



Turku PET Centre Brain Imaging Course 2021

Twitter: [@TurkuPETcentre](https://twitter.com/TurkuPETcentre)

WWW: <http://pet.utu.fi>

Objectives

- Understand basic principles of human neuroimaging
- Know basics of PET and structural and functional MR imaging
- Grasp the basic pharmacokinetic models behind PET imaging
- Understand the nuts and bolts of (f)MRI and PET data preprocessing
- Learn the principles of statistical analysis of brain imaging data

Practical stuff

- Lectures streamed on Echo360, accessible for review on the same platform
- Most practical lectures have hands-on exercises with applicable data
- **Wednesday 18th:** Principles of neuroimaging
- **Thursday 19th:** Practical issues in brain imaging and data analysis
- **Friday 20th:** Advanced topics in brain signal analysis
- 2 ECTS credits course, certificate of participation on demand

Meet our speakers

Lauri
Nummenmaa



Jouni
Tuisku



Jussi
Hirvonen



Chunlei
Han



Kerttu
Seppälä



Yngwie
Malmsteen



Vesa
Putkinen



Lihua
Sun



Severi
Santavirta



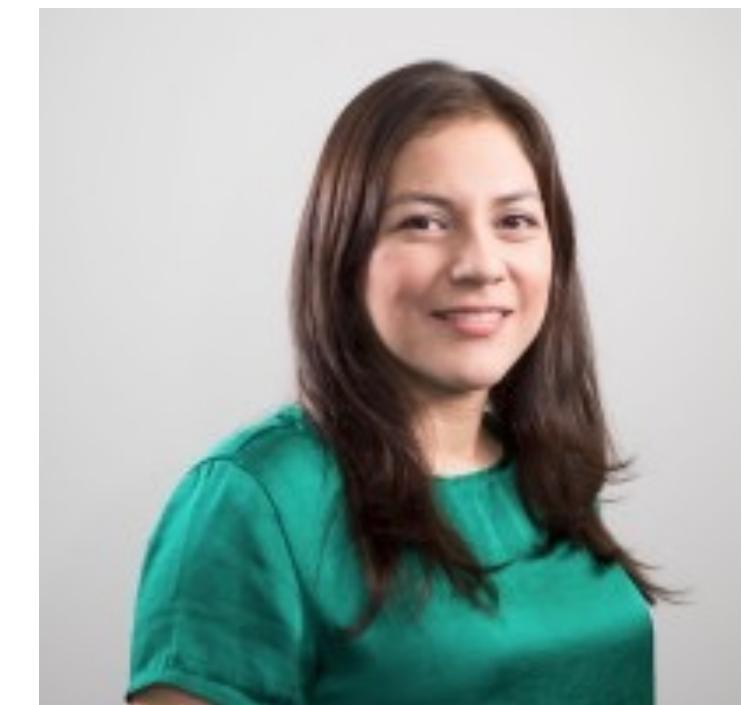
Tuulia
Malén



Heini
Saarimäki



Ana Triana
Hoyos





**NOW DITCH THE
EMPIRE AND START
DOING SOME
PET IMAGING**



Basic principles of human brain imaging

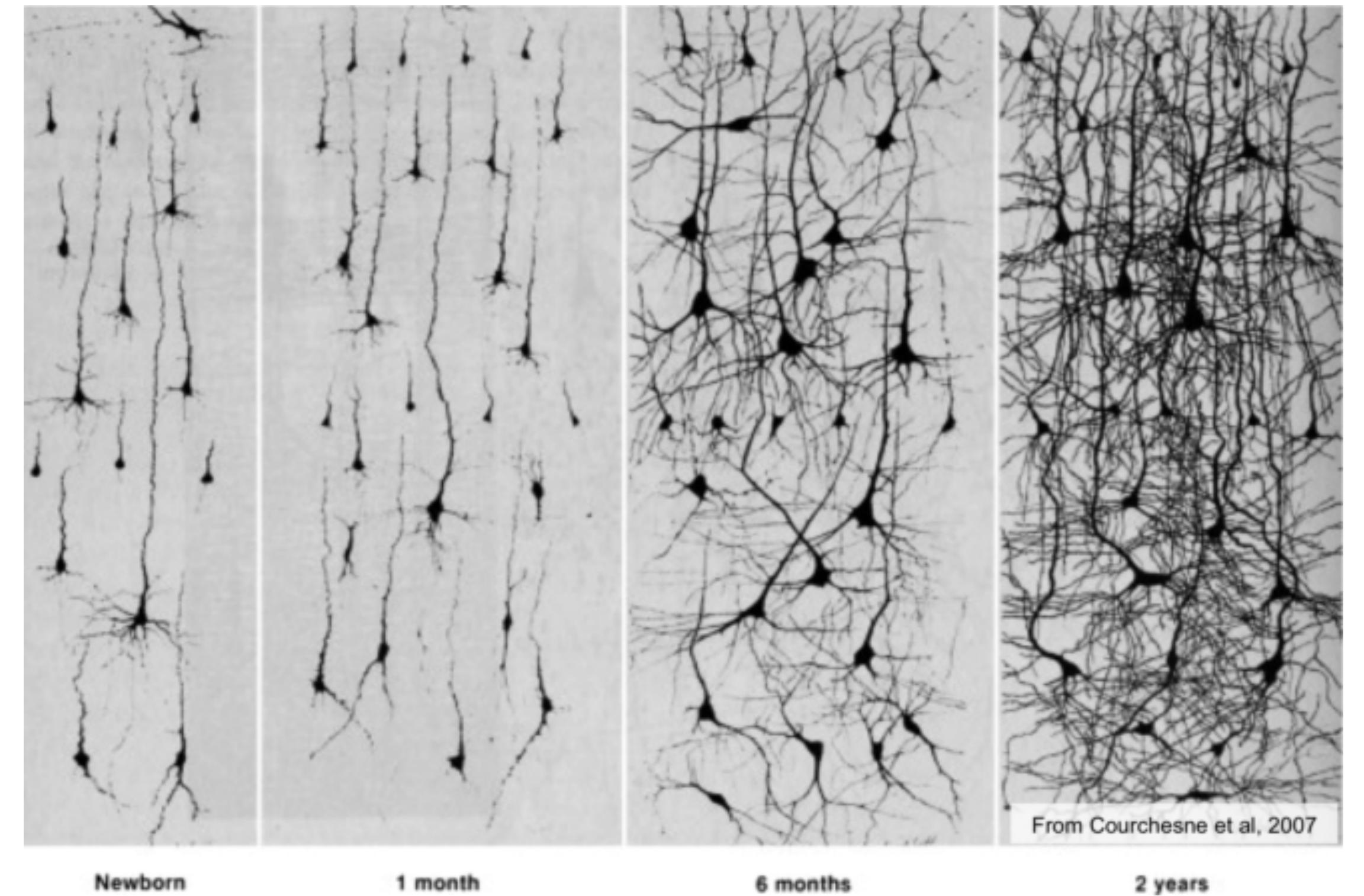
Lauri Nummenmaa
Turku PET Centre / TYKS

Twitter: [@LNummenmaa](https://twitter.com/Nummenmaa)

