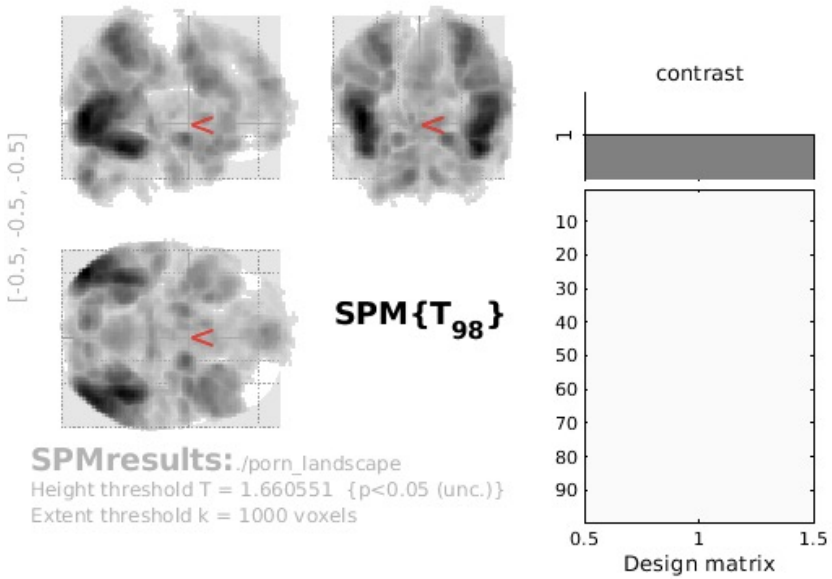
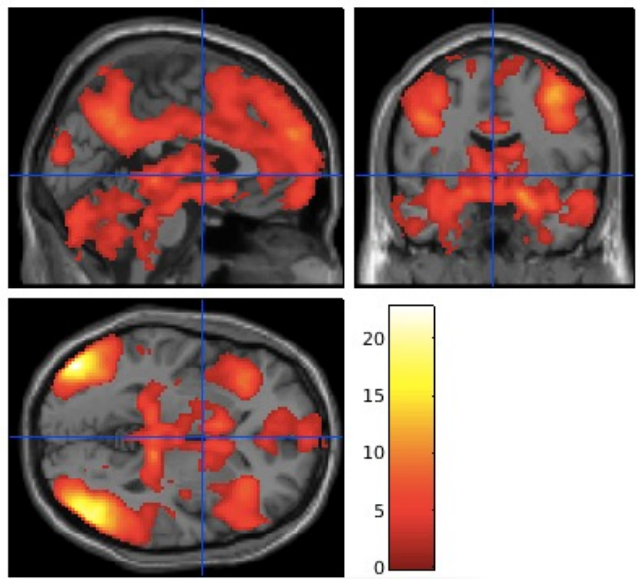
Neuroimaging data visualization

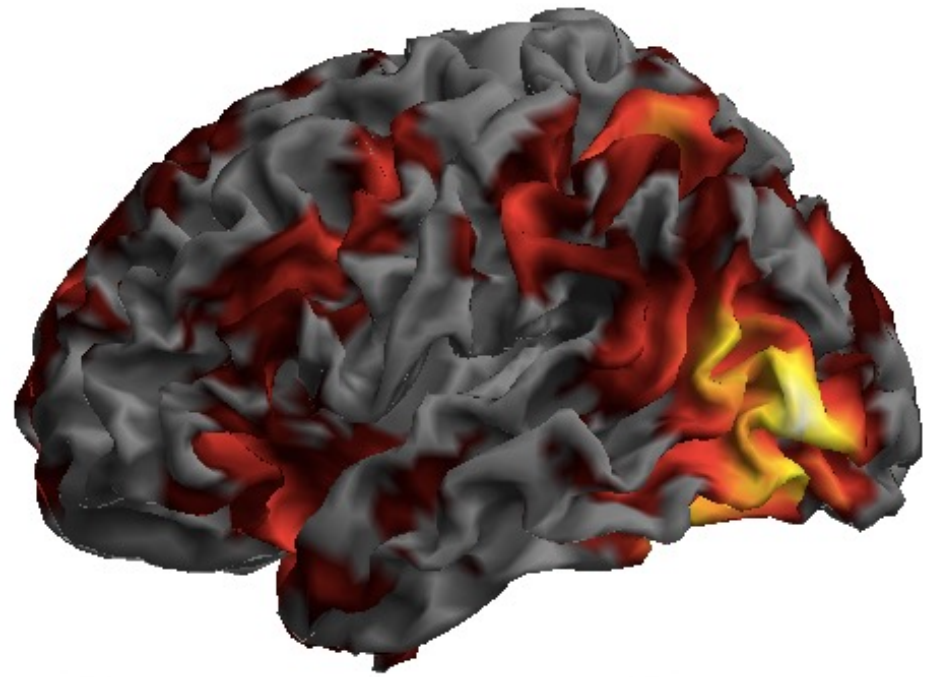
Vesa Putkinen

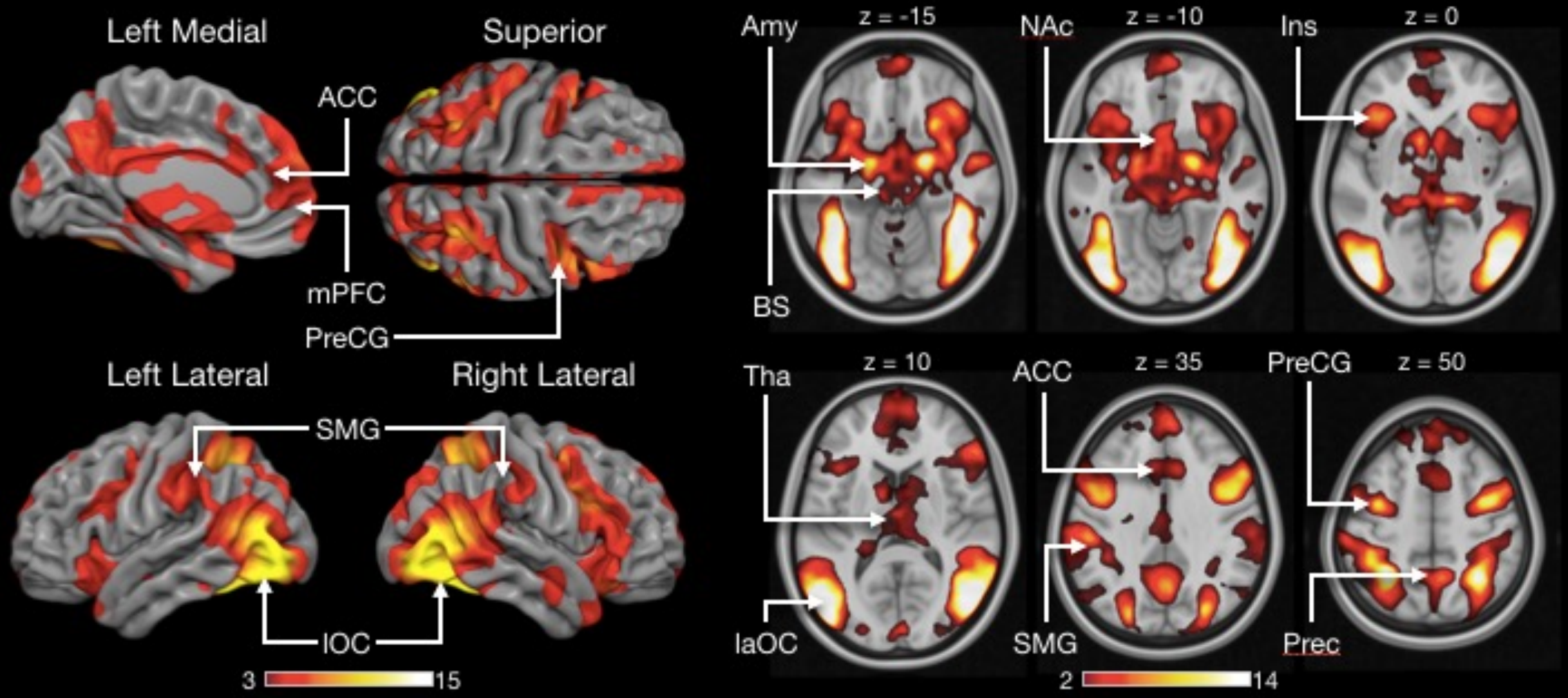
Academy Research Fellow

Turku PET Centre


[-0.5, -0.5, -0.5]
SPM{T98}
contrast
1
10
20
30
40
50
60
70
80
90
0.5
1
1.5
Design matrix
SPMresults: ./porn_landscape
Height threshold T = 1.660551 {p<0.05 (unc.)}
Extent threshold k = 1000 voxels


