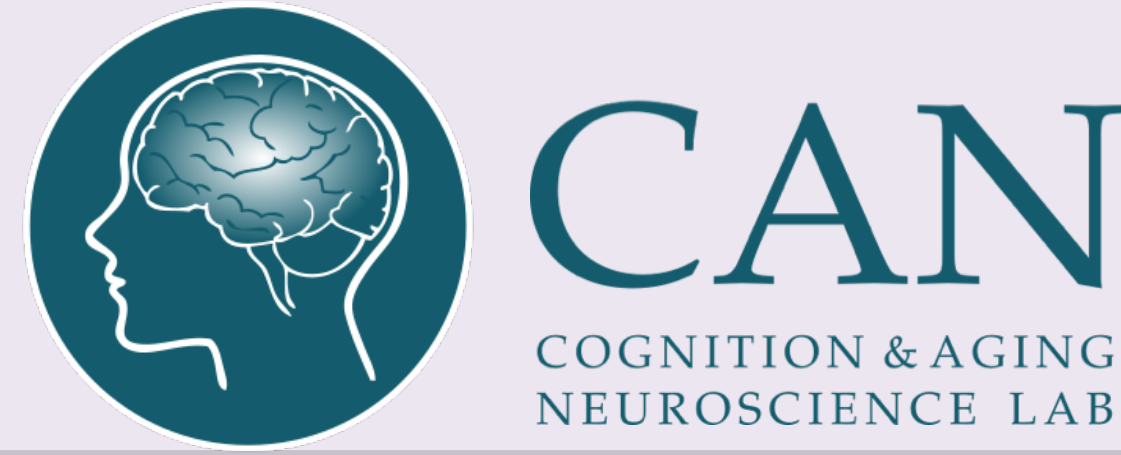


Caesarean-section birth is associated with atypical intrinsic functional connectivity of visual regions in adulthood



Lily M. Solomon-Harris, Scott A. Adler, & W. Dale Stevens

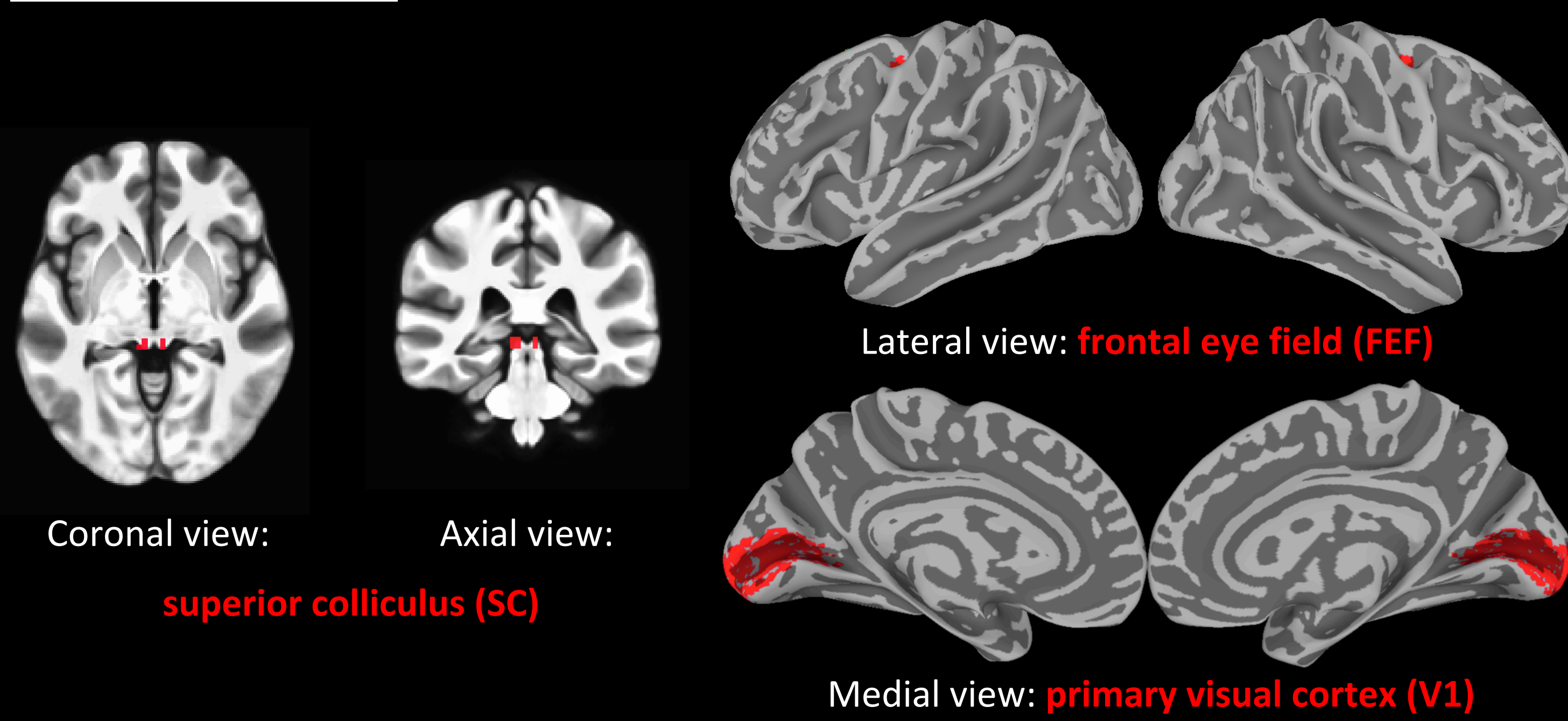
Department of Psychology & Centre for Vision Research, York University, Toronto, Ontario, Canada



