



Uncovering common variants of cortical folding through hierarchical surface registration

Yourong Guo^{1,2}, Mohamed Suliman¹, Logan Williams^{1,2}, Matthew Glasser³, Jonathan O'Muircheartaigh^{2,4,5}, Emma Robinson^{1,2,5}

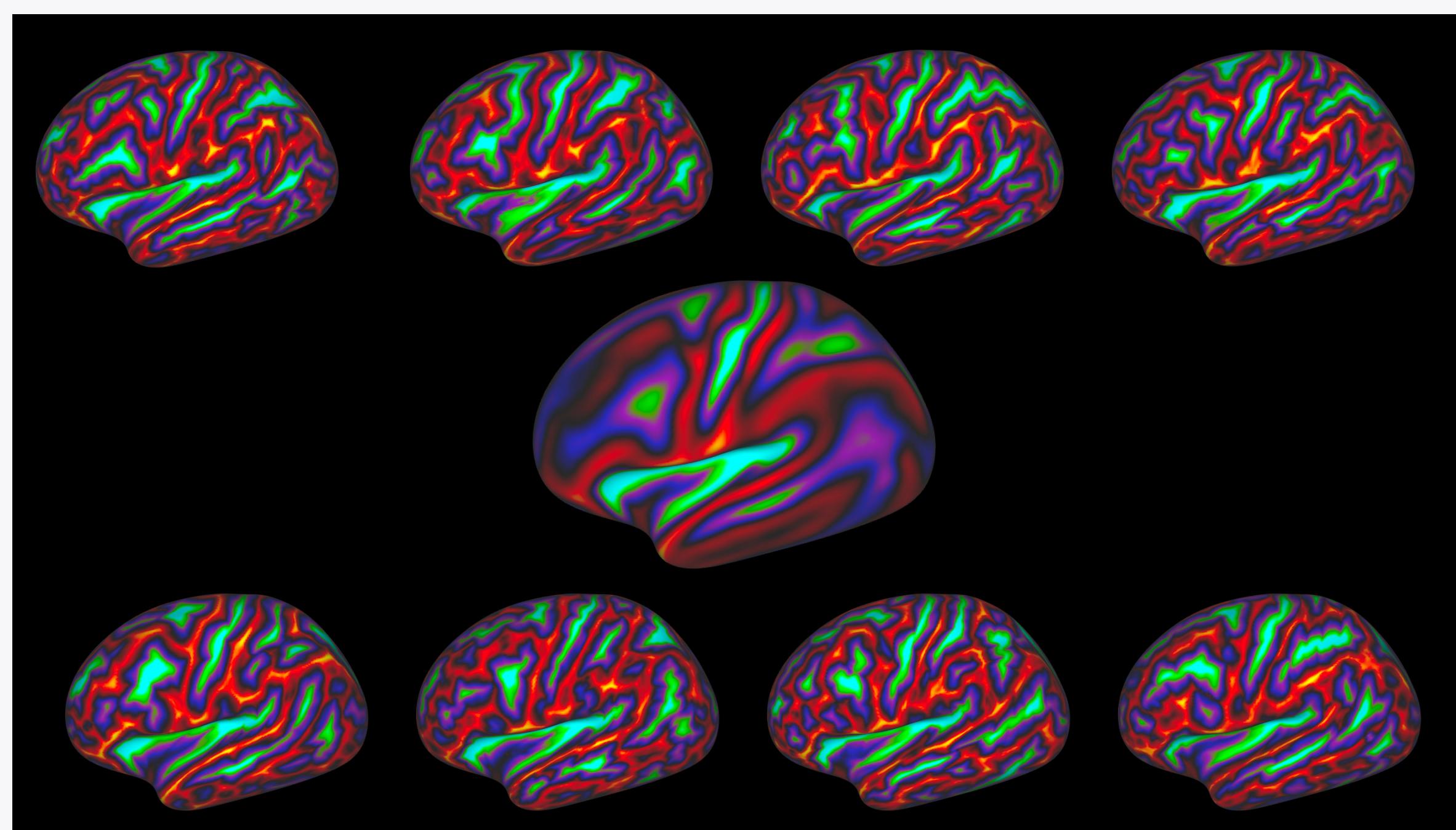
¹Department of Biomedical Engineering, King's College London, London, UK, ²Centre for the Developing Brain, King's College London, London, UK, ³Department of Radiology, Washington University, St. Louis, MO, USA, ⁴Forensic and Neurodevelopmental Sciences, King's College London, London, UK, ⁵MRC Centre for Neurodevelopmental Disorders, London, UK

