

Neuroimaging data visualization

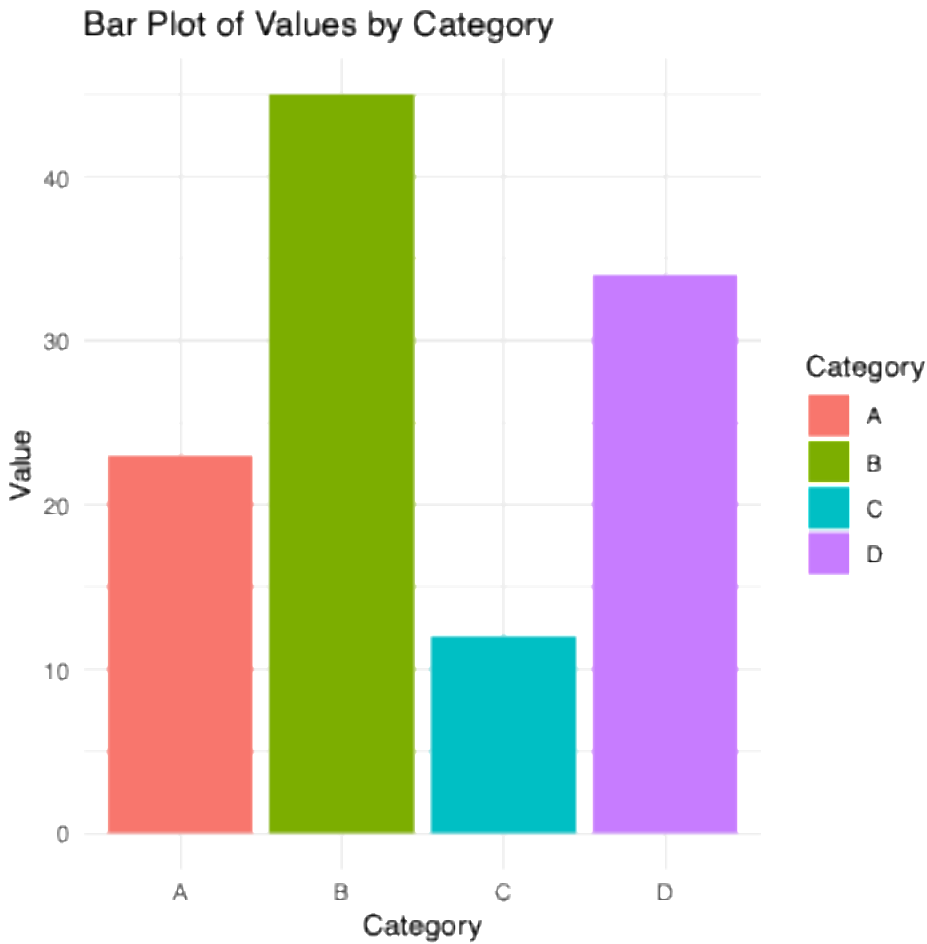
Turku PET Centre Brain Imaging Course 2024

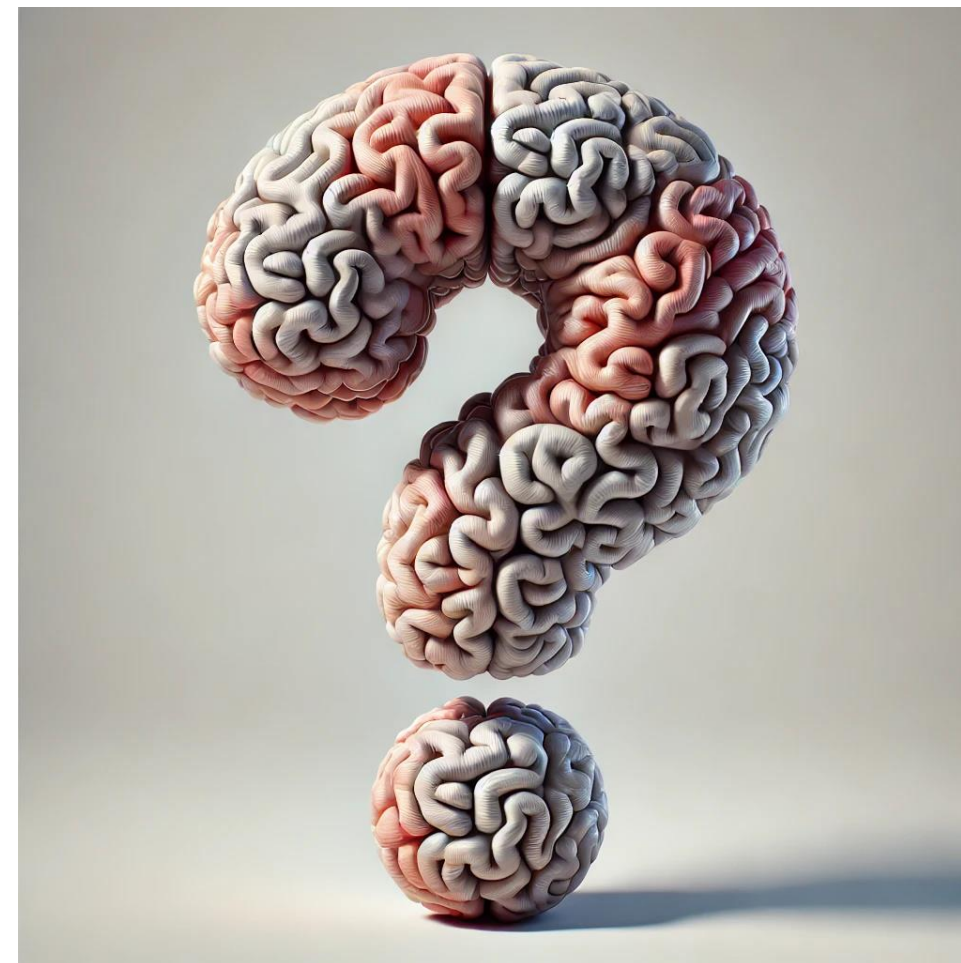
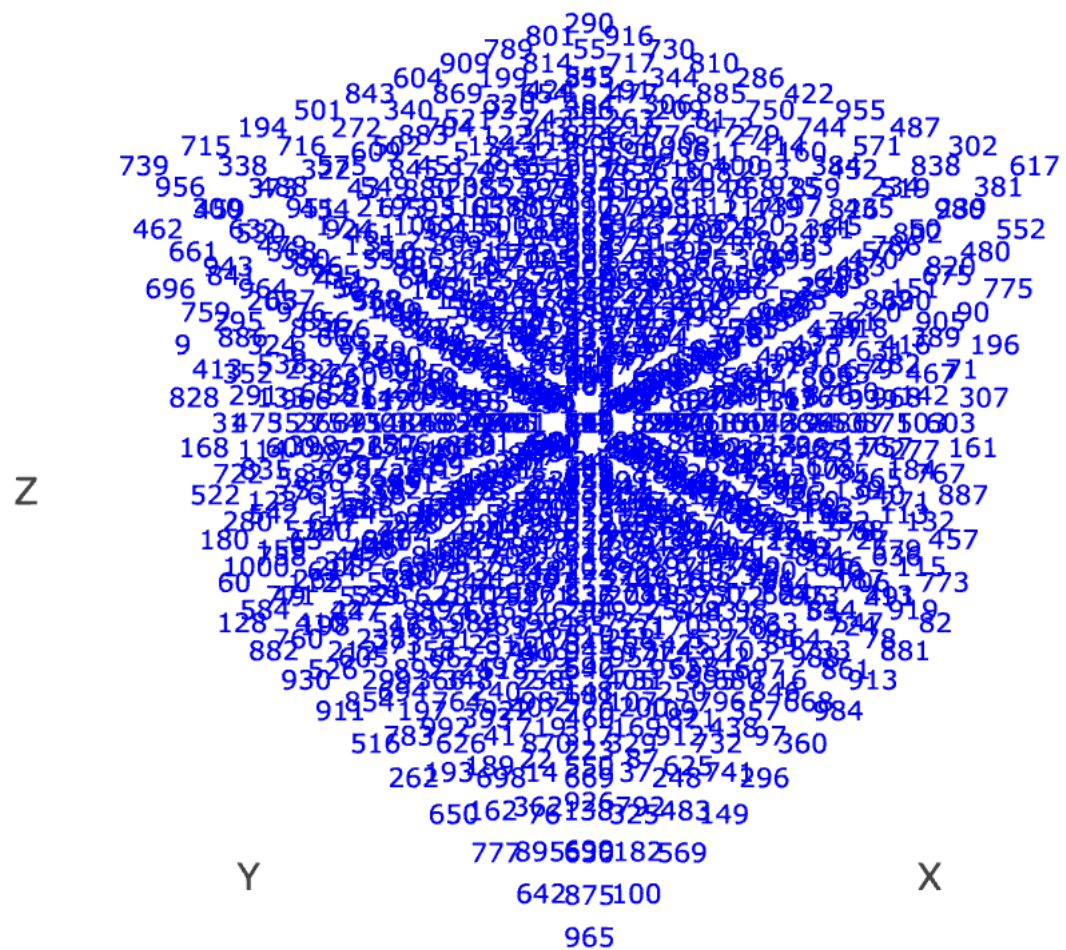
Vesa Putkinen, Turku PET Centre

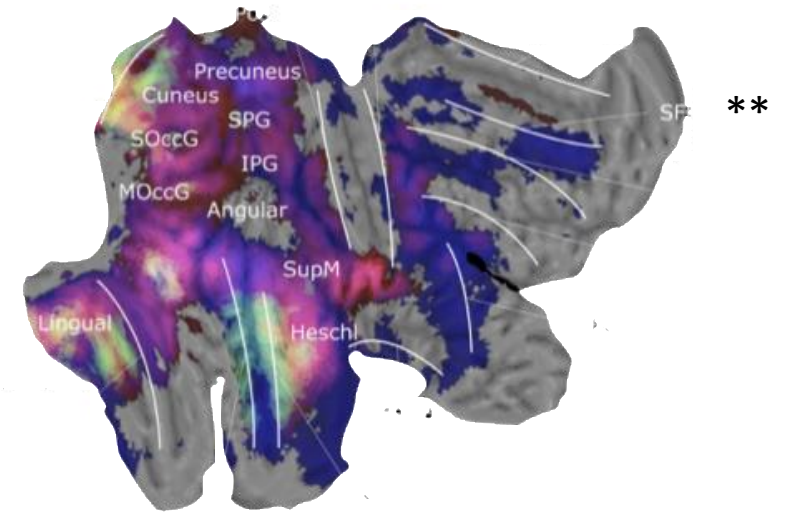
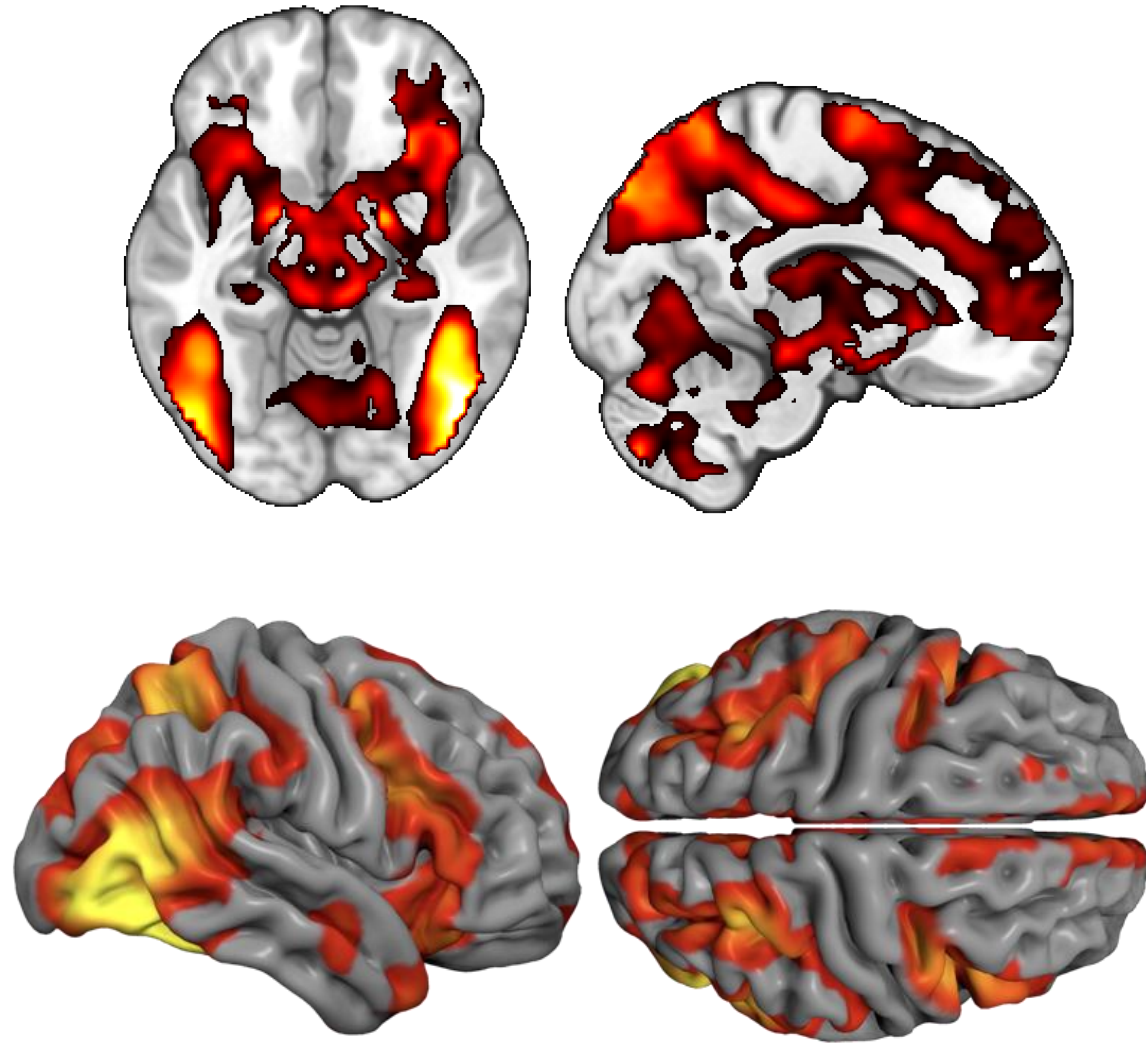


