Cytoarchitectonic Maps of five newly identified Areas in the human Dorsolateral Prefrontal Cortex

HIBALL
HELMHOLTZ International BigBrain Analytics & Learning Laboratory

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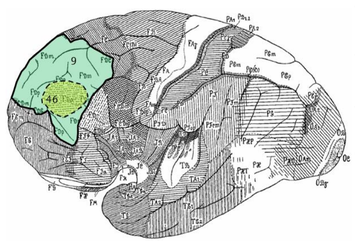
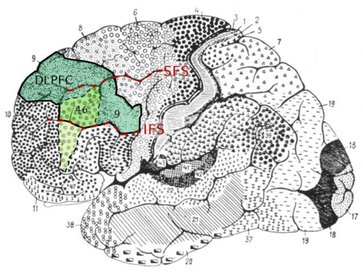
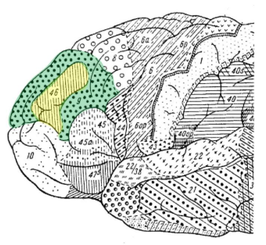
BACKGROUND

The Dorsolateral Prefrontal Cortex (DLPFC)







Location

Middle (medial and lateral) superior frontal gyrus; Brodmann area 9 & 46

Functions

'higher-order' cognitive functions attention[1,2] , planning, executive function, working memory[3-6], behavior[7,8]

Disorders

Schizophrenia[9], depression[10], obsessive-compulsive disorder[11]

Discrepancy

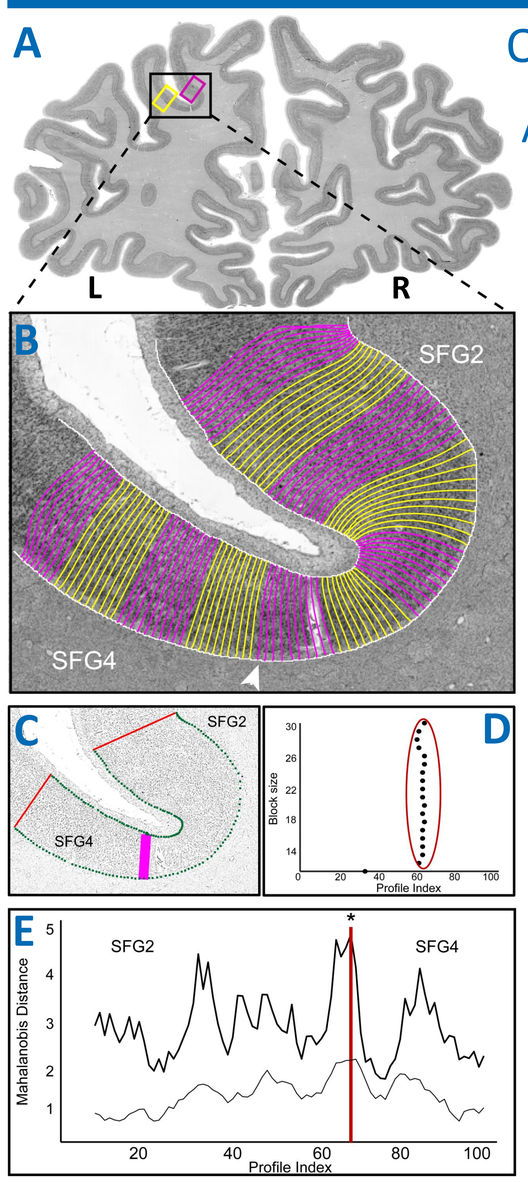
in maps (see figures): The locational relationship of area 46 and area 9[15,16]

Aims

- Delineation and cytoarchitectonic analysis of the human DLPFC with focus on the superior frontal gyrus and the middle frontal gyrus
- Generation of probabilistic cytoarchitectonic maps to assign potential functions
- High-resolution 3D reconstruction maps for interpretation and comparison of neuroimaging studies and future research projects on the human frontal lobe