1. Summary

- Common variants of cortical folding are uncovered through a hierarchical registration approach
- Improved alignment of cortical folds doesn't improve functional alignment

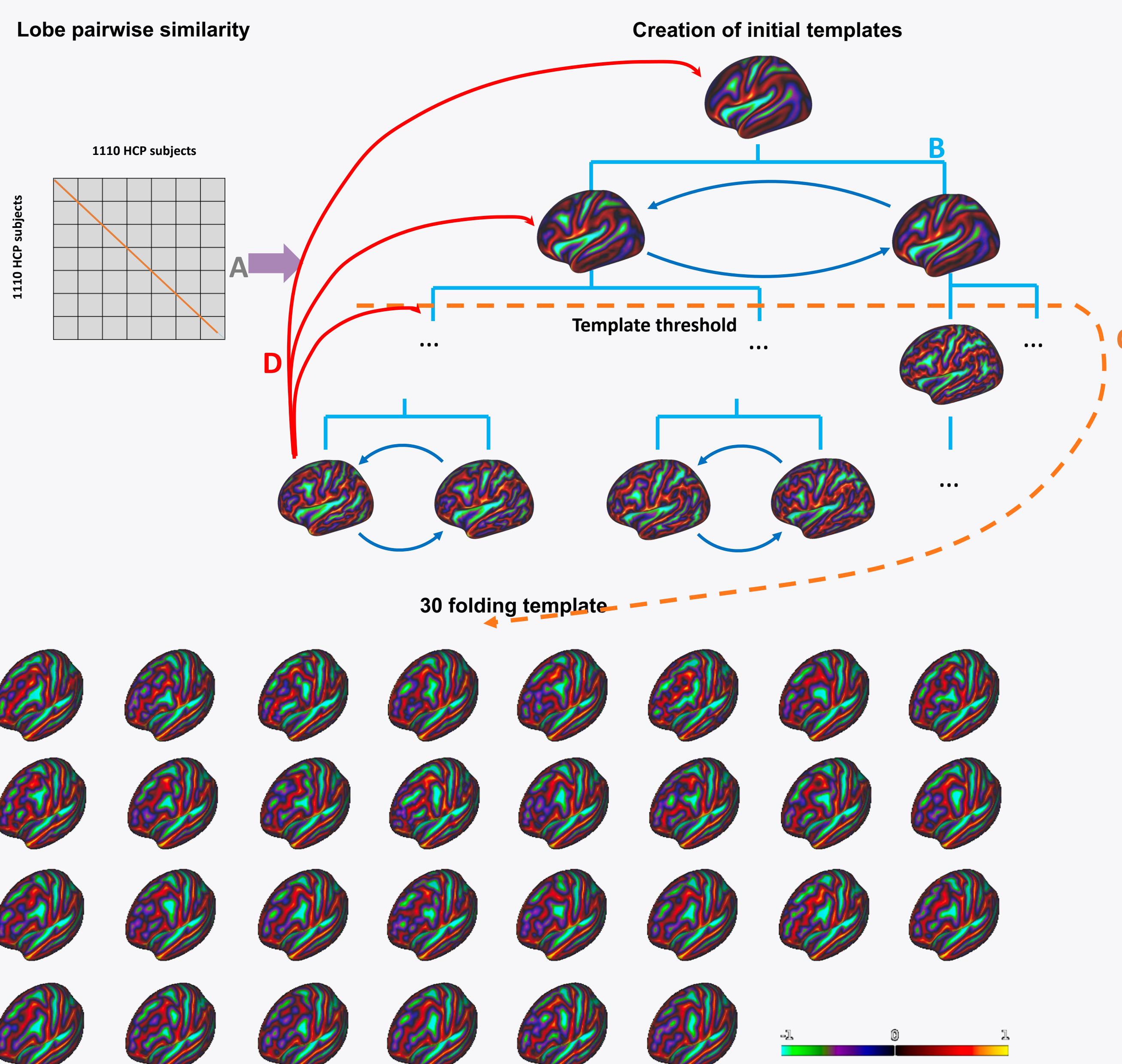
2. Motivation

- Cortical folding varies significantly across individuals.
- These variants cannot be brought into global alignment with a single population average reference using classical image registration techniques.



