511-2018-11-14-networks

Rick Gilmore

Today's Topics

- Networks
- Planning for student-led sessions

But first…

- Short answers means short sentences.
- Be complete. Show me that you know what you're talking about.

Resting potential ~ -70 mV

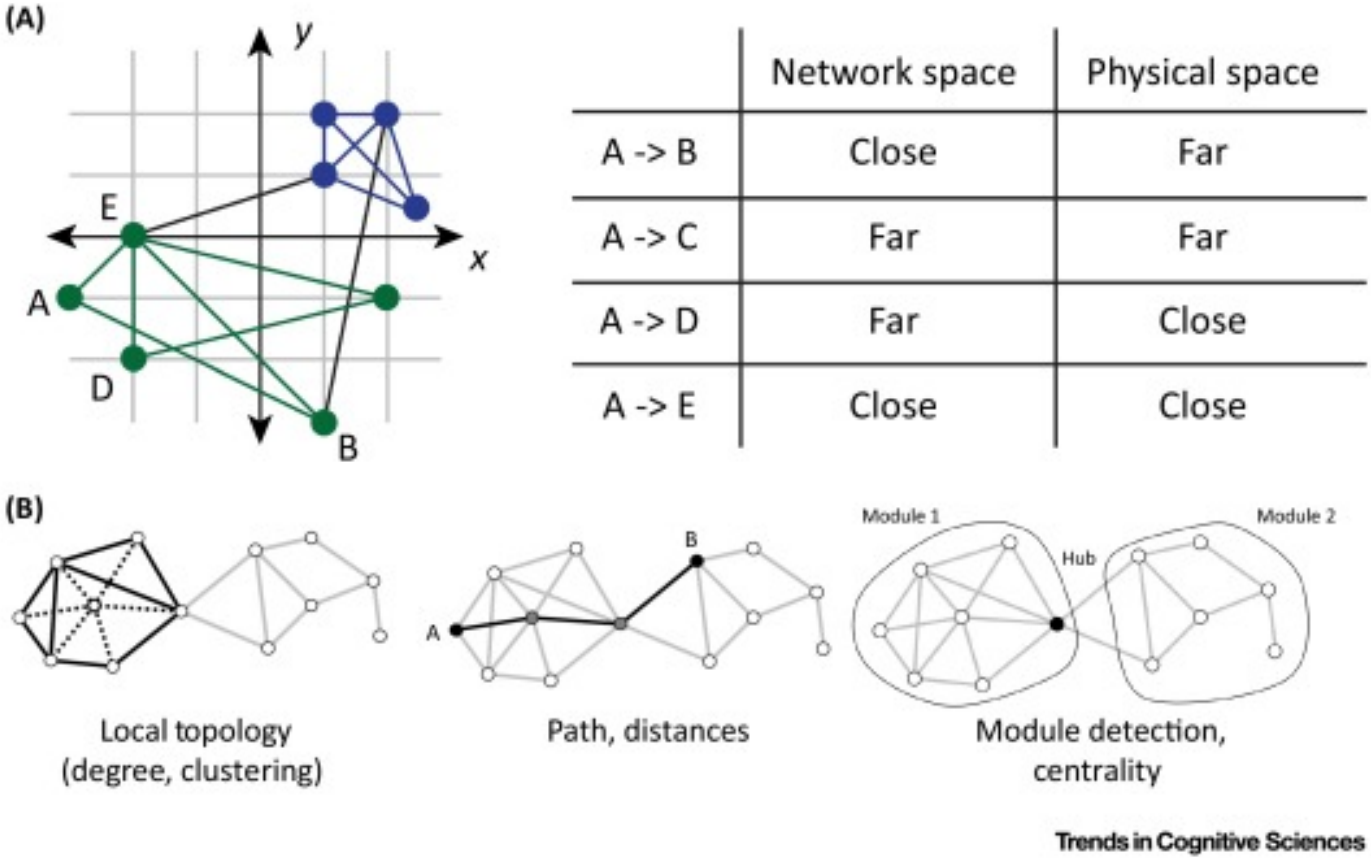
Ion	[inside]	[outside]	Conc Gradient	Equil potential	Driving force	Electrostatic gradient
K^+	~150 mM	~4 mM	outward	~-90 mV	+20 mV	outward
Na^+	~10 mM	~140 mM	inward	~+55 mV	-125 mV	inward

Components

- Nodes
- Edges

Measures of

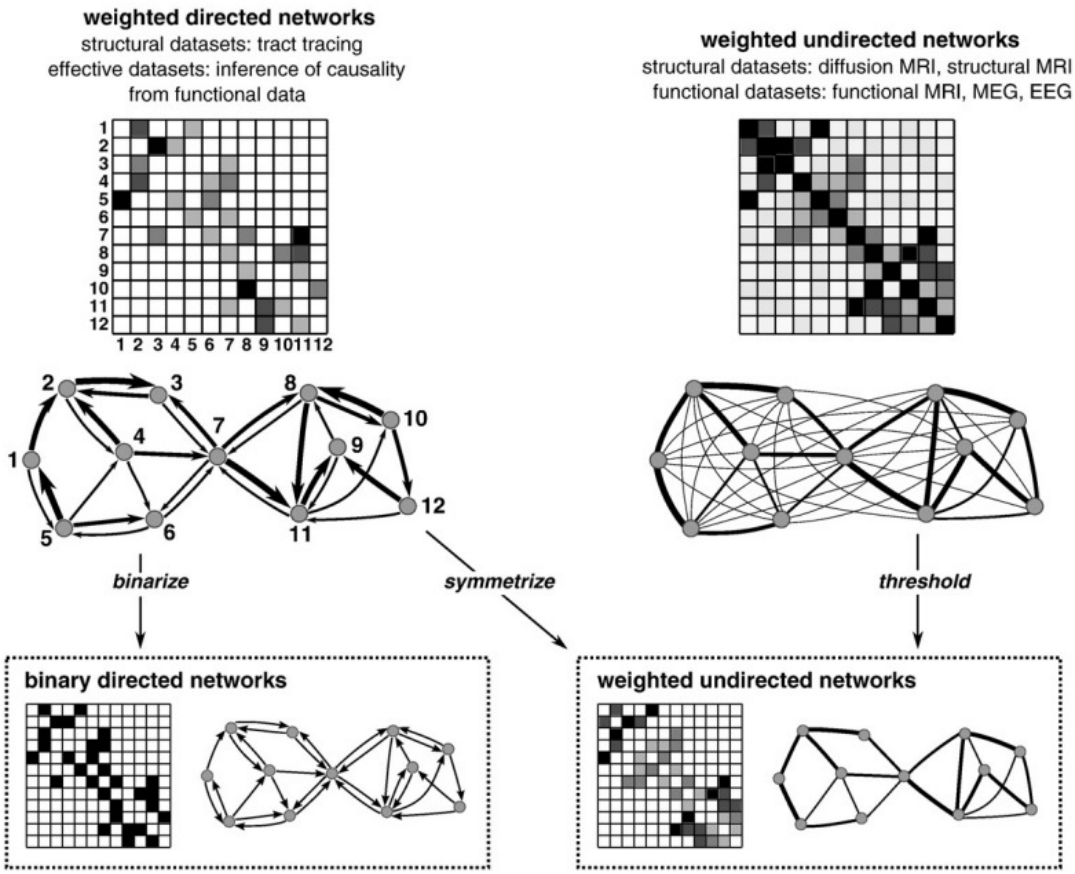
- Size
- Density
- Degree (# of edges)
- Centrality
- Motifs
- Path length



