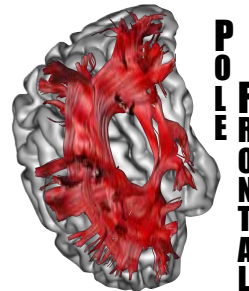


TOOLS TO PARCELLATE THE BRAIN AND ITS RELATION TO FUNCTION

TRACTOGRAPHY BASED SUBDIVISION

Michel Thiebaut de Schotten

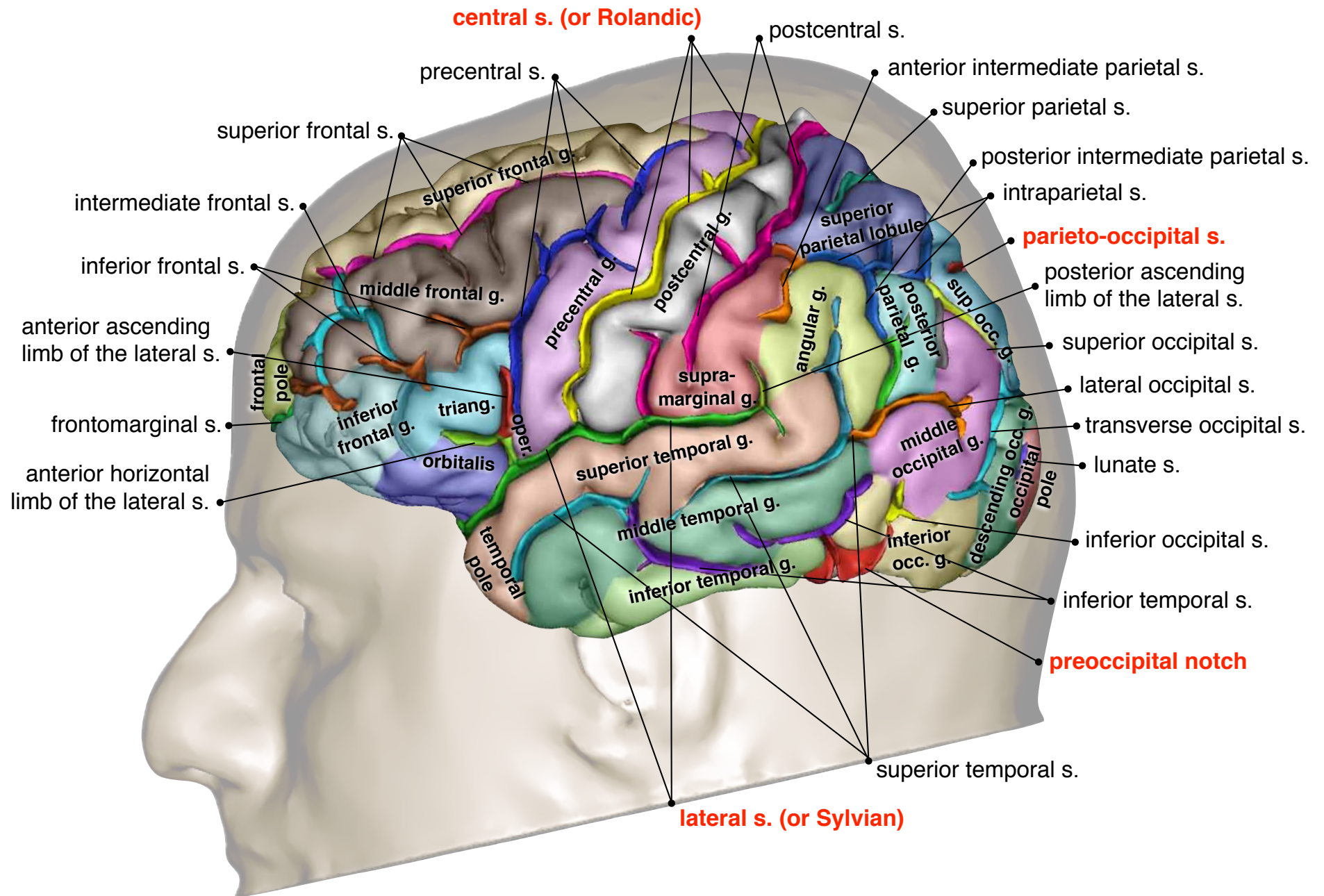


University of London

**Institute of
Psychiatry**

at The Maudsley







Ernest Auburtin
(1825-1893)



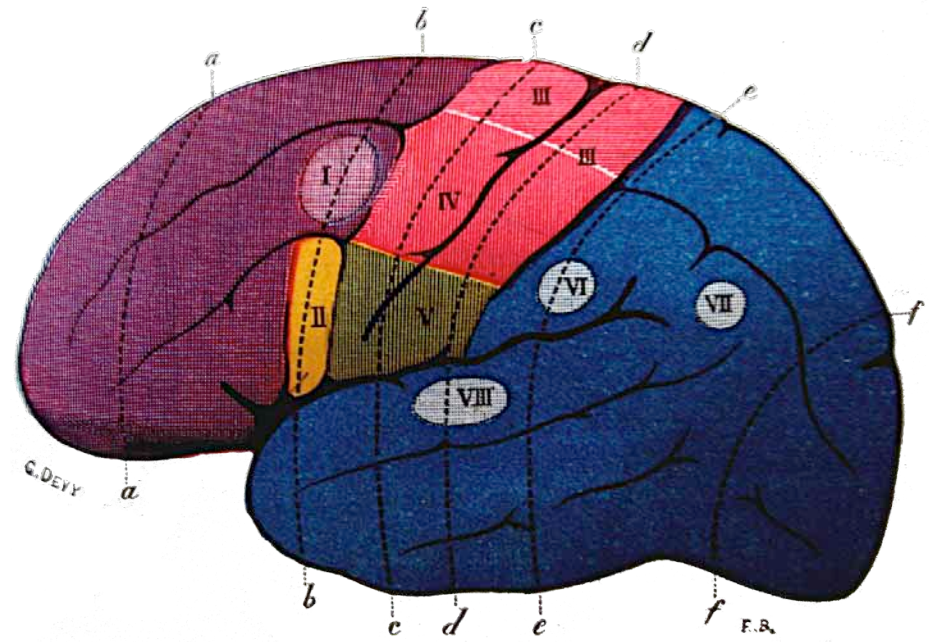
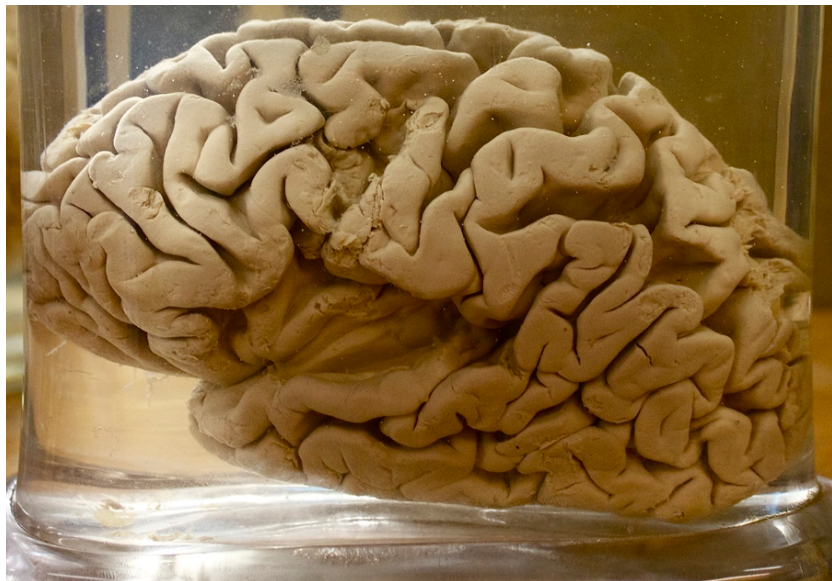
Paul Broca
(1824-1880)

