Visualizing volume and surface based data

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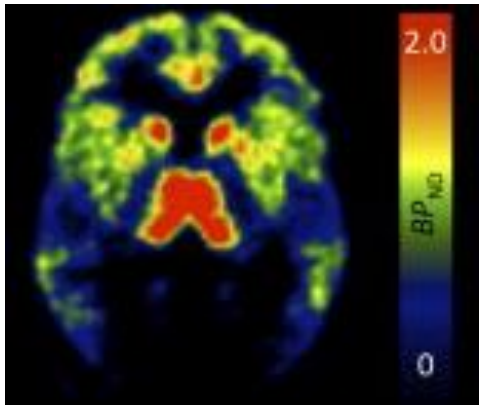
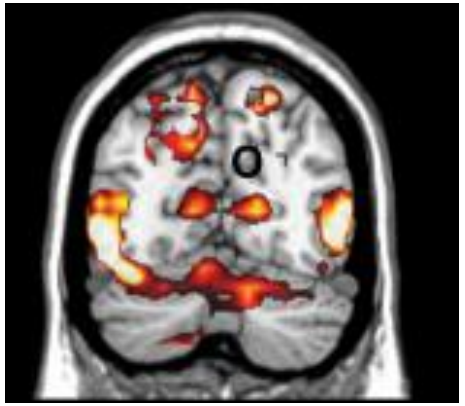
Visualizing 3D images

- This course has focused on producing various kinds of brain maps
  - Parametric images, statistical maps, VBM maps
- In each case the end product is structurally similar,
  and the same visualization methods can be used for all of them

BPnd image

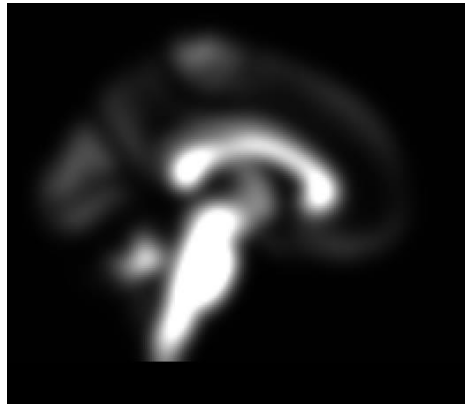


T-statistic map



Grey matter density

White matter density



DTI FA map

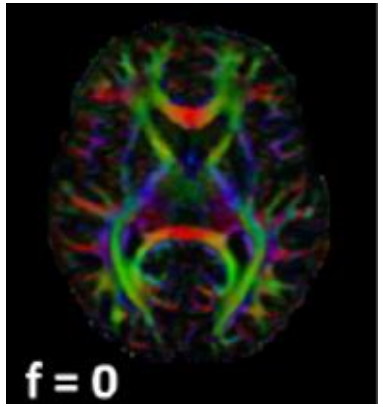


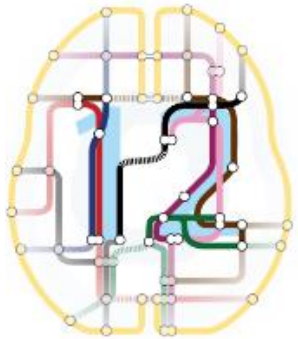
Image viewing software

- Numerous programs can be used for viewing dicom/nifti files:

Mango

http://ric.uthscsa.edu/mango/

SPM



http://www.fil.ion.ucl.ac.uk/spm/

Carimas

http://turkupetcentre.fi/carimas/

MRIcro

http://people.cas.sc.edu/rorden/mricron/index.html

FSLview

https://fsl.fmrib.ox.ac.uk/fsl/fslwiki/FslInstallation/SourceCode/FslView

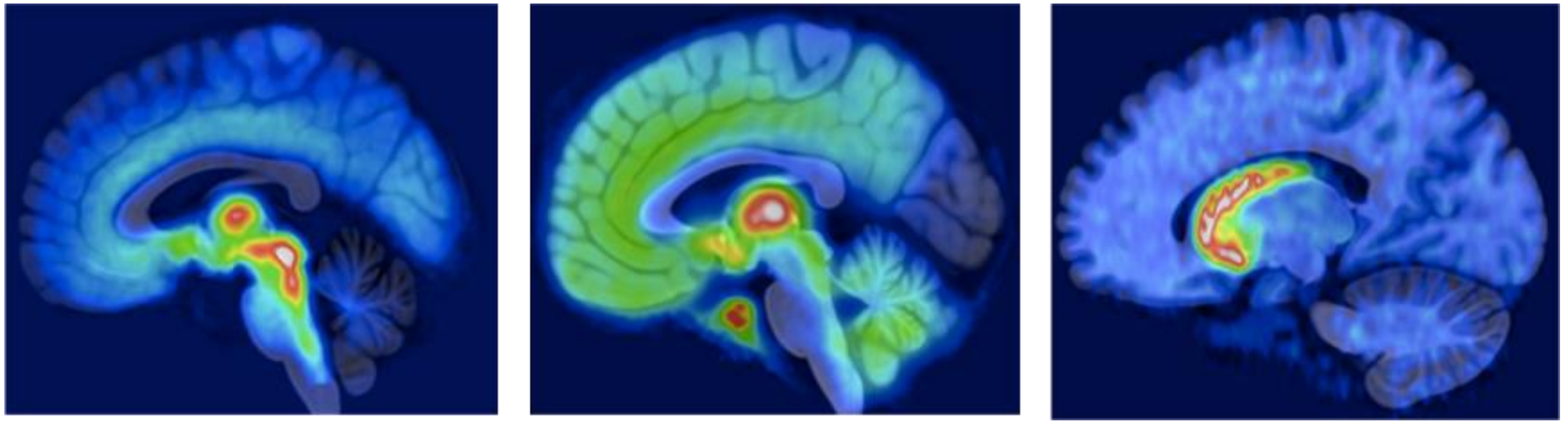
Design your visualizations

- You should design your visulizations to serve the purpose that you have
- Figures in neuroimaging papers typically:

1. show **where** in the brain you observe an effect
2. show **how big** the effect is
3. visualize the raw data for **transparency**

