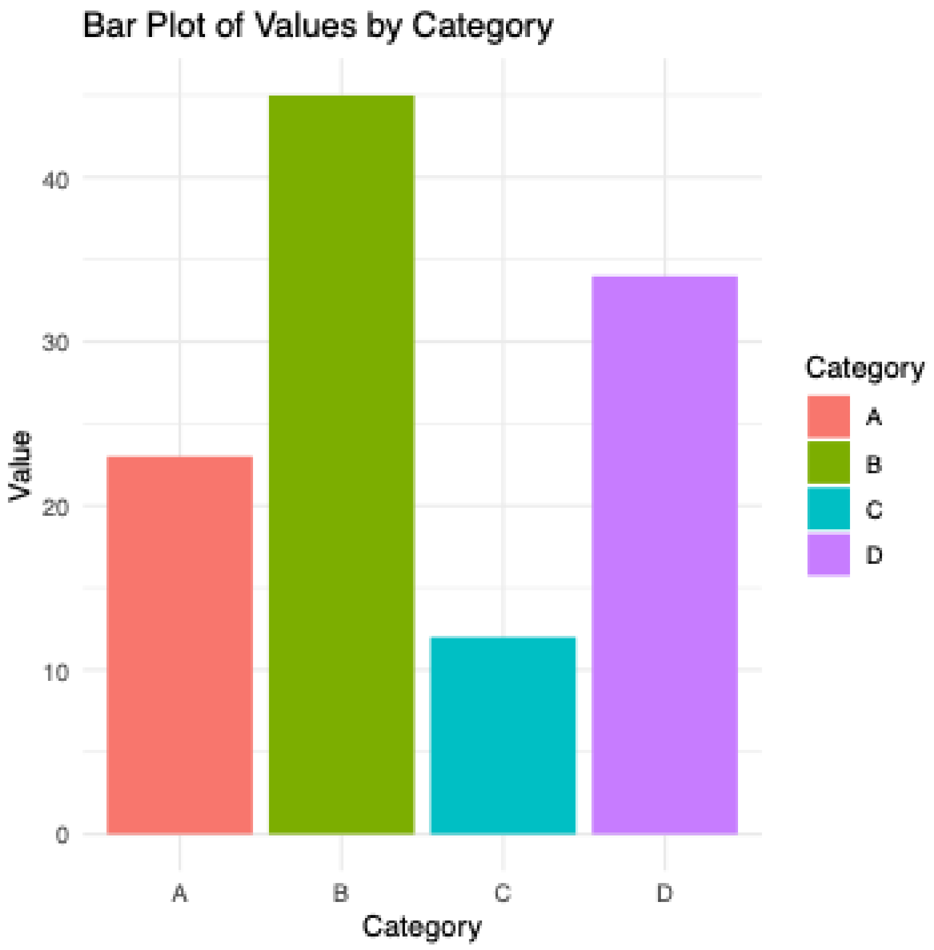
Neuroimaging data visualization

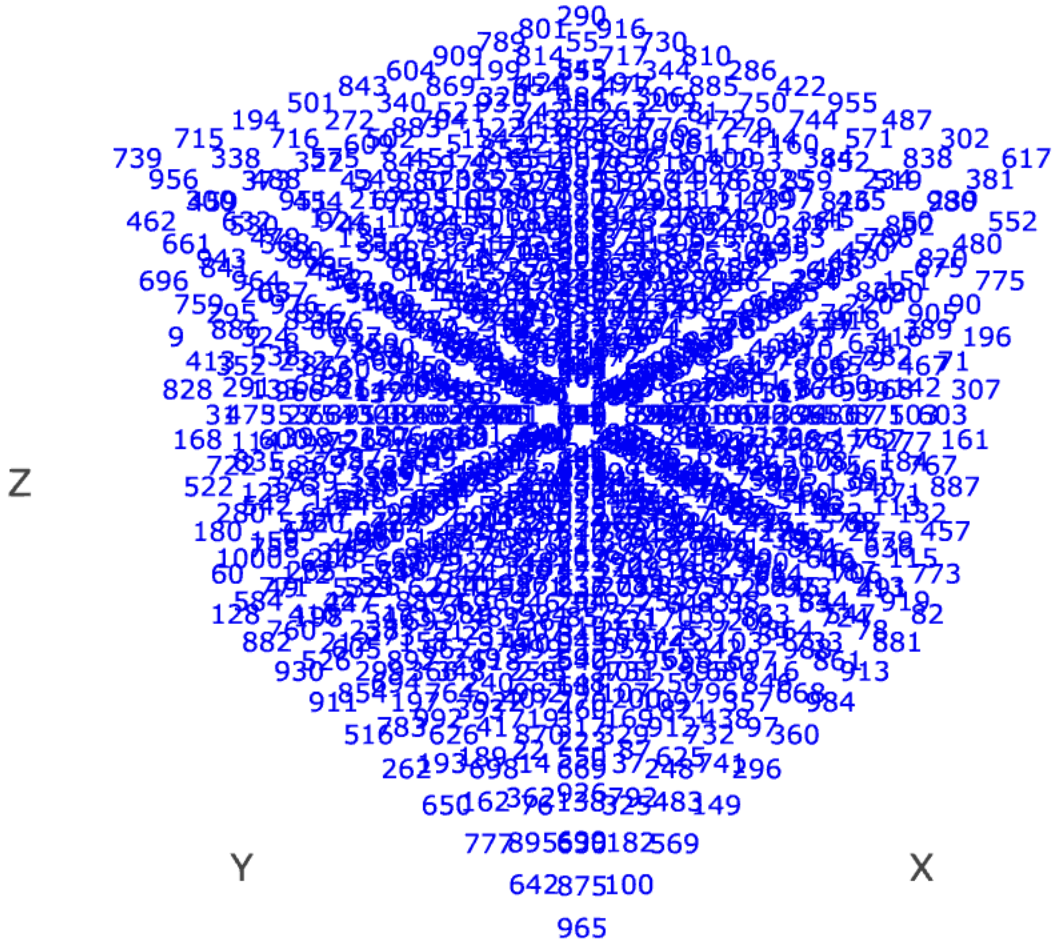
Turku PET Centre Brain Imaging Course 2024