20
15
10
5
0



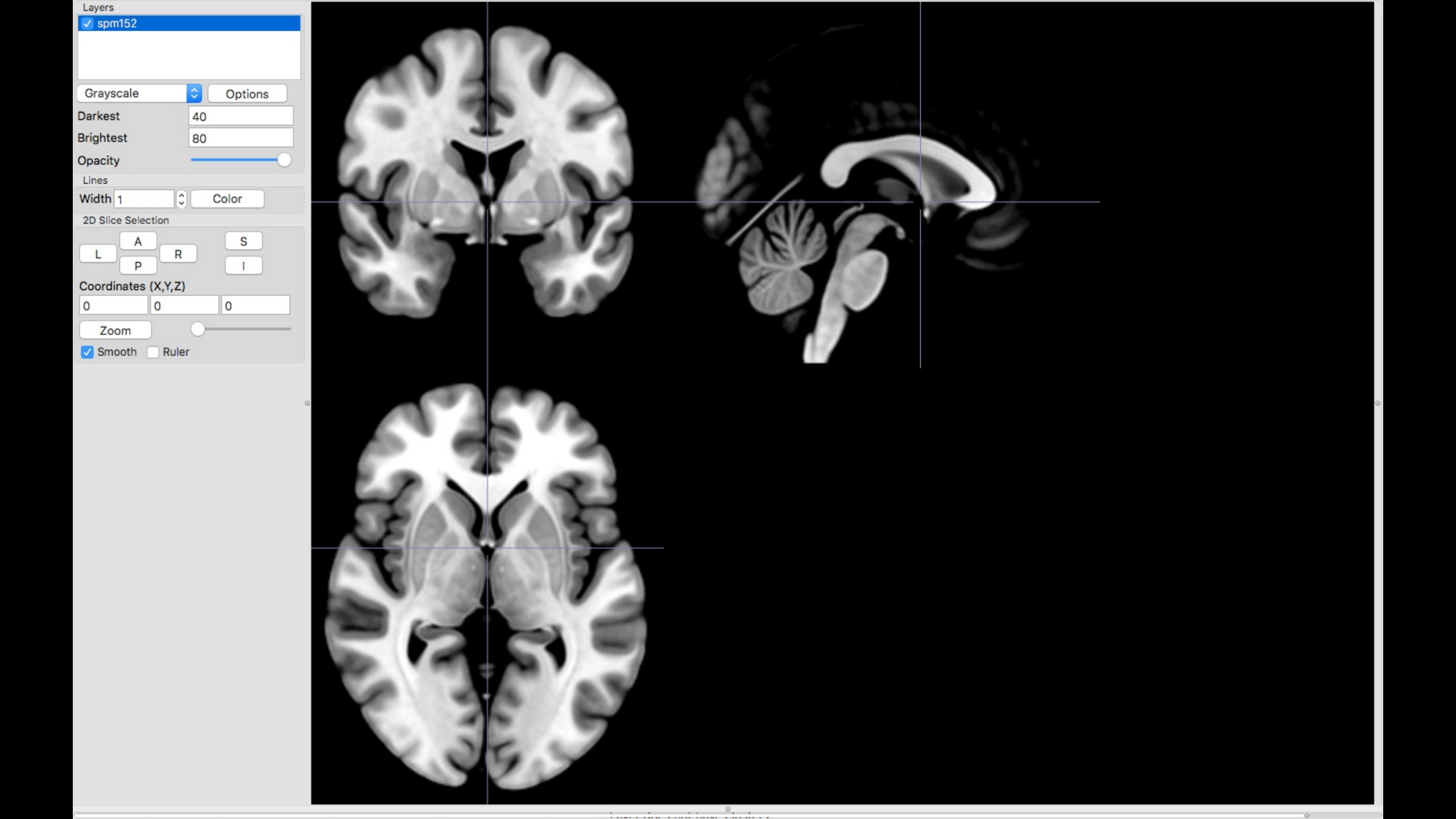


Putkinen et al. 2022

MRIcroGL

MRICroGL

- Open source medical image viewer
- Can be downloaded for free from www.nitrc.org/
- 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
P
S
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