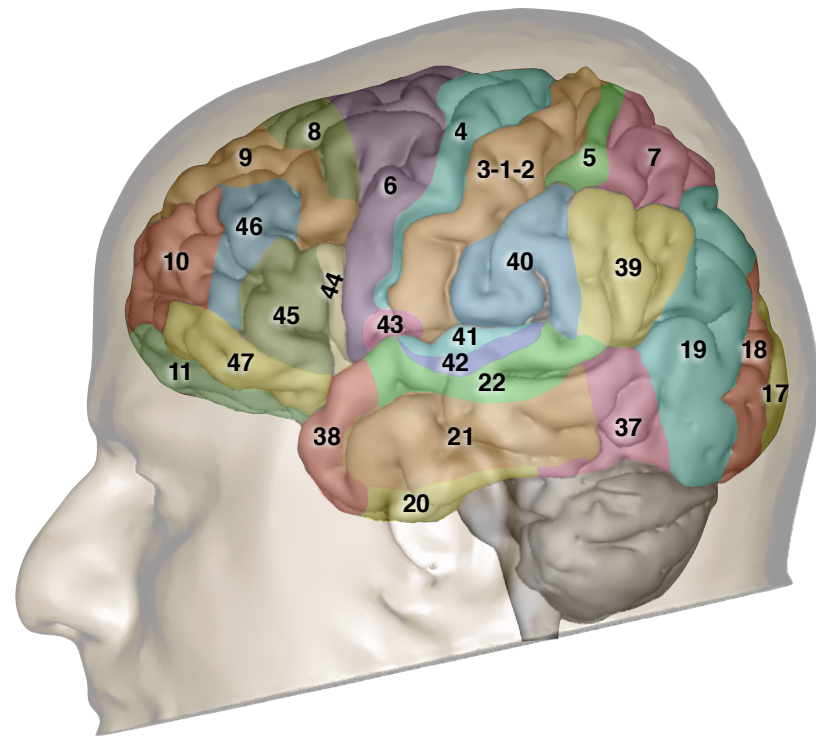
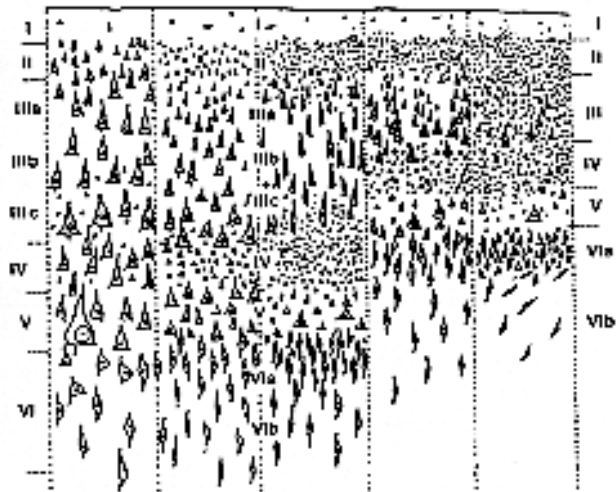


Carl Wernicke
(1848-1904)



Joseph Jules Dejerine
(1849-1917)



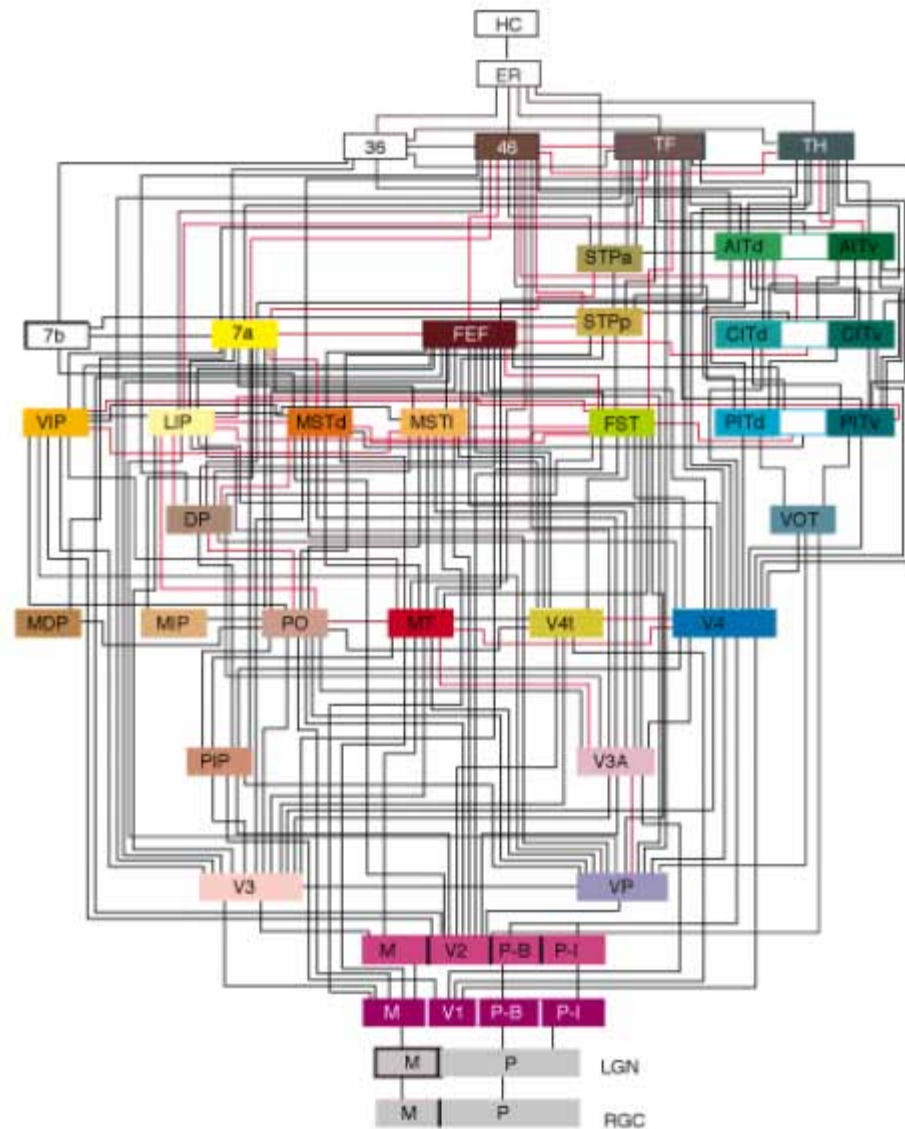




Areas can be arranged in a well-defined hierarchy on the basis of their pattern of interconnections.