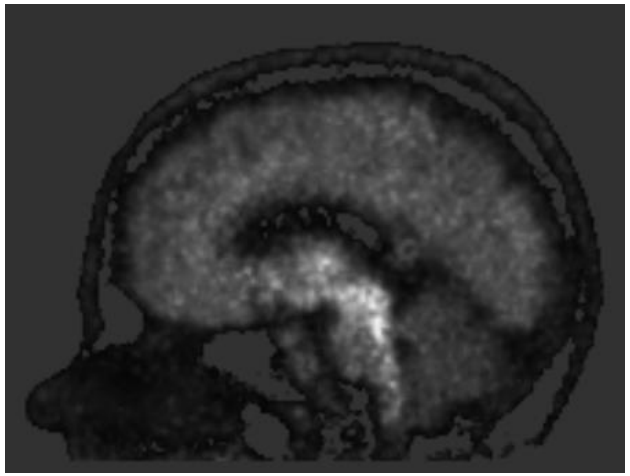
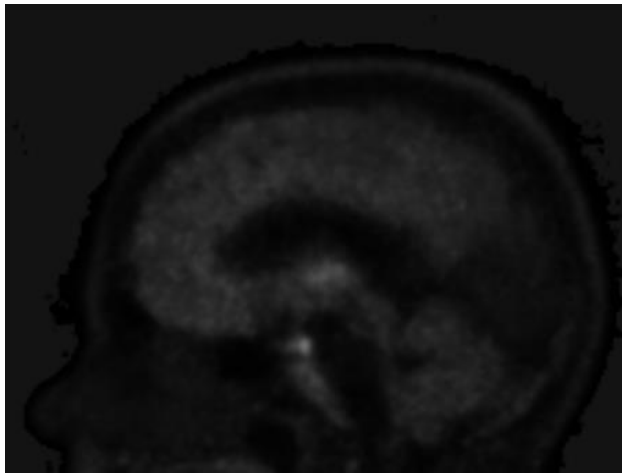
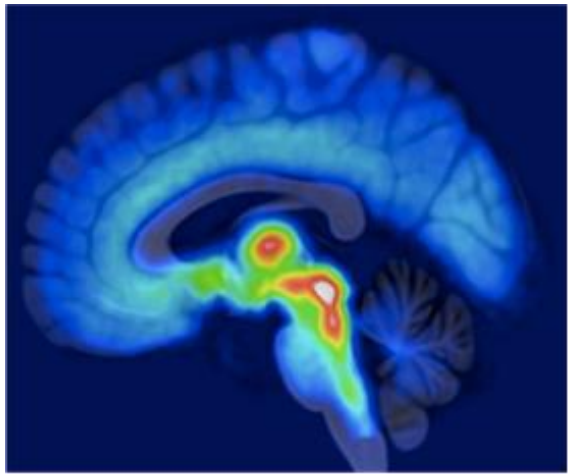
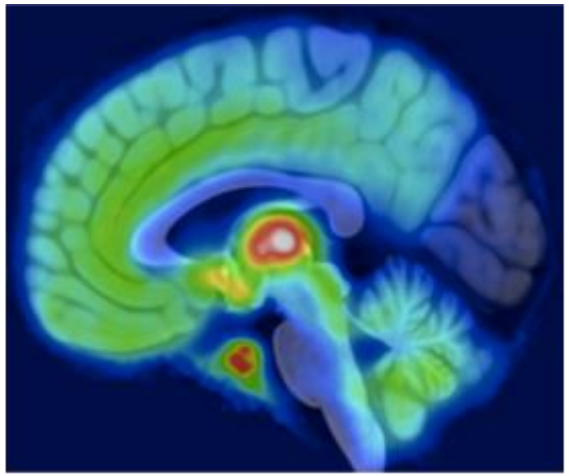
Slices

- Probably the most widely used method for visualizing brain maps
- Easy to create
- Good at visualizing subcortical effects
- Not optimal for cortical effects



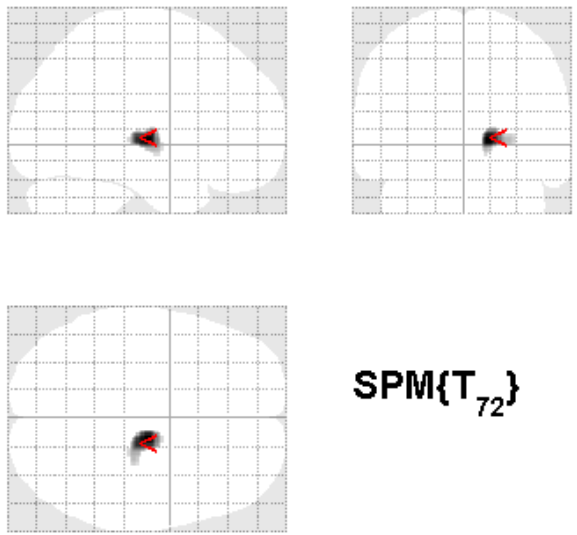
Slices

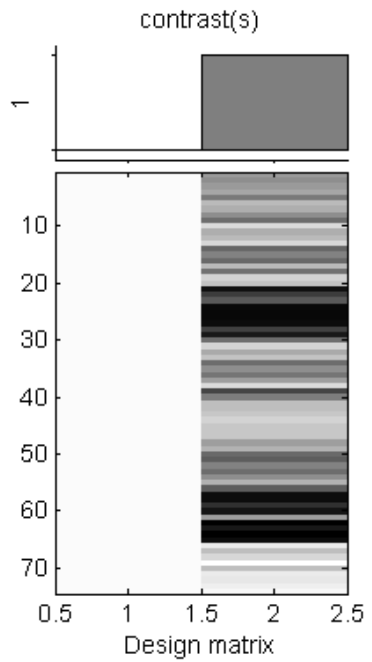
- BPnd images are normalised to standardized MNI space
- Brain is extracted,
- Groupwise average images are created and overlaid on the T1 template
- Color scales and color tables are adjusted
- Same slice selected for both of the images

Example : spm correlation analysis

SPM output (pos. correlation; contrast [0 1])



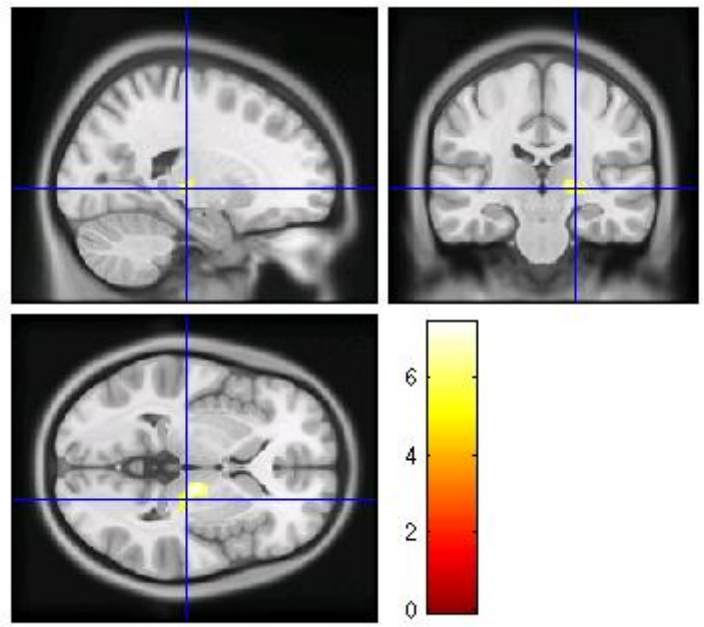


SPMresults: \s8mm\spm_DVR_age_corr
Height threshold T = 5.174179 {p<0.05 (FWE)}
Extent threshold k = 100 voxels

Statistics: ***p-values adjusted for search volume***

set-level		cluster-level			peak-level					mm mm mm
p	*c*				$p_{FWE-corr}$	$q_{FDR-corr}$	*T*	($Z_{\equiv}$)	p_{uncorr}	
		0.000	0.000	442	0.000	0.000	0.001	7.39	6.35	0.000	14 -15 1

SPM basic visualization



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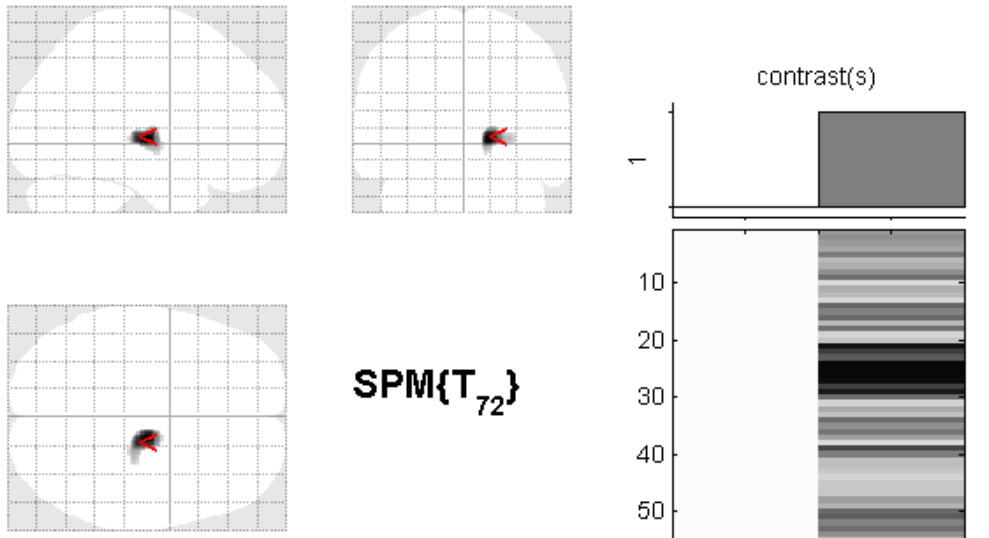