Table of Categories and Values

Category	Value
A	23
B	45
C	12
D	34



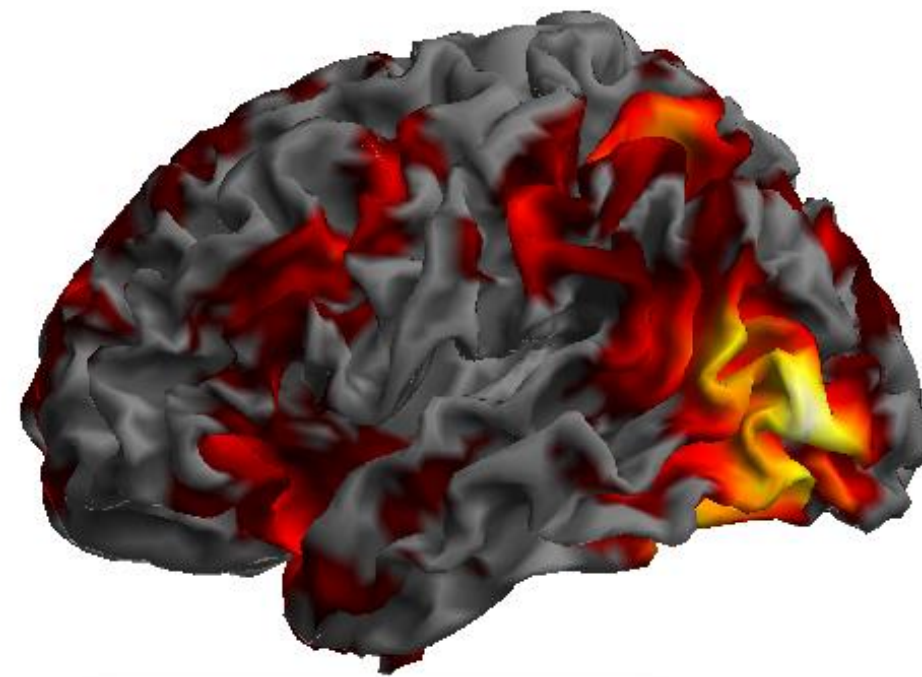
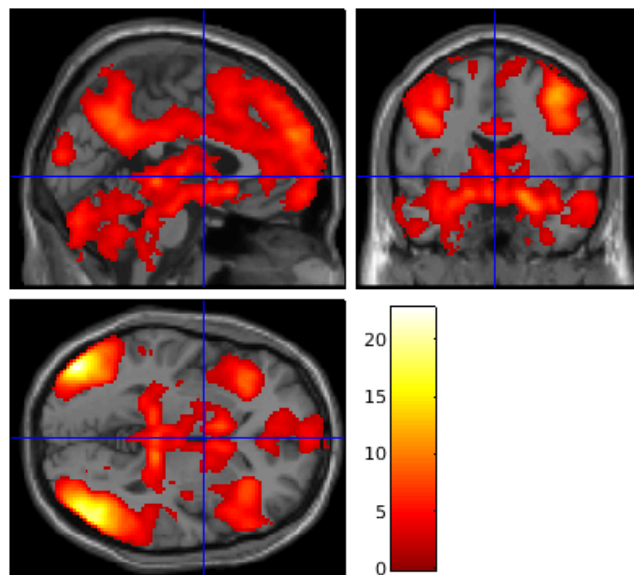
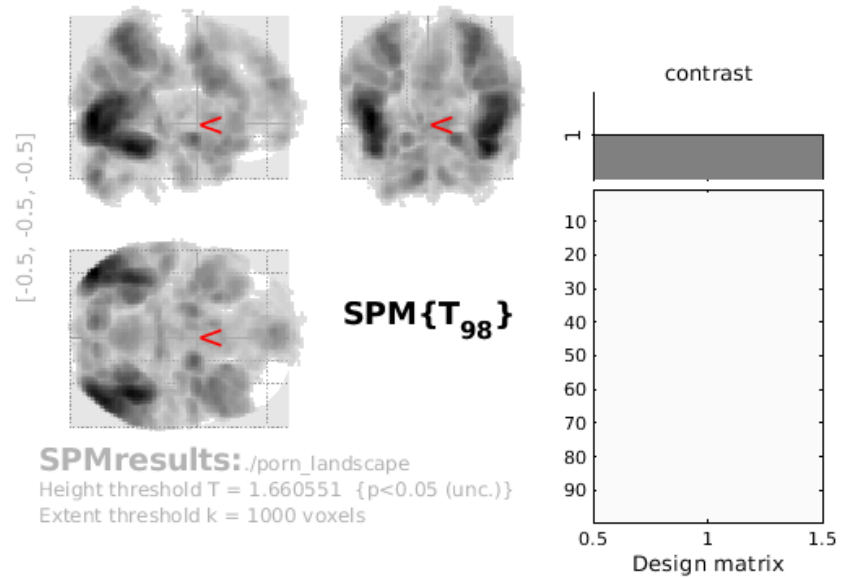




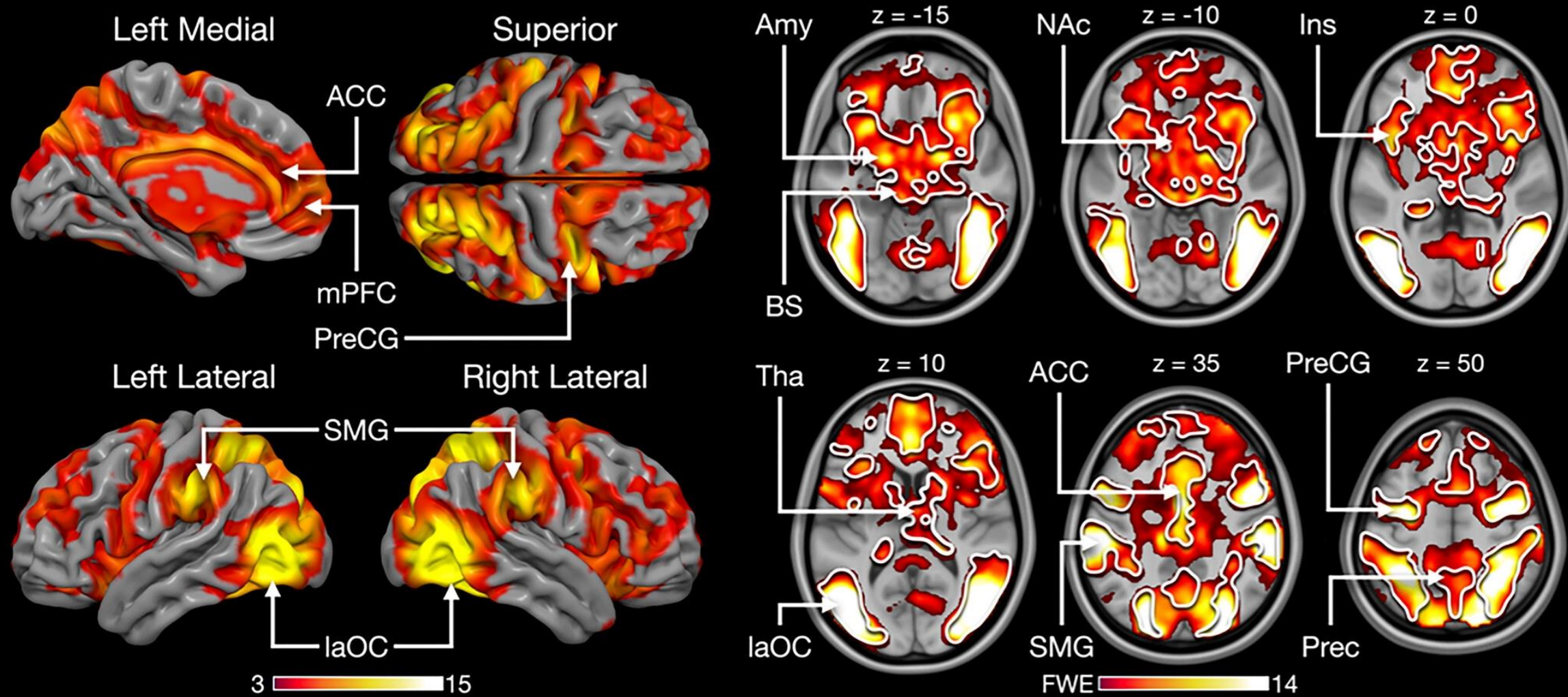
*Tuominen et al., 2015, **Santavirta et al., 2023

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.