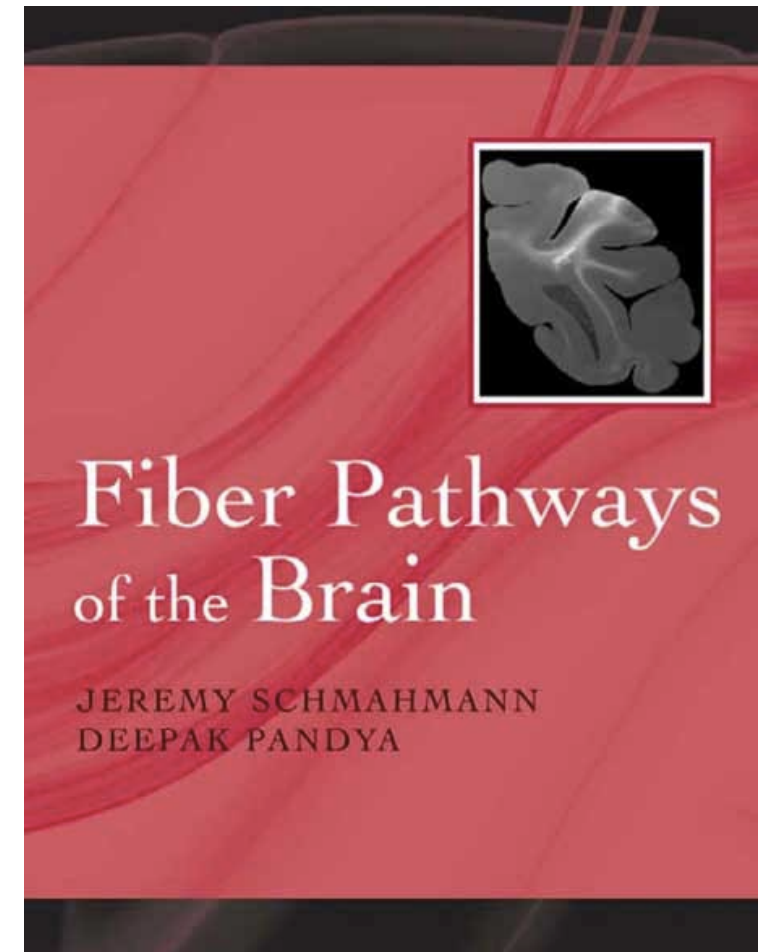
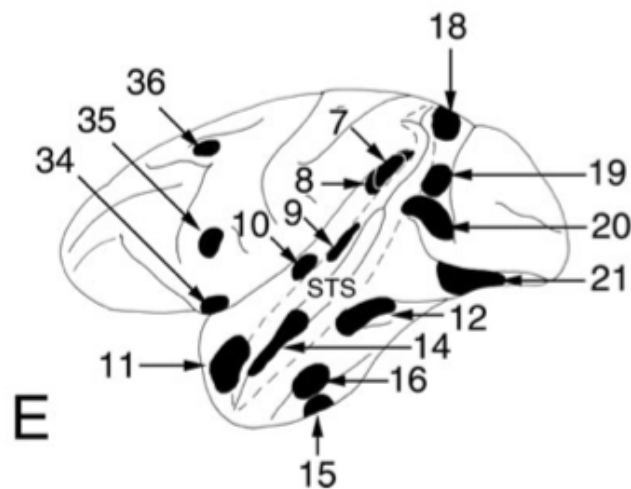
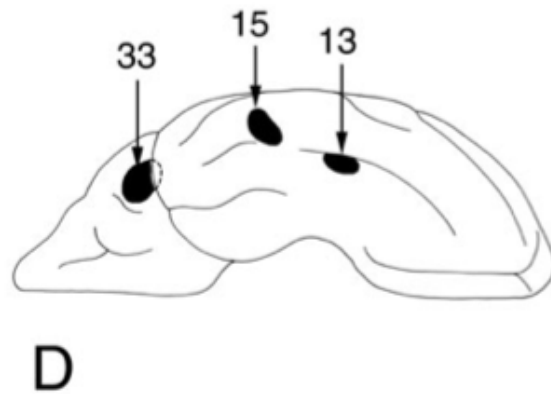
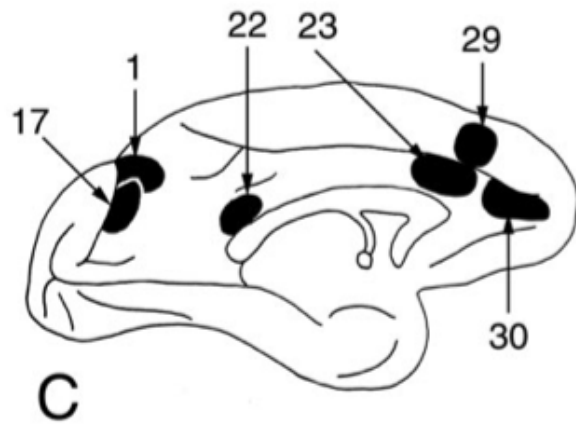
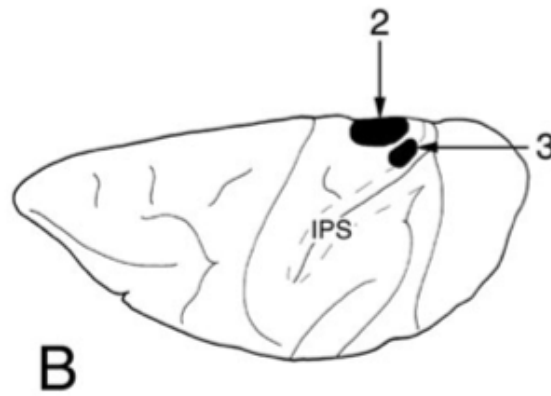
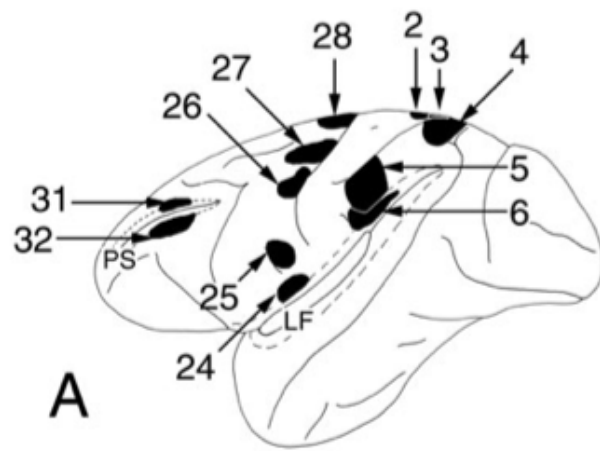
Nothing defines the function of a neuron more than its connections with other neurons

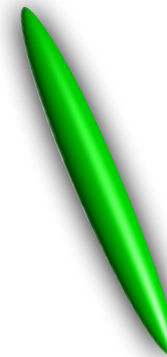
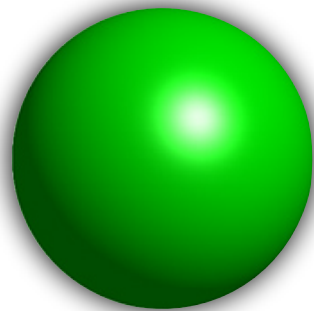
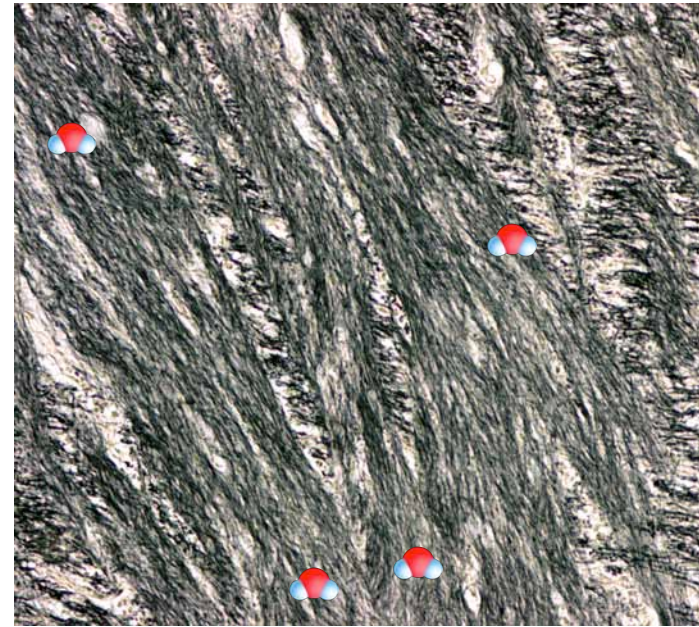
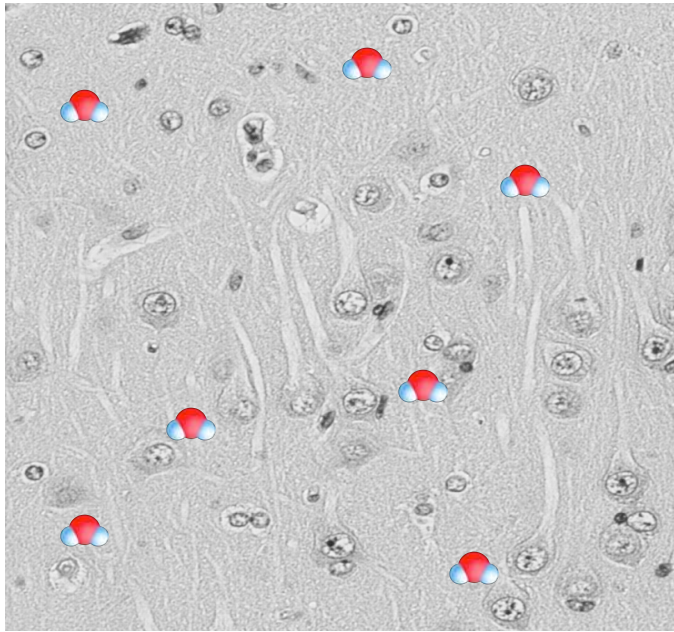