BACKGROUND

- Rate of caesarean-section (C-section) births has been steadily increasing worldwide since the 1990s
- Many studies show that a range of early birth factors affect cognitive development, but relatively few examine effects of delivery method
- Rat pups born via C-section may show differences in barrel cortex¹
- Human infants born via C-section show impaired stimulus-driven reflexive visual attention with eye-tracking at 3-months of age²
- This stimulus-driven (i.e., bottom-up) reflexive visual attention deficit persists into adulthood³
- **Aim: Determine if visual deficits might be related to altered intrinsic functional network architecture of visual regions in the brain**

Seed Regions: bilateral V1, SC, & FEF

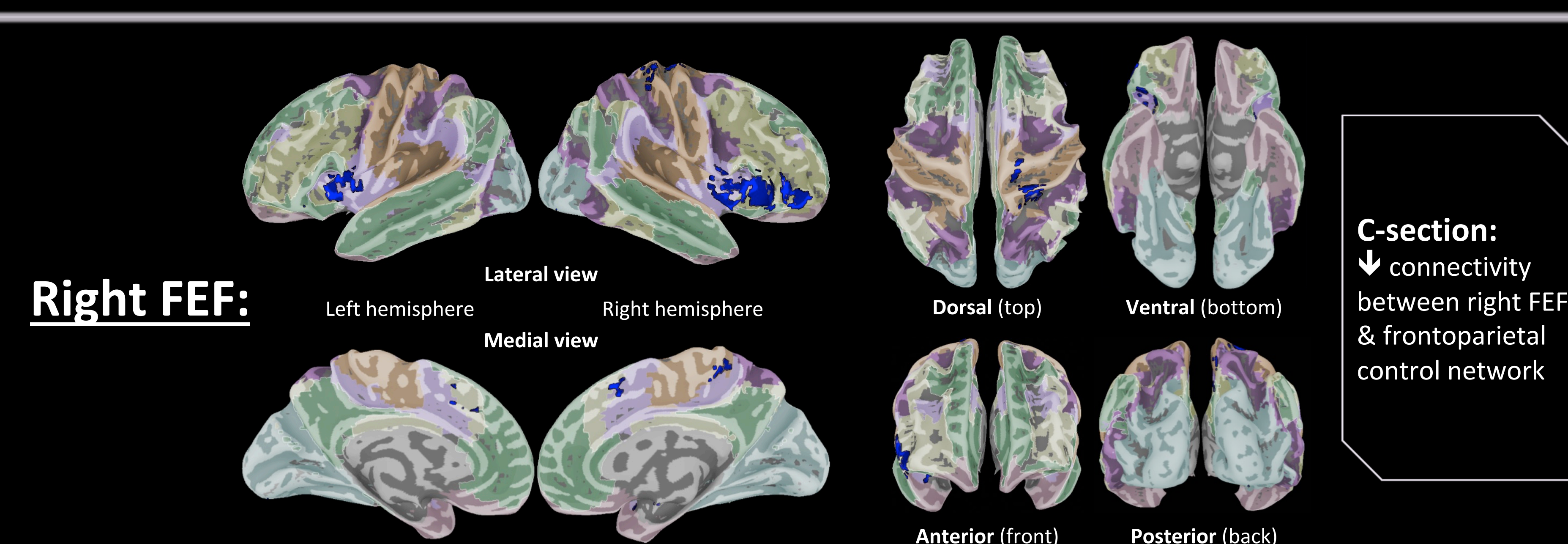
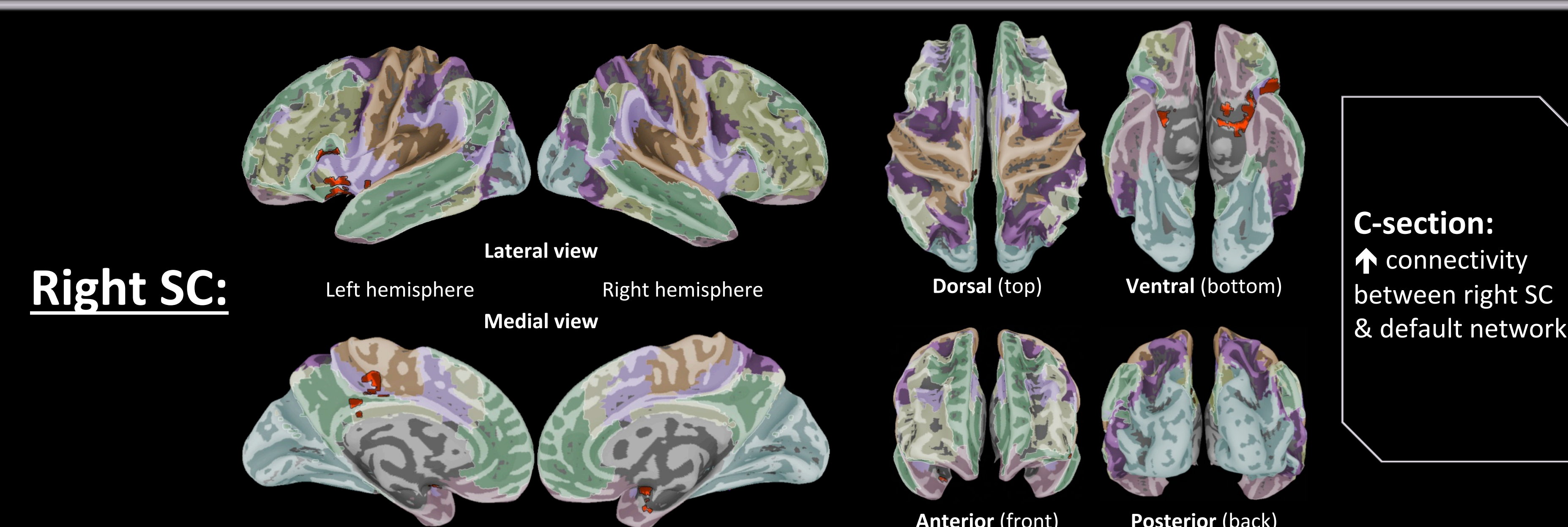
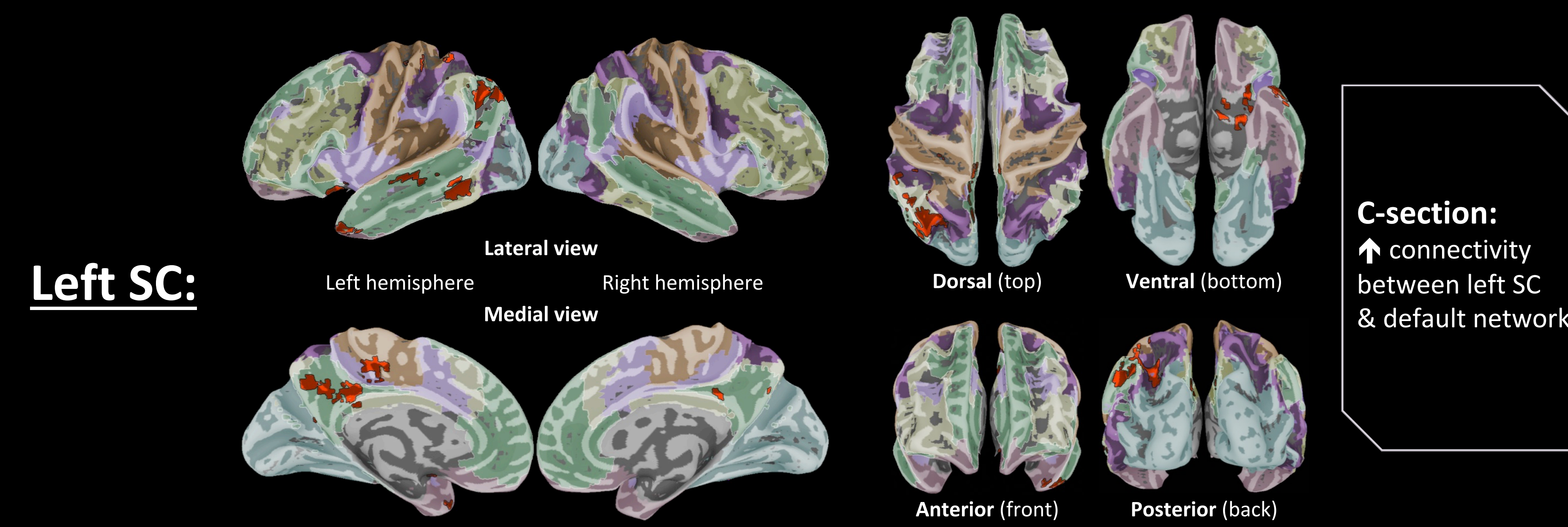
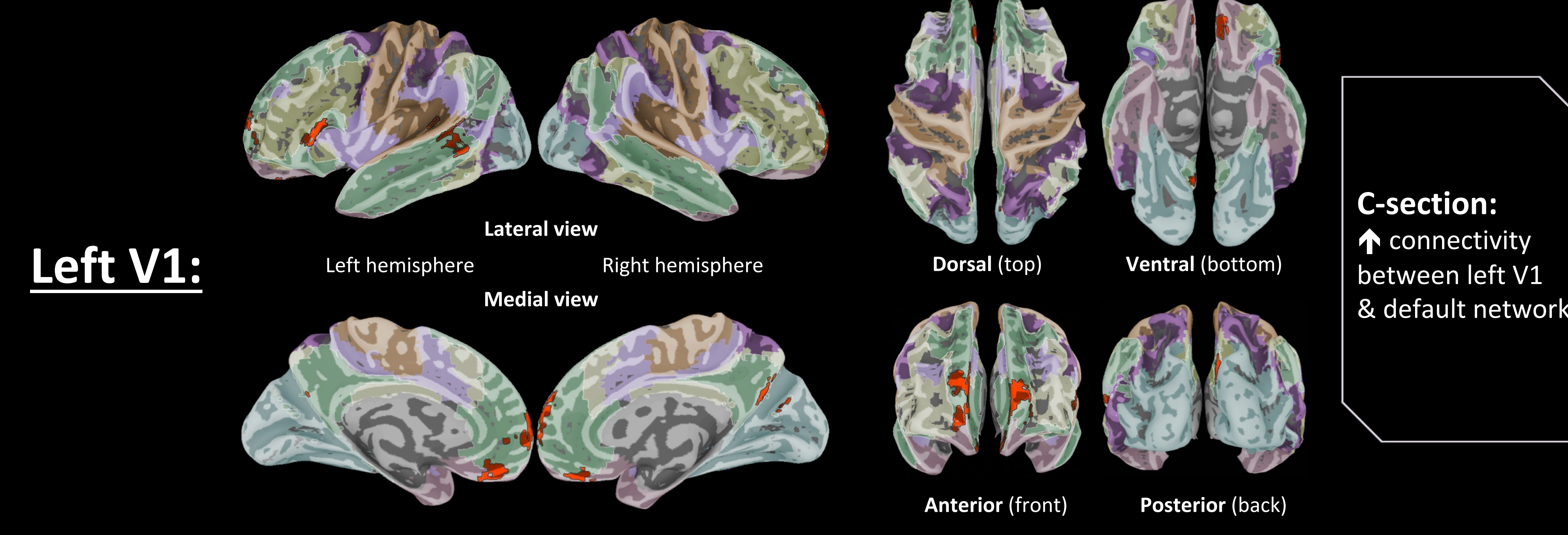


