



# Developmental Changes and Gender Differences in Structural Brain Networks of Children using Surface Area and Cortical Thickness

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## Introduction

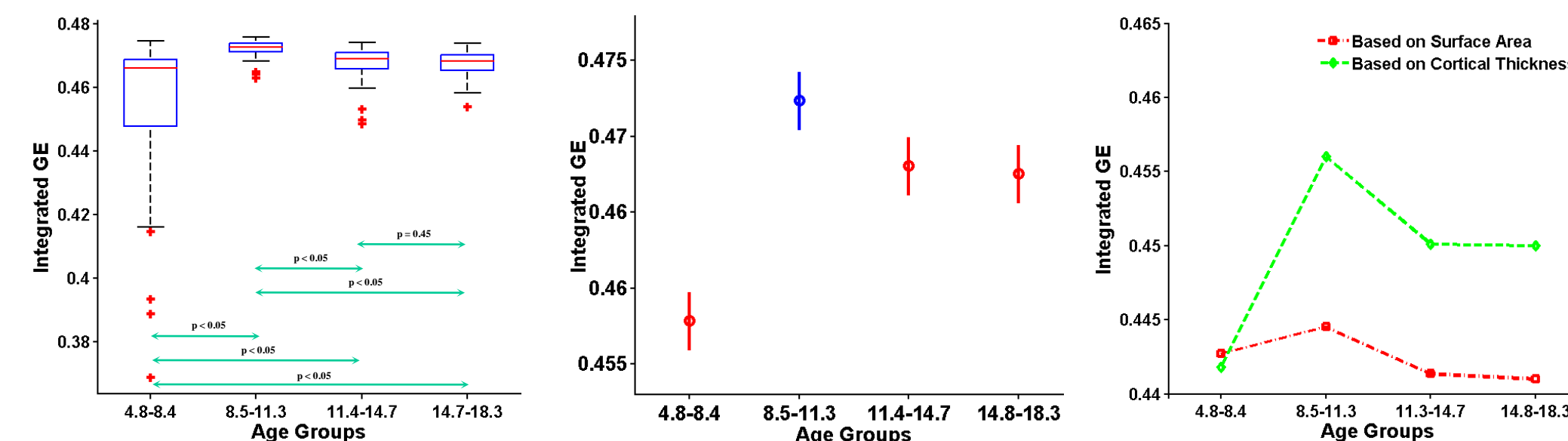
- Human brain changes dramatically in terms of structural and functional connections with development [1]
- Brain imaging studies have shown developmental changes in grey matter and white matter from childhood to adolescence [2,3]
- However, detailed studies investigating developmental changes using large-scale brain networks are few
- Graph theoretic tools can be used to look at large-scale structural brain networks and developmental changes and gender differences can be inferred [4]

