



INC Summer Neuroimaging Bootcamp 2022
Visualizations

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As Neuroscientists, We Tell Stories.

- Our stories are based on large, complex, and detailed data.
- We want our stories to be insightful, understood, and remembered.
- Visual elements provide a mechanism to interpret and present massive amounts of data to augment our story-telling.



The purpose of visualization is **not about pretty pictures.**
The purpose of visualization is **to provide insight.**

visualization is a mechanism for conveying information in an
accurate, meaningful, and impactful manner

3 Principals of Impactful Visualization

1. Truthful

- based on thorough, objective research
- portray data, models, and procedures accurately

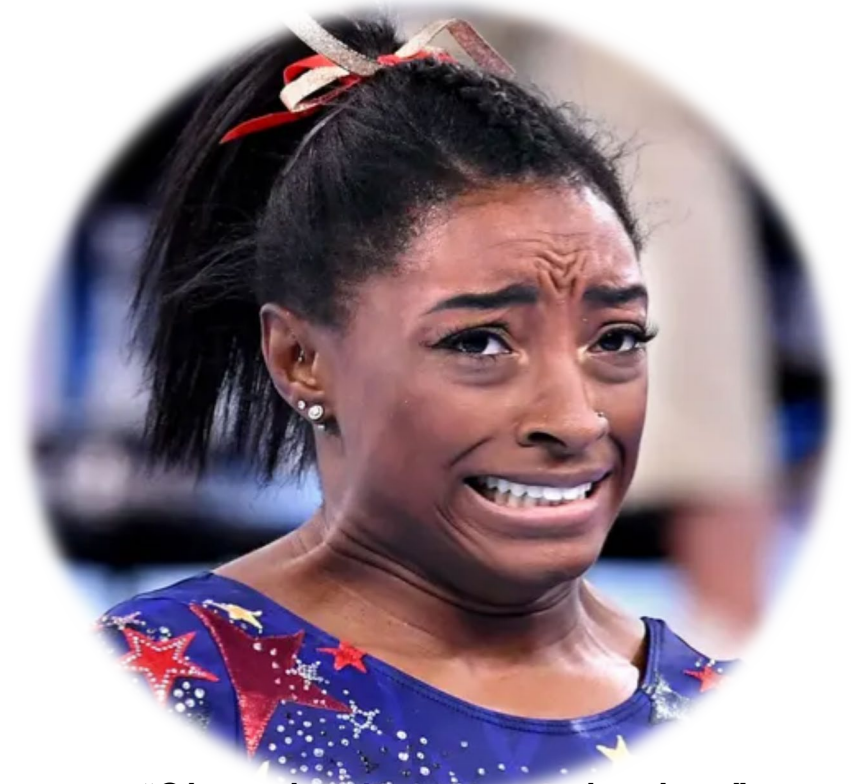
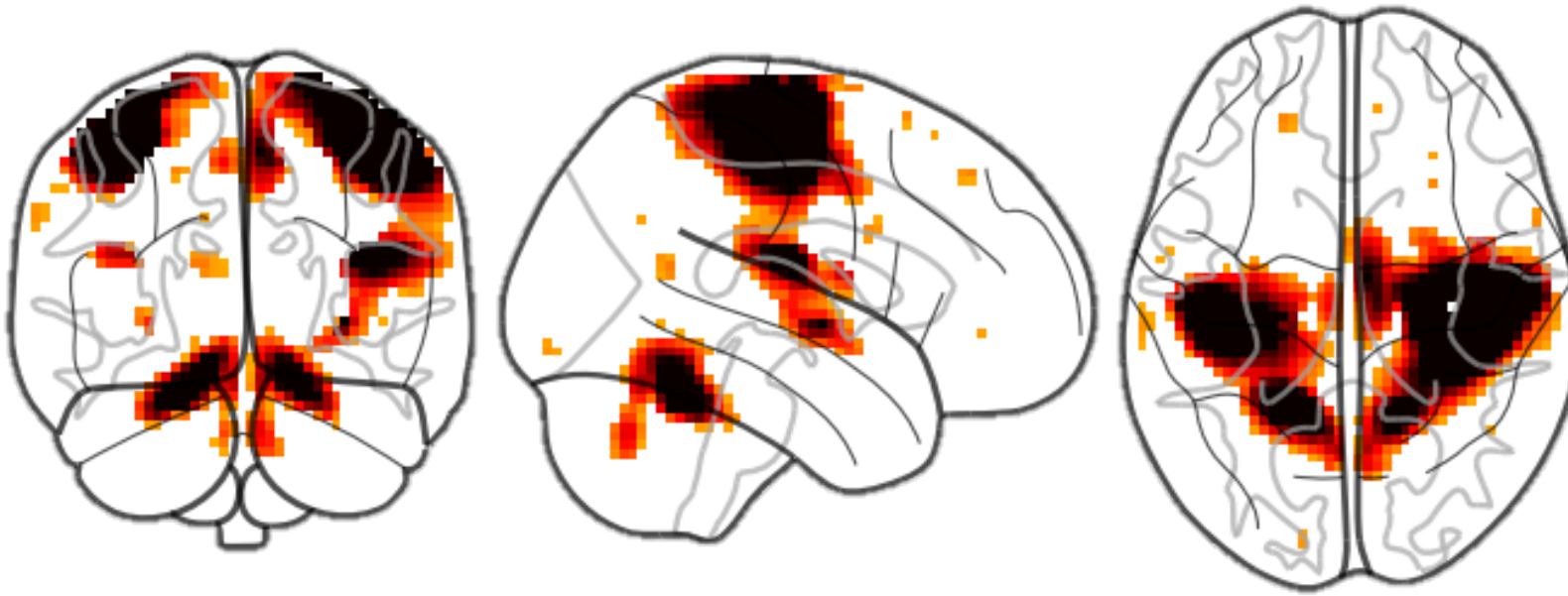
2. Insightful

- your story, evidence, complex trends, relationships, and inferences should be easy to see and understand
- viewers should be enlightened by the information you present and able to act on accordingly

3. Beautiful

- Effective visualization should be well-designed, draw attention, and be aesthetically pleasing.
- Aesthetics should be effectively deployed in service of the data-driven story

Visualizations that require mental gymnastics are not the G.O.A.T.



“Glass brains, worst brains.”
-Simone Biles
(if she was a neuroscientist)

Inventor of the PHYSICALLY Reorderable Matrix

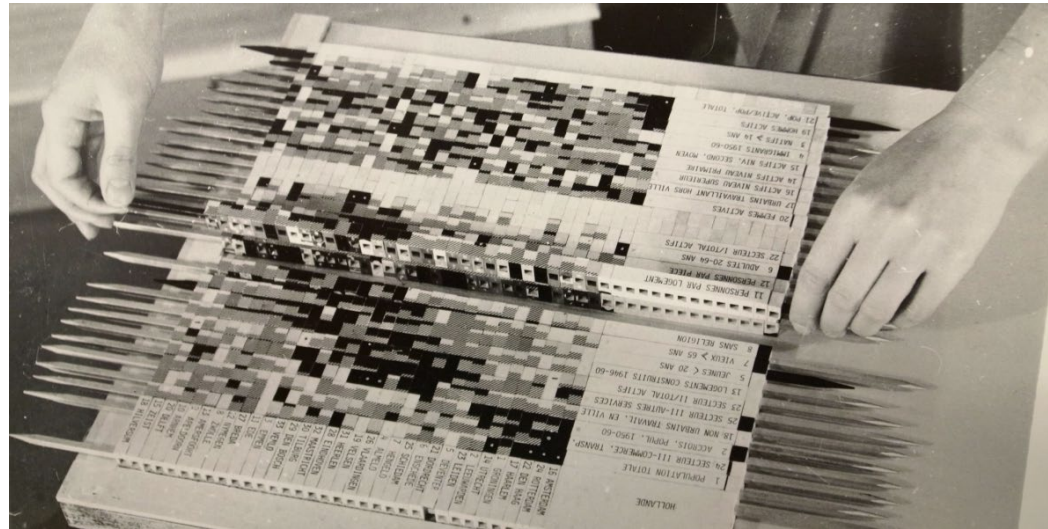
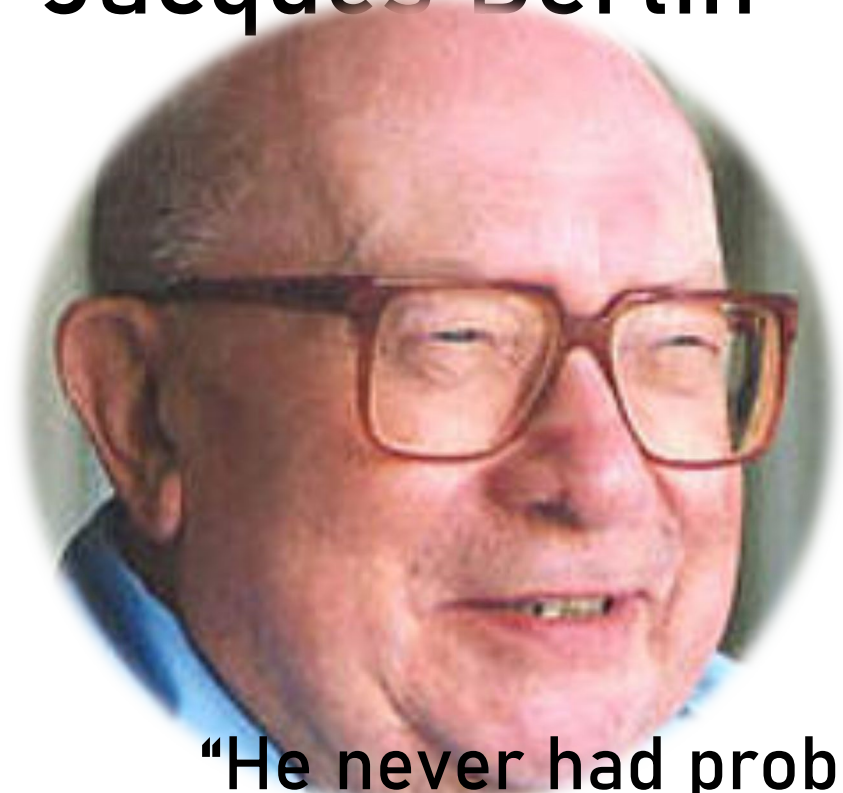


PHOTO SERGE BONIN, ARCHIVES NATIONALES

Jacques Bertin



not Danny Devito, sorry Lauren

“He never had problems with drawing....”