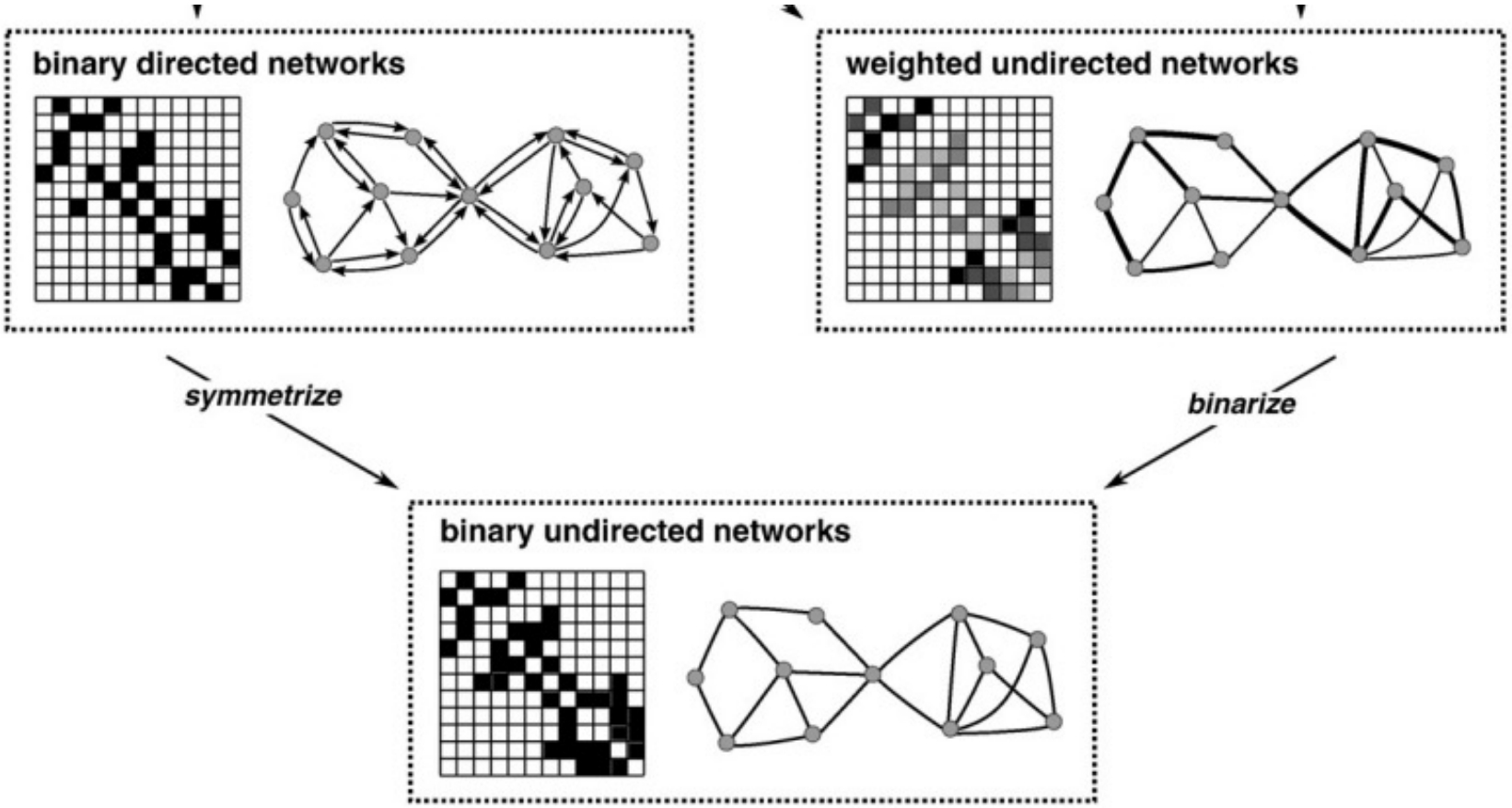
(Stiso & Bassett, 2018)

