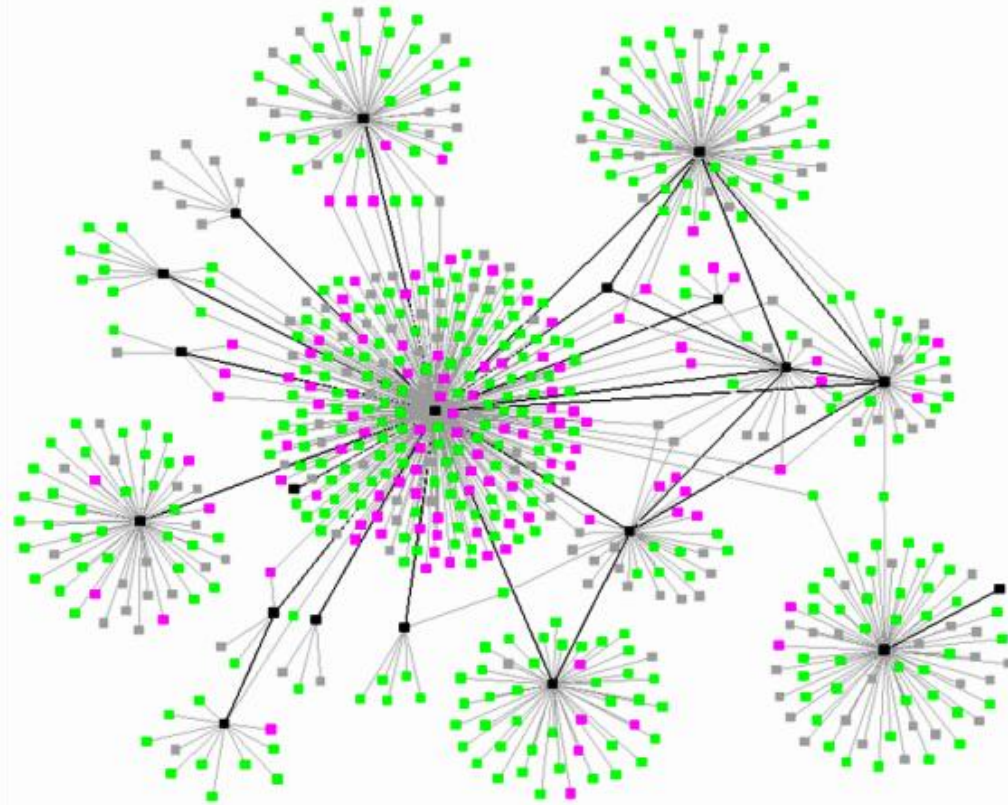


**GRAPH THEORETICAL
ANALYSIS REVEALS:
WOMEN'S BRAINS ARE
BETTER CONNECTED THAN
MEN'S**

Balázs Szalkai, ELTE Institute of Mathematics

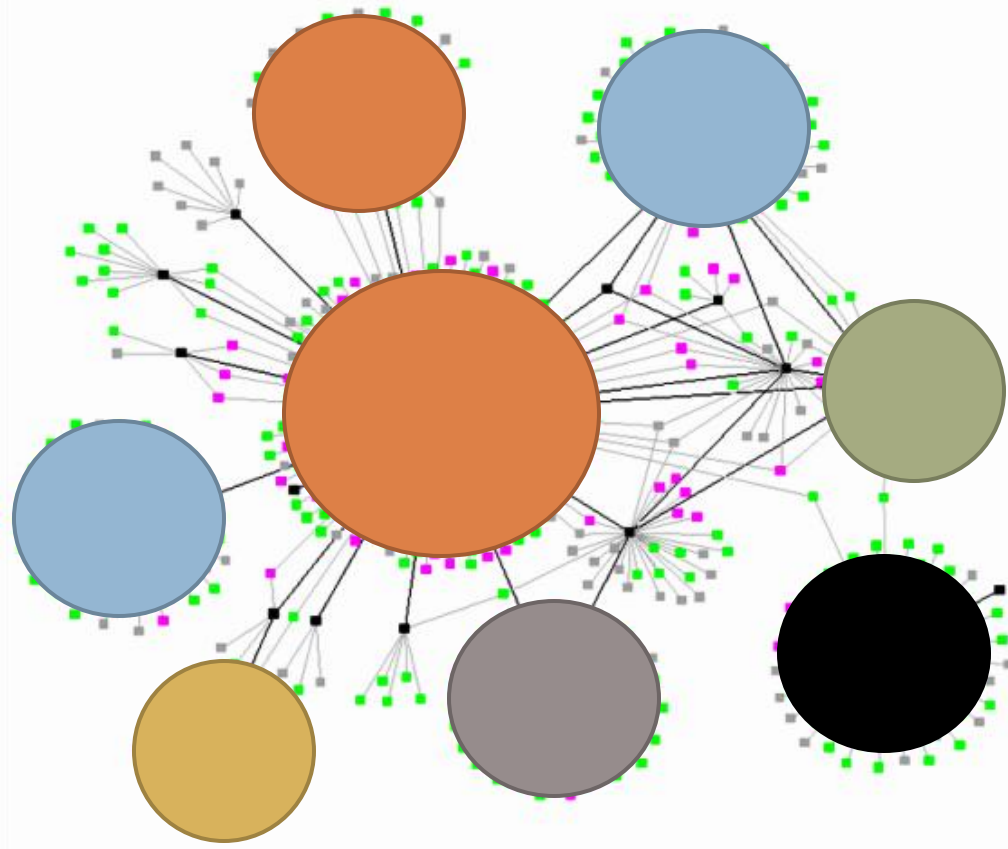
The brain from a mathematical point of view

Connectome (a network of **neurons**): nodes and edges