- actual quote from his Wikipedia page

If you ever doubt you live in the future, watch this...

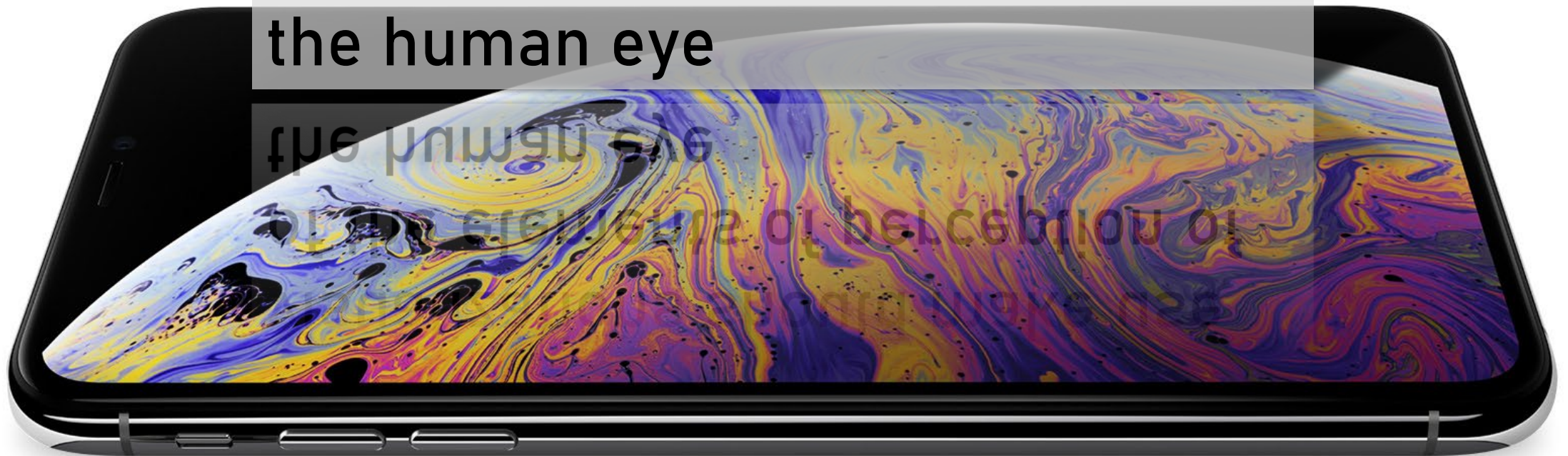


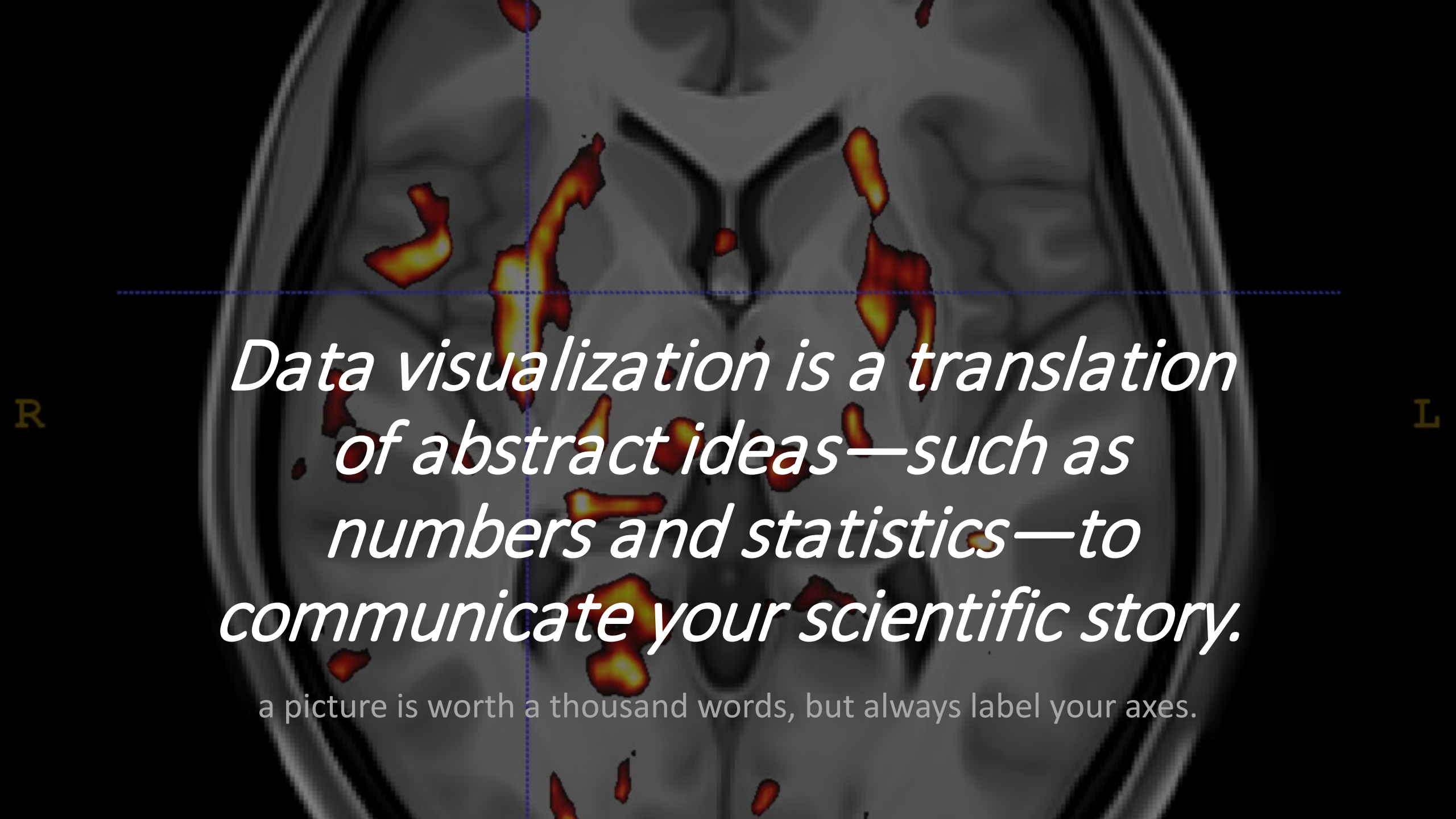
<http://dataphys.org/list/bertins-reorderable-matrices/>

Jacques Bertin Introduced “Retinal Variables”

position, size, shape, value, color, orientation, texture

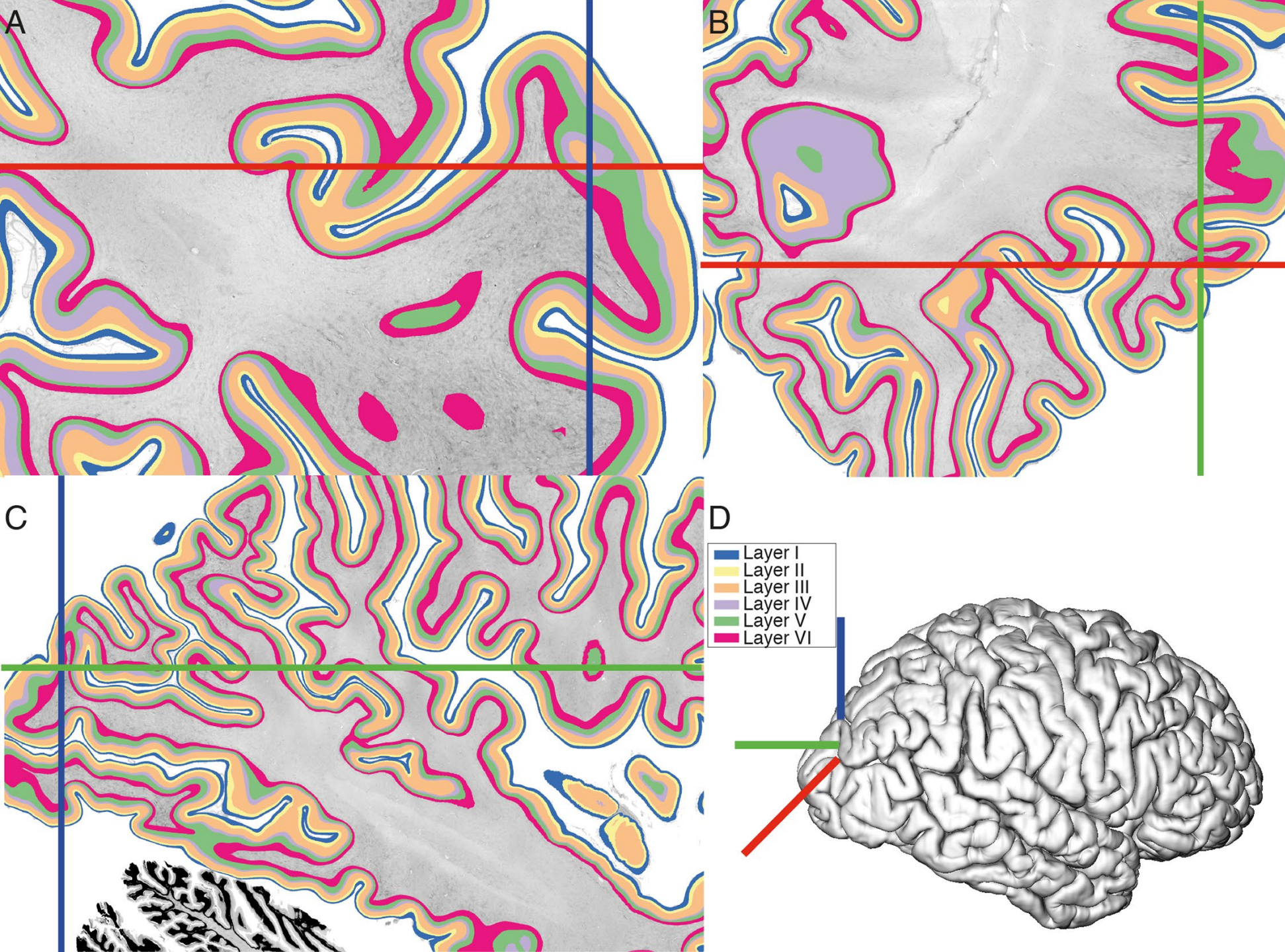
visualizations should make use
of the elements of perception of
the human eye