Types

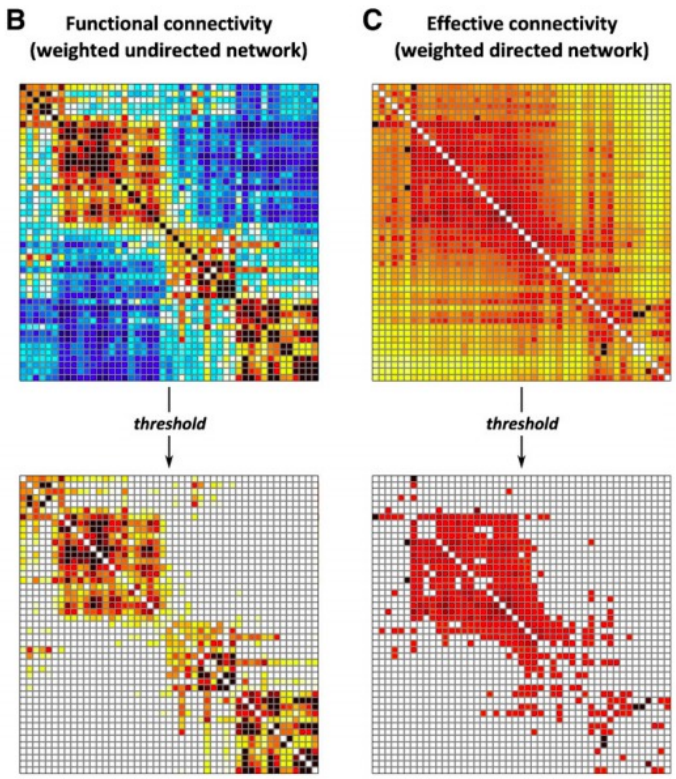
- Directed vs. undirected
- Weighted vs. binarized
- Structural (wiring), functional (activity covariance), effective (causal)



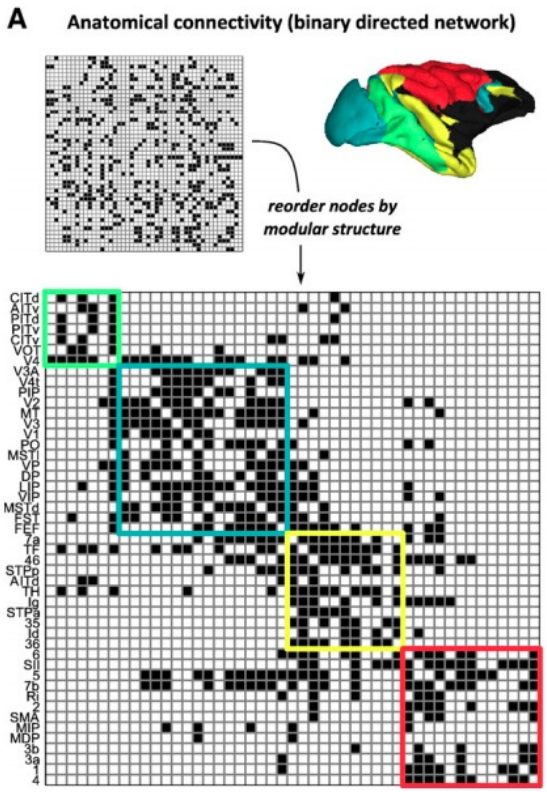
(Rubinov & Sporns, 2010)



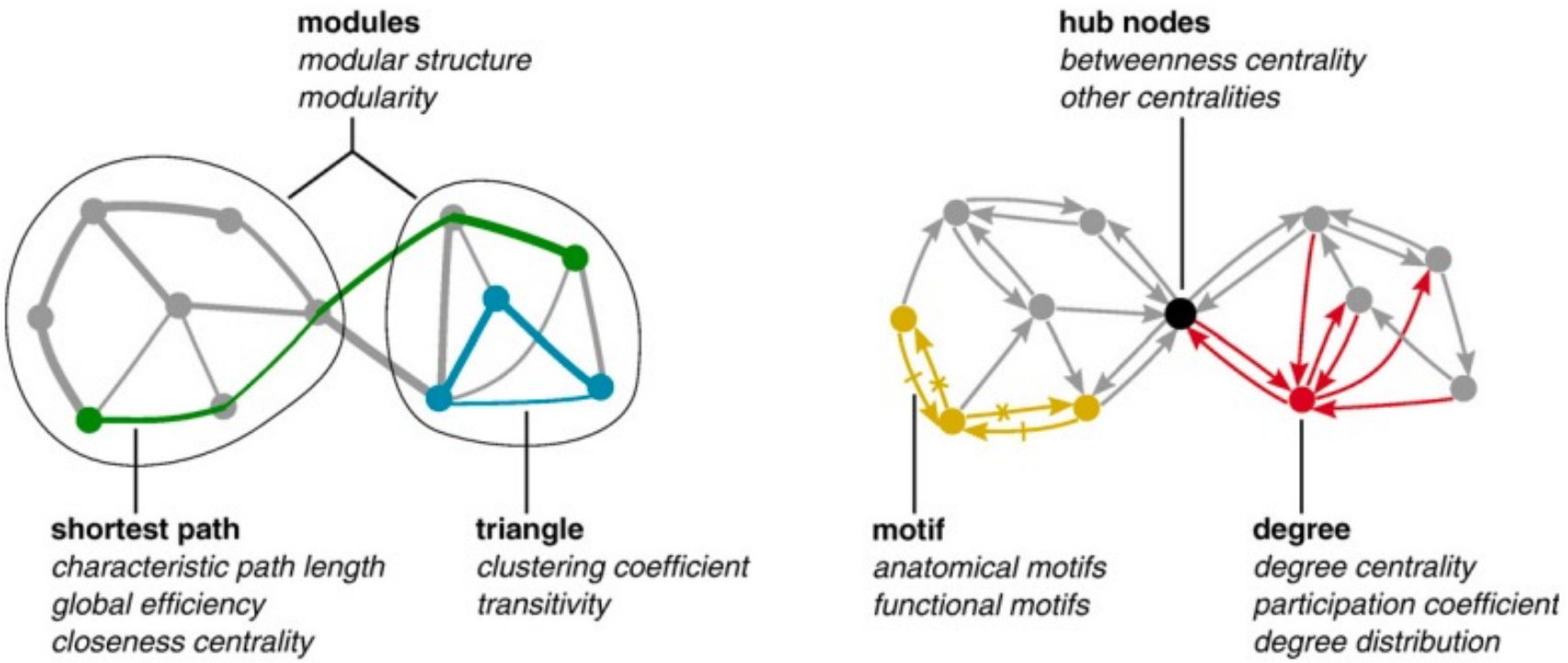
(Rubinov & Sporns, 2010)



