High-Resolution Cytoarchitectonic Maps of four new Areas in the Anterior Dorsolateral Prefrontal Cortex in the BigBrain enabled by Deep Convolutional Neural Networks

HIBALL
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BACKGROUND

Dorsolateral prefrontal cortex (DLPFC)

- organizational unit of the primate frontal brain
- involved in cognitive control and executive functions like attentional selection[1], behavioral strategies[2], decision making[3], working memory[4]
- disorders like schizophrenia, obsessive-compulsive disorder, depression, and bipolar disorder are suspected to be related to changes in DLPFC[5]

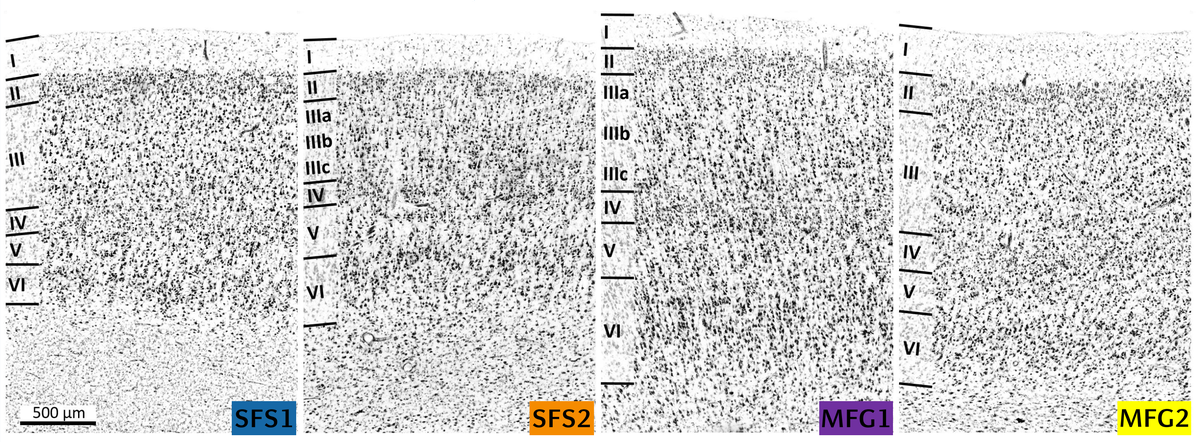
METHODS

High-Resolution BigBrain Maps

- Delineation of four areas SFS1, SFS2, MFG1, and MFG2 of the anterior DLPFC on high-resolution sections of the BigBrain[6] based on cytoarchitectonic criteria[7]
- Creating of mappings using Deep Convolutional Neural Network[8]
- 3D reconstruction in the BigBrain space[6]

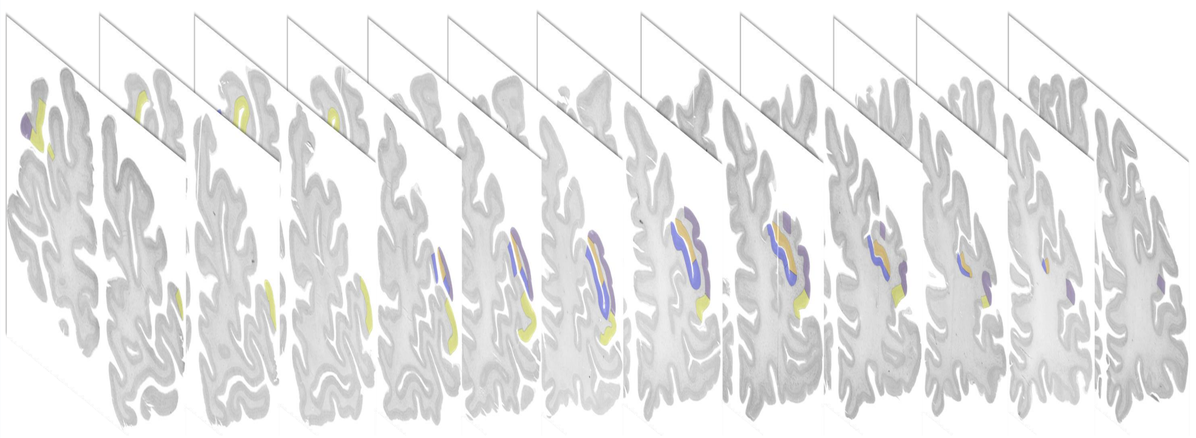
RESULTS

Identification of the areas SFS1, SFS2, MFG1, and MFG2 based on cytoarchitectonic criteria[5]



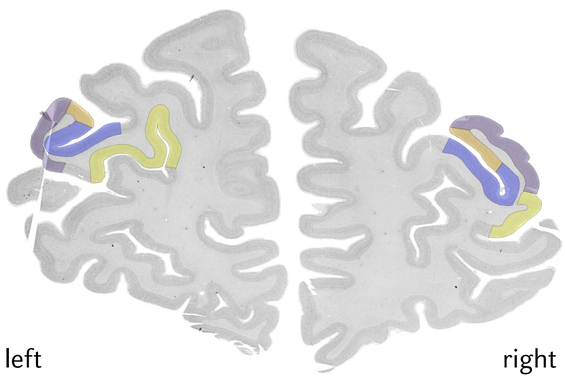
Four cytoarchitectonic areas of the anterior DLPFC within the superior frontal sulcus (SFS1, SFS2), on the surface of the middle frontal gyrus (MFG1), and extending into the ventrally adjacent sulcus (MFG2) were identified in the BigBrain.

