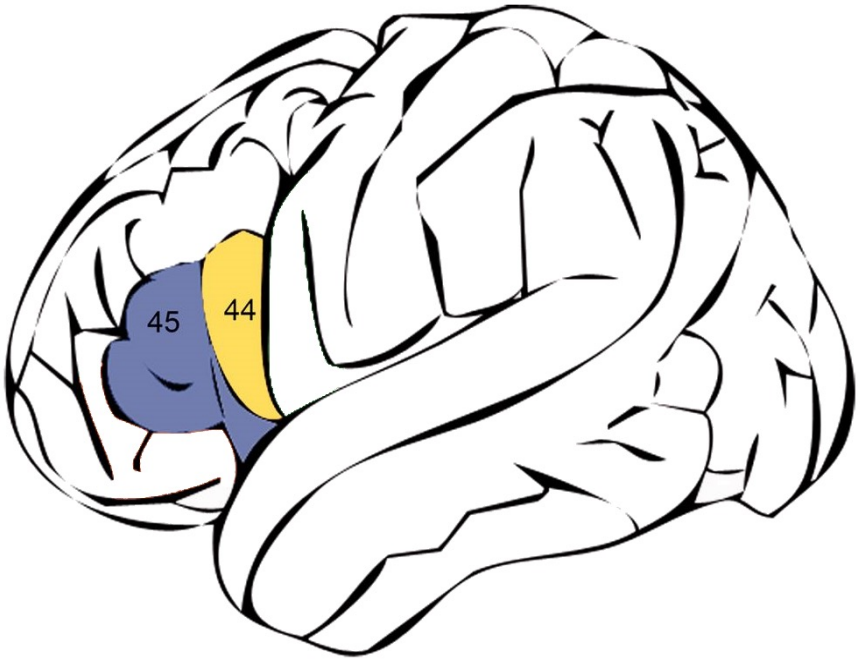


Correspondence between the individual Brain macrostruture, connectivity-based parcellation and functional activation of Broca's area

Nestor I. Zaragoza Jimenez
Tomas Goucha
Alfred Anwander
Angela D. Friederici

Max Planck Institute
for Human Cognitive and Brain Sciences
Leipzig, Germany

Why are we interested in parcellations?

(a)Relationship between macro structure of a region and its related functions
(b)Can we find this relationship employing a combinatorial approach between Diffusion MRI and Functional MRI?

Why **Broca's** area?

1. High degree of variability in topology features within a group subjects

2. Broca's as a core region in language processing (well established roll in language processing)

(A) Can we described Broca's function based on its structural properties?

(B) Does topology have an impact on the region's function?

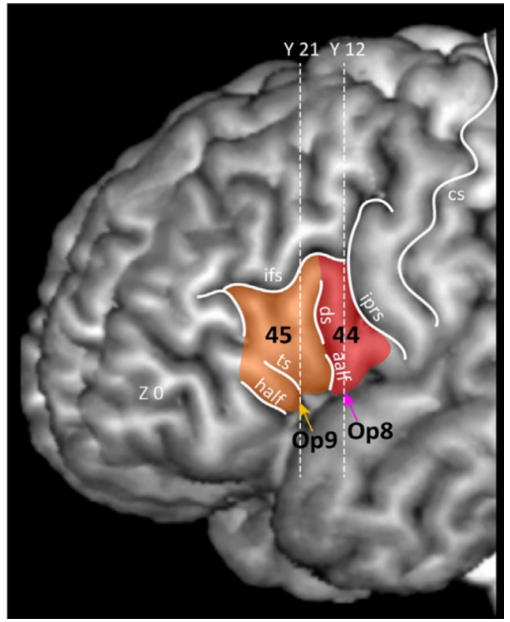
Step 1

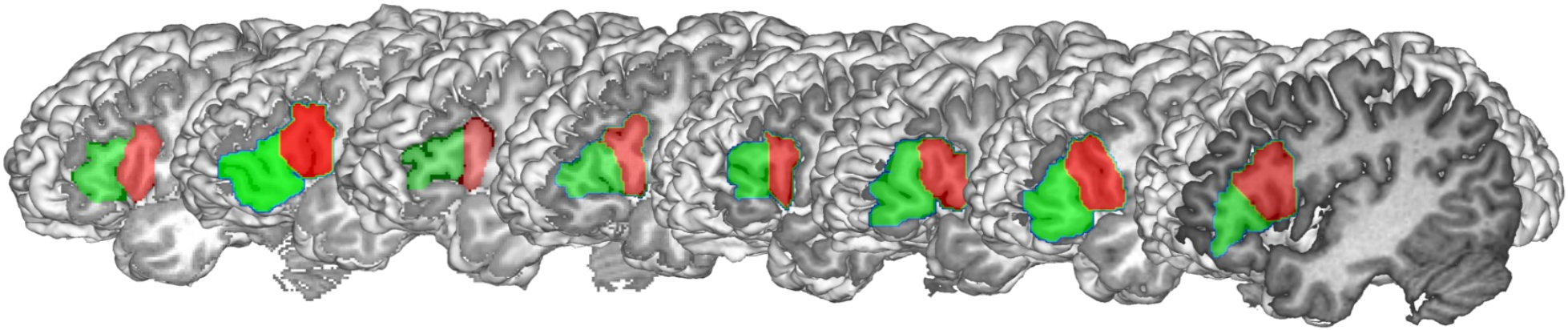
ROI definition

Anatomically consistent individual mask were created based upon well described anatomical landmakrs