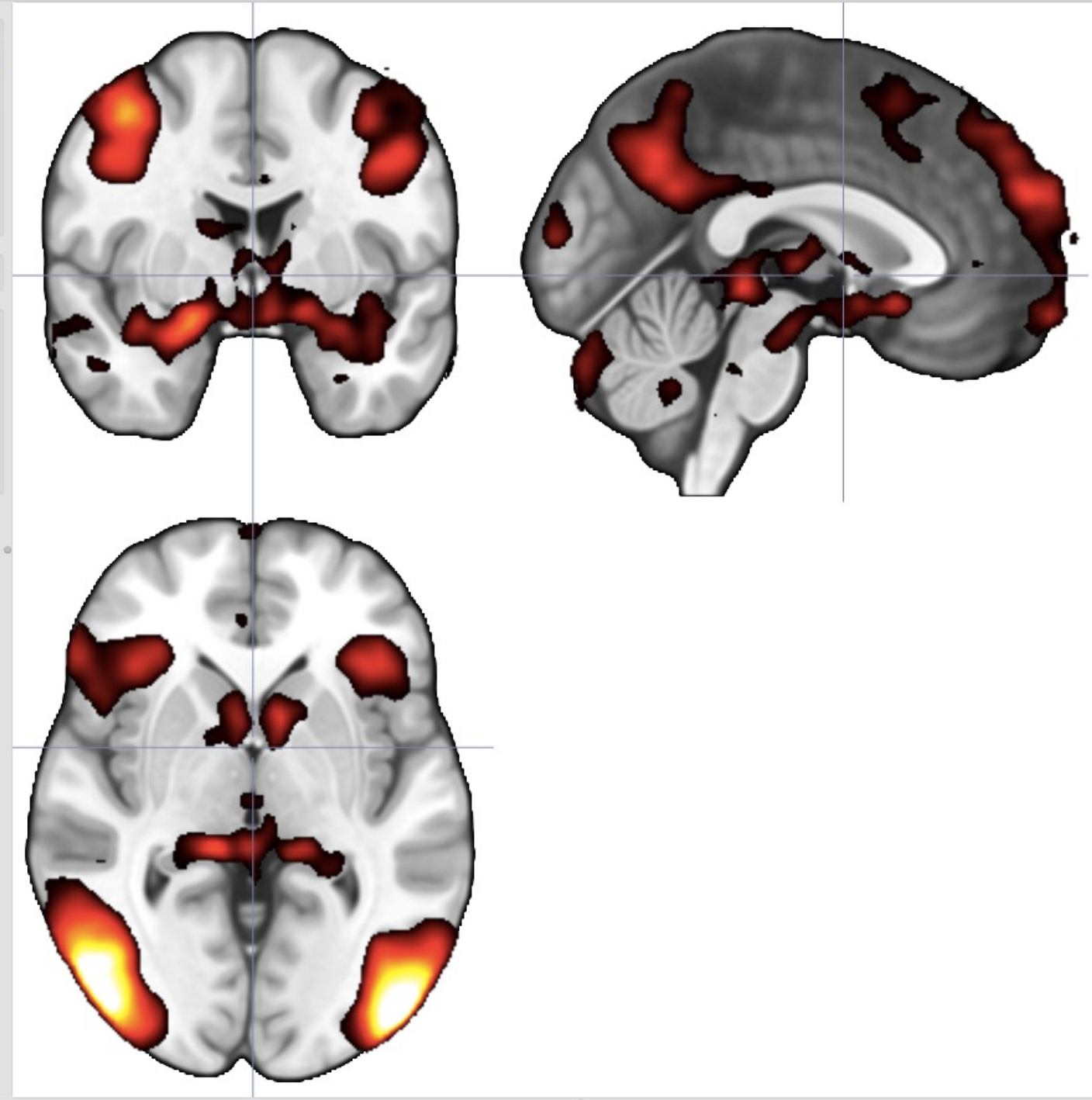
A L R P S I

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

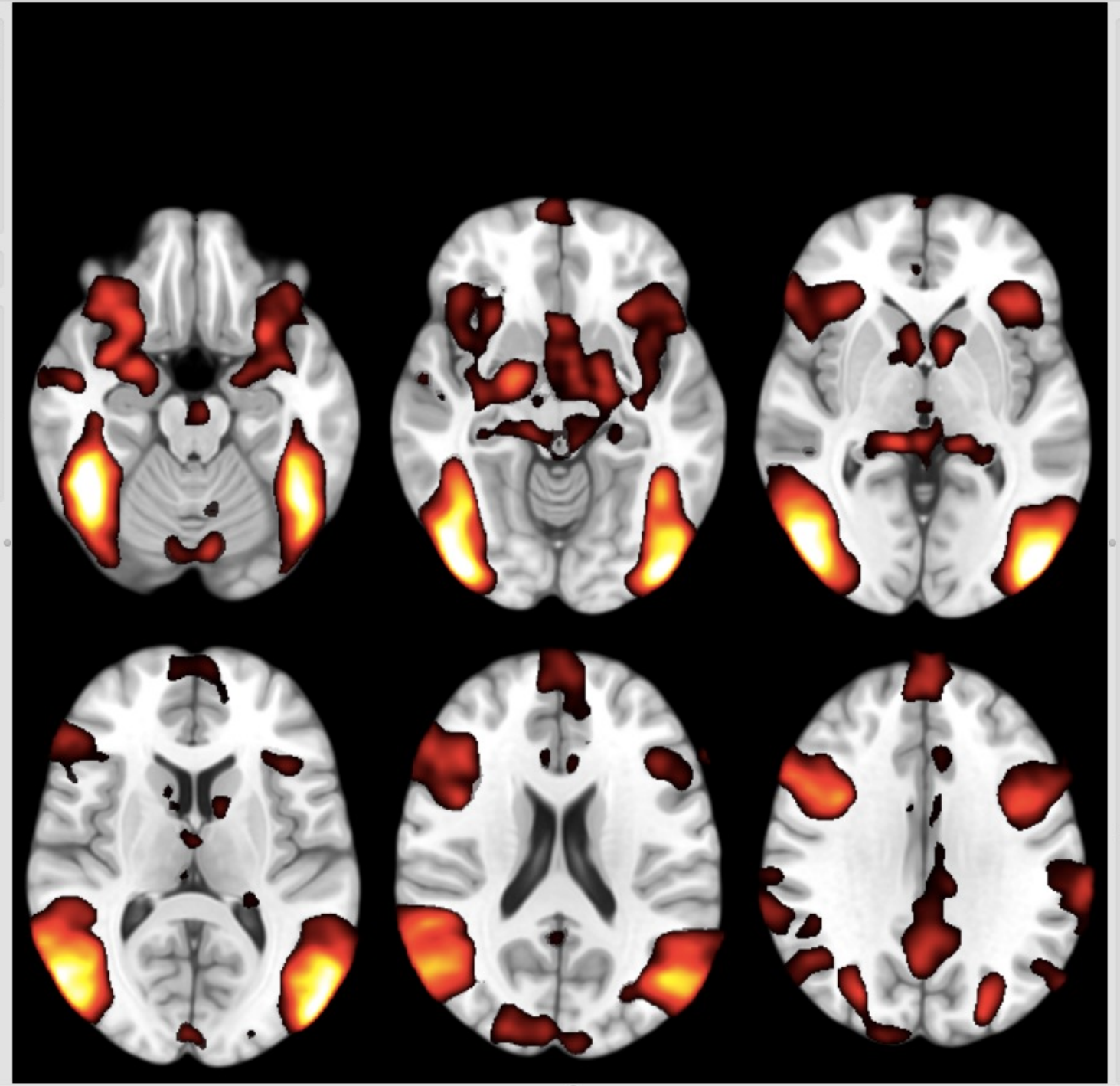
Mosaic

Columns 4

Rows 2

Orientation Axial

Cross Slice | Label Slices

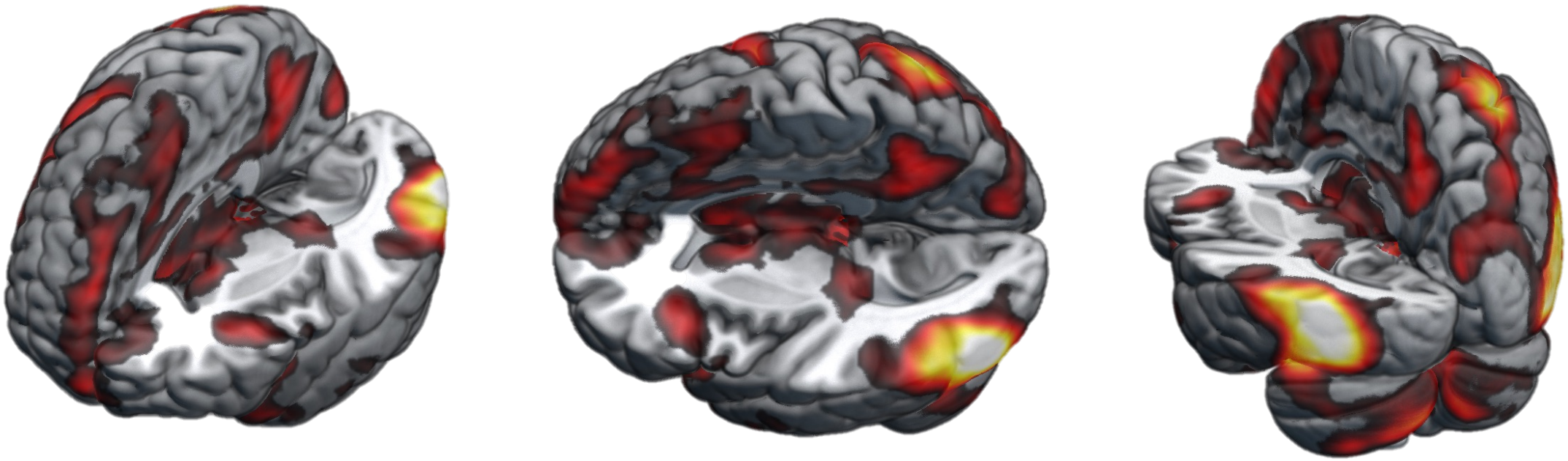


