Myeloarchitecture gradients in the human insula: Histological underpinnings and association to intrinsic functional connectivity

Jessica Royer, Psy. D.
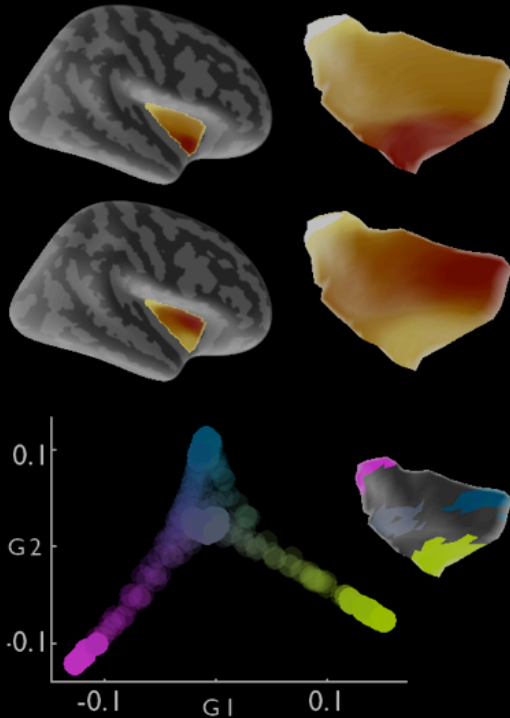
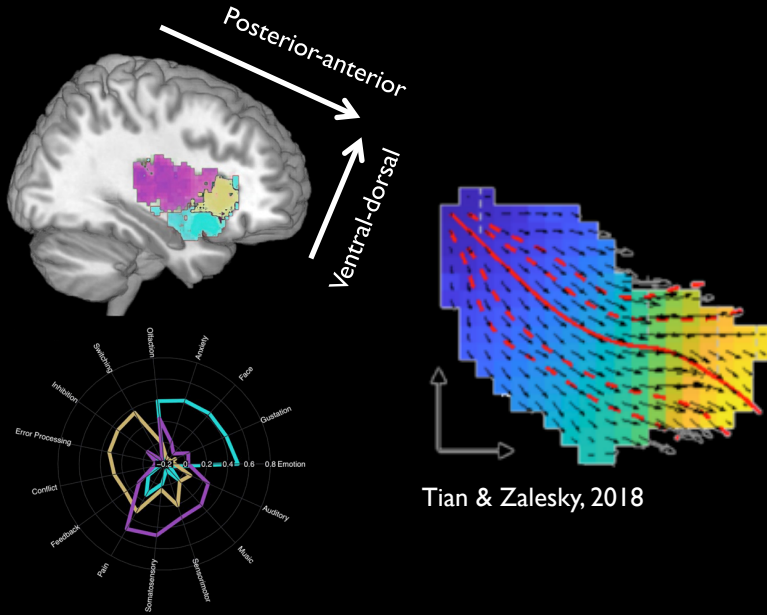4th BigBrain Workshop & HIBALL Launch
OHBM 2020
2020-06-26

MICA   neuro
Montreal Neurological
Institute–Hospital

Heterogeneity of the insular cortex

Functional heterogeneity

Posterior-anterior

Ventral-dorsal
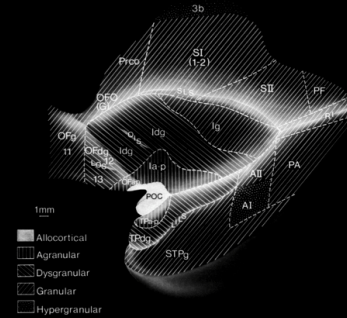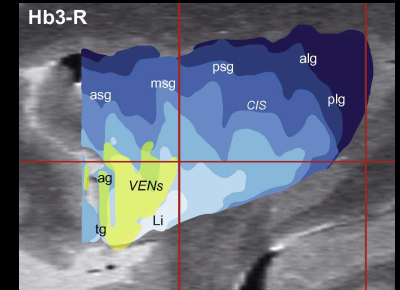
Chang et al., 2013