The horizontal ramus of the silvian fissure – was taken as anterior border, the precentral sulcus served as posterior border, The IFS serverd as superior border

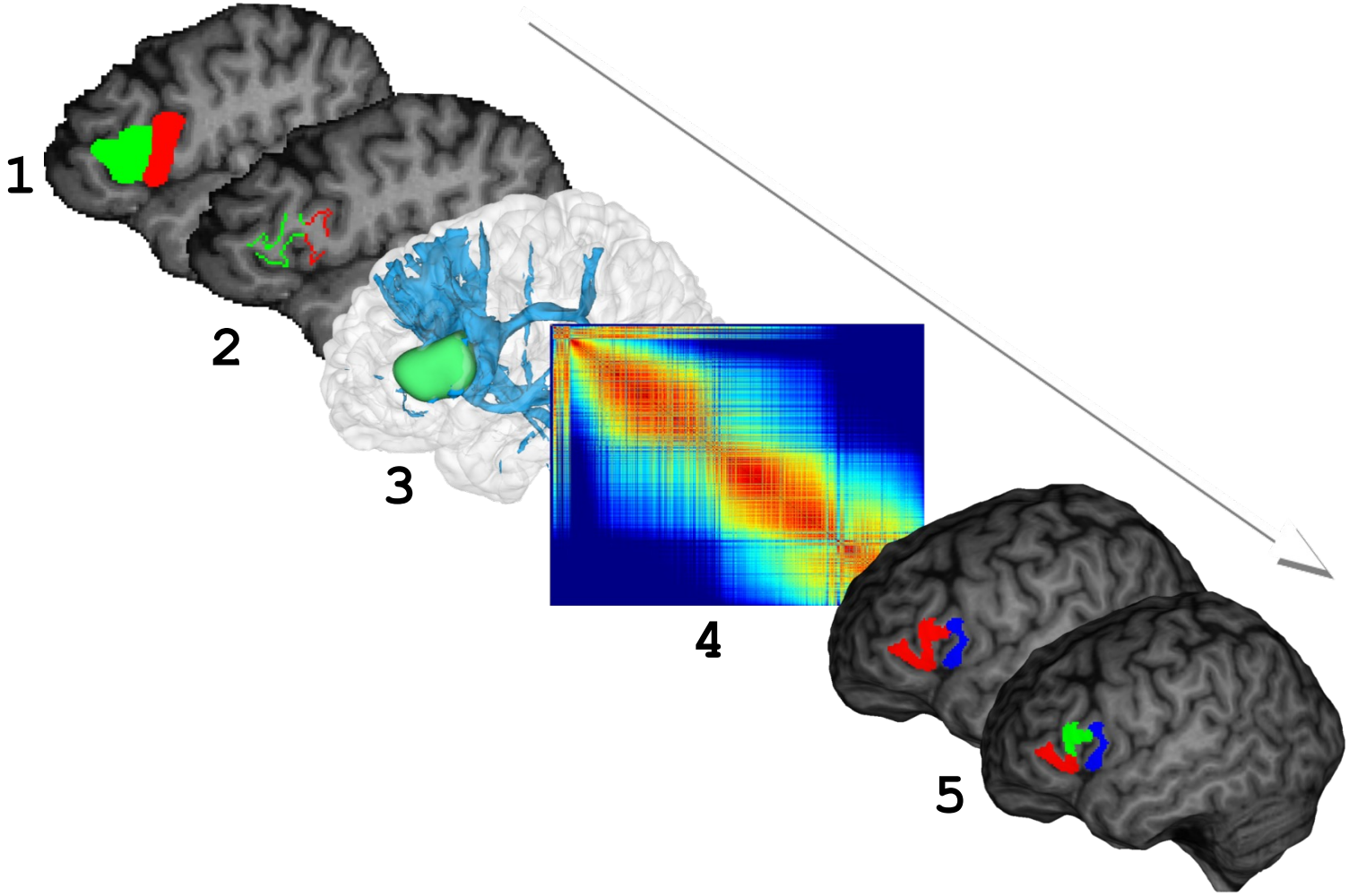
Subdivision between pars opercularis and parstriagularis was the ascending ramos of the silvian fissure.