METHODS

- Multi-echo resting-state fMRI
- 81 right-handed young adults:
 - 20 C-section (11 female, 22.8 ± 3 yrs) & 61 vaginally delivered (41 female, 23.1 ± 4 yrs)
- MEICA preprocessing to remove non-BOLD signal noise components (e.g. motion)
- Transformed to standard space (MNI) and compared at the group level
- **Seed regions of interest (ROIs):**
 - V1 → analogous to rat barrel cortex (ROI from Freesurfer cortical segmentation)
 - SC → bottom-up attention (r = 3mm sphere around peak literature coordinates⁴)
 - FEF → top-down attention (r = 6mm sphere around peak literature coordinates⁵)
- Mean residual denoised timeseries extracted from each ROI for each participant and its whole-brain connectivity was compared across groups (AFNI: 3dttest++)
- Voxelwise threshold of $p < .001$ and cluster threshold of $p < .05$ (-Clustsim)

Differences in Intrinsic Functional Connectivity with Seed Regions

[C-section – vaginal delivery]

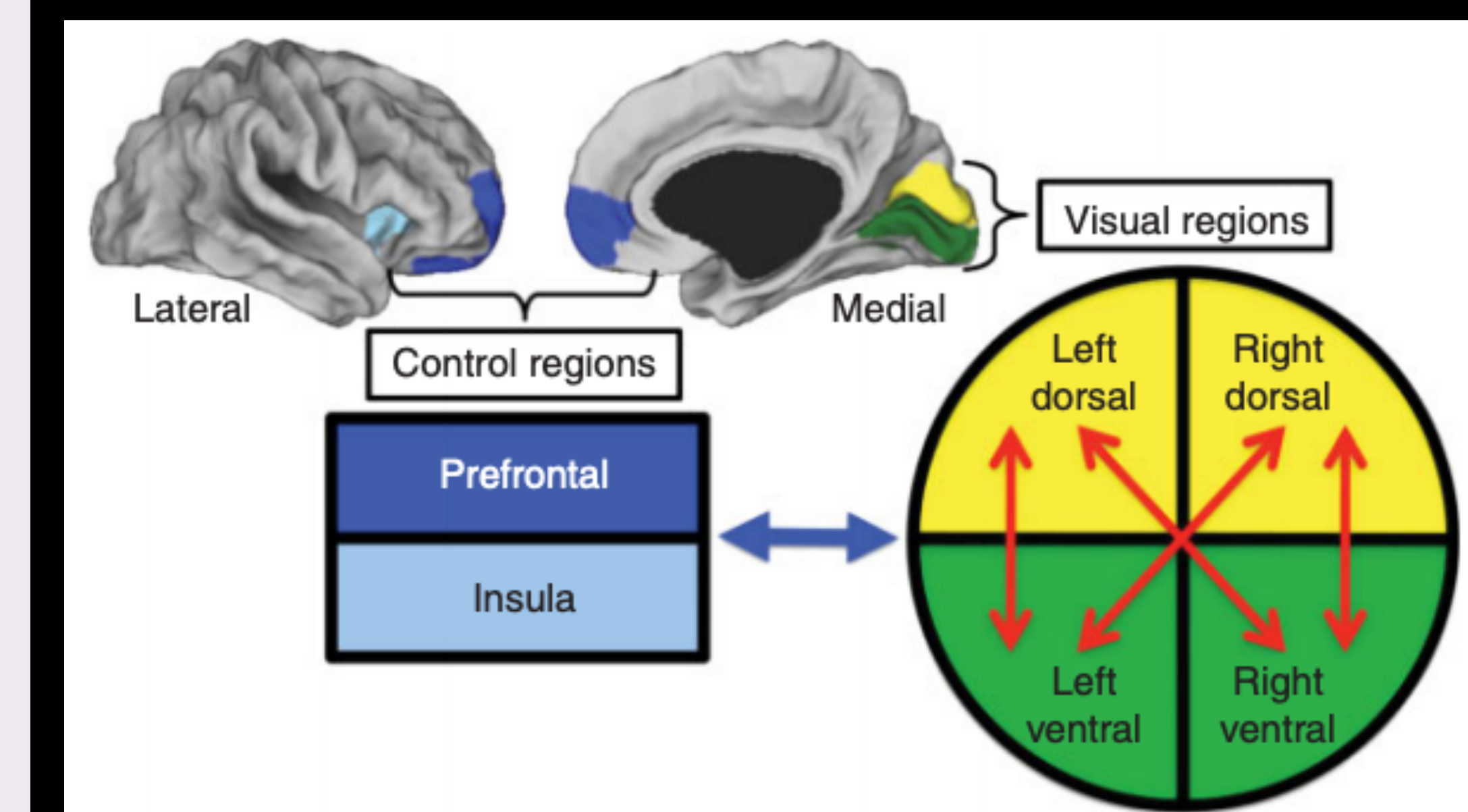


7-Network⁶ Legend:

1. Visual 2. Somatomotor 3. Dorsal Attention 4. Ventral Attention 5. Limbic 6. Frontoparietal 7. Default

SUMMARY & CONCLUSIONS

- **C-section group:**
 - Left V1 more connected with default network
 - Bilateral SC more connected with default network
 - Right FEF less connected with frontoparietal control network
- Previous work shows that stronger connectivity between V1 and the default network predicts worse performance on visual search tasks^{6,7}
- Stronger connectivity between default network and both the left V1 and bilateral SC could be related to bottom-up visual attention deficits^{2,3}