## Materials and Methods

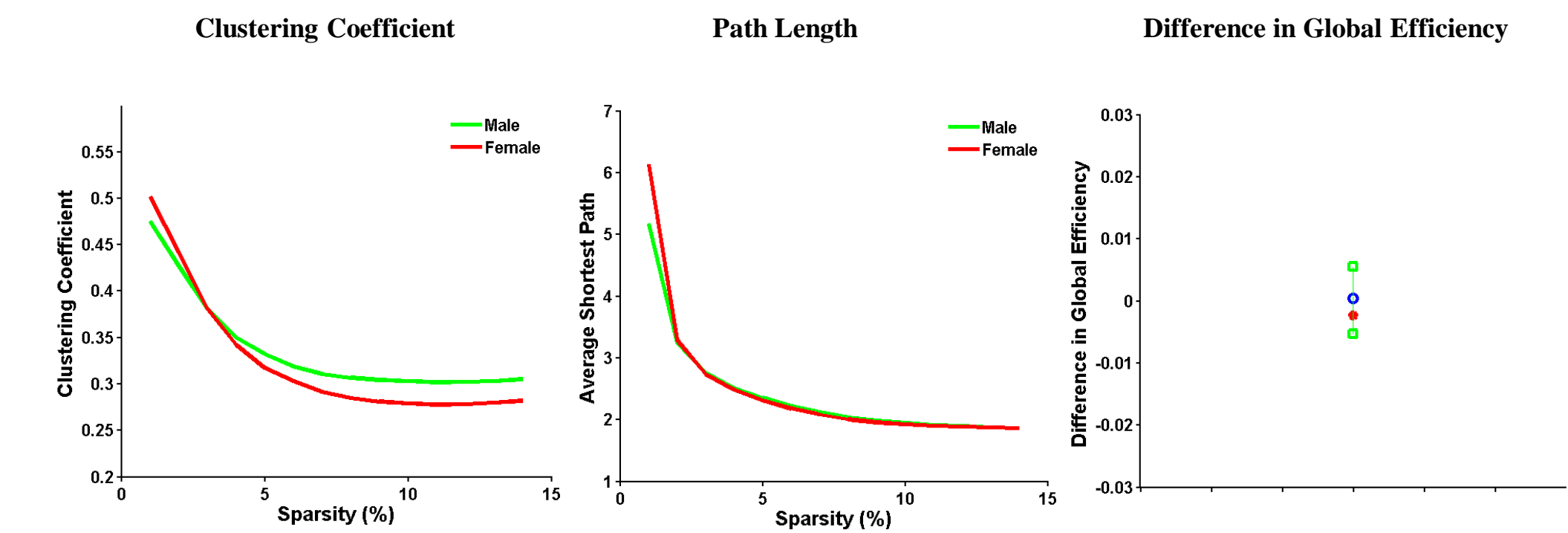
- We use brain scans of 203 normally growing children (age: 4.8 to 18.3 years, males/females: 92/111) from the NIH MRI study of normal brain development [5]
- For developmental changes: 4 groups
  - Group-I (Early Childhood): n = 51, age = 4.8-8.4 years
  - Group-II (Late Childhood): n = 51, age = 8.5-11.3 years
  - Group-III (Early Adolescence): n = 51, age = 11.4-14.7 years
  - Group-IV (Late Adolescence): n = 51, age = 14.8-18.3 years
- For gender differences: 2 groups
  - Group-A (Males): n = 99
  - Group-B (Females): n = 111
- Graph theoretic tools are applied to connection matrices (computed with 1168 ROIs) for the age groups and the gender groups

## Results

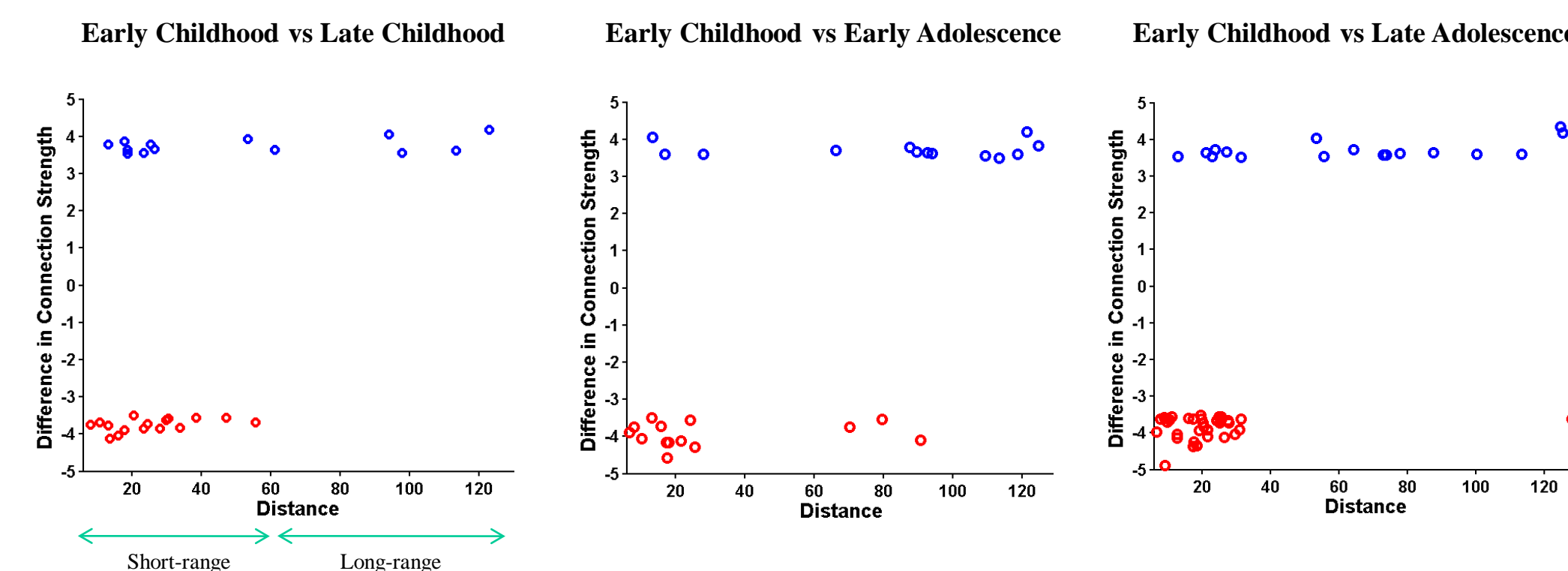
### Significant differences in integrated global efficiency with development (500 Bootstrap samples)