Step 2

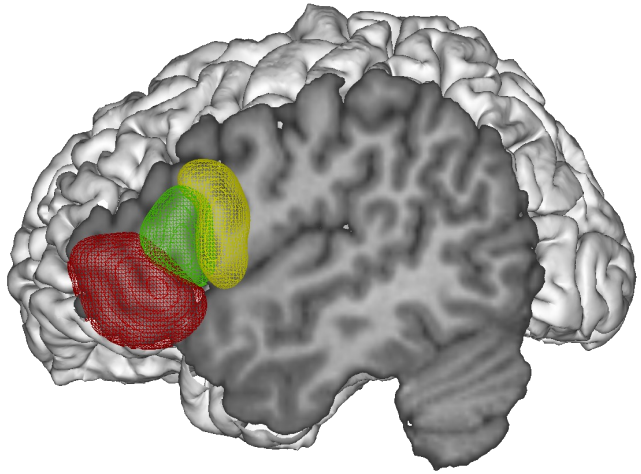
Probabilistic dMRI tractography based parcellation

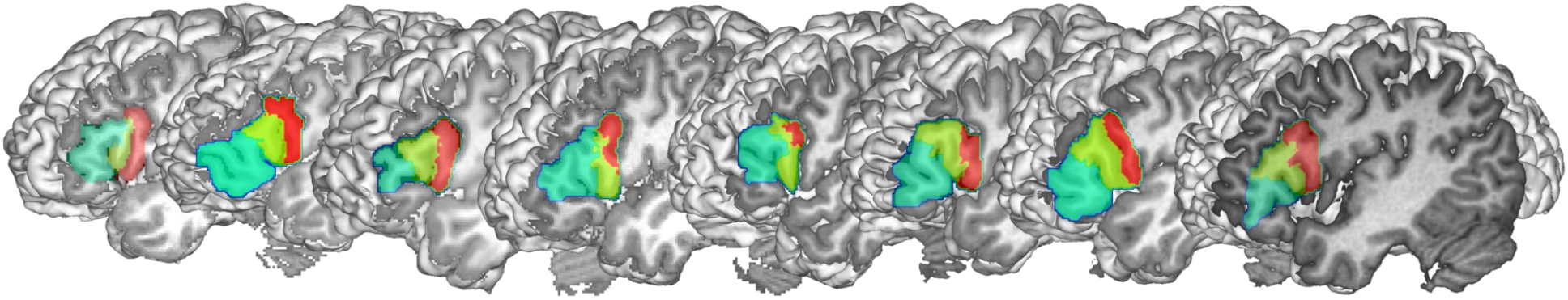


Parcellation of Broca's region

Three region parcellation was selected as the most representative for every individual.

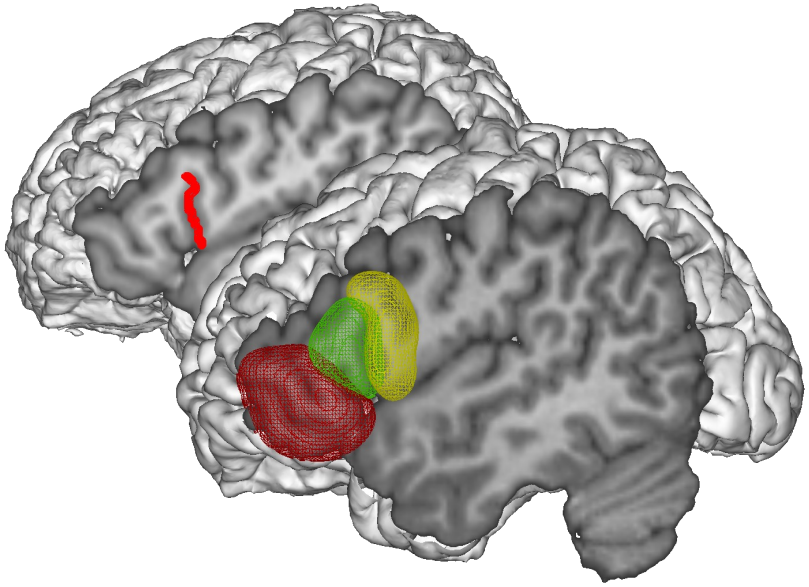
High variability on topological features.