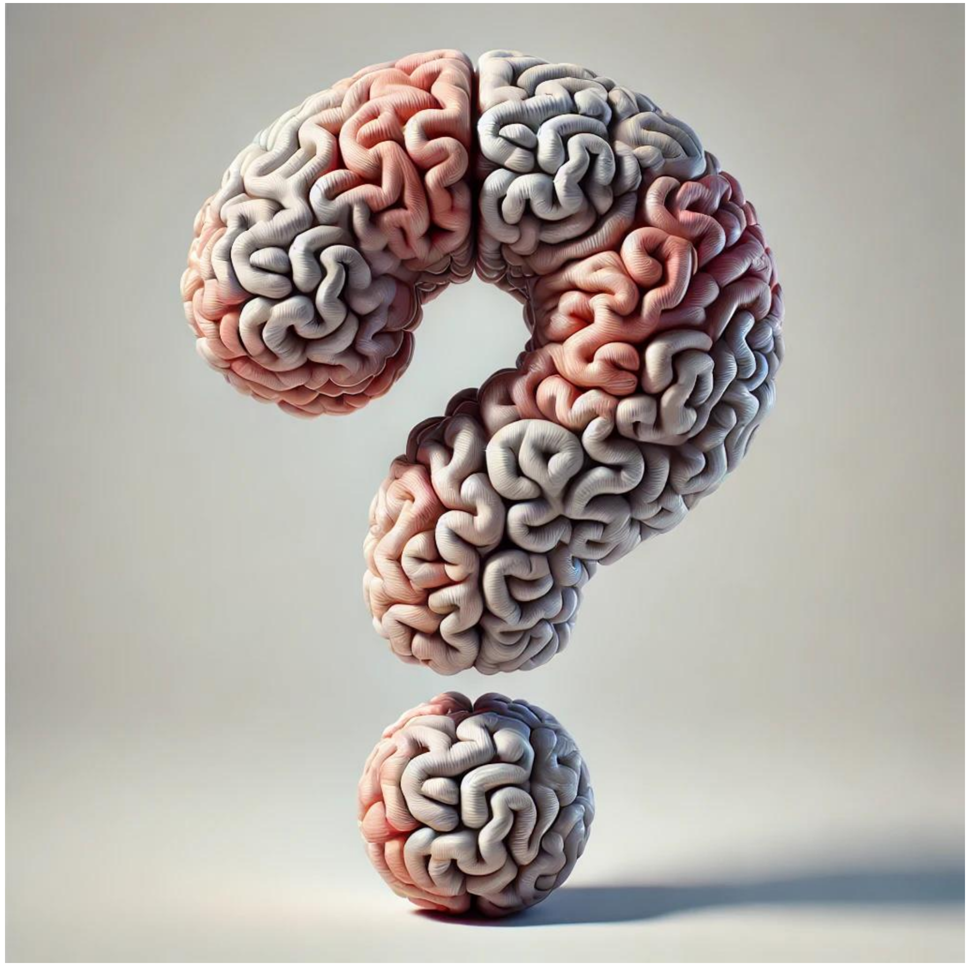
Vesa Putkinen, Turku PET Centre

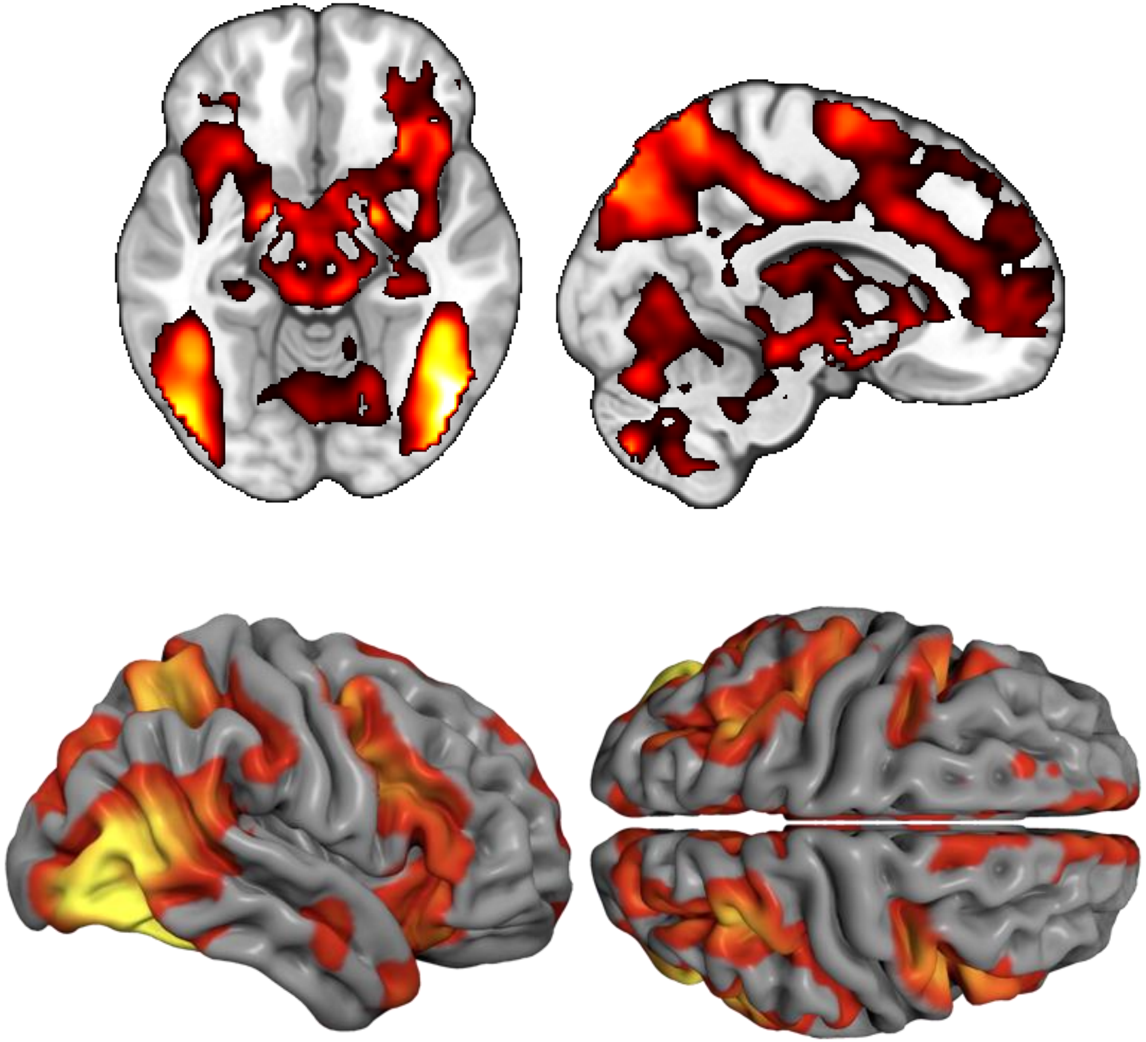
Table of Categories and Values

Category	Value
A	23
B	45
C	12
D	34

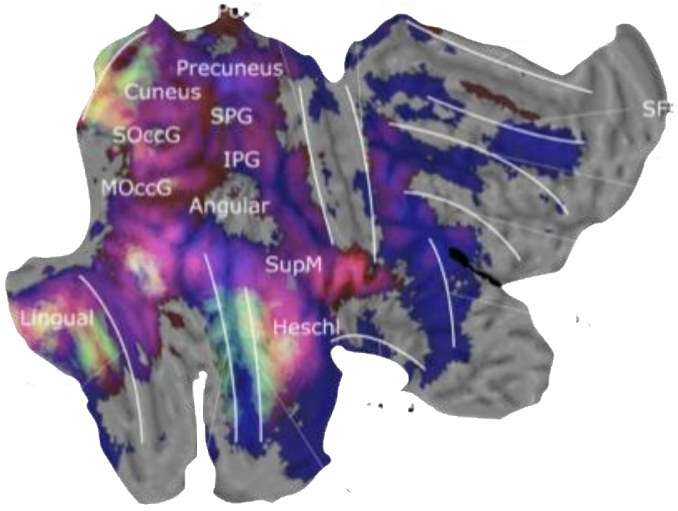



Z
Y
X





*

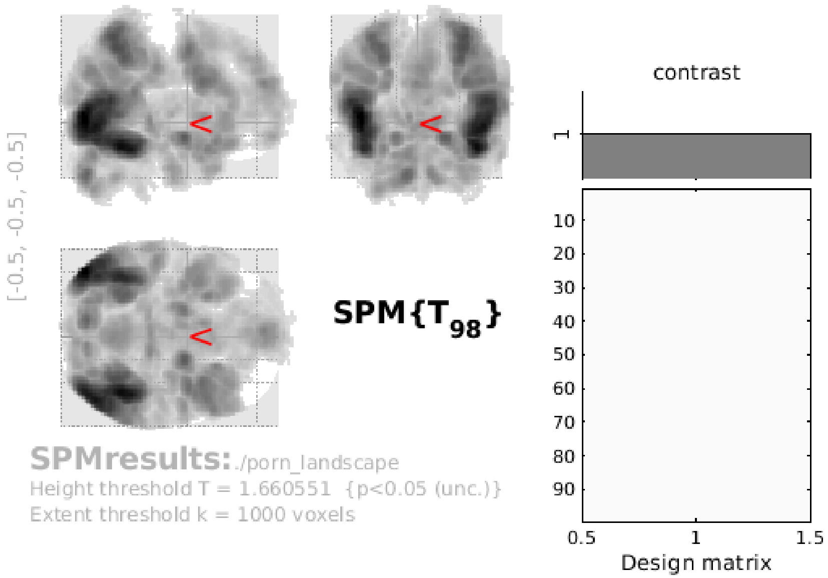


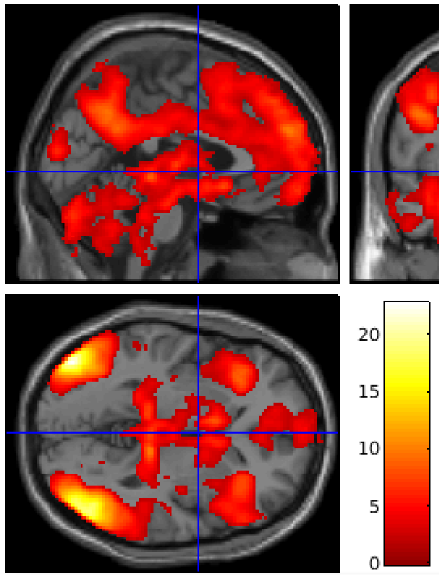
**

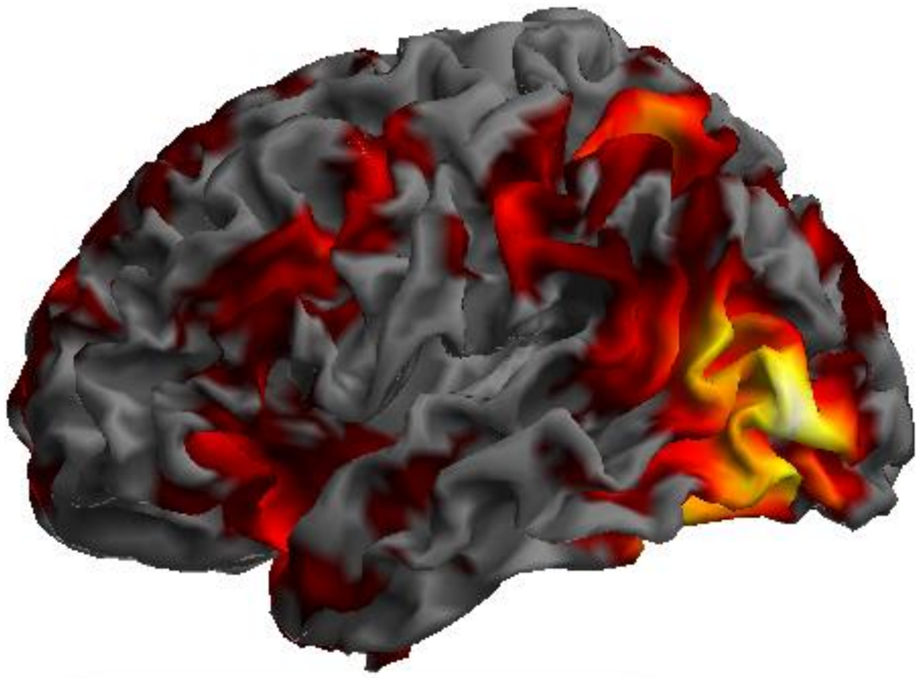
*Tuominen et al., 2015, **Santavirta et al., 2023

Neuroimaging data visualization

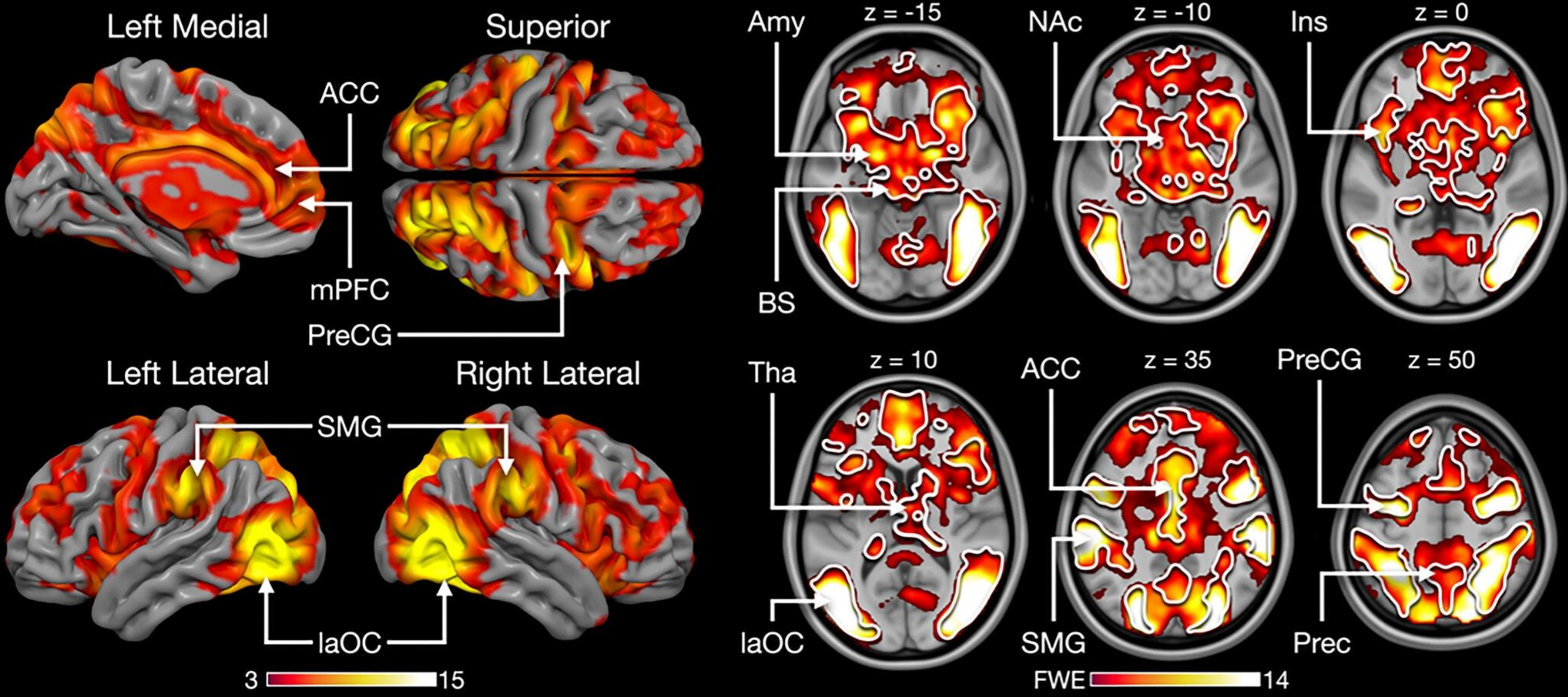
- **Clarity and Simplicity**: Keep your illustrations clear and straightforward.
- **Accurate Representation**: Ensure that your illustrations accurately represent the findings.
- **Choose the Right Visualization Type**: Select appropriate visualization type for your data.
- **Annotations and Labels**: Provide clear labels, annotations, and legends.
- **Consistency**: Maintain consistency in your illustrations throughout your publication.


[-0.5, -0.5, -0.5]
SPM{T98}
contrast
Design matrix
SPMresults: ./porn_landscape
Height threshold T = 1.660551 {p<0.05 (unc.)}
Extent threshold k = 1000 voxels