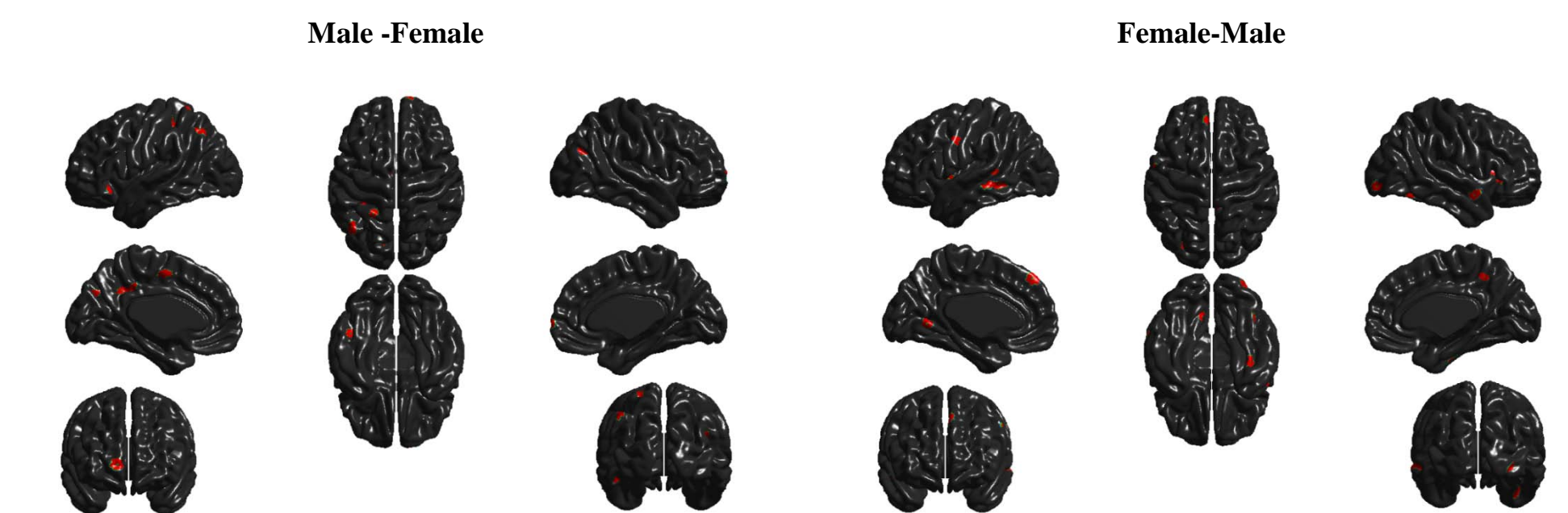
### Gender differences in terms of global topological properties