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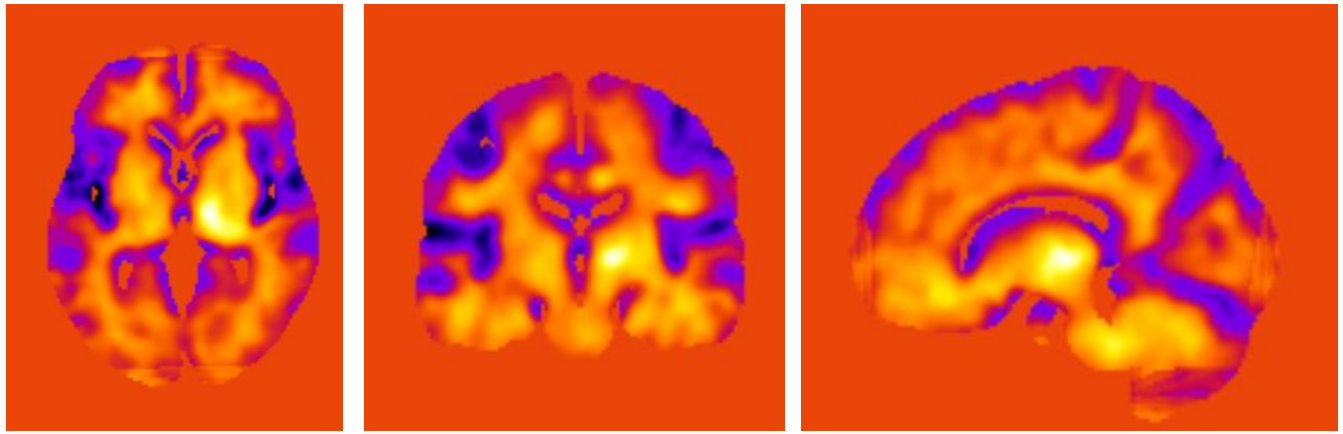
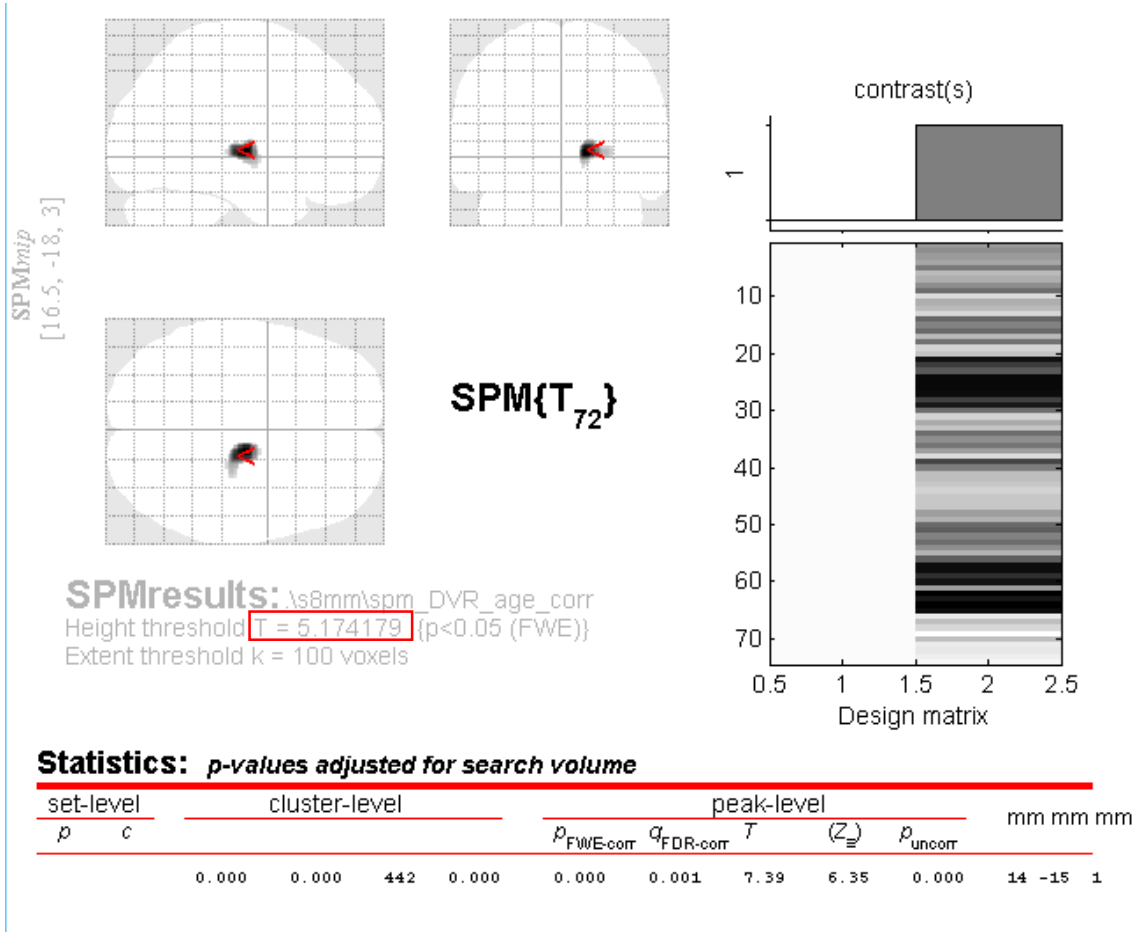
p	c				$p_{FWE\text{-}corr}$	$q_{FDR\text{-}corr}$	T	$(Z_{\equiv})$	p_{uncorr}	
0.000	0.000	442	0.000		0.000	0.001	7.39	6.35	0.000	14 -15 1

t-statistic map spmT_0001.nii,
No anatomical underlay; scale: [-7,9]