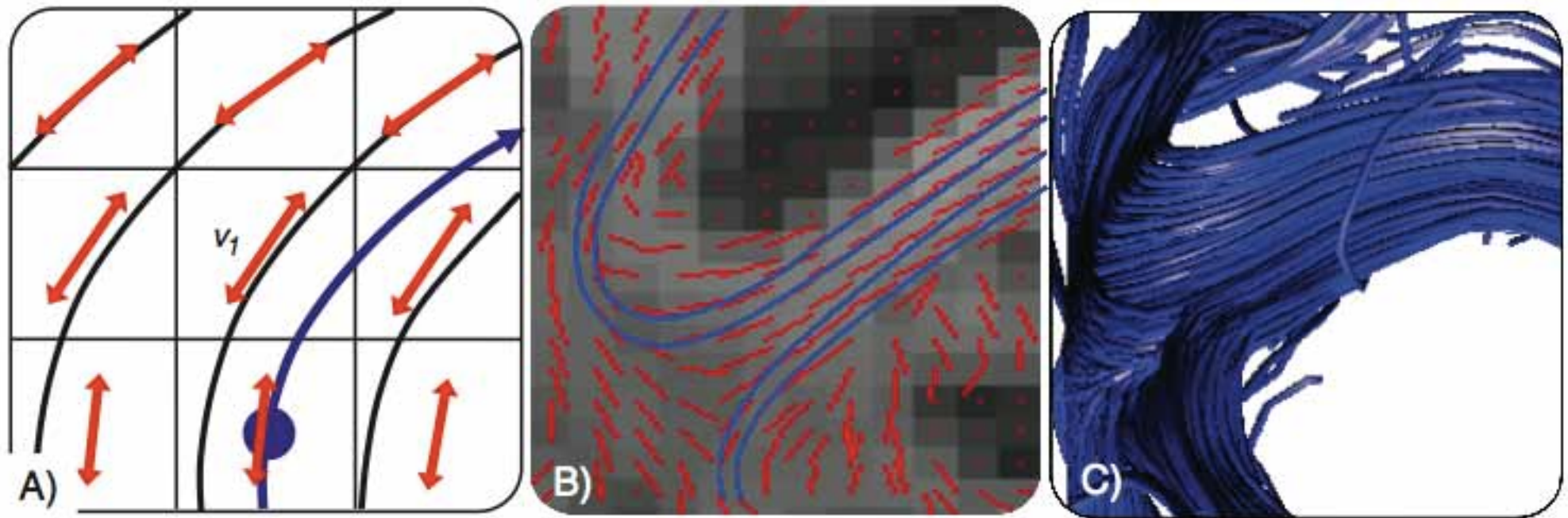
Van Essen & Maunsell, Trends in Neuroscience (1983)

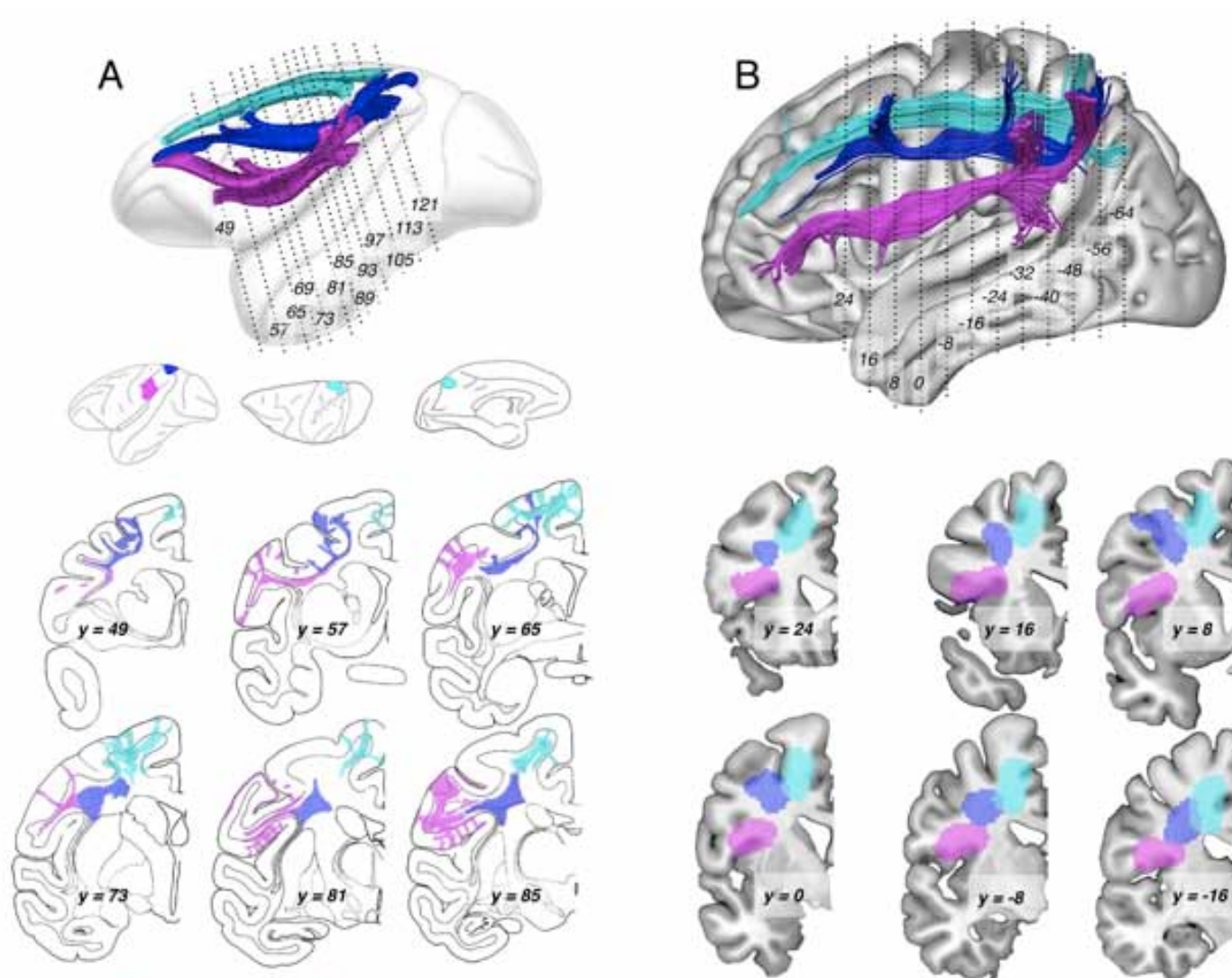
Fellman & Van Essen, Cerebral Cortex (1991)