WWW: <http://emotion.utu.fi/>

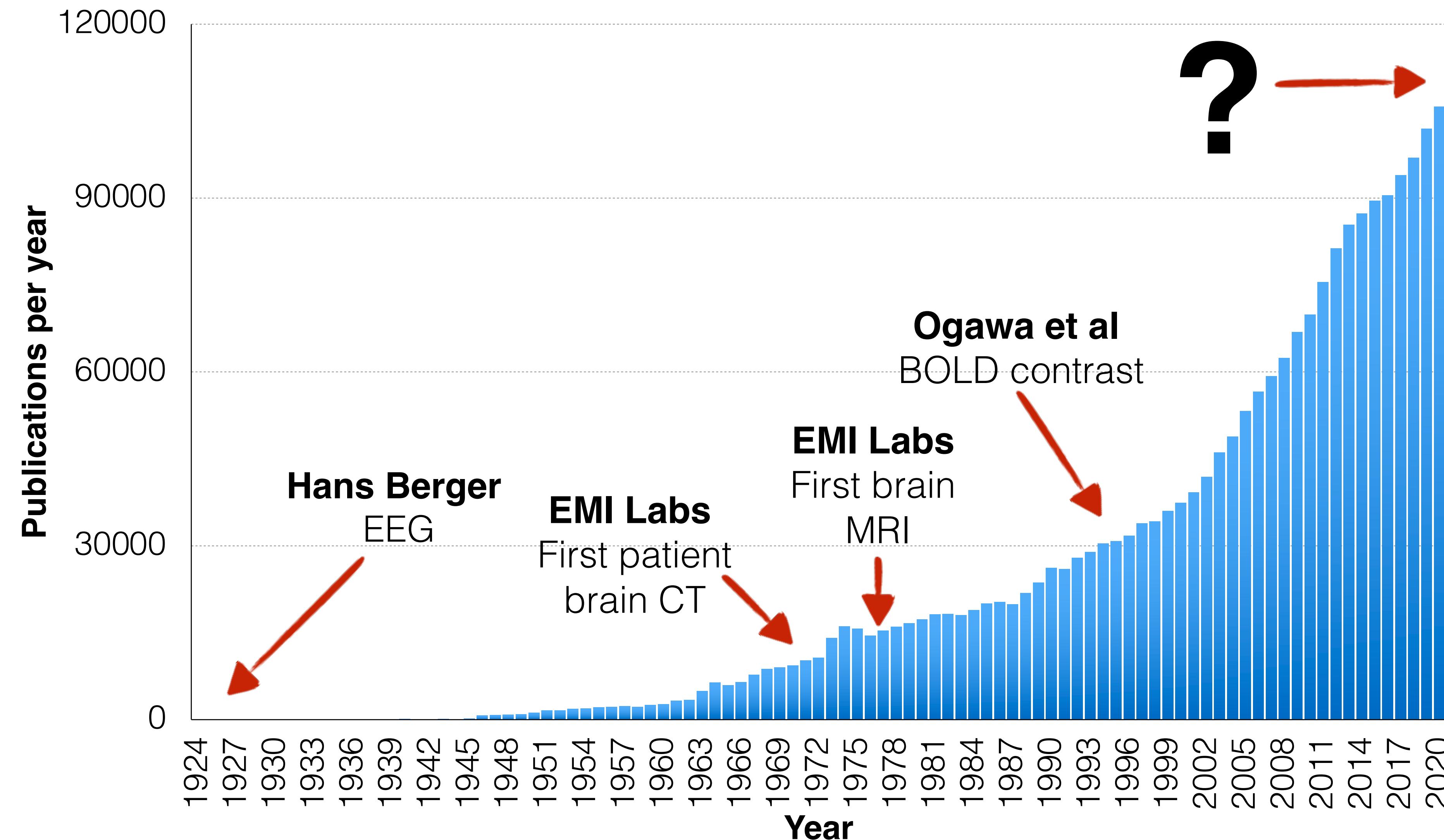
The human brain

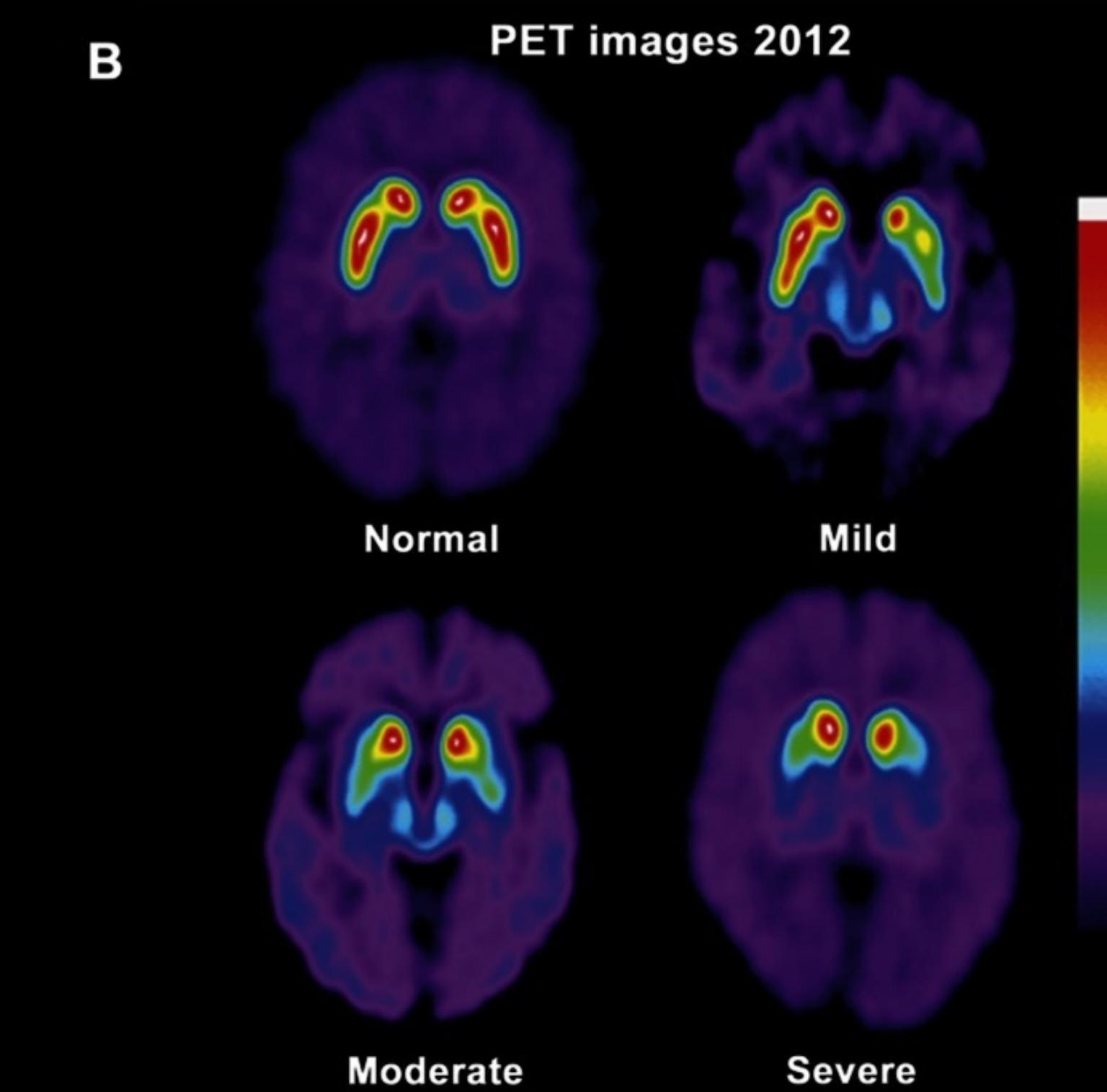
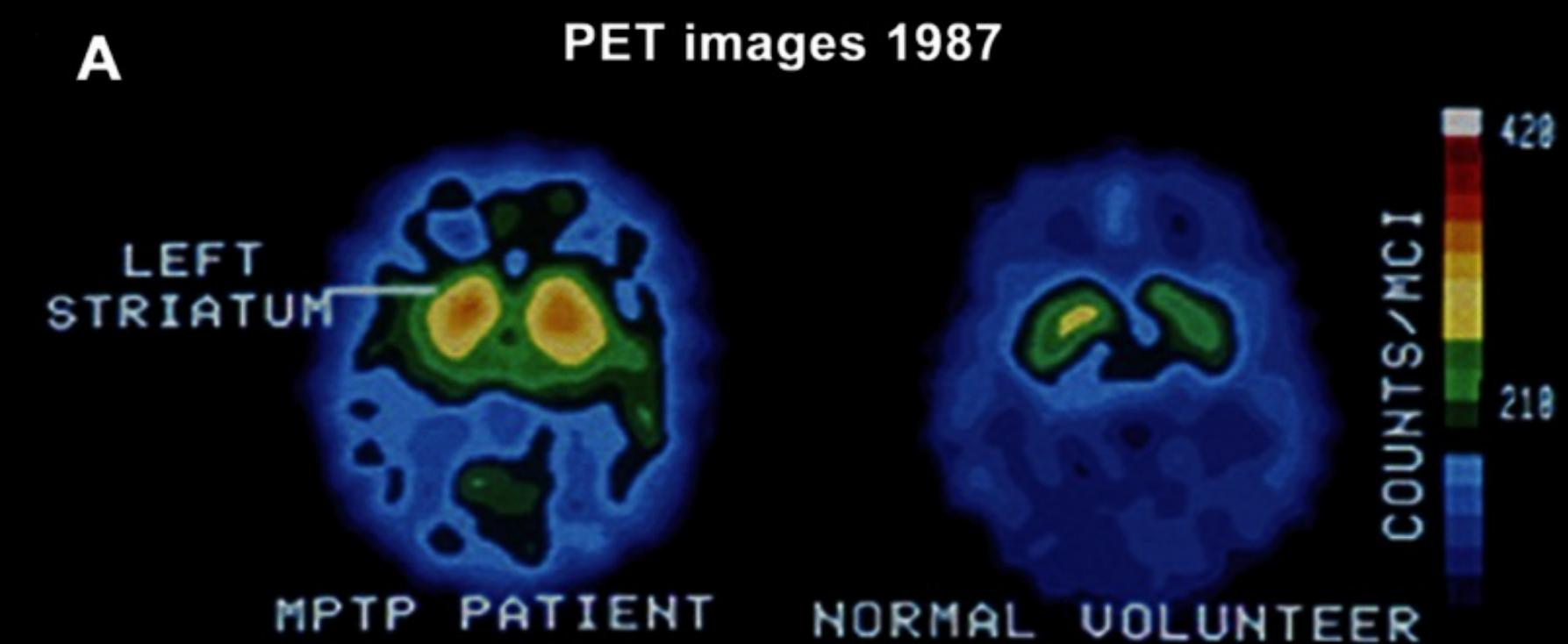
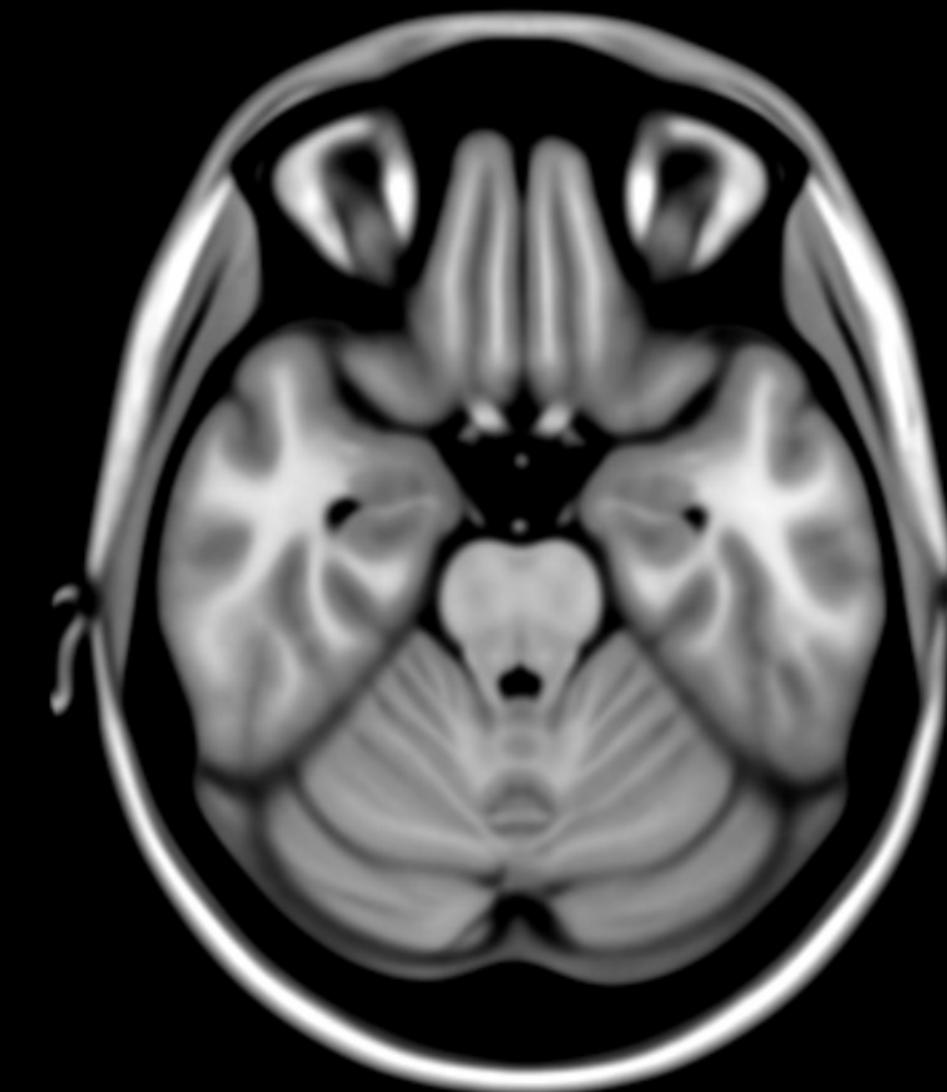
- **Weight** 1.3 - 1.5 kg; volume ~ 1.3 l
- A total of **86 billion** neurons
- Main function: **to coordinate the human bodily functions** via spinal cord and its innervation
- Brains **receive, process and store** information gathered by the senses to **predict the future**
- Most important manifestation of brain function: **behaviour**
- **Protected** by skull, meninges and brain-blood barrier



What do we want to know about brain?

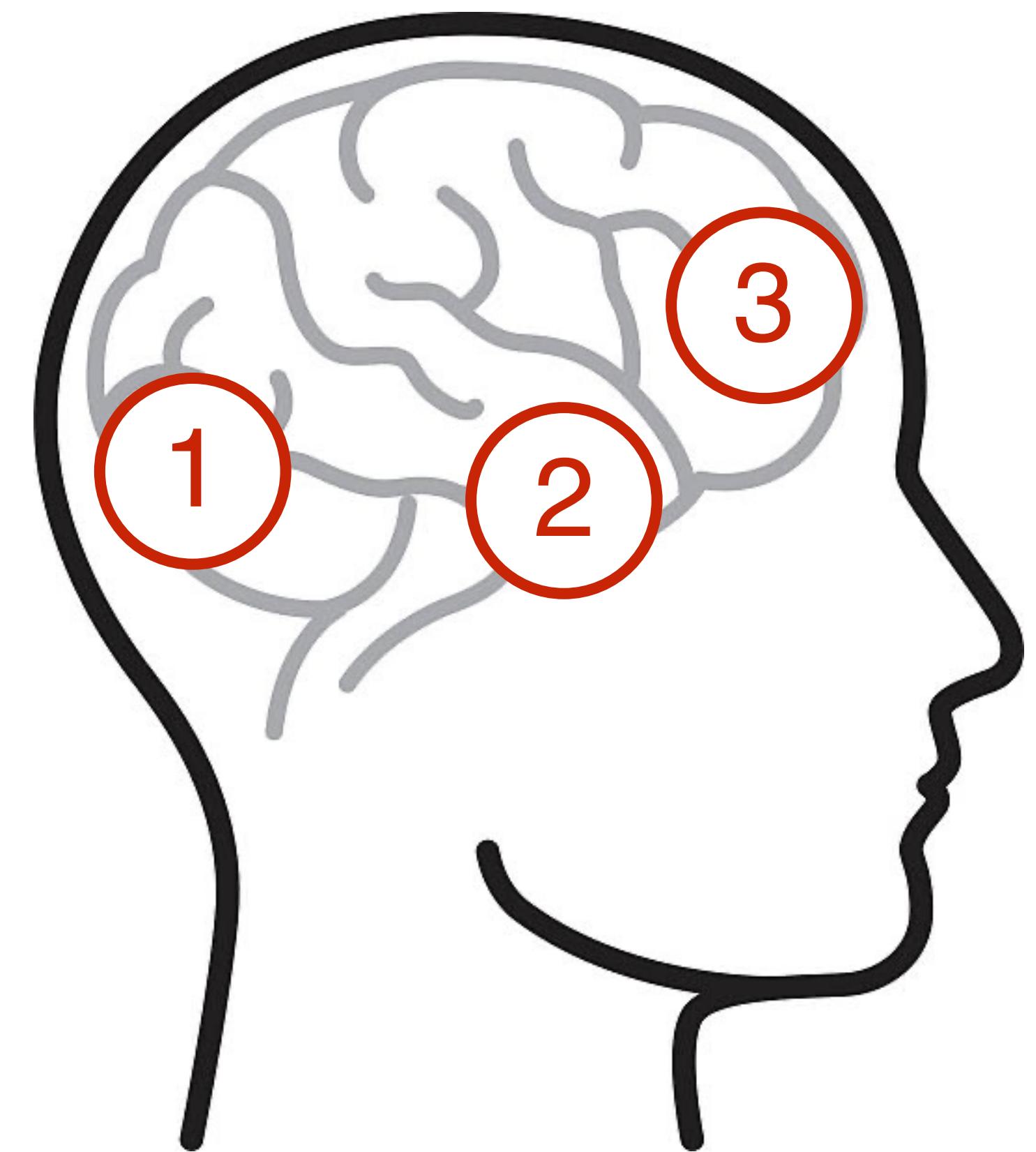
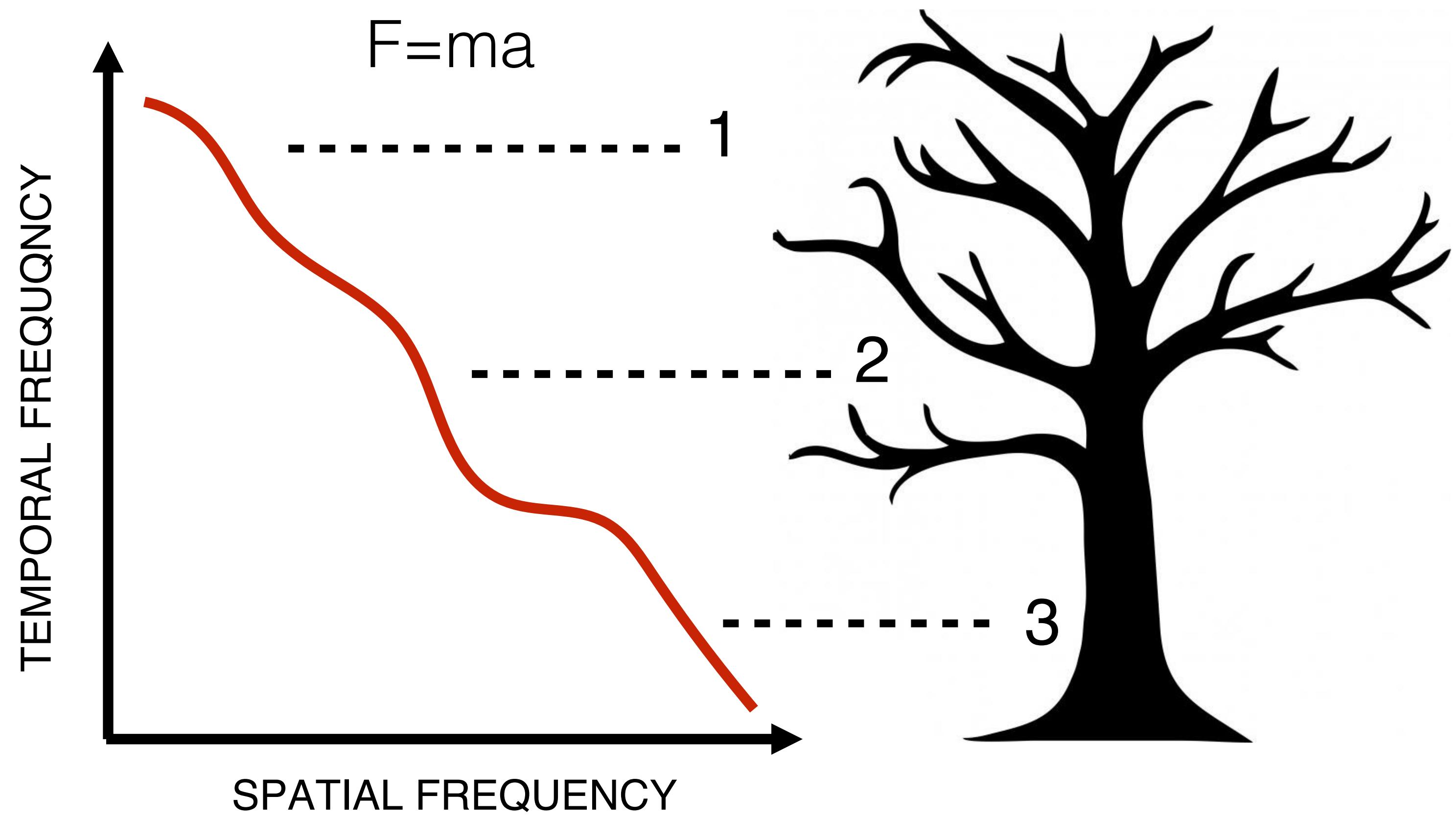
- **LOCATION:** Where different processes (consciousness, emotions, memory...) happen?
- **SPEED:** When and at which time scales different processes occur in the brain?
- **MECHANISMS:** How different processes occur in the brain?
- **INDIVIDUAL DIFFERENCES:** Do different groups (patients / controls; men / women...) differ in the above?
- **CAUSALITY:** How we can influence brain function with external manipulations (learning, experience, drugs...)