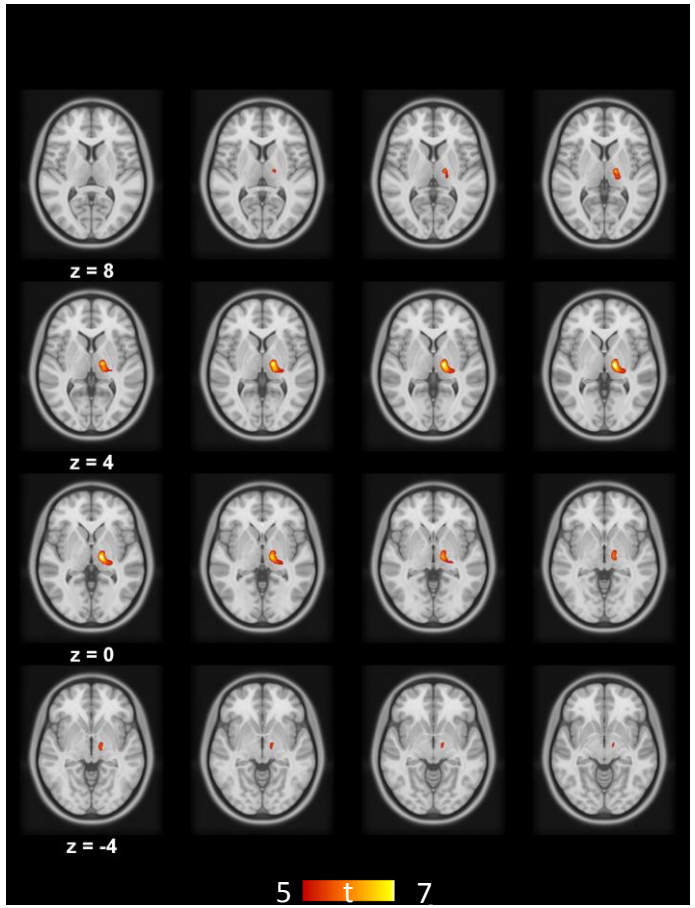


Example : spm correlation analysis

SPM output

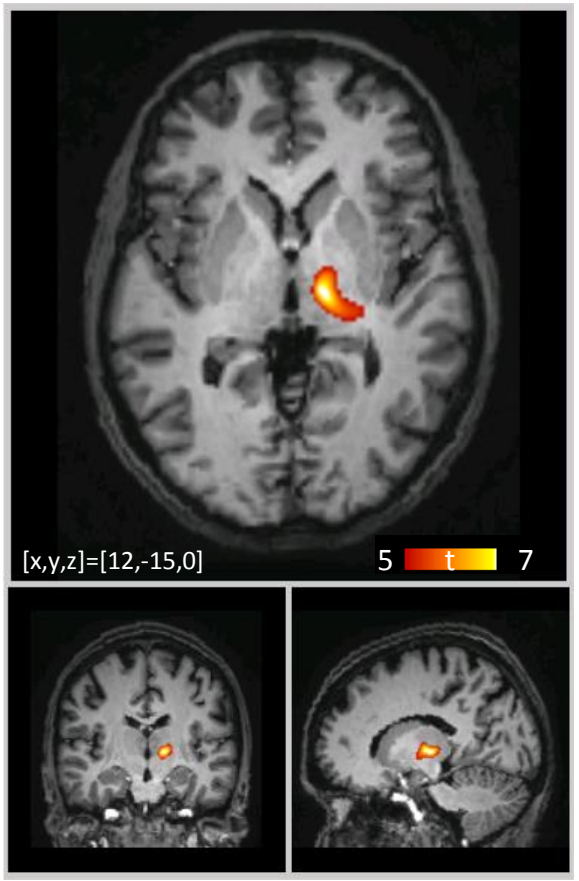


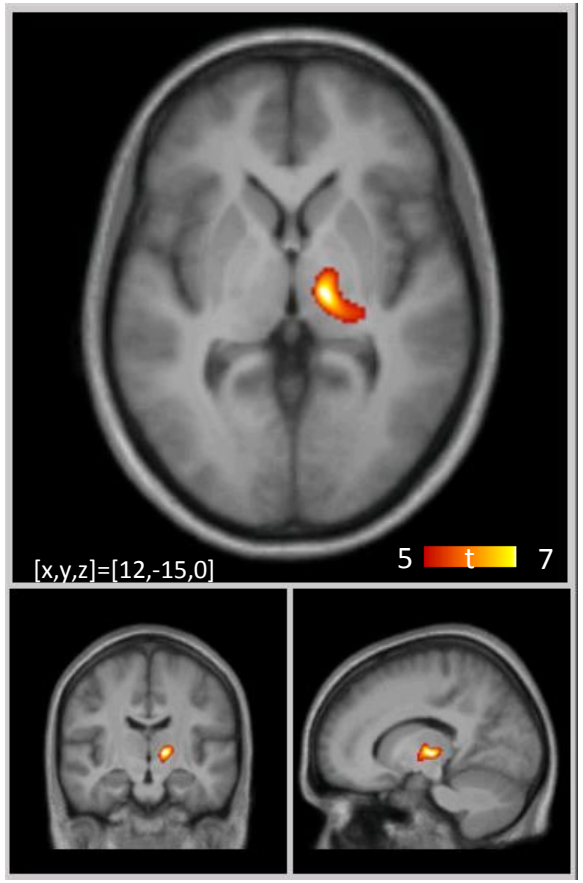
Thresholded t-statistic map (t>5.17)
overlaid with T1 MNI template (slice layout)

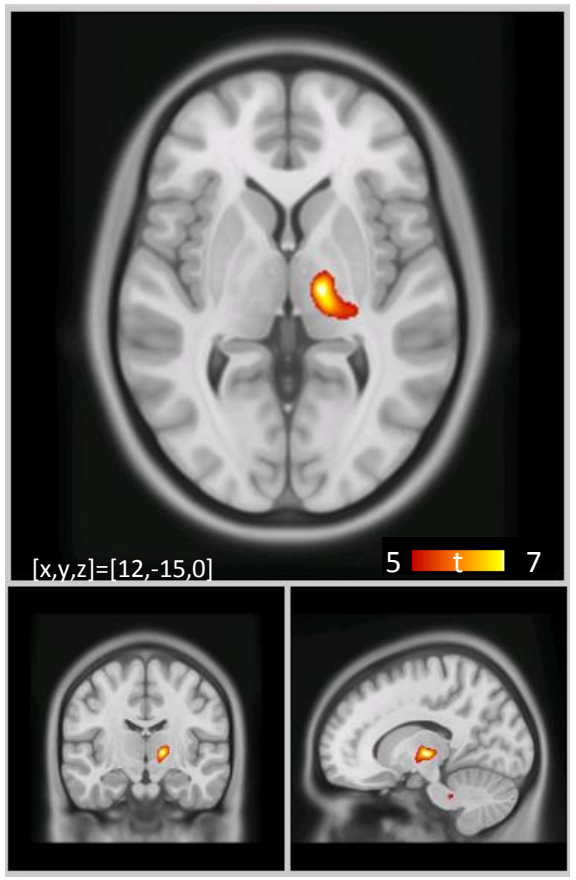


Different underlays

T-map (t>5.17) overlaid with normalised T1: one subject, group average, MNI T1 template

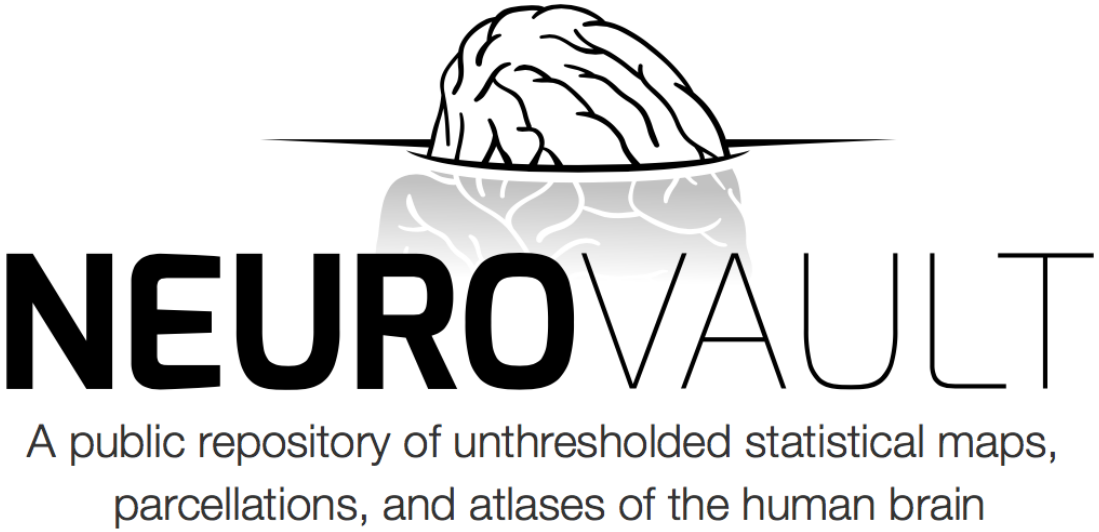






Neurovault

- It’s also possible to publish 3D summary statistic maps (nifti)
  - https://neurovault.org
- Instead of selected slices, everyone can look at the whole images
- Easier to understand where the effect truly is
- Facilitates meta-analyses