Mesulam. Ann. Neurol (2005)

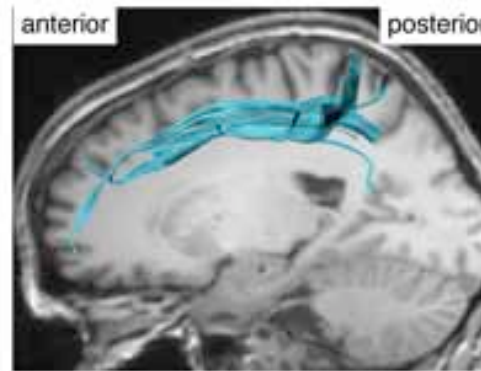
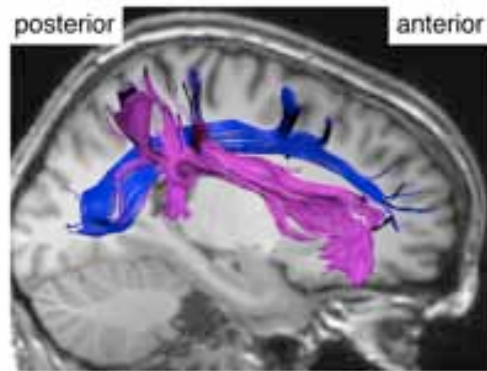
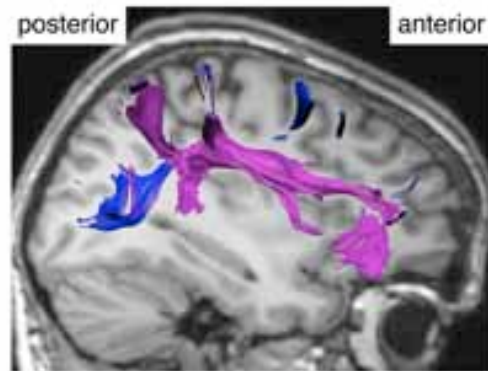






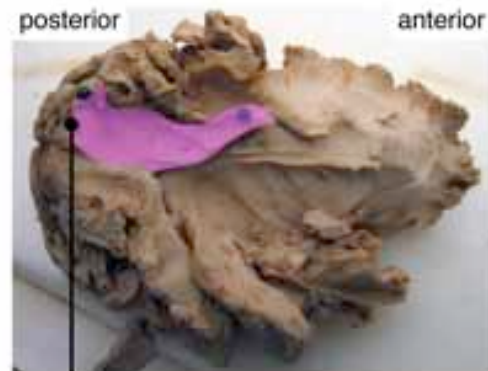


A: In Vivo tractography

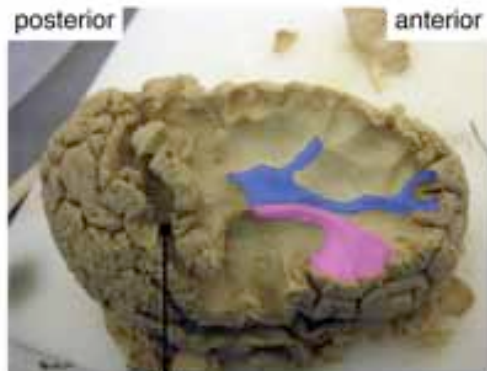


- SLF I
- SLF II
- SLF III

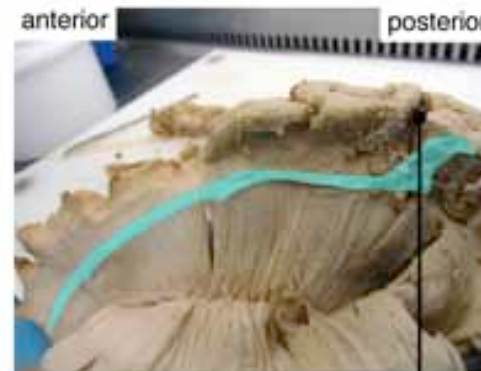
B: Post-mortem histology



temporo-parietal
junction



central (or rolandic)
sulcus



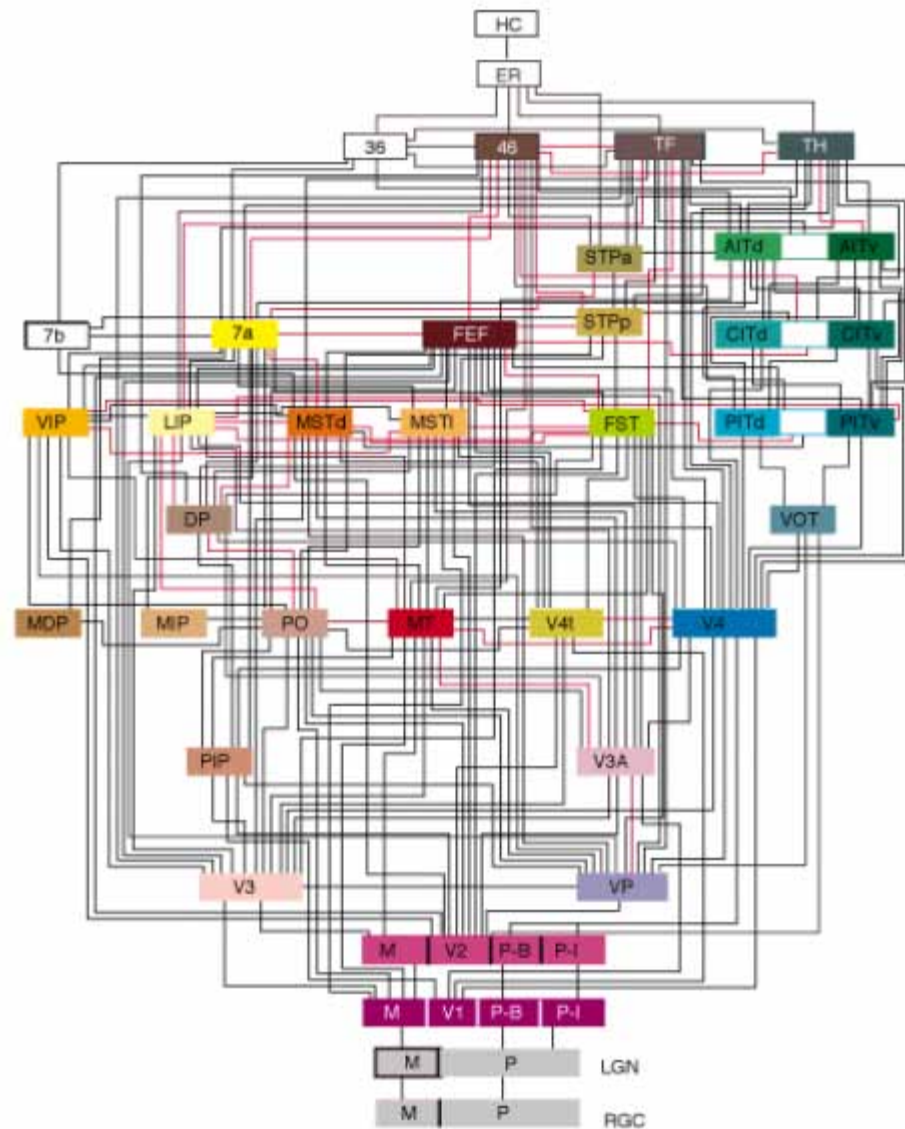
central (or rolandic)
sulcus



Areas can be arranged in a well-defined hierarchy on the basis of their pattern of interconnections.