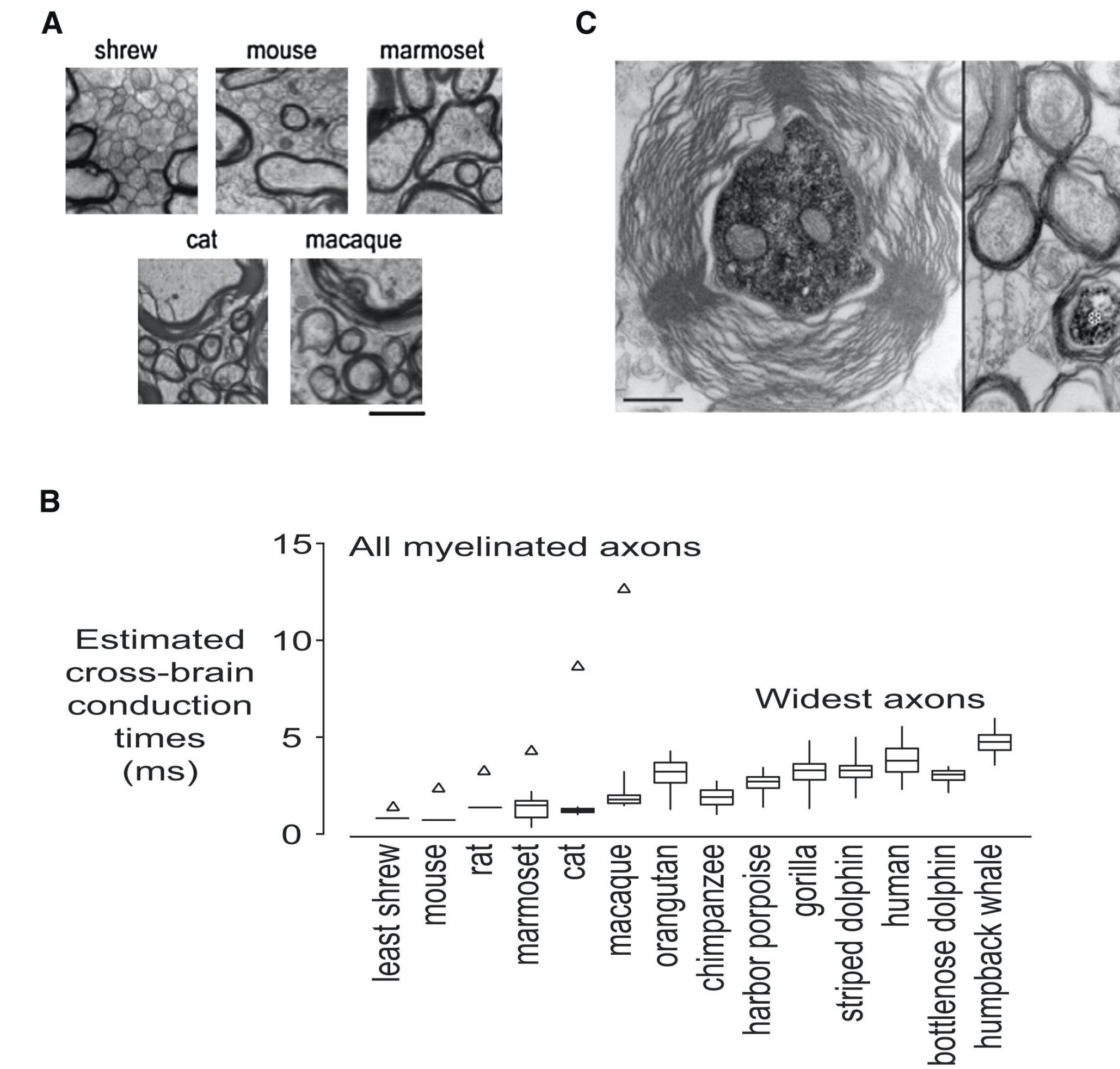
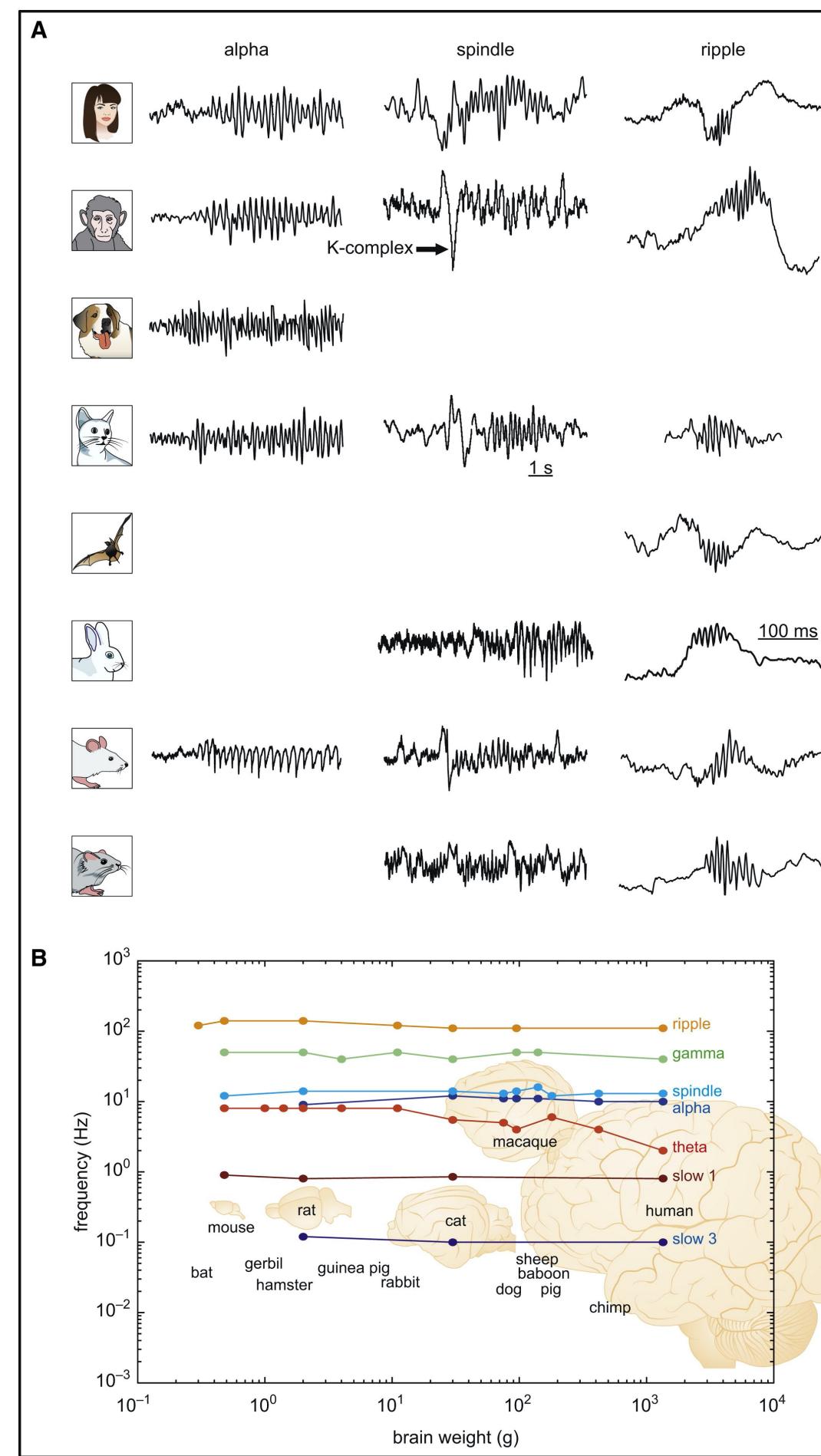
EMI central laboratories & MNI

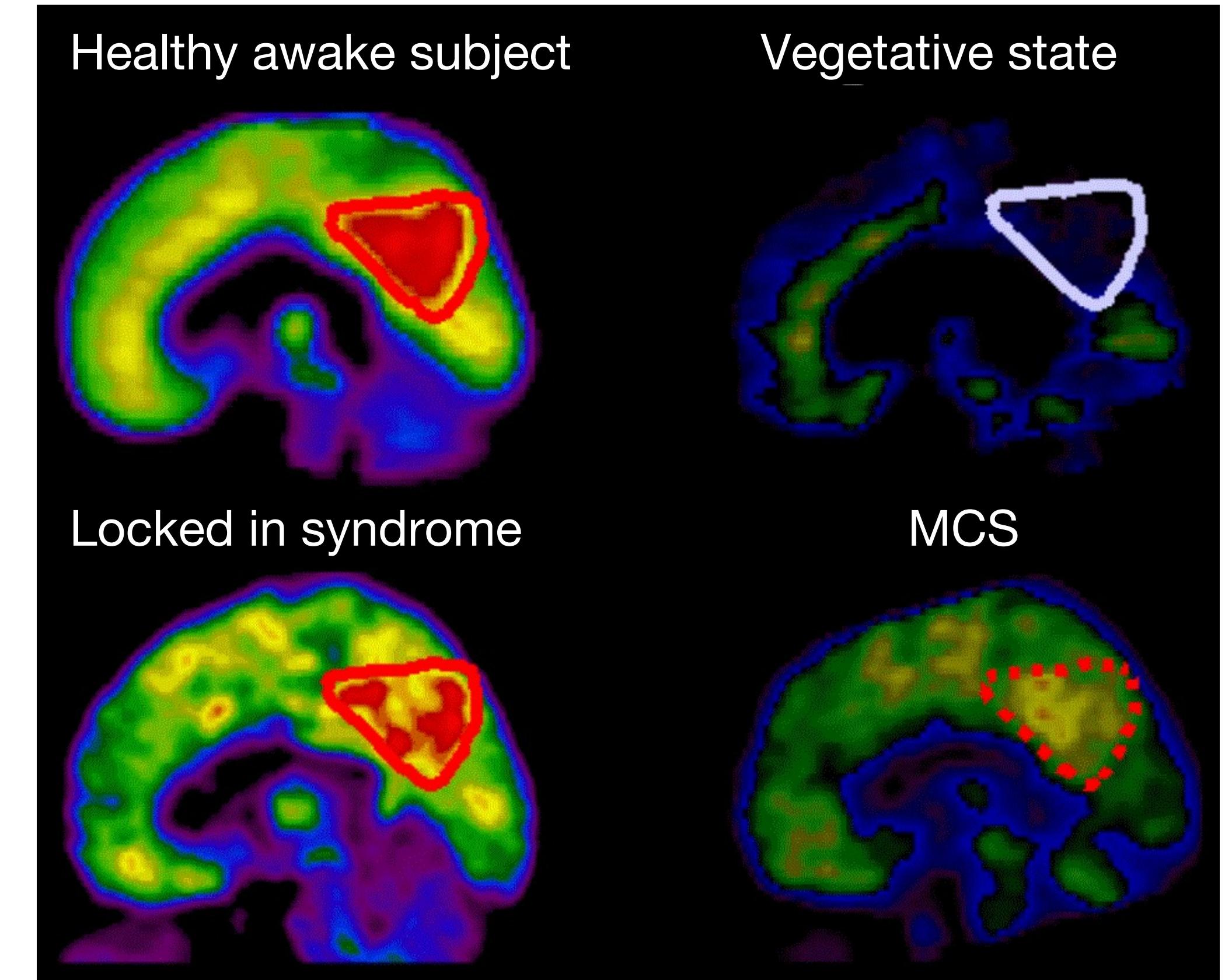
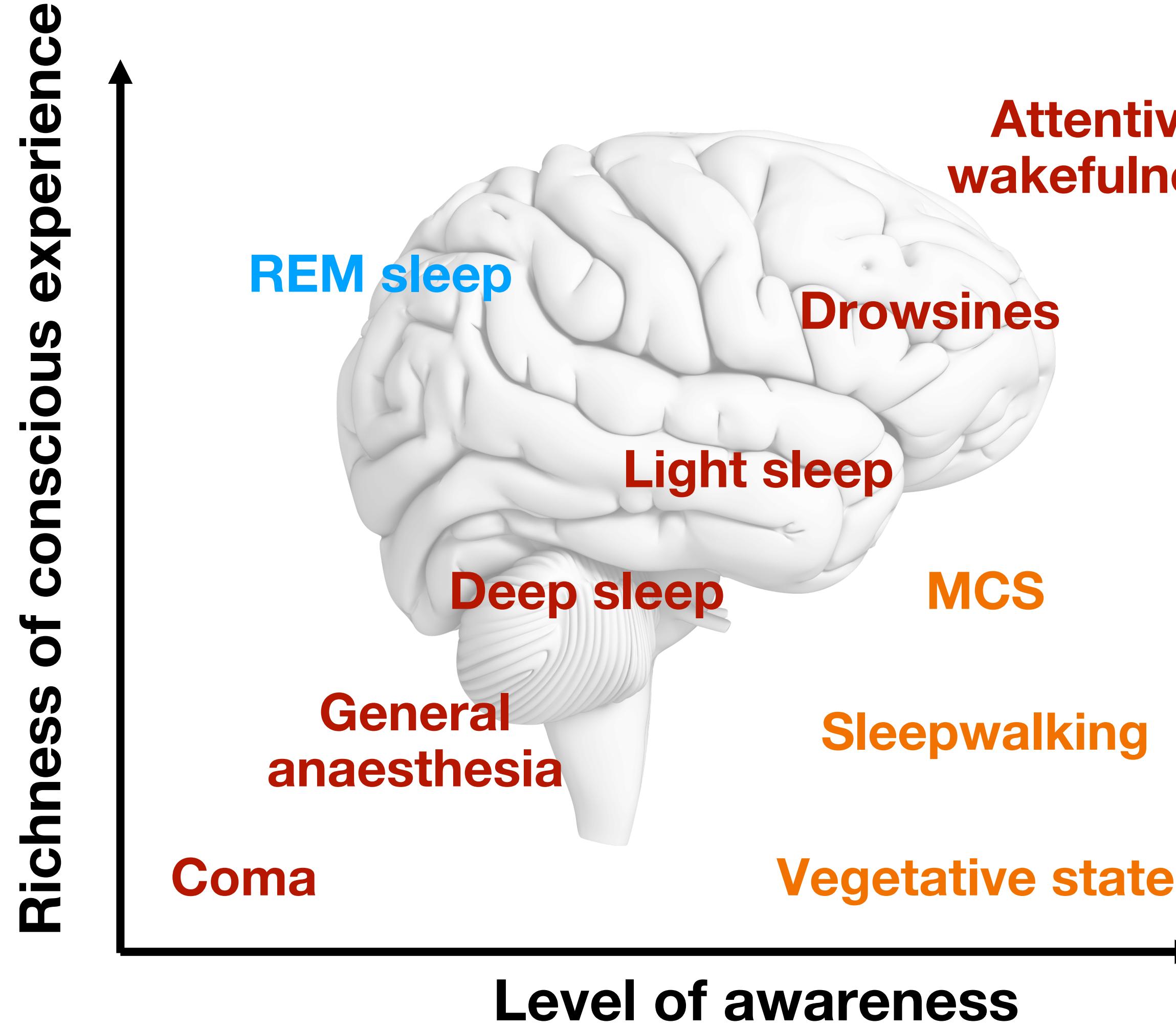
Portnow (Neurology 2013)



