8th International Conference on FASD

Brain structural connectome alterations in children and youth with prenatal alcohol exposure

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Disclosure

No conflict of interest

Potential Bias

No potential bias

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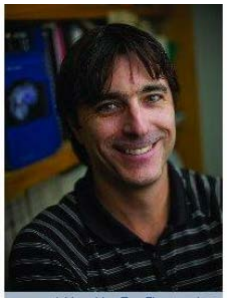


Learning objectives

- Get basic concepts about brain structural connectome analysis

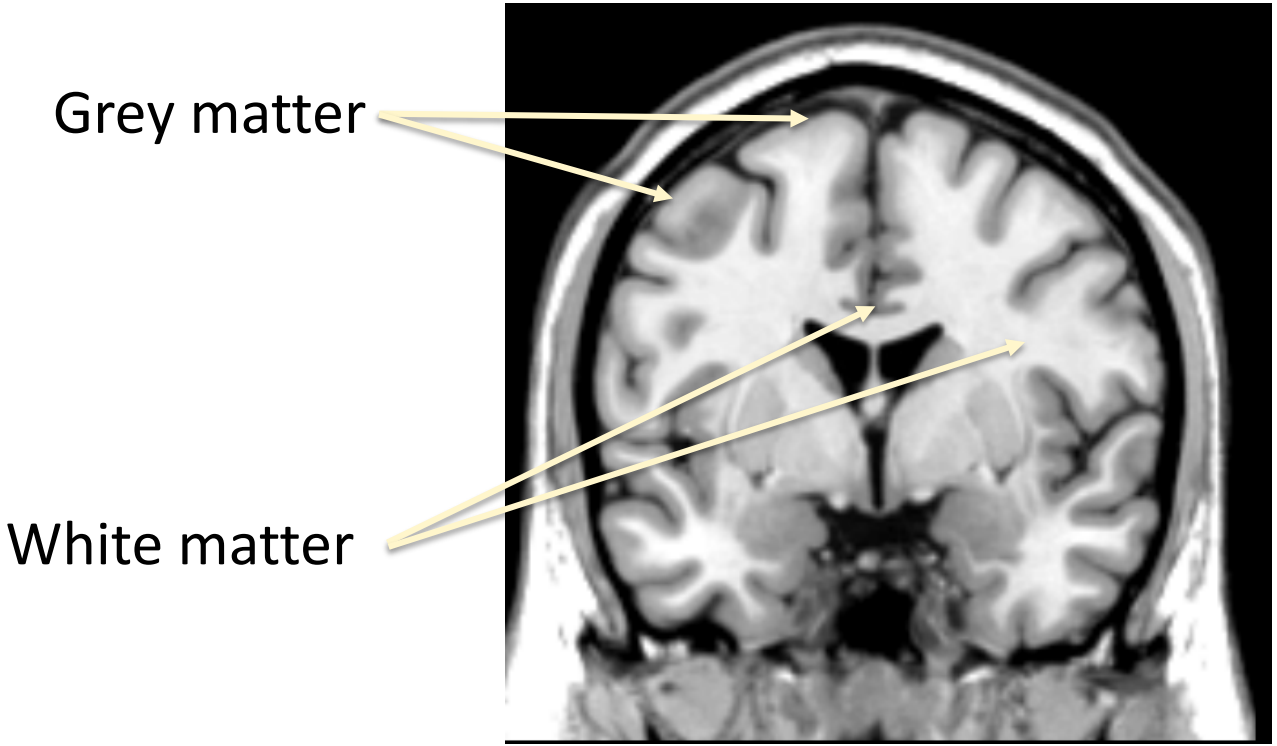
- Identify brain areas where structure is altered in individuals with PAE

Outline

- Background
- Material & Methods
- Results
- Conclusions
- Future plans

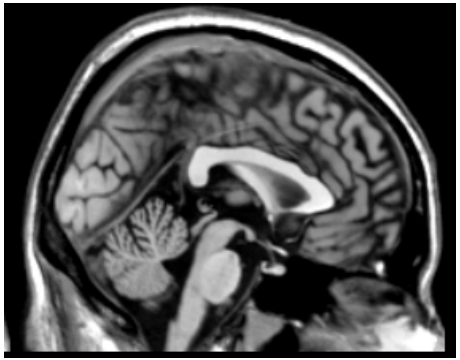
Background

- What are human brain structures?

