# Geometric constraints on individual brain function: a deep learning approach

Gajwani M[a], Zendarski Z[a,b], Oldham S[a,c], Cao T[a], Harandi M[a,b], Pang JC[a], Fornito A[a]

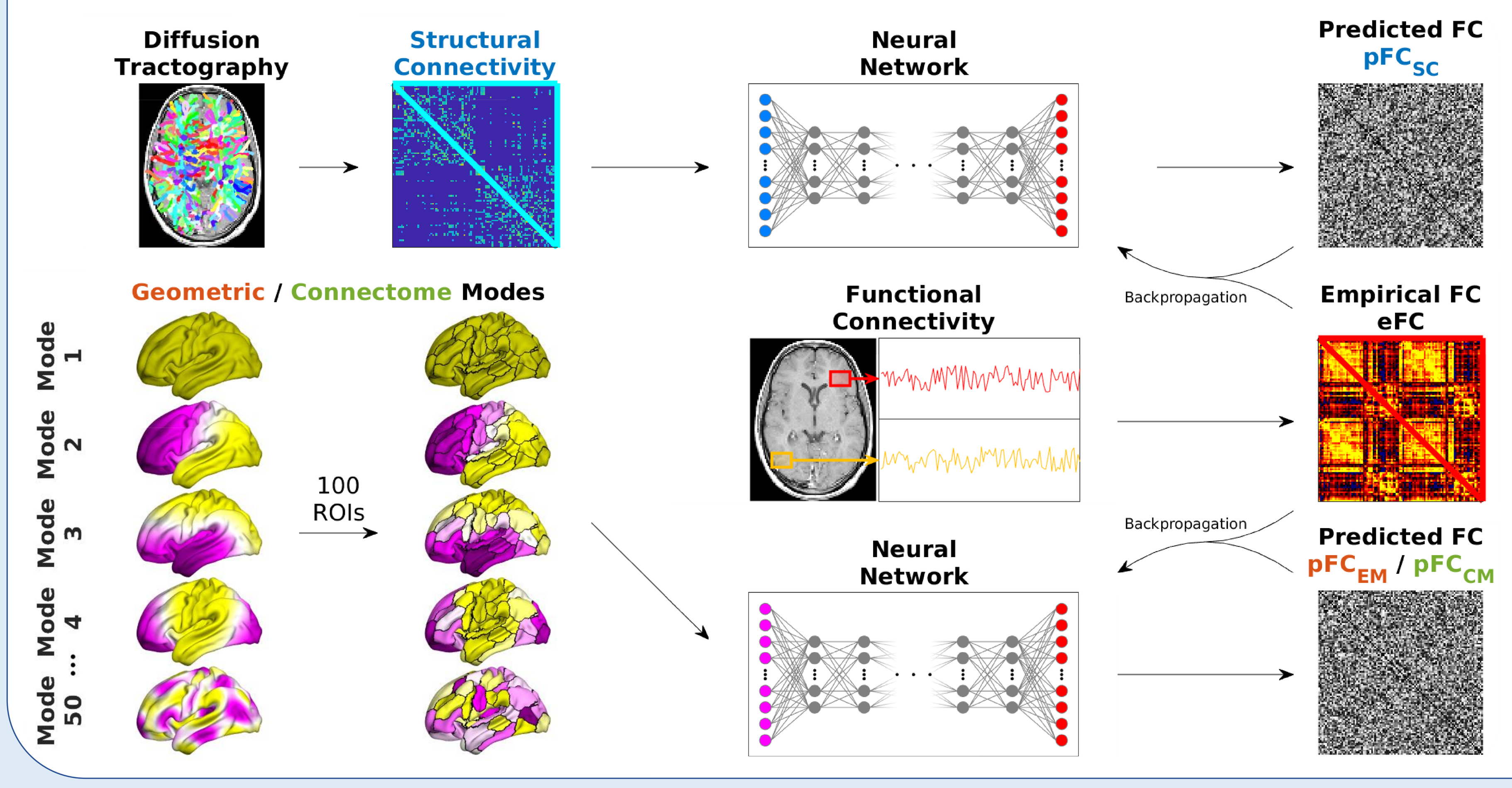
NSB Lab

## INTRODUCTION

- Brain structure necessarily constrains brain function, but current models show a relatively modest coupling from structure to function[1-3]
- State-of-the-art deep learning models[4] typically use structural connectivity (SC) to reproduce functional connectivity (FC) with a reasonable degree of accuracy (e.g. Pearson's r = 0.9 at the group level)
- However, recent work[5] has shown that brain geometry also constrains brain function, potentially more parsimoniously than SC