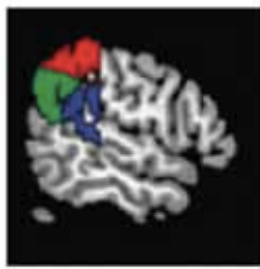
Nothing defines the function of a neuron more than its connections with other neurons



Van Essen & Maunsell, Trends in Neuroscience (1983)

Fellman & Van Essen, Cerebral Cortex (1991)

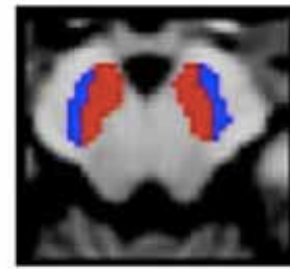
Mesulam. Ann. Neurol (2005)



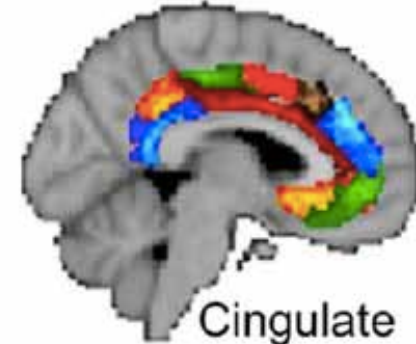
Temporo-parietal junction
Mars 2012



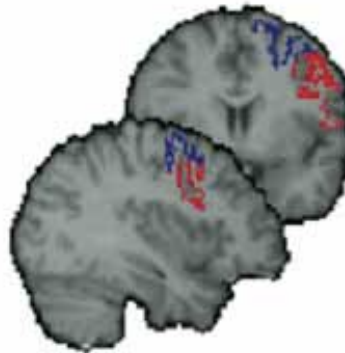
Lateral Parietal
Mars 2011



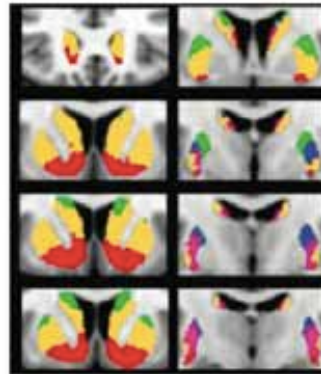
Substantia Nigra
Menke 2010



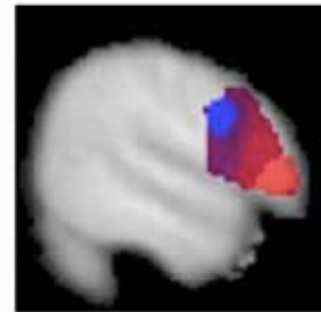
Cingulate
Beckmann 2009



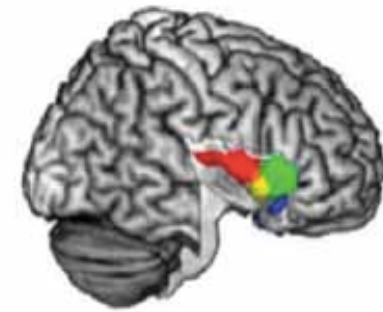
Lateral pre-motor
Tomassini 2007



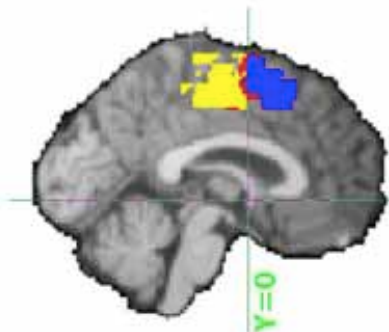
Striatum