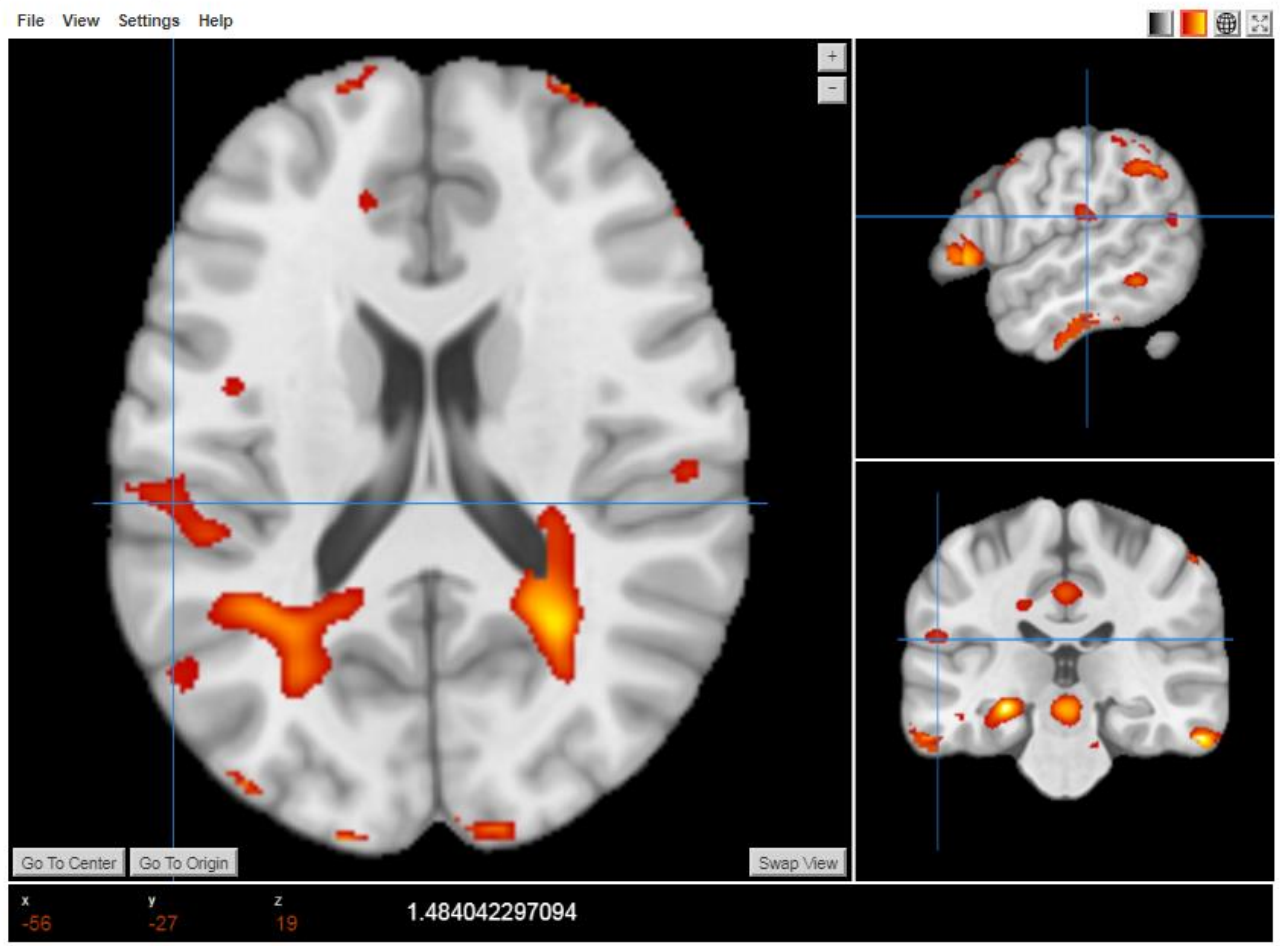
Pearson correlation: [11C]carfentanil BPnd posterior insula vs. haemodynamic responses to vicarious pain

Contributed by tomi.karjalainen@aalto.fi on April 10, 2017

Collection: Dissociable Roles of Cerebral μ-Opioid and Type 2 Dopamine Receptors in Vicarious Pain: A Combined PET–fMRI Study

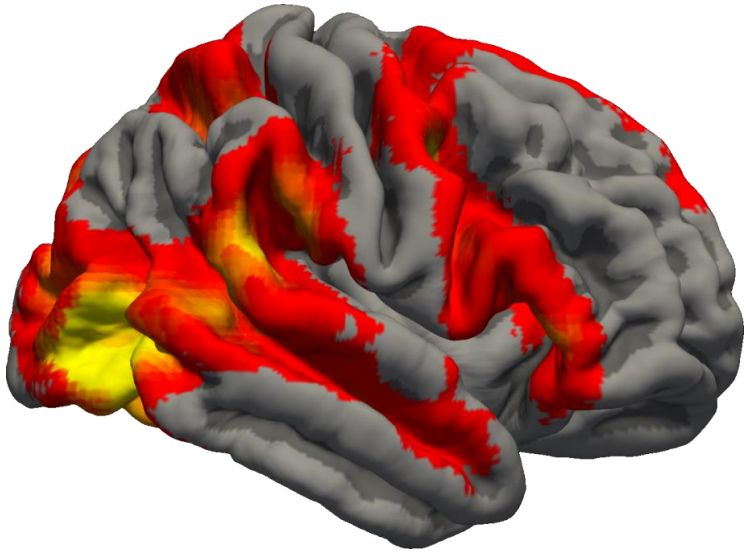
Task View | 3D View | Download | Analysis

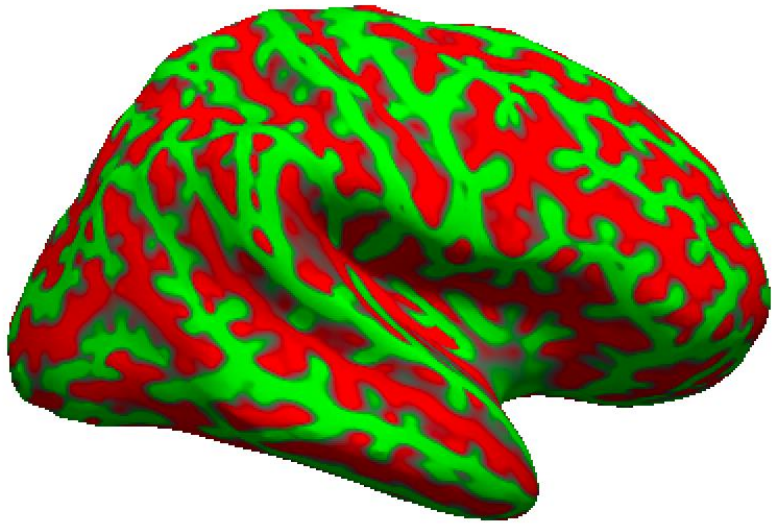
Papaya viewer | Details | Embed



Surfaces

- Surfaces are the best way to visualize cortical effects
- Compared to slices, gyral organization is easier to see
- 3D rendering shows an overall representation of the results
- Inflated surfaces also reveal sulci

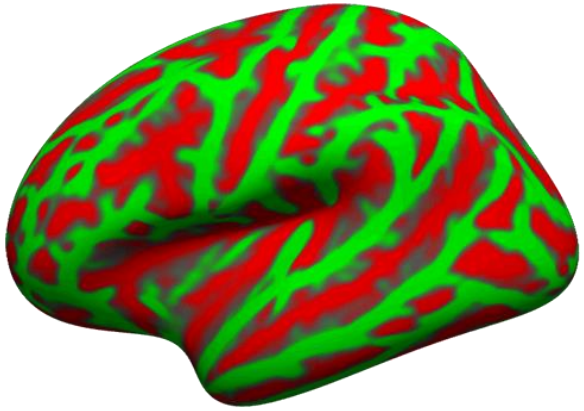




Surfaces

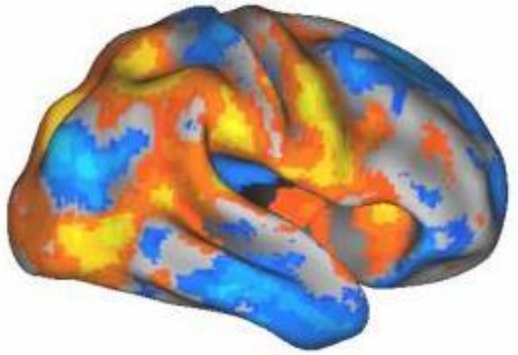
- Mricron, mango, SPM, and fslview all have a surface rendering property
- Other options:

Freeview (Fresurfer)



https://surfer.nmr.mgh.harvard.edu/fswiki/DownloadAndInstall

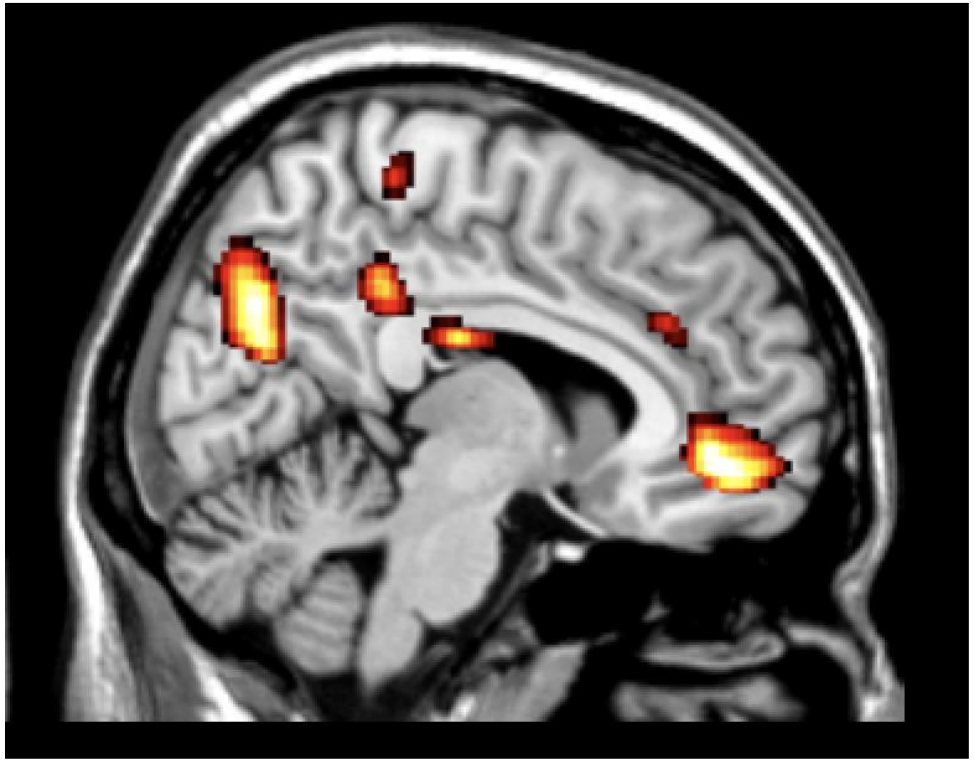
Caret



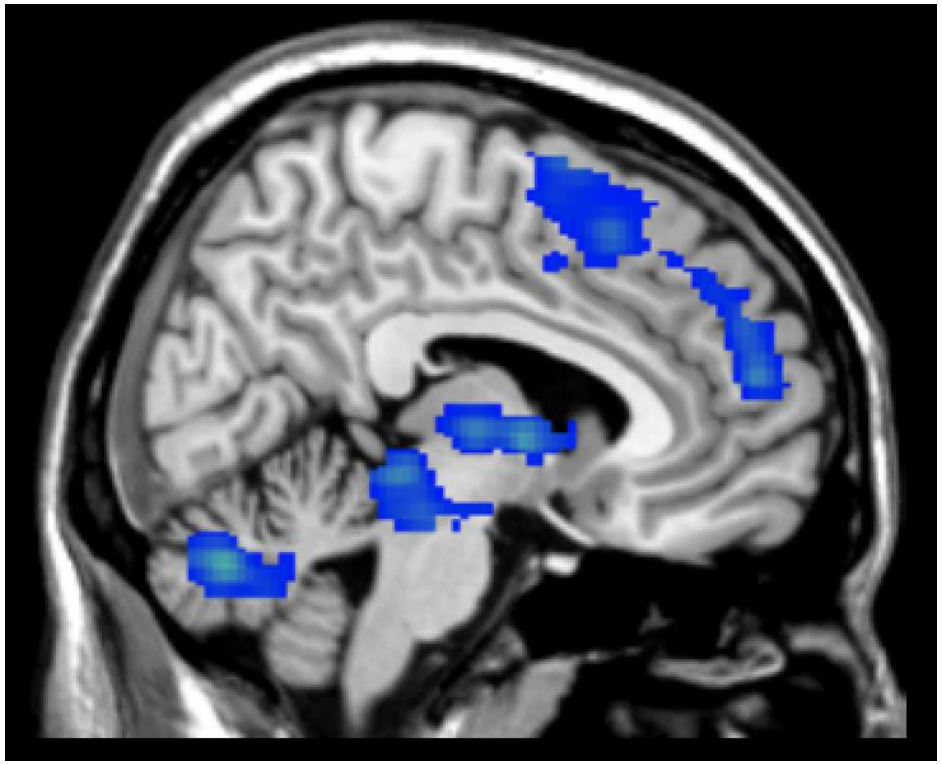
http://brainvis.wustl.edu/wiki/index.php/Caret:Download

Alternative designs:

Positive effect

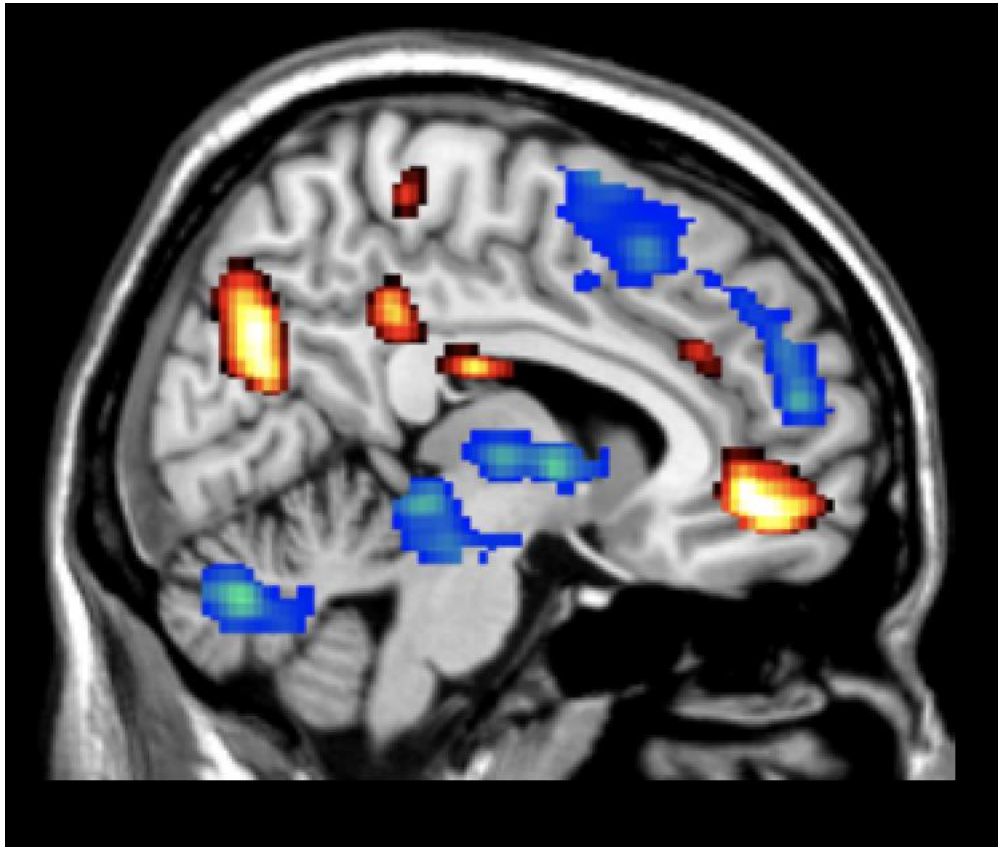


Negative effect



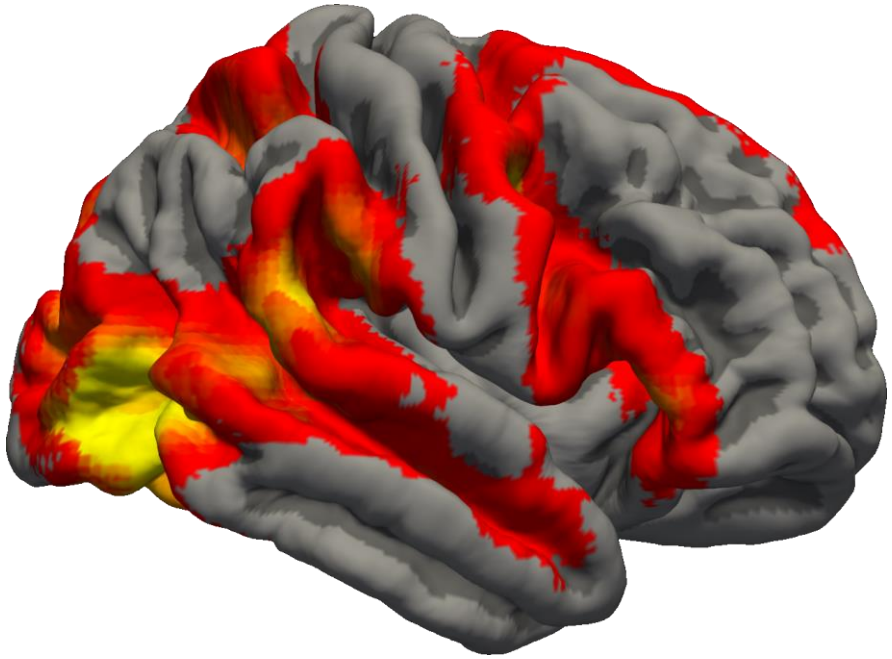
Alternative designs:

Positive and negative effect

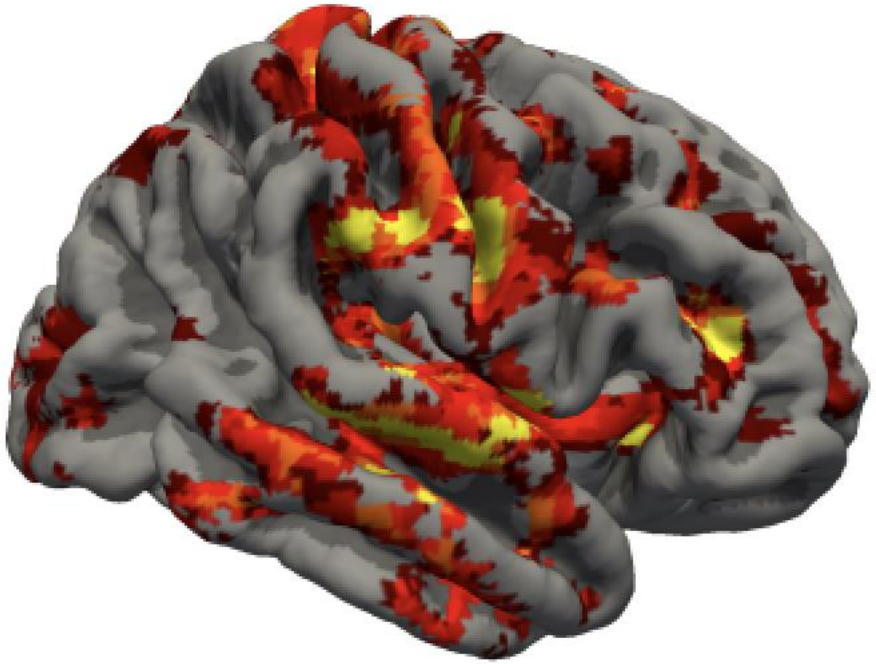


Alternative designs

Main effect

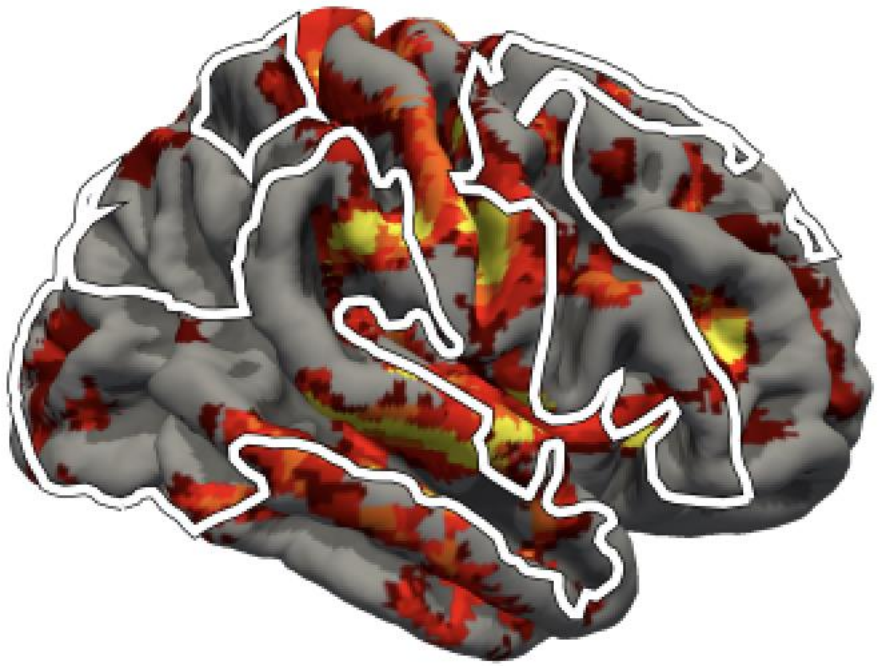


Correlation

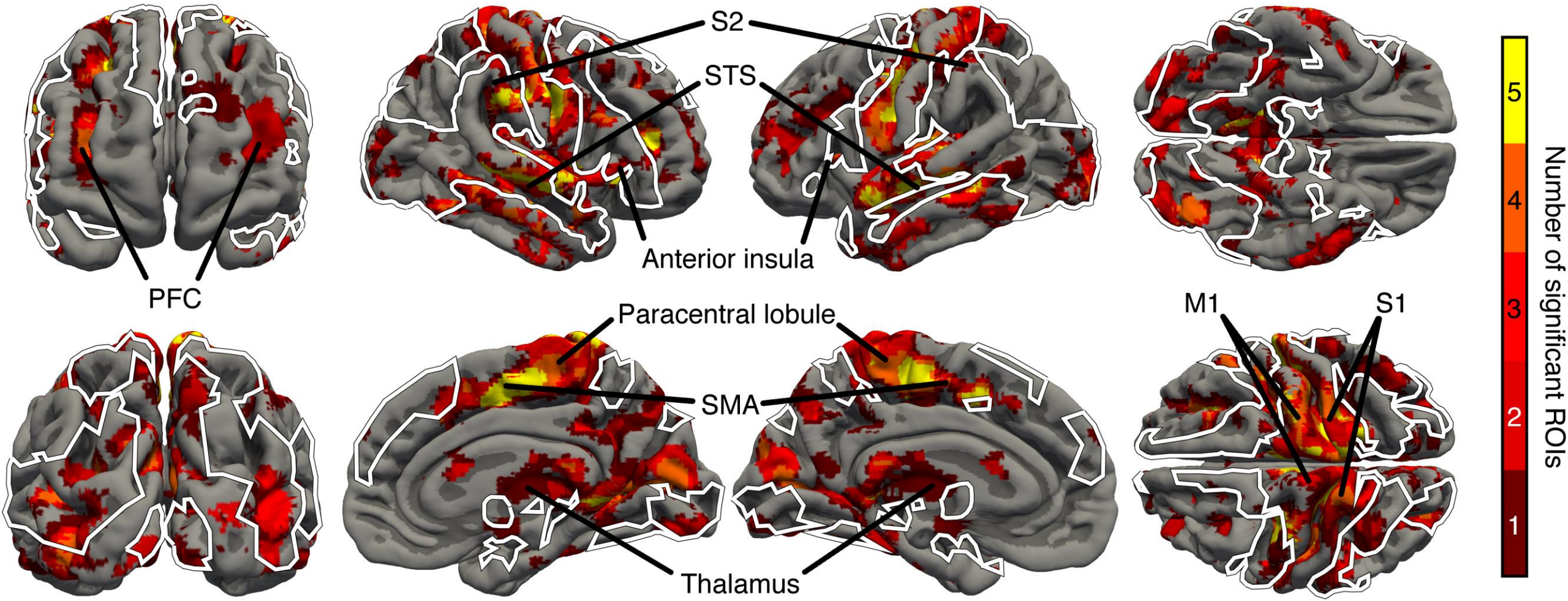


Alternative designs

The main effect and correlation

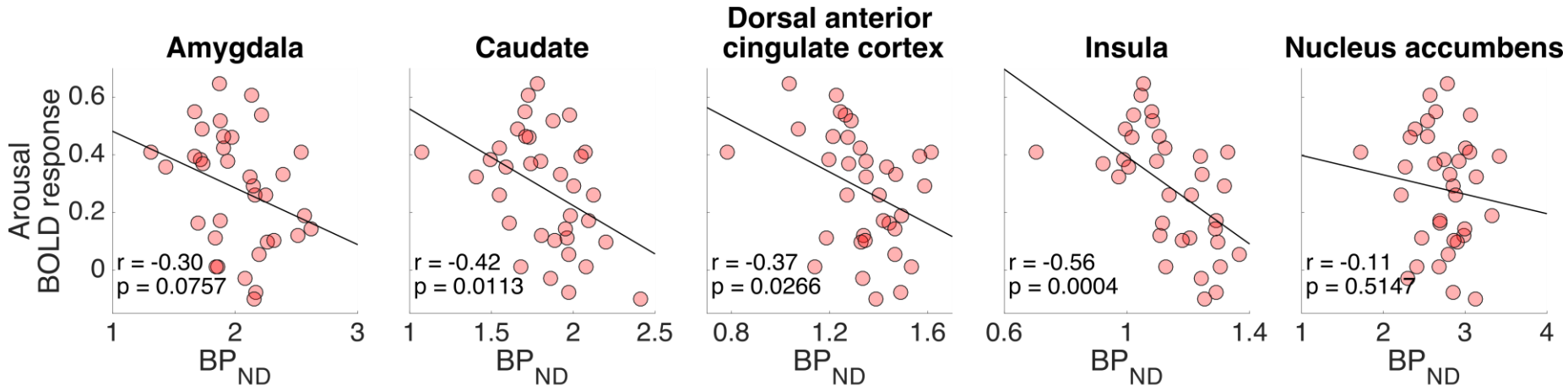


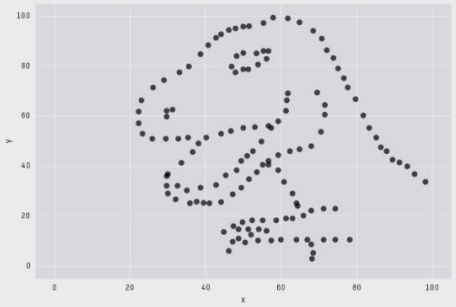
Pointing anatomical regions



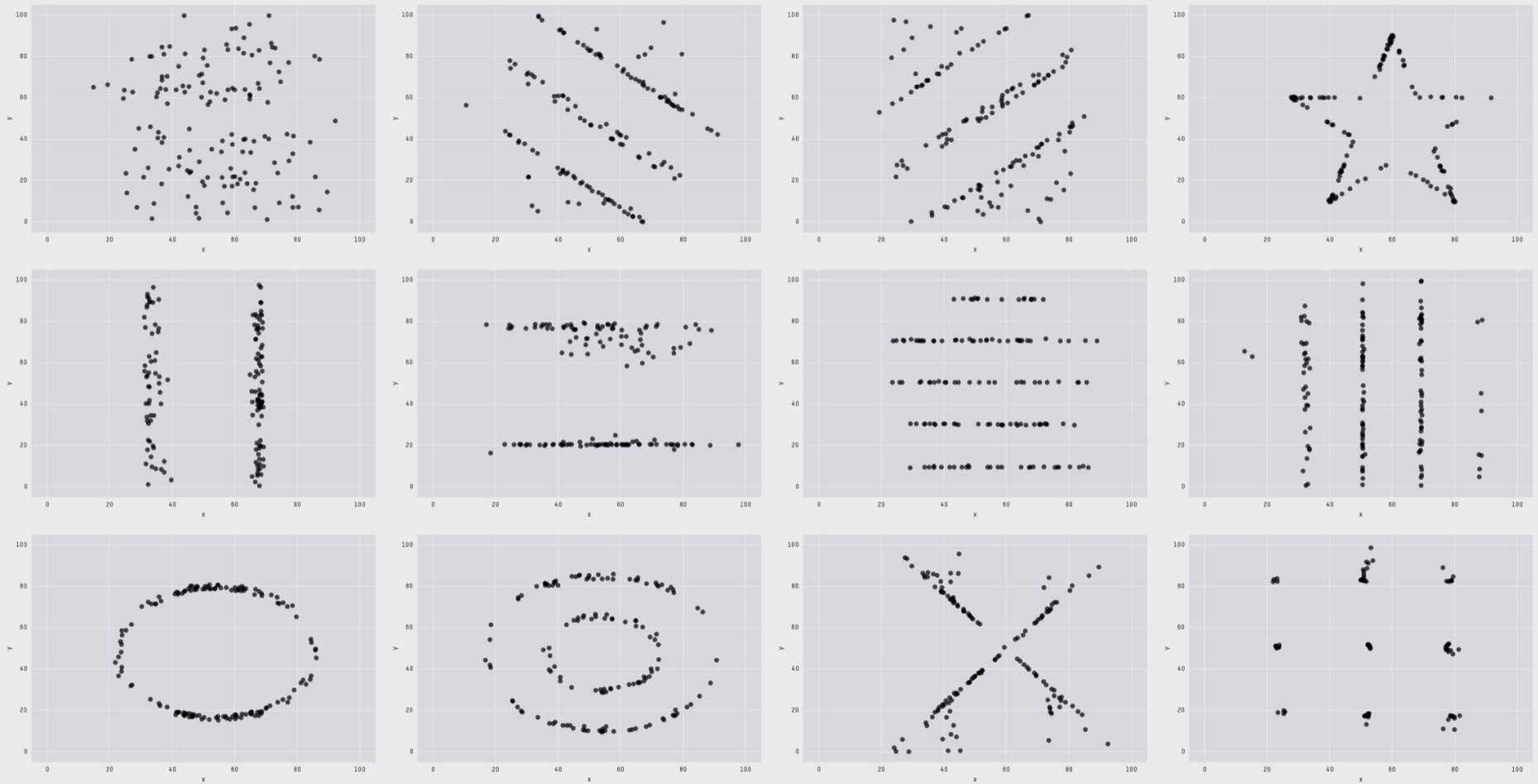
Scatter plots

- The fancy looking brain images don’t tell anything about the relationship between your variables
- It’s important to show the raw data whenever possible
- Typically scatter plots are shown for ROI level analyses





X Mean: 54.26
Y Mean: 47.83
X SD : 16.76
Y SD : 26.93
Corr. : -0.06



https://www.autodeskresearch.com/publications/samestats