Brain Networks: The Connectome

NIH – 10/02/2020

Olaf Sporns



Brain Networks



Networks on Multiple Scales



Network Neuroscience



Bassett & Sporns (2017) Nature Neuroscience 20, 353

Human Connectomics



Klingler (1956)

DSI (2005)





Hagmann et al (2008)

Vincent & Raichle (2007)

Connectomes: Structural and functional connectivity



Analytic Framework: Network Science

Insights from Human Connectomics



Hub regions and rich club organization



Modules (network communities) and resting-state networks



Large cohorts, open science, multi-modal and multi-omics data, crosssectional/longitudinal (Human Connectome Project, ABCD etc)

Images: Hagmann & Sporns, van den Heuvel, Bullmore, Betzel, Yeo & Buckner, Saykin & Sporns

Advances in Connectome Analysis

Brain networks have complex, multiscale organization – especially evident in modules/communities:

Multi-resolution consensus clustering (MRCC)



Rat endbrain (cortex, basal ganglia) structural connectivity

Swanson, Hahn, Sporns (2018) PNAS

Jeub, Sporns, Fortunato (2018) Scientific Reports

Advances in Connectome Analysis

Fine-scale (single TR) dynamics of fMRI functional connectivity



Esfahlani et al (2020) PNAS

Applications of Connectomics in AD/Dementia

SUB

de la







Resting-state fMRI functional connectivity across the dementia spectrum

Selective and progressive disturbance of connections within and between FP and DMN functional systems – loss of functional 'boundaries'



Connectomics: Data-Driven Science of Brain Networks

Themes: Hubs and Modules – Structure and Dynamics

Increasing Refinement of Spatial and Temporal Scales

Growing Range of Clinical Applications



NEUROSCIENCE

Questions? Contact: osporns@indiana.edu