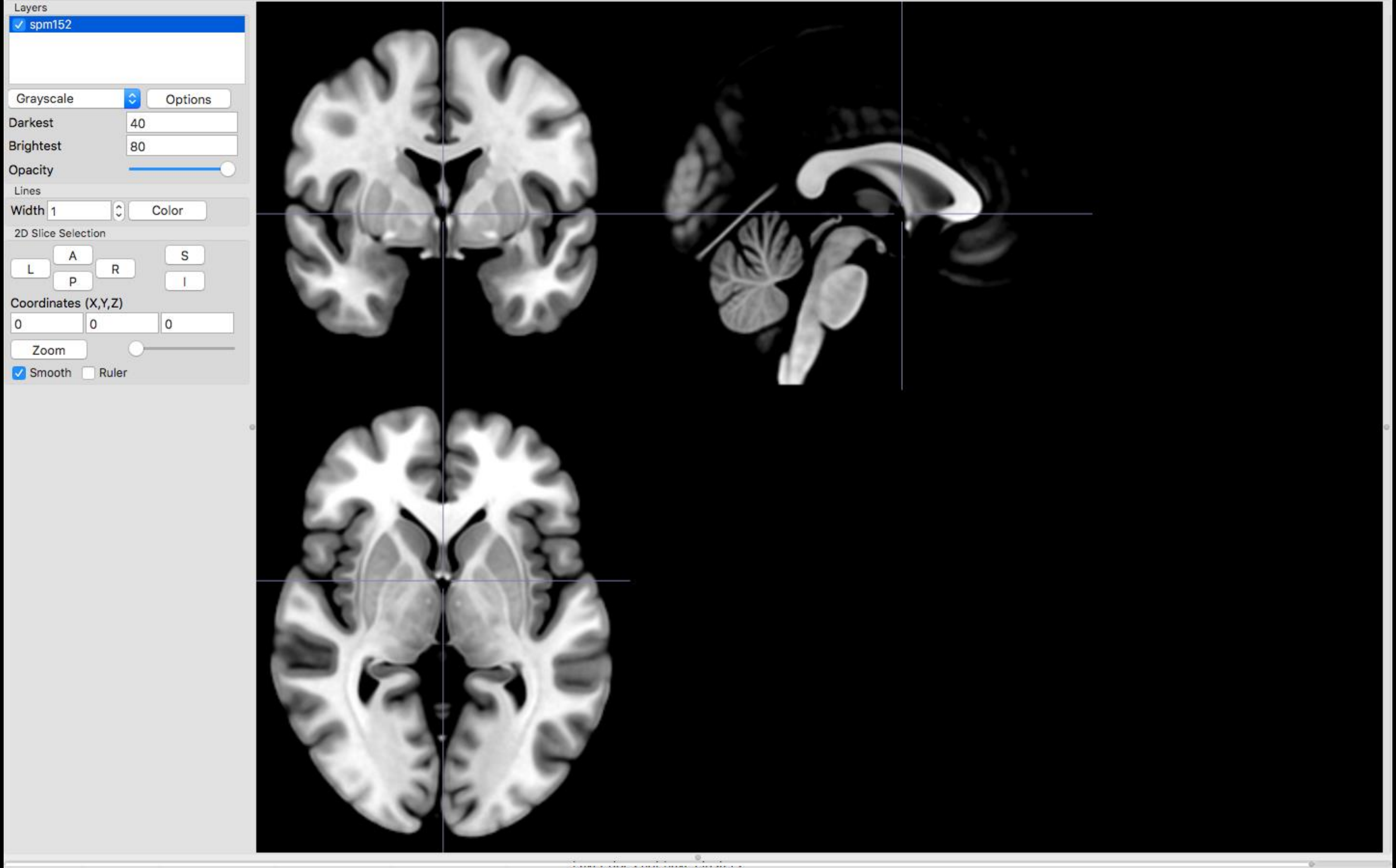
(a) Responses to sexual movies

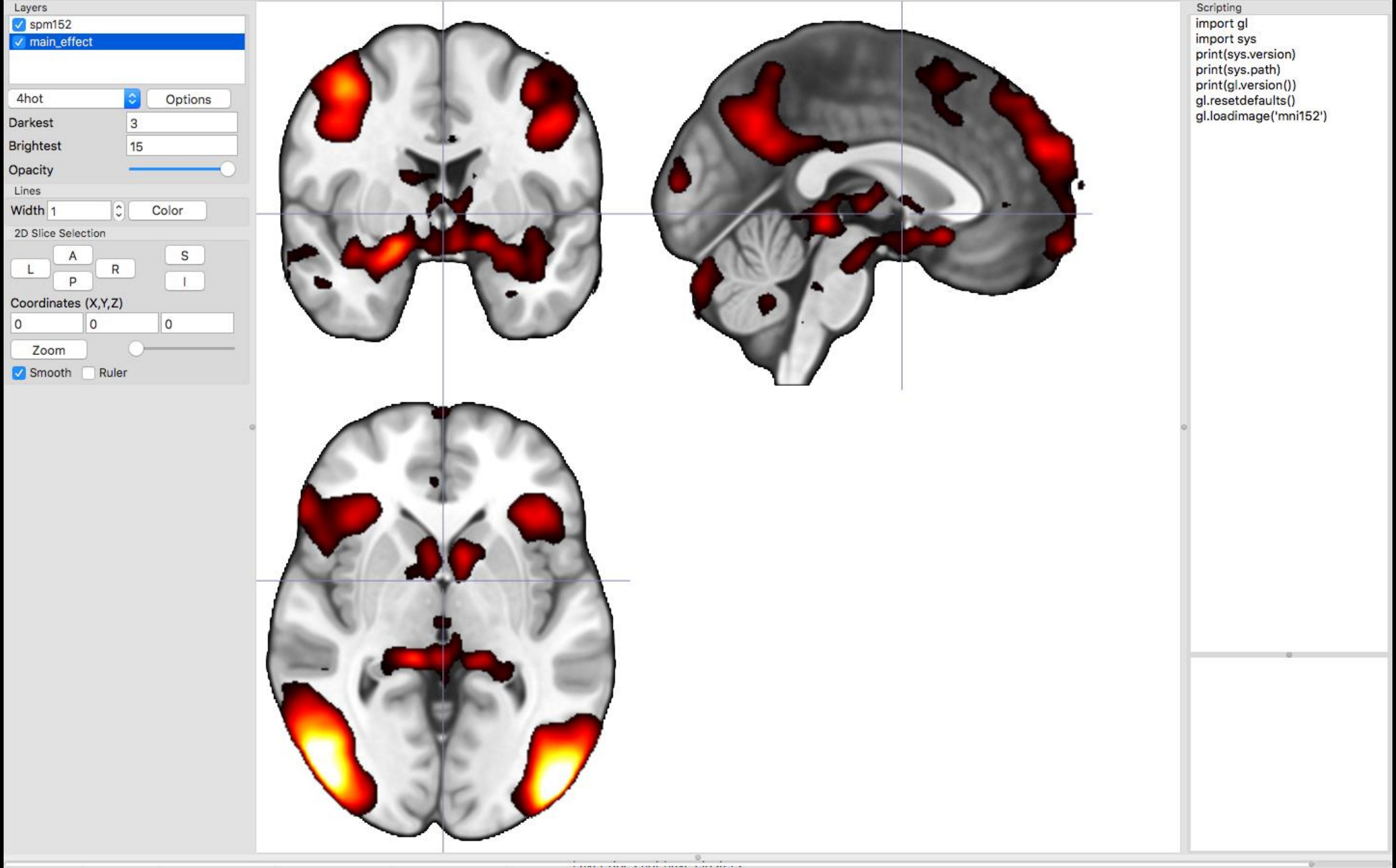


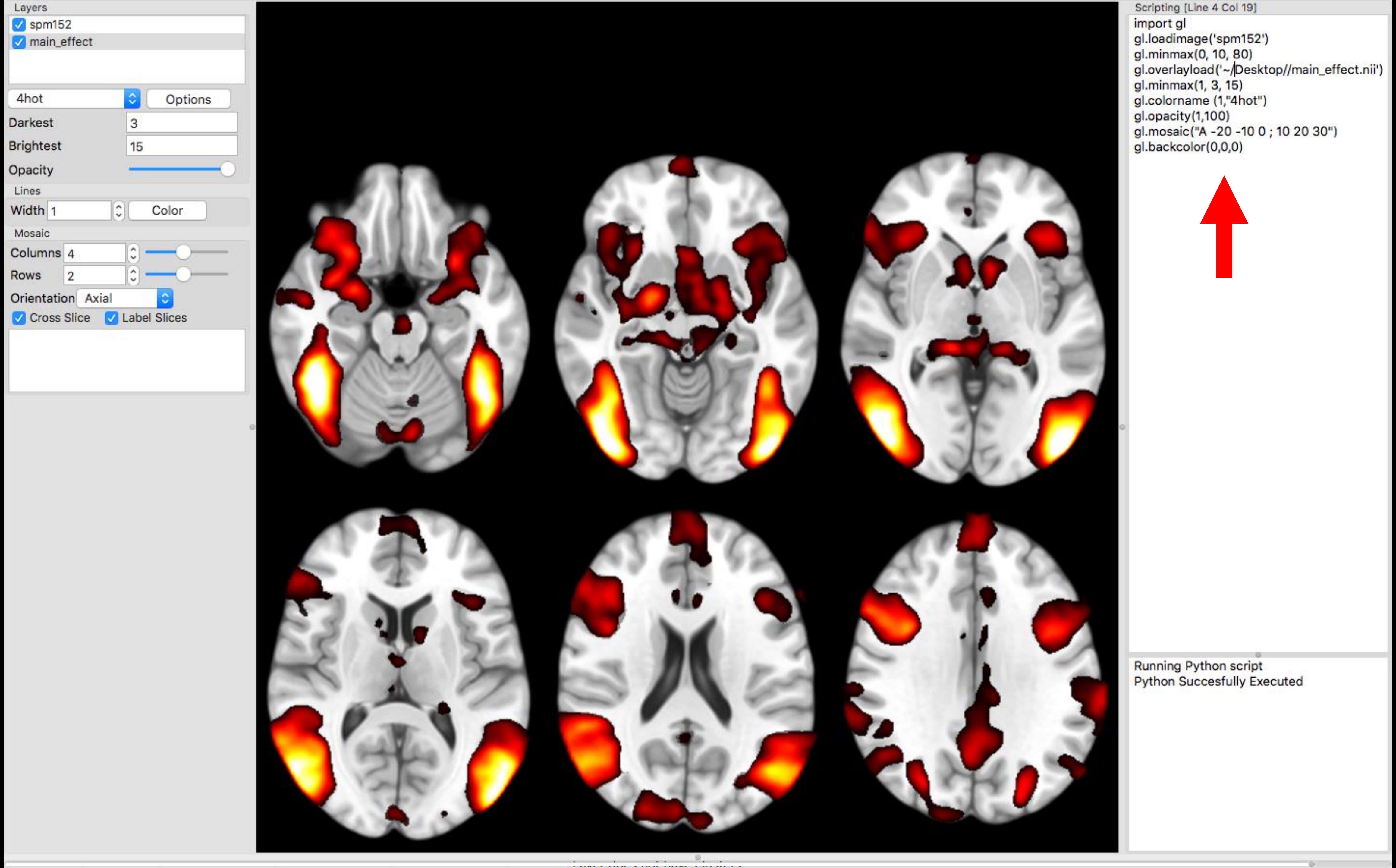
Putkinen et al. 2023, HBM

MRICroGL

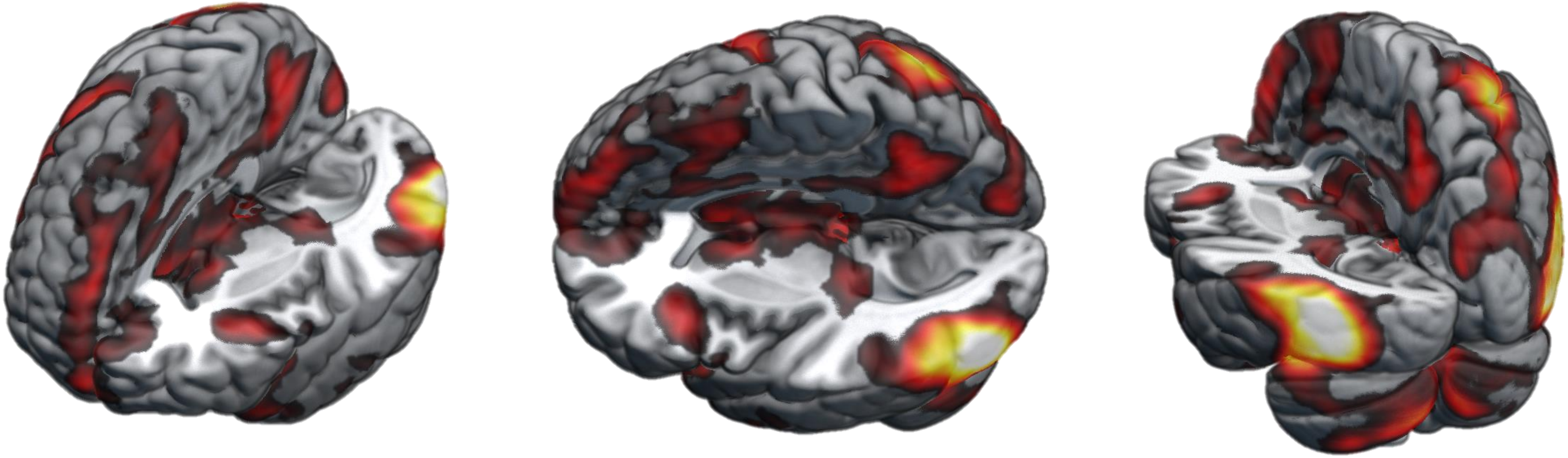
- Open source medical image viewer
- Can be downloaded for free from www.nitrc.org/ or Github
- Runs on Mac, Windows and Linux
- Includes a a graphical interface and scripting
- Scripts can be run from the GUI or invoked from the command line
- (Can do DICOM to NifTI conversion)


Layers
spm152
Grayscale
Options
Darkest
40
Brightest
80
Opacity
Lines
Width
1
Color
2D Slice Selection
A
L
R
S
P
I
Coordinates (X,Y,Z)
0
0
0
Zoom
Smooth
Ruler


Layers
spm152
main_effect
4hot
Options
Darkest
3
Brightest
15
Opacity
Lines
Width
1
Color
2D Slice Selection
A
L
R
P
S
I
Coordinates (X,Y,Z)
0
0
0
Zoom
Smooth
Ruler
Scripting
import gl
import sys
print(sys.version)
print(sys.path)
print(gl.version())
gl.resetdefaults()
gl.loadimage('mni152')

