

Cytoarchitectonic mapping of five new areas in the anterior lateral prefrontal cortex



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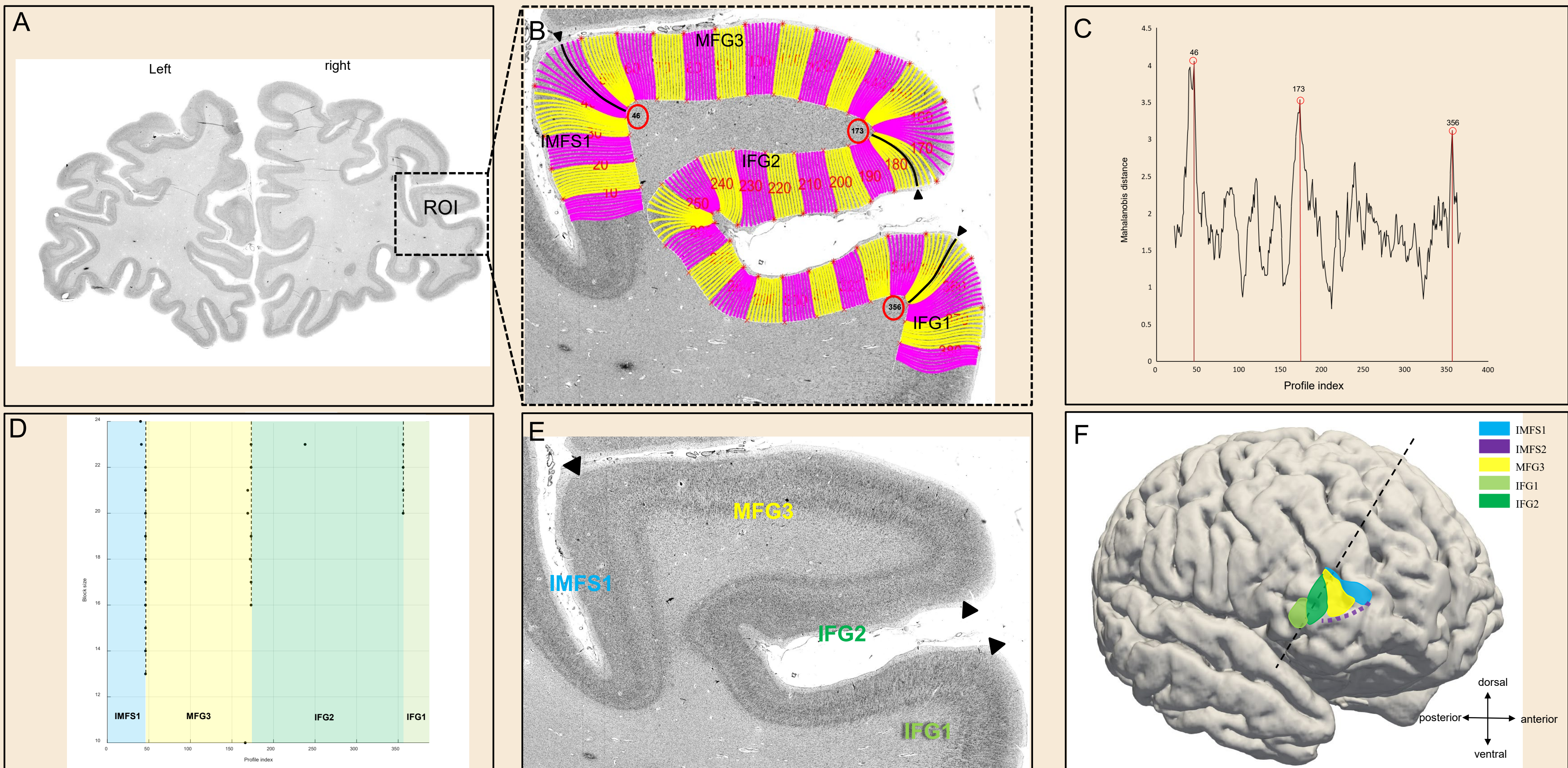
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INTRODUCTION

- ❖ The lateral prefrontal cortex contributes vital functions, including motor preparation¹, working memory², empathy³, language control⁴ and music perception⁵
- ❖ Our research region is located in the formerly described area 46 and transitional area 9/46 in the previous maps^{6,7,8}, but these maps don't reflect the functional parcellations
- ❖ This region exhibits a high variability in the sulcal pattern between individuals, and areal borders are not reliable for associated with macroanatomical landmarks
- ❖ Developing a cytoarchitectonic map based on observer-independent method will enable a more precise interpretation of functional imaging data of this brain region