(a) Responses to sexual movies



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 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

Darkest 40

Brightest 80

Opacity

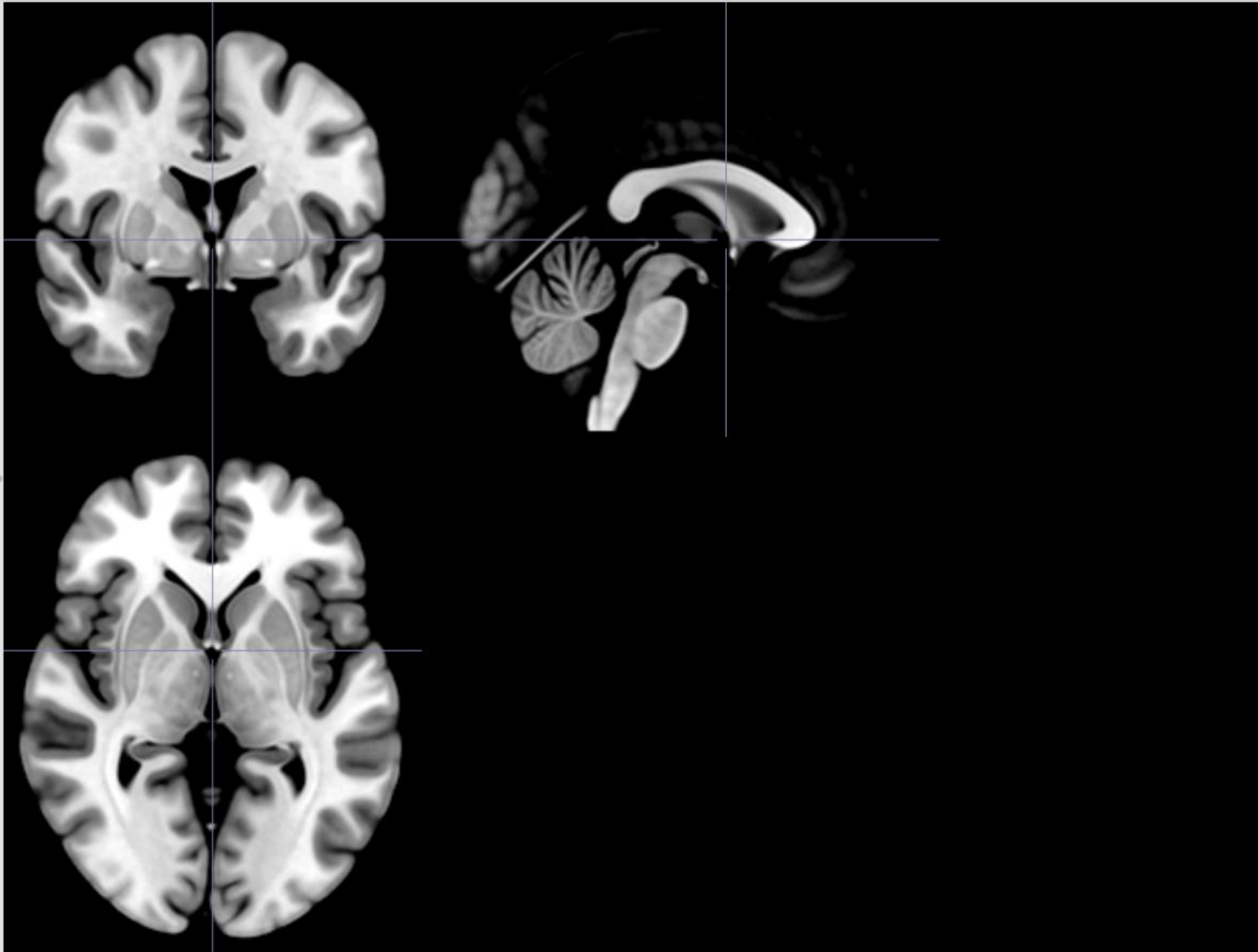
Lines
Width 1

2D Slice Selection

Coordinates (X,Y,Z)
0 0 0

Zoom

☒ Smooth ☐ Ruler



Layers

- ☒ spm152
- ☒ main_effect

4hot

Darkest

Brightest

Opacity

Lines

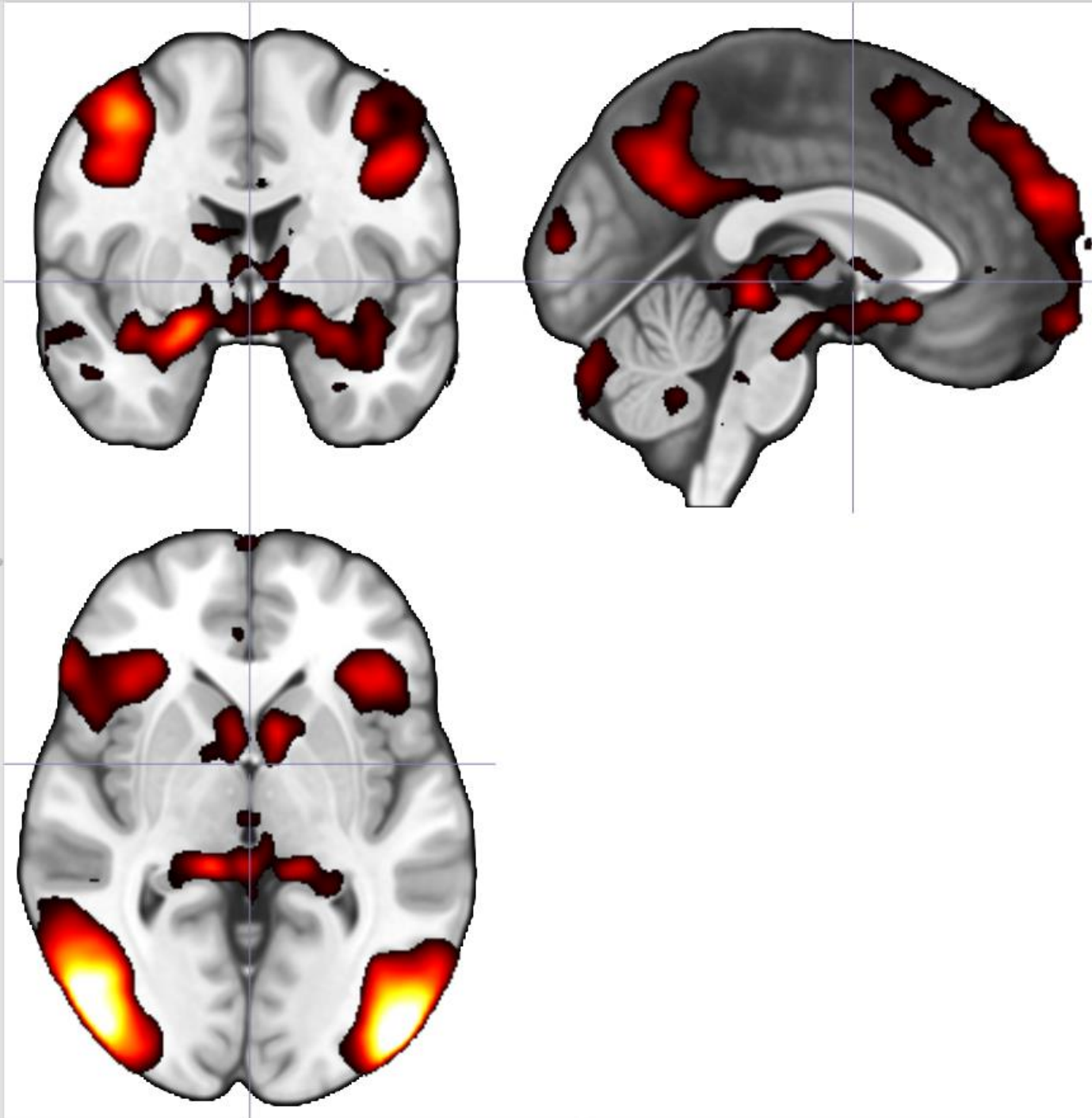
Width

2D Slice Selection

Coordinates (X,Y,Z)

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

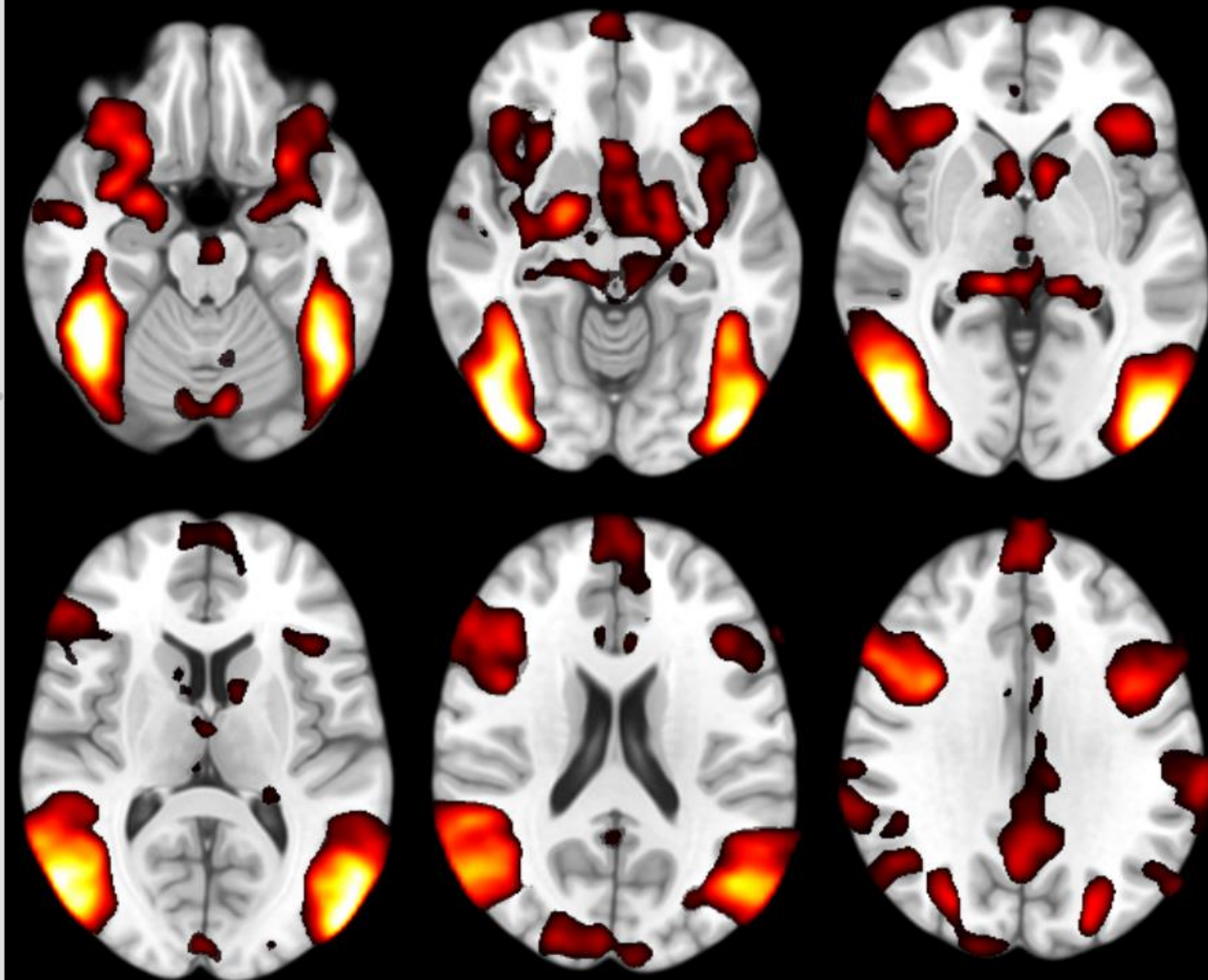
Mosaic

Columns 4

Rows 2

Orientation Axial

☒ Cross Slice ☒ Label Slices



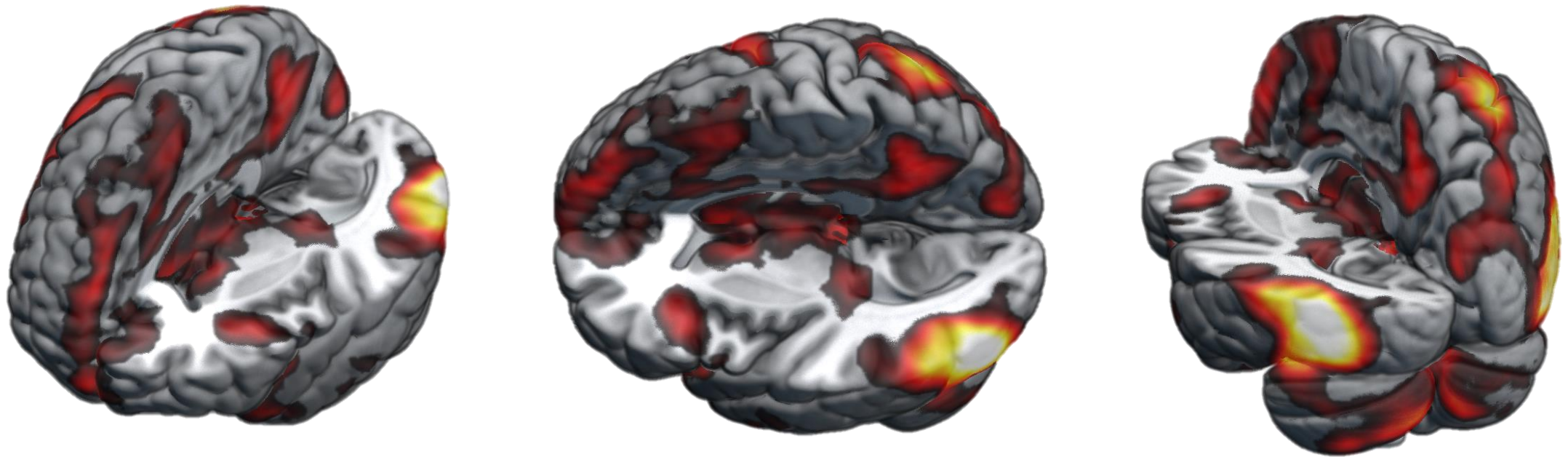
Scripting [Line 4 Col 19]

```
import gl
gl.loadimage('spm152')
gl.minmax(0, 10, 80)
gl.overlayload('~\\Desktop\\main_effect.nii')
gl.minmax(1, 3, 15)
gl.colourname (1,"4hot")
gl.opacity(1,100)
gl.mosaic("A -20 -10 0 ; 10 20 30")
gl.backcolor(0,0,0)
```