Tian & Zalesky, 2018

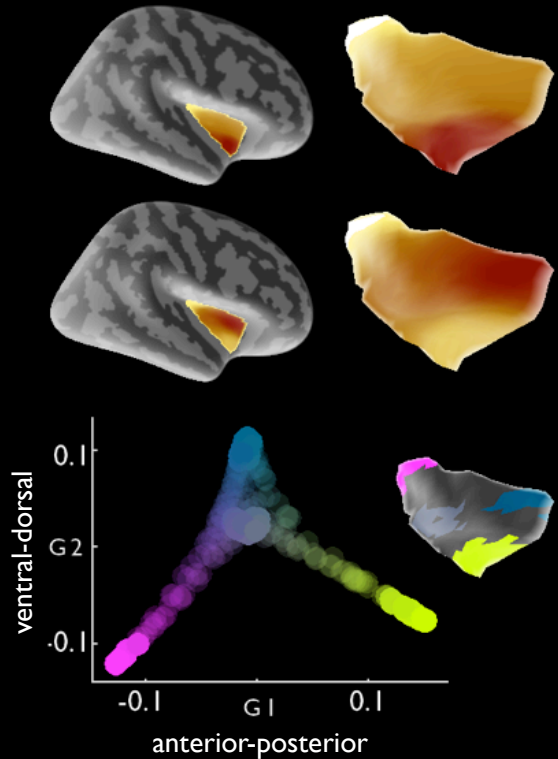## Cyto- and myeloarchitecture

Mufson & Mesulam, 1985

Morel et al., 2013

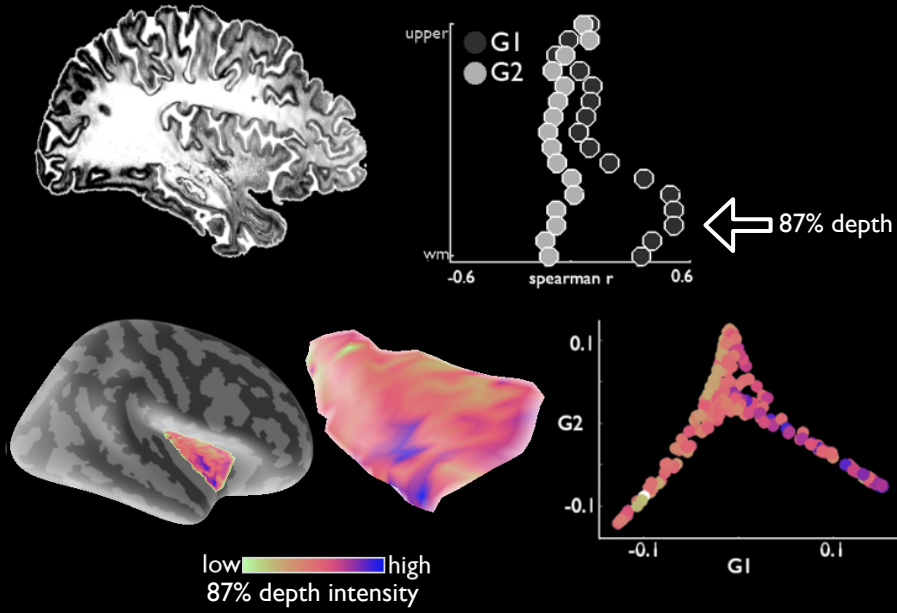# Mapping in vivo microstructural gradients in the human insula

Myelin-sensitive T1w/T2w available in HCP within segmented insula

Intensities sampled across cortical depth, and cross-correlated to form microstructural profile similarity matrices

Diffusion map embedding to derive gradients in microstructural similarity

Anterior-posterior G1 & Ventral-dorsal G2

Histological validation


low 87% depth intensity high

In vivo microstructural gradients were validated with post mortem histological data

Intensities sampled across cortical depths revealed maximum correlation with G1 at 87% depth (r = 0.51), but no correlation with G2