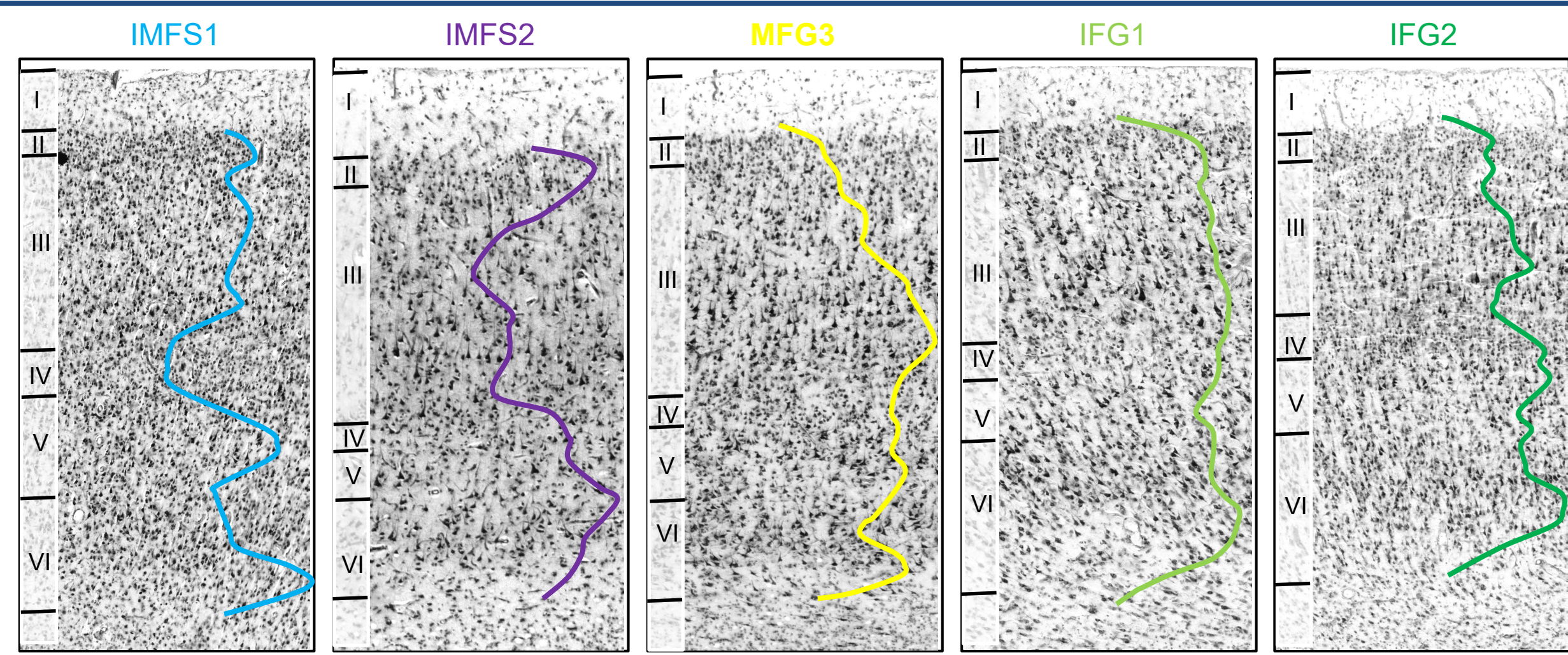
METHODS



Observer-independent mapping approach⁹. Coronal cut section with cell body stained from one of the ten brains with rectangular region of interest (ROI, box) (A). The profiles of areas were extracted between the outer contour line and inner contour line (B). Significant maxima of the Mahalanobis distance (MD) were calculated with different block size (n=10-24) (D) and at profile numbers 46, 173, and 356 are plotted against the profile index (labeled with red circles) (C). These positions indicate the laminar pattern changes between IMFS1, MFG3, IFG2 and IFG1 (B, E). The corresponding maxima of the MD function are accepted as borders marked with black arrowheads (E). The overview of the five new areas in the anterior lateral prefrontal cortex (F). The area IMFS2, situated within the intermediate frontal sulcus, is not visible from a lateral surface perspective and therefore indicated with a dotted line.