(Rubinov & Sporns, 2010)

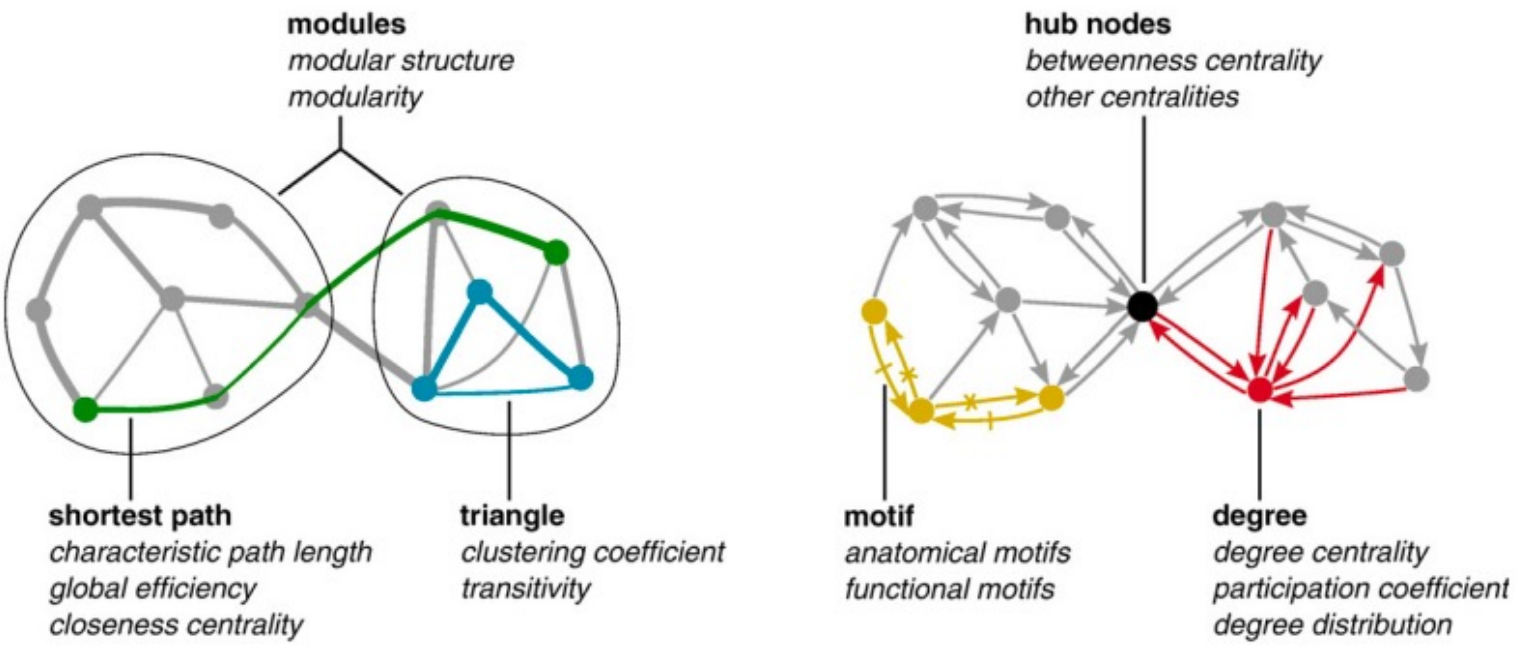


(Rubinov & Sporns, 2010)



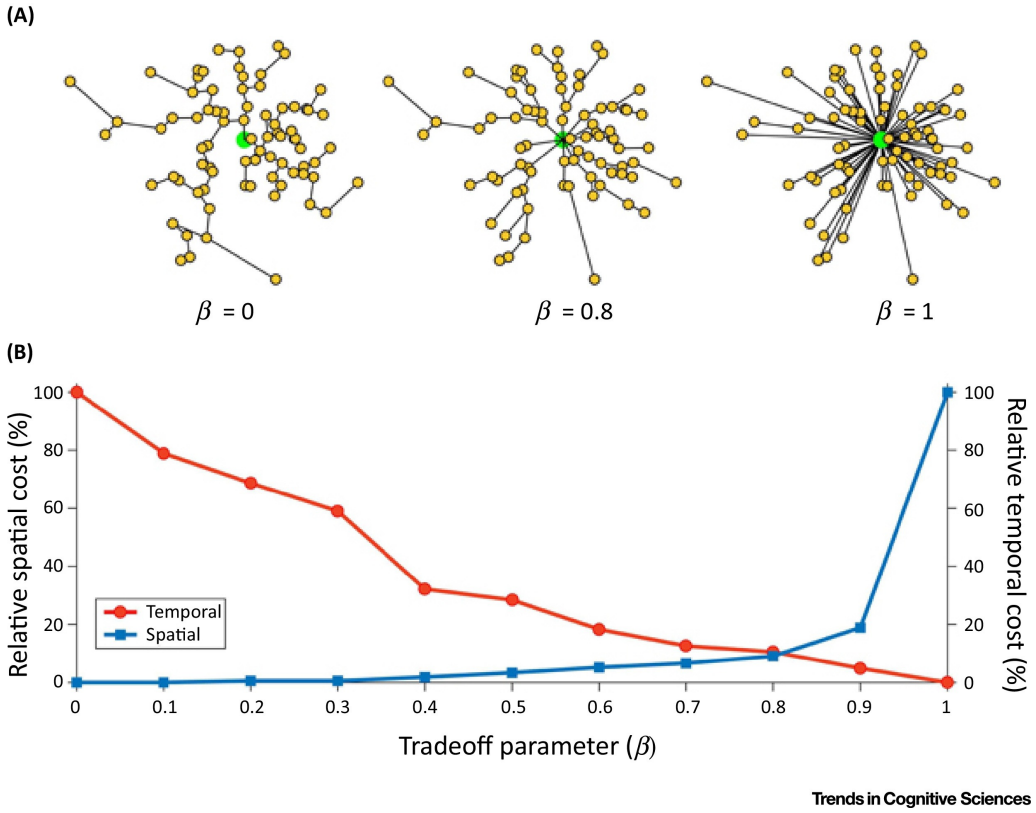
(Rubinov & Sporns, 2010)