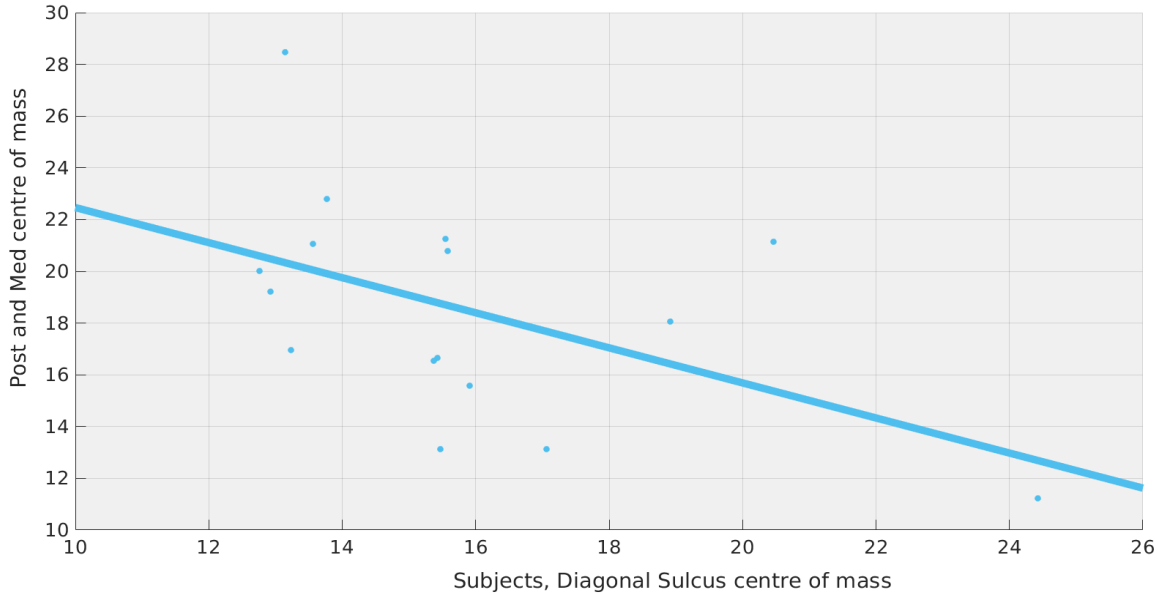




Parcellation of Broca's region (2)

Correspondence between parcellation borders and the presence of the Diagonal Sulcus (DS)

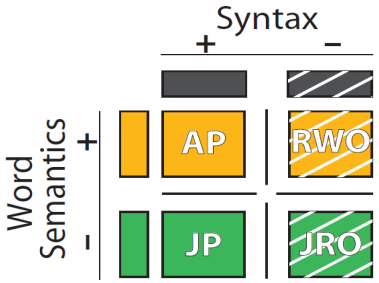


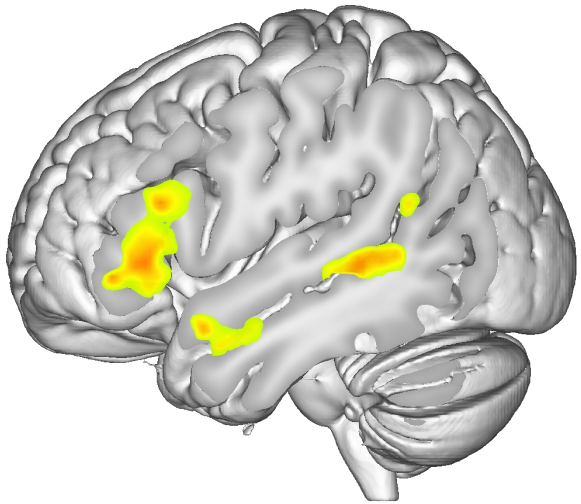


THW DS was identified on 16 of the 26 subjects in our sample. A correlation between the center of mass of the parcellaton's posterior-medial border and the centre of mass of the DS location (r=-0.50). The presnce of the DS sulcus seems to displace posteriorly the Border between the medial and posterior border.