Running Python script
Python Successfully Executed

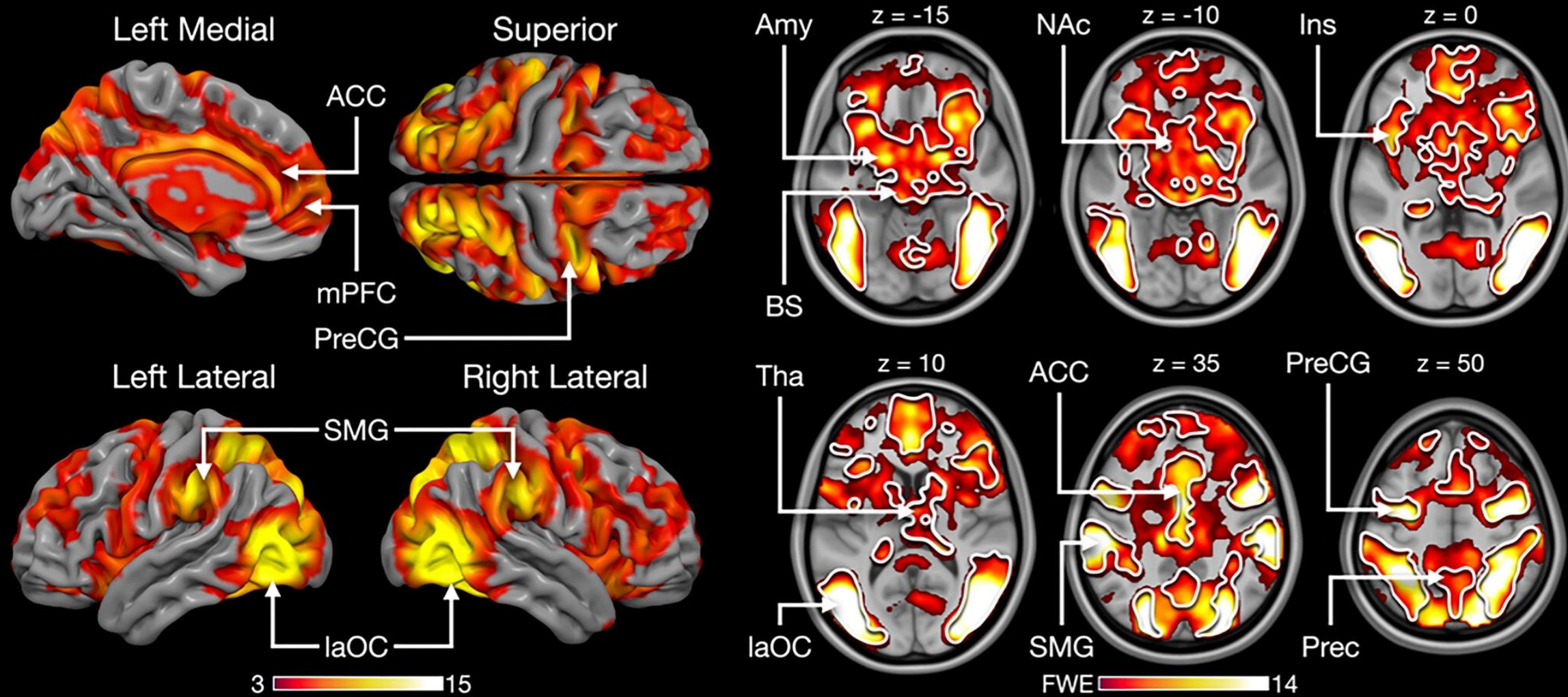
Volume Rendering with MRICroGL



Note!

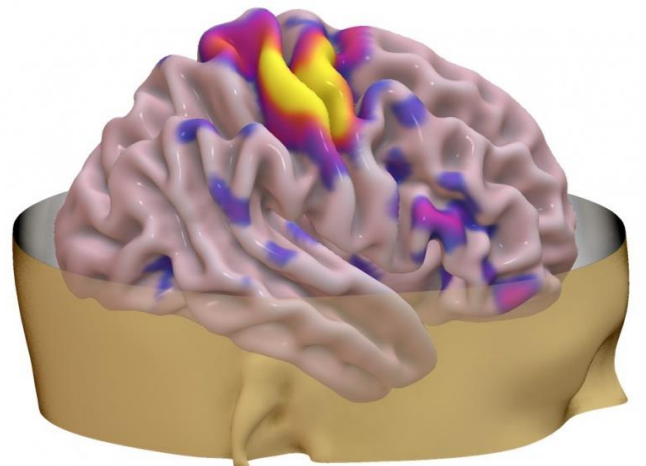
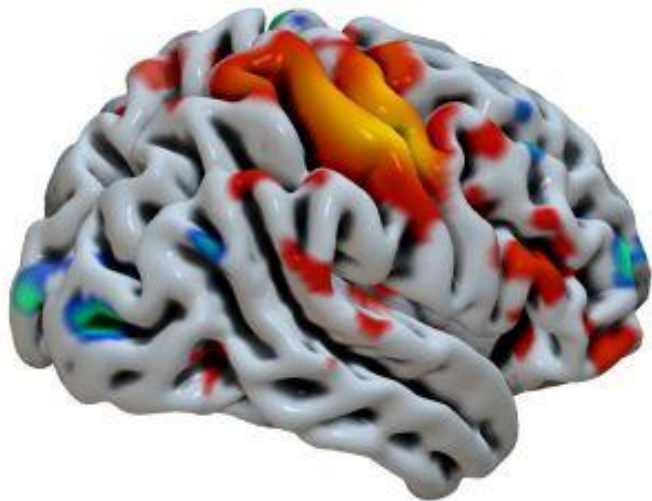
- **Orientation:** Different visualization tools display images either in radiological (left on right) or neurological (left on left) convention by default.
- **Interpolation:** If overlays have a different resolution from the background image, they need to be resampled. Different software may do this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

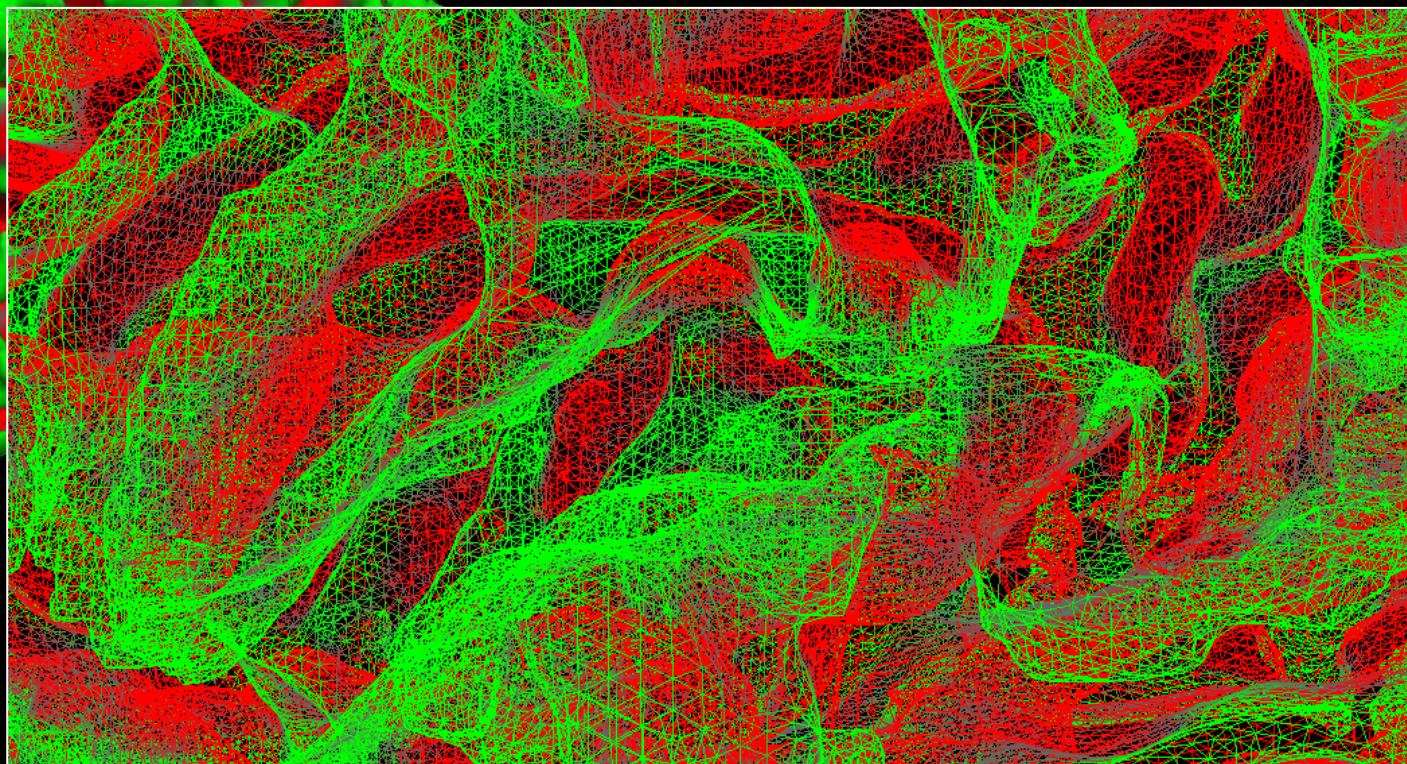
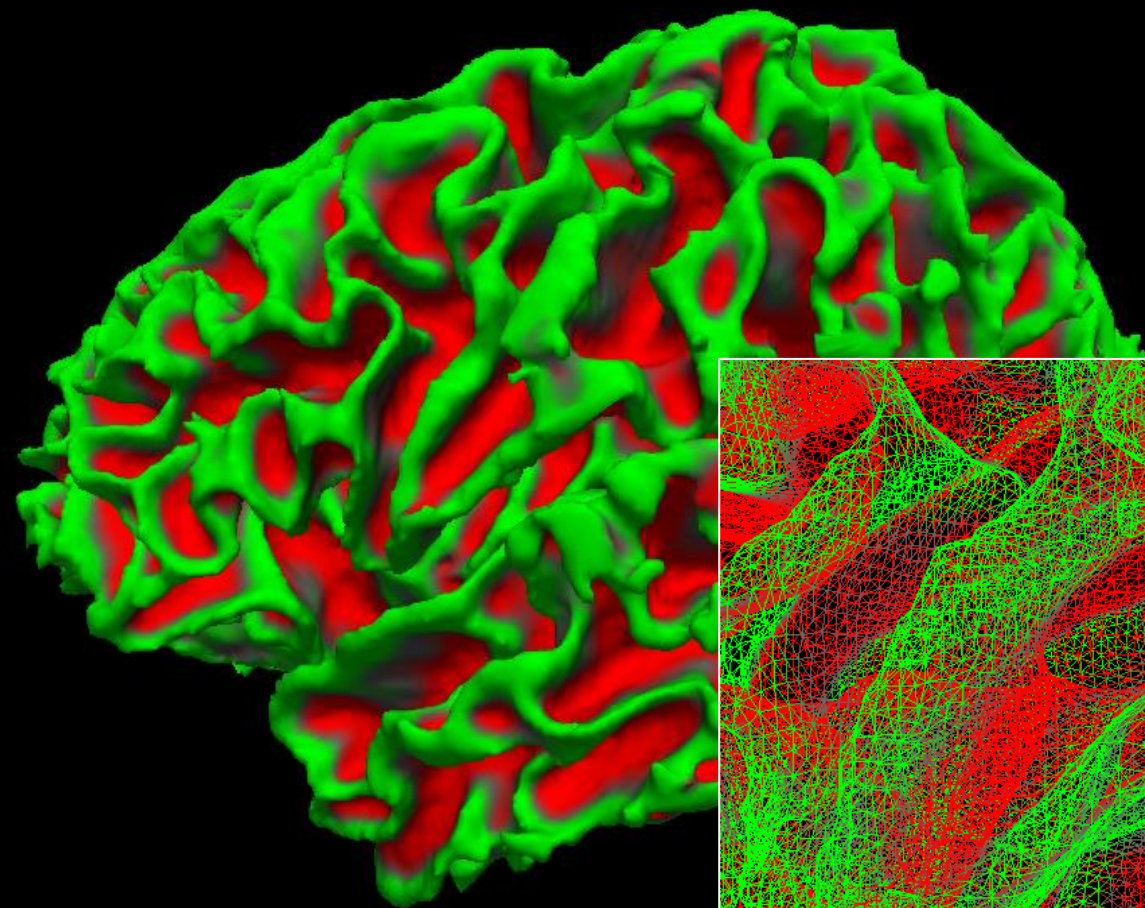
(a) Responses to sexual movies