Beautiful 3-D Brain Scans Show Every Synapse | National Geographic



(Swanson & Lichtman, 2016)

Temporal (speed) vs. spatial (wiring) constraints



(Stiso & Bassett, 2018)

Some networks in the "resting" brain

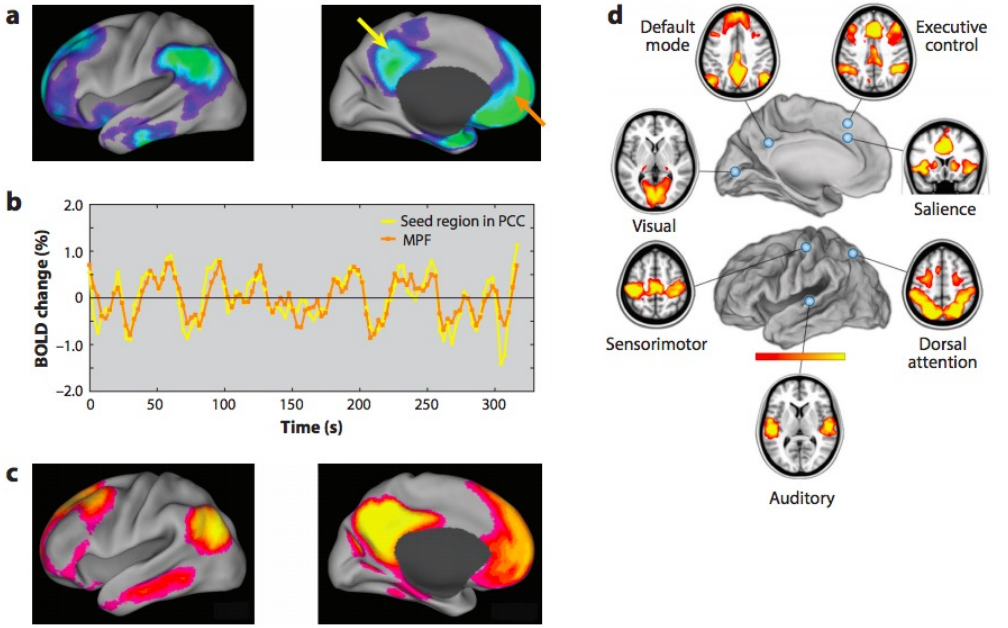
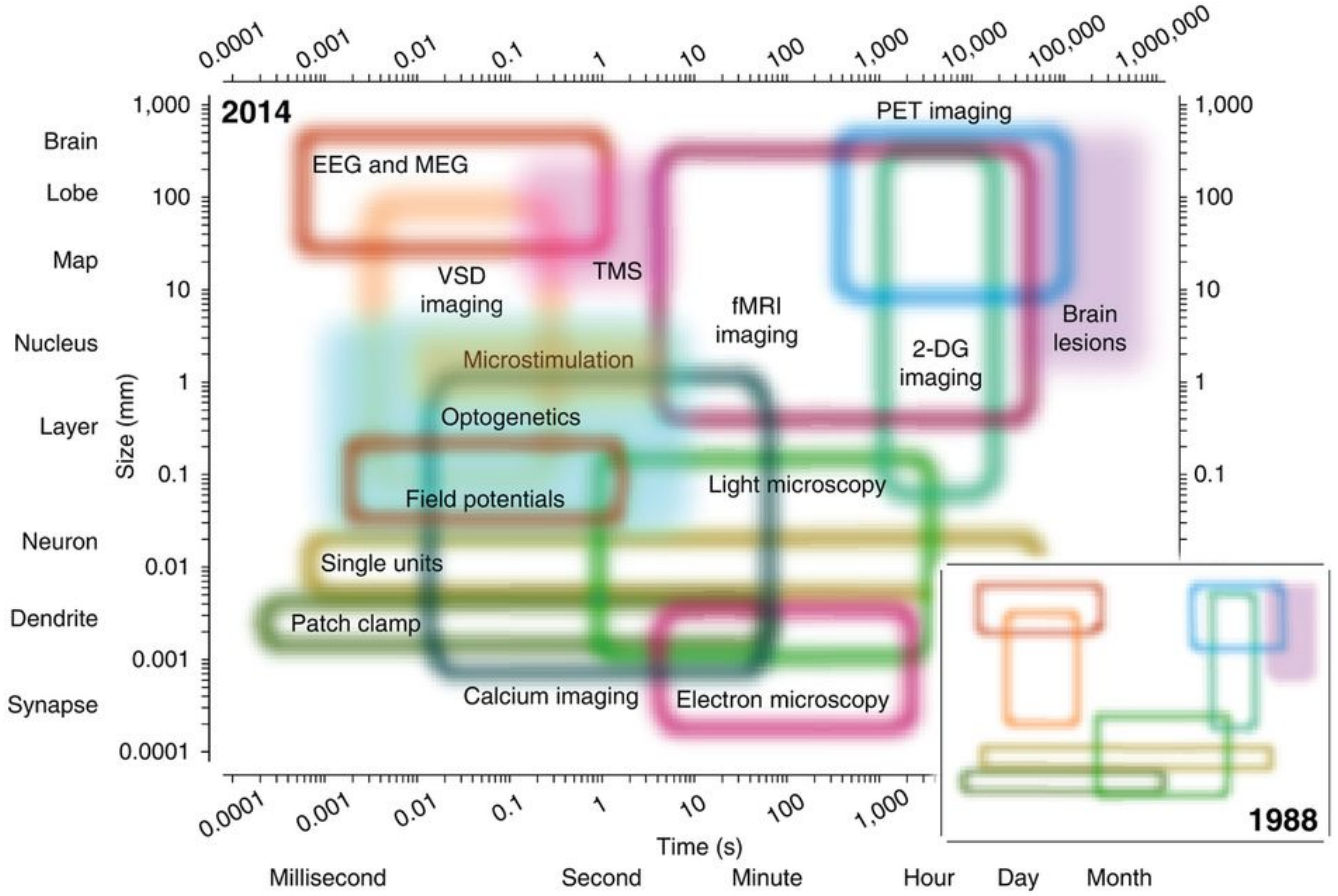