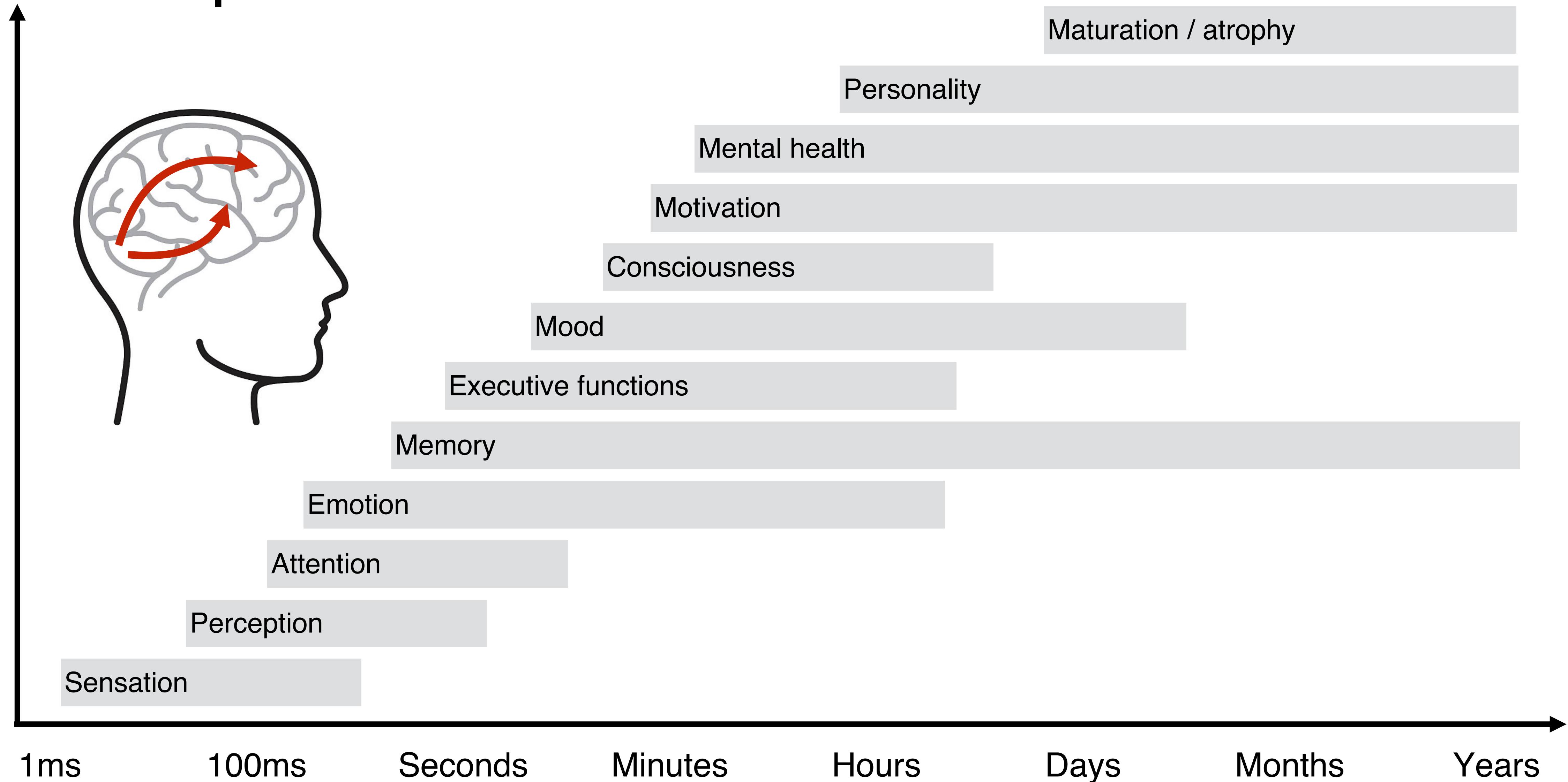
Adapted from Hari (2018)