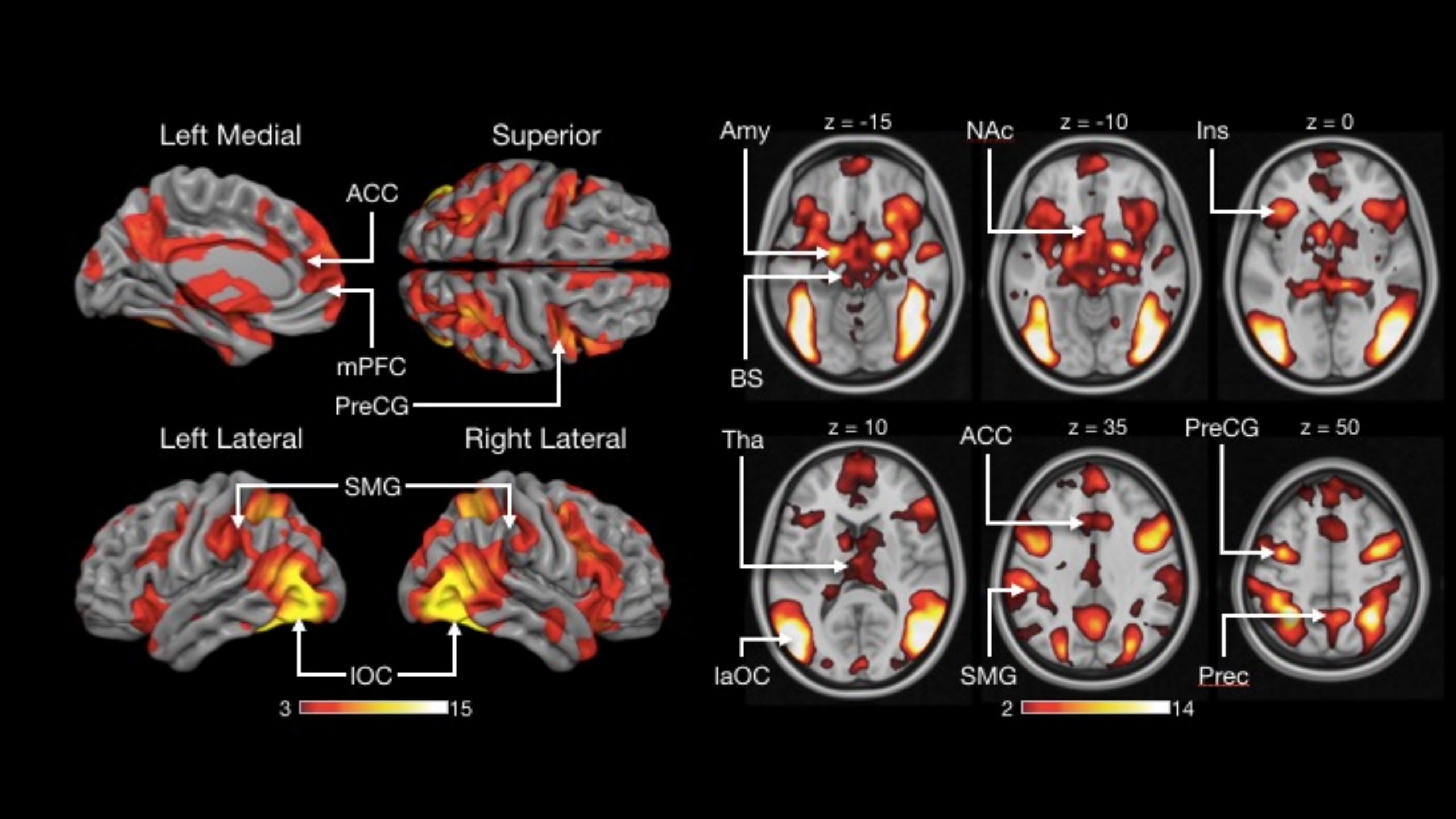
Scripting [Line 4 Col 19]

```
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




Left Medial
Superior
ACC
mPFC
PreCG
Left Lateral
Right Lateral
SMG
lOC
3
15
Amy
z = -15
NAc
z = -10
Ins
z = 0
BS
Tha
z = 10
ACC
z = 35
PreCG