Delineations of the areas SFS1, SFS2, MFG1, and MFG2

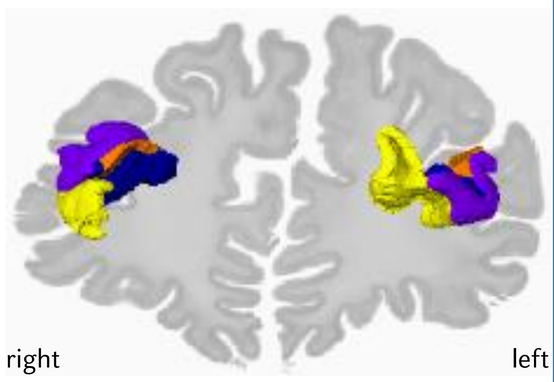


Areas SFS1, SFS2, MFG1, and MFG2 were delineated on at least every 30th section of the BigBrain dataset.

High-Resolution 3D Cytoarchitectonic Maps in the BigBrain

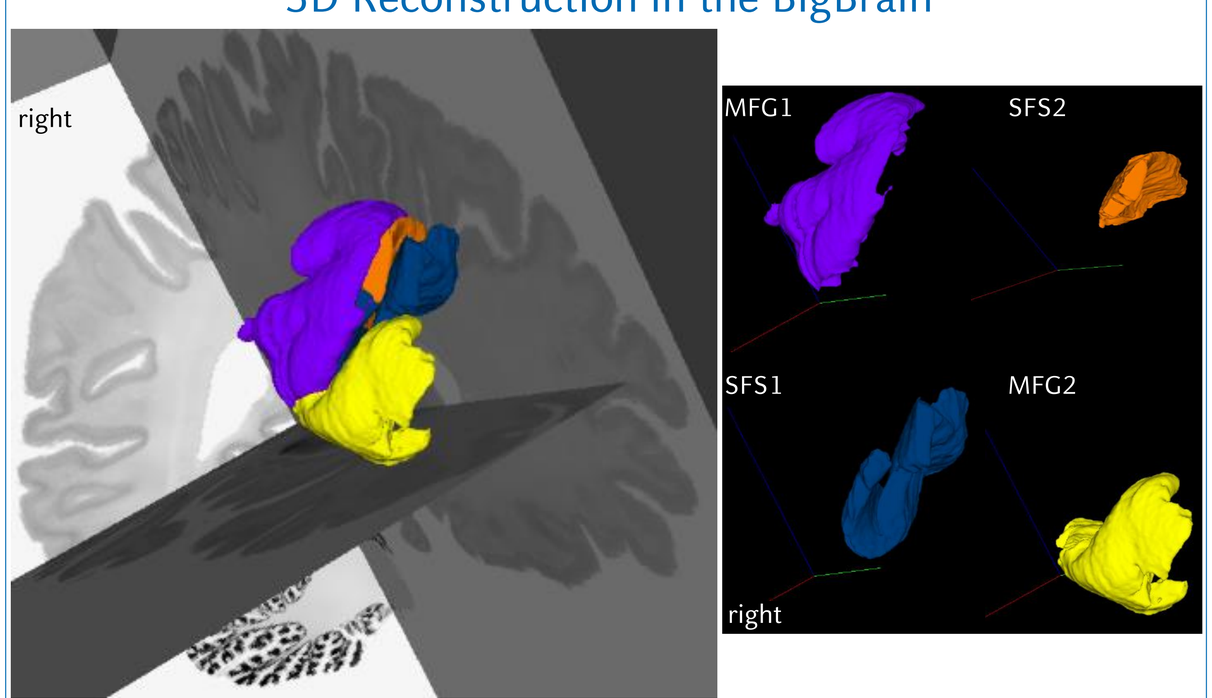


Delineation of areas on section 6571



3D Reconstruction in the BigBrain

3D Reconstruction in the BigBrain



3D reconstructions of the areas SFS1, SFS2, MFG1, and MFG2 in the right hemisphere of the BigBrain.

CONCLUSION

New 3D high-resolution cytoarchitectonic maps of the areas SFS1, SFS2, MFG1, and MFG2 of the human anterior DLPFC are part of the integrative framework of the Julich-Brain[9] and are accessible through the multilevel human brain atlas on EBRAINS.

→ a profound basis for interpreting and comparing neuroimaging studies
→ maps help to clarify further the organizational principle and the functioning of the prefrontal cortex

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