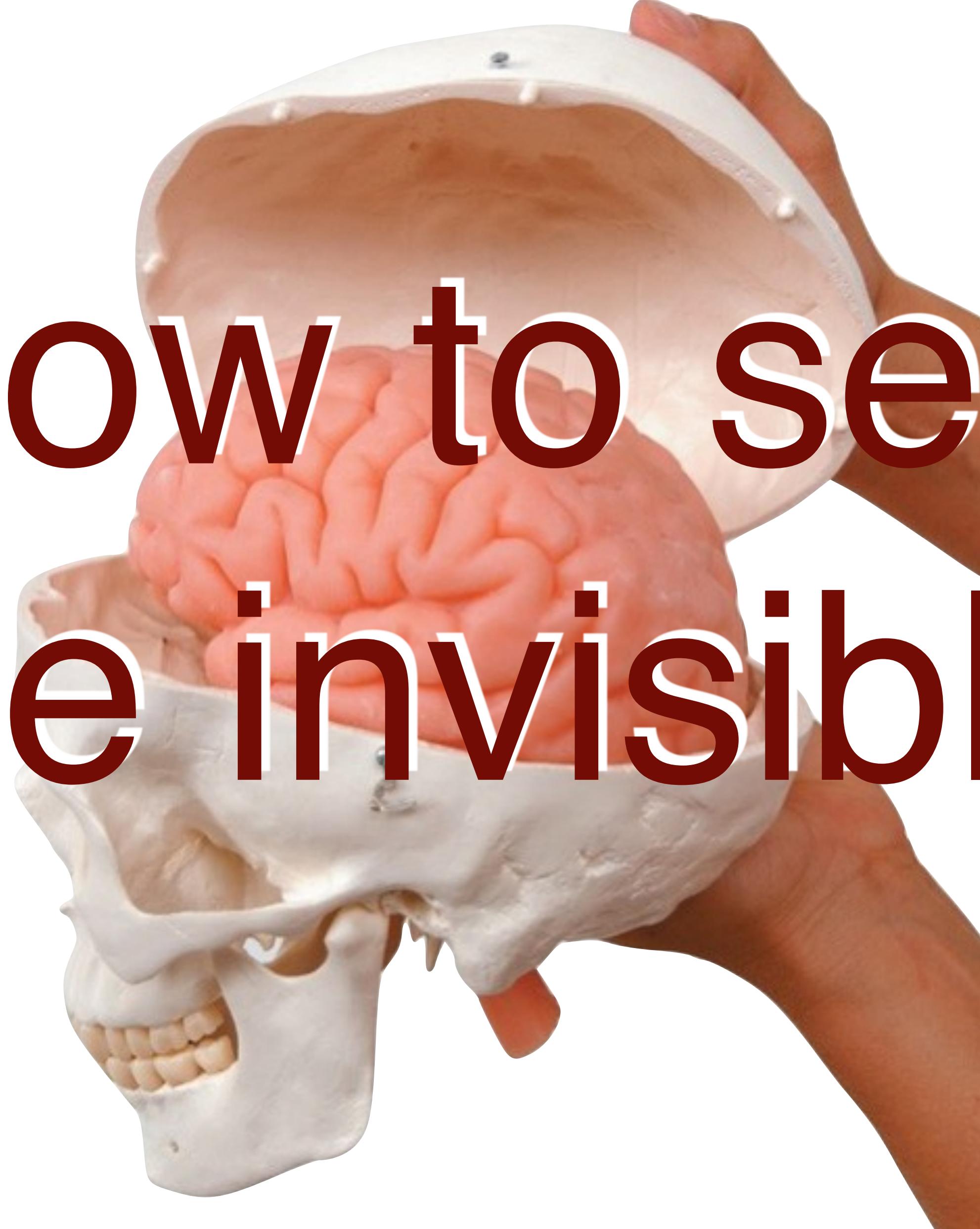
Fast reactions with slow brains





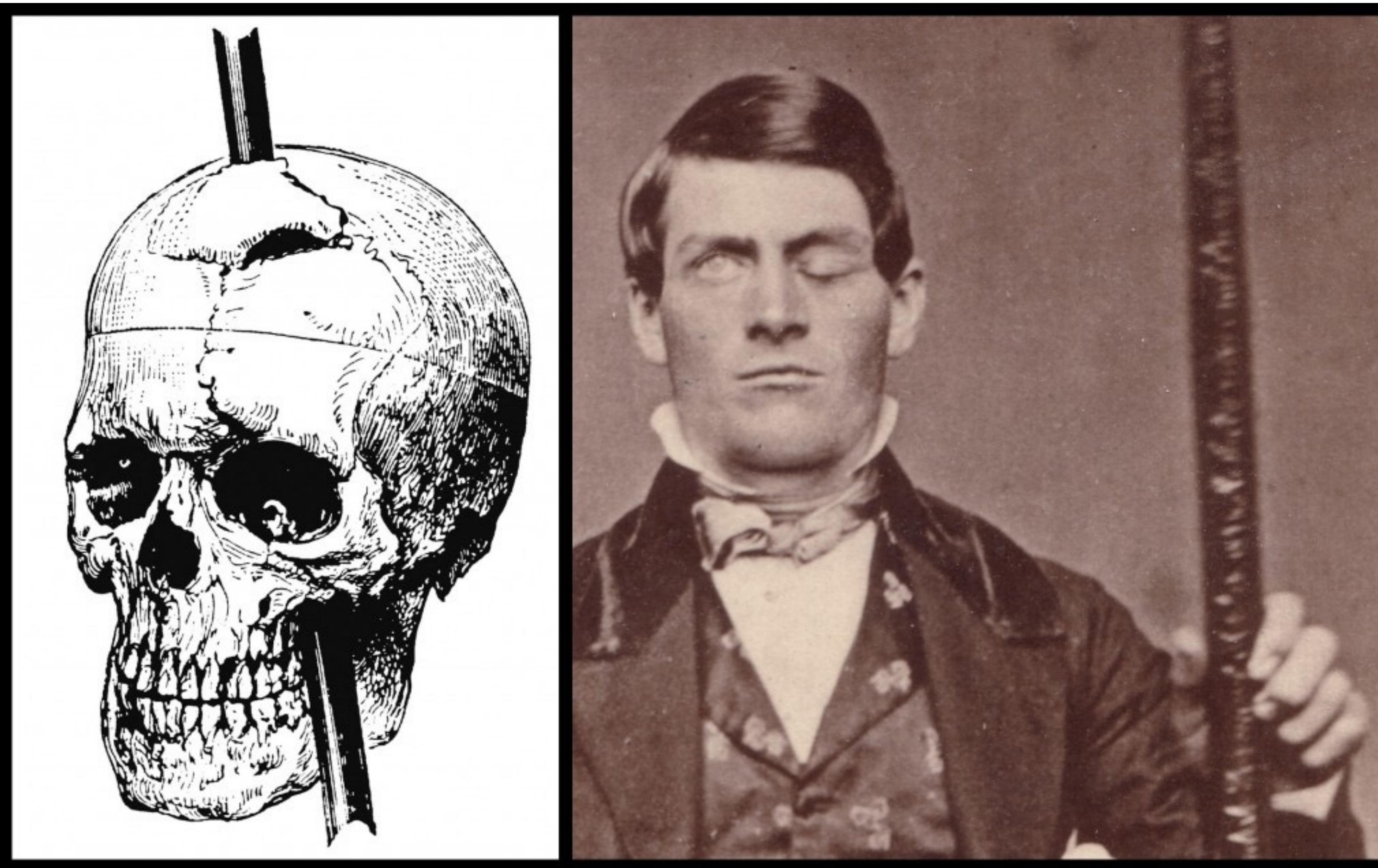
Temporal windows in brain





How to see
the invisible

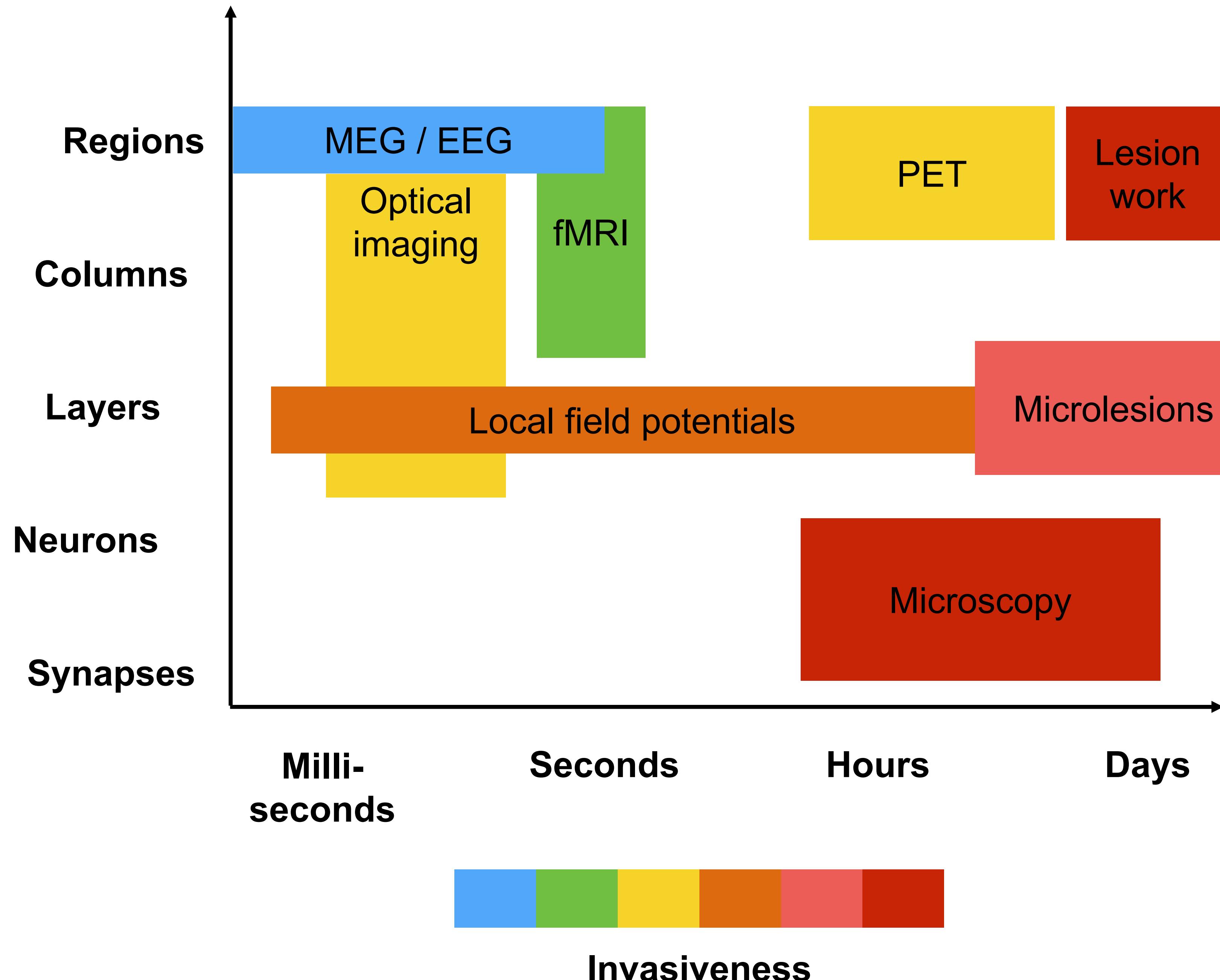
Old school cognitive neuroscience



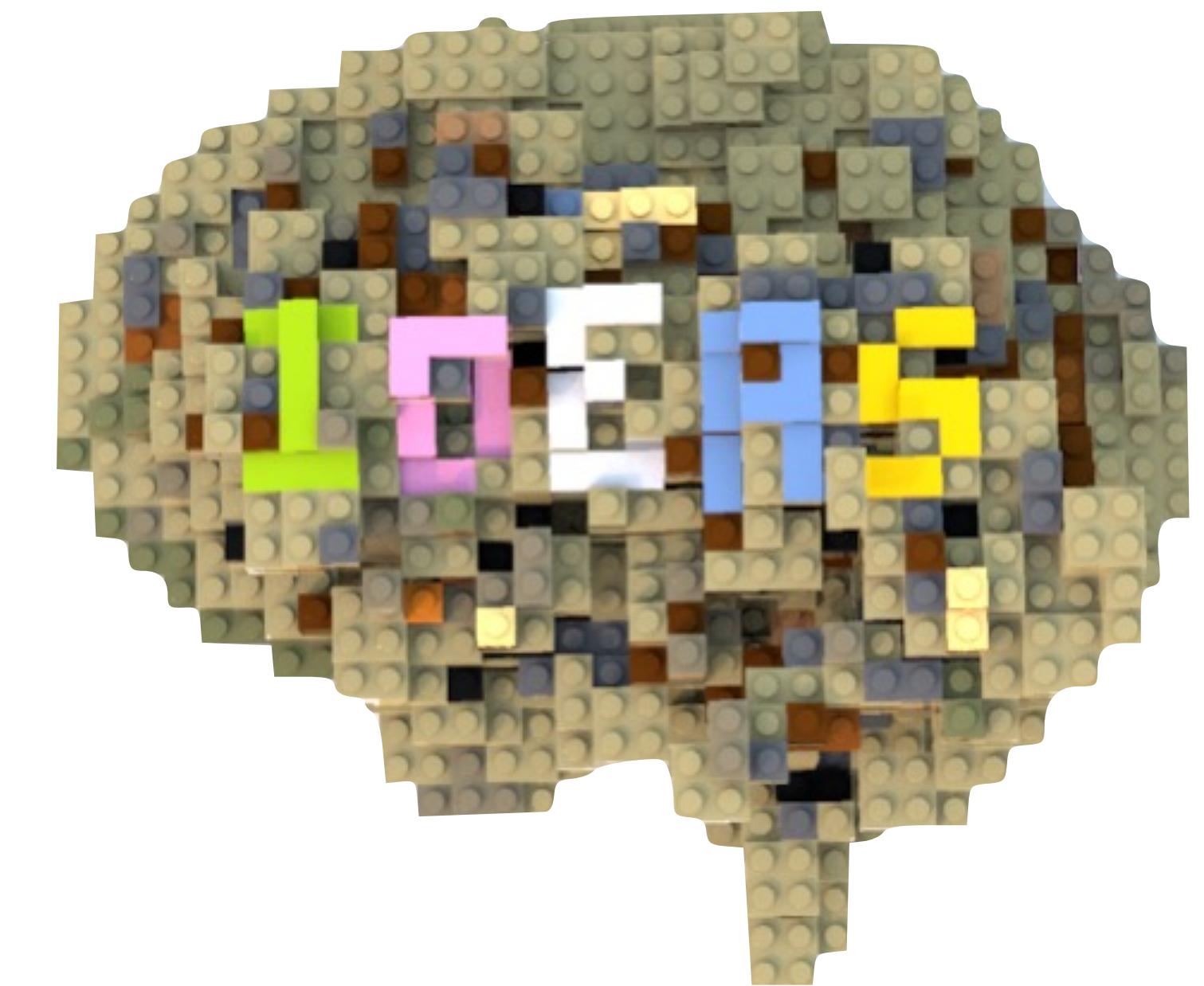


209%

Video courtesy
of prof. Pirjo Nuutila



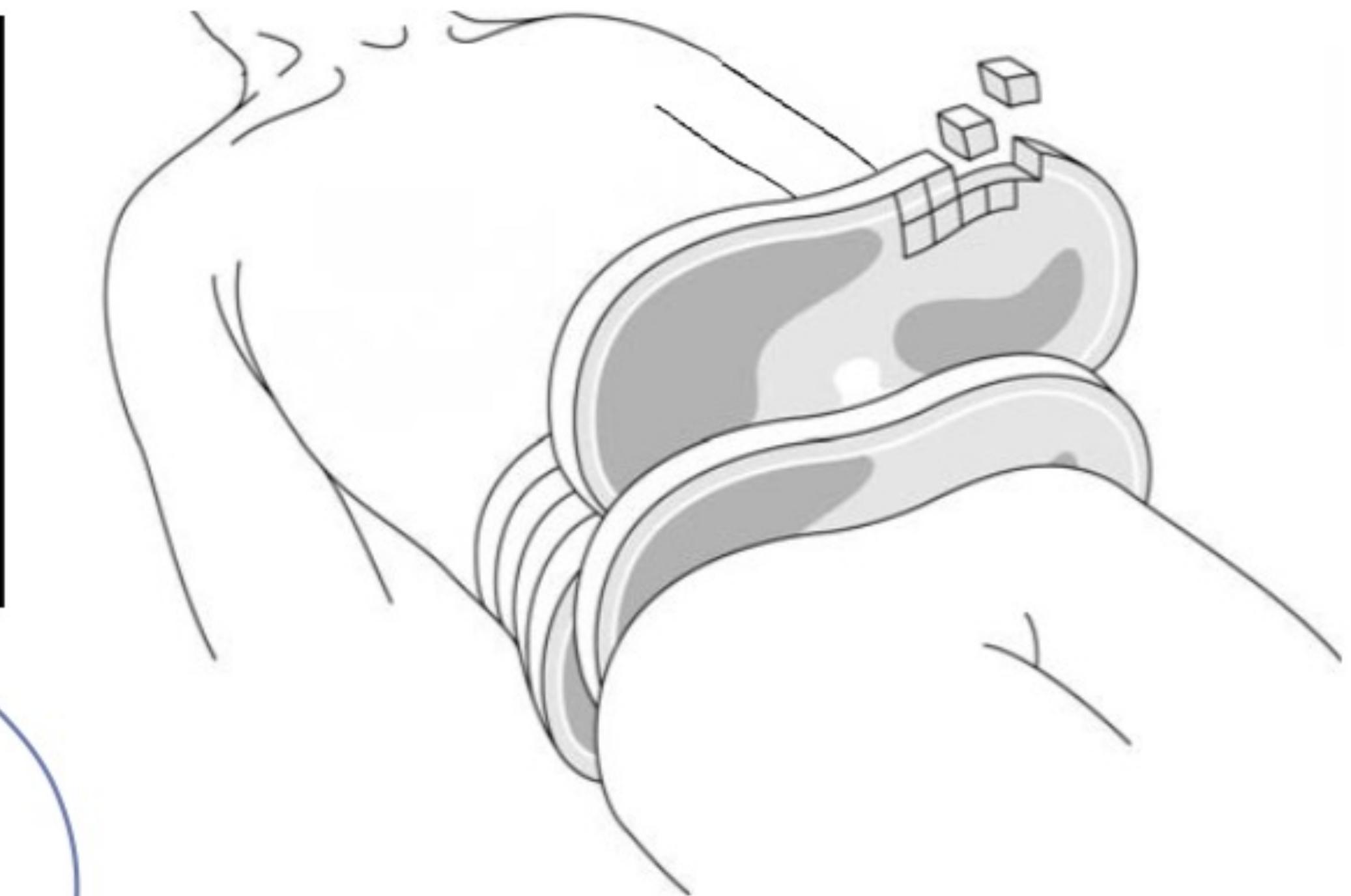
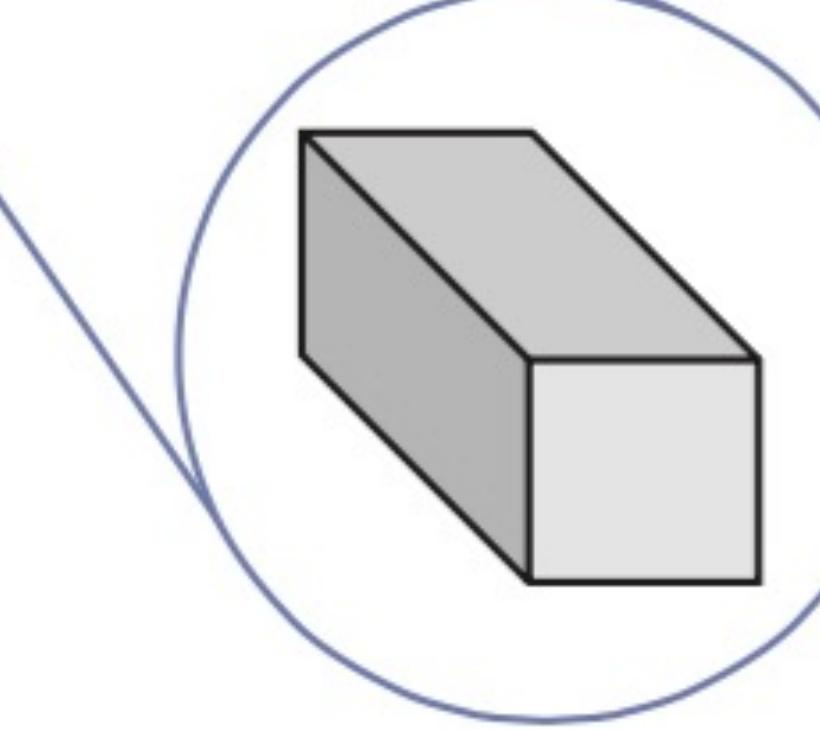
Imaging: seeing the invisible