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

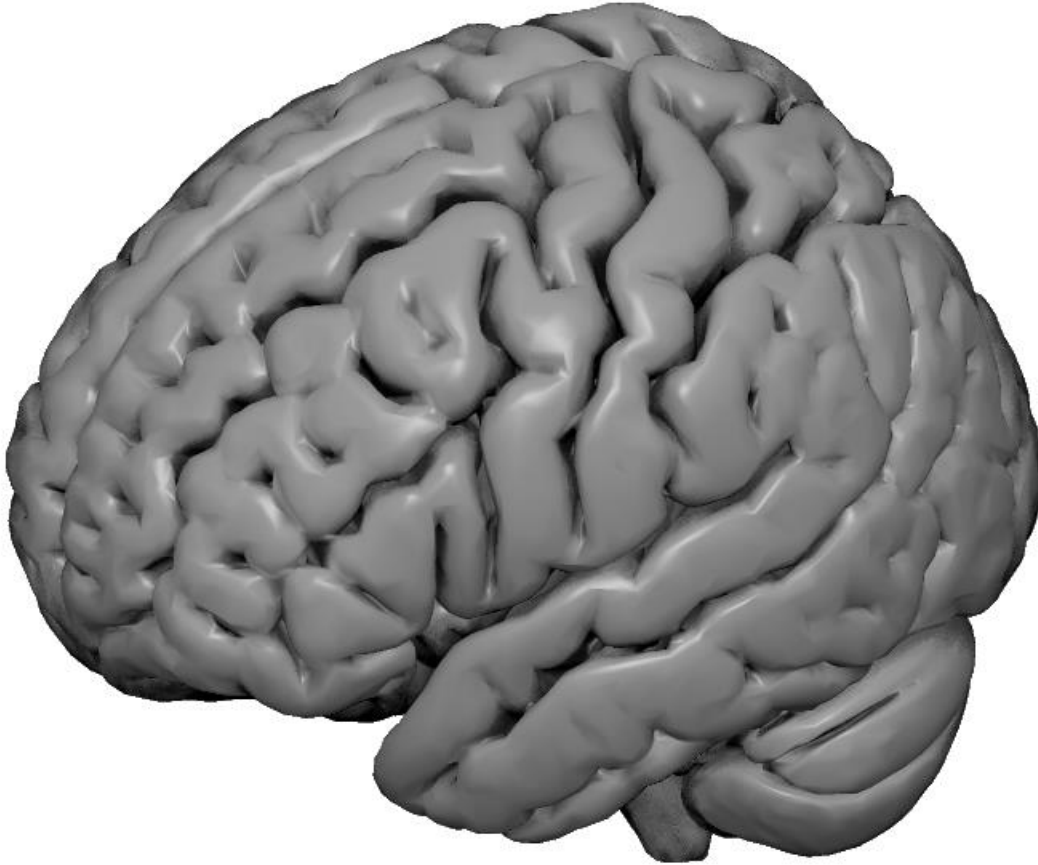
Ambient

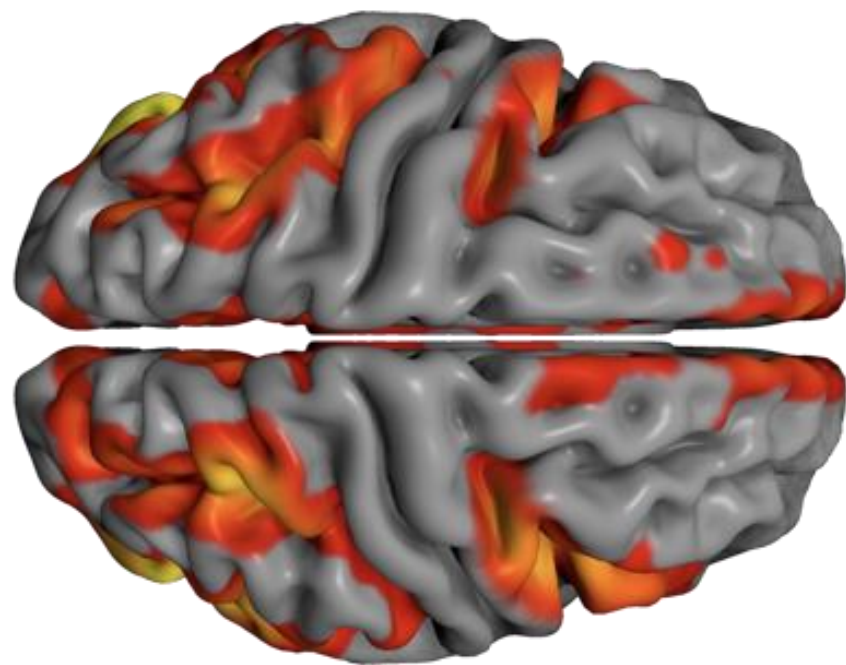
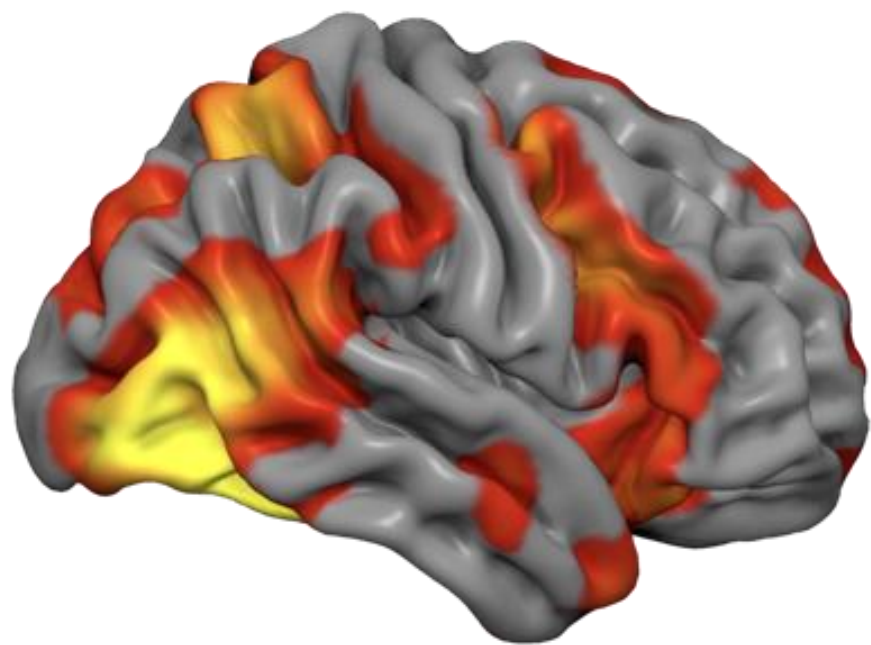
Diffuse

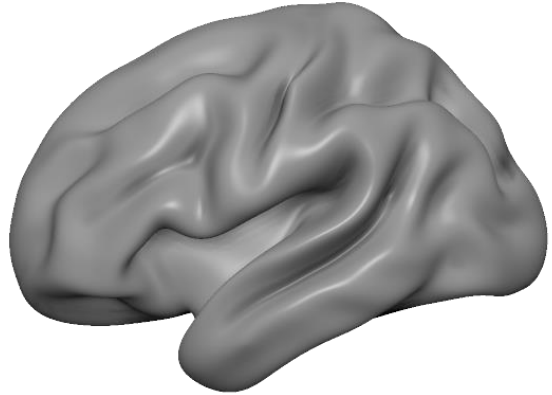
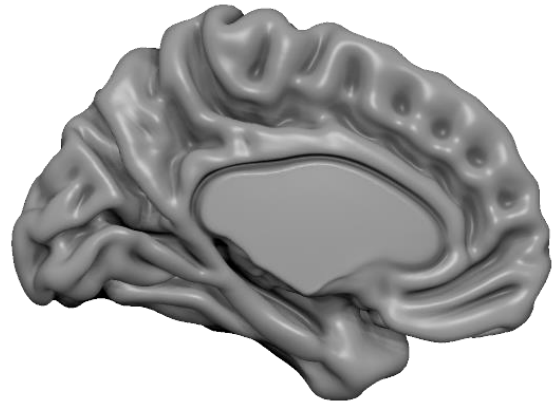
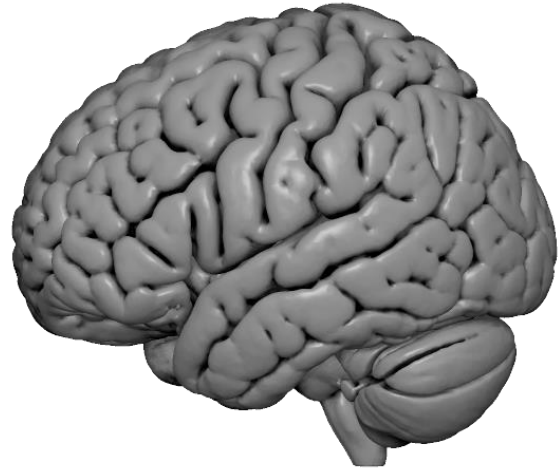
Specular