Histological intensities at this depth were highest in the ventral anterior insular bank

Royer, Paquola, et al. (2020) *NeuroImage*, 116859

Microstructure-function coupling

i) functional community affiliation
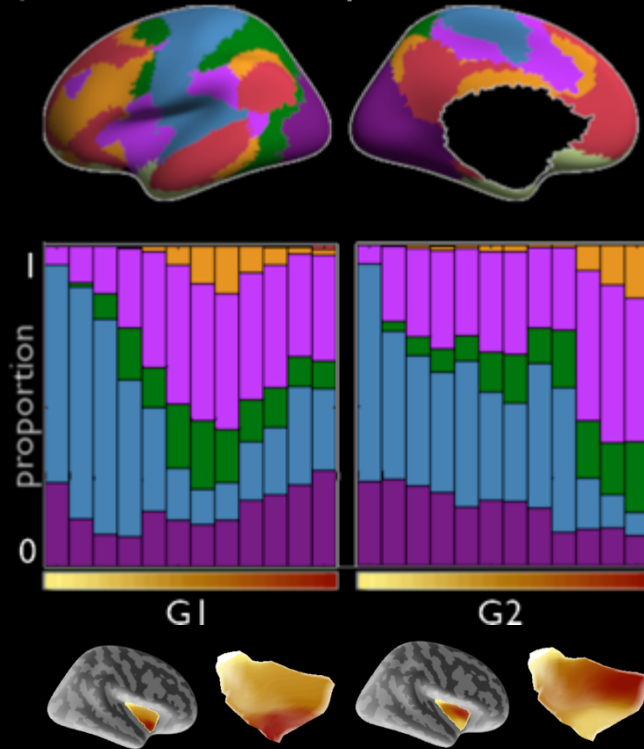
Microstructural gradients tracked changes in functional connectome fingerprints

Changes along gradient space followed changes in unimodal to transmodal network affiliations

Royer, Paquola, et al. (2020) *NeuroImage*, 116859

Summary

This multiscale investigation of the human insular cortex reconciles:

In vivo microstructure

We uncover two main axes of microstructural differentiation in the insular cortex in anterior-posterior (G1) and ventral-dorsal (G2) directions

Post mortem histology

Anterior-posterior G1 followed changes in soma size and cell density sampled in the vicinity of deeper cortical layers, with highest values found in ventral anterior insular banks

Functional connectome organization

Increasing affiliation to higher-order functional communities, diversity of functional connections, and physical distance of functional connections follows the microstructural gradient space

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Jessica Royer [a,*,1], Casey Paquola [a,1], Sara Larivière [a], Reinder Vos de Wael [a], Shahin Tavakol [a], Alexander J. Lowe [a], Oualid Benkarim [a], Alan C. Evans [b], Danilo Bzdok [d,e], Jonathan Smallwood [c], Birgit Frauscher [b], Boris C. Bernhardt [a,**]

[a] Multimodal Imaging and Connectome Analysis Laboratory, McConnell Brain Imaging Centre, Montreal Neurological Institute and Hospital, McGill University, Montreal, Canada
[b] Montreal Neurological Institute and Hospital, McGill University, Montreal, Canada
[c] Department of Psychology, University of York, York, UK
[d] Montreal Institute for Learning Algorithms (MILA), Montreal, Canada
[e] Department of Biomedical Engineering, Faculty of Medicine, McGill University, Montreal, Canada

Thank you

MICA lab
PI: Boris Bernhardt
Oualid Benkarim
Sara Larivière
Casey Paquola
Bo-Yong Park
Raul Rodriguez-Cruces
Shahin Tavakol
Reinder Vos de Wael

ANPHY lab
PI: Birgit Frauscher
Tamir Avigdor
Petr Klimes
Véronique Latreille

Collaborators
Danilo Bzdok
Alan Evans
Jonathan Smallwood

Open data resources
Human Connectome Project
BigBrain repository
Neurosynth