RESULTS

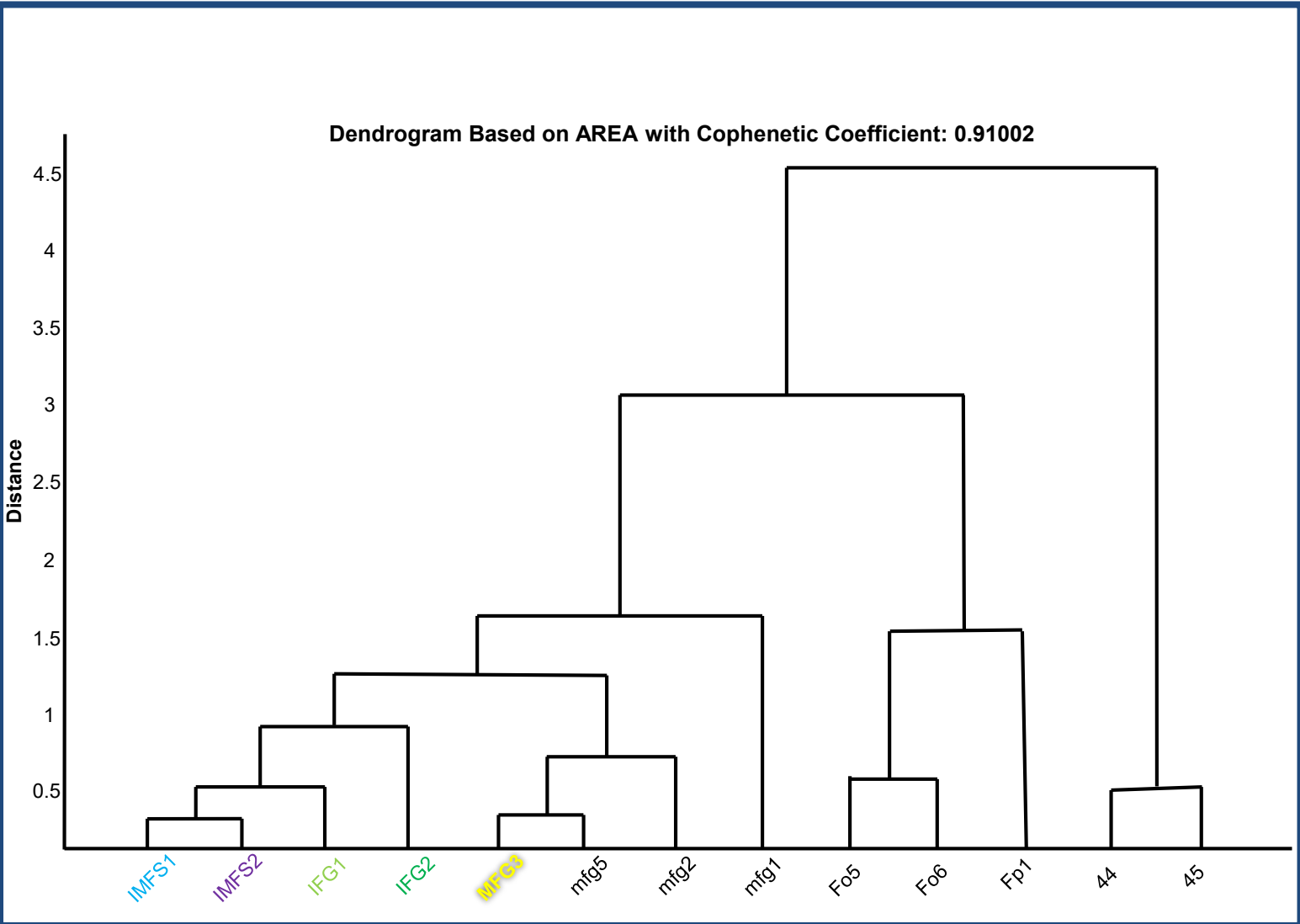
Cytoarchitectonic characteristics of new five areas



