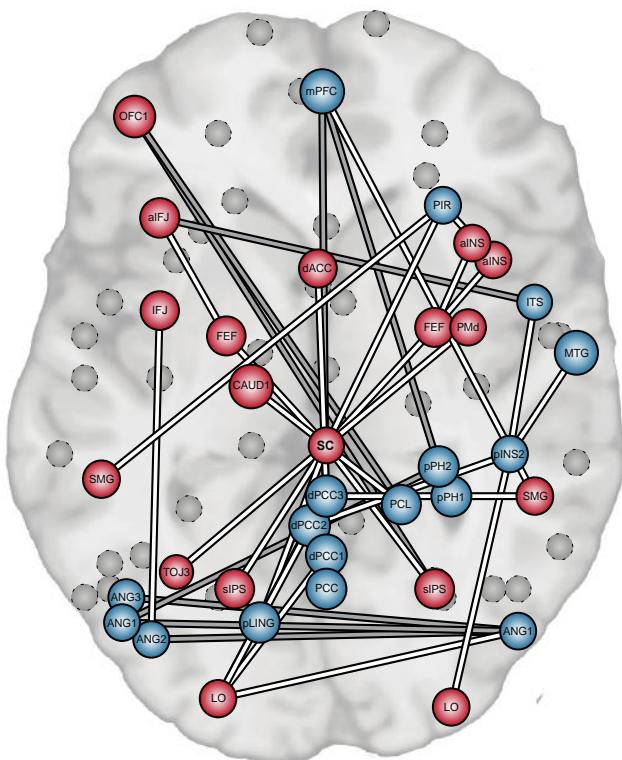
# task-related



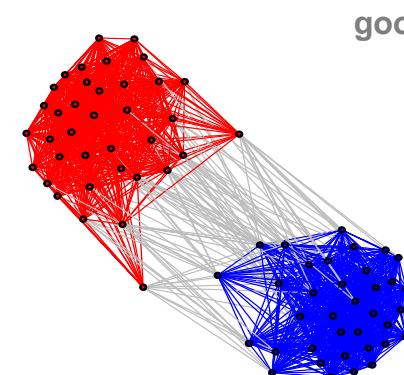
**cognitive control**



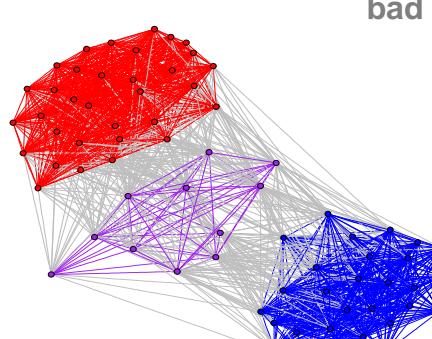
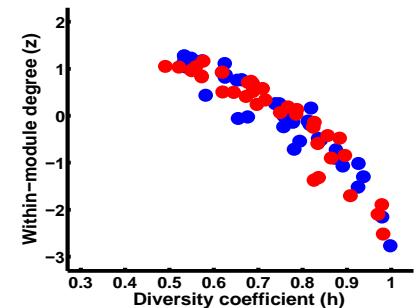
task but not rest FC correlated with RT



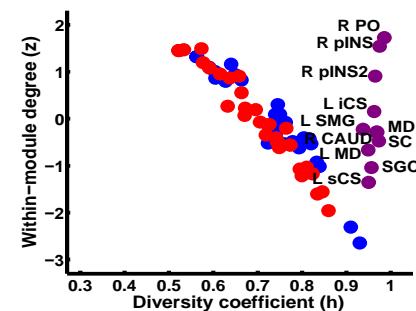
- Cognitive Control Nodes
  - Default-Mode Nodes
  - Non-Significant Nodes
- Positive Correlation
  - Negative Correlation