METHODS

Observer-independent border detection



A: Cytoarchitectonical analysis

ten post-mortem brains (5 men, 5 women: 39 – 86 years old); serial, coronal sections (thickness: 20 µm; every 15th section); cell body silver staining[17]
Box: ROI, SFG2 (pink) and SFG3 (blue)

B: GLI-Profiles

microscopically defined region of interest digitized; computation of gray level index (GLI) images
GLI profiles represent laminar changes between layer II and cortex/white matter borders (yellow and magenta lines), i.e., cytoarchitecture. Arrow marks the border of SFG2 and SFG3 that was computed (C, D)[18,19]

C/D: Significant border detection

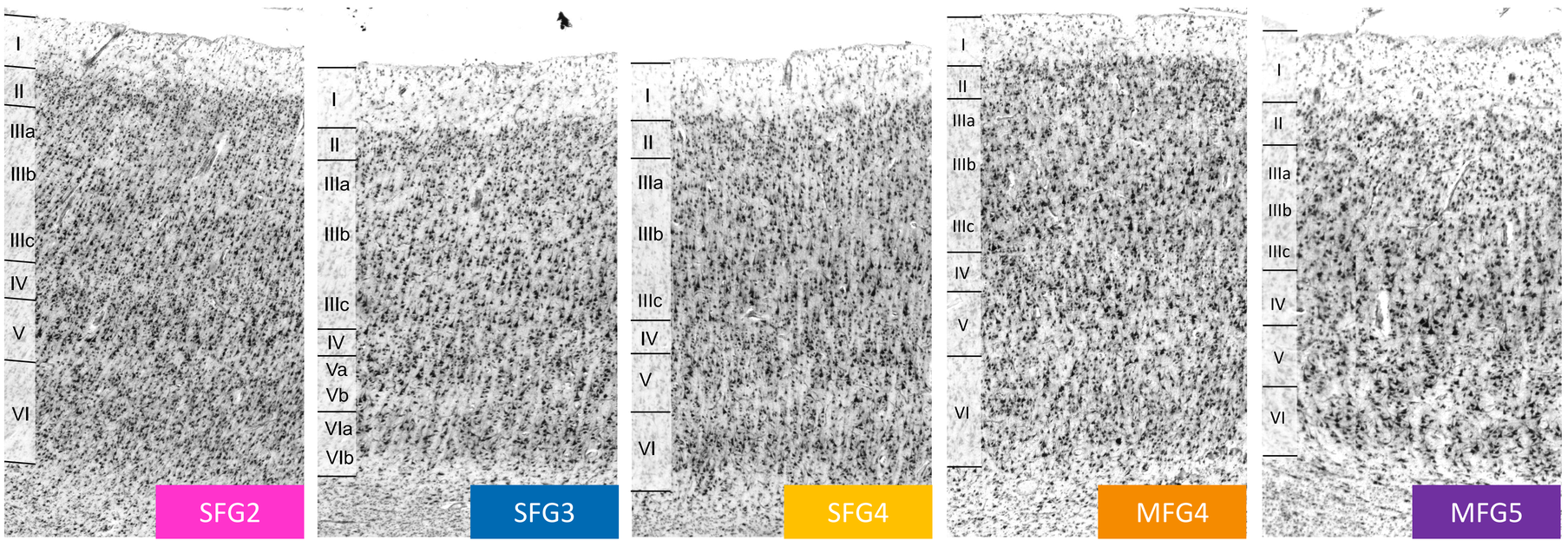
Significant maxima of Mahalanobis distance (black dots) were tested for different block sizes (E; *n* = 20 - 30). At least three block sizes mark a significant border (Bonferroni corrected alpha level of 0.001)[18,19]

D: Mahalanobis distance

Observer-independent border detection; significant maxima of Mahalanobis distance at profile number 53 (asterisk and red line) are plotted against the profile index[18,19]