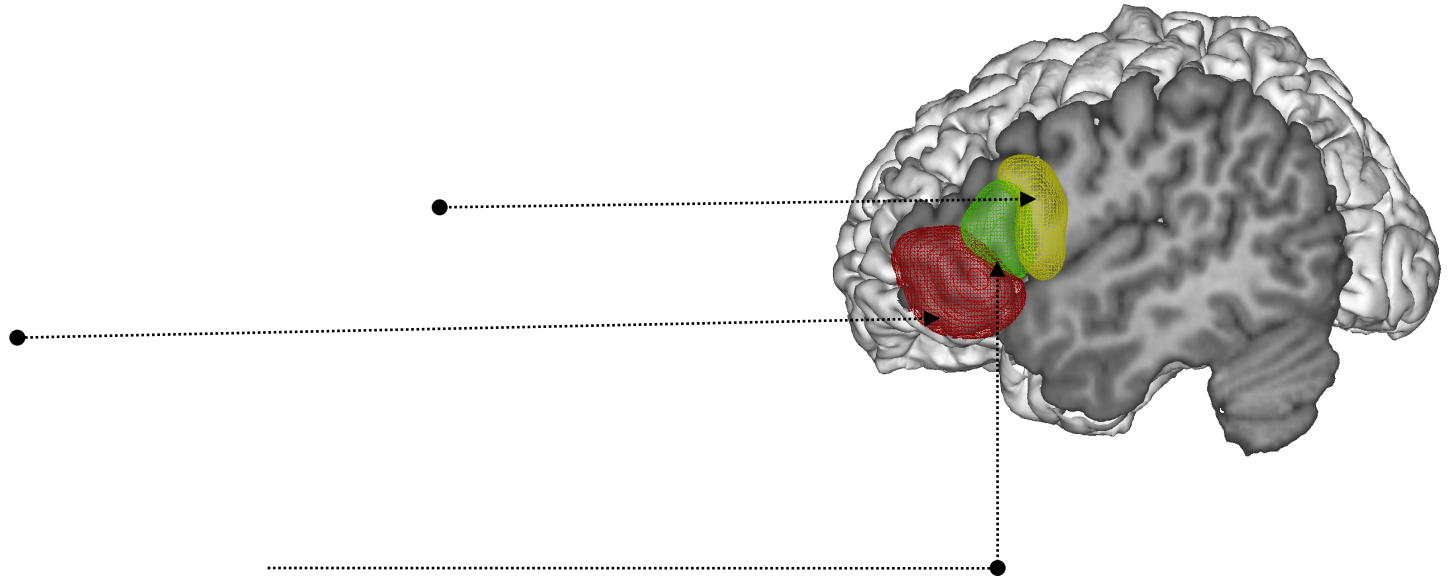
Functional fMRI correspondence

The experiment (Goucha et al. 2015)

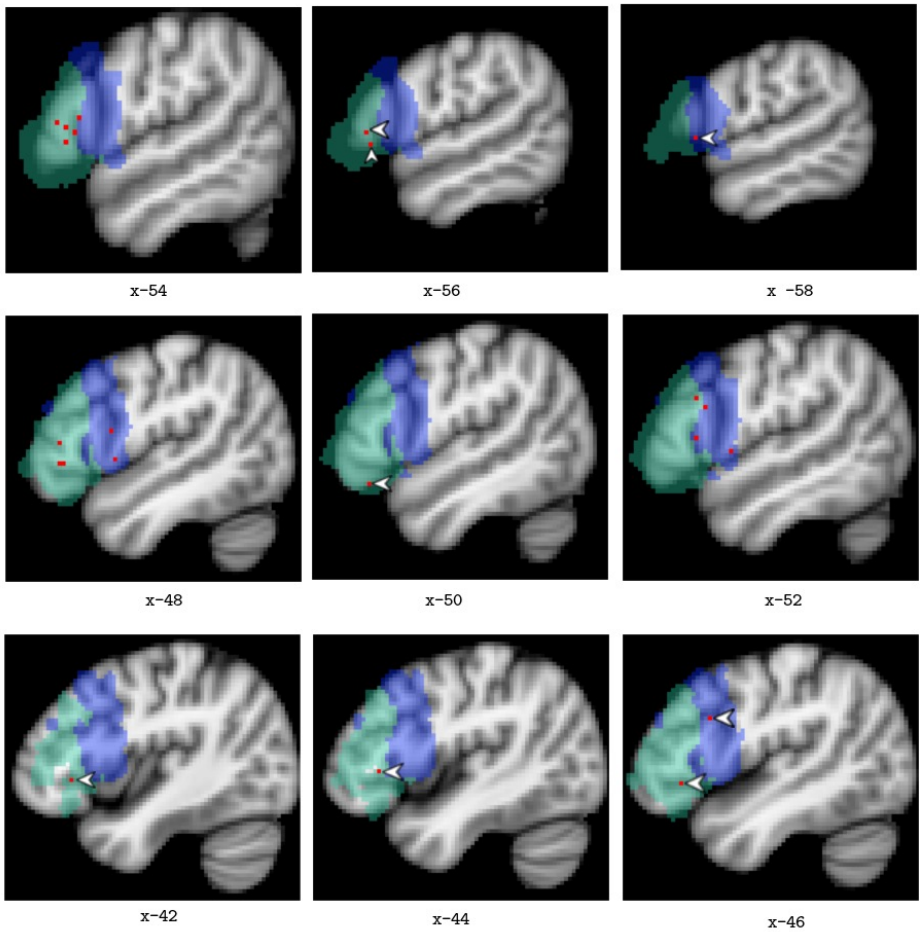




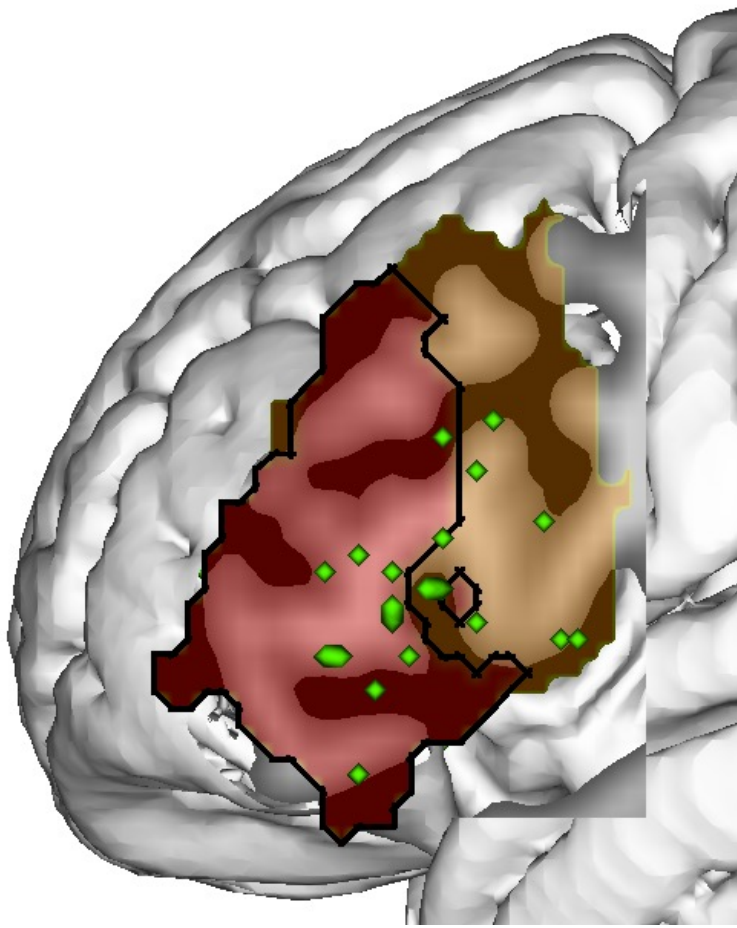
Activation peaks and their relationship with Diffusion parcellation