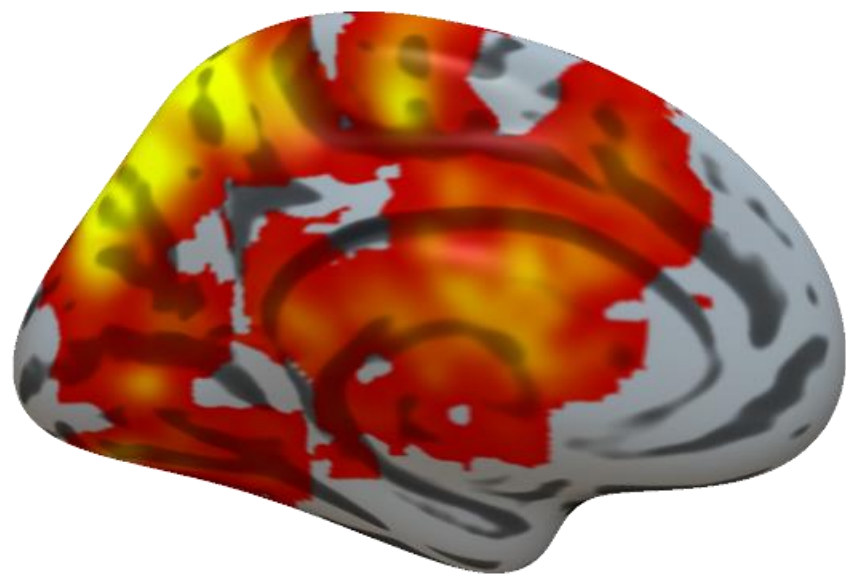
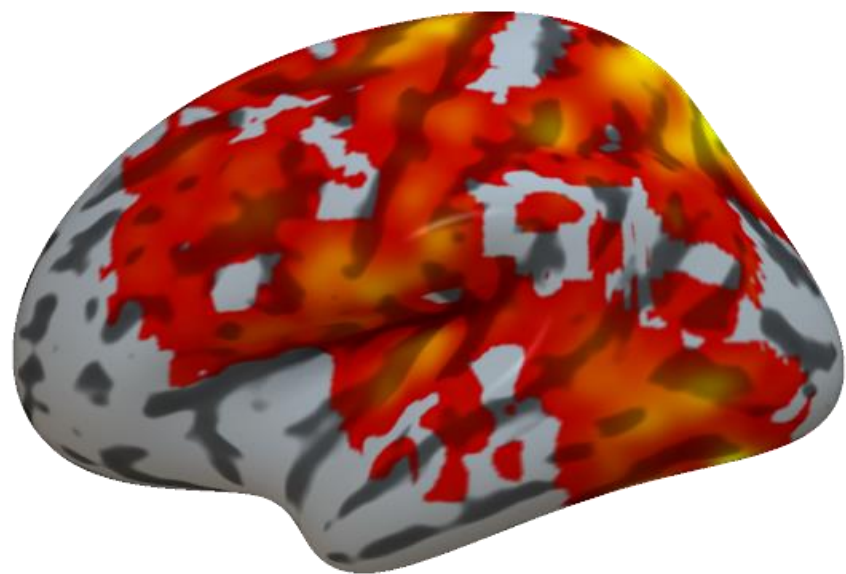
Shininess

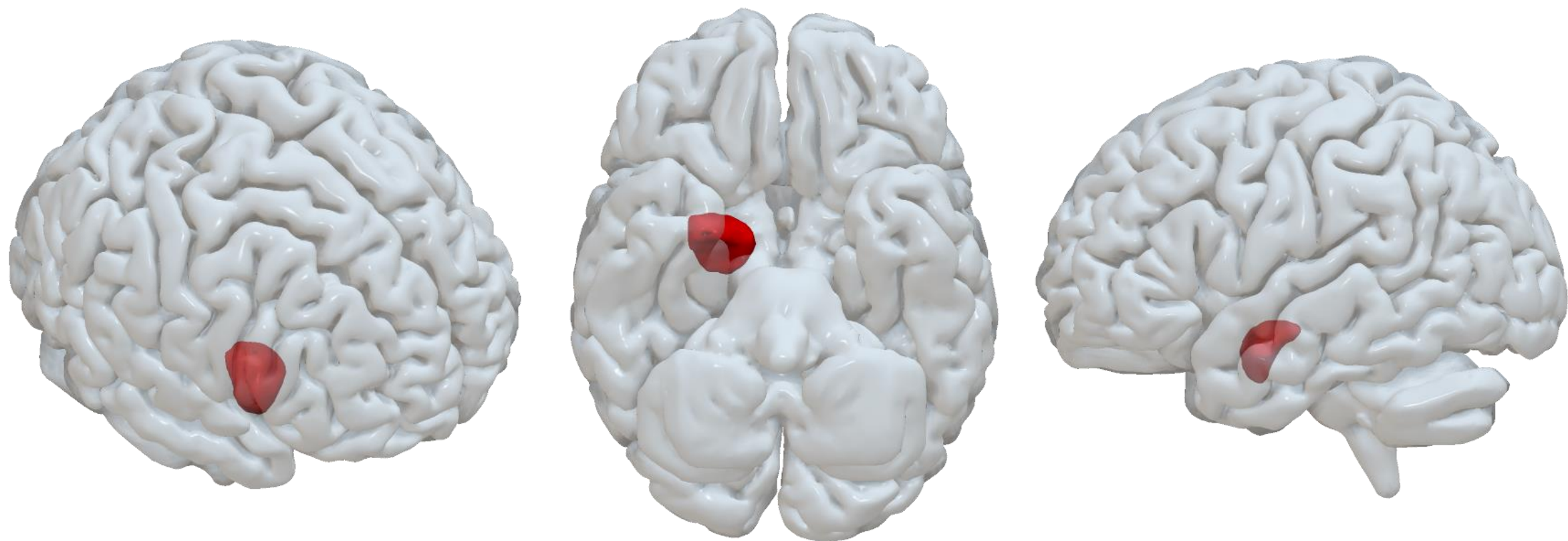
Blinn-Phong shading with Lambertian dif









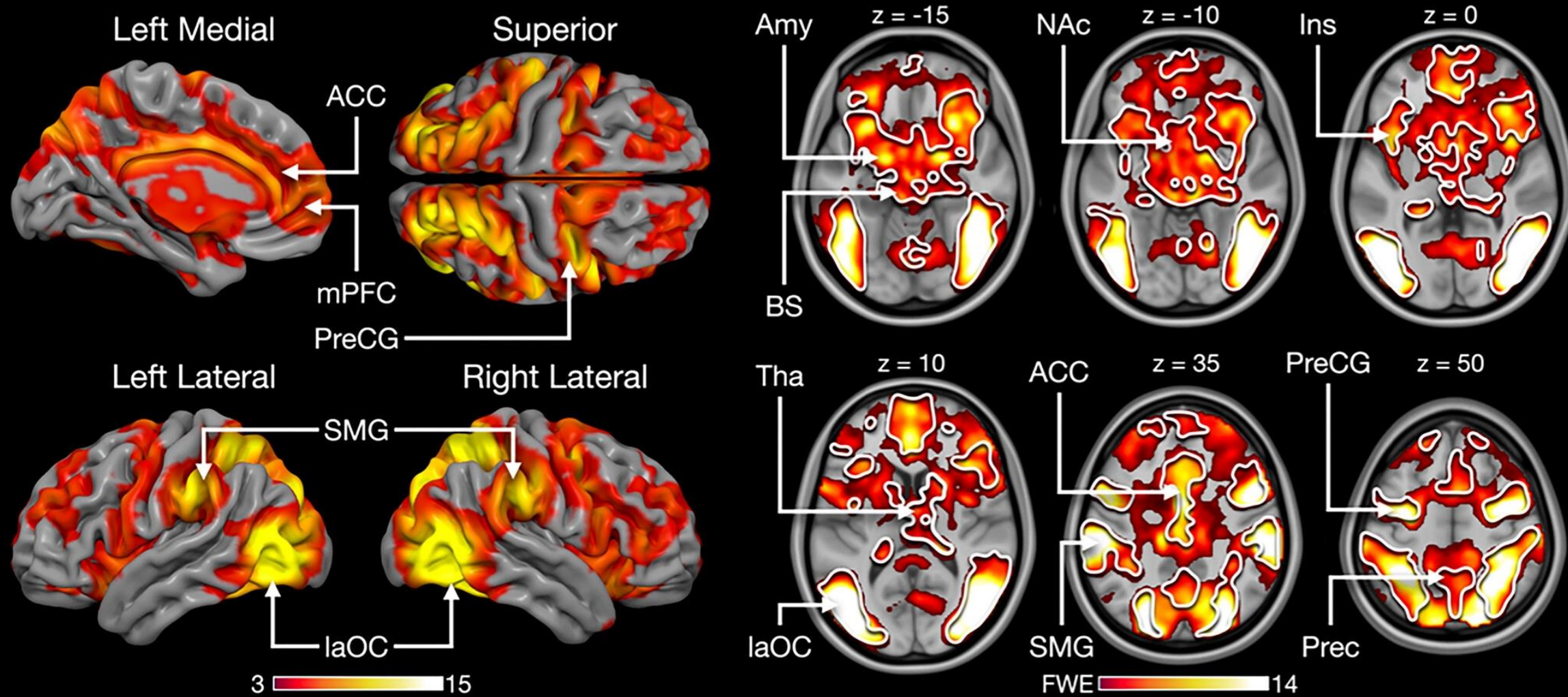


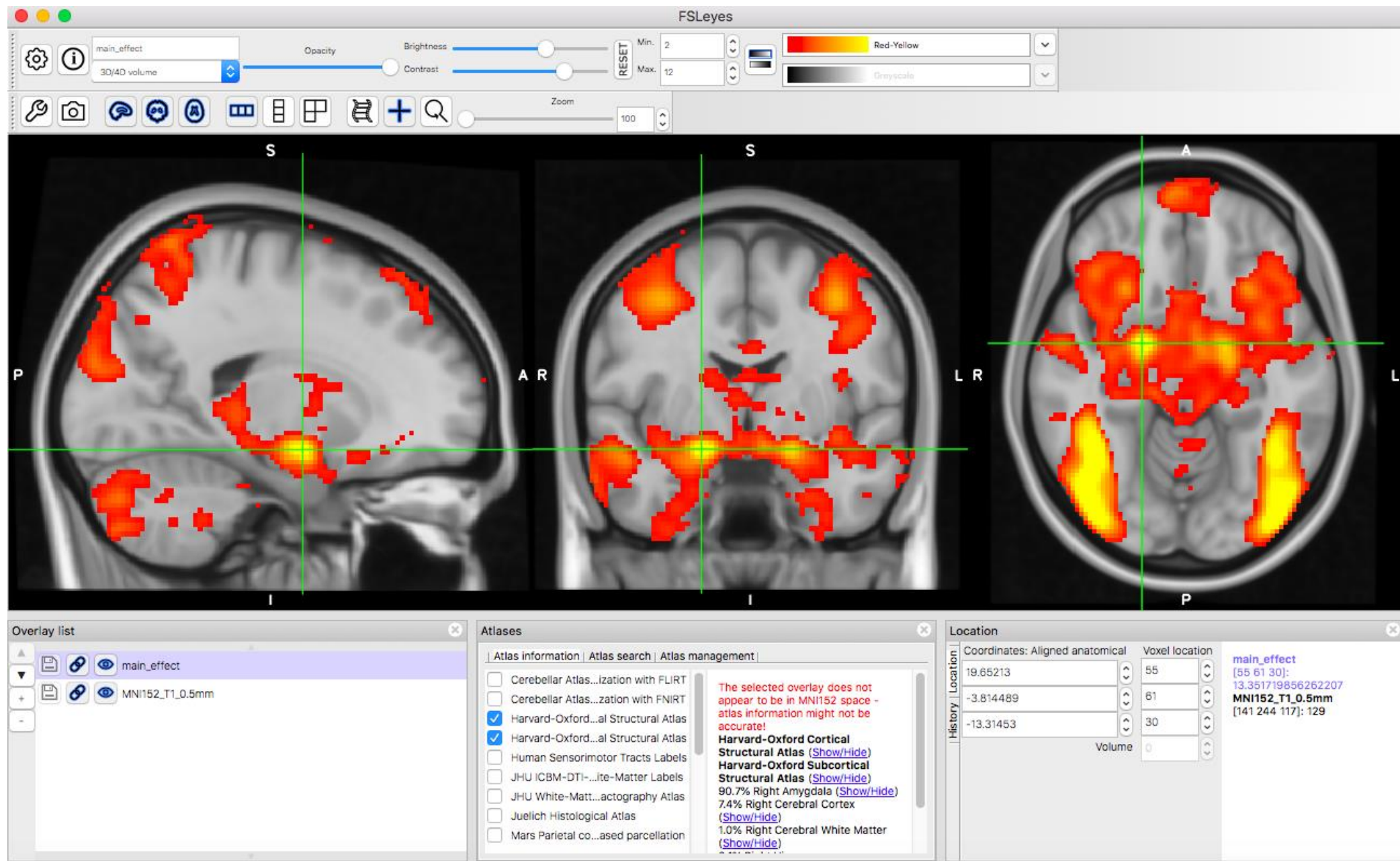
Advanced > Convert voxelwise volume to mesh



```
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()
```

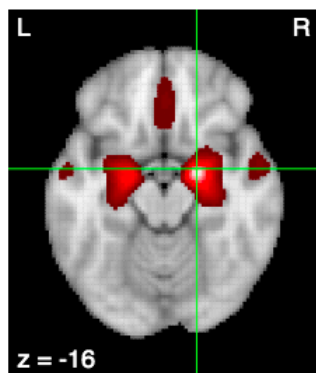
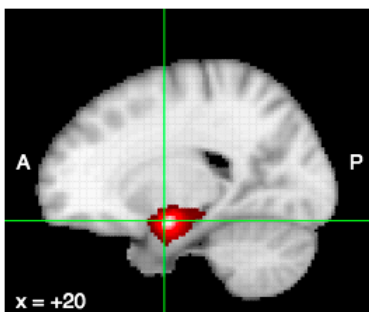
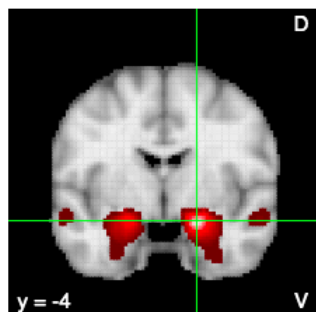
(a) Responses to sexual movies





[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 et al \(2011\)](#), [Buckner et al \(2011\)](#), and [Choi et al \(2012\)](#).