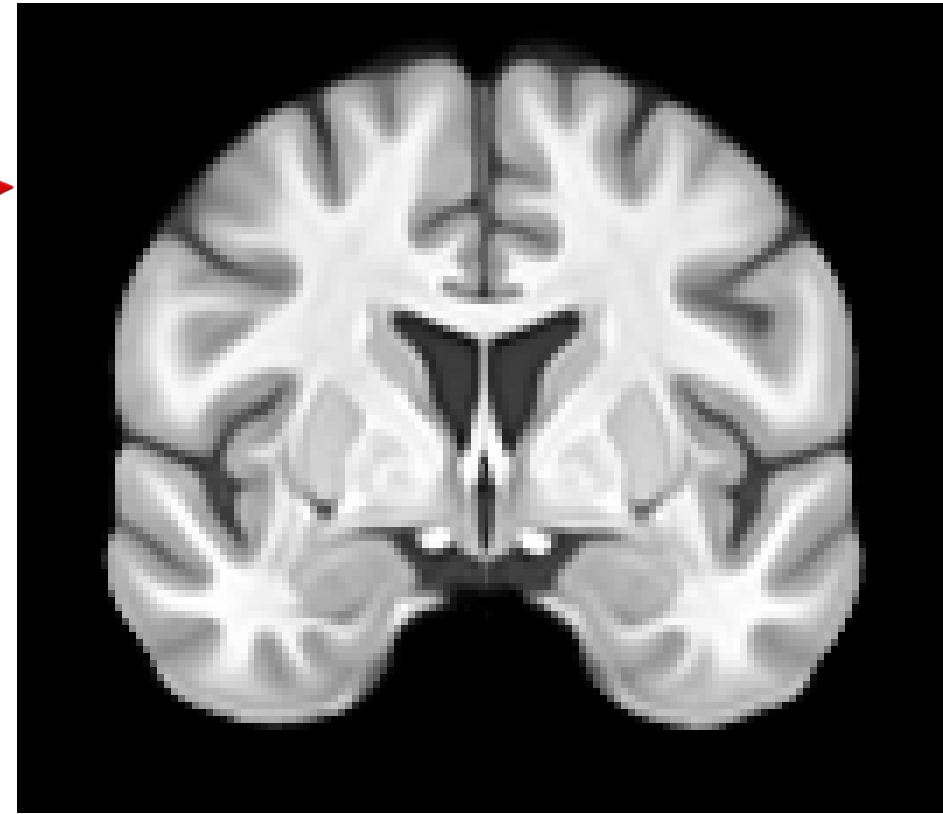
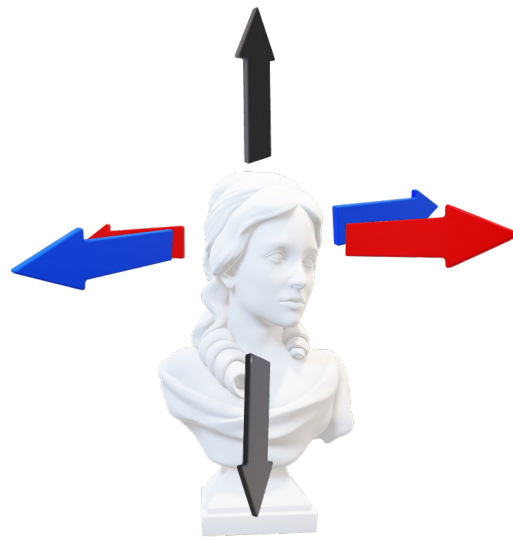
*Data visualization is a translation
of abstract ideas—such as
numbers and statistics—to
communicate your scientific story.*

a picture is worth a thousand words, but always label your axes.

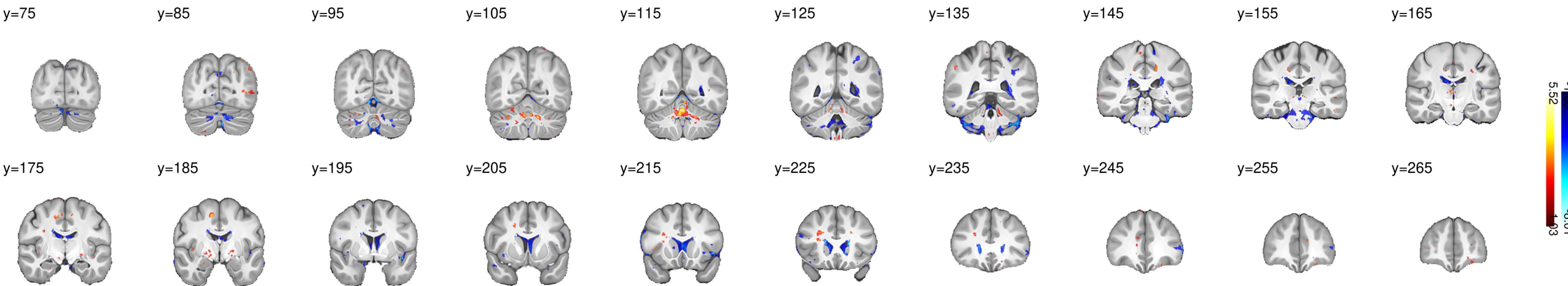




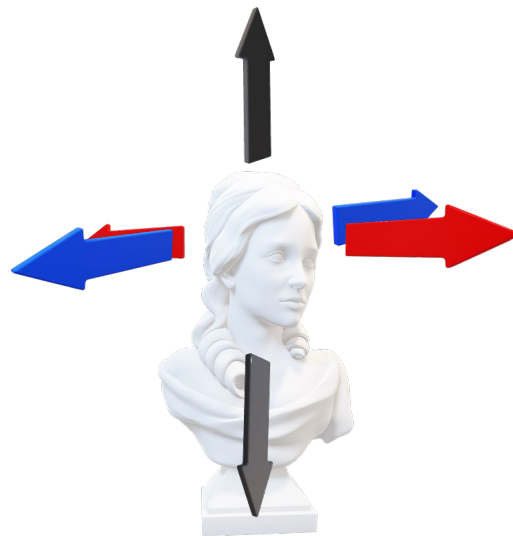
Choose a Slice Plane that Captures Your Data Best