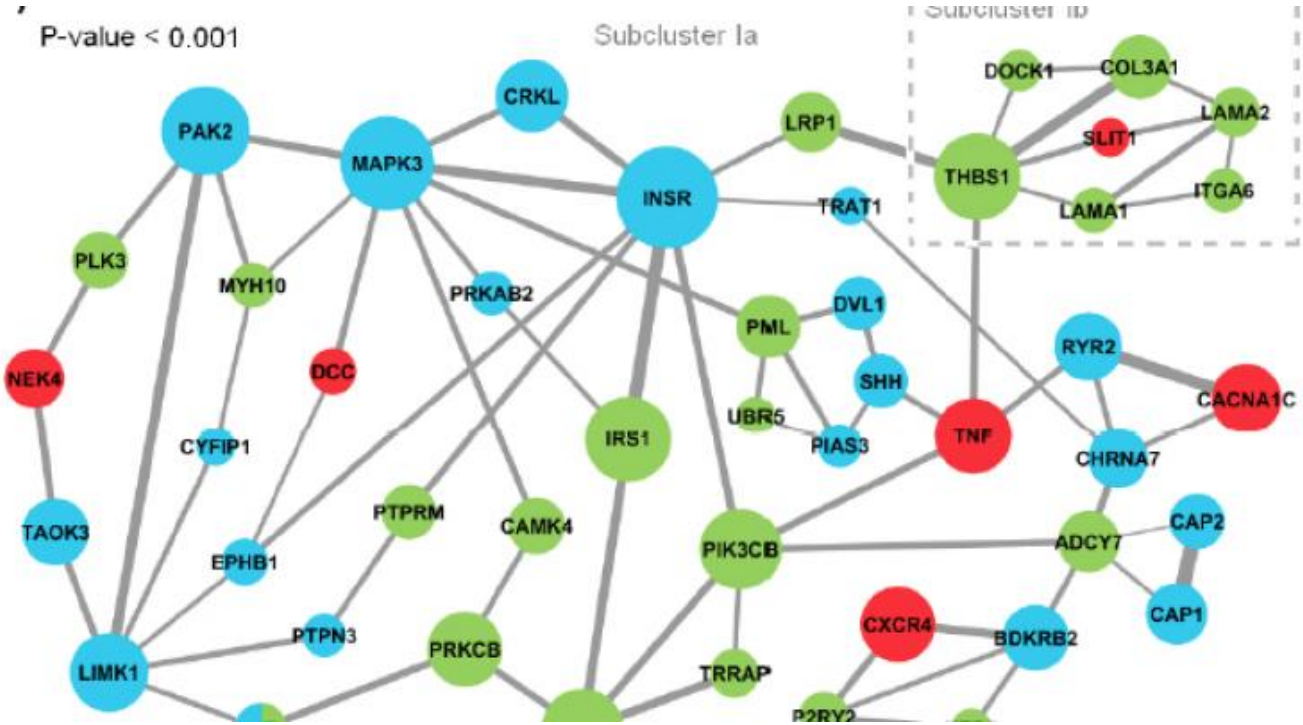
Figure 2

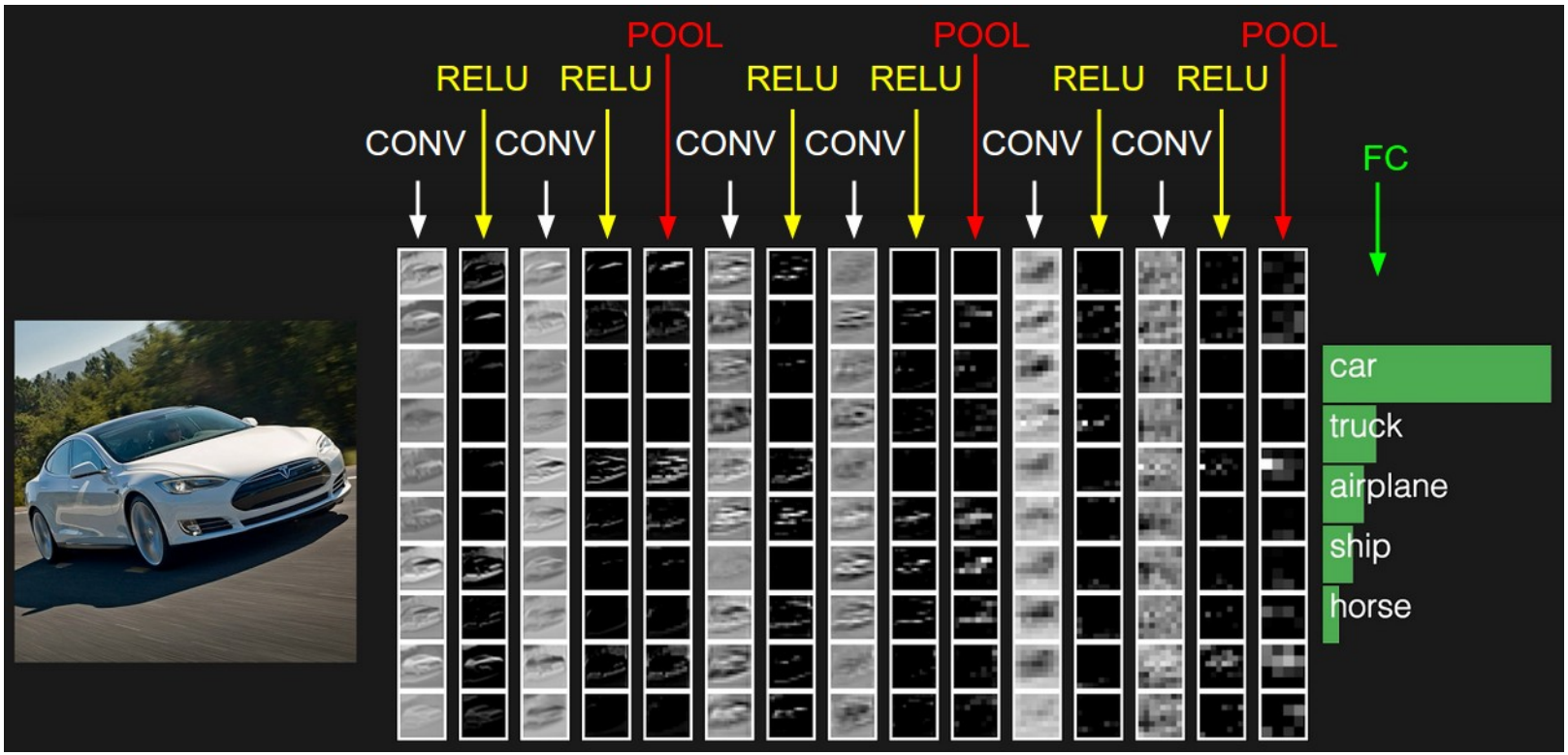
Views of the default mode network from the perspective of activity decreases during task performance (*a*) and resting-state functional connectivity (*b* and *c*), and in relation to other networks that exhibit resting-state patterns of functional connectivity (*d*). The yellow and orange arrows in panel *a* denote the source of the BOLD resting-state, time-activity curves shown in panel *b*. Abbreviations: BOLD, blood-oxygen-level-dependent; MPF, medial prefrontal cortex; PCC, precuneus and posterior cingulate cortex. Elements of this figure were adapted from Raichle (2010, 2011).