Associations with meta-analysis maps

Show 10 entries

Search:

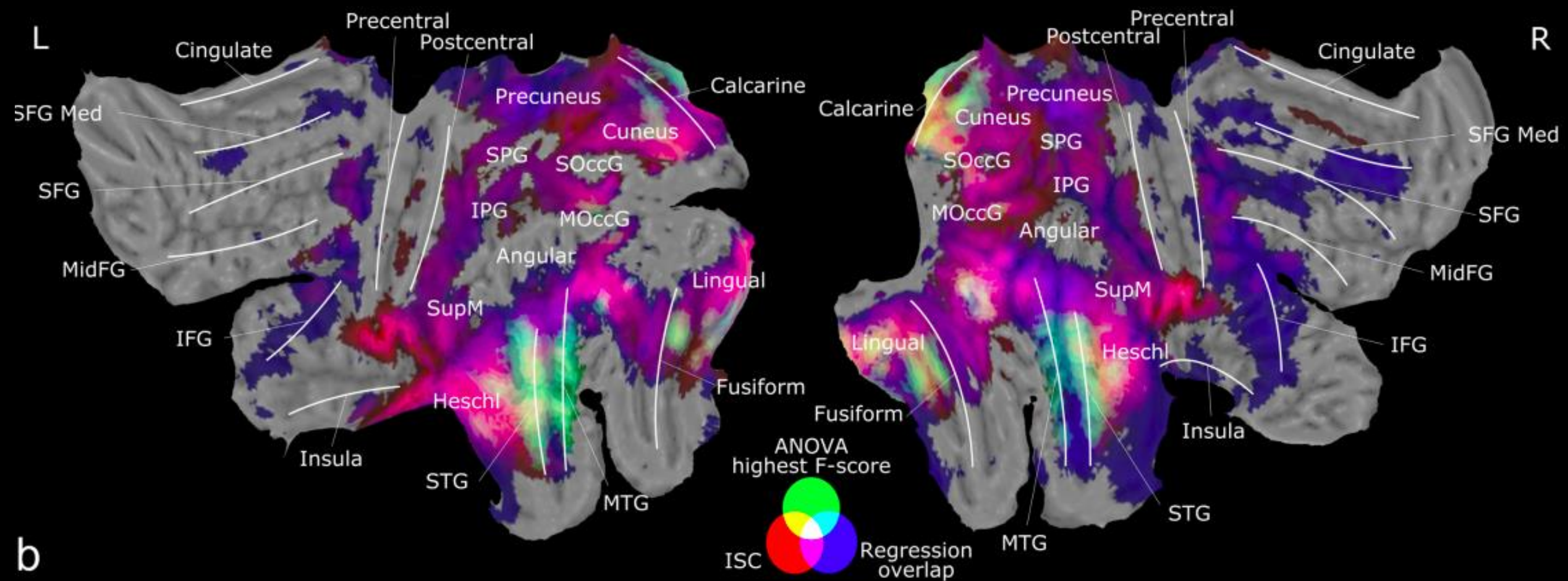
Name	Individual voxel		Seed-based network	
	z-score	Posterior prob.	Func. conn. (r)	Meta-analytic coact. (r)
amygdala	33.11	0.89	0.46	0.74
emotional	18.23	0.79	0.39	0.65
faces	15.5	0.79	0.24	0.5
neutral	15.5	0.79	0.38	0.68
fear	13.8	0.82	0.32	0.59
facial	13.41	0.8	0.31	0.6
mood	13.3	13.3	0.13	0.4
face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



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

```
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,
```

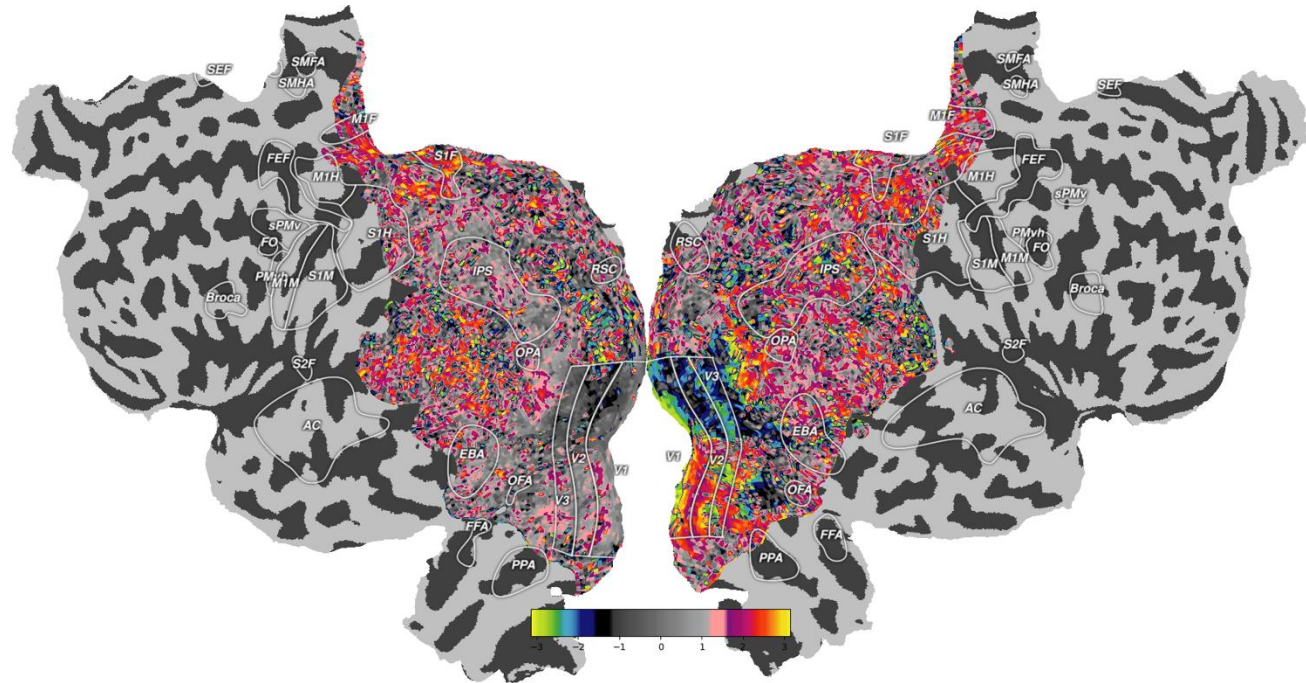
```
plt.show()
```

```
right_data = ret_data.angle_right
cortex.quickshow(right_data, with_curvature=True,
```

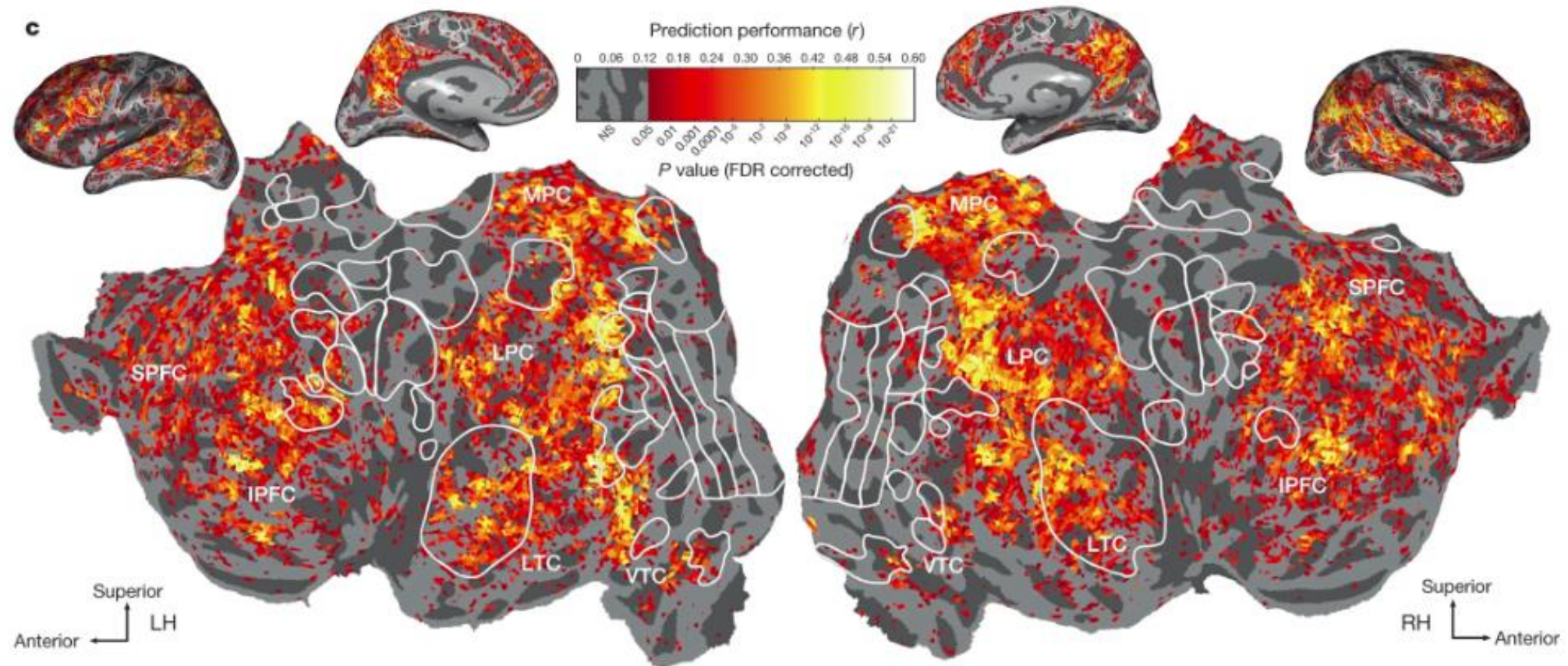
```
plt.show()
```

```
curvature_contrast=0.5,
curvature_brightness=0.5,
curvature_threshold=True)
```

```
curvature_contrast=0.5,
curvature_brightness=0.5,
curvature_threshold=True)
```