- No connectivity differences between the FEF and default network regions, and no top-down visual attention deficits previously reported^{2,3}
- Cognitive/perceptual deficits resulting from C-section birth have profound implications, given the rising prevalence of this procedure



↑ connectivity between V1 & default network predicts worse performance on visual search tasks in healthy young adults^{6,7}

REFERENCES

1. Toda et al. (2013). *Developmental Cell*, 27(1), 32-46.
2. Adler & Wong-Kee-You (2015). *Attention, Perception, & Psychophysics*, 77(8), 2529-39.
3. Adler, Comishen, & Wong-Key-You (2019). [Presentation]. 19th Annual Meeting of the Vision Sciences Society.
4. Arcaro, Pinsk, & Kastner (2015). *The Journal of Neuroscience*, 35(27), 9848-71.
5. Yeo et al. (2011). *Journal of Neurophysiology*, 106(3), 1125-65.
6. Baldassarre et al. (2012). *Proceedings of the National Academy of Sciences of the USA*, 109(9), 3516-21
7. Martin, Barnes, & Stevens (2012). *Proceedings of the National Academy of Sciences of the USA*, 109(9), 3201-2
8. Spreng et al. (2018). *Neuropsychologia*, 110, 37-43.

ACKNOWLEDGEMENTS

- Vision: Science to Applications (VISTA) Program; Canada First Research Excellence Fund (CFREF; 2016-2023)
- Natural Sciences and Engineering Research Council of Canada (NSERC; grant awarded to Dr. W. Dale Stevens)
- The Hallward Fund of the Toronto Foundation (grant awarded to Dr. Scott A. Adler)
- Dataset generously provided by Drs. Gary R. Turner & R. Nathan Spreng⁸