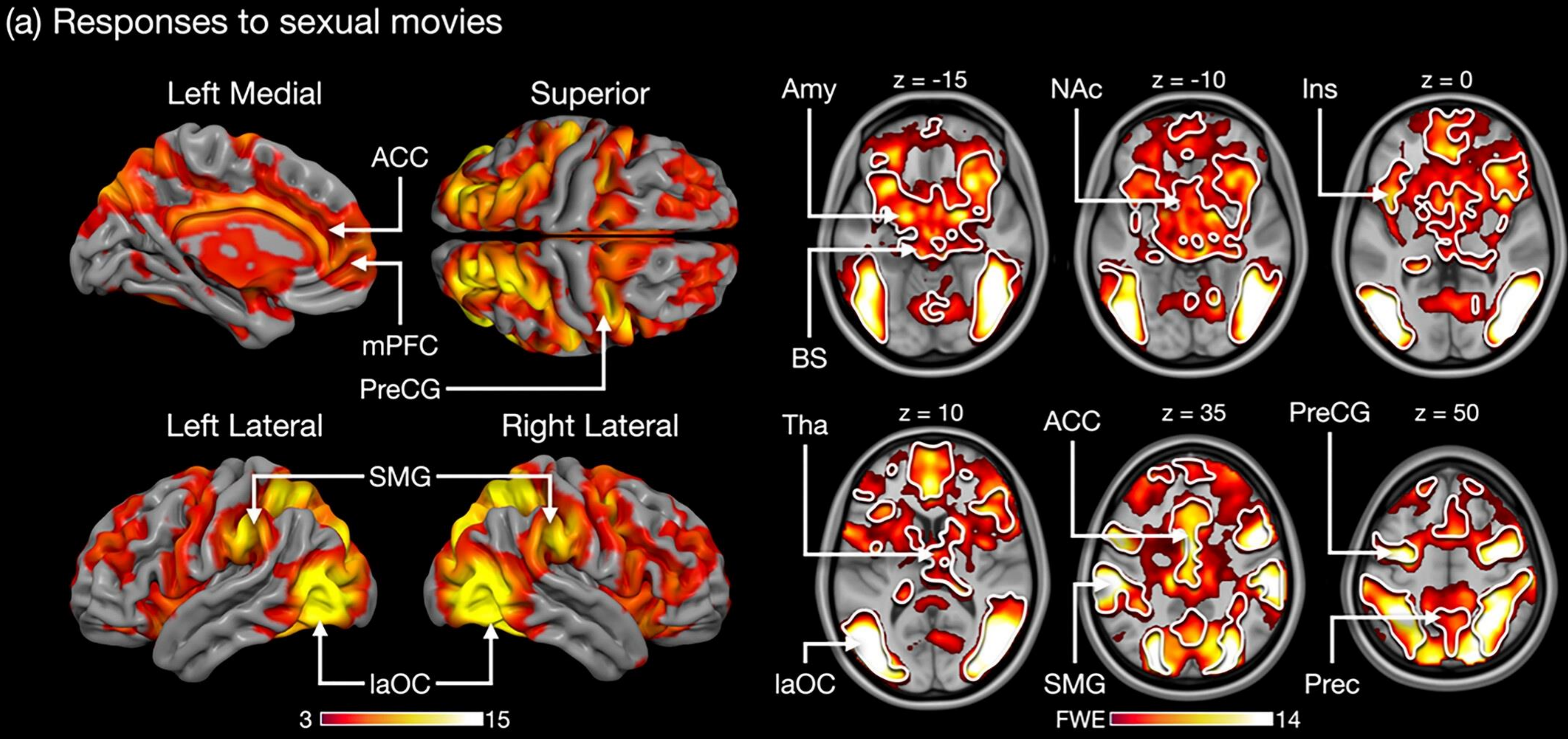

Layers
spm152
main_effect
4hot
Options
Darkest 3
Brightest 15
Opacity
Lines
Width 1
Color
Mosaic
Columns 4
Rows 2
Orientation Axial
Cross Slice
Label Slices
Scripting [Line 4 Col 19]
import gl
gl.loadimage('spm152')
gl.minmax(0, 10, 80)
gl.overlayload('~/Desktop//main_effect.nii')
gl.minmax(1, 3, 15)
gl.colorname (1,"4hot")
gl.opacity(1,100)
gl.mosaic("A -20 -10 0 ; 10 20 30")
gl.backcolor(0,0,0)
Running Python script
Python Succesfully Executed

Volume Rendering with MRIcroGL



Note!

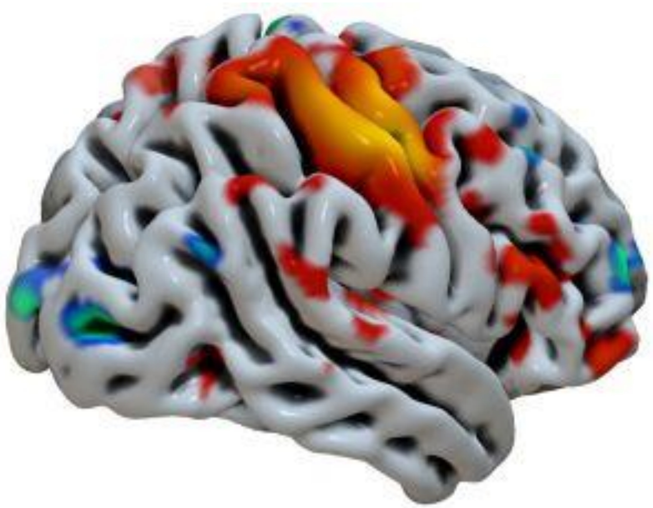
- **Orientation:** Different visualization tools display images either in radiological (left on right) or neurological (left on left) convention by default.
- **Interpolation:** If overlays have a different resolution from the background image, they need to be resampled. Different software may do this differently by default (e.g. FSLeyes vs. MRIcroGL)
- **Smoothing:** Visualization tools may apply smoothing to the overlays.