z = 50
laOC
SMG
Prec
2
14

Surf Ice

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

Clipping

Depth

Azimuth

Elevation

Background Mesh

XRay

Shader For Background Only

Render

Minimal

AO

Light

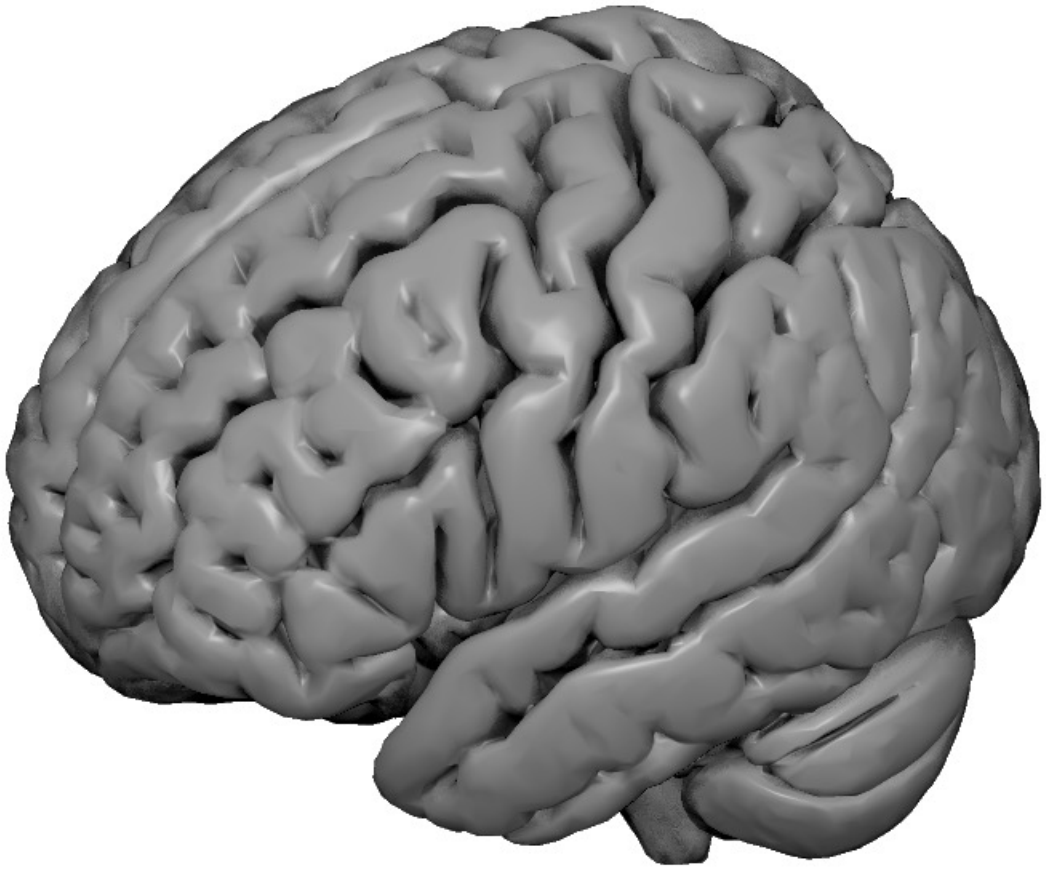
Ambient