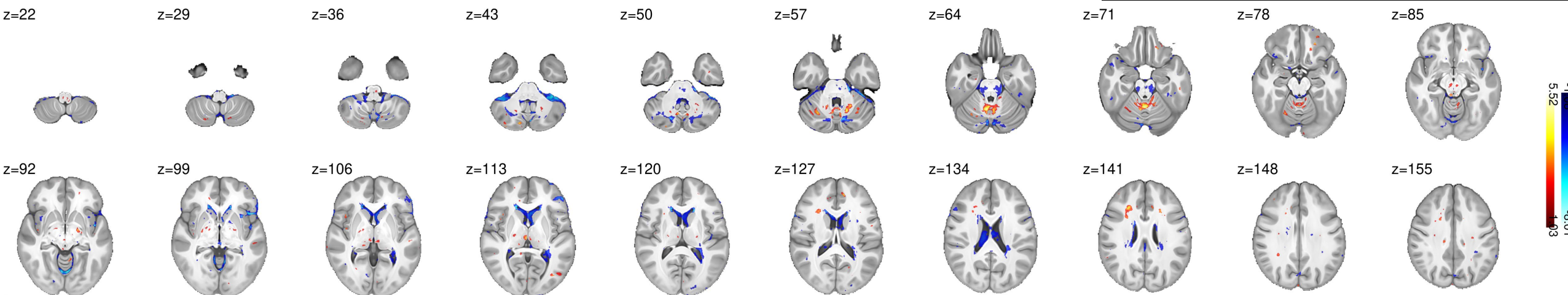
y – anterior/posterior – coronal



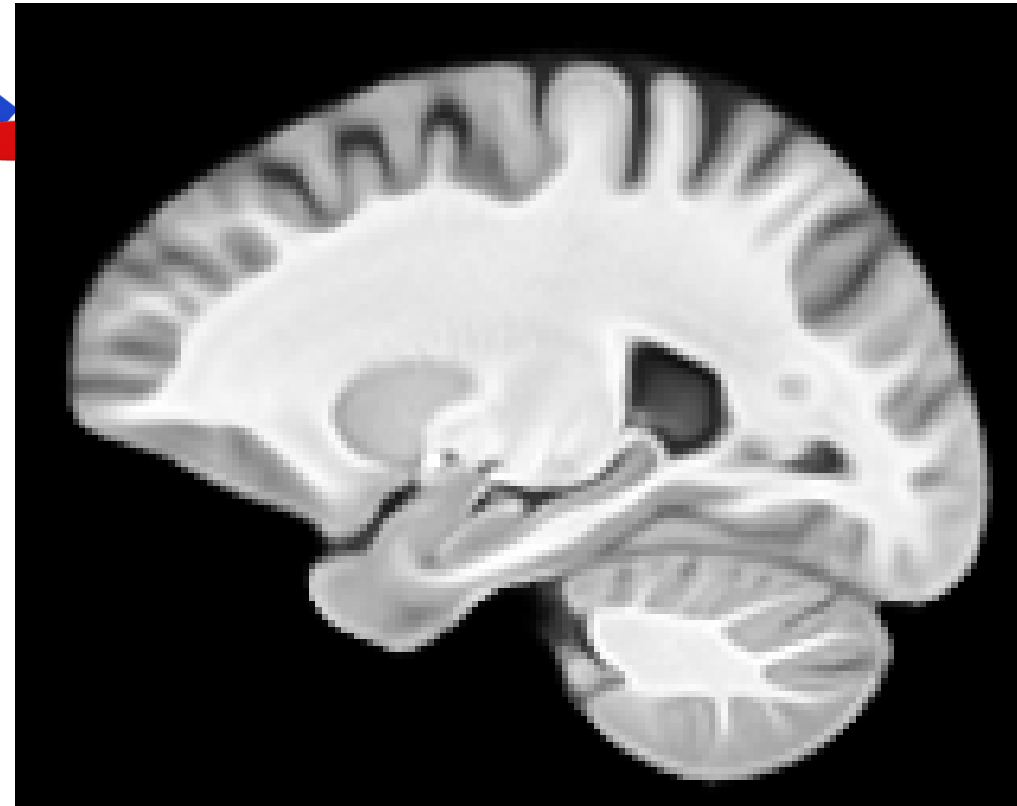
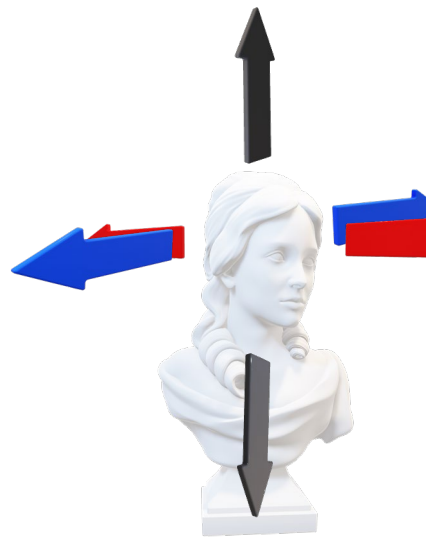
Choose a Slice Plane that Captures Your Data Best



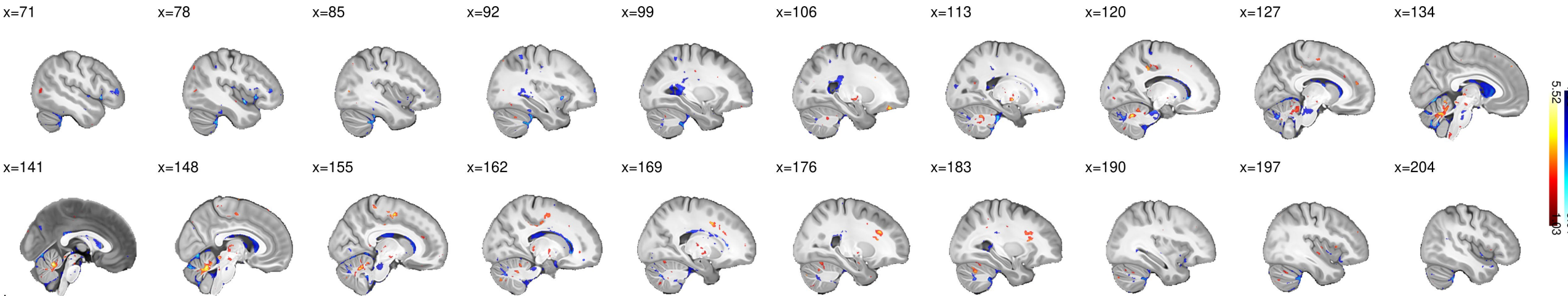
z - superior/inferior - axial



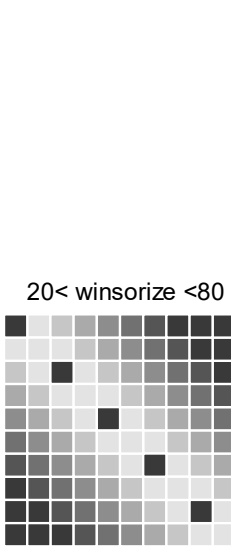
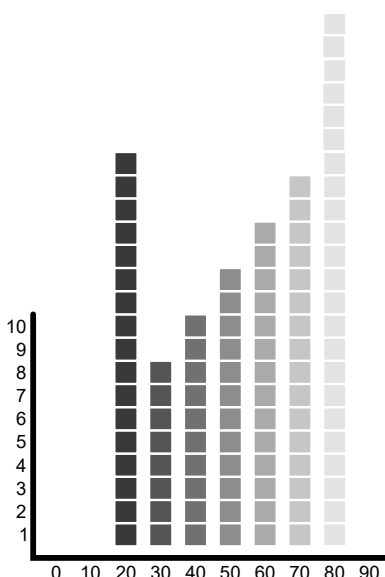
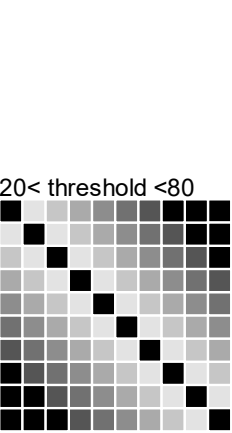
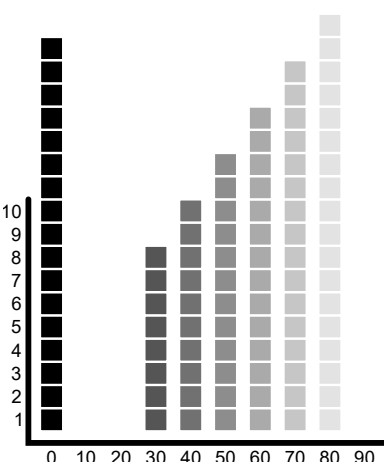
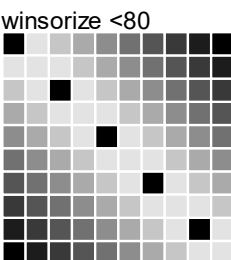
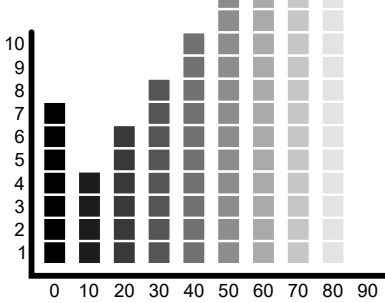
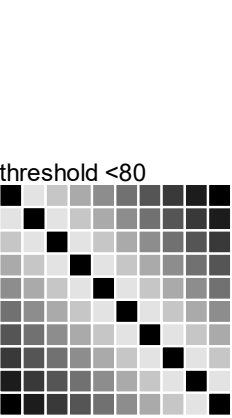
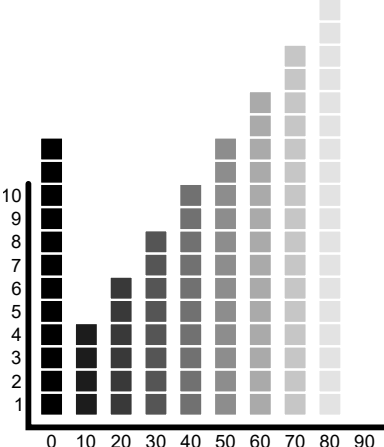
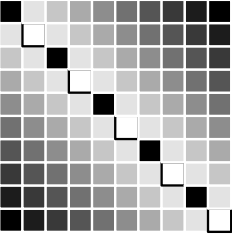
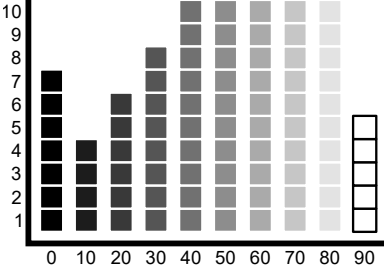
Choose a Slice Plane that Captures Your Data Best