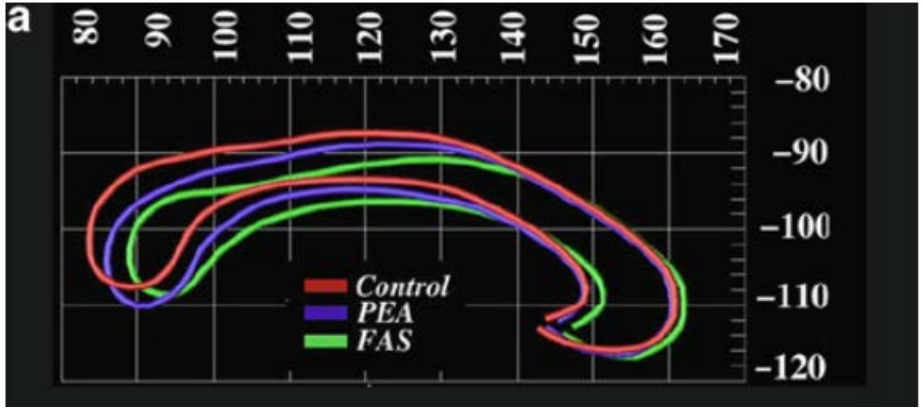


Background

- PAE and white matter
- Abnormal corpus callosum



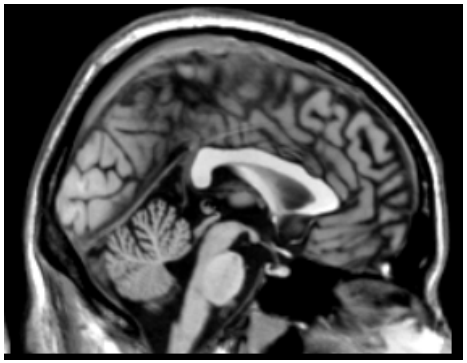
Unexposed

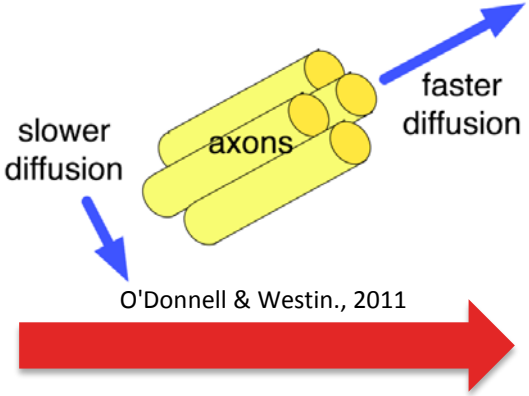


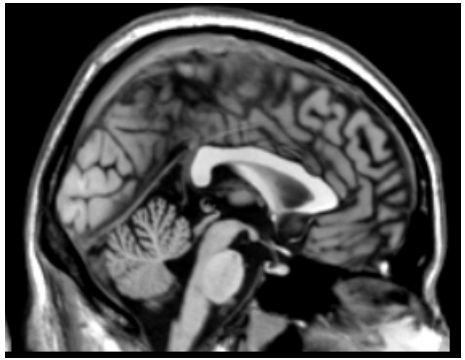
Sowell et al., 2001

Background

- Diffusion tensor imaging

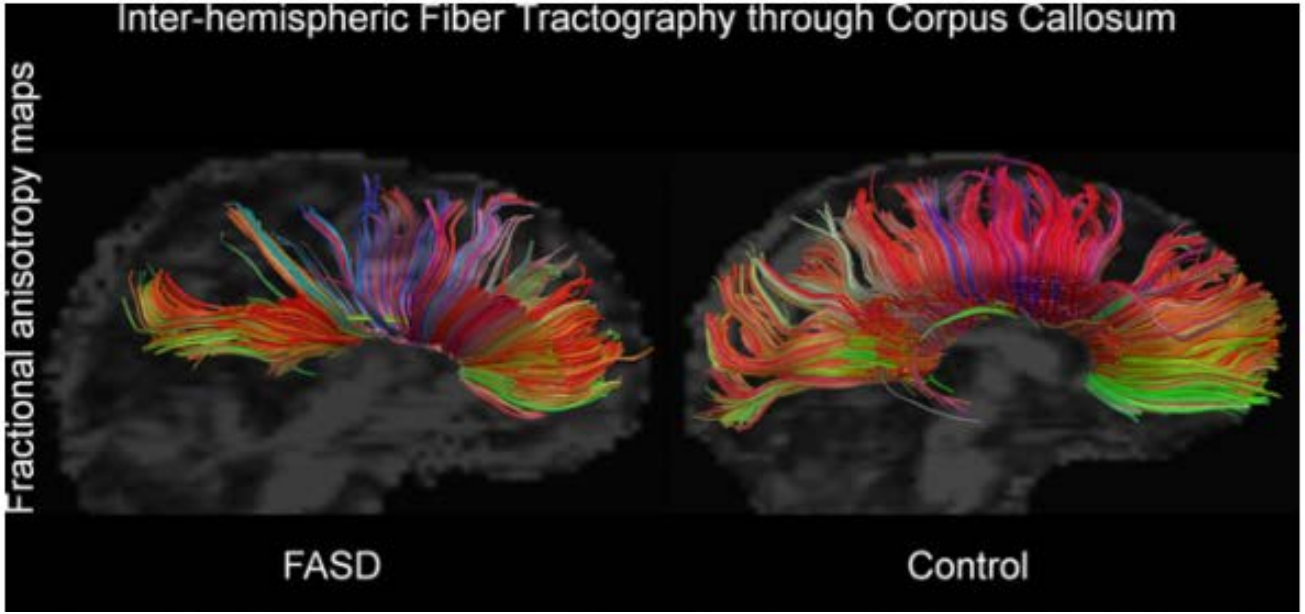