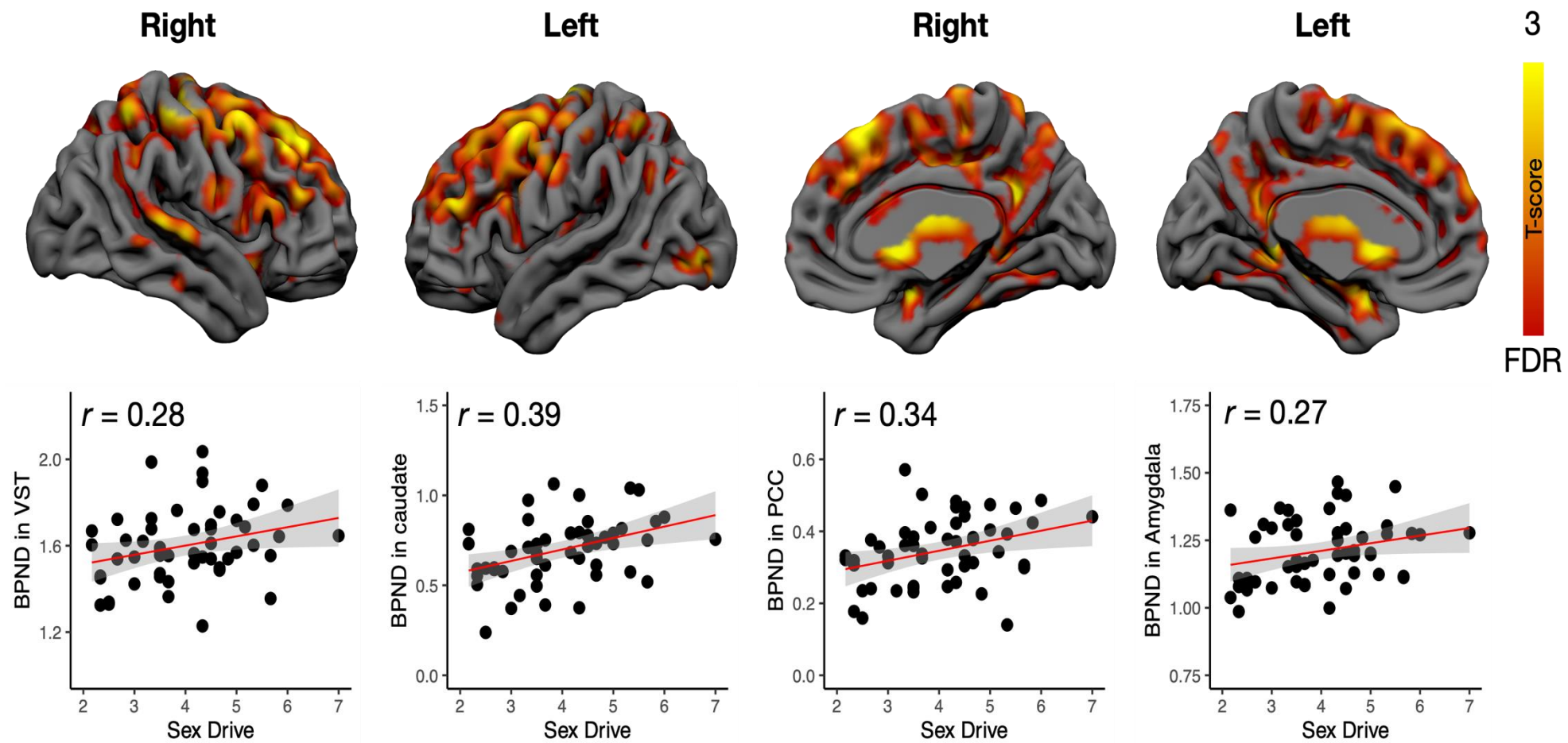
PyCortex



Huth et al, 2016, Nature

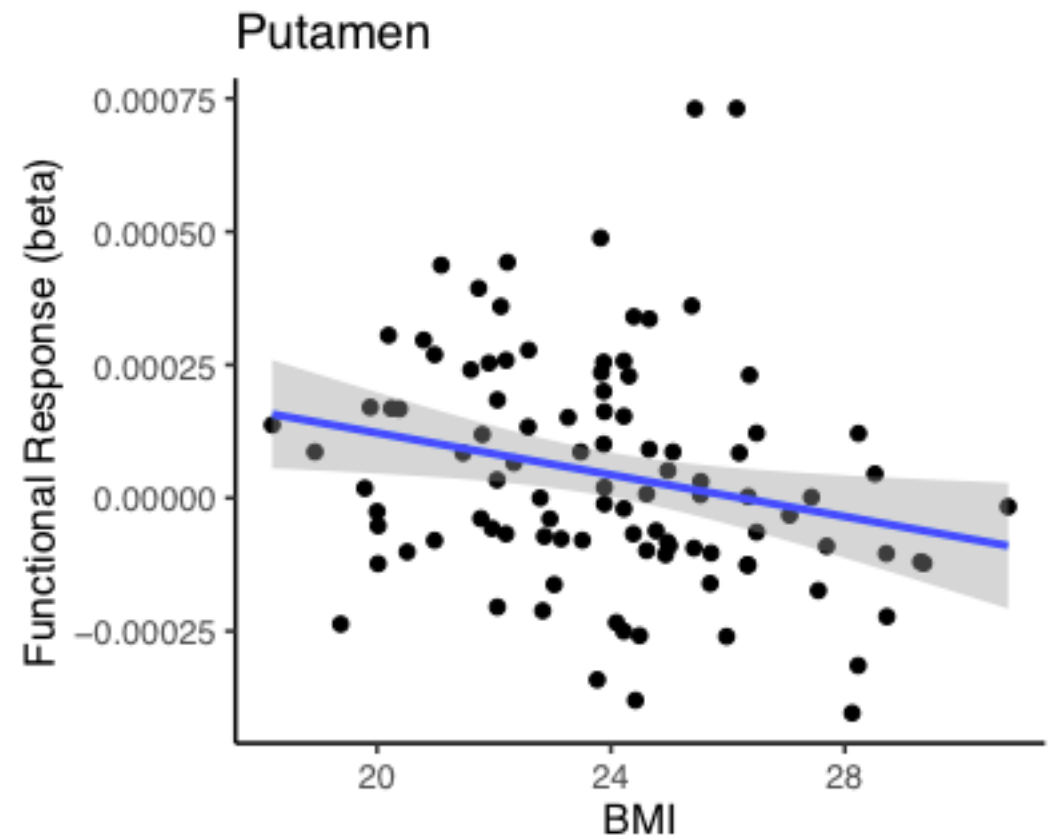
PyCortex

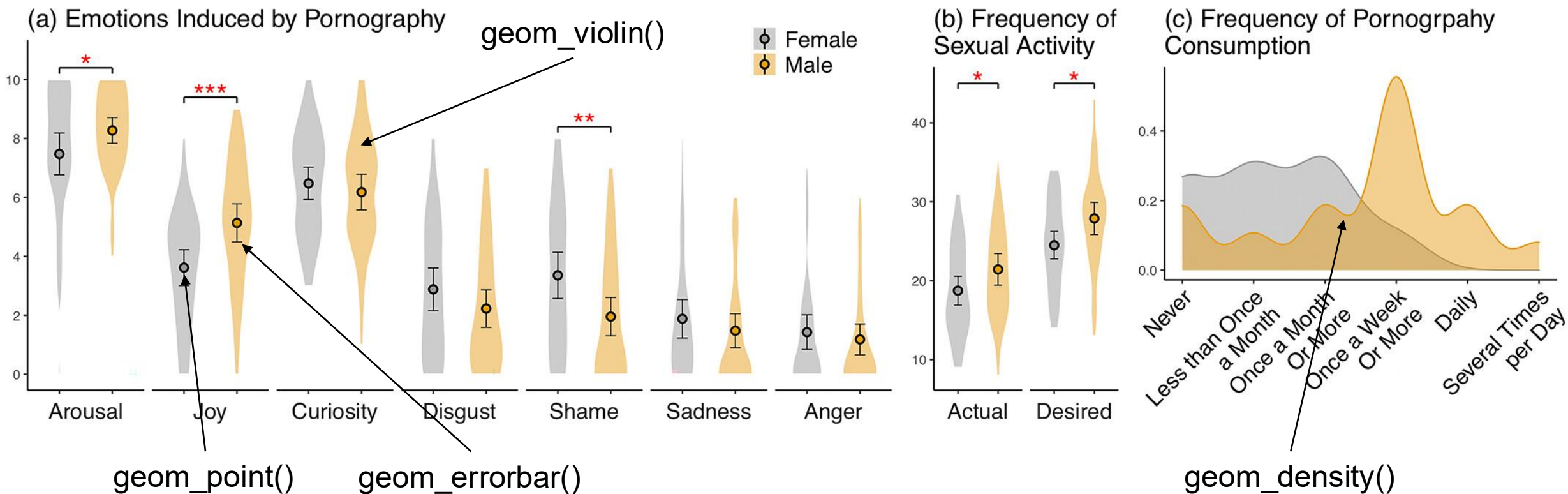
<https://gallantlab.org/viewer-lescroart-2018/>





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





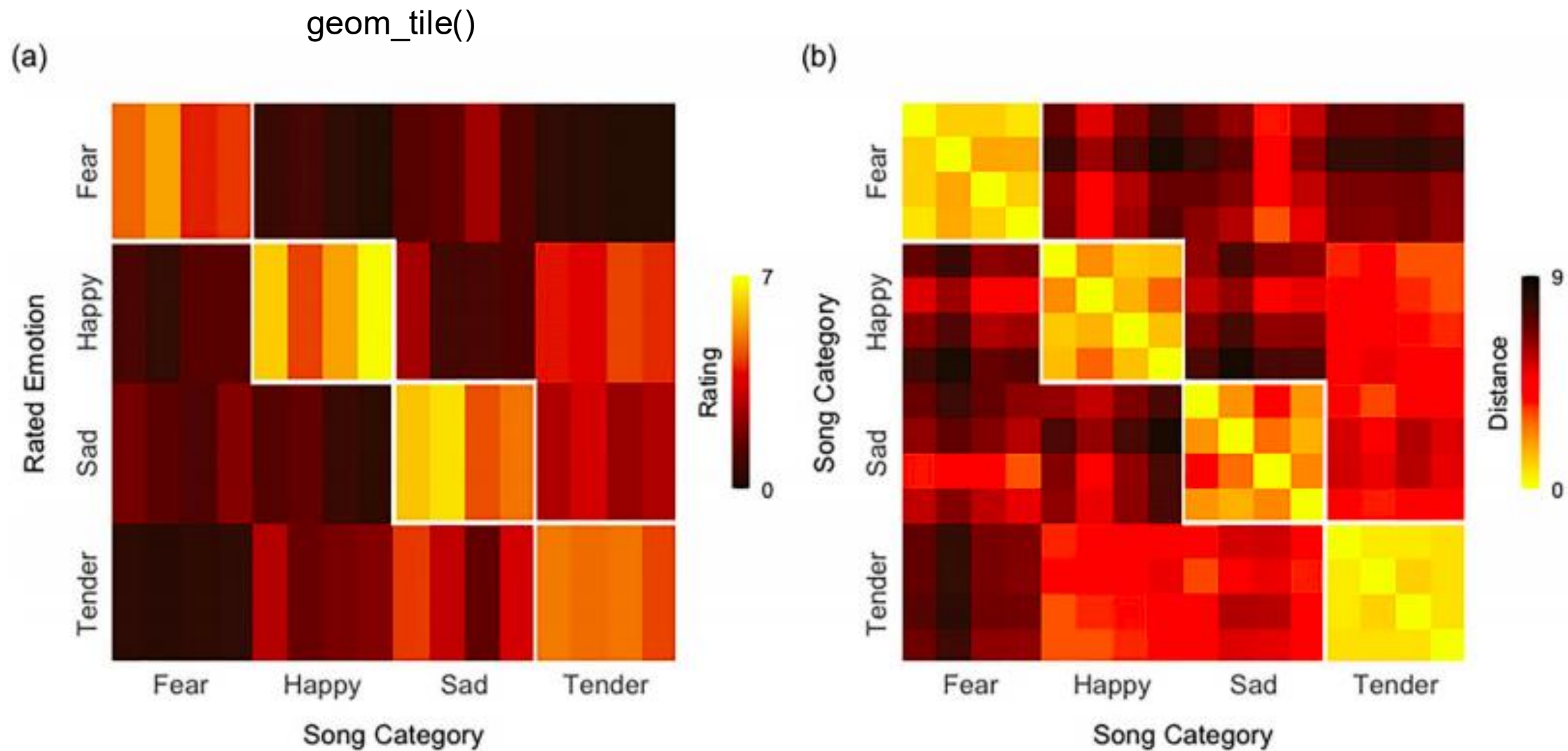


Figure 1. (a) Mean ratings for the intensity of each emotion for each musical excerpt. (b) Rating dissimilarity matrix (Euclidean distance) for each song pair.

<https://www.rstudio.com/>

<https://ggplot2.tidyverse.org/>