x – left/right – sagittal

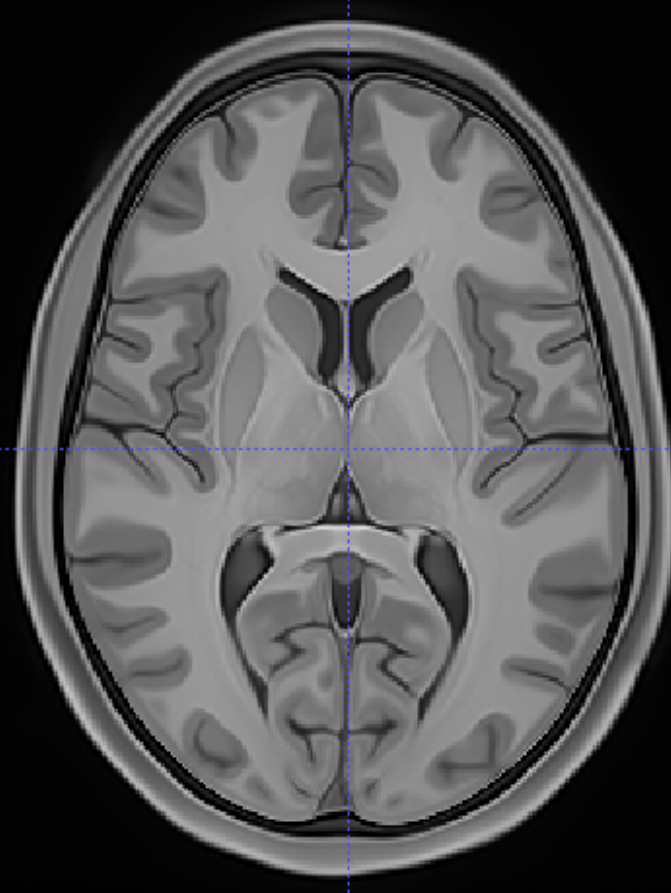


Thresholding and Winsorizing





thresholded

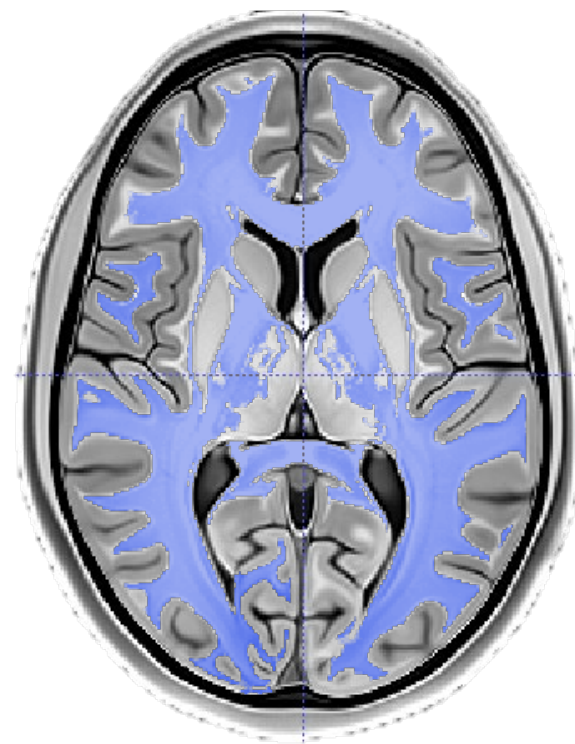
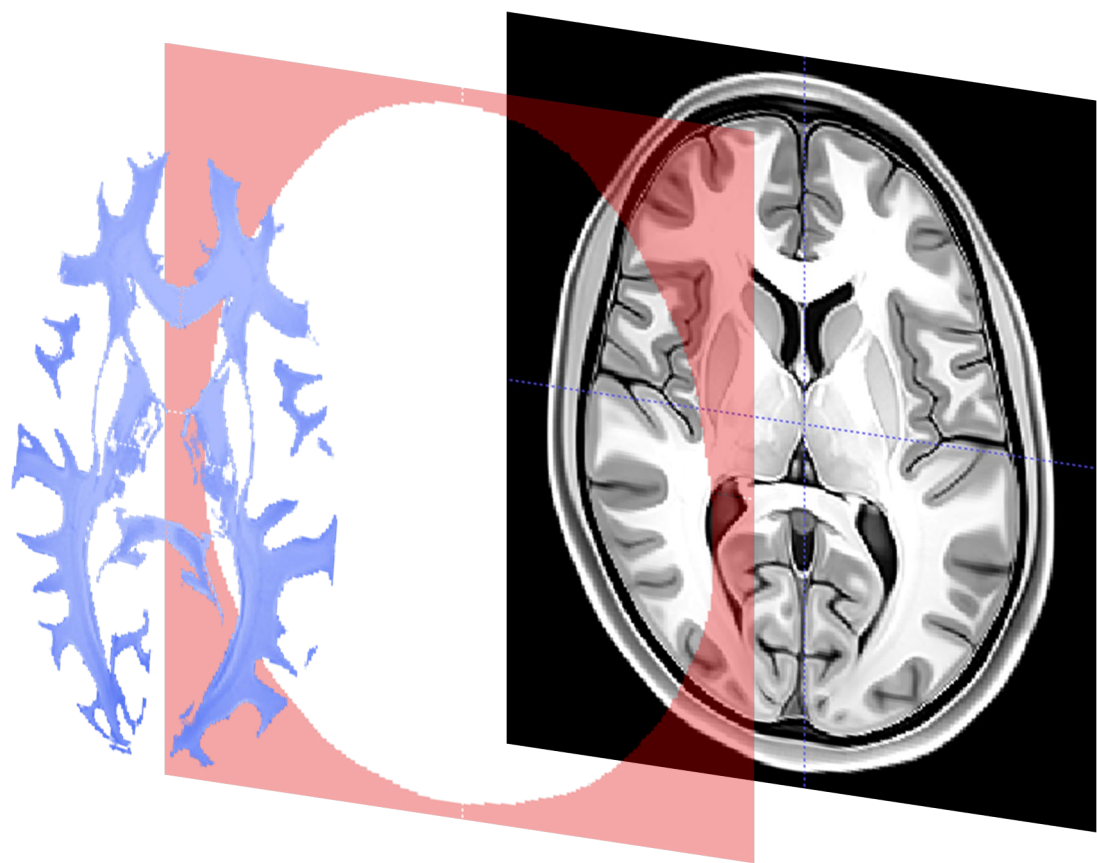


raw intensity



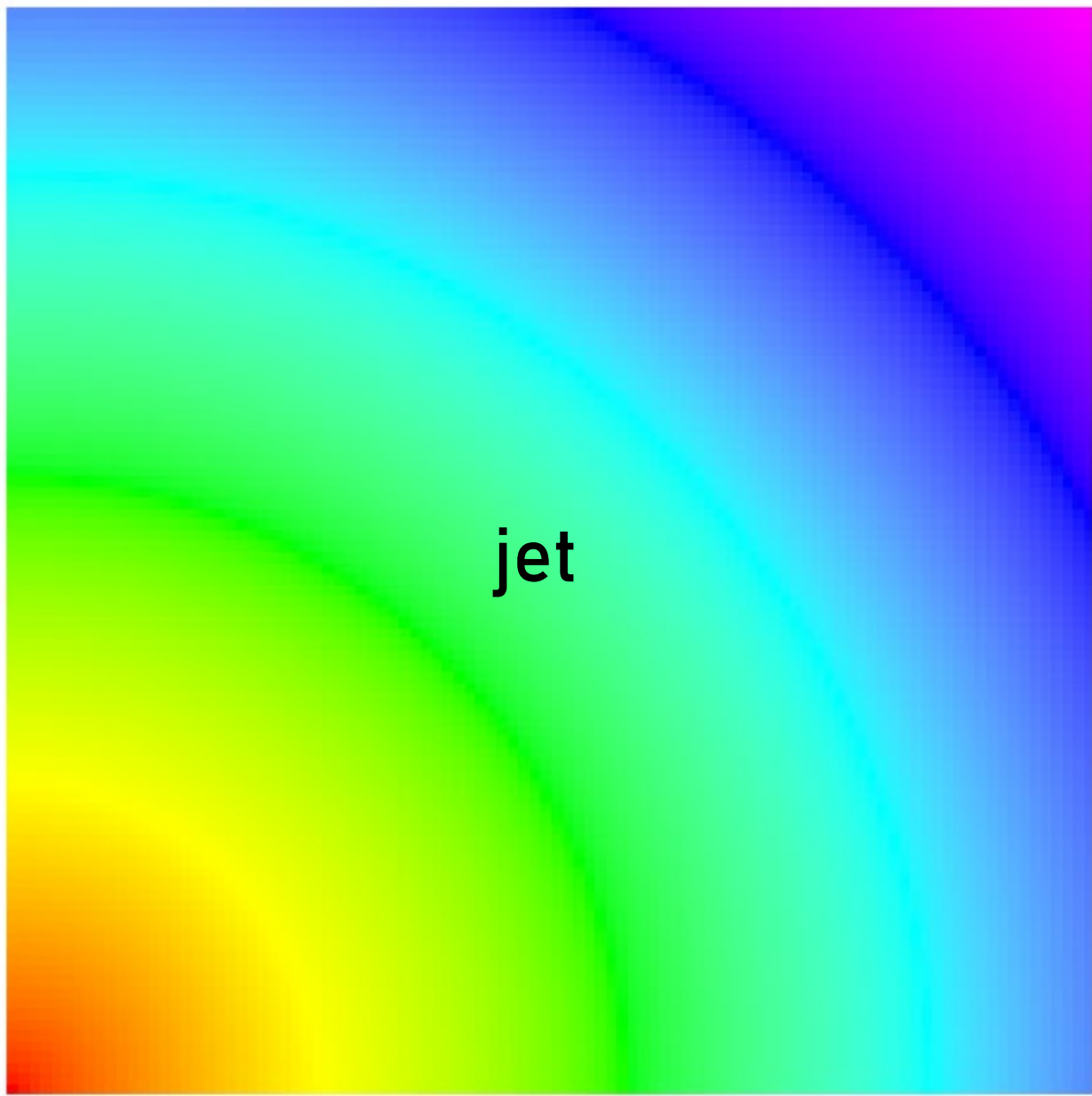
winsorized

Compositing

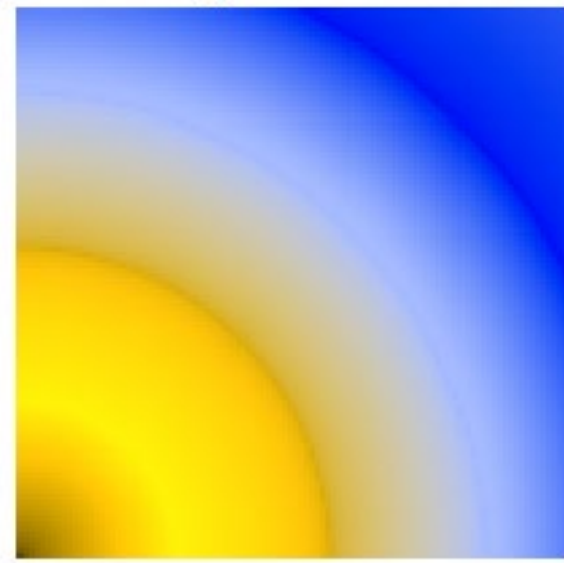


Colors

- color scales are best when colors draw attention to data or levels or values of interest, colors “pop out”
- ideally, the color scale you choose should be robust against a change in apparent scale for colorblind individuals as well as when printed or displayed in grayscale