Background

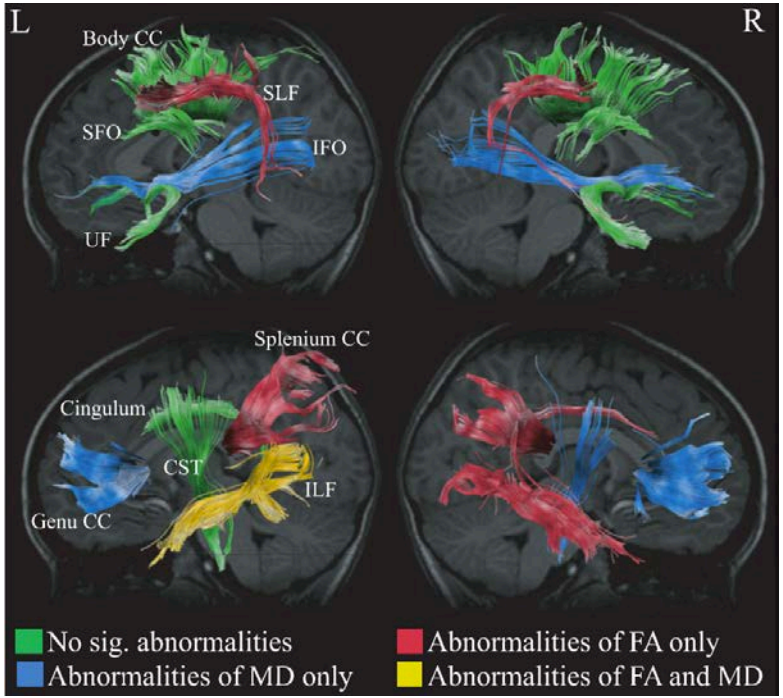
- Abnormal white matter fibers through the corpus callosum:



Wozniak et al., 2011

Background

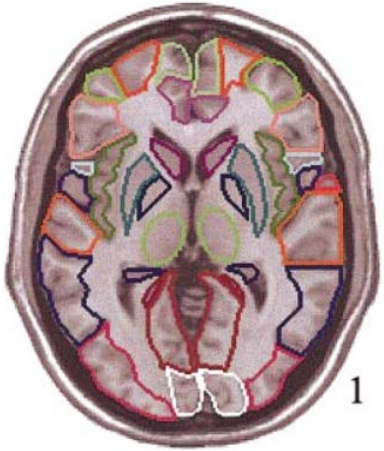
- Abnormal white matter anisotropy across the whole brain



Lebel et al., 2008

Background

- Graph theory based analysis:



Brain regions

Tzourio-Mazoyer., 2002

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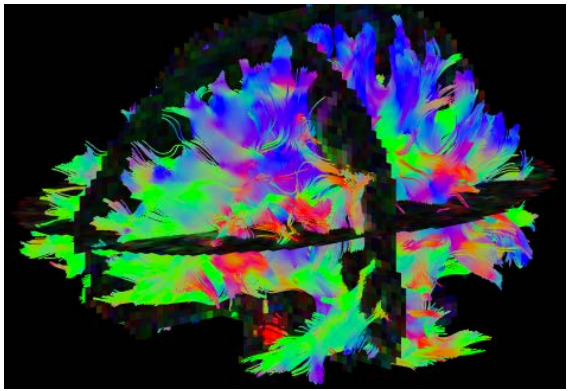
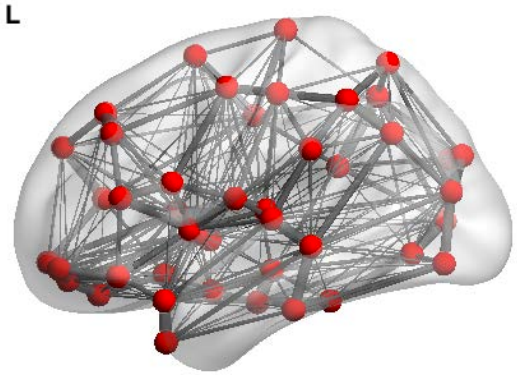


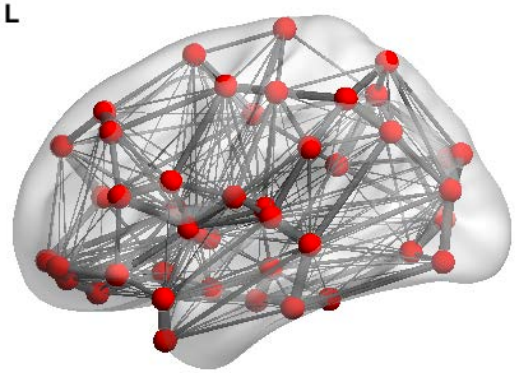
White matter tractography

=



Structural connectome

Background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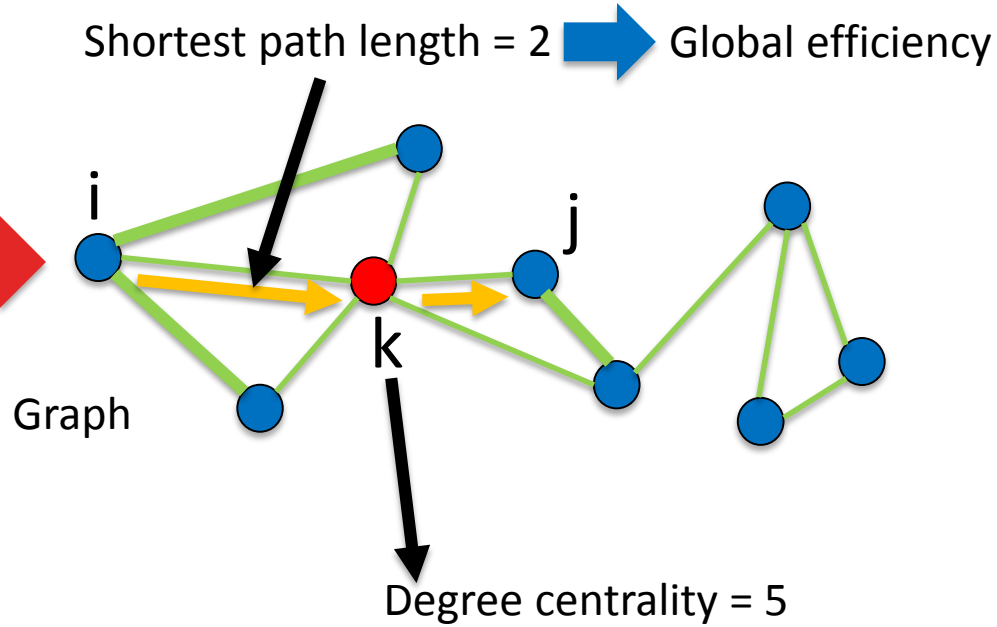

Shortest path length = 2
Global efficiency
i
j
k
Graph
Degree centrality = 5

Background

- Small world: High local connectivity and low shortest path length.