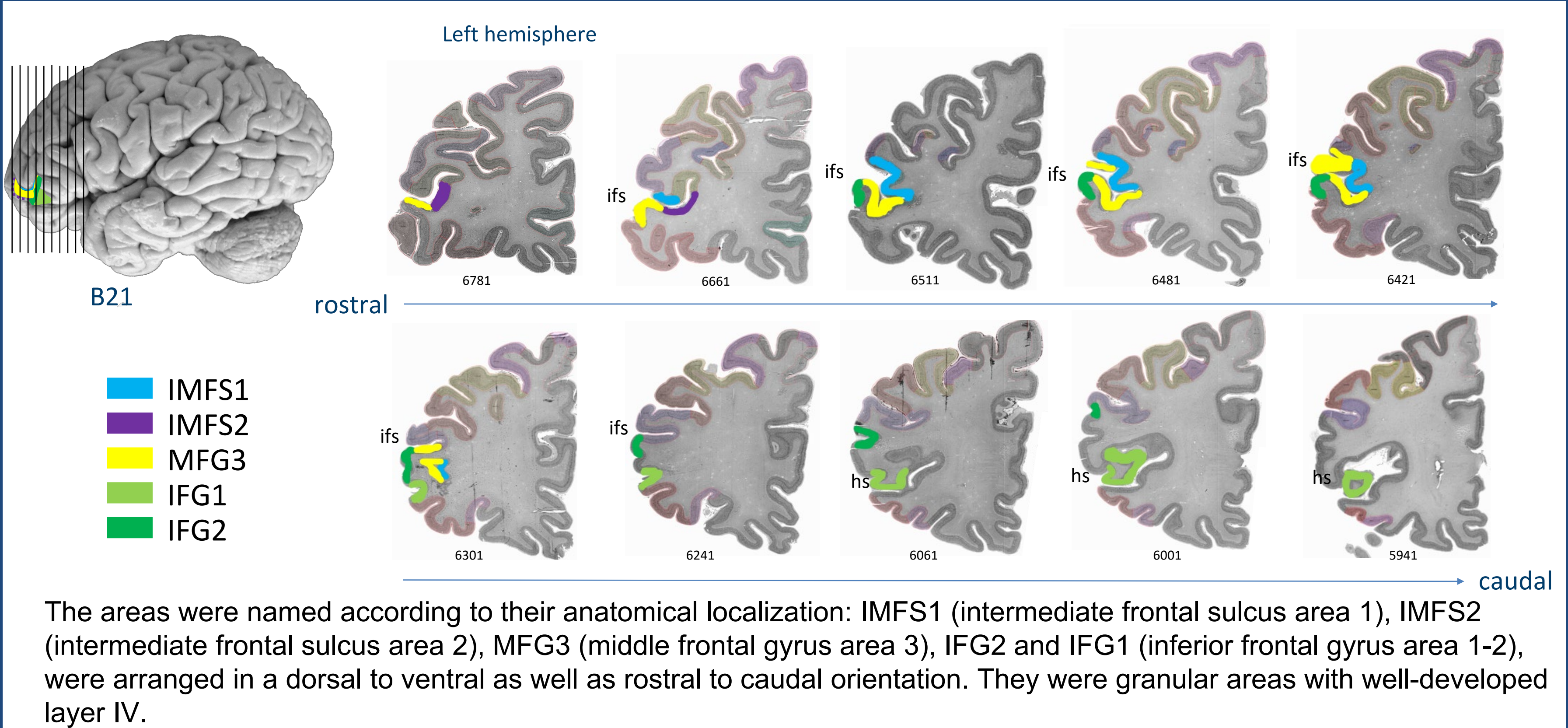
Cytoarchitectonic features of areas IMFS1, IMFS2, MFG3, IFG1 and IFG2

- IMFS1** Blurry border between layer II and III
- IMFS2** Medium sized pyramidal cells in layers III, V and VI and distinct layer IV
- MFG3** Narrow layer II and blurry border between layer II and III
- IFG1** low cell density in layer III
- IFG2** Thinner layer IV and larger cell size (deeper part) than IMFS1
- IFG1** Blurry border between layer II and III
- IFG2** Dense layer III, small to larger pyramidal cells from the upper to deeper part
- IFG1** Layer IV is thinner than IMFS1 and wider than IMFS2
- IFG2** Pale deeper layer V and sharp border with white matter
- IFG1** No sharp border between layers II and III
- IFG2** Larger pyramidal cells in deeper than in upper layer III
- IFG1** Thinner layer IV than IMFS1
- IFG2** Distinct layer II
- IFG1** small to middle-sized pyramidal cells in layer III
- IFG2** Broader layer IV than IFG1 and dense layer VI