good performers

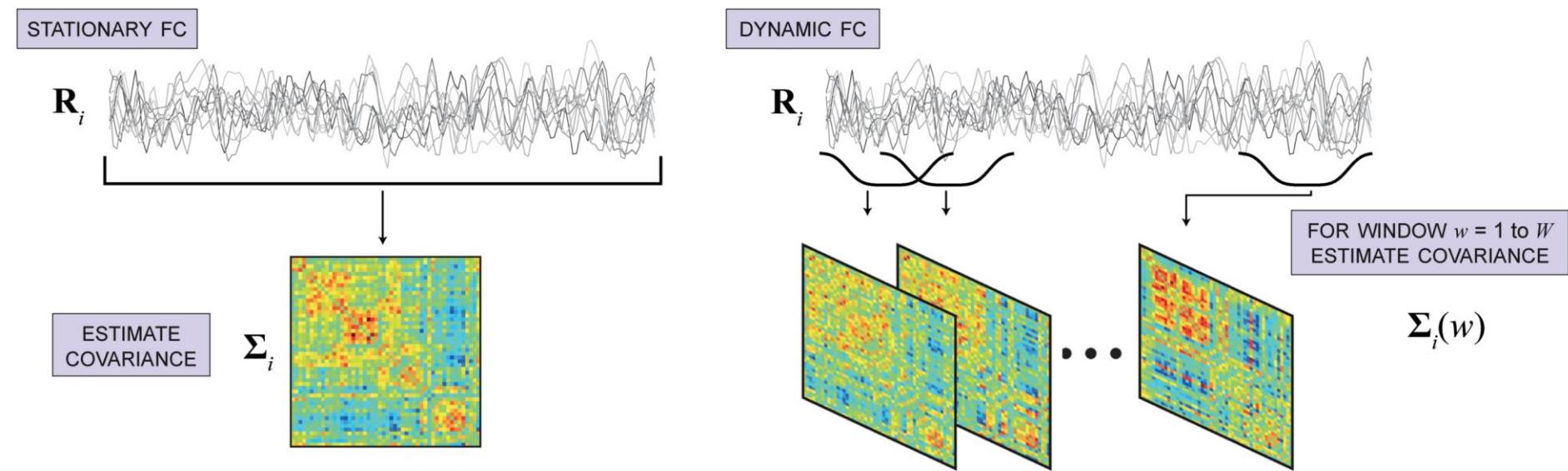


bad performers

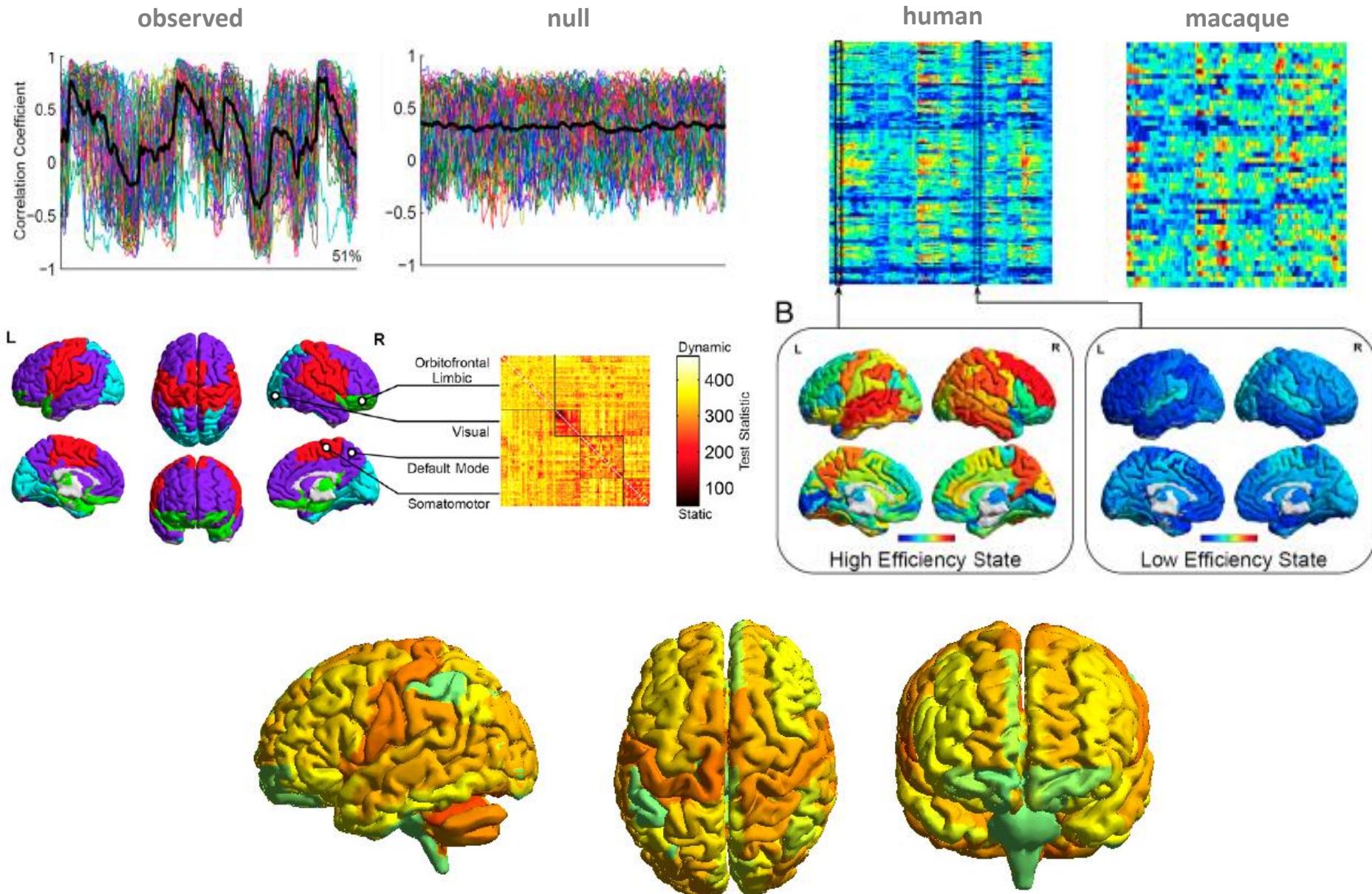


**rest**

# dynamic connectivity



# non-stationary spontaneous dynamics



## conclusions

isolating task-related functional connectivity can reveal behaviourally meaningful individual differences

large-scale brain networks dynamically reconfigure their pair-wise interactions in response to changing task demands

context dictates the optimum network configuration for behaviour

highly variable and dynamic inter-module connections enable transient, large-scale synchronization events

# acknowledgements

Monash University

Murat Yücel

University of Melbourne

Andrew Zalesky  
Dominic Dwyer  
Christos Pantelis  
Ben Harrison  
Nicholas Allen  
Sarah Whittle

Queensland Institute for Medical Research

Michael Breakspear  
Leonardo Gollo

Queensland Brain Institute

Luca Cocchi

University of Cambridge

Ed Bullmore  
Jon Simons



email: [alex.fornito@monash.edu](mailto:alex.fornito@monash.edu)

software available from:

*task-related functional connectivity*  
[https://www.nitrc.org/projects/cppi\\_toolbox](https://www.nitrc.org/projects/cppi_toolbox)

*network-based statistic*  
<https://www.nitrc.org/projects/nbs>