Watts & Strogatz., 1998

Background

Alcoholism: Clinical and Experimental Research

Vol. 37, No. 5
May 2013

Global Functional Connectivity Abnormalities in Children with Fetal Alcohol Spectrum Disorders

Jeffrey R. Wozniak, Bryon A. Mueller, Christopher J. Bell, Ryan L. Muetzel, Heather L. Hoecker, Christopher J. Boys, and Kelvin O. Lim

Functional connectivity abnormalities and associated cognitive deficits in fetal alcohol Spectrum disorders (FASD)

Jeffrey R. Wozniak[1] · Bryon A. Mueller[1] · Sarah N. Mattson[3] · Claire D. Coles[4] · Julie A. Kable[4] · Kenneth L. Jones[5] · Christopher J. Boys[1] · Kelvin O. Lim[1] · Edward P. Riley[3] · Elizabeth R. Sowell[2] · the CIFASD

- Aim: Structural connectome in children and youth with PAE

Materials & Methods

103 Unexposed controls, 97 PAE;

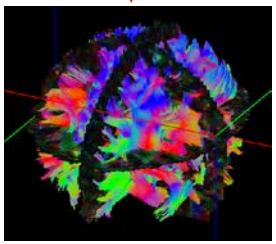
5 ~ 18 years old, 83 females

Diffusion tensor imaging

Materials & Methods

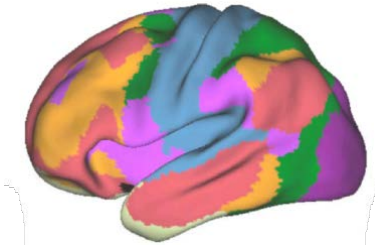
DTI datasets

deterministic tractography



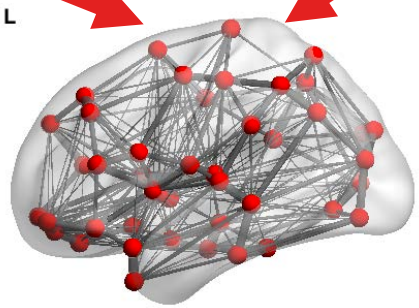
Whole brain tractography

Brain regions



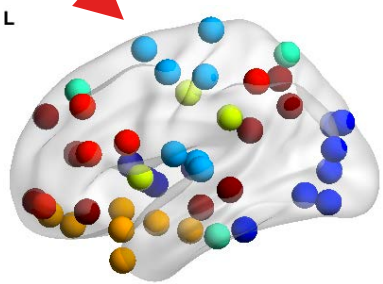
Yeo et al., 2011

Purple (Visual)
Blue (Somatomotor)
Green (Dorsal Attention)
Violet (Ventral Attention)
Cream (Limbic)
Orange (Frontoparietal)
Red (Default)