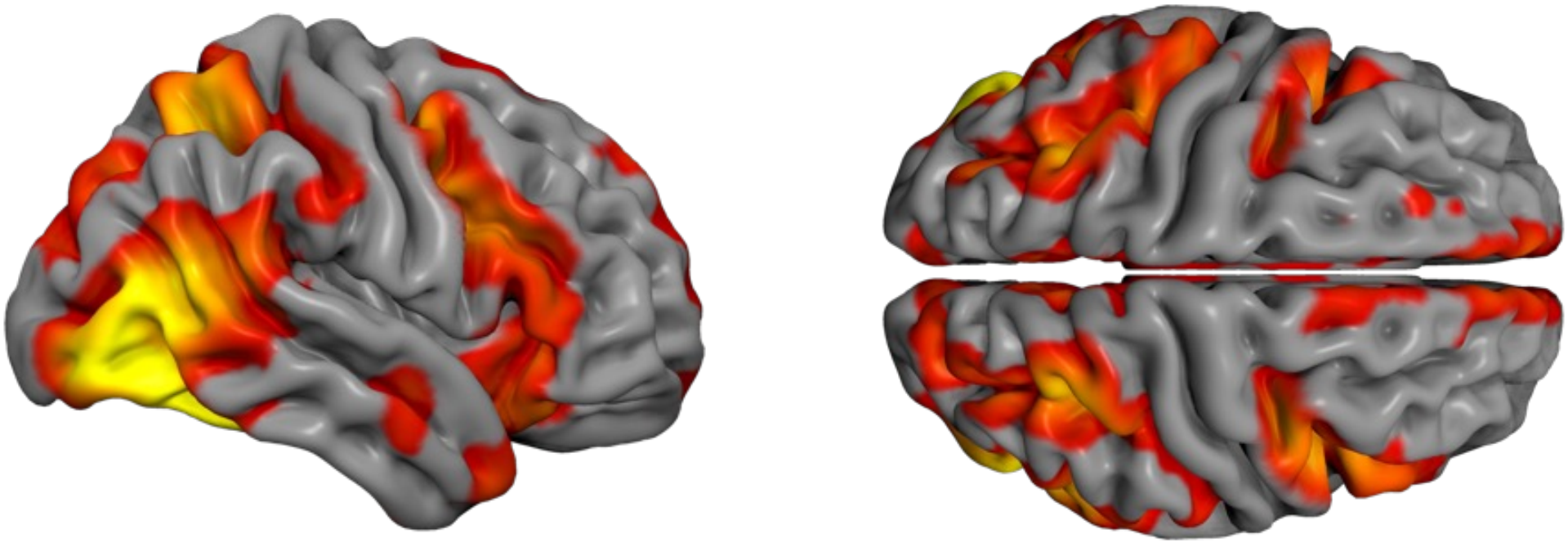
Diffuse

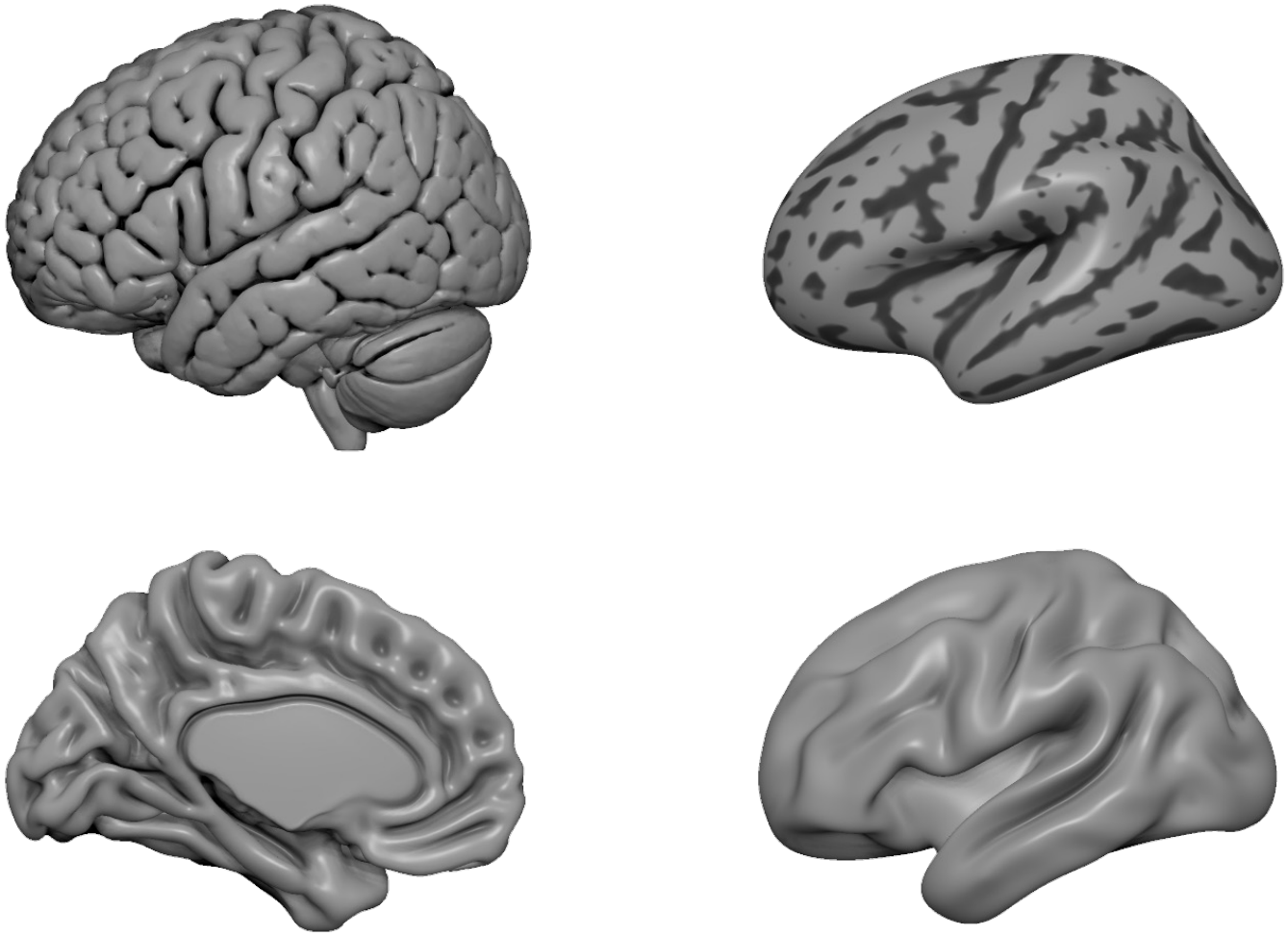
Specular

Shininess

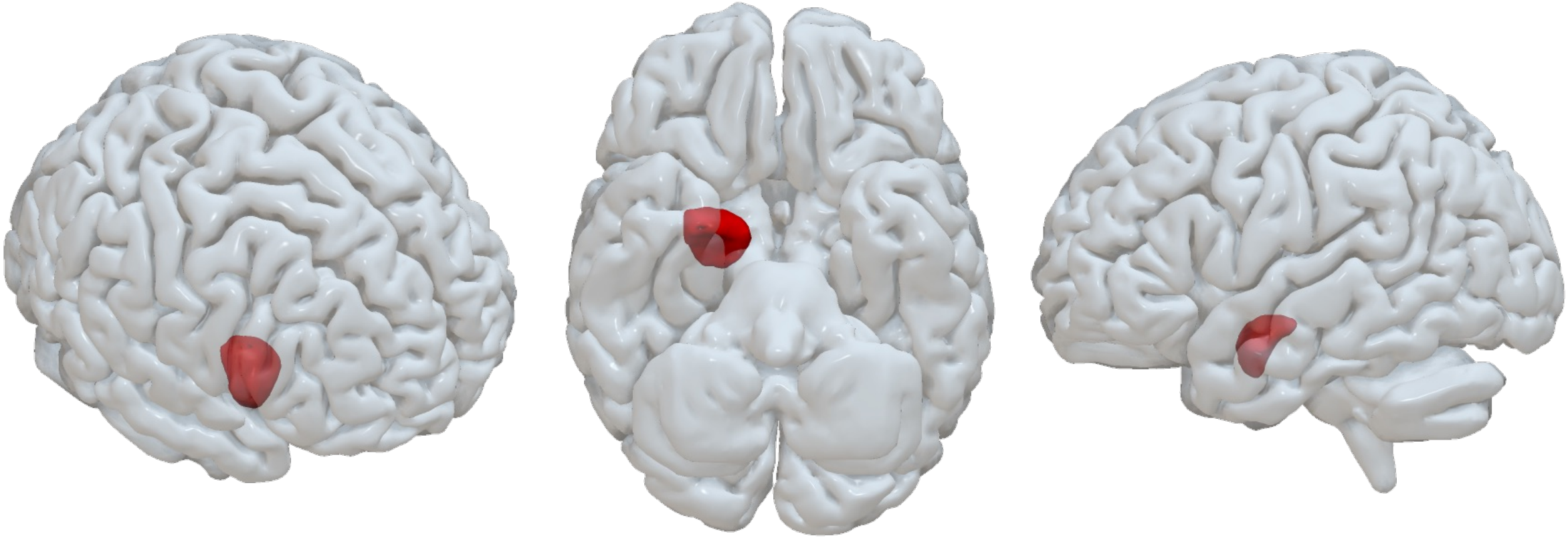
Blinn-Phong shading with Lambertian dif

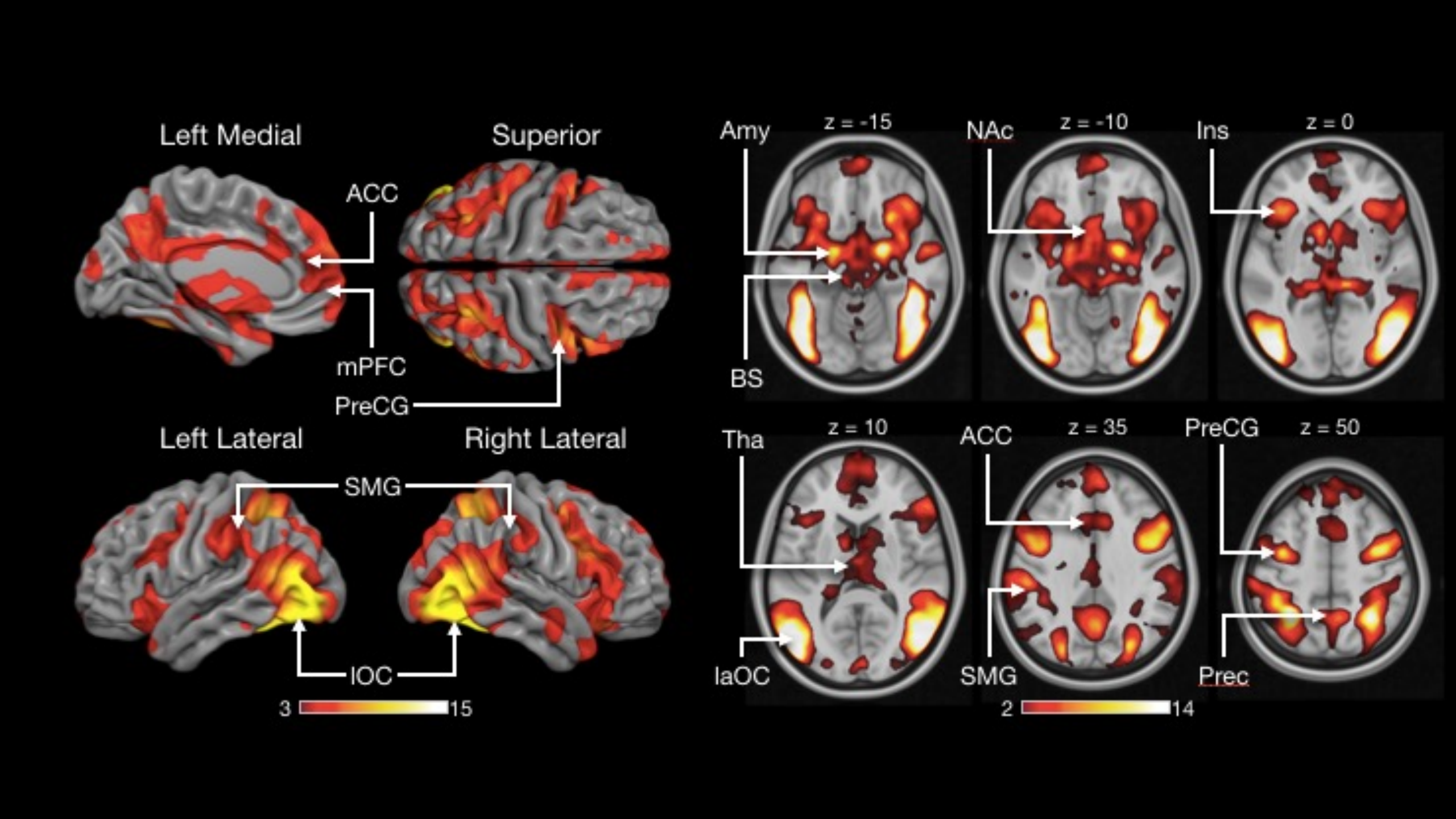


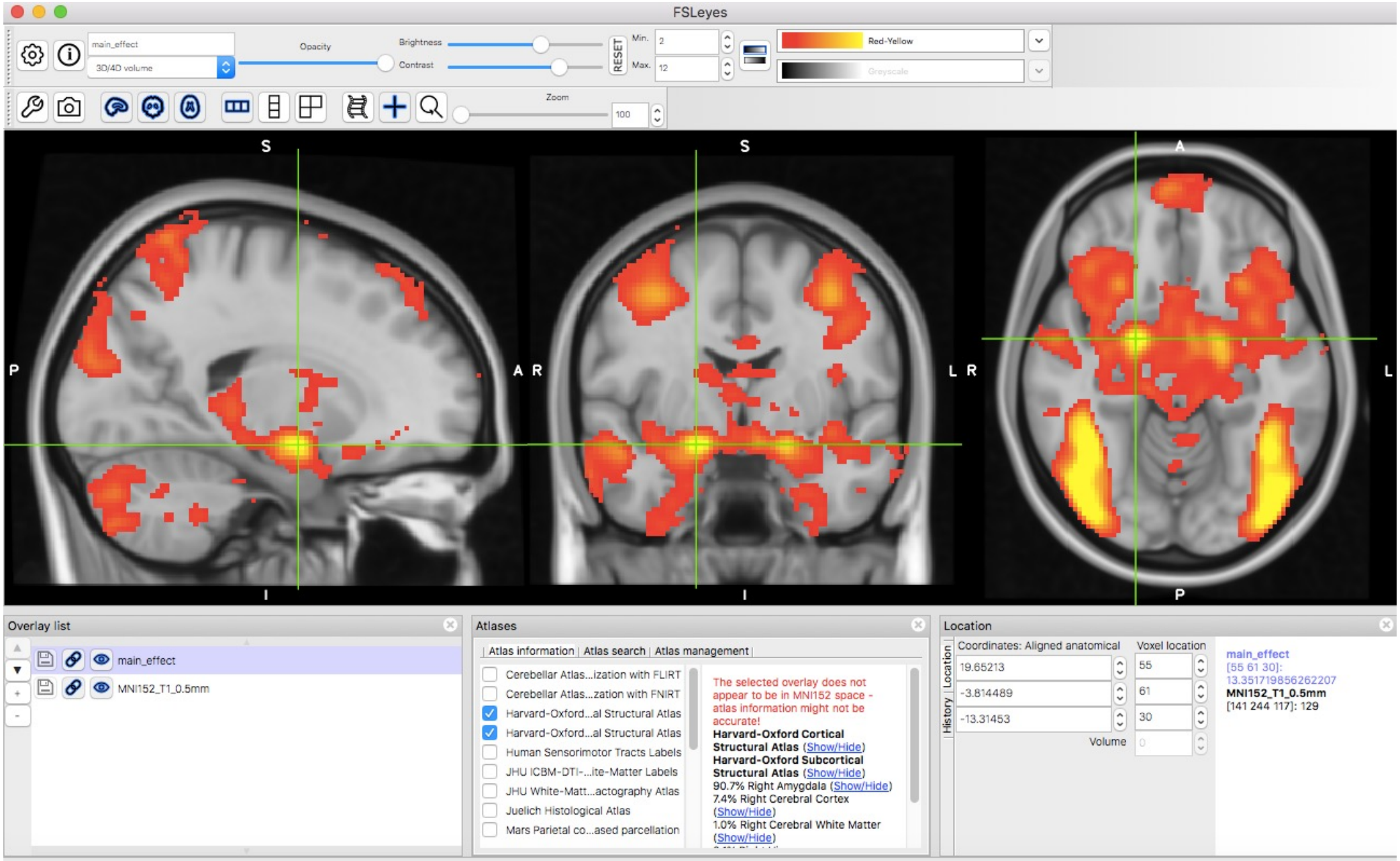