General individual peak distribution on Broca's region (JP-JRO contrast)

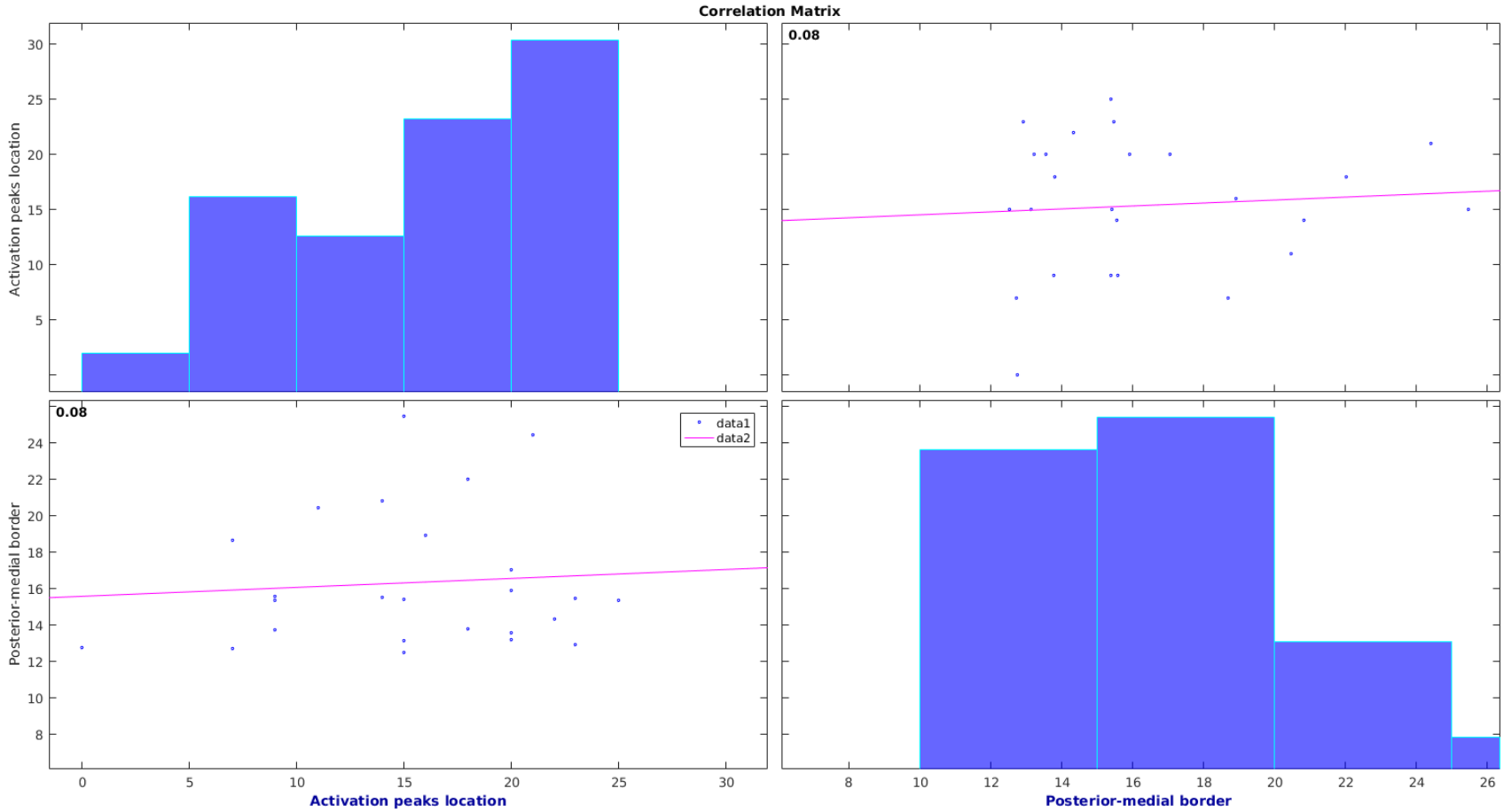


Activation Peaks on top of Jülich maximal probability anatomical atlas.