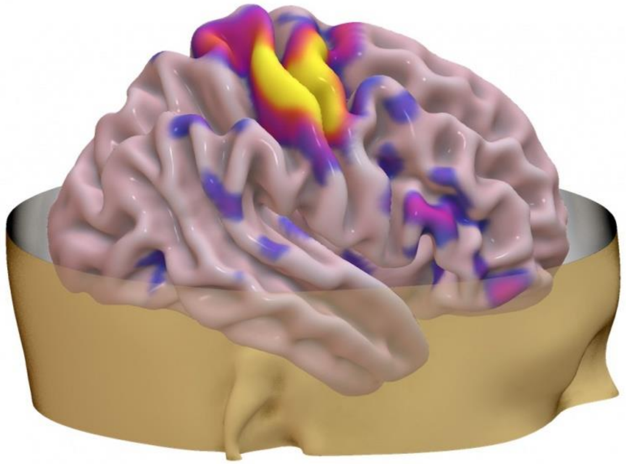


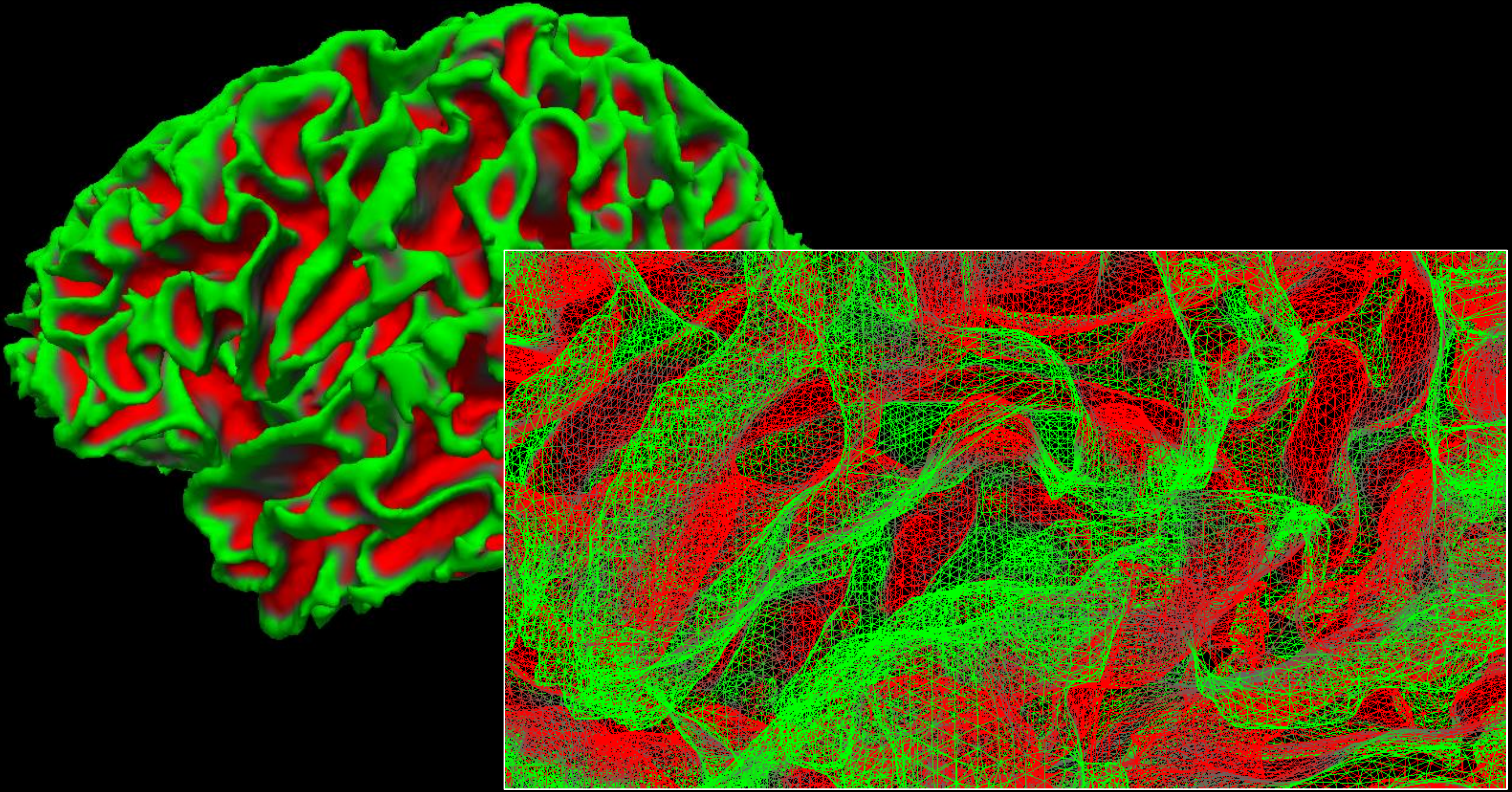
Putkinen et al. 2023, HBM

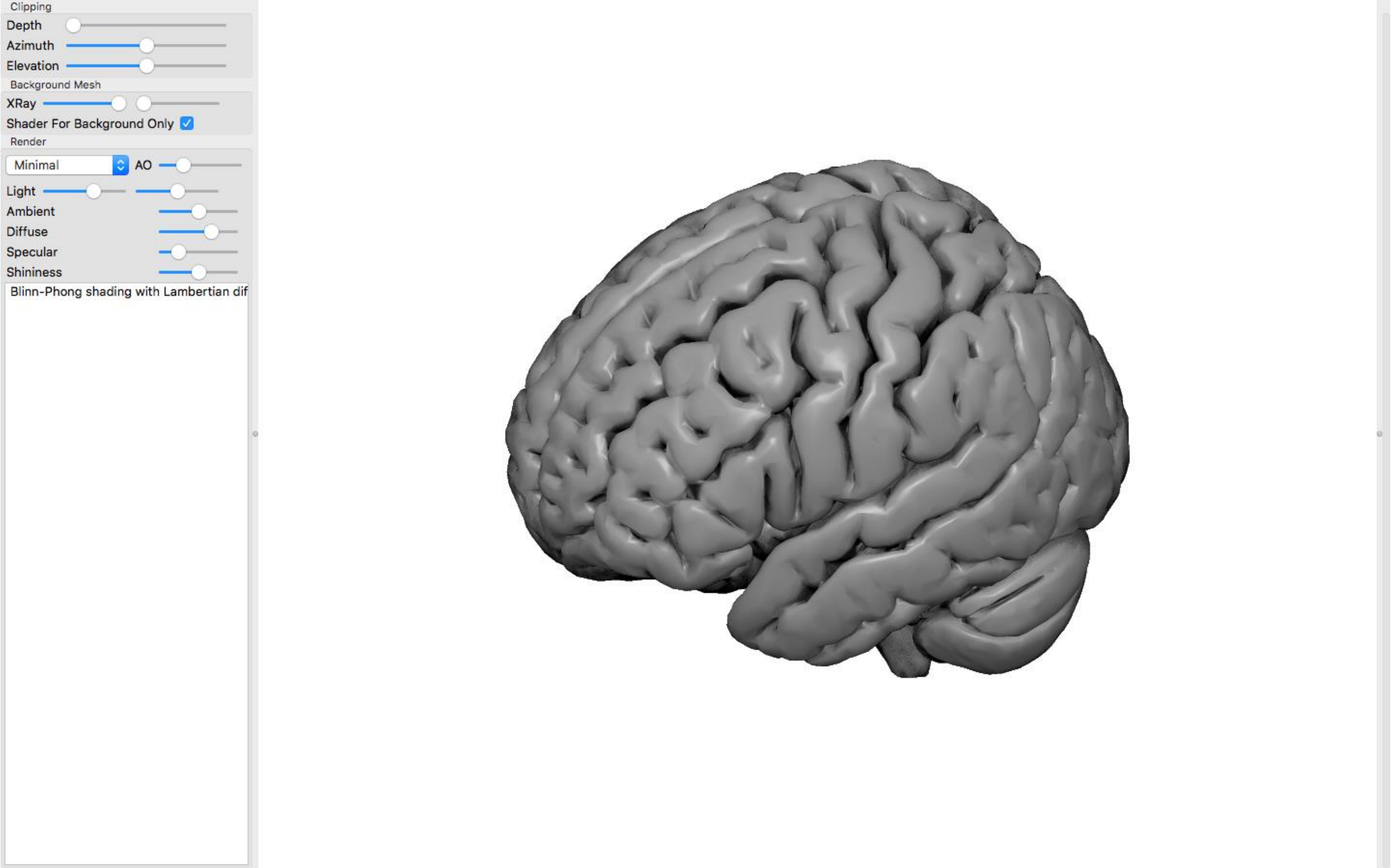
Surf Ice

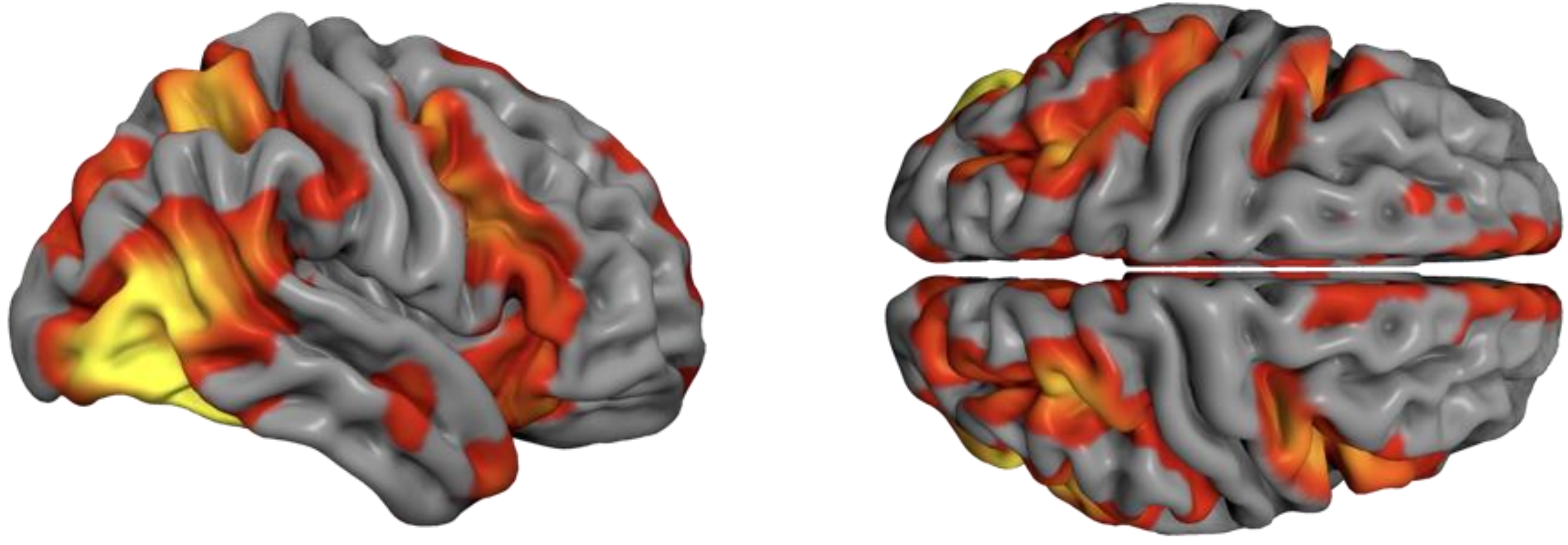
- A surface renderer closely related to MRIcroGL
- Can also be downloaded for free from www.nitrc.org/ or Github
- Similar scripting capabilities as MRIcroGL

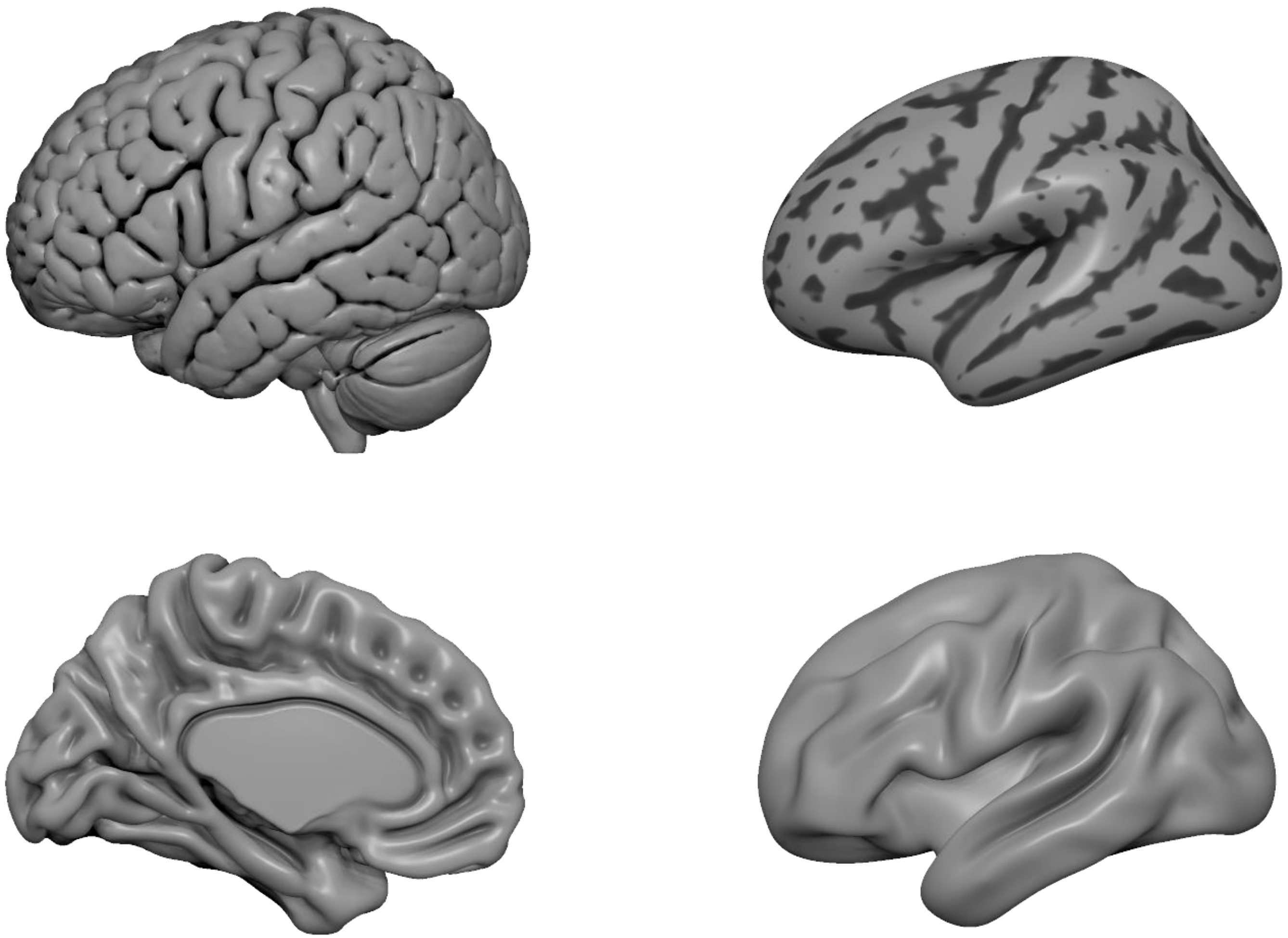


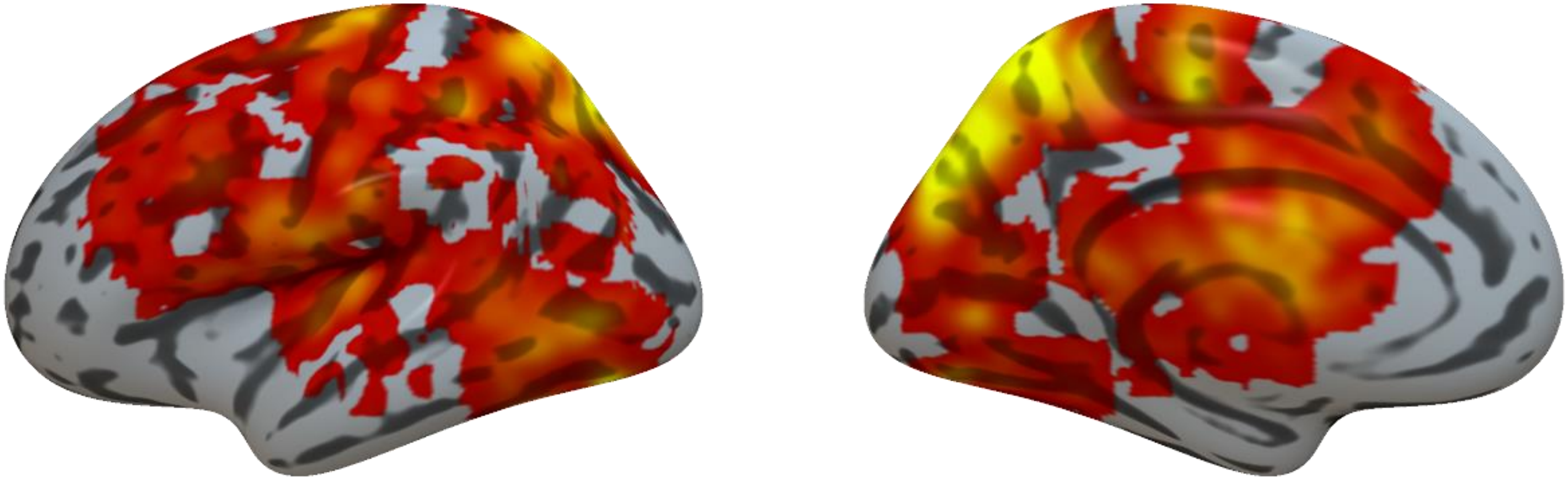


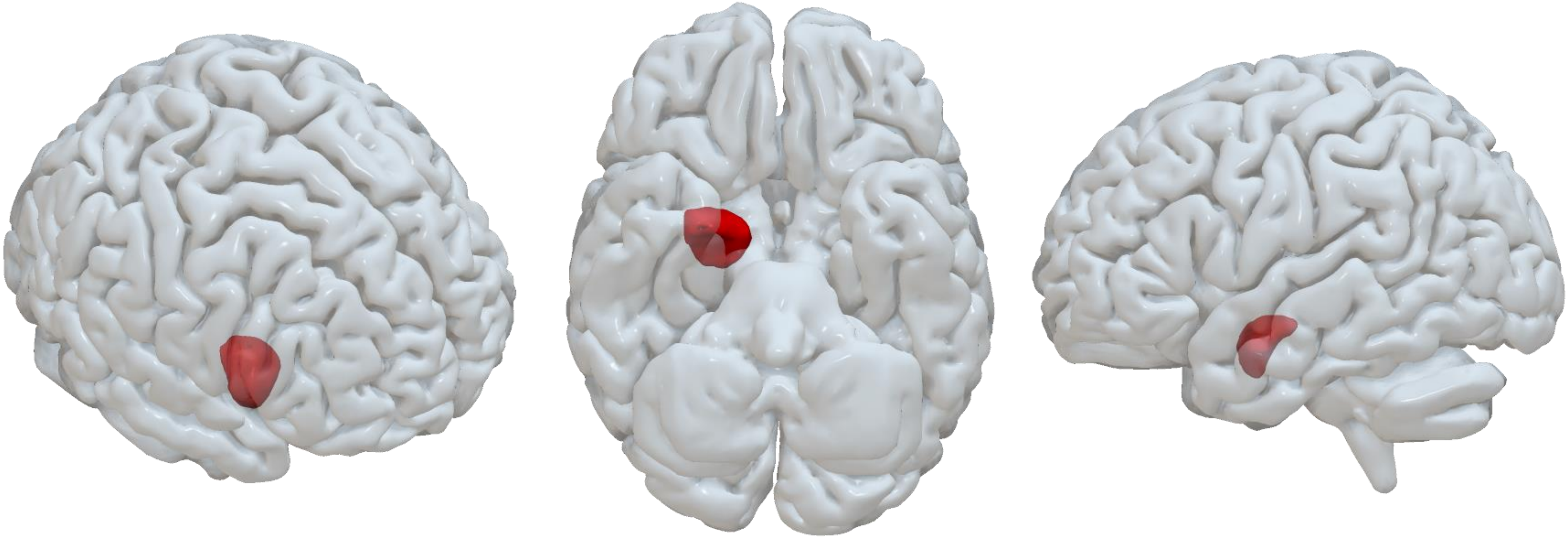



Clipping
Depth
Azimuth
Elevation
Background Mesh
XRay
Shader For Background Only
Render
Minimal
AO
Light
Ambient
Diffuse
Specular
Shininess
Blinn-Phong shading with Lambertian dif



