

BRAIN

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DORSAL COLUMN

Occasional Paper

The hubs of the human connectome are generally implicated in the anatomy of brain disorders

Nicolas A. Crossley,¹ Andrea Mechelli,¹ Jessica Scott,¹ Francesco Carletti,¹ Peter T. Fox,²
Philip McGuire^{1,*} and Edward T. Bullmore^{3,4,5,*}

Jaybree Lopez

Neuro 2

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Intro

-Hubs: integrative processing and adaptive behaviors

- areas with high numbers of connections to other areas

-High value and high biological cost

Question: Are pathological brain regions concentrated in hub regions?

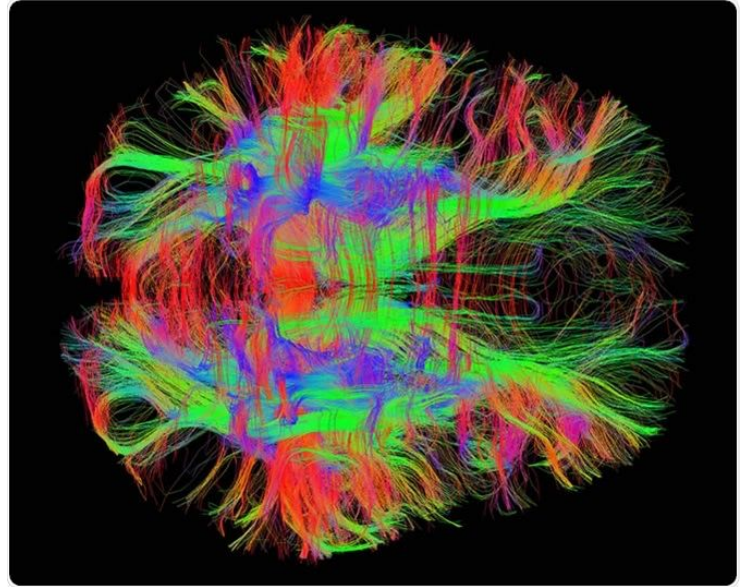
Methods

-Diffusion tensor imaging

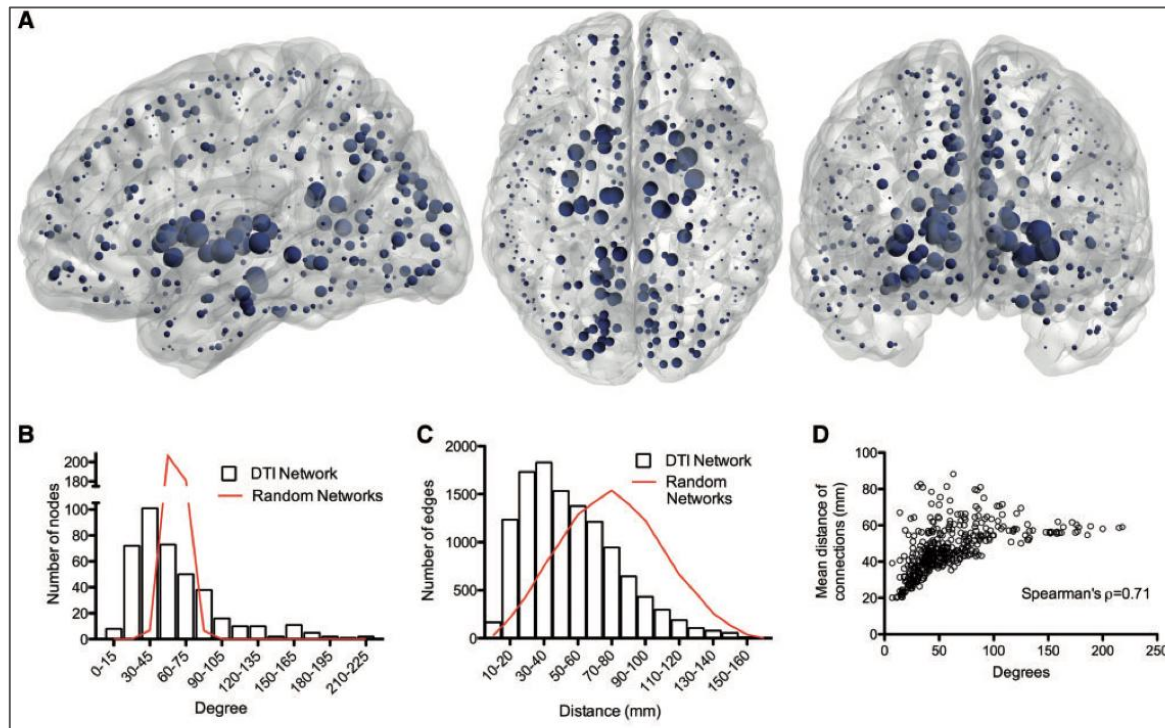
- Uses movement of water molecules to measure white matter tracts