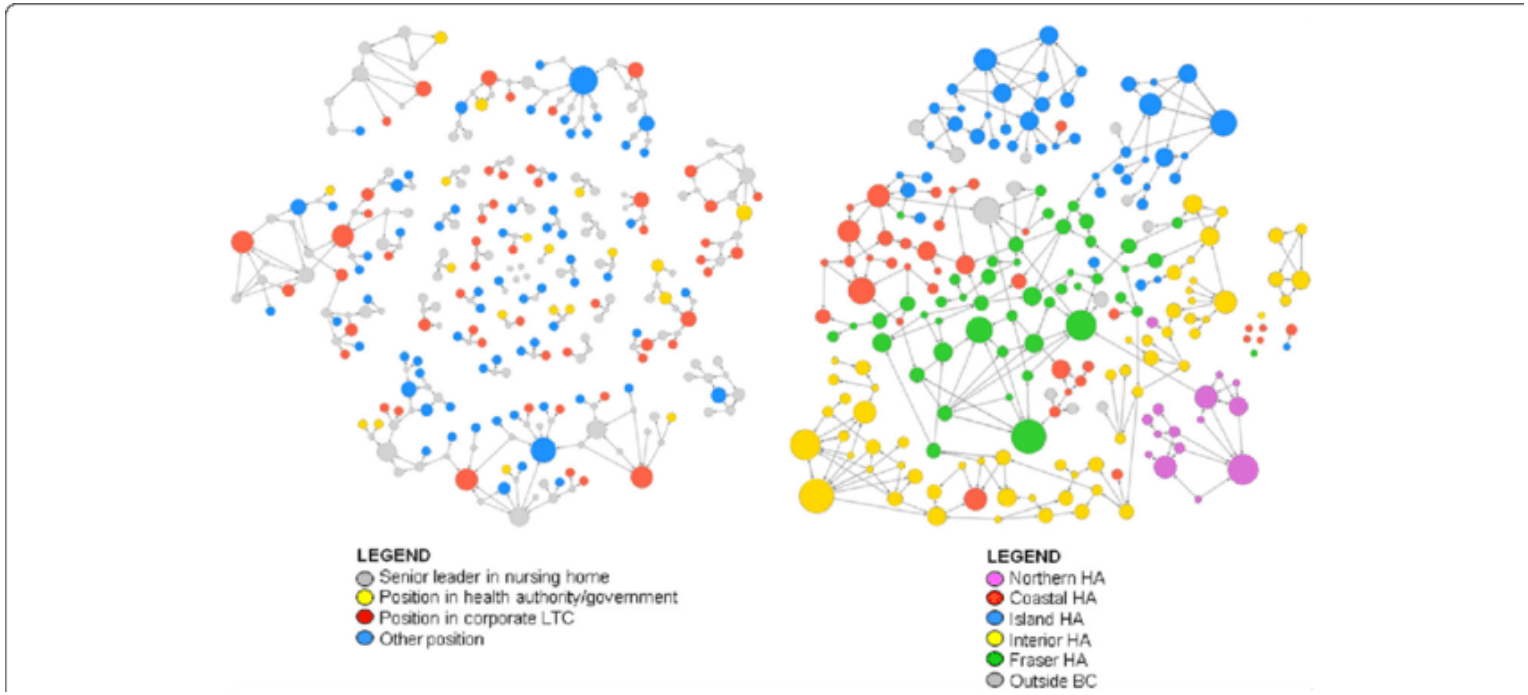
(Raichle, 2015)