3. Method

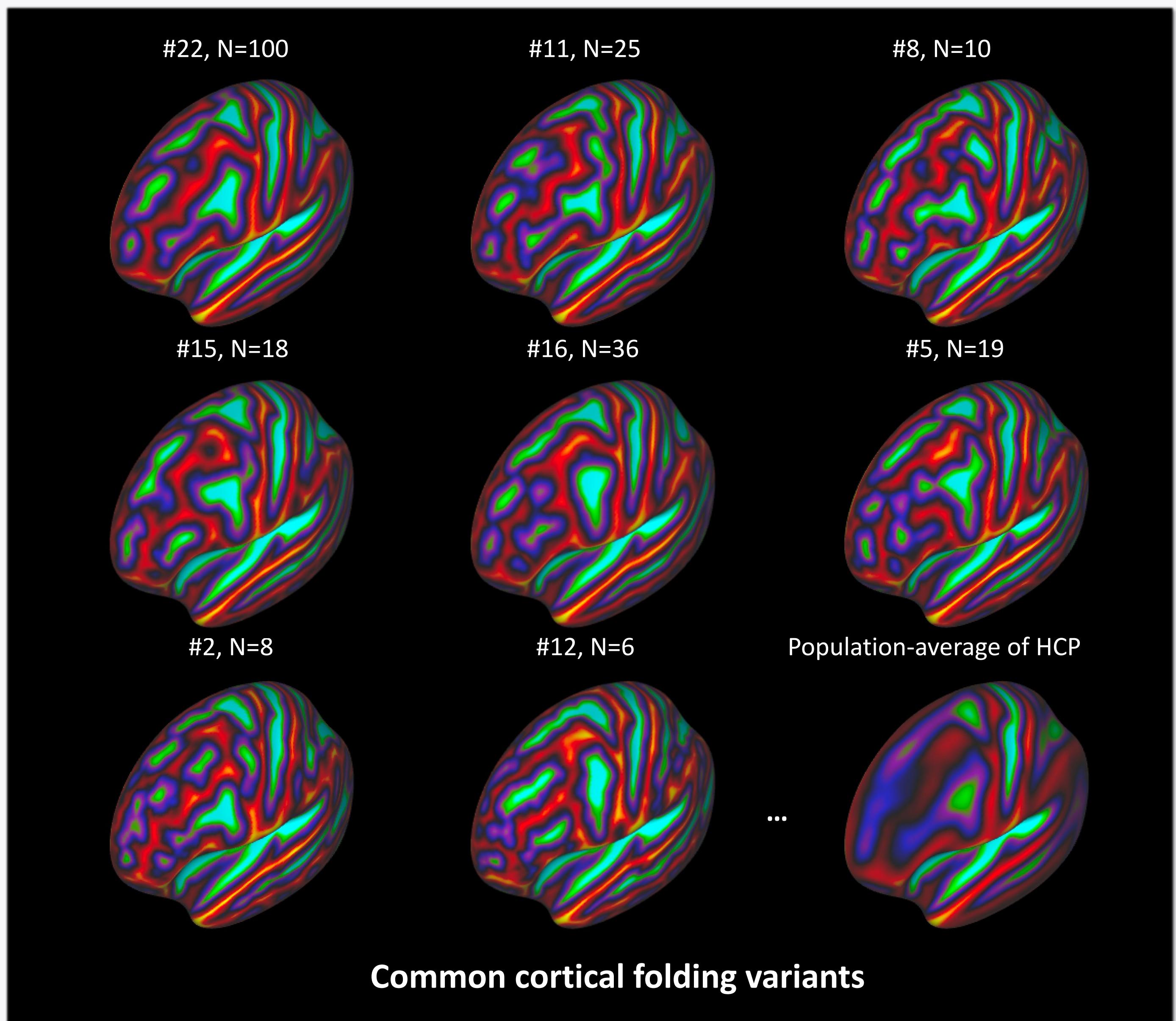
- A similarity matrix is created by co-registering pairs of images using a fast learning-based surface registration algorithm, then calculating overlap.
- Agglomerative hierarchical clustering is used to group subjects with similar cortical folding patterns.
- Images are co-registered within each cluster to generate a family of templates using Multimodal surface matching (MSM). These are then hierarchically aligned to a single global average reference space.