-Anatomical network construction

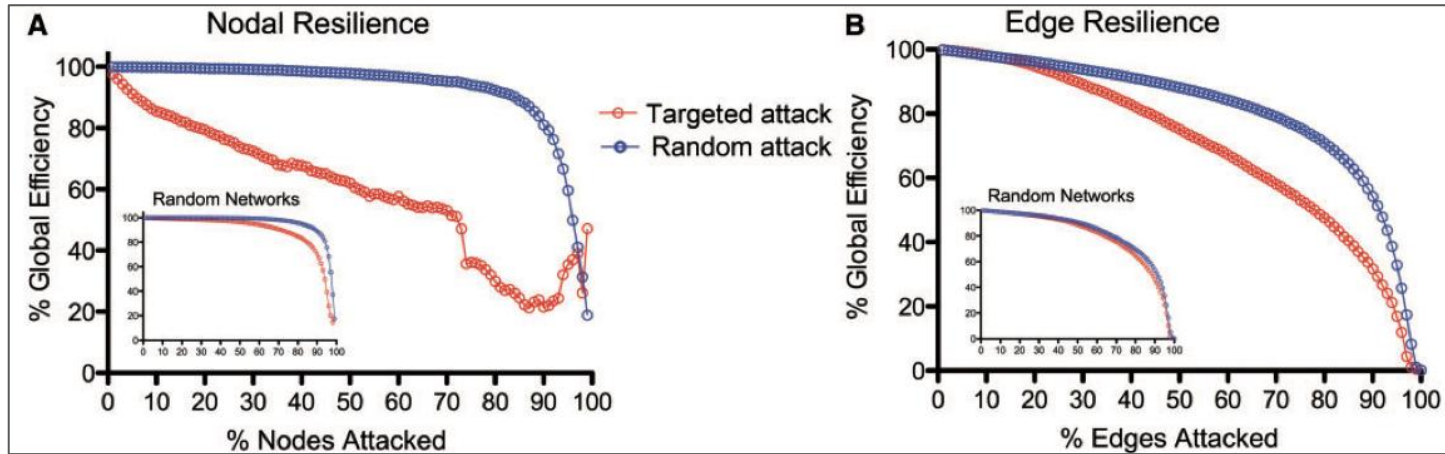
- Gray matter lesion maps; meta analysis of clinical disorders (MRI)