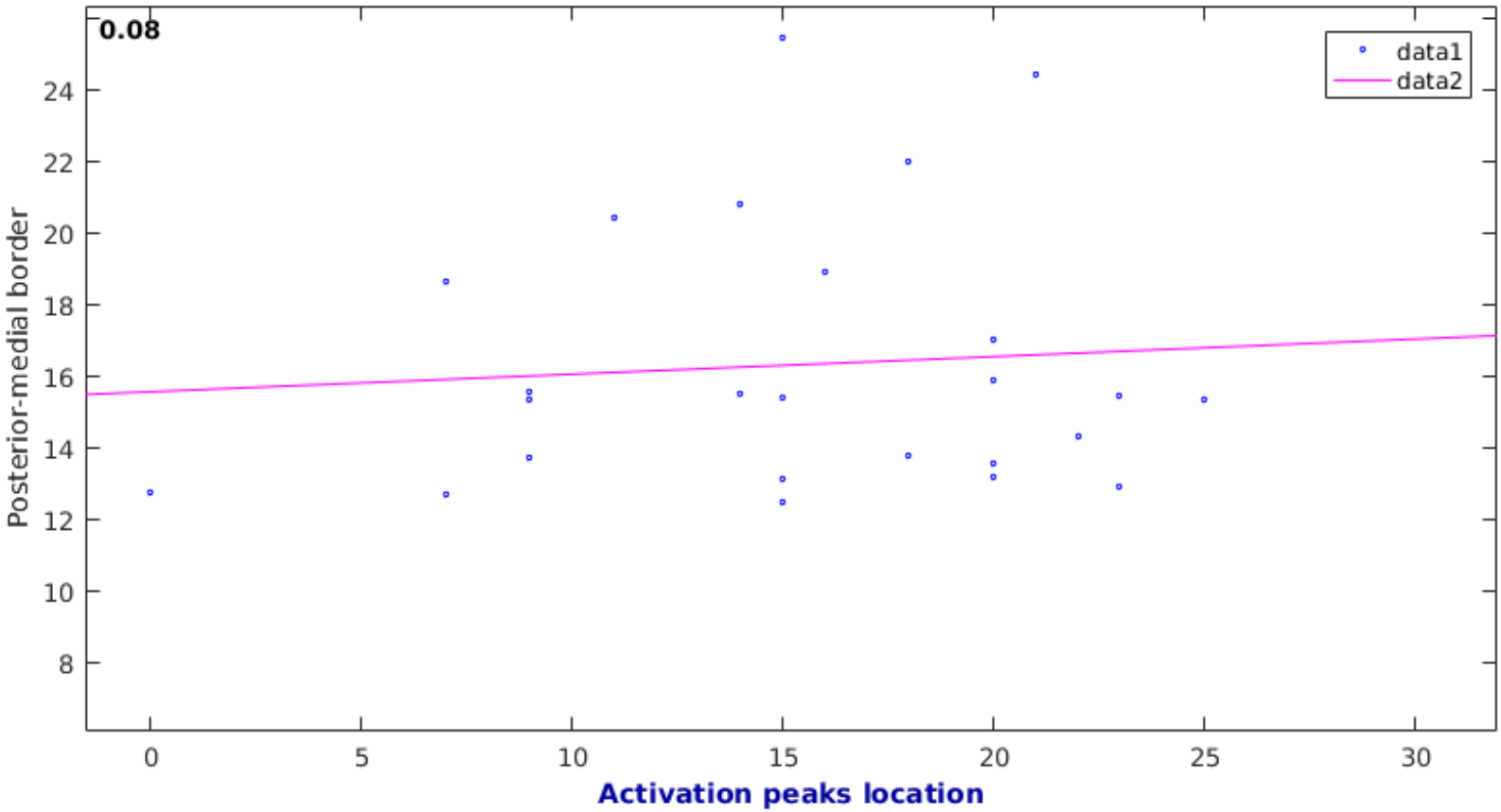
3D rendering of the individual peak distribution (JP-JRO contrast)

Correlation between Posterior-Medial Borders and location of activation peaks (JP- JRO contrast)

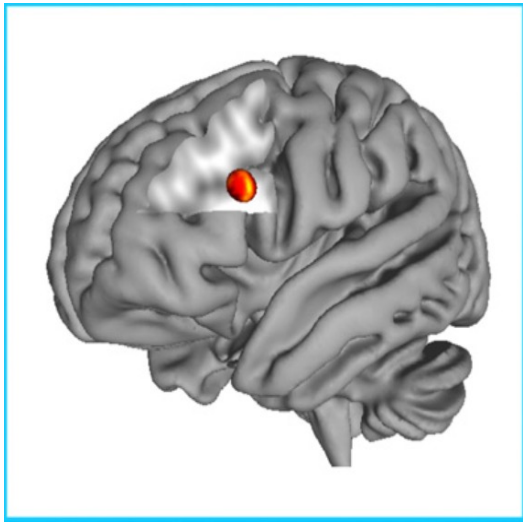


R = 0.08

No correlation between fMRI activation peaks and posterior-medial parcellation.