Tomographic imaging

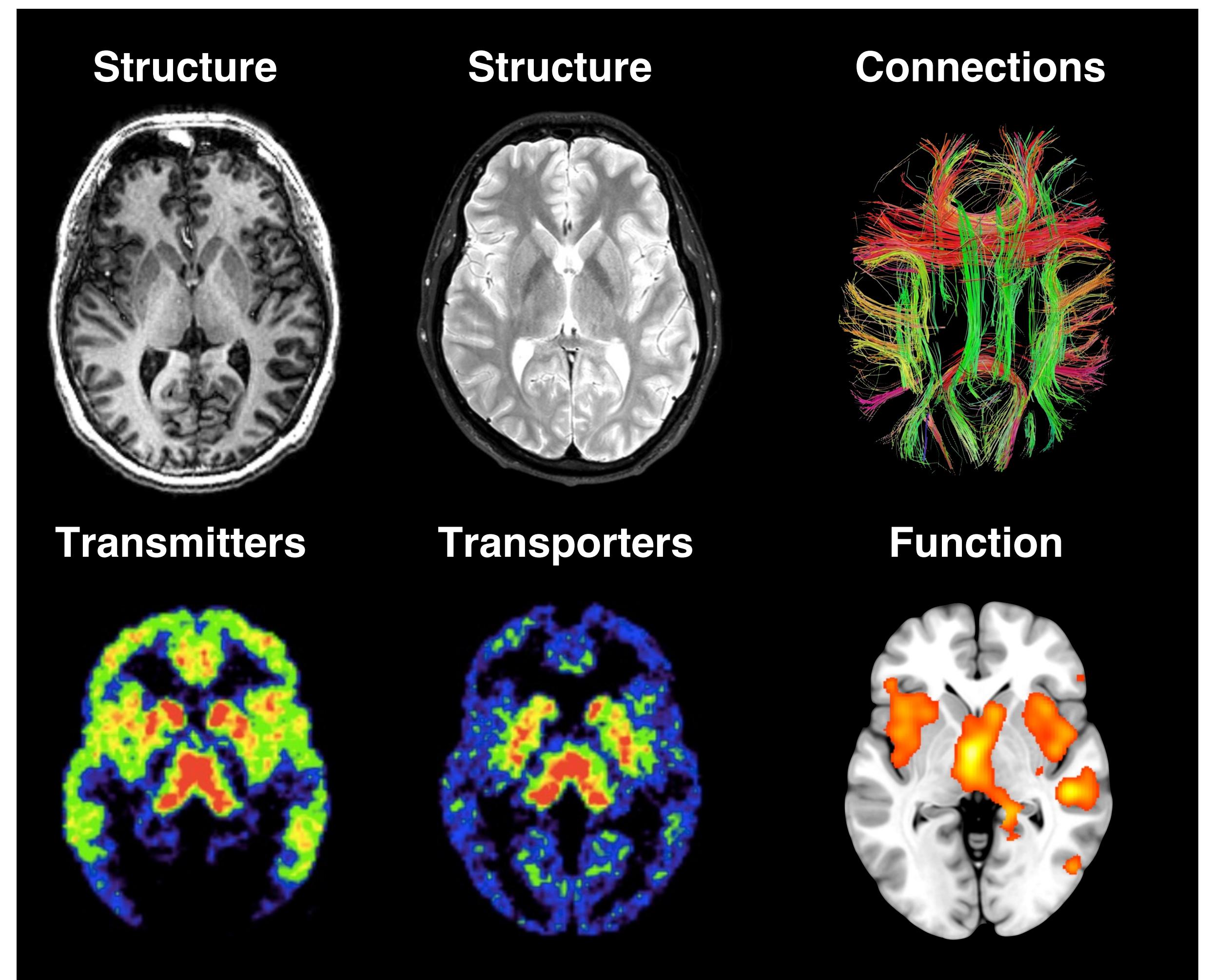
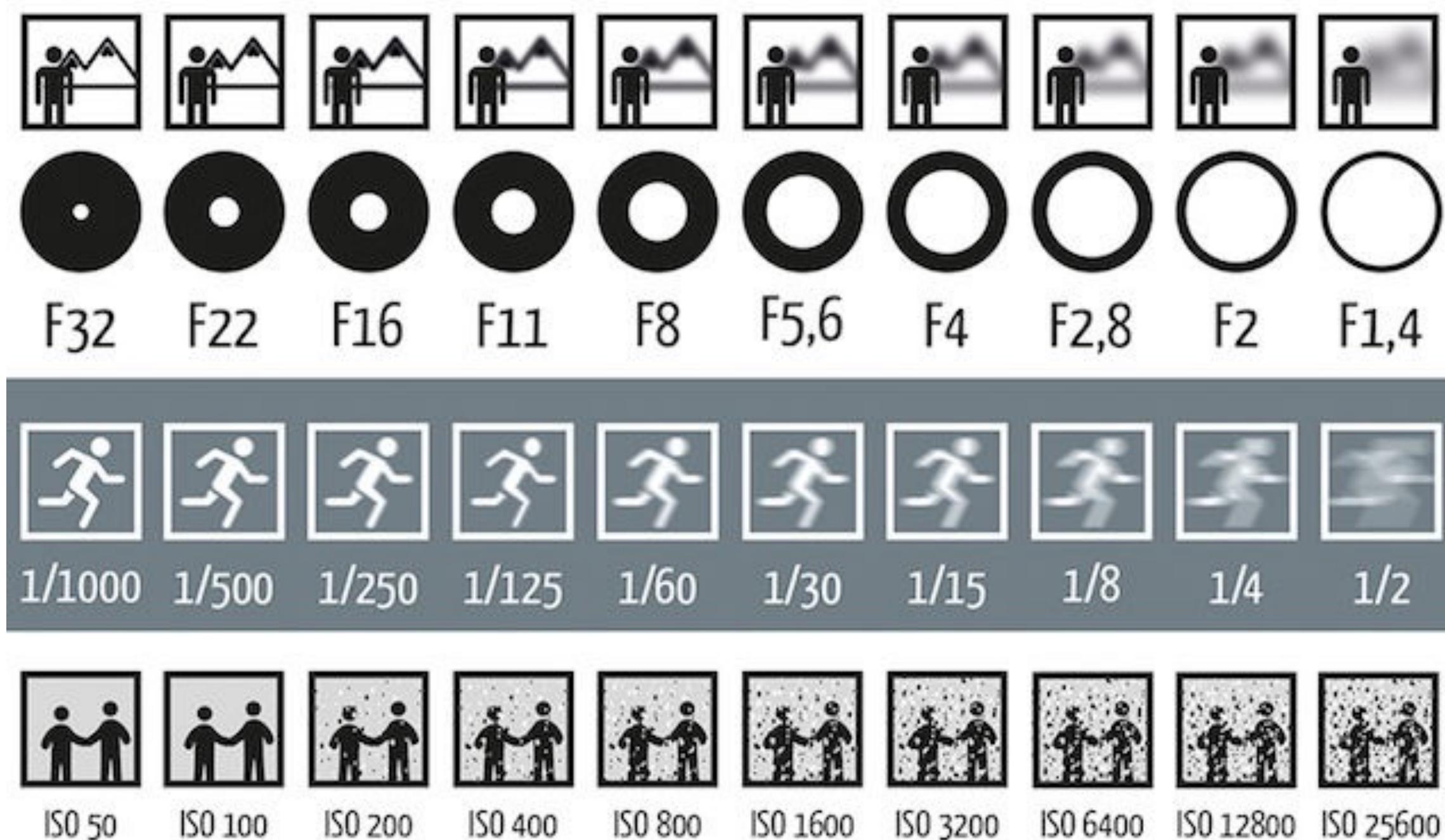


(a)

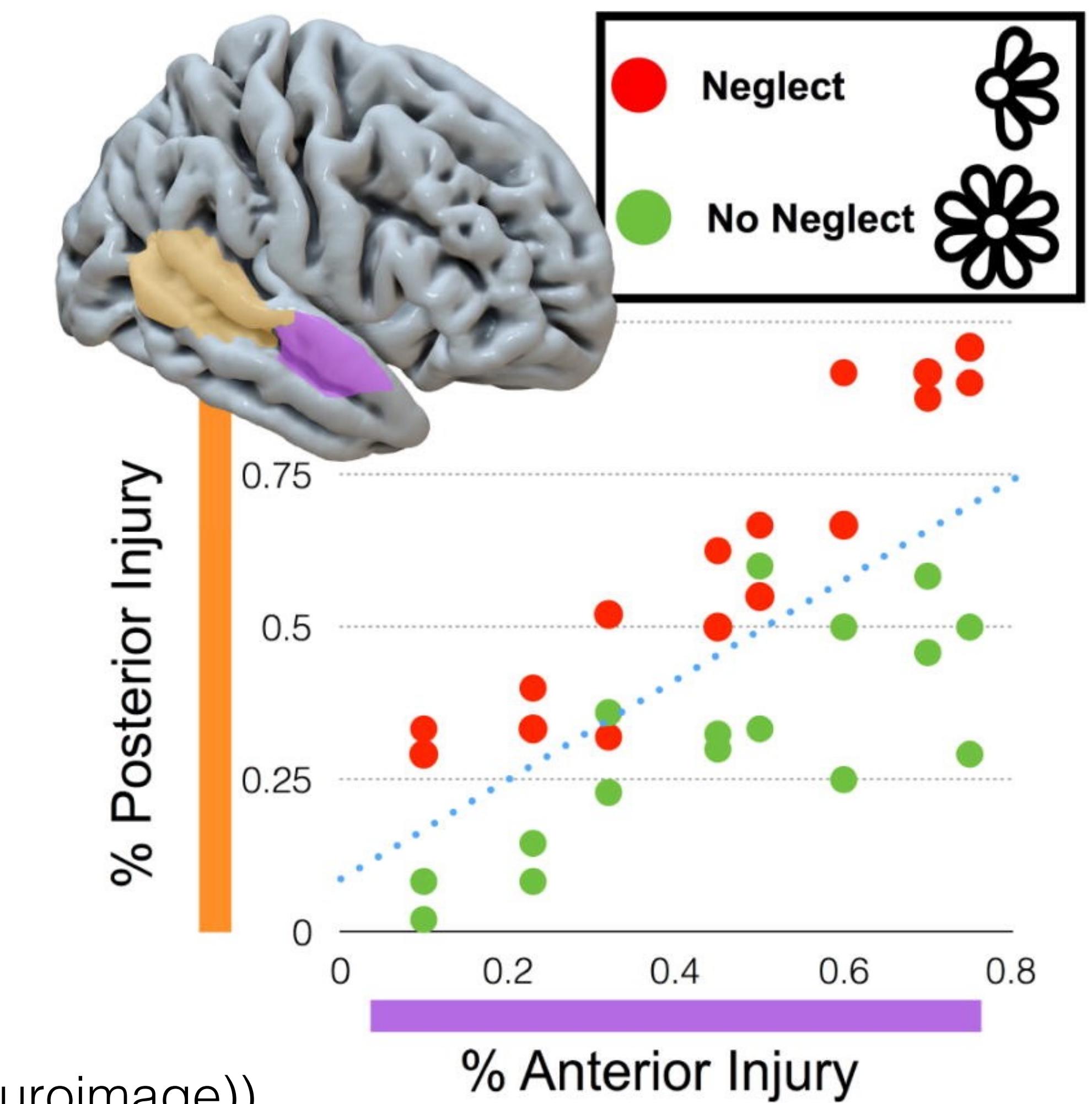
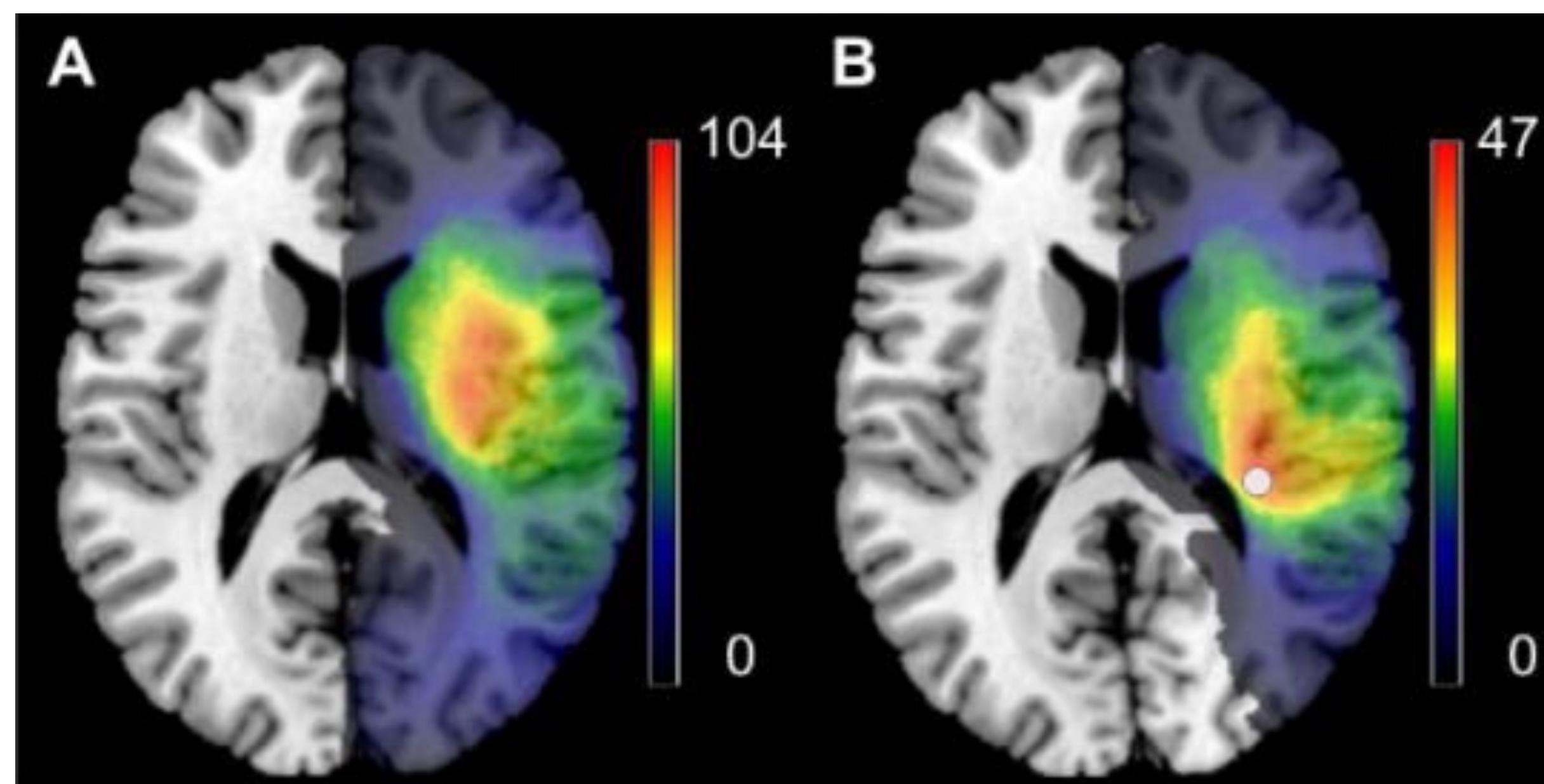


(b)