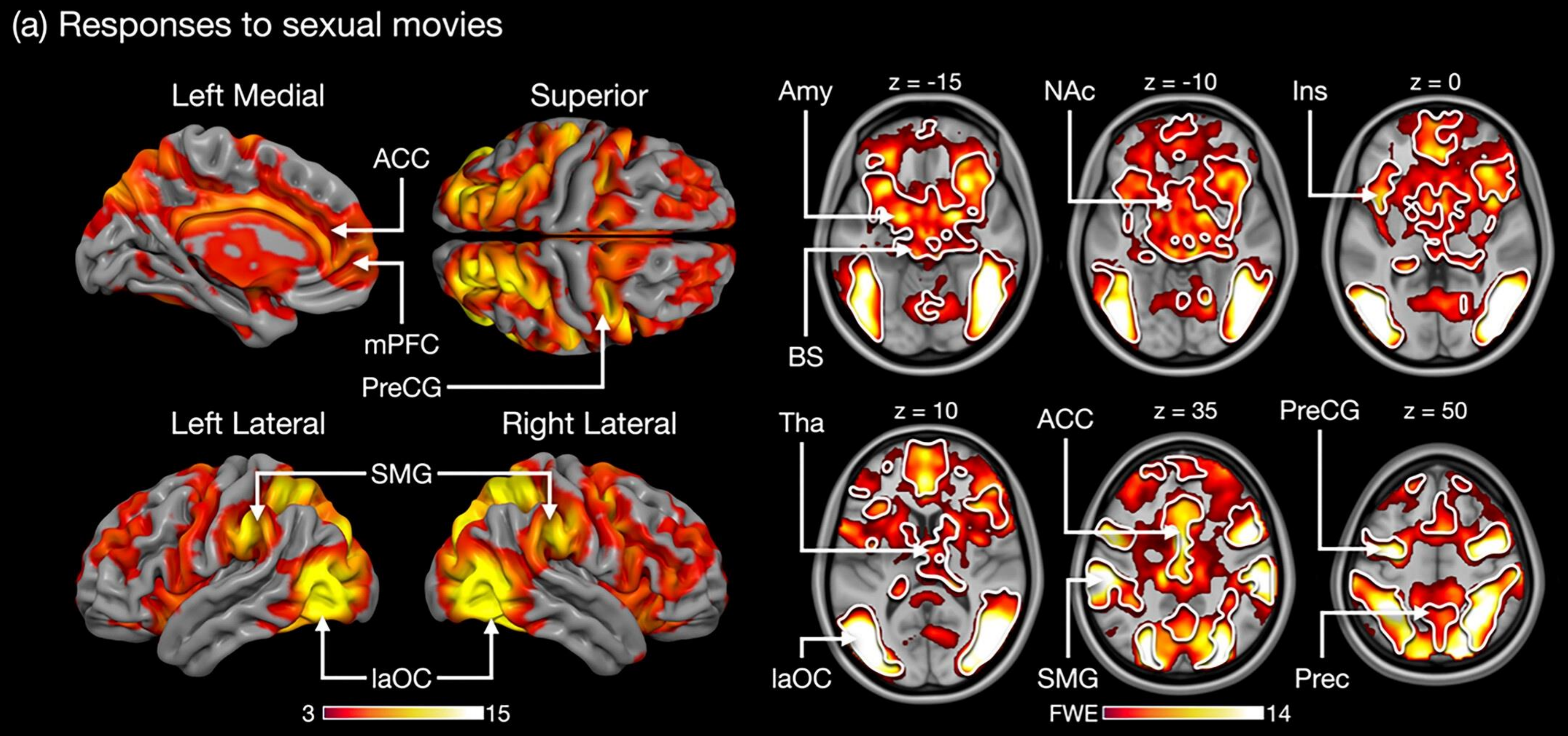




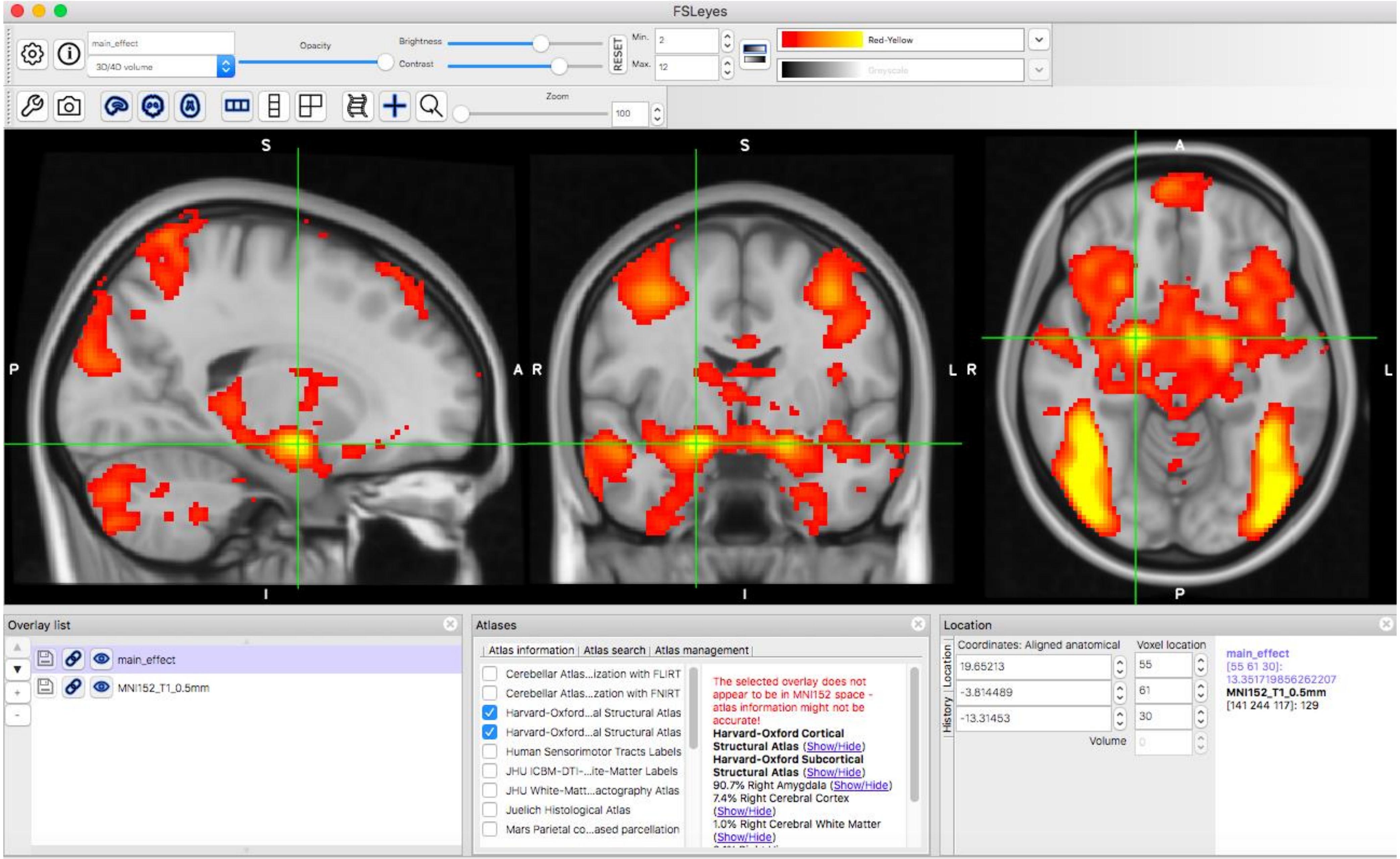


Advanced > Convert voxelwise volume to mesh

```
import gl
gl.resetdefaults()
gl.meshload('BrainMesh_ICBM152.rh.mz3')
gl.overlayload('motor_4t95mesh.rh.mz3')
gl.overlaycolorname(1, 'red')
gl.shaderxray(1.0, 0.3)
gl.azimuthelevation(110, 15)
gl.meshcurv()
```

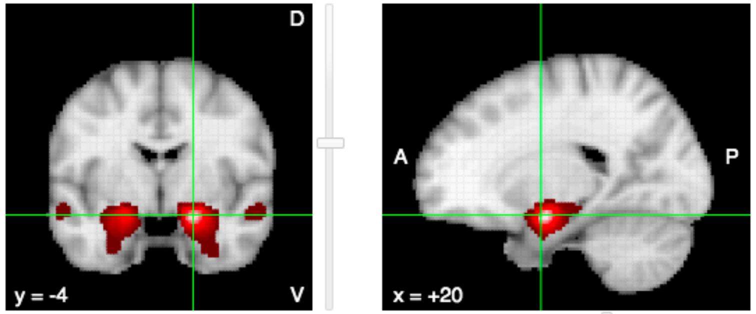


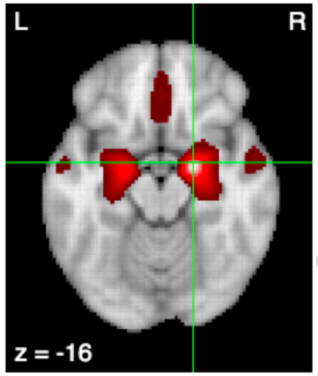
Putkinen et al. 2023, HBM


FSLeyes
main_effect
3D/4D volume
Opacity
Brightness
Contrast
RESET
Min. 2
Max. 12
Red-Yellow
Greyscale
Zoom
100
S
P
A
I
R
L
Overlay list
main_effect
MNI152_T1_0.5mm
Atlases
Atlas information | Atlas search | Atlas management
Cerebellar Atlas...ization with FLIRT
Cerebellar Atlas...zation with FNIRT
Harvard-Oxford...al Structural Atlas
Harvard-Oxford...al Structural Atlas
Human Sensorimotor Tracts Labels
JHU ICBM-DTI-...ite-Matter Labels
JHU White-Matt...actography Atlas
Juelich Histological Atlas
Mars Parietal co...ased parcellation
The selected overlay does not appear to be in MNI152 space - atlas information might not be accurate!
Harvard-Oxford Cortical Structural Atlas (Show/Hide)
Harvard-Oxford Subcortical Structural Atlas (Show/Hide)
90.7% Right Amygdala (Show/Hide)
7.4% Right Cerebral Cortex (Show/Hide)
1.0% Right Cerebral White Matter (Show/Hide)
Location
Coordinates: Aligned anatomical
Voxel location
19.65213
-3.814489
-13.31453
55
61
30
Volume
0
Location
History
main_effect
[55 61 30]:
13.351719856262207
MNI152_T1_0.5mm
[141 244 117]: 129

Maps Studies Associations FAQs

Functional connectivity and coactivation maps





corr. (r): 1

What's here?