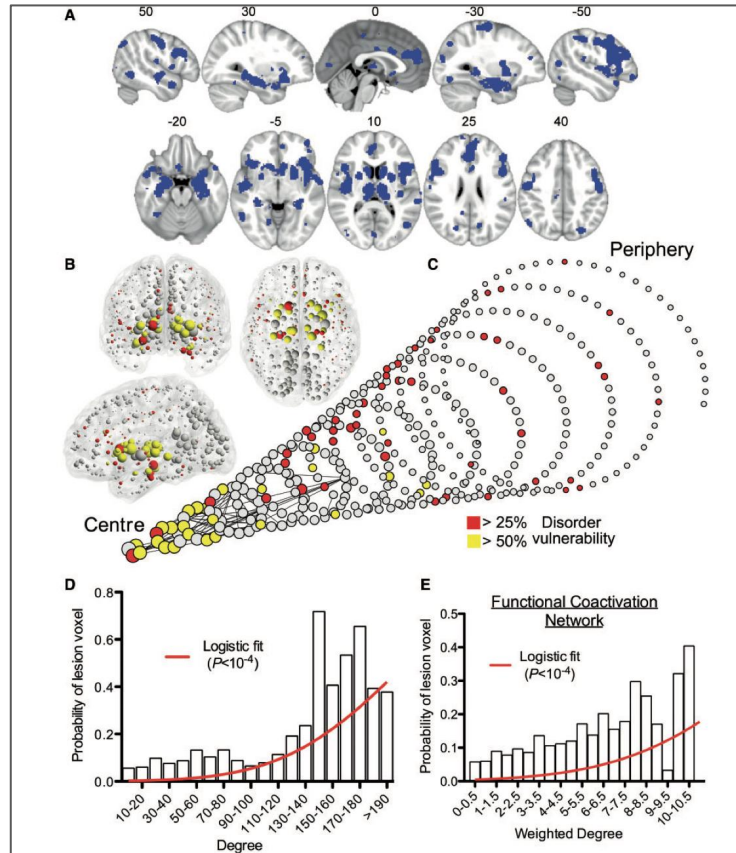
DTI connectomics are replicable



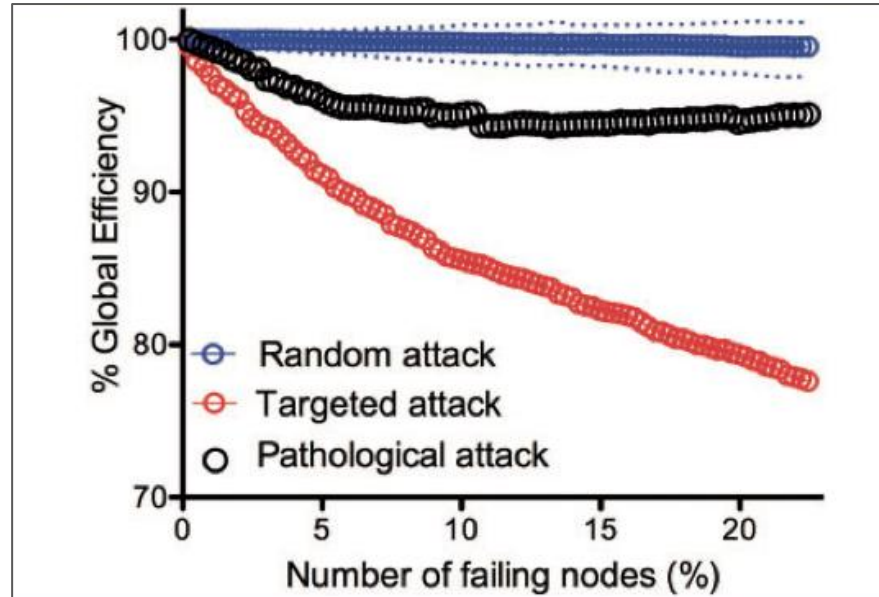
DTI connectomics are resilient to computational attacks, while specific to high degree nodes and long distance edges.



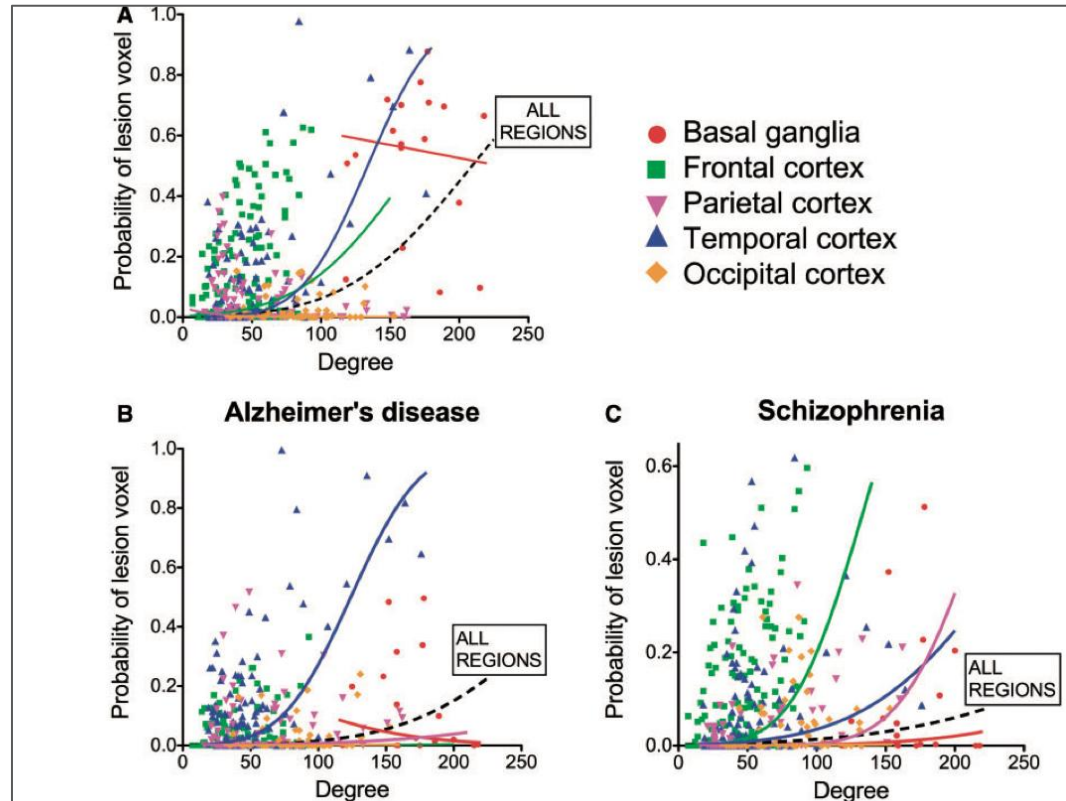
MRI lesions in brain disorders impact preferentially on hubs of normal connectome