Tziortzi 2013



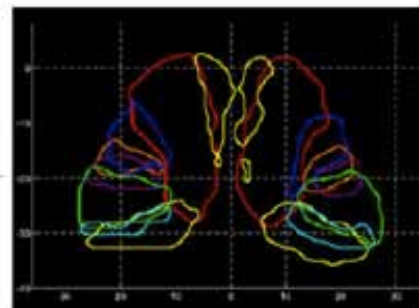
Broca's area
Klein 2007



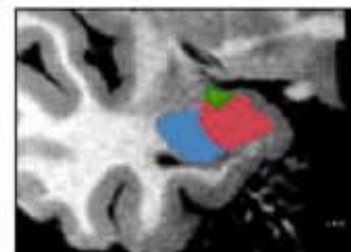
Insular cortex
Cerliani 2012



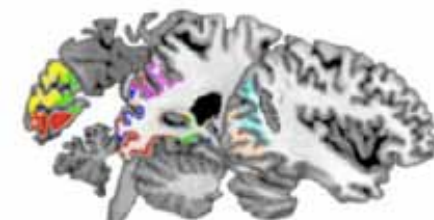
Medial prefrontal
Johansen-Berg 2004



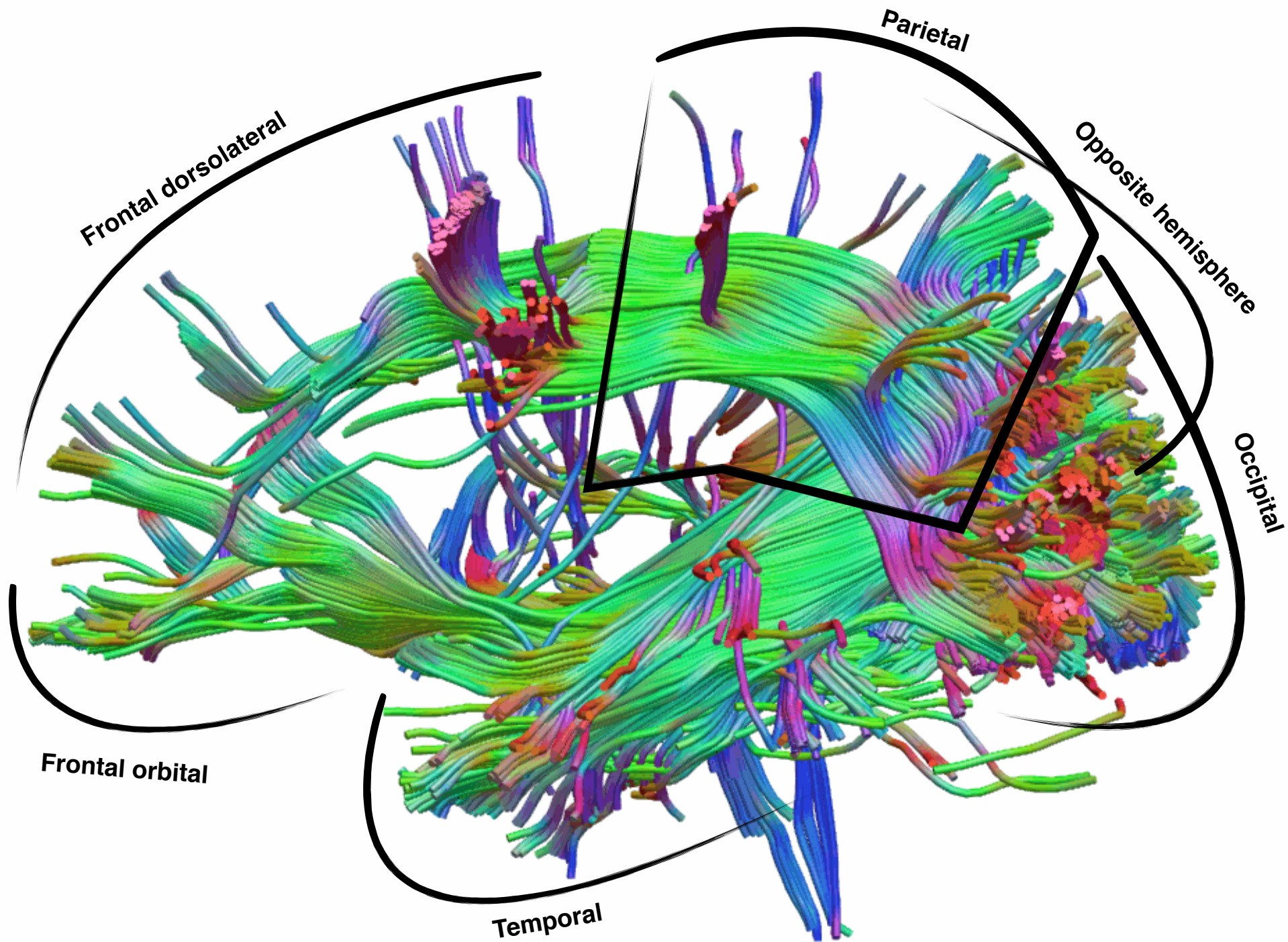
Thalamus
Behrens 2003



Amygdala
Saygin 2011



Occipital cortex
Thiebaut de Schotten 2013



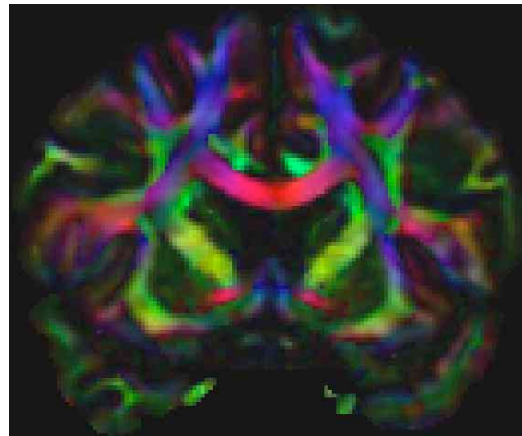
METHOD

MR ACQUISITION



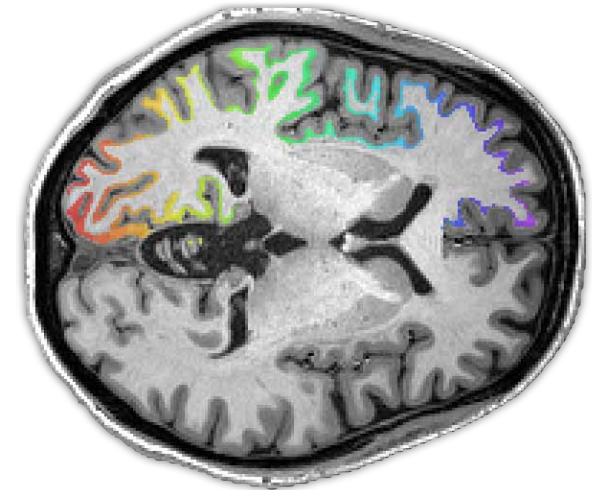
18 participants (20-35)
60 directions
Bvalue = 1500
Matrix size 2*2*2
+ MPRAGE 1*1*1

DW PROCESSING

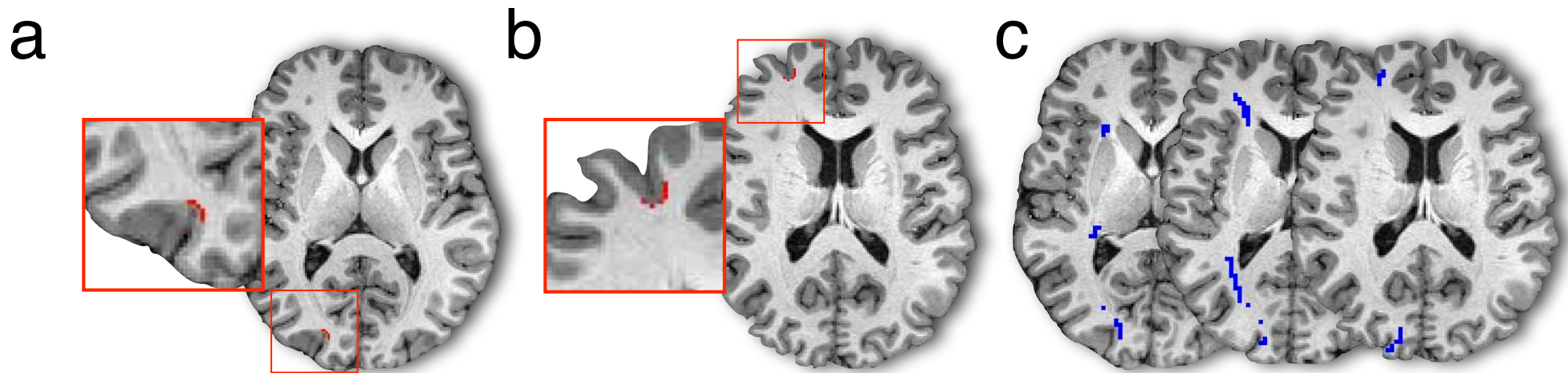


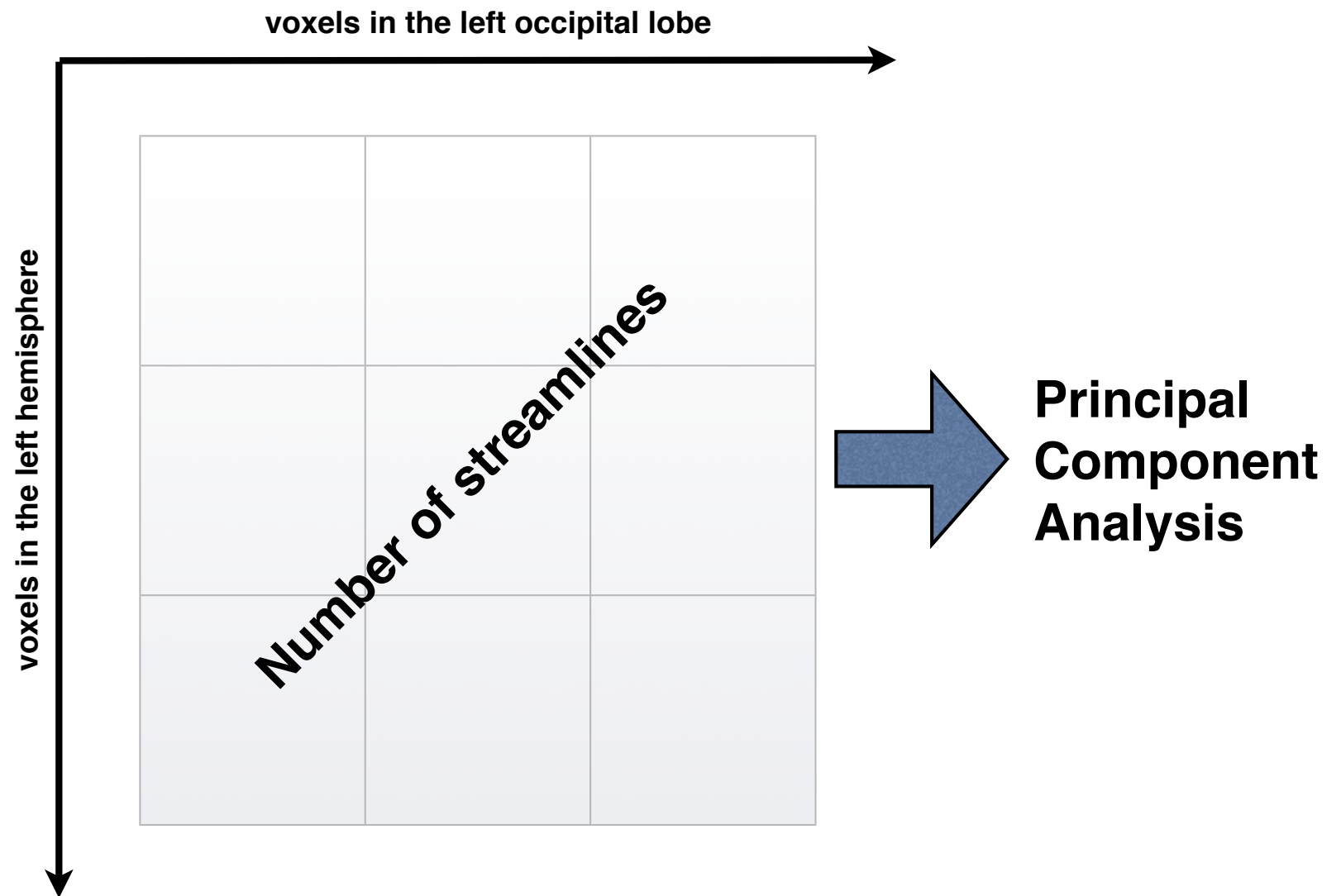
2 fibres ball and stick model
Probabilistic tractography