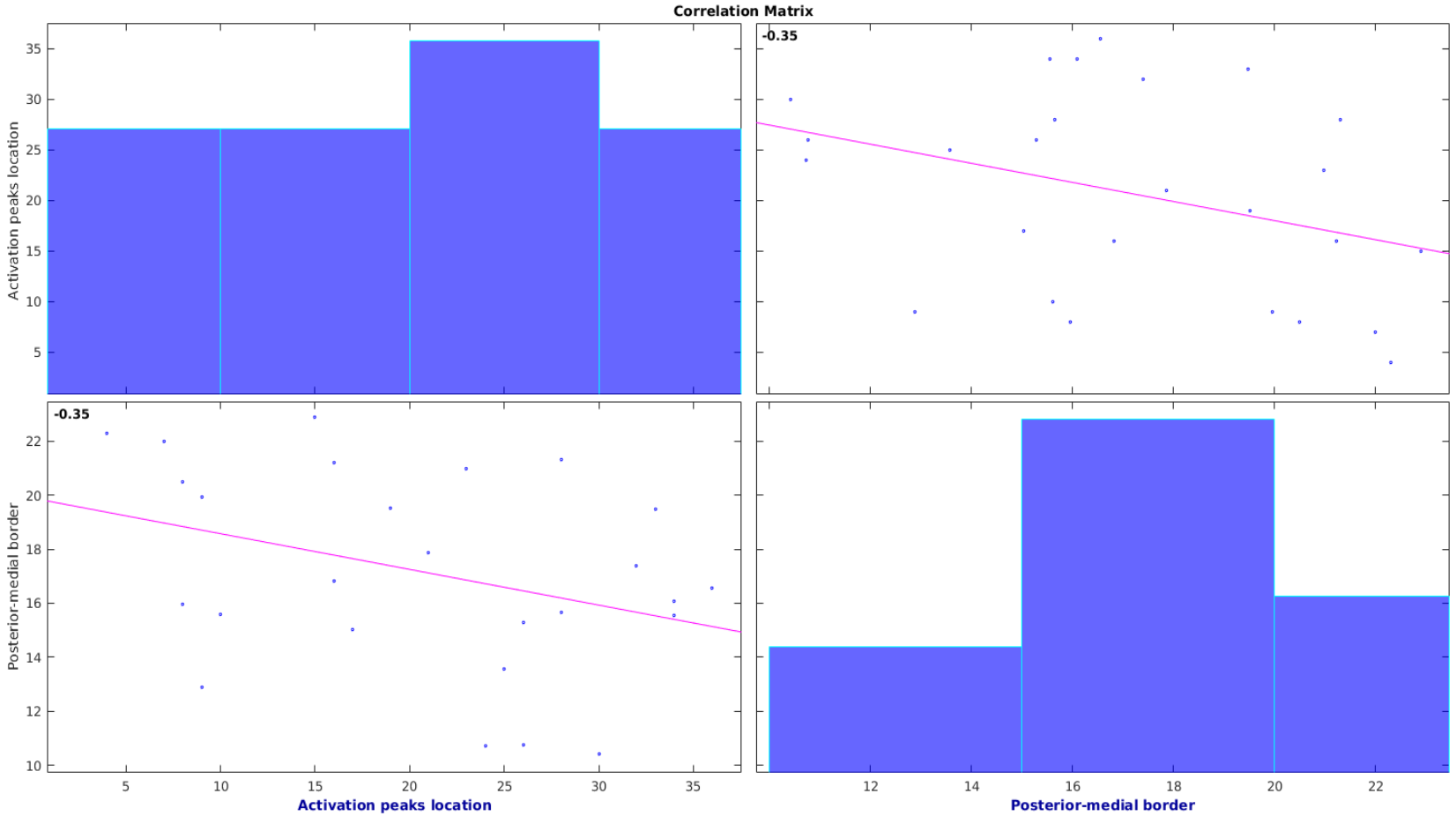


Let’s try another contrast: JP - RWO



Goucha et al; 2015

JP-RWO activation peaks in 44 and its correlation with Posterior-medial border of the Parcellation



Further steps:

Correspondence with manual segmentation and the parcellation. Evaluating volume of regions and its correspondence between borders.

Functional parcellation of Broca's, comparison with diffusion parcellation. The functional parcellation can be based on the work by E. Jakobsen et al. 2017.

Functional activation predicted by anatomical connectivity patterns (Saygan et al , 2011).

ICA group parcellation


MAX
PLANCK
INSTITUTE
FOR
HUMAN
COGNITIVE AND BRAIN SCIENCES
LEIPZIG