### Local to distributed reorganization with development



### Gender differences in terms of local topological properties



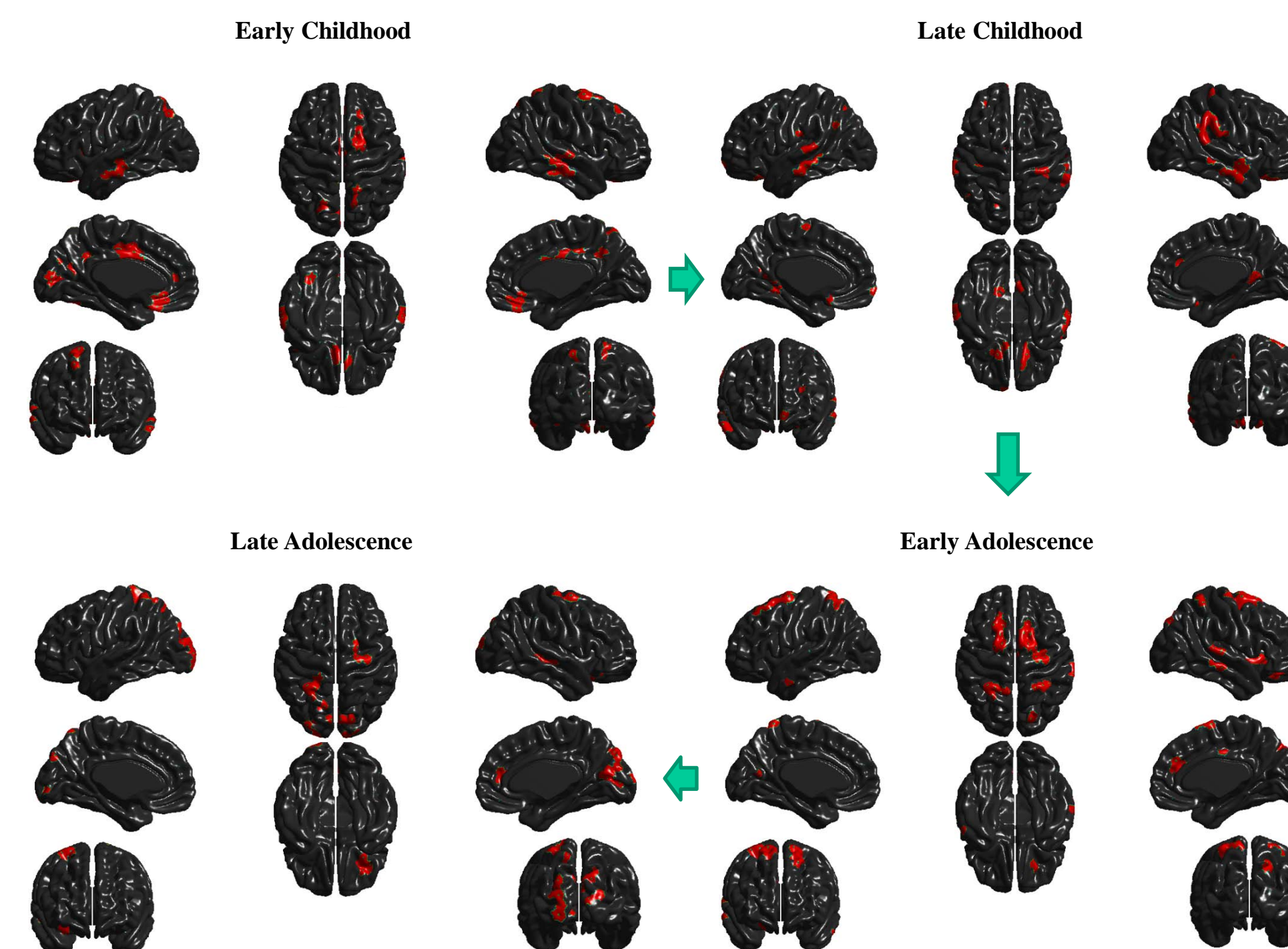
## Conclusion

- There is a significant increase in global efficiency from early childhood to late childhood ( $p < 0.05$ ) which decreases significantly from late childhood to older age groups ( $p < 0.05$ ) but there is no significant change in global efficiency between early and late adolescence ( $p = 0.45$ ).
- There is a local to distributed reorganization in connections with development.
- The cortical hubs are localized in cingulate and temporal regions in the early and late childhood while in adolescence, they are localized to frontal and association areas in parietal regions.
- There is no significant difference in efficiency of male and female brains, but the cortical hubs are situated in insula, right precuneus and right superior occipital gyrus in females and inferior frontal gyrus in males.