Structural connectome

Graph theoretical analysis

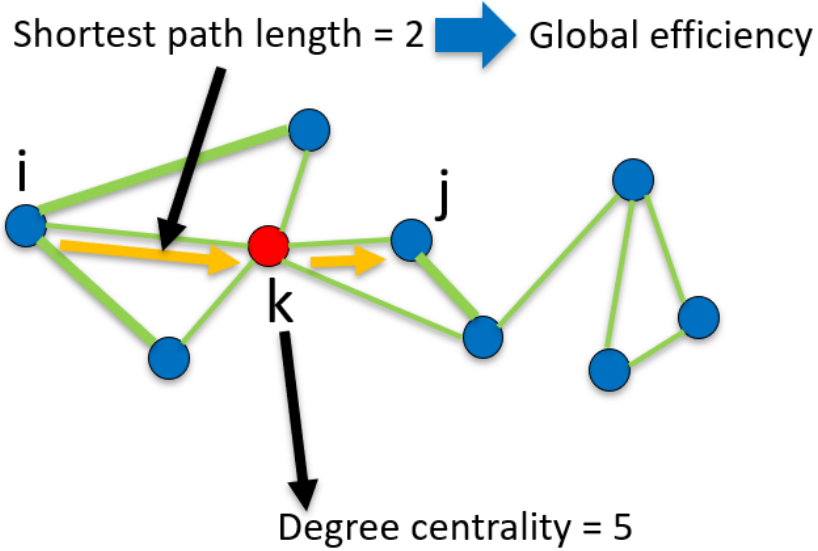


Pre-defined networks

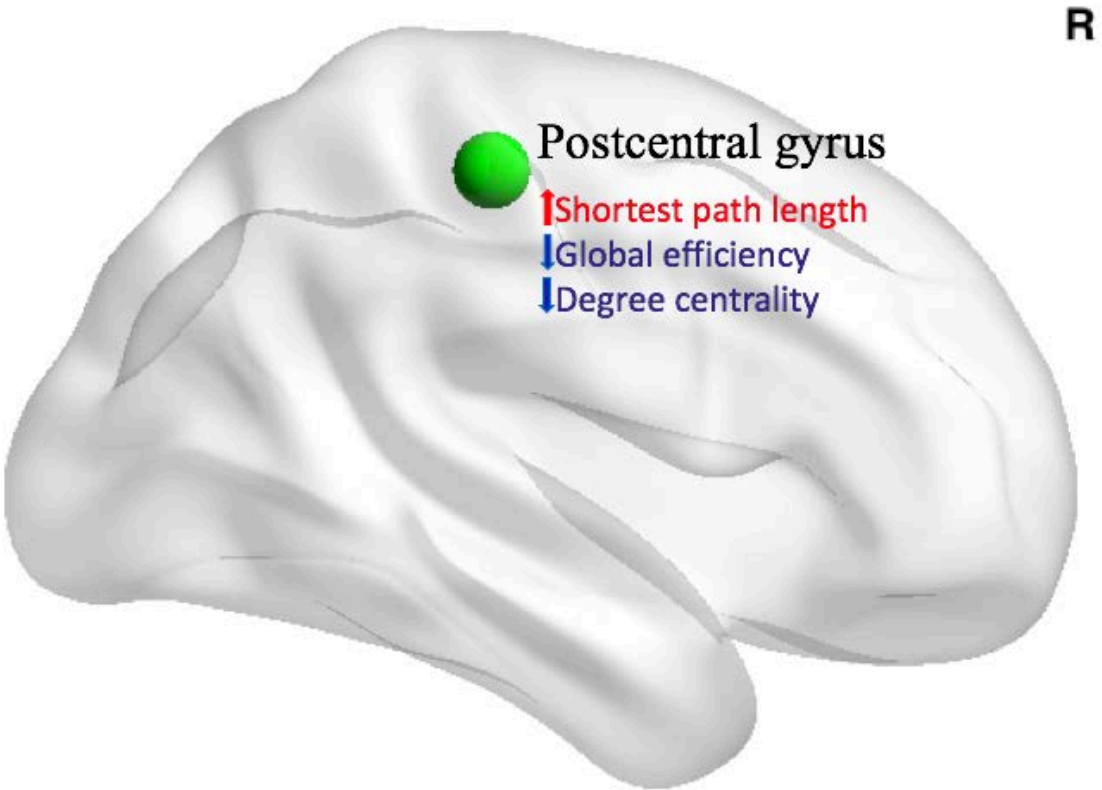
Results: Whole brain level

- Children and youth with PAE:

- Higher shortest path length;
- Lower global efficiency;
- Lower degree centrality;
- Nearly Small-world;