X: 0 Y: 0 Z: 0

Description

This image displays resting-state functional connectivity for the seed region in a sample of 1,000 subjects. To reduce blurring of signals across cerebro-cerebellar and cerebro-striatal boundaries, fMRI signals from adjacent cerebral cortex were regressed from the cerebellum and striatum. For details, see Yeo etal (2011), Buckner et al (2011), and Choi et al (2012).

Associations with meta-analysis maps

Show 10 entries

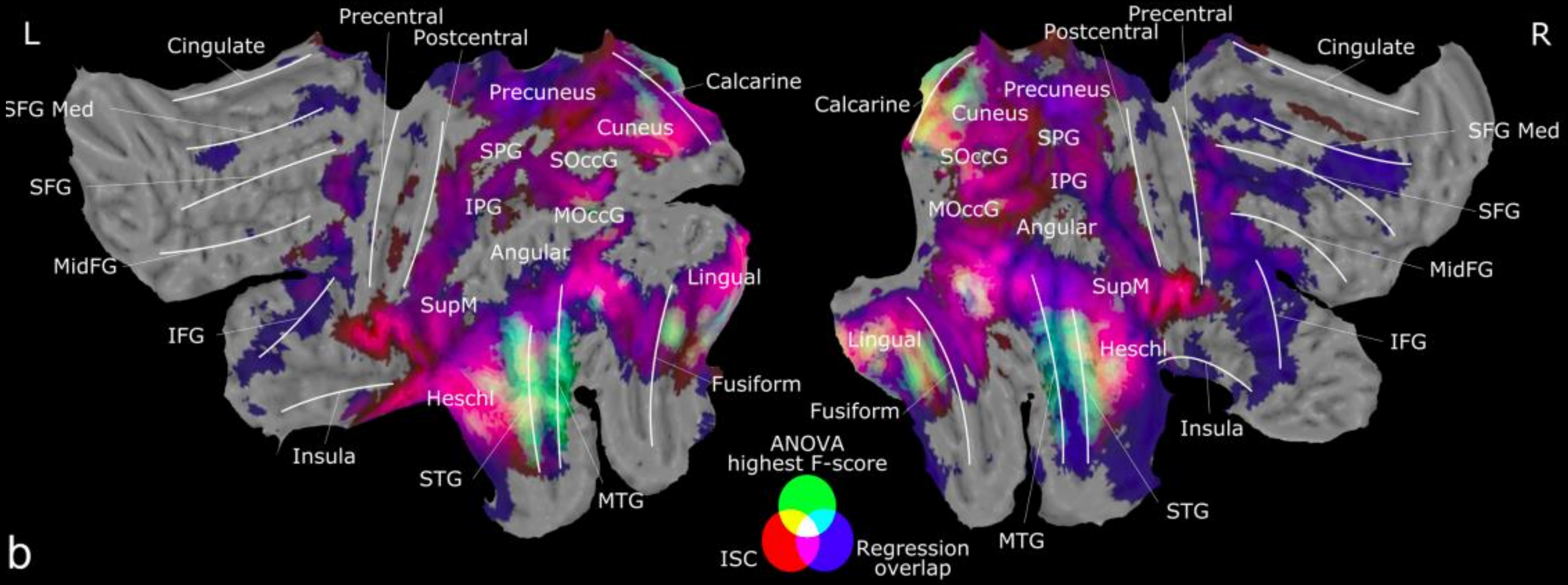
Search:

	Individual voxel		Seed-based network	
Name	z-score	Posterior prob.	Func. conn. (r)	Meta-analytic coact. (r)
amygdala	33.11	0.89	0.46	0.74
emotional	18.23	0.79	0.39	0.65
faces	15.5	0.79	0.24	0.5
neutral	15.5	0.79	0.38	0.68
fear	13.8	0.82	0.32	0.59
facial	13.41	0.8	0.31	0.6
mood	13.3	13.3	0.13	0.4
face	11.86	0.75	0.17	0.38
fearful	11.86	0.82	0.34	0.67
expressions	11.18	0.79	0.32	0.61

Showing 1 to 10 of 1,334 entries

First Previous 1 2 3 4 5 ... 134 Next Last

www.neurosynth.org



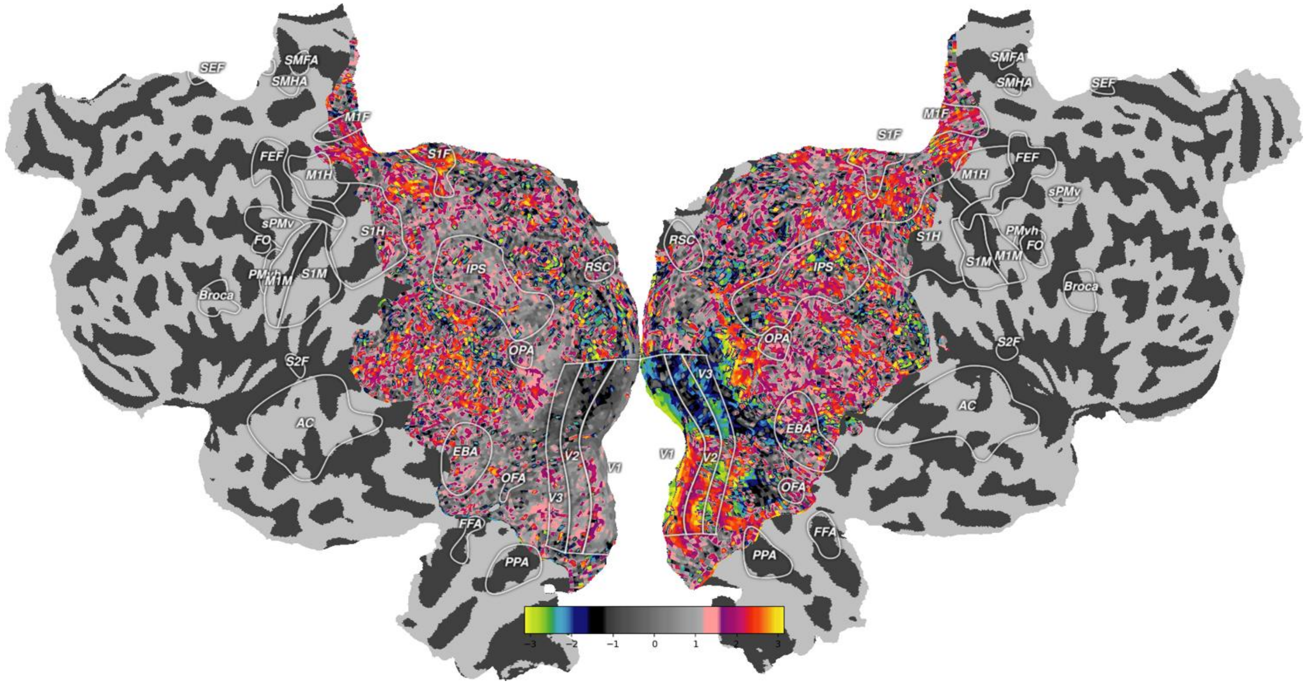
Santavirta et al. NeuroImage, 2023

PyCortex

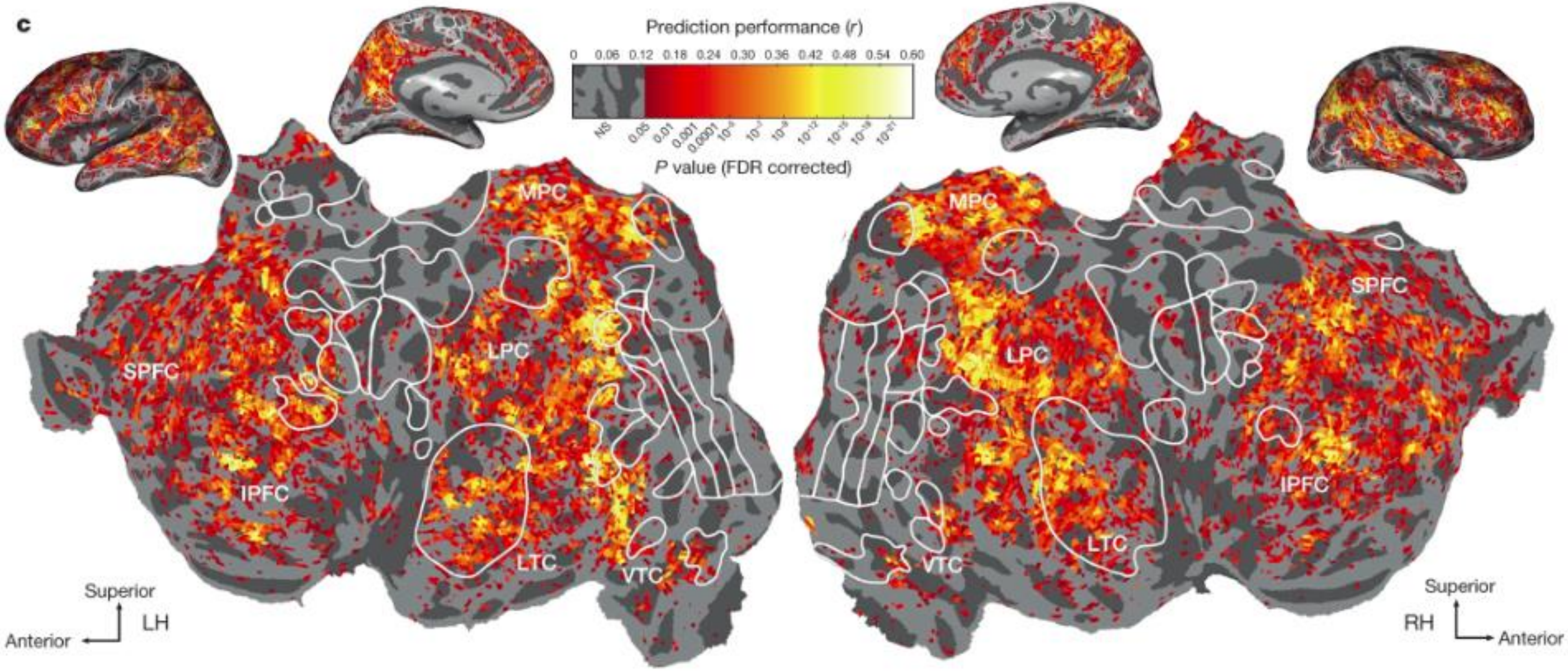
- Python package for generating 3D visualizations of fMRI data projected onto cortical surface.
- Allows interactive data visualizations in a web browser.
- Can generate 2D flattened cortical visualizations.
- **Github:** https://github.com/gallantlab/pycortex
- **Documentation:** https://gallantlab.org/pycortex/
- **Ref:** Gao, J. S., Huth, A. G., Lescroart, M. D., & Gallant, J. L. (2015). Pycortex: an interactive surface visualizer for fMRI. *Frontiers in neuroinformatics*, 23.