4. Result

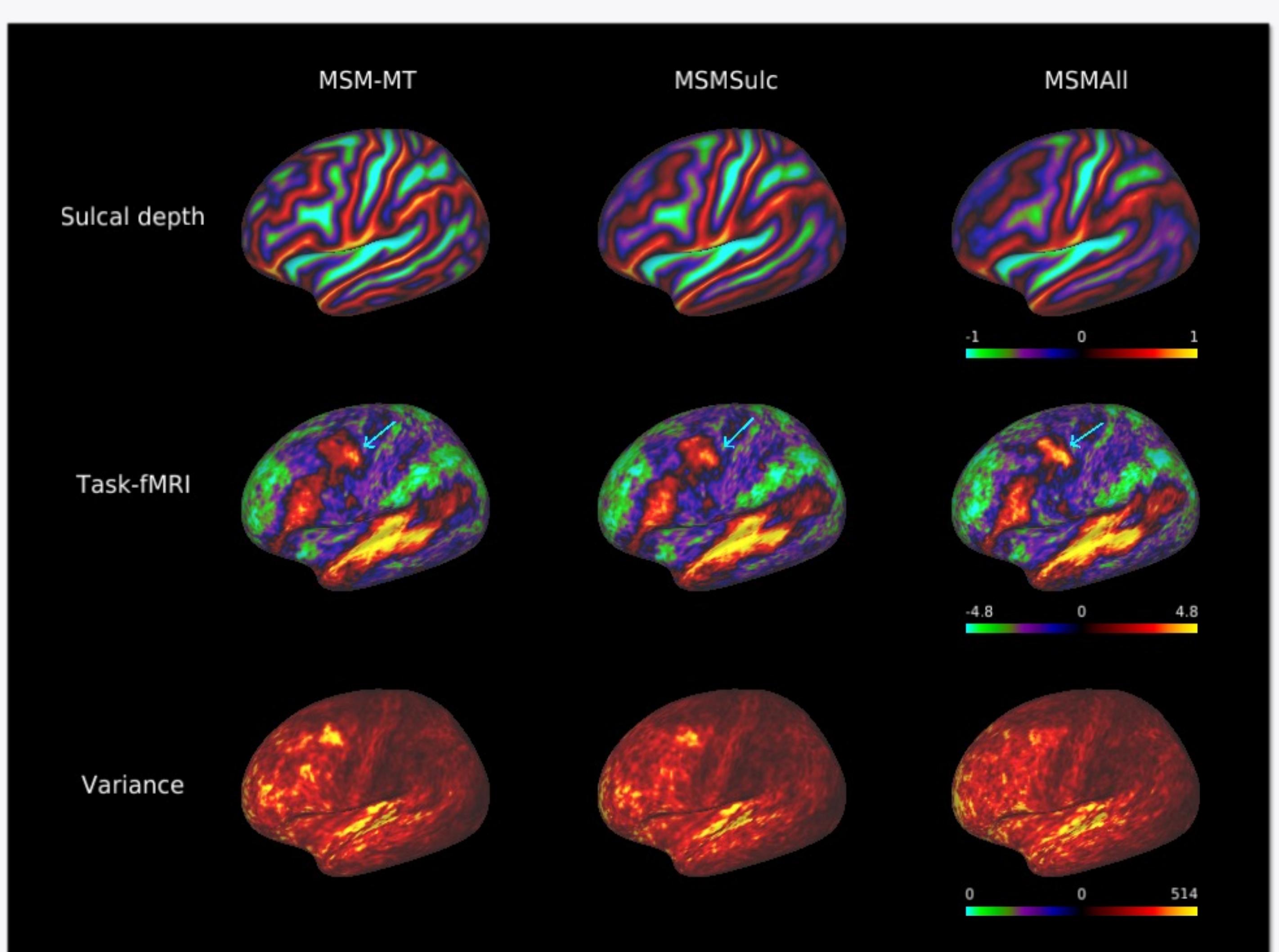
Cortical folding patterns

- 30 distinctive clusters were uncovered in the frontal lobe. These findings align with observational characterisation of common cortical folding variants [1-3]



Group-average tfMRI analysis

- Hierarchical registration can generate much sharper and detailed folding templates than registration to a single population average reference.
- For some areas improved folding alignment does not correspond to improved functional alignment.



5. References

- Ono, Michio. 1989. Atlas of the Cerebral Sulci.
- Juch, H. et al., Anatomical variability of the lateral frontal lobe surface: implication for intersubject variability in language neuroimaging.
- Petrides, M., & Pandya, D. N. Chapter 26 - The Frontal Cortex. In J. K. Mai & G. Paxinos (Eds.), The Human Nervous System (Third Edition)