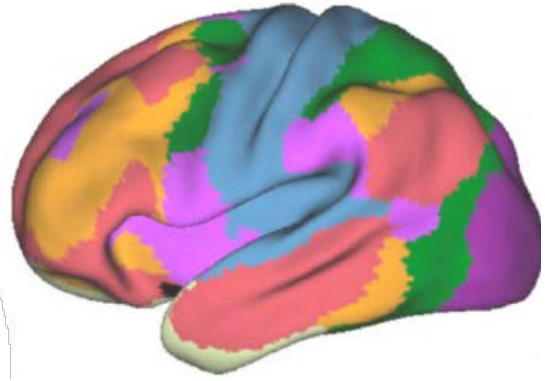


Results: Regional level



Red: PAE > Controls; Blue: PAE < Controls

Results: Network level



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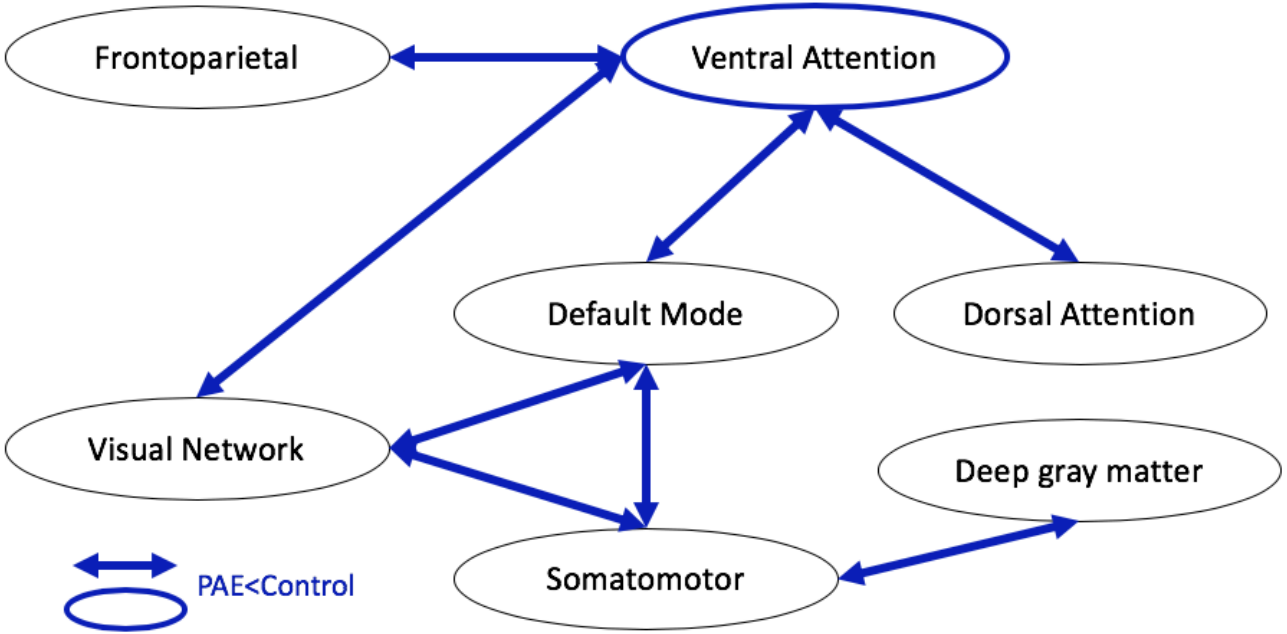

Conclusions

- Structural network in children and youth with PAE requires longer path to transfer information, lead to decreased efficiency;
- Brain regions related to sensorimotor functions at the right hemisphere dominate the changes;
- Disrupted coorperations between cognitive, sensorimotor and attention system associated with PAE.

Future plans

- Relationship with cognitive and behavioural outcomes;

- Interactions between brain functions and structures;

Learning objectives

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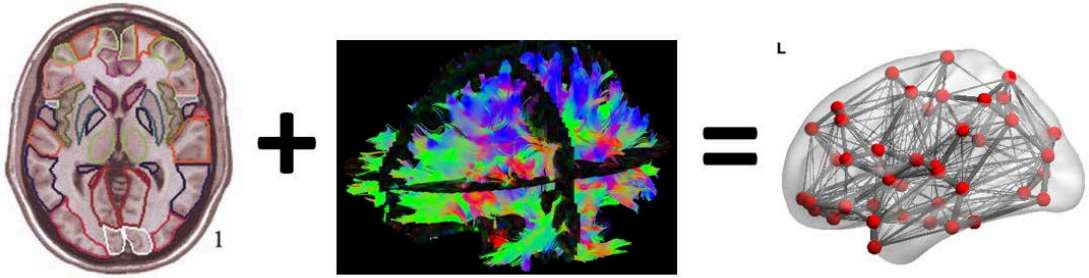

Brain regions
Tzourio-Mazoyer., 2002

White matter tractography

Structural connectome

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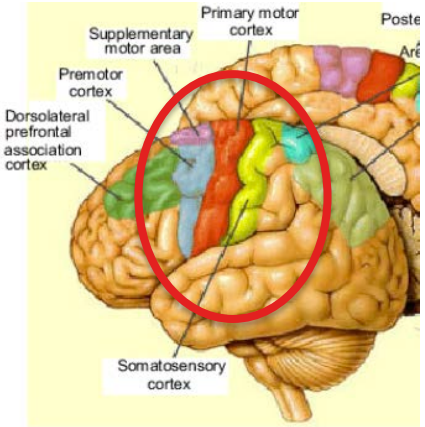

http://thebrain.mcgill.ca/flash/a/a_06/a_06_cr/ a_06_cr_mou/a_06_cr_mou.html

UNIVERSITY OF CALGARY

Thank you for listening!

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