The brain from a mathematical point of view

Macro-scale connectome (a network of **ROIs**, regions of interest)



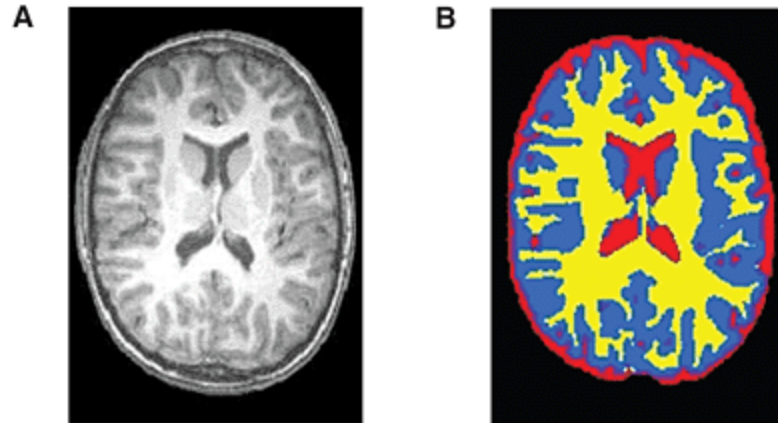
Computing a macro-scale connectome

- **Diffusion MRI scan**
- Segmentation
- Parcellation
- Tractography
- Graph construction



