

# Model-based comparison of connectomes: applications in a whole insect brain

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## Acknowledgements



Mike  
Powell



Eric  
Bridgeford



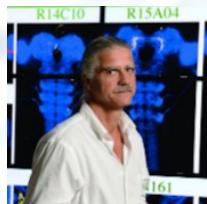
Michael  
Winding



Marta  
Zlatic



Albert  
Cardona

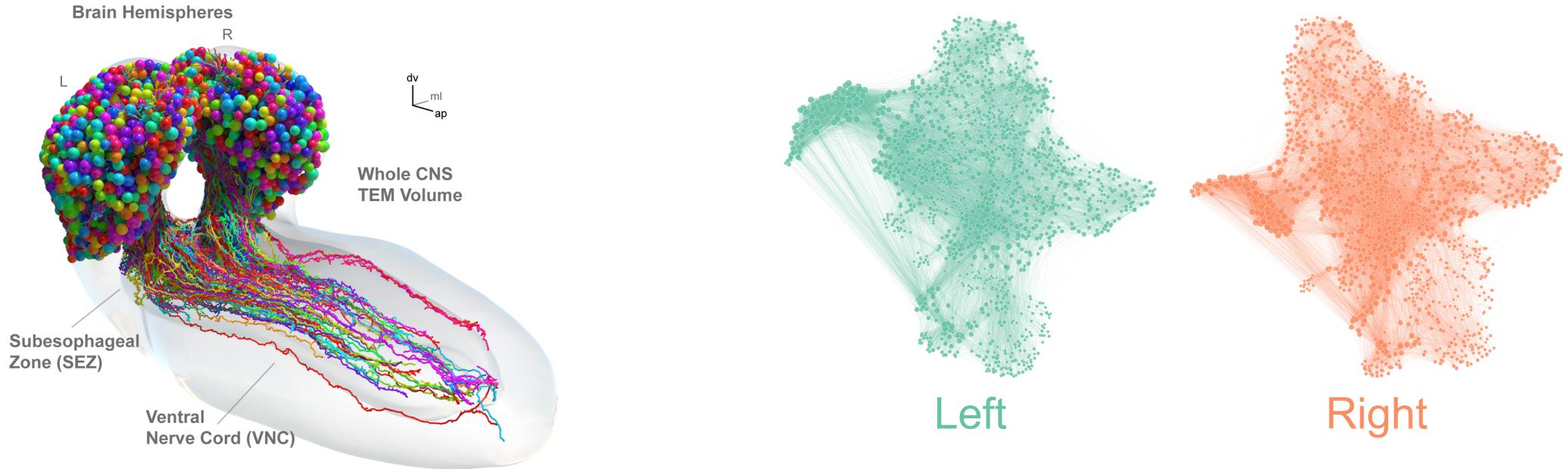


Carey  
Priebe



Joshua  
Vogelstein

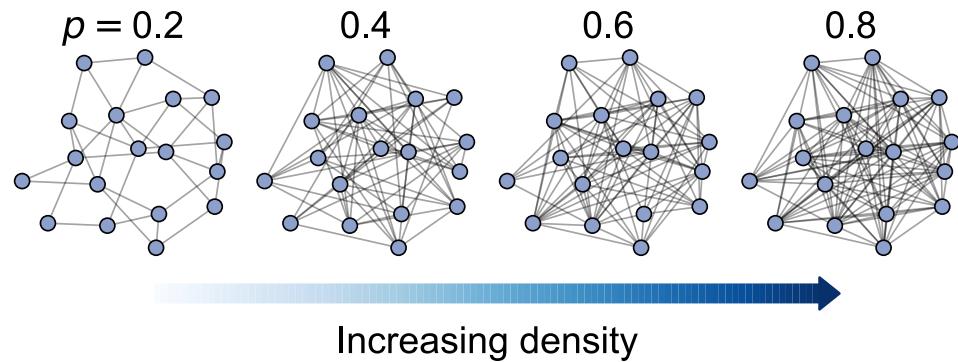
# *Drosophila* larva brain connectome



Are the **left** and **right** sides of this connectome  
*different?*

# We reject even the simplest notion of symmetry

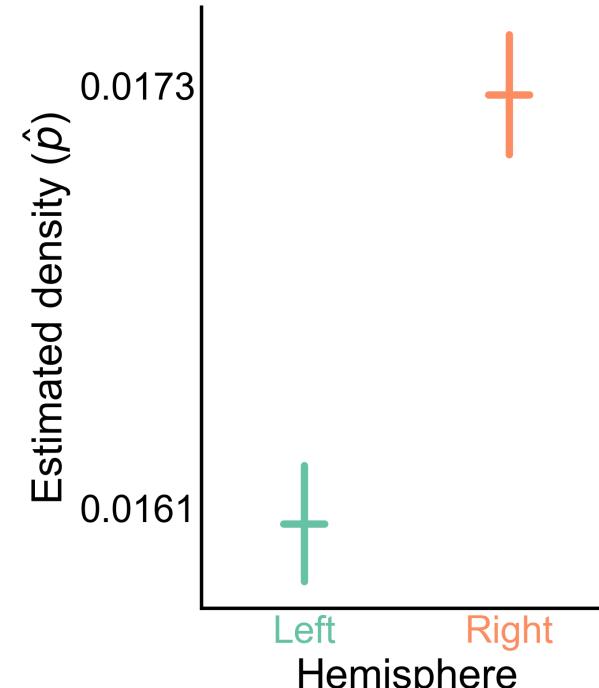
- Fit Erdos-Renyi models to the left and the right brain networks