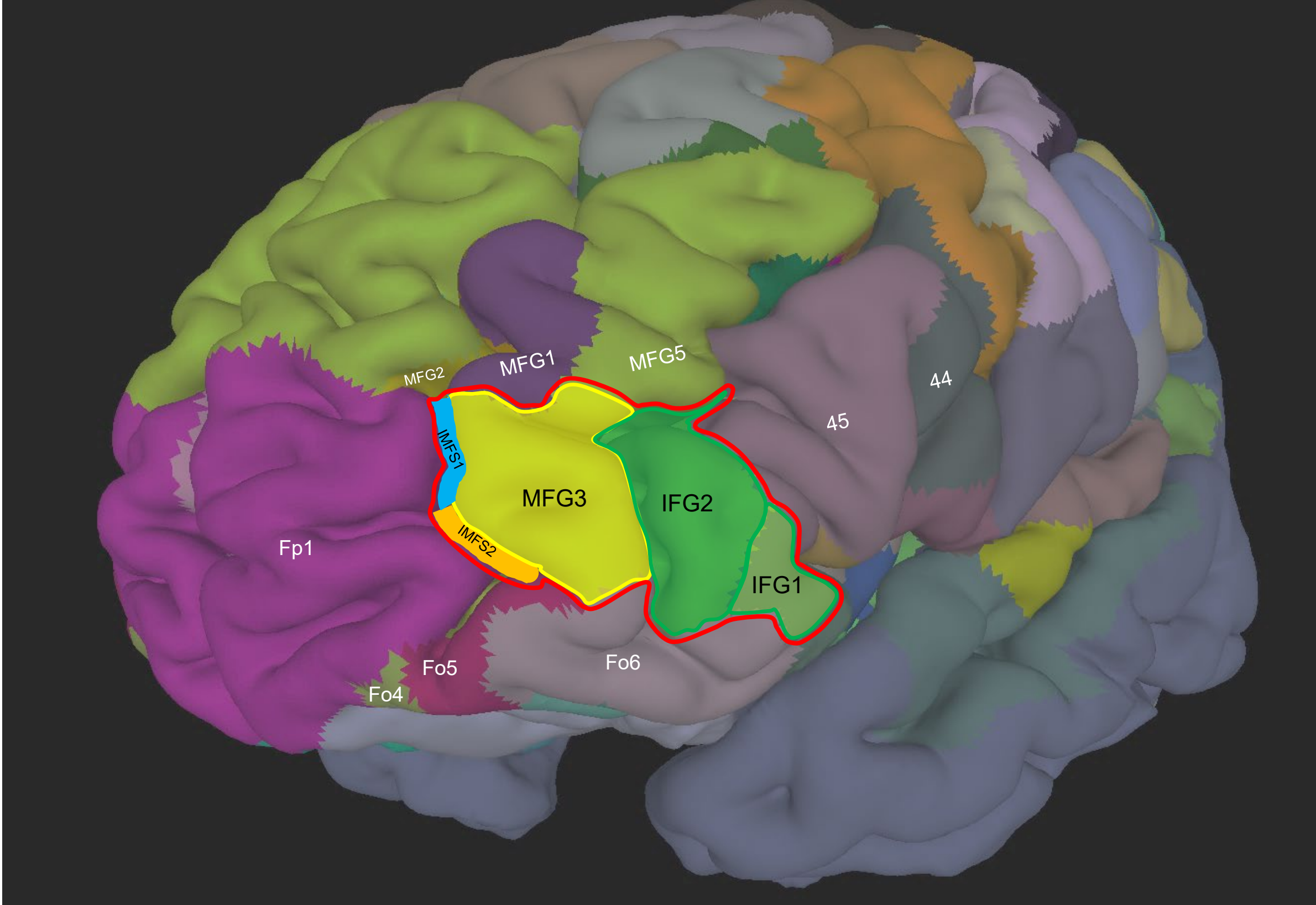
Cluster analysis



Serial mapping of new five areas



Location of areas in the Julich brain



CONCLUSION

- We mapped five areas in the anterior lateral prefrontal cortex (IMFS1) as a reference for localizing results from functional studies and linking them to cytoarchitectonic areas.
- The cluster analysis demonstrated that the areas could be classified according to their cytoarchitectural characteristics. The newly defined five areas showed higher cytoarchitectonic similarity with the areas of the mfg (MFG5, MFG2 and MFG1), lateral orbitofrontal cortex (Fo5 and Fo6) than to Broca's areas 44 and 45 and the frontal pole (Fp1).
- The new map will be implemented in the Julich Brain Atlas and will be accessible through the multilevel human brain atlas on EBRAINS.

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