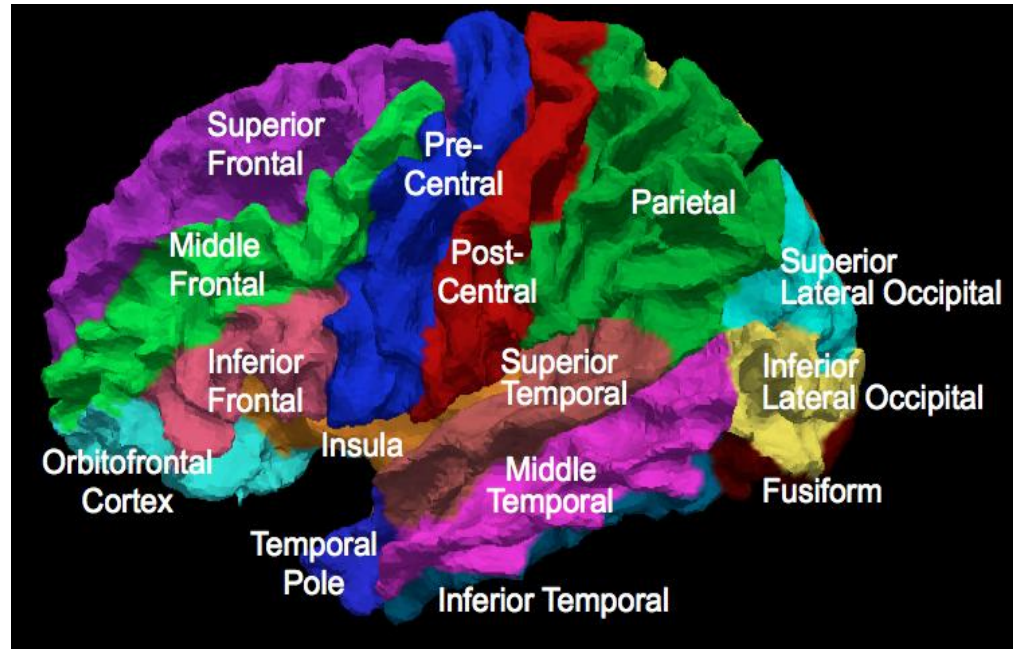
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Computing a macro-scale connectome

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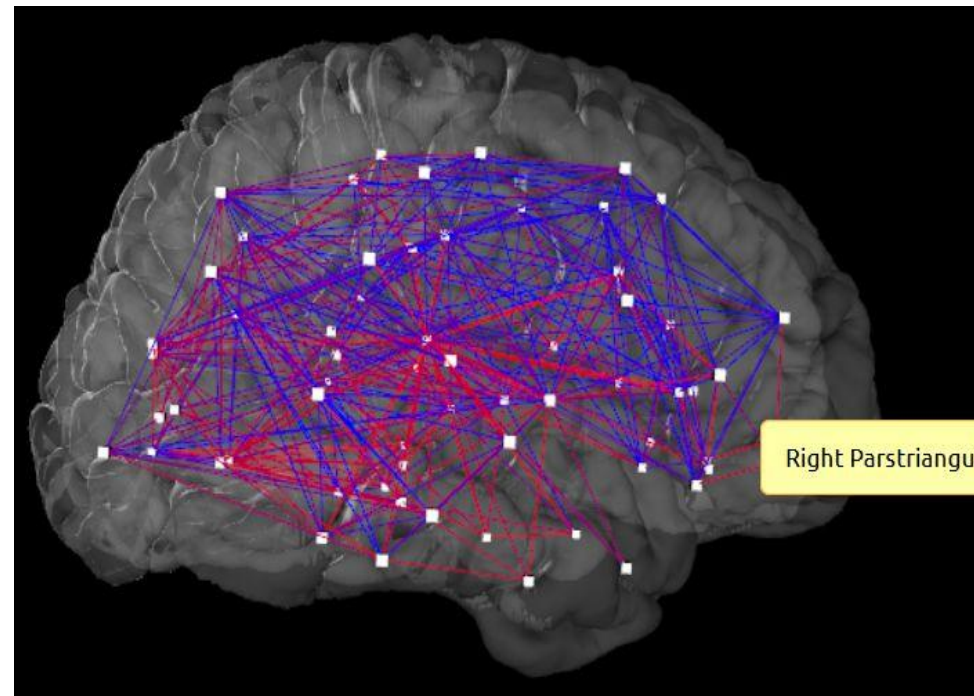
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Computing a macro-scale connectome

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Materials and Methods

- **Human Connectome Project**
- Healthy male and female subjects, age 22—35
- 96 subjects (52 females and 44 males)
- 83, 129, 234, 463 and 1015-node resolutions
- 5 different weight functions
- **Mathematical analysis**