Same target - multiple contrasts

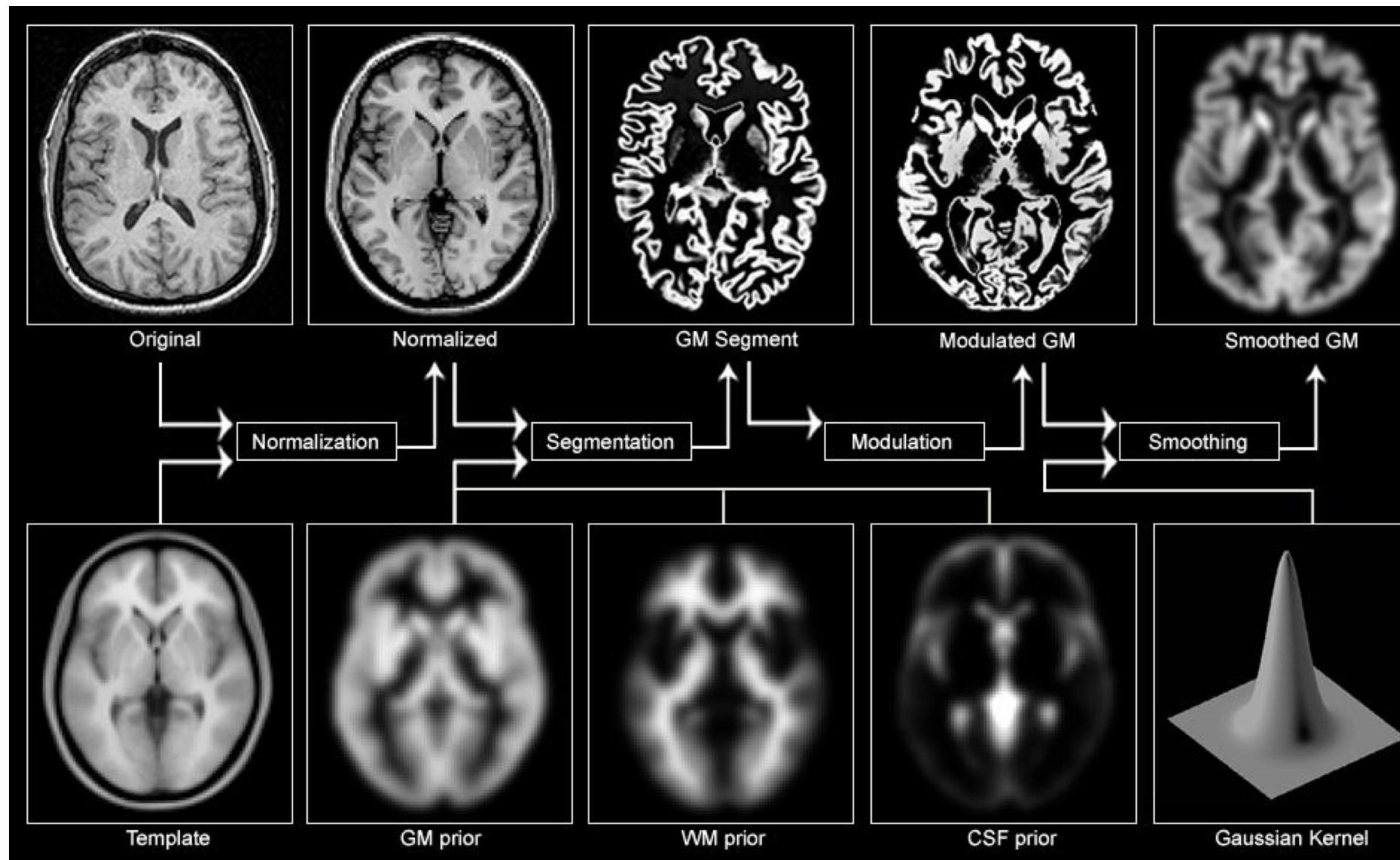


Lesion mapping

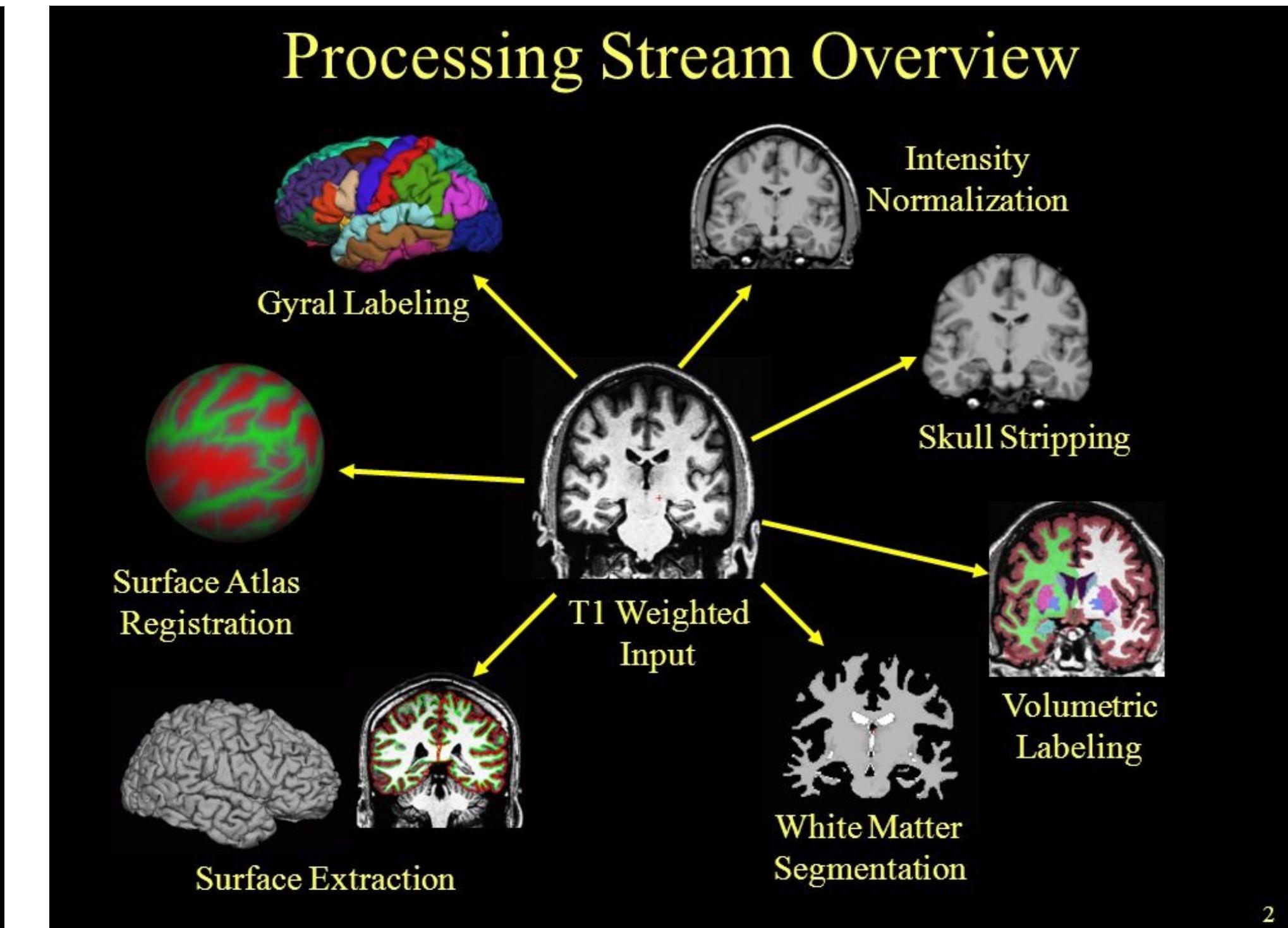


Morphometric analysis

Voxel-based morphometry (VBM)

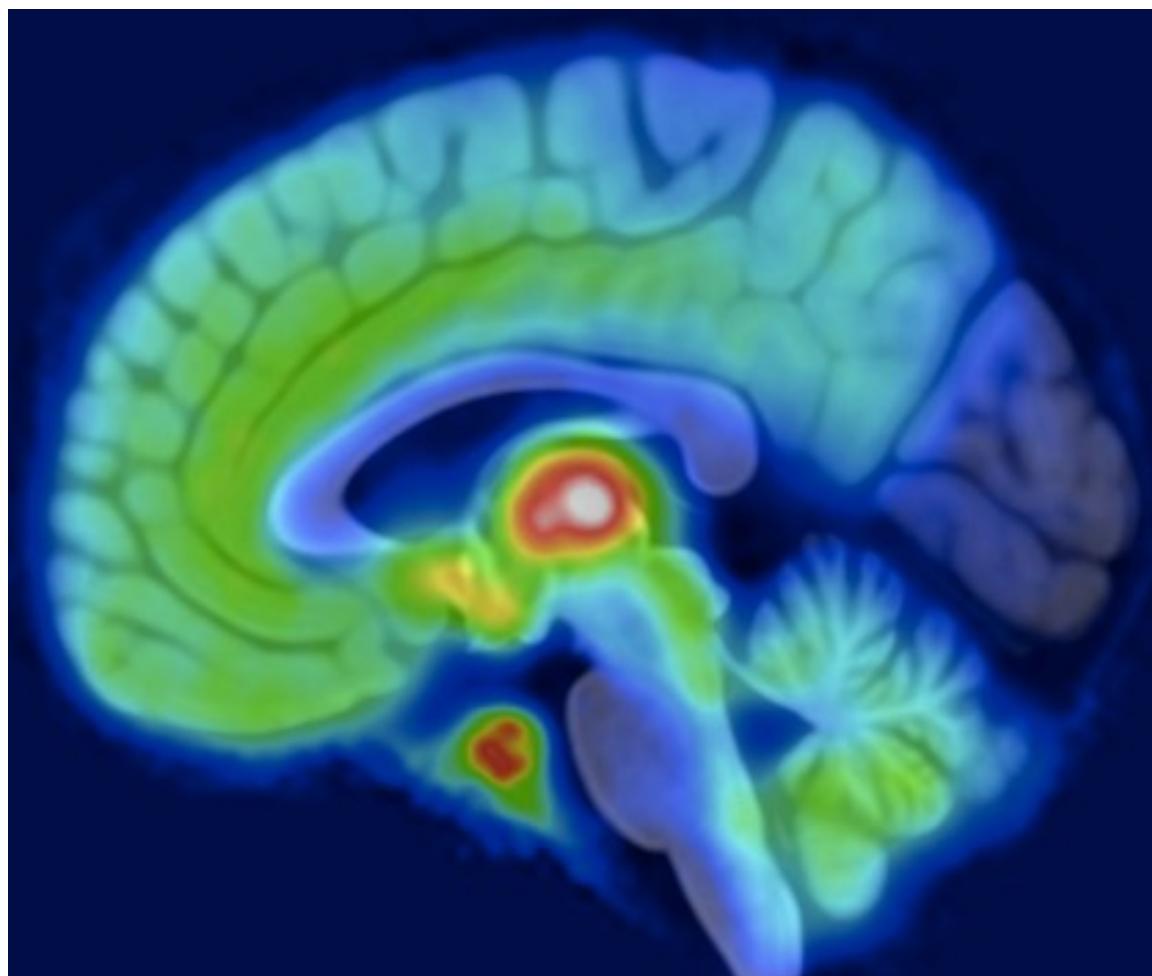


Surface analysis (FreeSurfer)