RESULTS

Cytoarchitectonic characteristics of the DLPFC Areas



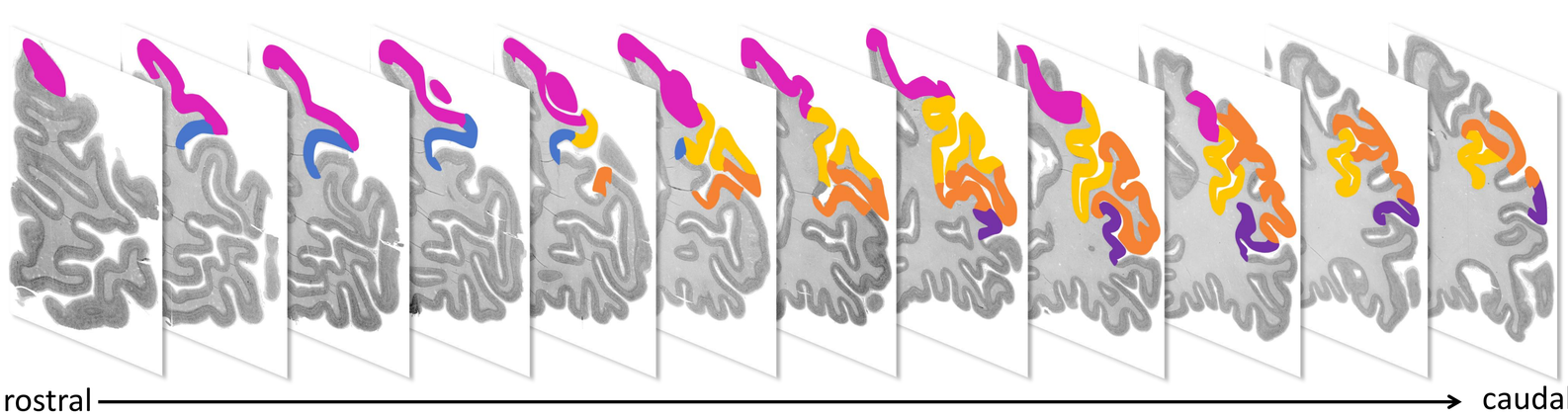
Location

five new cytoarchitectonic areas on the superior frontal gyrus (SFG2, SFG3 and SFG4), on the surface of frontal gyrus (MFG4 and MFG5)

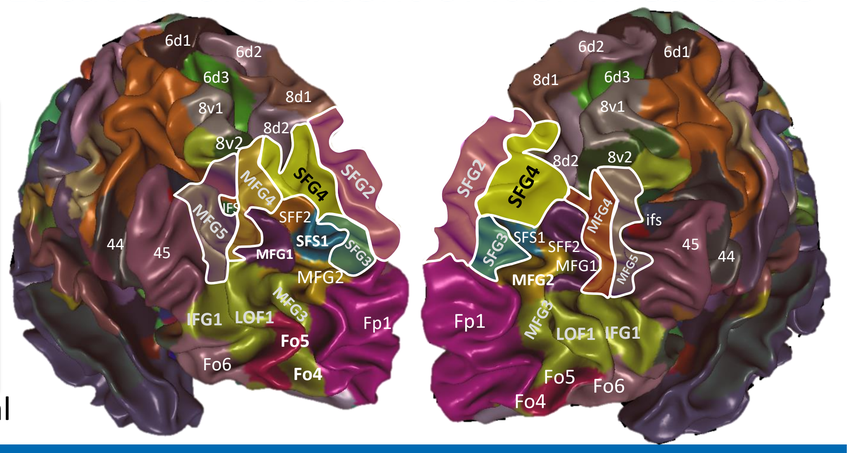
Boundaries

Rostral: Frontal pole (area 10)[19]
Lateral: anterior DLPFC (SFS1, SFS2, MFG1, MFG2)[20]
Ventral: Broca (area 44/45)[21]
Caudal: Premotor & prefrontal cortex (area 6 & 8)[22]

Delineations of ROIs



Location and extent of identified areas



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