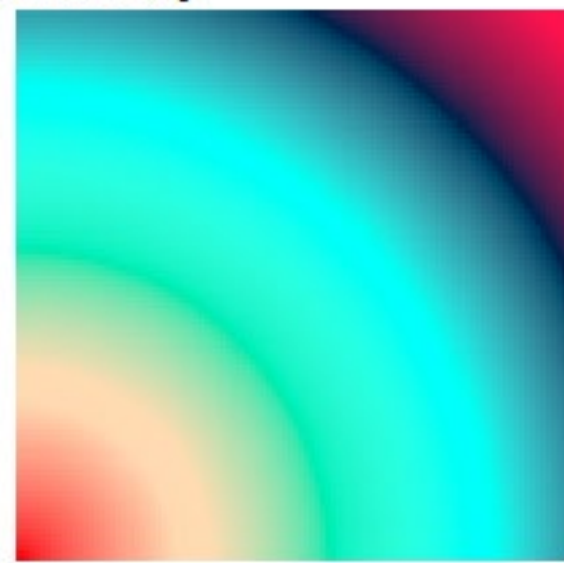
Deutanomaly



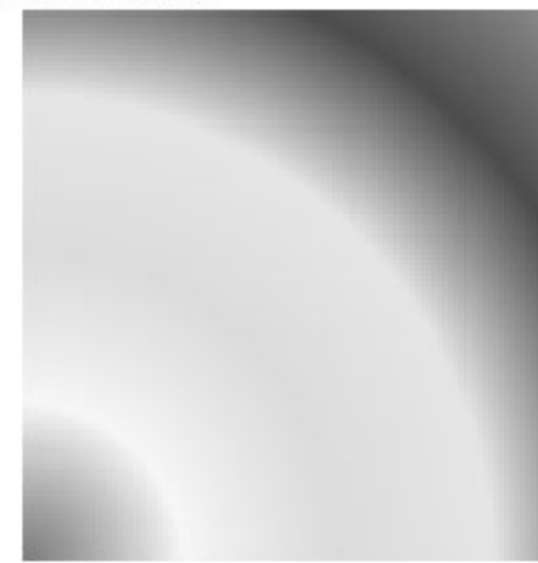
Protanomaly



Tritanomaly



Desaturated



red/white/blue

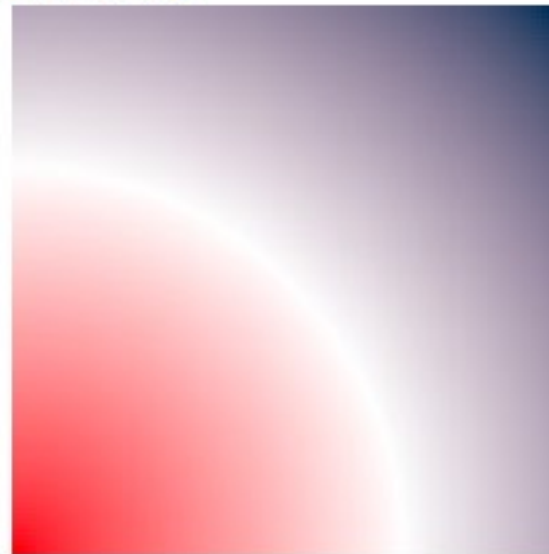
Deutanomaly



Protanomaly

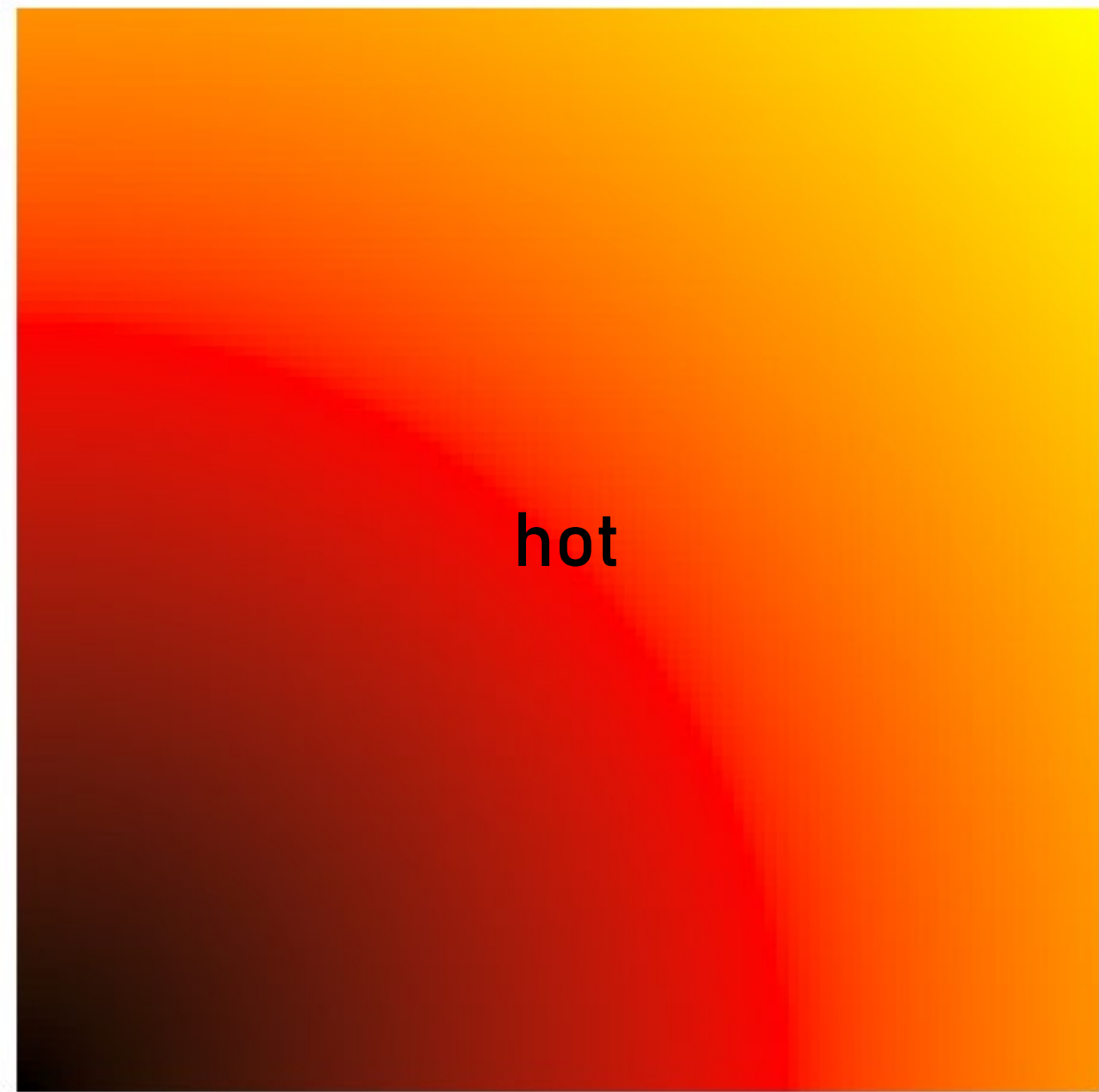


Tritanomaly

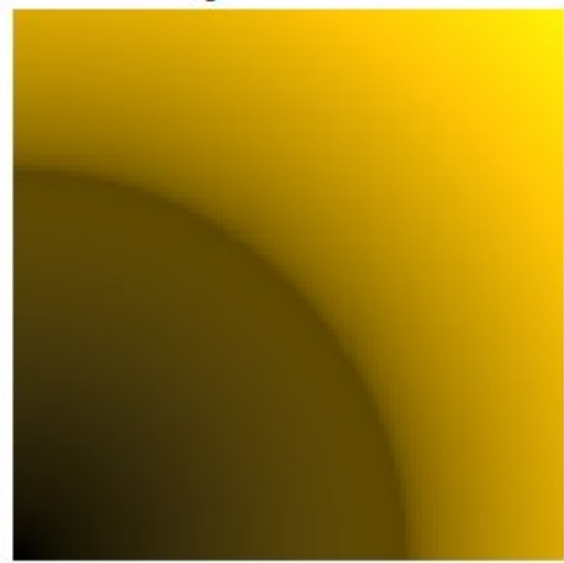


Desaturated

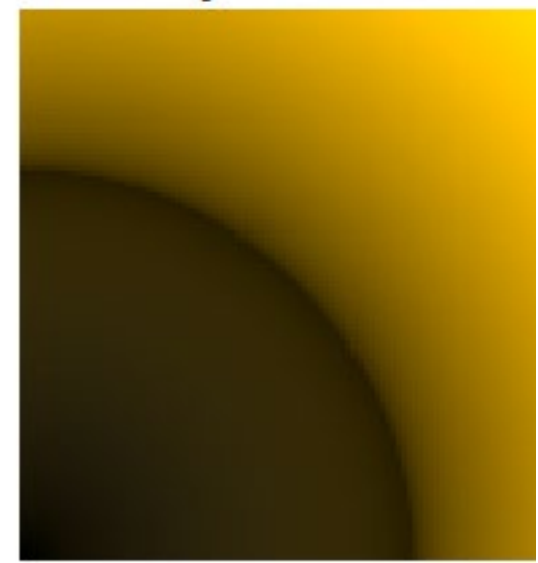




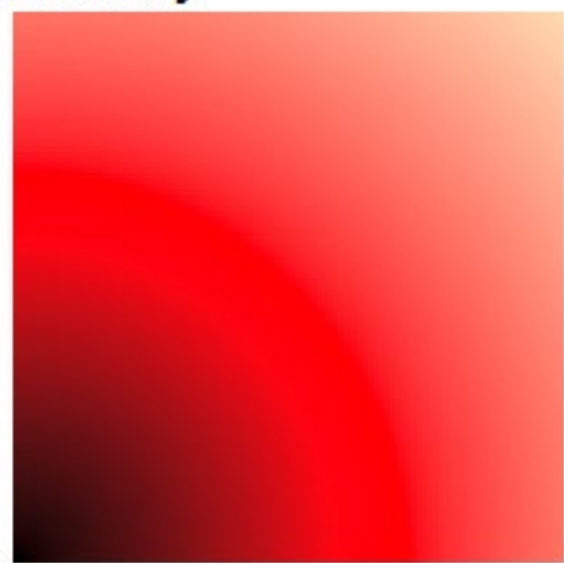
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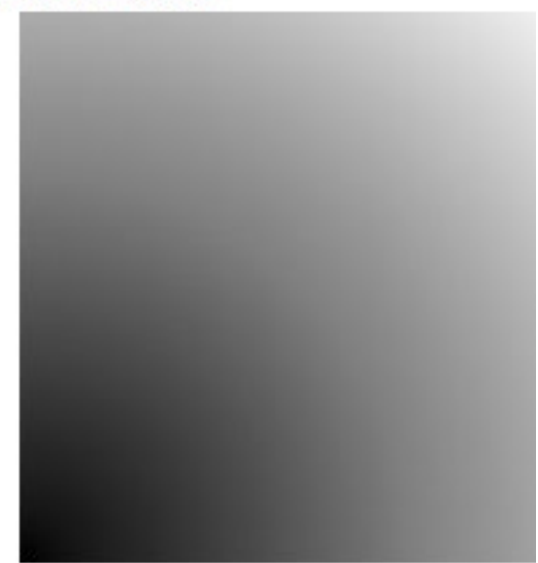
Protanomaly