What we know about brain and gender

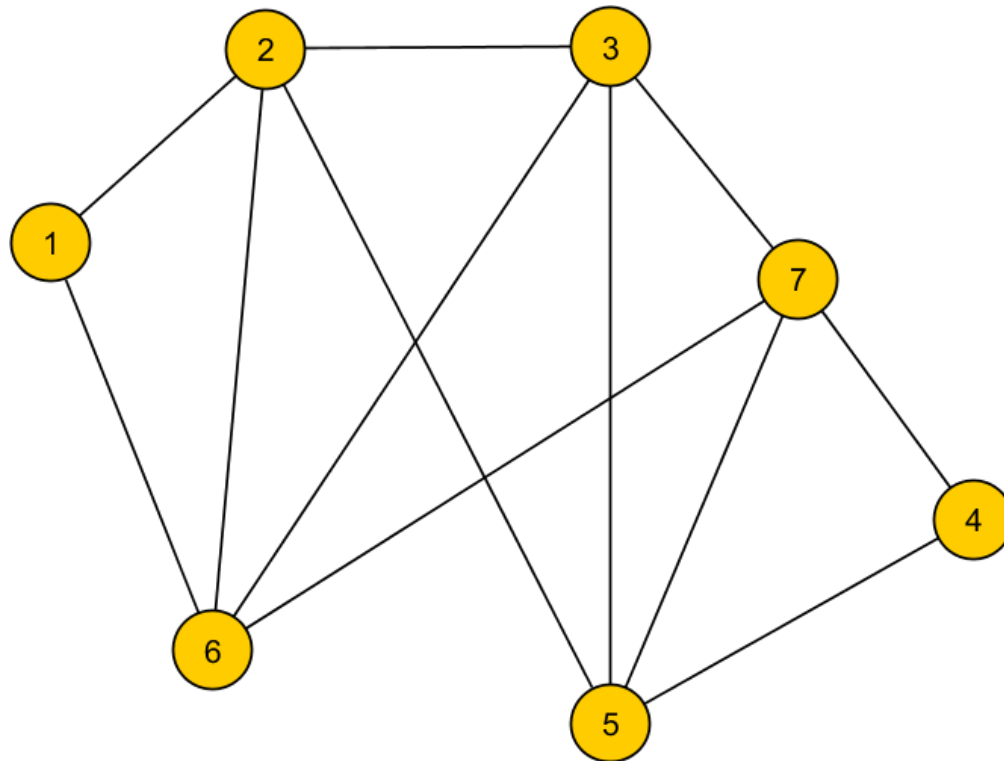
- Females have...
 - **smaller brains**
 - **larger gray/white** ratio
 - **larger cortical thickness** and **cortical complexity**
- **Hippocampus** and **amygdala**
- **Homosexuality** and brain characteristics of the opposite sex

