

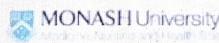
- O HBM DAY 2
- 24 June 2020
- 09:00 NY

## Brain network hubs Maps, models, and molecules

Alex Fornito

Turner Institute for Brain and Mental Health,  
School of Psychological Sciences,  
& Monash Biomedical Imaging,  
Monash University  
Melbourne, Australia

e: alex.fornito@monash.edu  
Twitter: @AFornito



### Regular Topology

- conserve material



### Complex topology

- Network economy



### Random Topology

conserve time



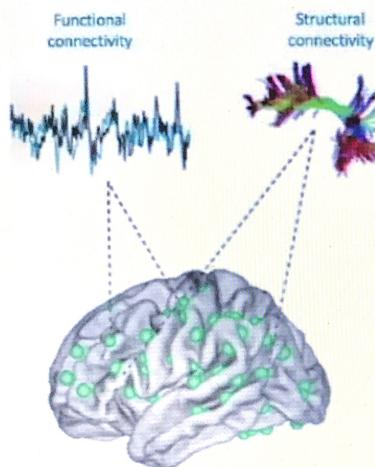
left

COST ↑  
time ↓

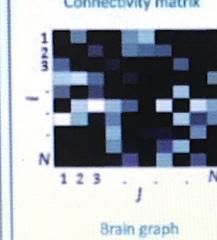
Right

### How to build a connectome

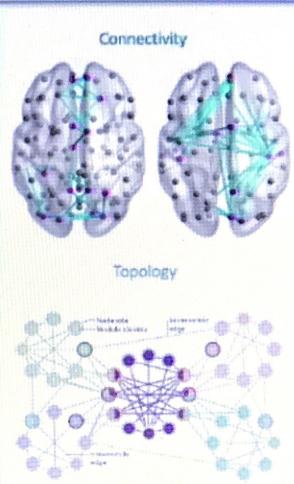
#### Define nodes and edges

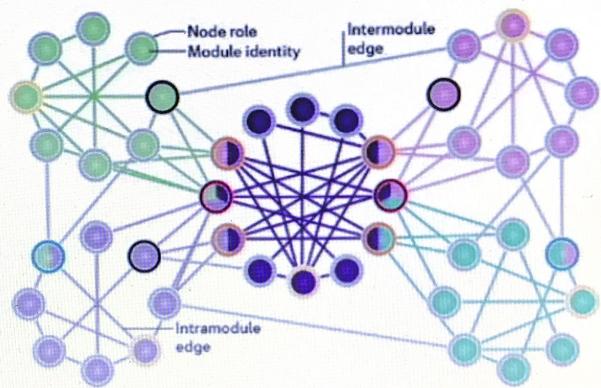


#### Build graph



#### Network analysis





Modules support functional specialization (conserve material)

Hubs and rich clubs support functional integration (conserve time)

Fornito, Zalesky, & Breakspear, Nat Rev Neurosci, 2015

Majority of presentation based on this

Fulcher & Fornito, PNAS (2016) :  $\phi(k) = \frac{2E_{\geq k}}{N_{\geq k}(N_{\geq k}-1)}$

(A lot of details were mentioned from this paper)

$\leftarrow$  No. of connect<sup>n</sup>  
 $\leftarrow$  Total possible connect<sup>n</sup> b/w hubs

Hubs are costly  $\Rightarrow$  high metabolic demand  $\Rightarrow$  implicated in disease

e.g. Alzh., Schizo, depression etc.

Modelling cost vs value trade-off in the connectome

(Betz et al. Neuroimage, 2016 ; Ventes et al. PNAS, 2012)

$$P_{uv} \propto D_{uv}^{-n} \times T_{uv}^{\gamma}$$

↑ connect<sup>n</sup> probability      ↑ wiring cost      ↑ topology

$n$  &  $\gamma$  are +ve  $\Rightarrow$  we can see connect<sup>n</sup> probability is inversely proportional to wiring cost & directly proportional to topology

Note: the presentation went too specific after this, better read papers if you need to research on this topic.