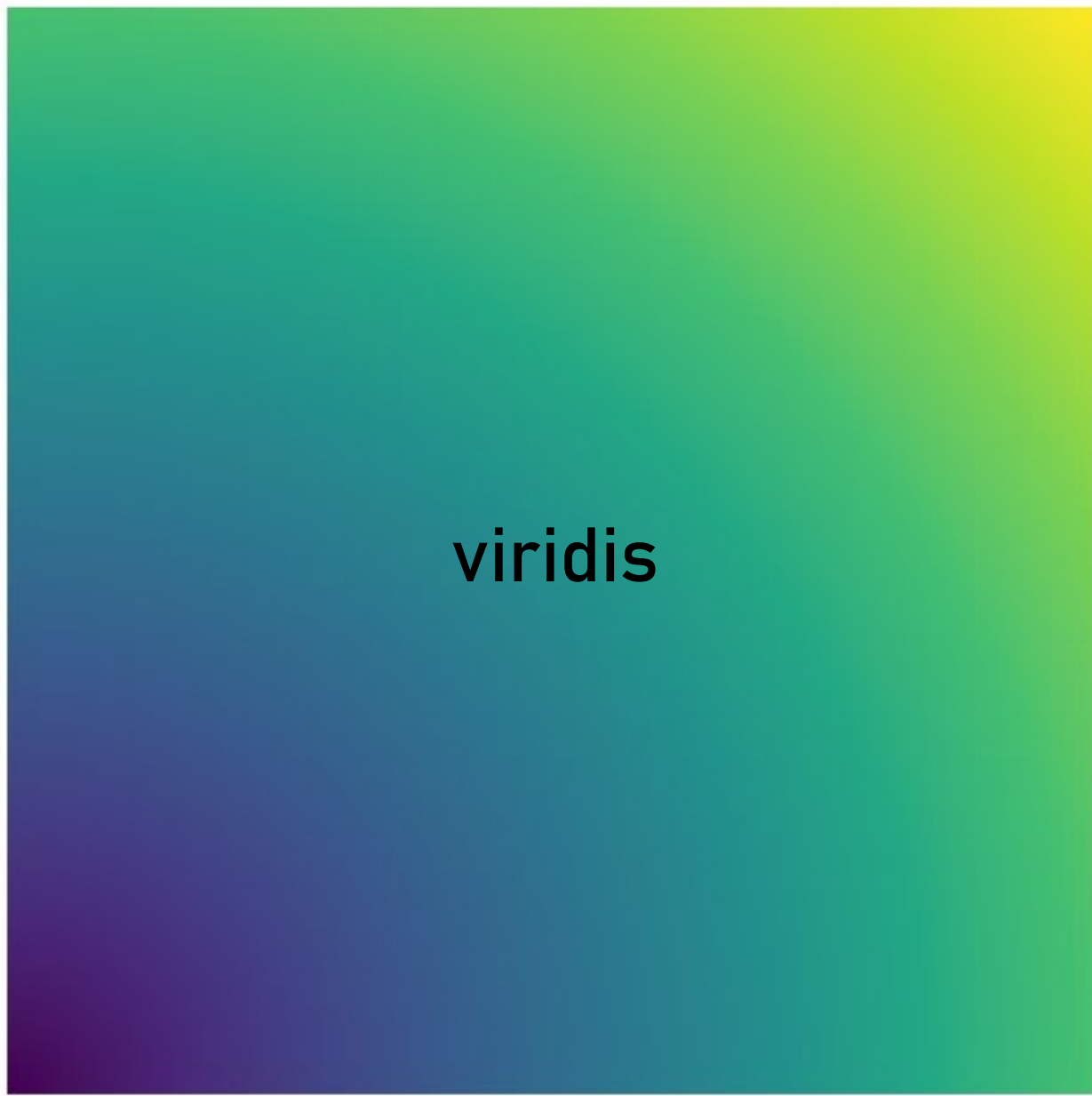


Tritanomaly



Desaturated





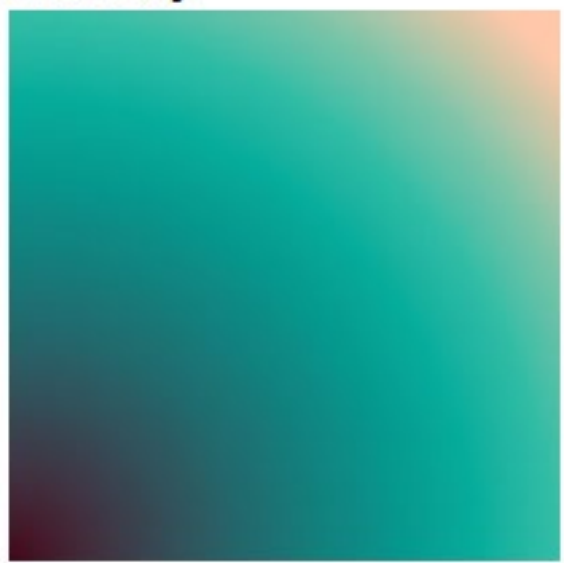
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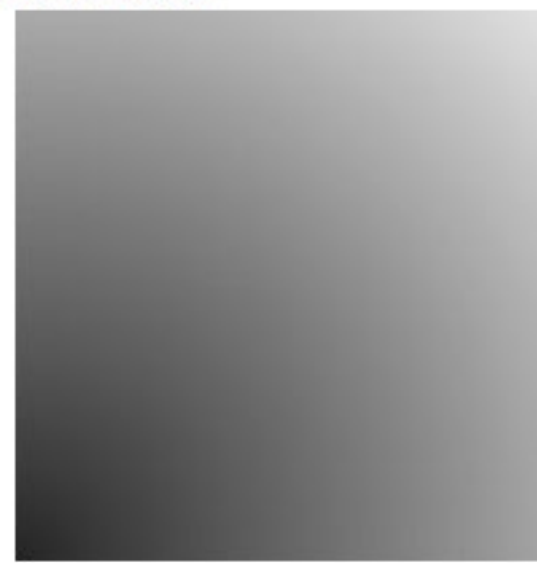
Protanomaly



Tritanomaly



Desaturated



viridis plasma

Deutanomaly



Protanomaly



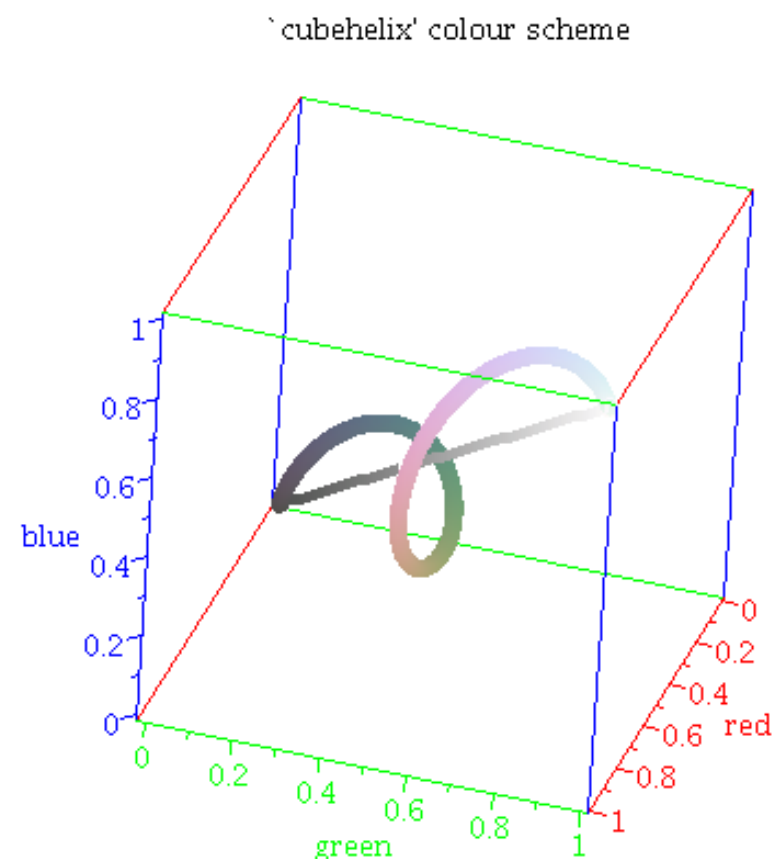
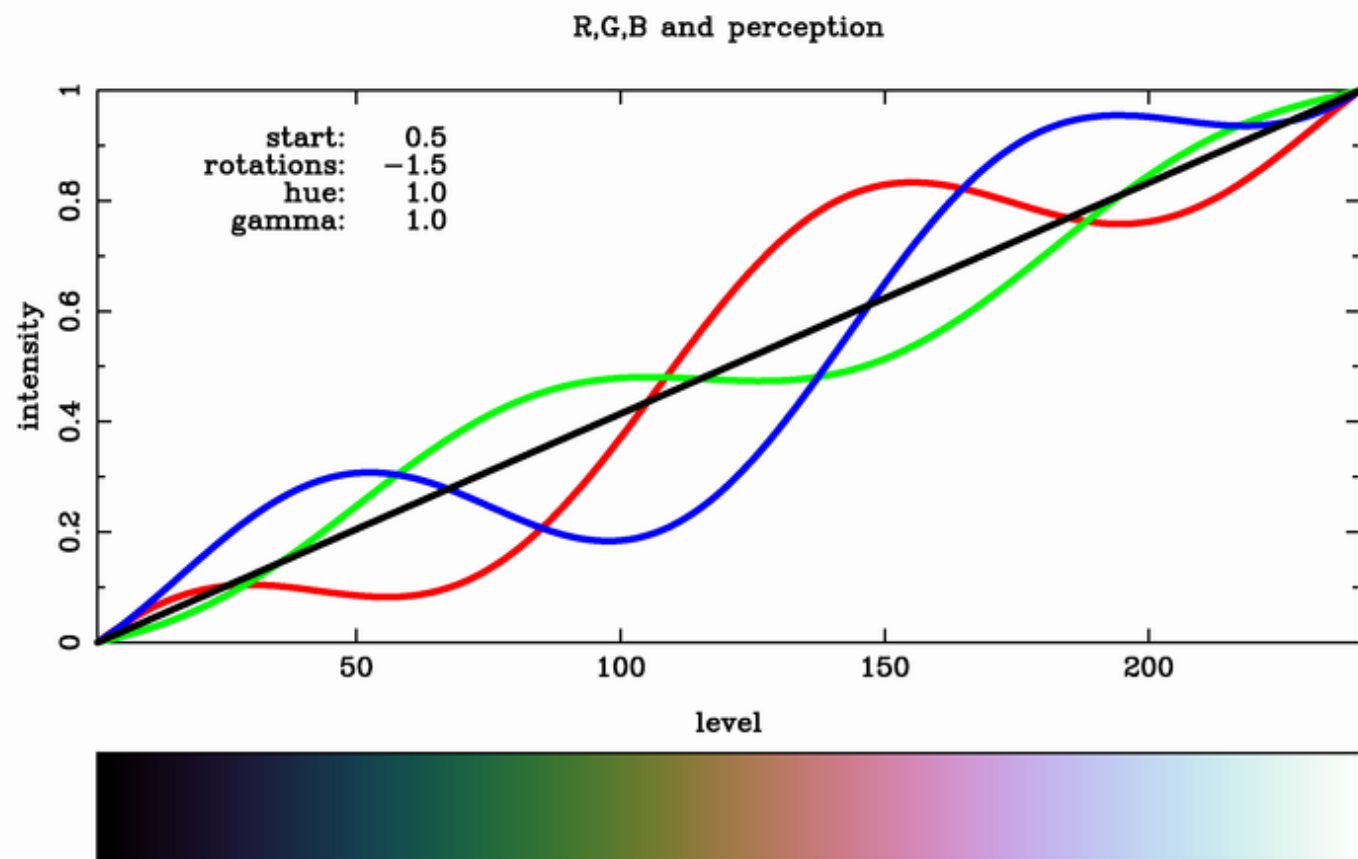
Tritanomaly