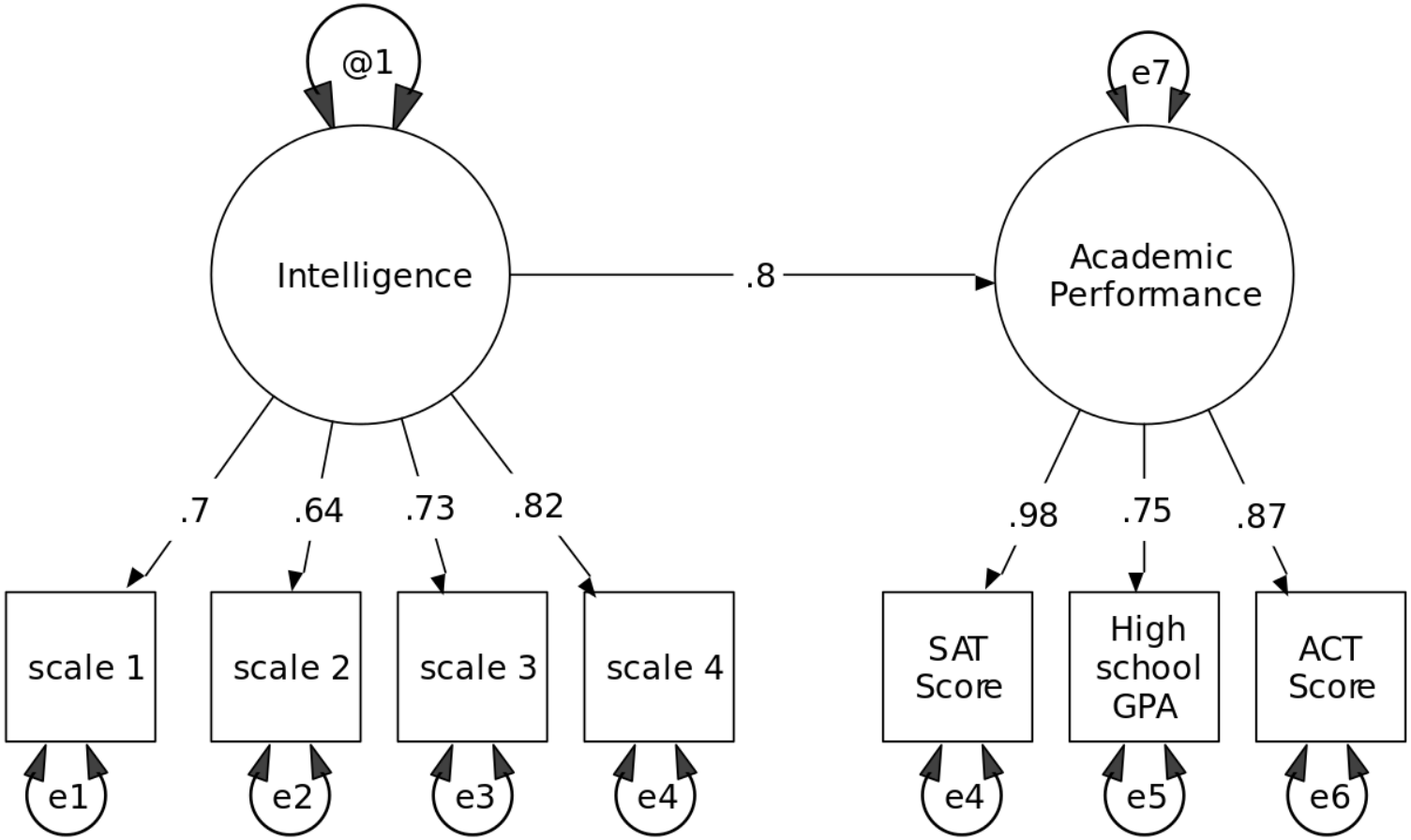


(Sejnowski, Churchland, & Movshon, 2014)


P-value < 0.001
Subcluster Ia
Subcluster Ib
CRKL
PAK2
MAPK3
INSR
LRP1
DOCK1
COL3A1
LAMA2
SLIT1
THBS1
ITGA6
LAMA1
TRAT1
PLK3
MYH10
PRKAB2
PML
DVL1
RYR2
NEK4
DCC
SHH
CACNA1C
UBR5
IRS1
TNF
CYFIP1
PIAS3
CHRNA7
TAOK3
PTPRM
CAMK4
PIK3CB
ADCY7
CAP2
EPHB1
CXCR4
CAP1
PTPN3
PRKCB
BDKRB2
LIMK1
TRRAP
P2RY2


POOL
POOL
POOL
RELU
RELU
RELU
RELU
RELU
RELU
CONV
CONV
CONV
CONV
CONV
CONV
FC
car
truck
airplane
ship
horse


LEGEND
Senior leader in nursing home
Position in health authority/government
Position in corporate LTC
Other position
LEGEND
Northern HA
Coastal HA
Island HA
Interior HA
Fraser HA
Outside BC


@1
e7
Intelligence
.8
Academic Performance
.7
.64
.73
.82
.98
.75
.87
scale 1
scale 2
scale 3
scale 4
SAT Score
High school GPA
ACT Score
e1
e2
e3
e4
e4
e5
e6

Prepping for student presentations

Group Theme	Members	Presentation Day?
Measuring brain & behavior	Kelley, Anna, Alison, Lauren, Rhea	
Neurodegeneration & disorder	Kaitlin, Sam, Daryl, *Emily*	
Development, aging, & plasticity	Liz, Michael, Lia, Chloe	
Cognition & emotion	Austen, Brandon, Shane, *Emily*	

Not assigned: Natalia, Nate

Scope of group presentations

- Provide 2-3 background readings in advance
- 25 min (max) presentation + 10 min discussion
- Focused themes + integrative section
    - What have we learned/what do we know?
    - What don't we know?
    - Why are these answers important to know?
    - How does topic X relate to/inform another theme?
- Submit slides
    - Statement about who did what

References

Raichle, M. E. (2015). The brain's default mode network. *Annual Review of Neuroscience*, *38*, 433–447. https://doi.org/10.1146/annurev-neuro-071013-014030

Rubinov, M., & Sporns, O. (2010). Complex network measures of brain connectivity: Uses and interpretations. *NeuroImage*, *52*(3), 1059–1069. https://doi.org/10.1016/j.neuroimage.2009.10.003

Sejnowski, T. J., Churchland, P. S., & Movshon, J. A. (2014). Putting big data to good use in neuroscience. *Nat. Neurosci.*, *17*(11), 1440–1441. https://doi.org/10.1038/nn.3839

Stiso, J., & Bassett, D. S. (2018). Spatial embedding imposes constraints on neuronal network architectures. *Trends in Cognitive Sciences*, *22*(12), 1127–1142. https://doi.org/10.1016/j.tics.2018.09.007

Swanson, L. W., & Lichtman, J. W. (2016). From cajal to connectome and beyond. *Annual Review of Neuroscience*, *39*, 197–216. https://doi.org/10.1146/annurev-neuro-071714-033954