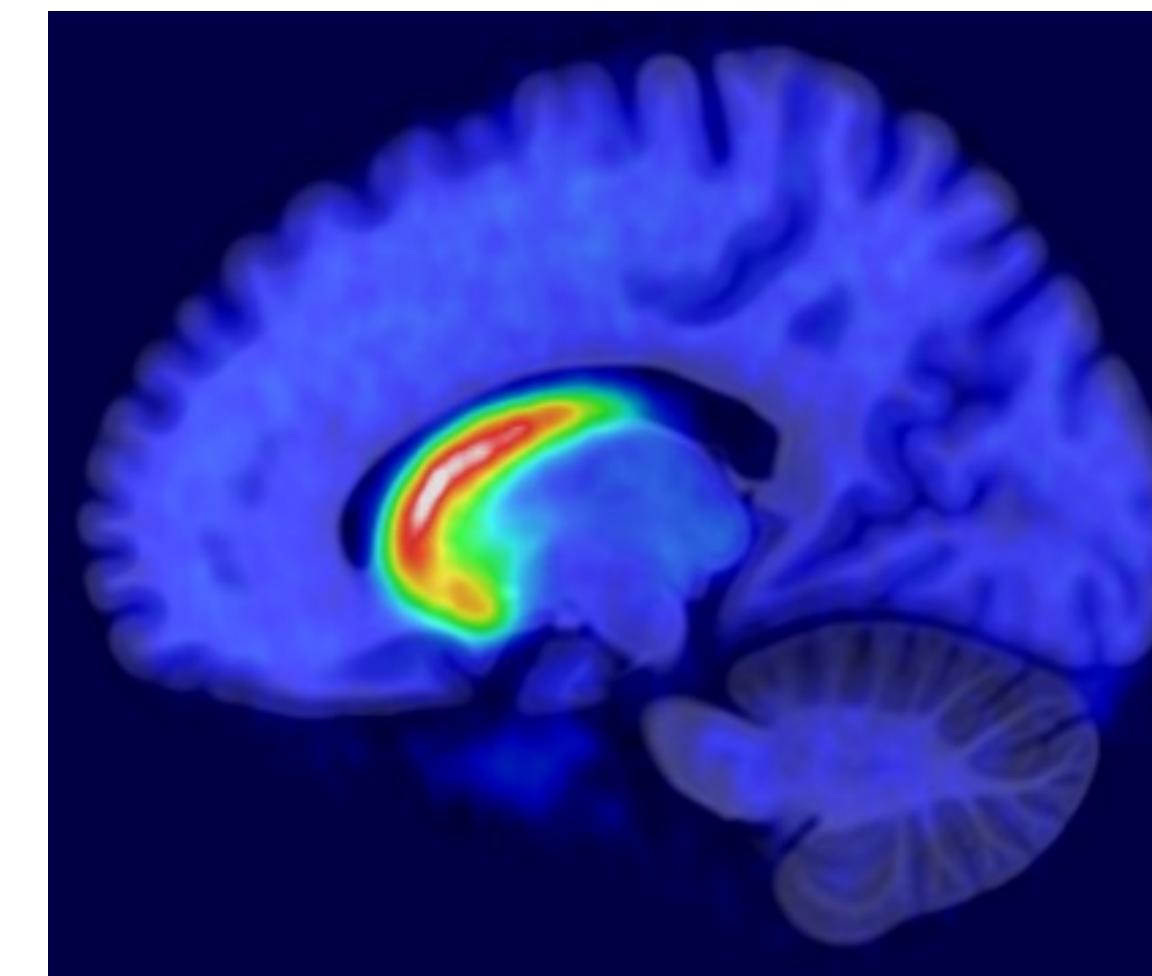
Positron emission tomography

Mu-opioid receptors



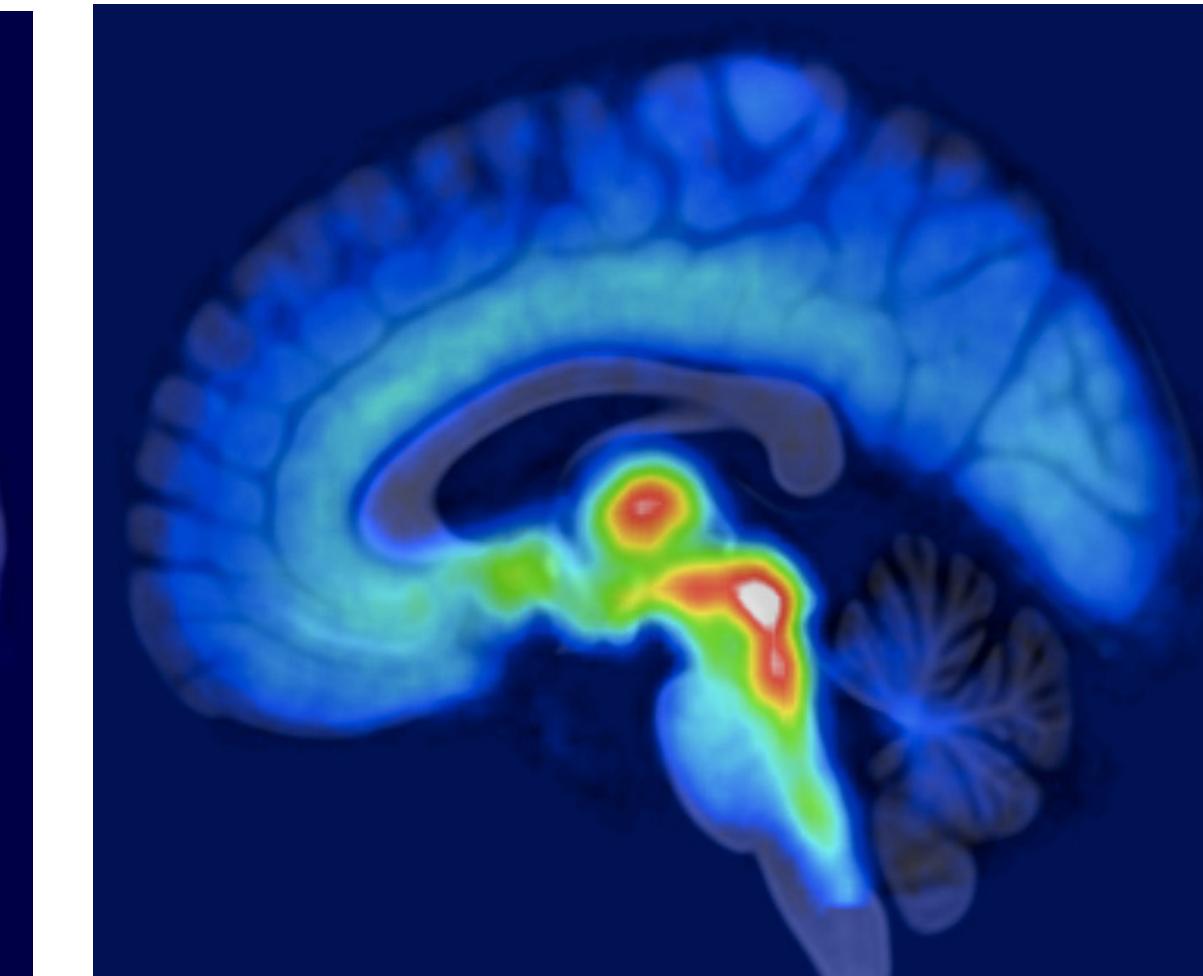
[¹¹C]carfentanil

Type 2 dopamine receptors



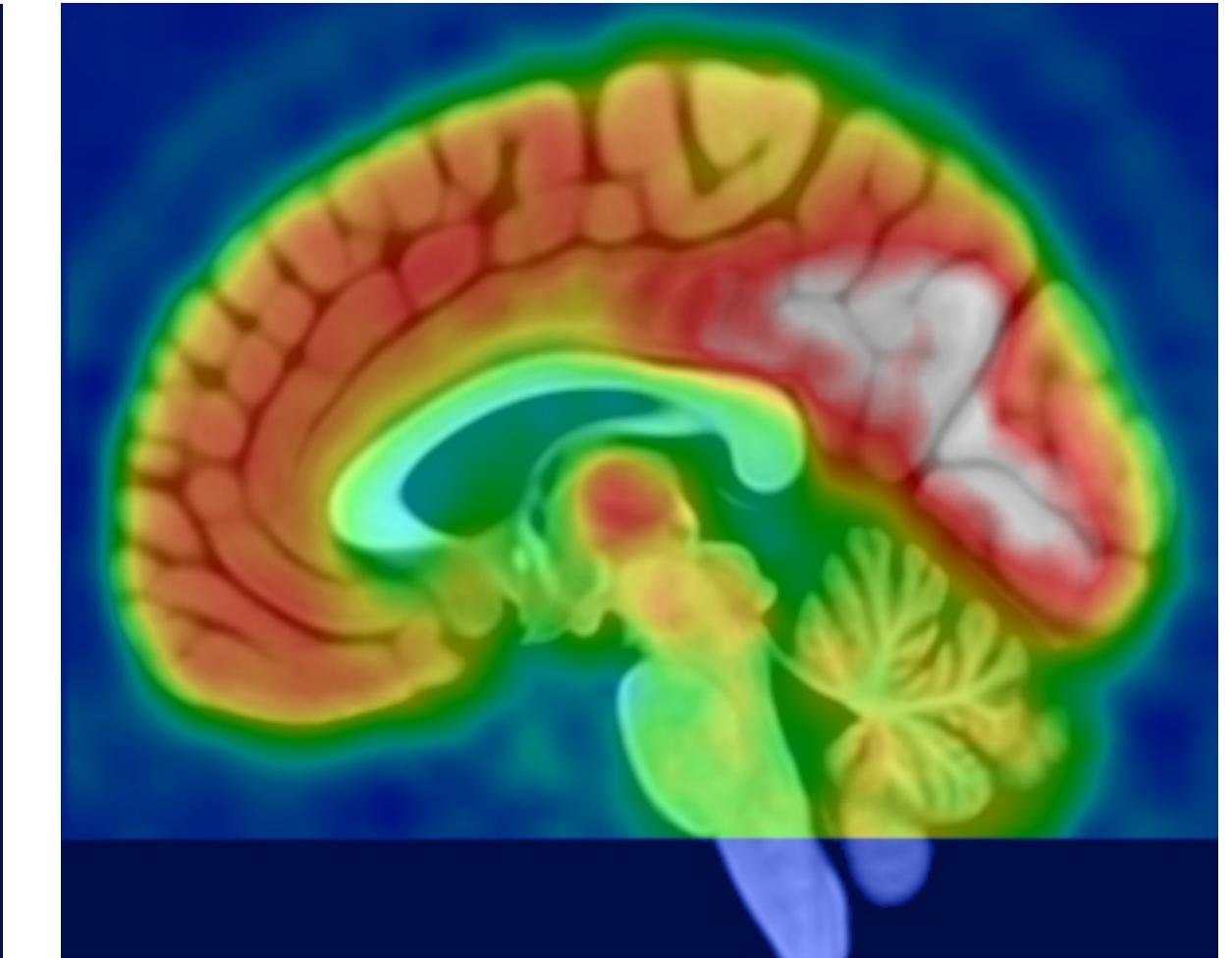
[¹¹C]raclopride

Serotonin transporters



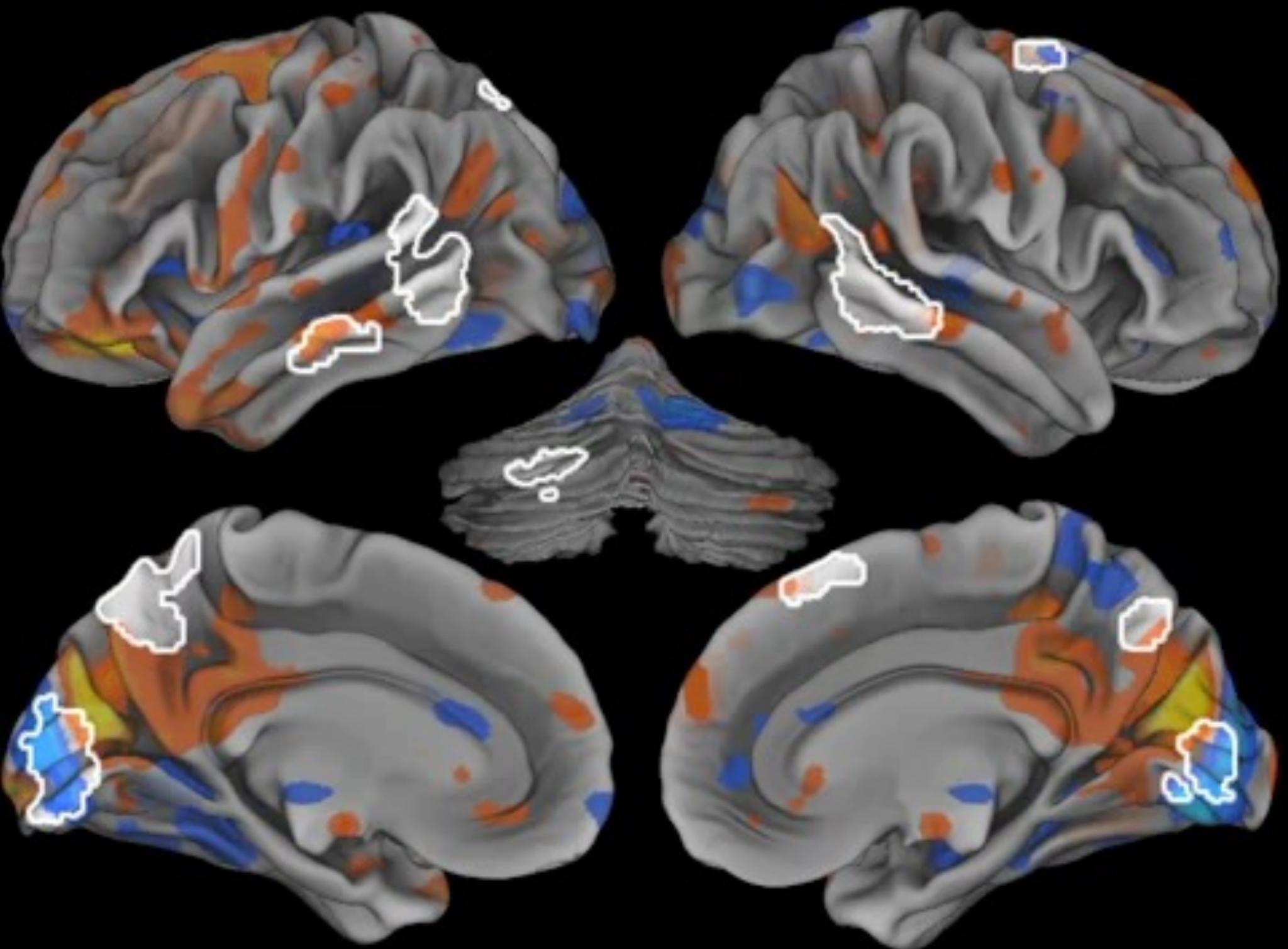
[¹¹C]MADAM

Glucose metabolism



[¹⁸F]FDG

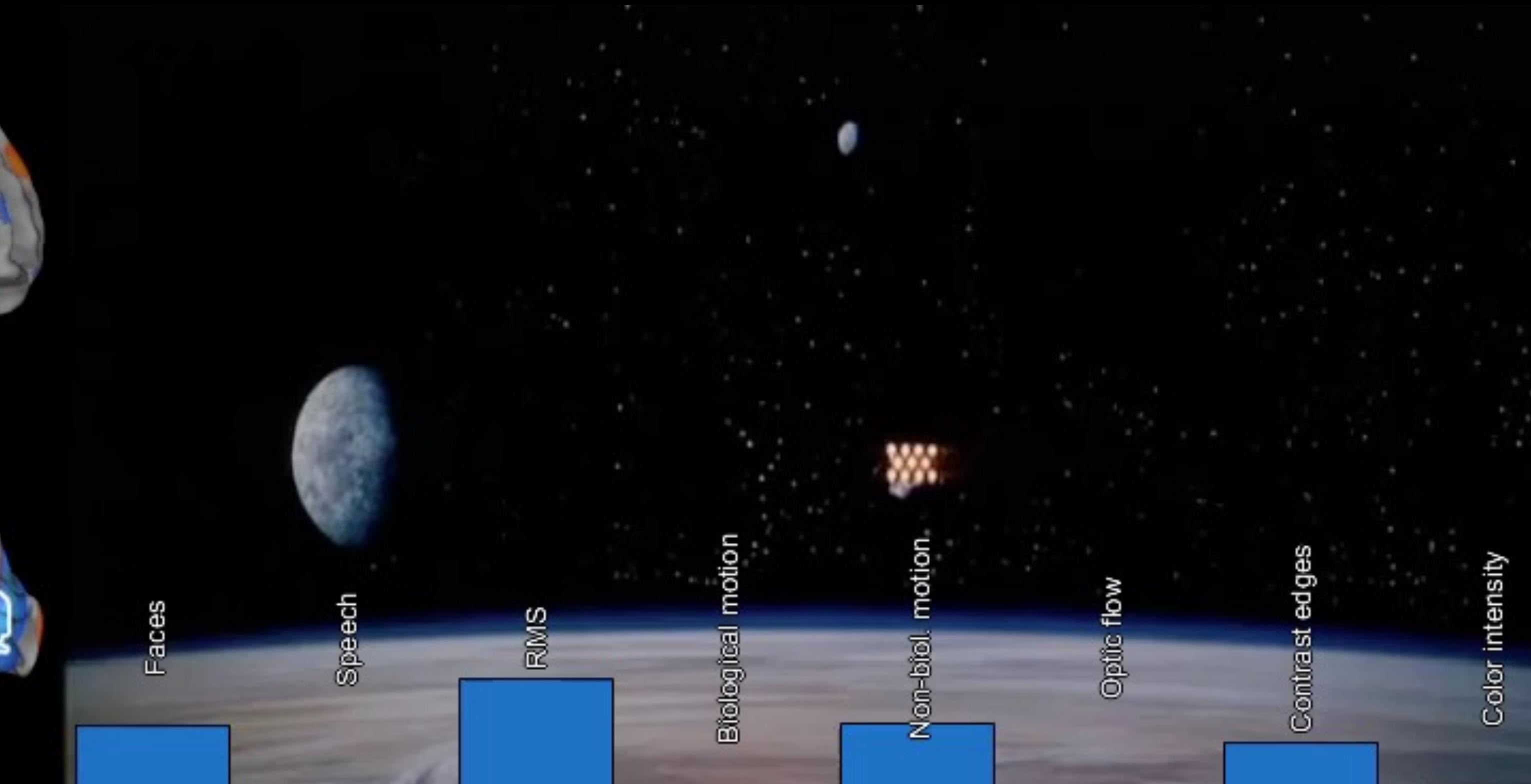
Brain activity



■ Activation

■ Deactivation

Sensory stimulus (Star Wars Episode IV)



Movie features

Lahnakoski et al (2017 Hum Brain Mapp)