Desaturated



cubehelix

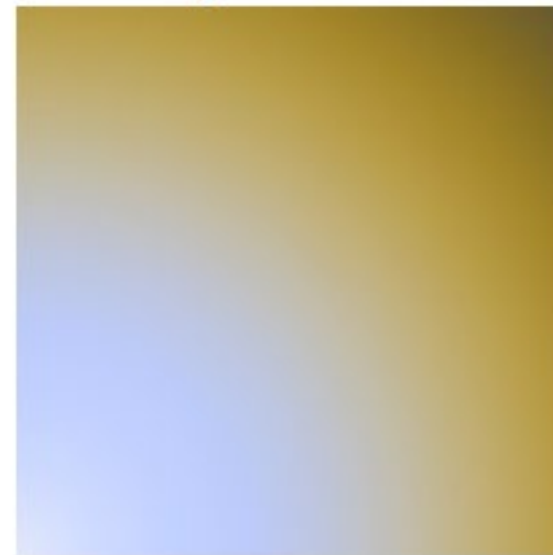


cubehelix

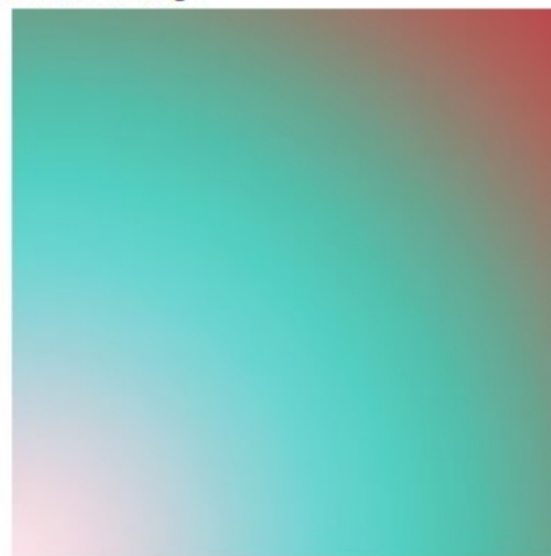
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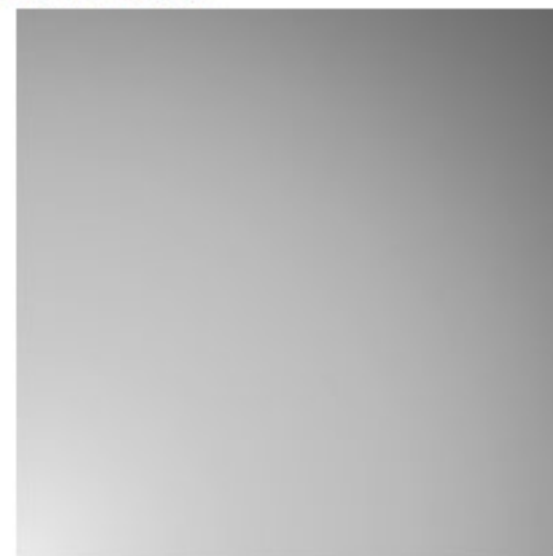
Protanomaly



Tritanomaly



Desaturated

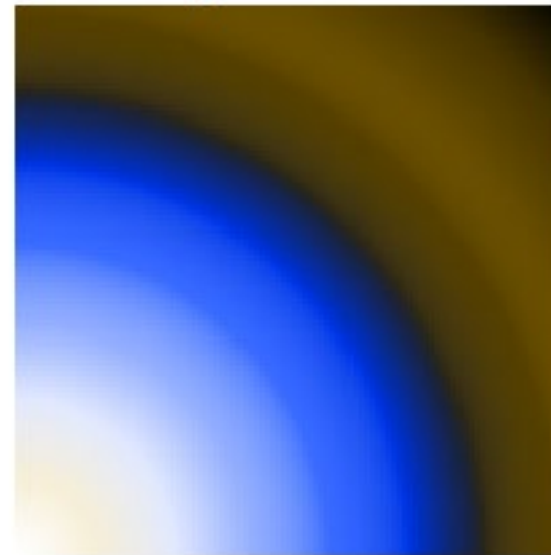




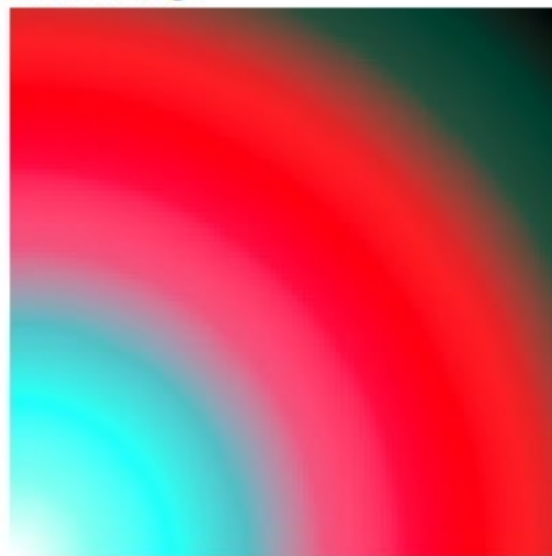
Deutanomaly



Protanomaly



Tritanomaly



Desaturated



Representations of Colors

- RGB

- red, green, and blue values from 0 to 255, indicating the mixture of additive colors
- this pink is **255, 105, 180**

- Hex Colors

- computers have bits (0's and 1's) arranged into groups of 8, making a byte
- $2^8 = 256$, hence we can represent 8 bit RGB colors with three binary values
 - in binary this pink is **11111111, 01101001, 10110100**
 - but that's a lot of digits
- base 16 digits, or hexadecimal makes this easier, we can represent every byte with 2 digits (0,1,2,3,4,5,6,7,8,9,0,A,B,C,D,E,F)
- in Hex, hot pink is **#FF69B4**

There is a lot of visualization software out there...

This list is woefully incomplete, because I got tired of looking.

- 3D Brain Atlas Reconstructor
- 3D Slicer
- ABrainVis (Android)
- AFQ-Browser
- Analysis of Functional NeuroImages (AFNI)
- Analyze
- BECA
- BiImage Suite
- Blue Brain Brains (*histology)
- BrainBrowser
- BrainImageJava
- BrainMiner
- BrainNetViewer
- Brainnetome DiffusionKit
- BrainPainter
- BrainScope
- BrainSuite (successor to BrainVox?)
- BrainVisa
- BrainVoyager
- CARET
- CAWorks
- CONN
- Connectome Viewer
- Connectome Workbench
- DataViewer3D
- Diamond
- Dragonfly**
- ENIGMA Toolbox
- FIV
- FSL (e.g., FSLEyes, FSLview)
- FreeSurfer (e.g., FreeView, tkview)
- Histolozee
- ImageJ
- ITKSnap
- LONI (e.g., Shapeviewer)
- Mango
- Matlab
- MIPAV
- MRICron
- MRICroS
- MMVT (Multi-modal Neuroimaging & Visualization Tool)**
- MRtrix
- MultiTracer version 2
- NeuroLens
- NeuroMorphVis (*neurons)
- NeuroSynth
- R (ggseg, ggseg3d)
- SPM
- STAPLE
- Vaa3D
- Visbrain
- xjView

A 3D visualization of a human brain, rendered with a color gradient from purple to yellow. The brain is shown from a slightly elevated, lateral perspective. The text is centered over the brain's surface.

**Get out there,
visualize some brains,
and tell your story**