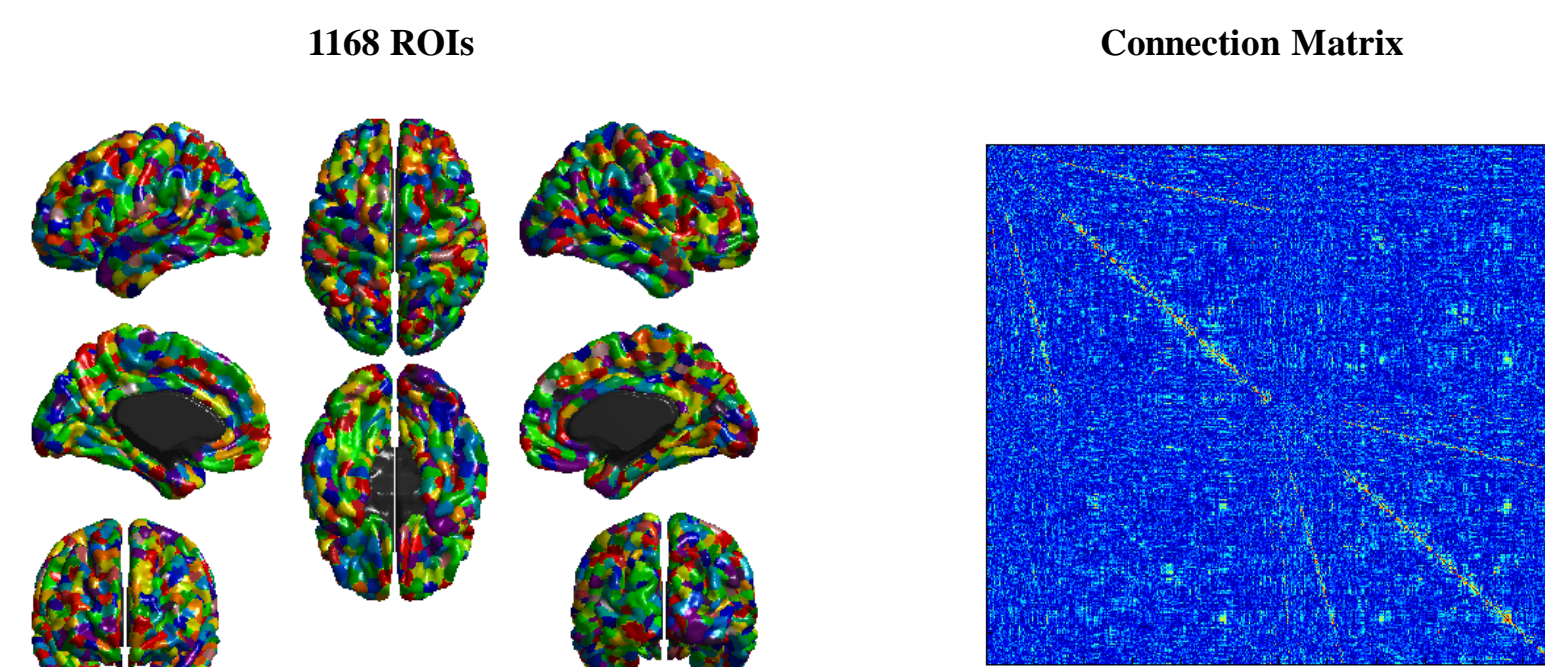
## References

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- Shaw P, *et al.* Journal of Neuroscience, 28(14), 2008.
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### Regional topological changes with development



### Creation of connection matrix



### Global topological changes with development