Our results

- **Women's brains...**

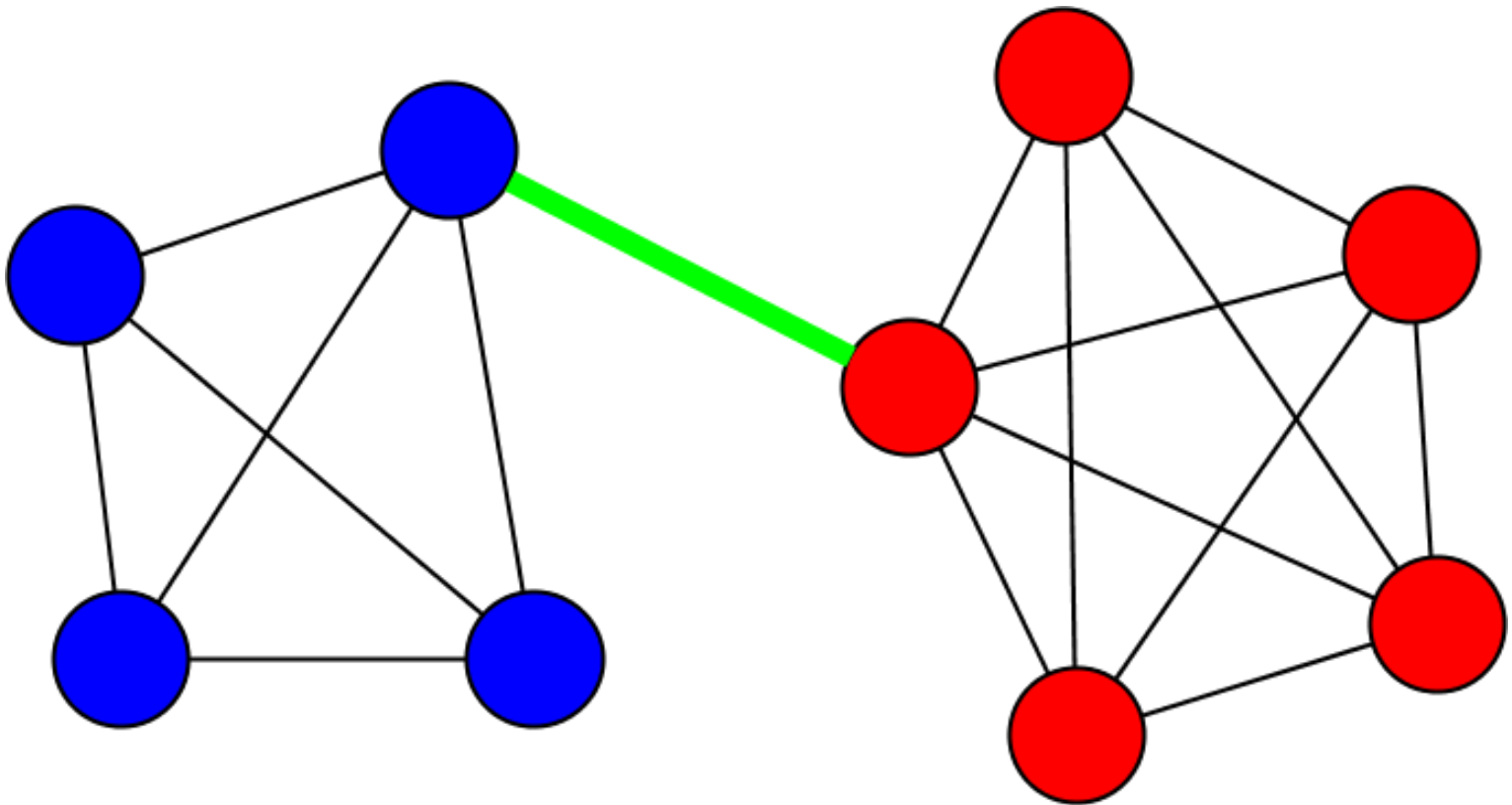
- ...have **more edges** on general

- Denser network



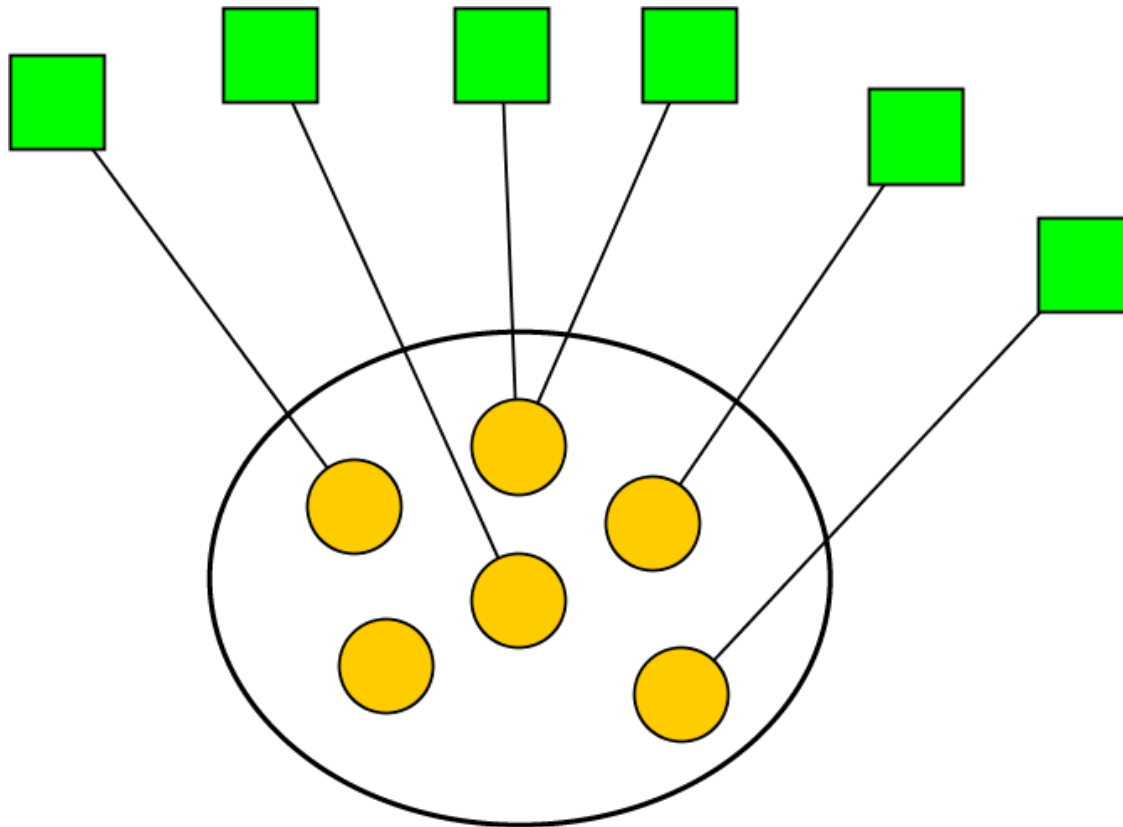
Our results

- ...have a larger **minimum bisection width**
 - ▣ More interhemispheric connections



Our results

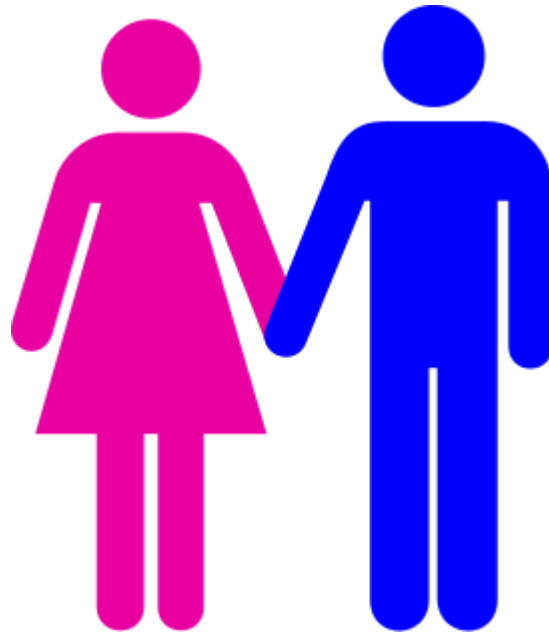
- ...are better **expander graphs**
 - ▣ Node groups have more neighbors



Conclusion

- First application of graph theory on brain graphs
 - ▣ (as opposed to network science)
- Women's brain graphs: denser and more effective graphs
- **Not** explained solely by the physical size of the brain

Thank you for your attention!



Szalkai B, Varga B, Grolmusz V (2015) **Graph Theoretical Analysis Reveals: Women's Brains Are Better Connected than Men's.** *PLoS ONE* 10(7): e0130045.doi: 10.1371/journal.pone.0130045