```
import gl
gl.resetdefaults()
gl.meshload('BrainMesh_ICBM152.rh.mz3')
gl.overlayload('motor_4t95mesh.rh.mz3')
gl.overlaycolorname(1, 'red')
gl.shaderxray(1.0, 0.3)
gl.azimuthelevation(110, 15)
gl.meshcurv()
```

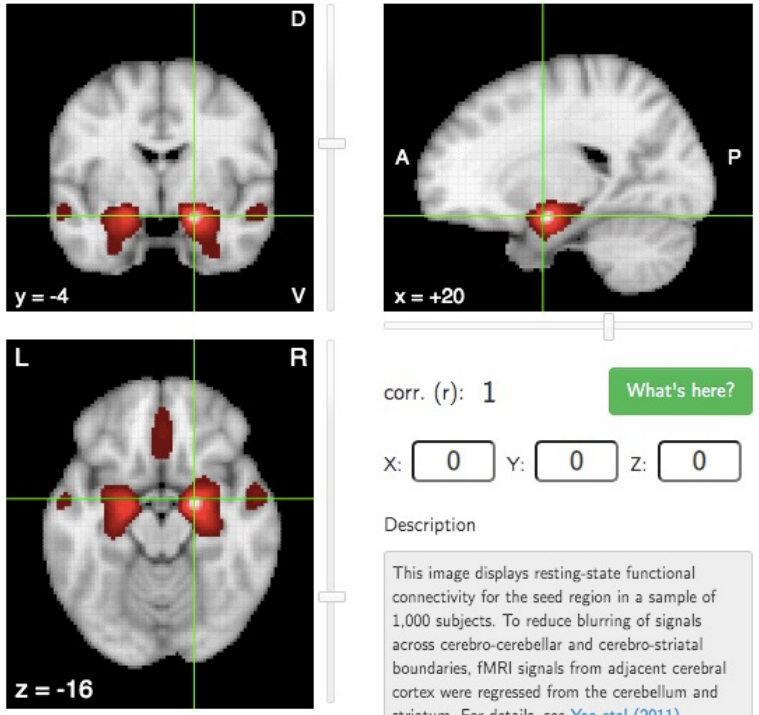



Left Medial
Superior
ACC
mPFC
PreCG
Left Lateral
Right Lateral
SMG
lOC
3
15
Amy
z = -15
NAc
z = -10
Ins
z = 0
BS
Tha
z = 10
ACC
z = 35
PreCG
z = 50
laOC
SMG
Prec
2
14


FSLeyes
main_effect
3D/4D volume
Opacity
Brightness
Contrast
RESET
Min.
2
Max.
12
Red-Yellow
Greyscale
Zoom
100
S
P
A
R
I
S
L
R
I
A
L
P
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
History
Location
Coordinates: Aligned anatomical
Voxel location
19.65213
55
-3.814489
61
-13.31453
30
Volume
0
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).