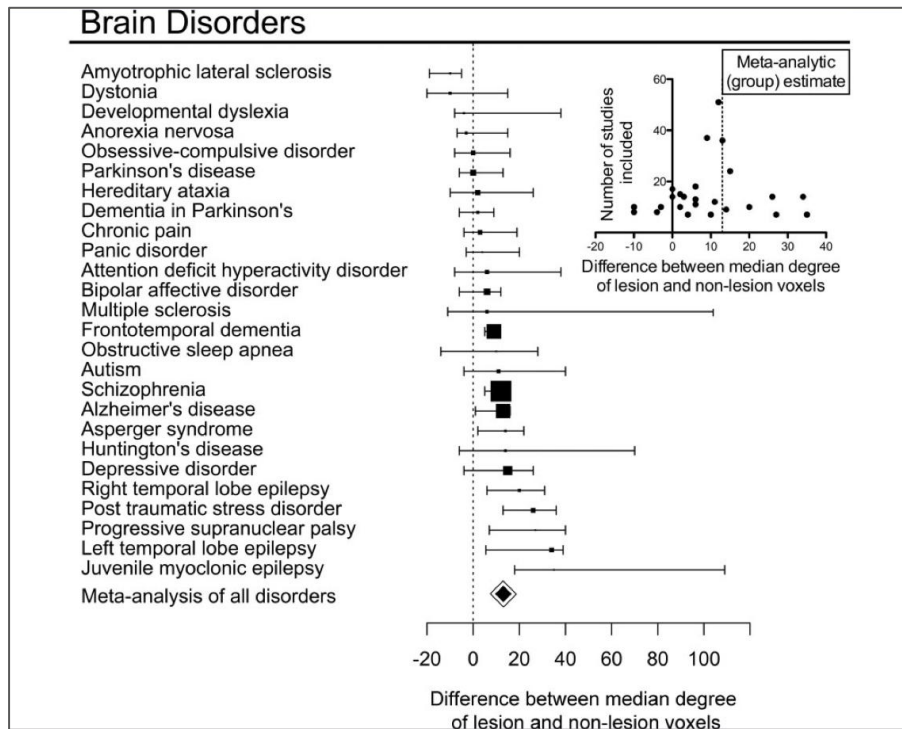
Global deficiency deteriorates significantly faster in pathological attacks compared to random



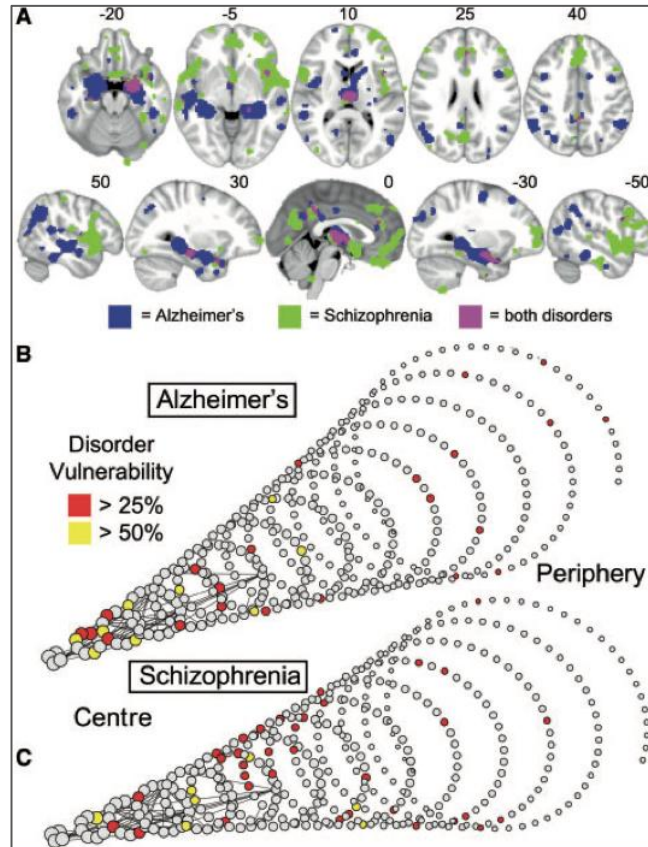
There is a significant relationship between nodal degree and lesion probability in frontal and temporal regions, parietal opposite



Hub concentration of lesions are common to brain disorders



Schizophrenia and Alzheimer's impact distinct subsets of hubs



Conclusion

High cost/high value hubs in normal human brain networks are more likely to be anatomically abnormal than non-hubs in many brain disorders

Limitations

- Not significant for all 26 disorders, only 20

 - ALS had less non-lesioned areas than lesioned areas

- “Vulnerability” of system claim must be researched further

 - Areas may be more systematic, but not make system more vulnerable. Need global insult studies to show hubs are more affected than non-hubs

Discussion

1. Are DTI connectomics a good way to study disease?
2. How much should we trust computational approaches?
3. In ALS, the degree of lesion voxels was significantly lower than non-lesion voxels. Why could this be?