PyCortex

```python
import six
import cortex
import matplotlib.pyplot as plt
if six.PY2:
    from urllib import urlretrieve
elif six.PY3:
    from urllib.request import urlretrieve


# Download the dataset and load it
_ = urlretrieve("http://gallantlab.org/pycortex/S1_retinotopy.hdf",
                "S1_retinotopy.hdf")
ret_data = cortex.load("S1_retinotopy.hdf")

# The retinotopy data has to be divided into left and right hemispheres
left_data = ret_data.angle_left
cortex.quickshow(left_data, with_curvature=True,
                                                              curvature_contrast=0.5,
                                                              curvature_brightness=0.5,
                                                              curvature_threshold=True)
plt.show()

right_data = ret_data.angle_right
cortex.quickshow(right_data, with_curvature=True,
                                                               curvature_contrast=0.5,
                                                               curvature_brightness=0.5,
                                                               curvature_threshold=True)
plt.show()
```



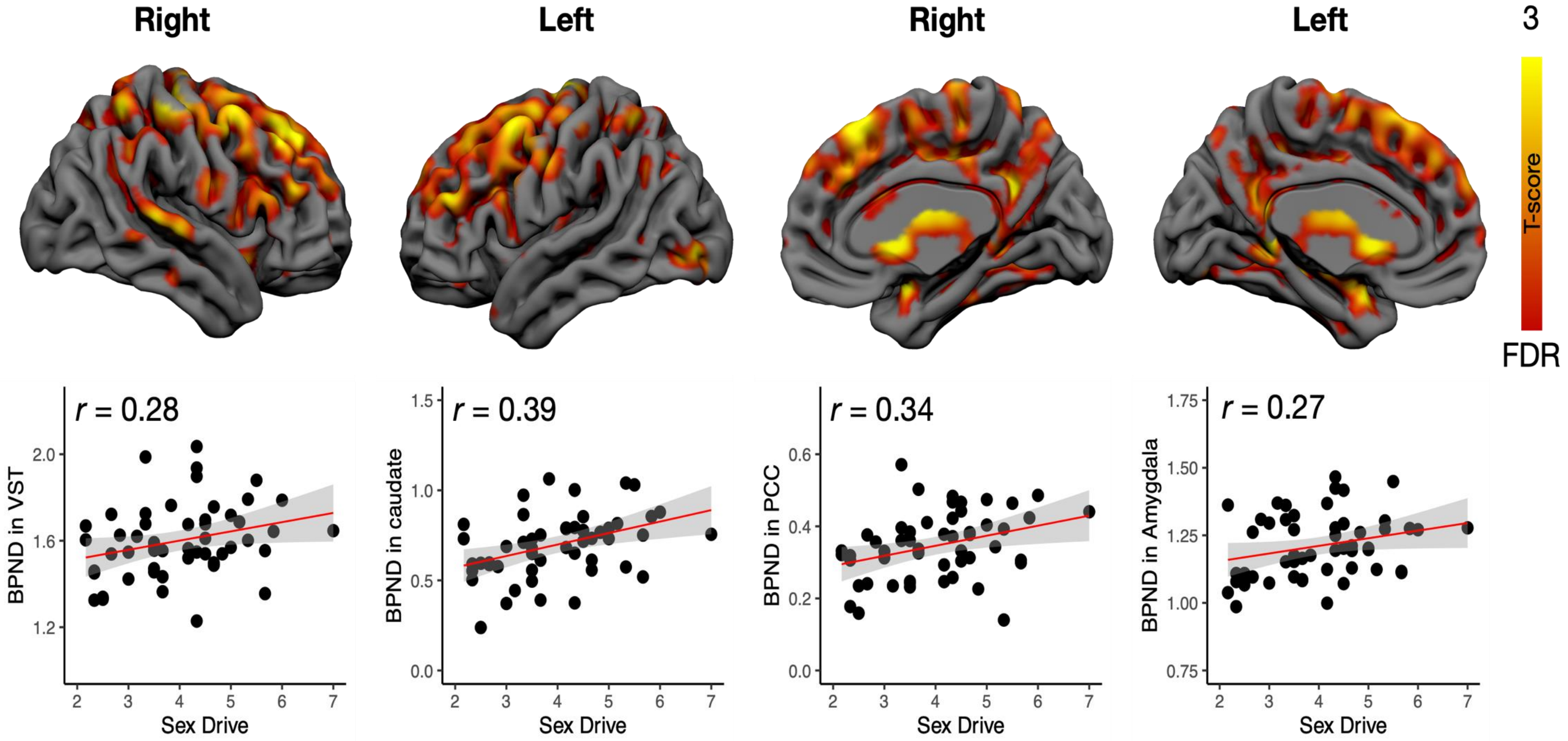
PyCortex



Huth et al, 2016, Nature

PyCortex

https://gallantlab.org/viewer-lescroart-2018/

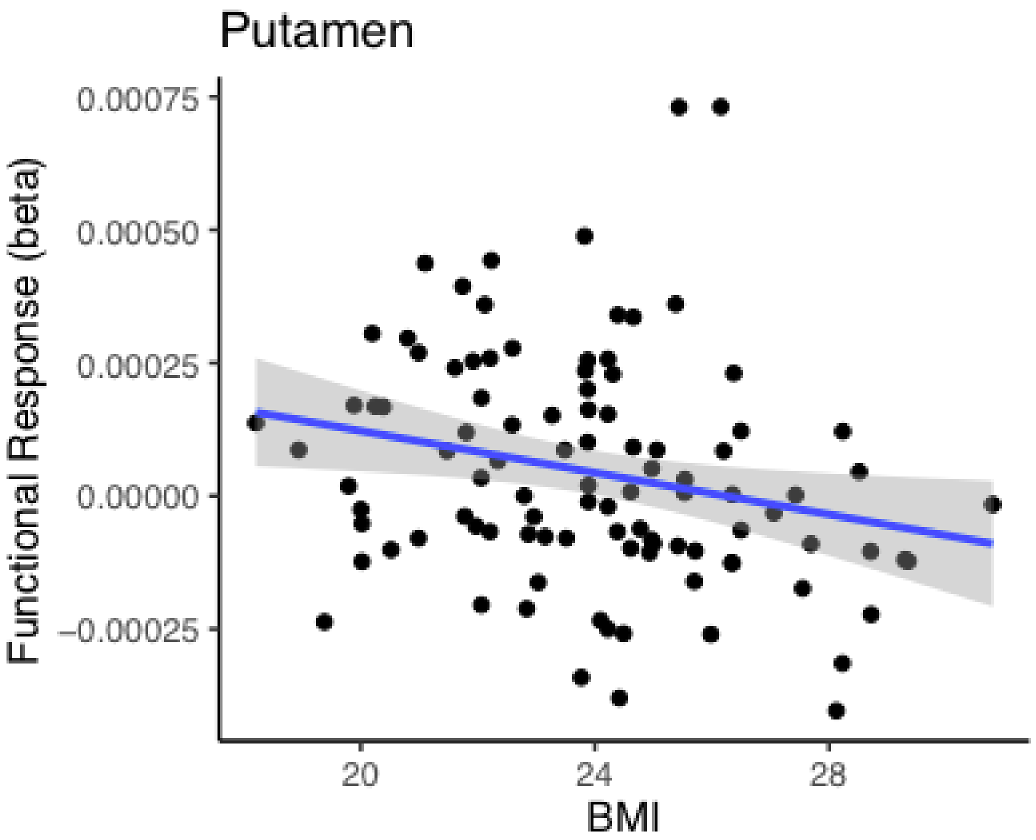


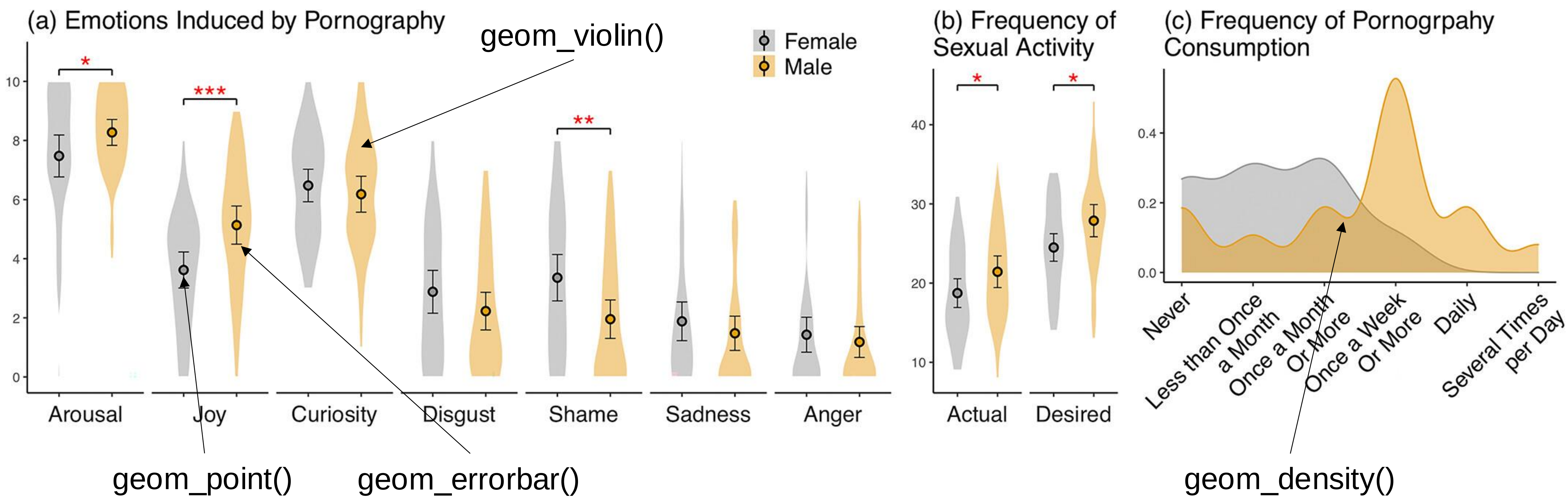
Nummenmaa et al, 2022

RStudio®

ggplot2

```r
ggplot(df,aes(bmi,beta))+
  geom_point()+
  geom_smooth(method = 'lm')+
  theme_classic()+
  xlab('BMI')+ # x axis label
  ylab('Functional Response (beta)')+
  ggtitle('Putamen')
```





Putkinen et al. 2023, HBM

geom_tile()

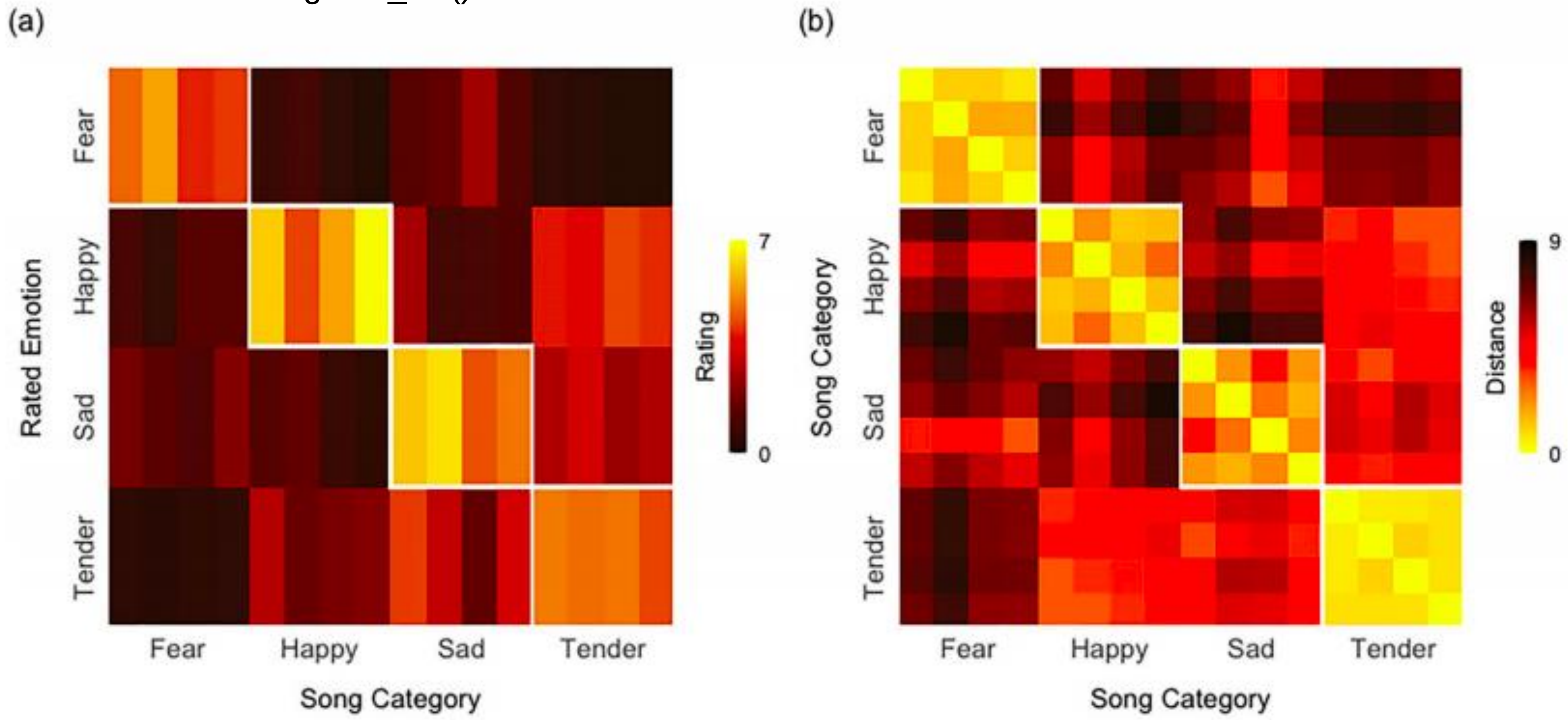


Figure 1. (a) Mean ratings for the intensity of each emotion for each musical excerpt. (b) Rating dissimilarity matrix (Euclidean distance) for each song pair.

Putkinen et al., Cerebral Cortex, 2021

https://www.rstudio.com/

https://ggplot2.tidyverse.org/