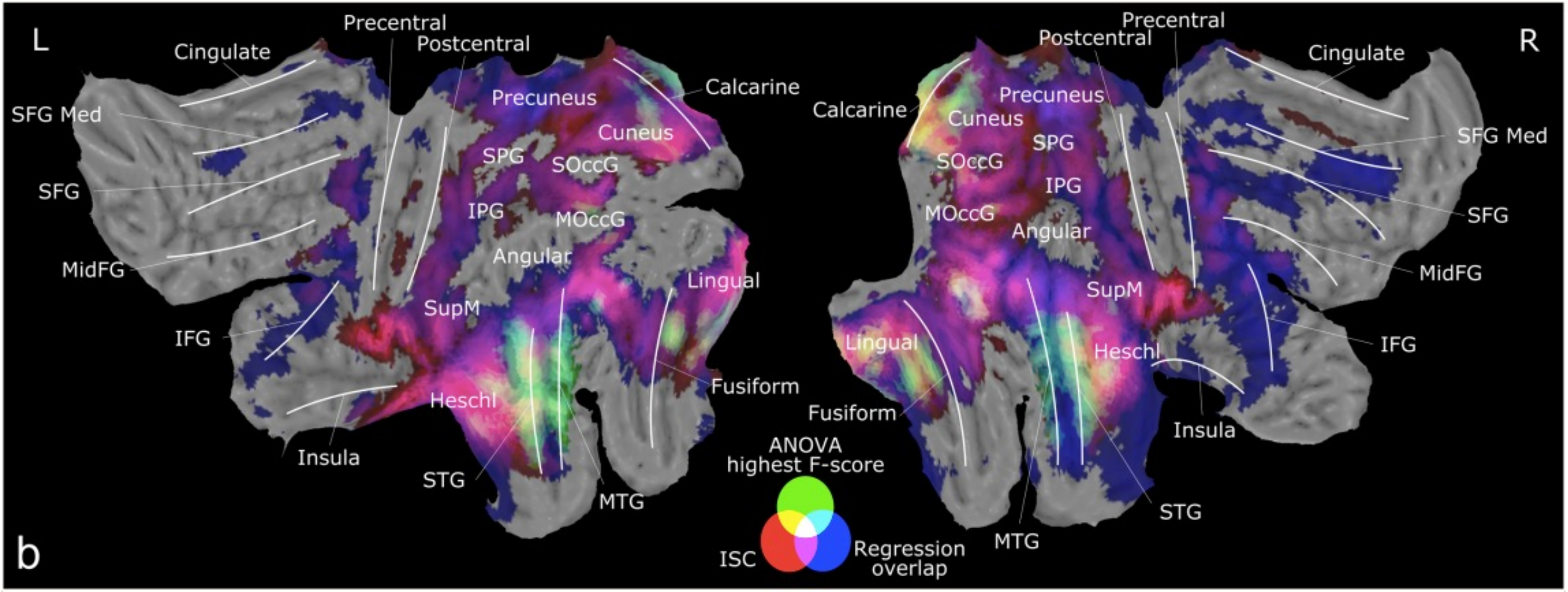
Associations with meta-analysis maps

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

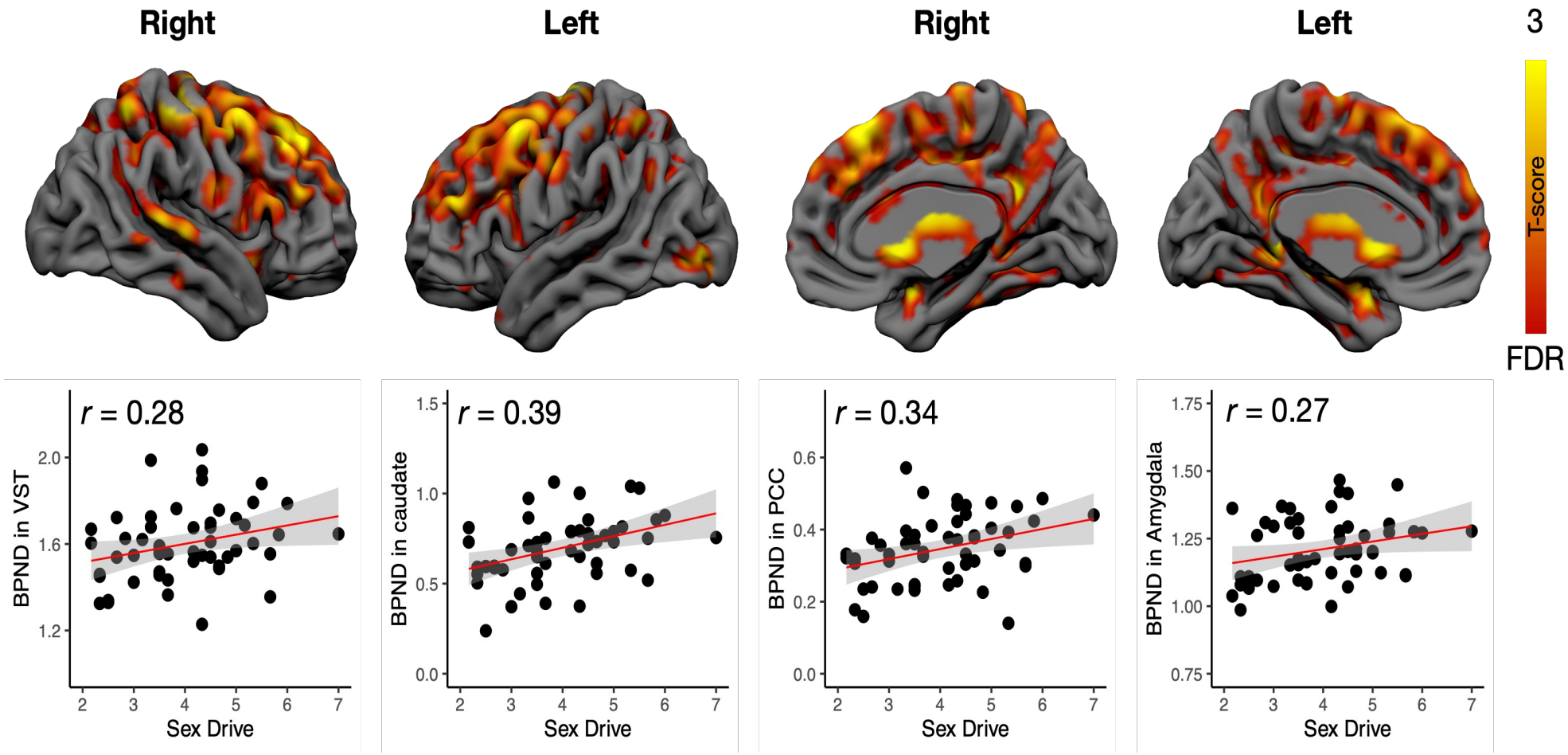
www.neurosynth.org



Santavirta et al. Submitted

Other rendering tools

- Caret
- Fsleyes
- Freeview
- ParaView
- PyCortex
- See links in the course web page

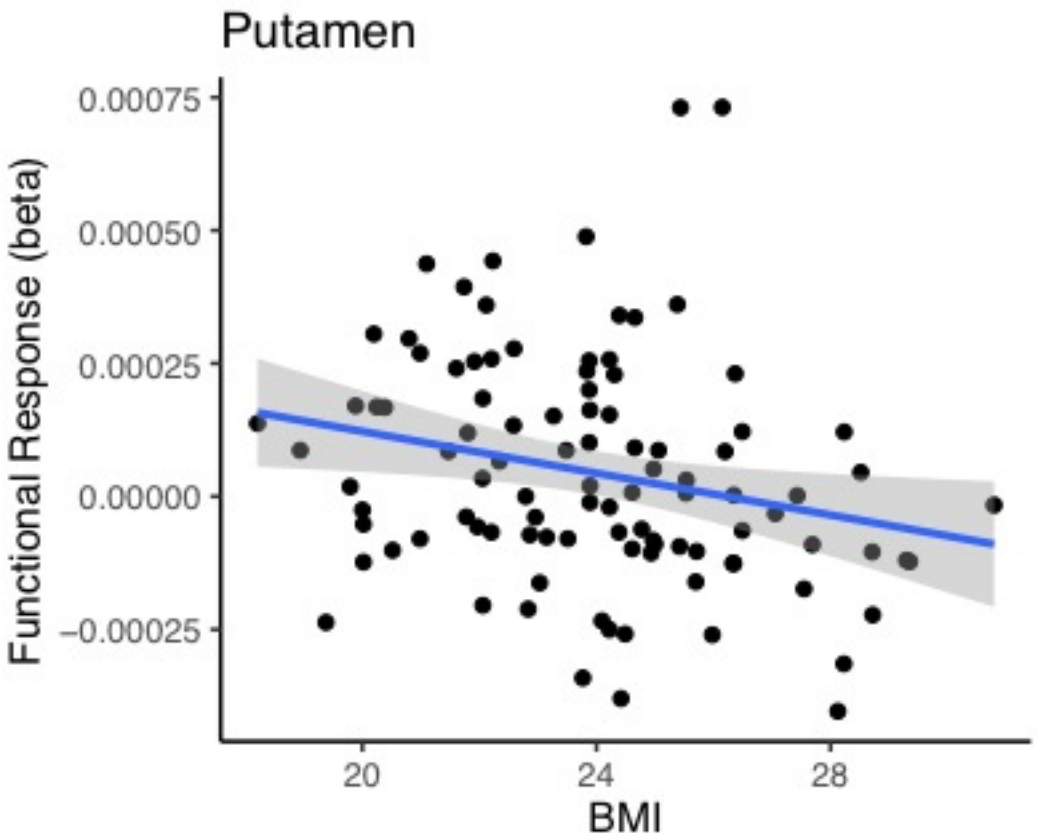


Nummenmaa et al, 2022

R Studio®

ggplot2

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



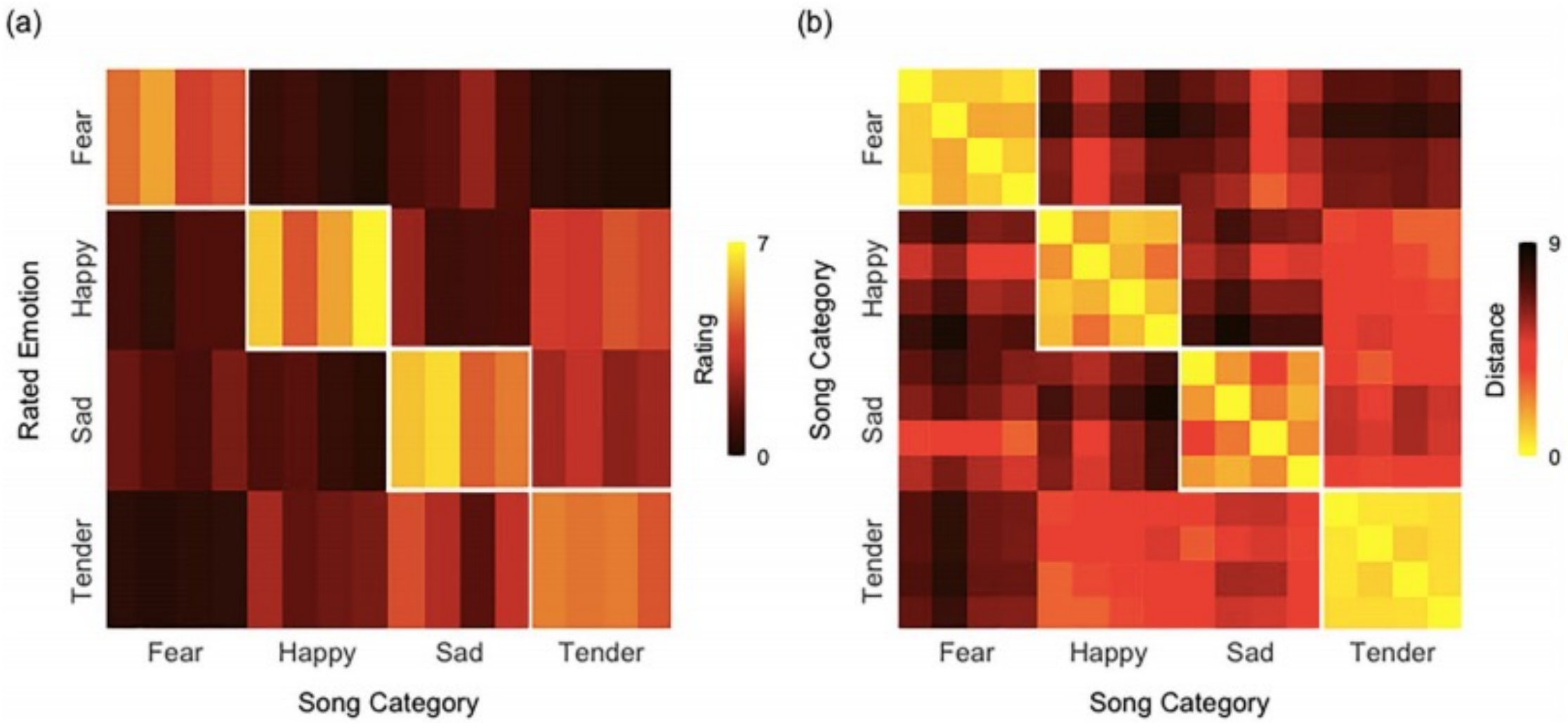


Figure 1. (*a*) Mean ratings for the intensity of each emotion for each musical excerpt. (*b*) Rating dissimilarity matrix (Euclidean distance) for each song pair.

Putkinen et al., Cerebral Cortex, 2021

https://www.rstudio.com/

https://ggplot2.tidyverse.org/