- Compare densities:

$$H_0 : p^{(L)} = p^{(R)}$$

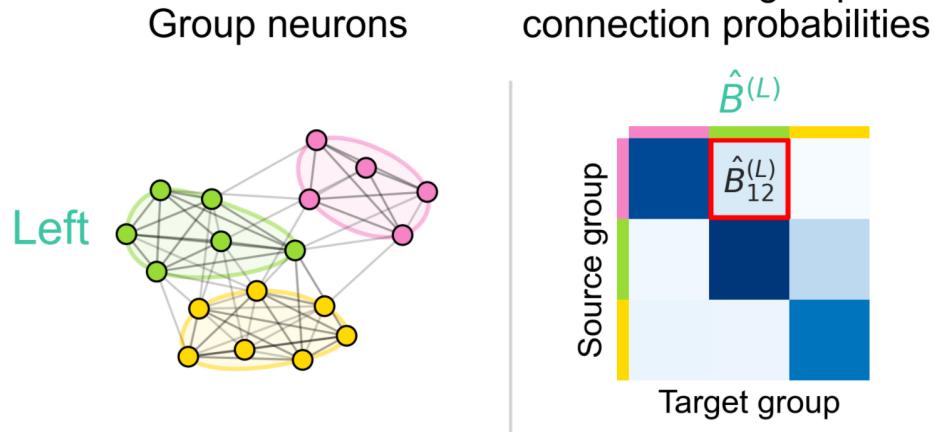
$$H_A : p^{(L)} \neq p^{(R)}$$



p-value:  $< 10^{-23}$

# Localizing differences to cell type connections

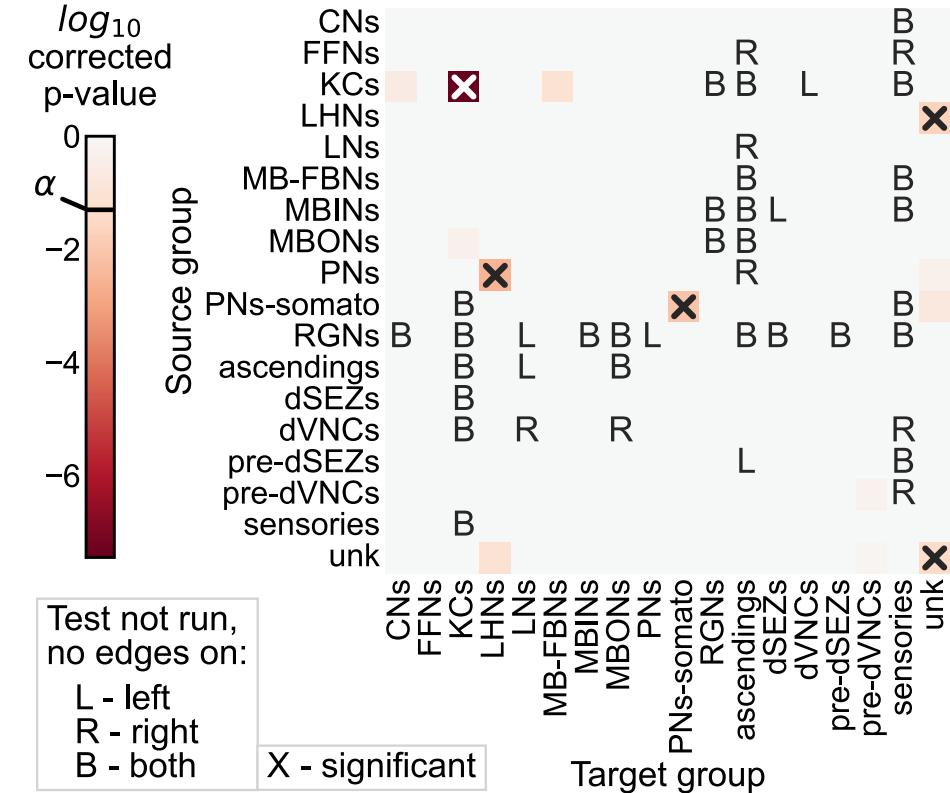
- Fit block models to both hemispheres



- Compare group connection probabilities:

$$H_0 : \hat{B}^{(L)} = \hat{B}^{(R)}$$

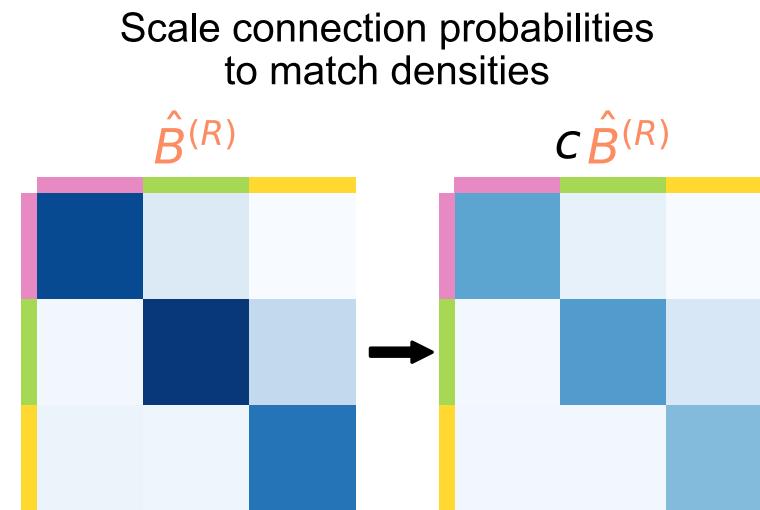
$$H_A : \hat{B}^{(L)} \neq \hat{B}^{(R)}$$



p-value:  $<10^{-7}$

# Modified definitions of symmetry which ARE exhibited

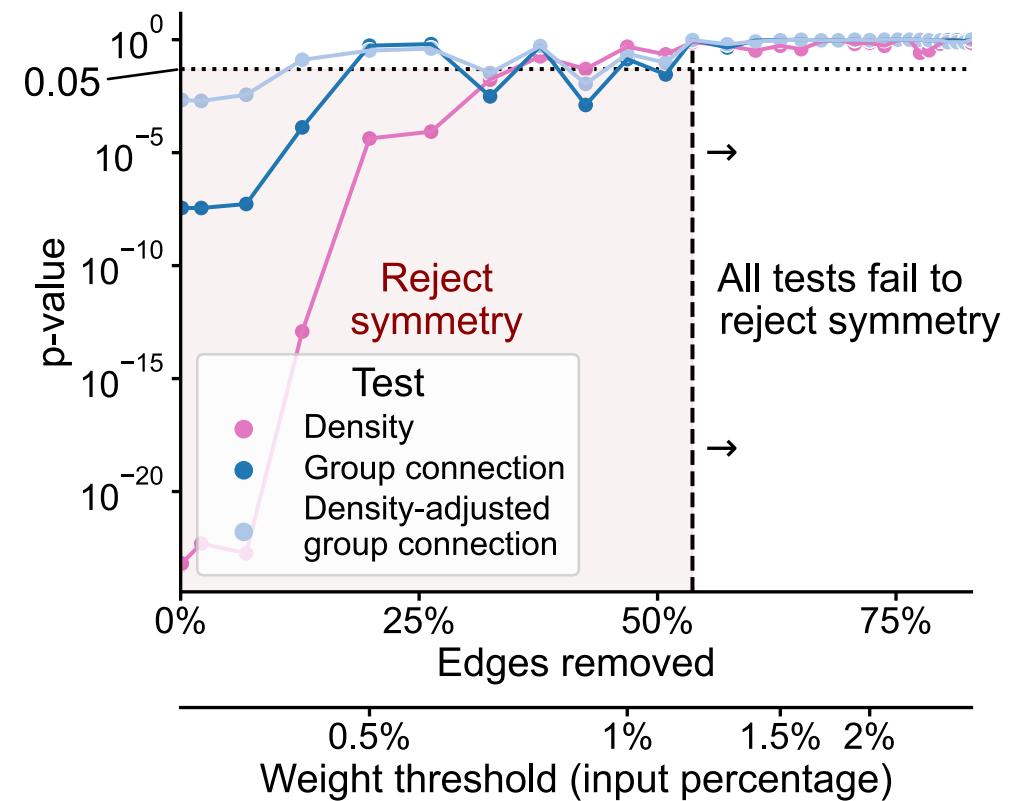
Rescaled connection probabilities AND removed Kenyon cells



$$\begin{aligned} H_0: & B^{(L)} = cB^{(R)} \\ H_A: & B^{(L)} \neq cB^{(R)} \end{aligned}$$

p-value: ~0.51

Used only high weight edges (by input proportion)



# Conclusions

- Testing hypotheses in connectomics requires specialized techniques for networks
  - We presented 2-sample testing procedures for comparing connectomes
  -  **Graspologic** downloads 121k
  - This work: [github.com/neurodata/bilateral-connectome](https://github.com/neurodata/bilateral-connectome)  **jupyter**  **book**
- We applied these tools to evaluate bilateral symmetry as a case study, finding several ways in which this brain is/is not bilaterally symmetric
- Poised to apply to new datasets to answer...
  - **{Your question here}**
  - Get in touch:  [bpedigo@jhu.edu](mailto:bpedigo@jhu.edu)  [jovo@jhu.edu](mailto:jovo@jhu.edu)