**Can cortical eigenmodes be used in a deep learning model to accurately predict individual FC?**

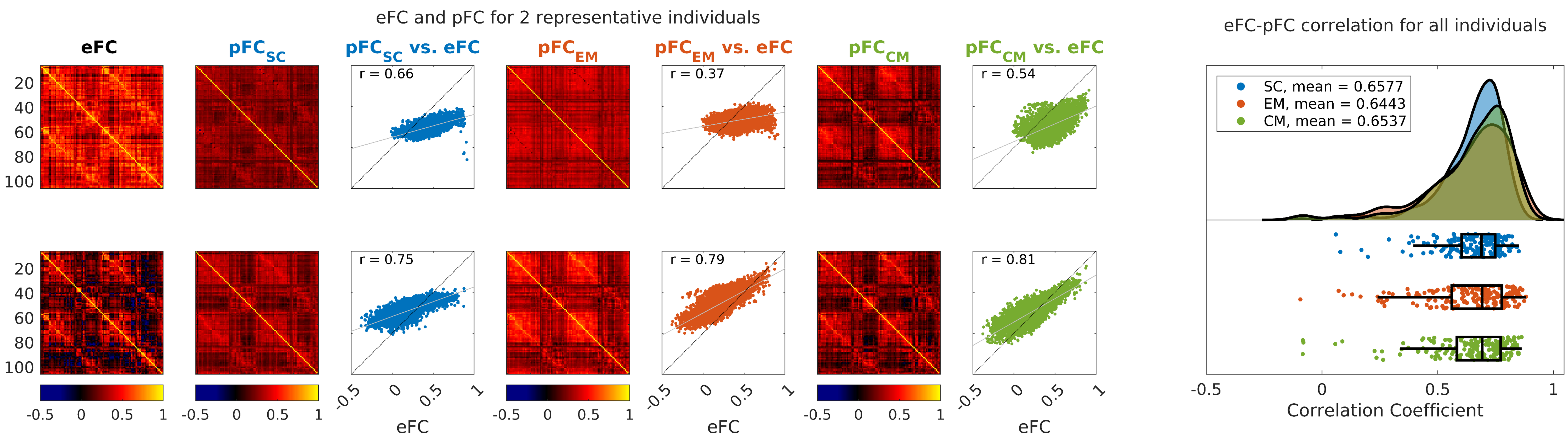
## METHODS



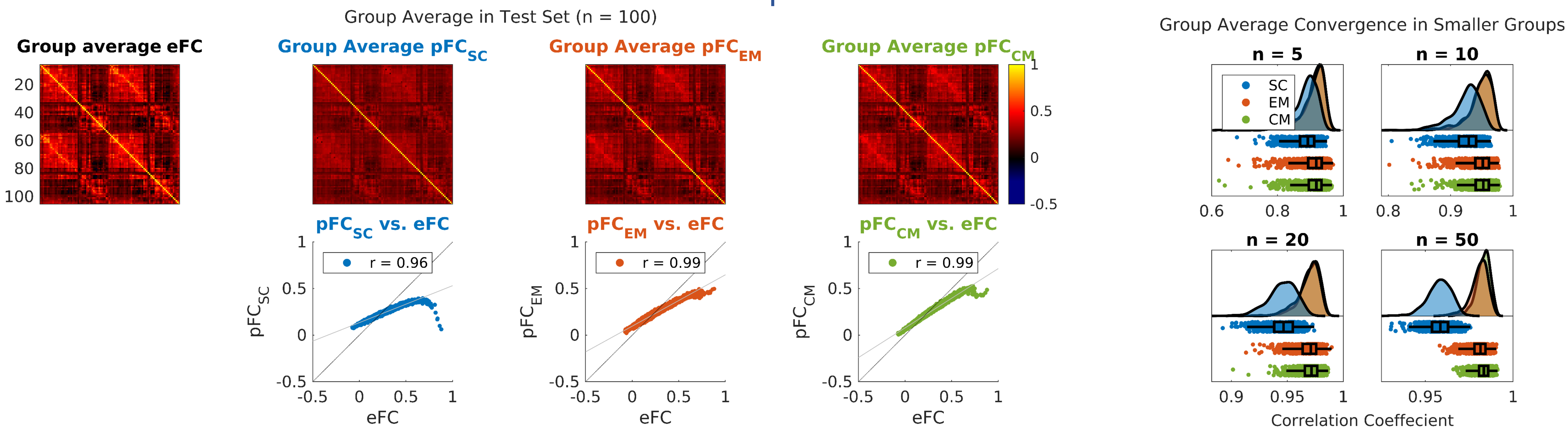

- We trained three deep learning models: **SC**, **geometric modes**, or **connectome modes** as input
- The models are trained to maximize the accuracy of the predicted FC, whilst also minimizing inter-subject correlation
- Model accuracy is assessed at group and individual levels

## RESULTS

### Individual Level




### Group Level




## CONCLUSIONS

- We improve previous models relating structural connectivity to functional connectivity
- We extend mode-based modelling to the individual level using non-linear reconstructions
- Geometric and connectome eigenmode models reconstruct FC more accurately than structural connectivity models at the group level, but not at the individual level
- Individual reconstruction accuracy and inter-individual variability are preserved in these models

## REFERENCES

[1] Honey et al., PNAS, 2009
[2] Ribeiro et al., NeuroImage, 2021
[3] Zamani Esfahlani et al., Nat Comms, 2022
[4] Sarwar et al., NeuroImage, 2021
[5] Pang, Aquino, et al., Nature, 2023

@m_gajwani
@NSB_Lab
mehul.gajwani1@monash.edu

[a]The Turner Institute for Brain and Mental Health, School of Psychological Sciences, and Monash Biomedical Imaging;
[b]Department of Electrical and Computer Systems Engineering, Monash University;
[c]Developmental Imaging, Murdoch Children's Research Institute;
Melbourne, Australia.

MONASH University

TURNER INSTITUTE FOR BRAIN AND MENTAL HEALTH