TRACTOGRAPHY

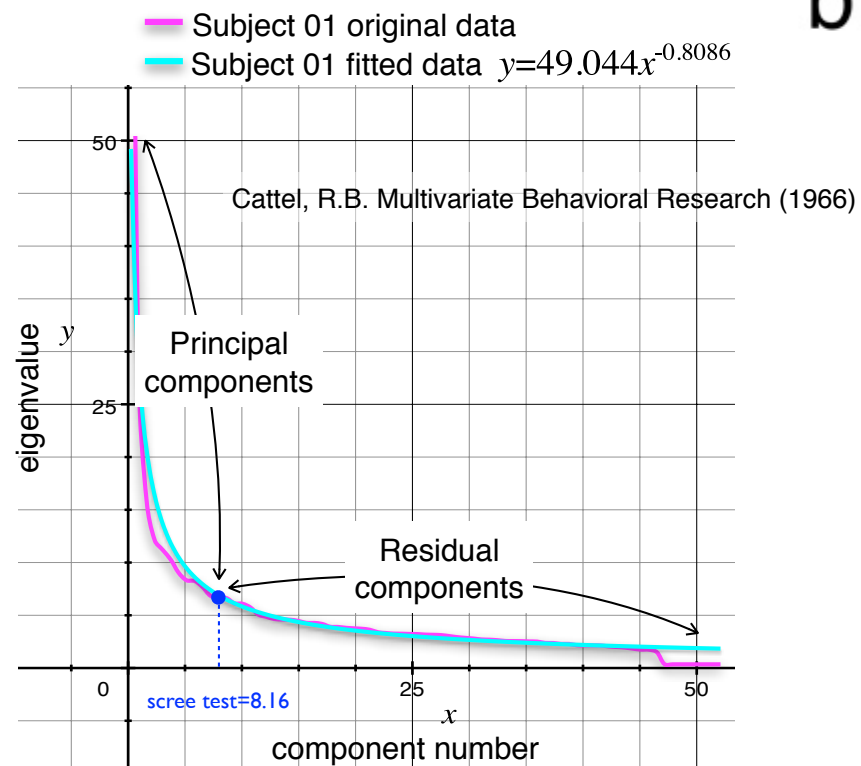


2-ROIs approach

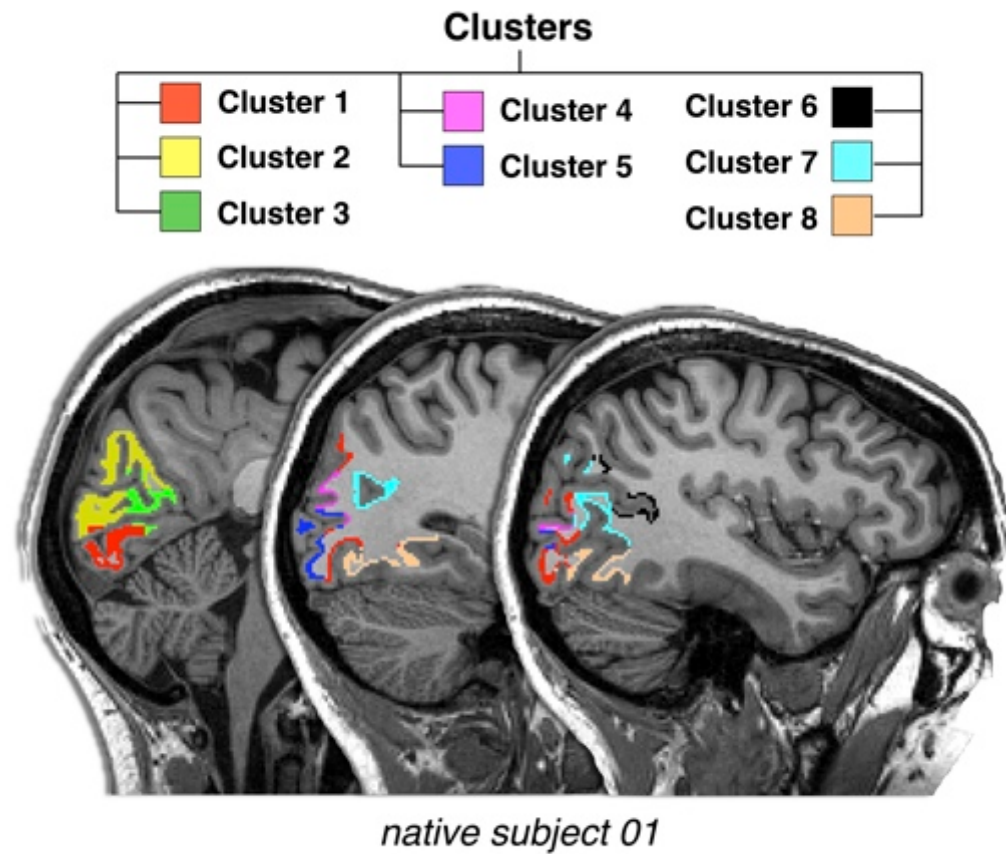




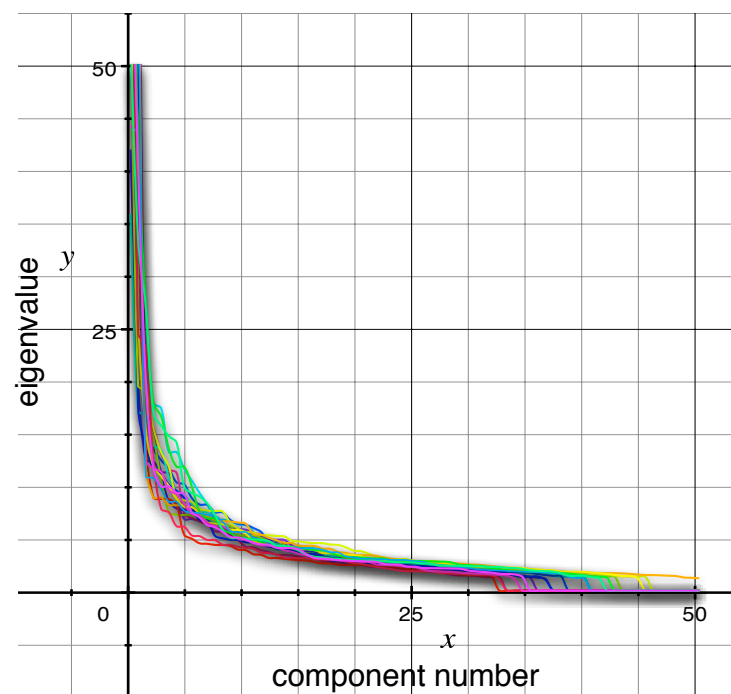
a



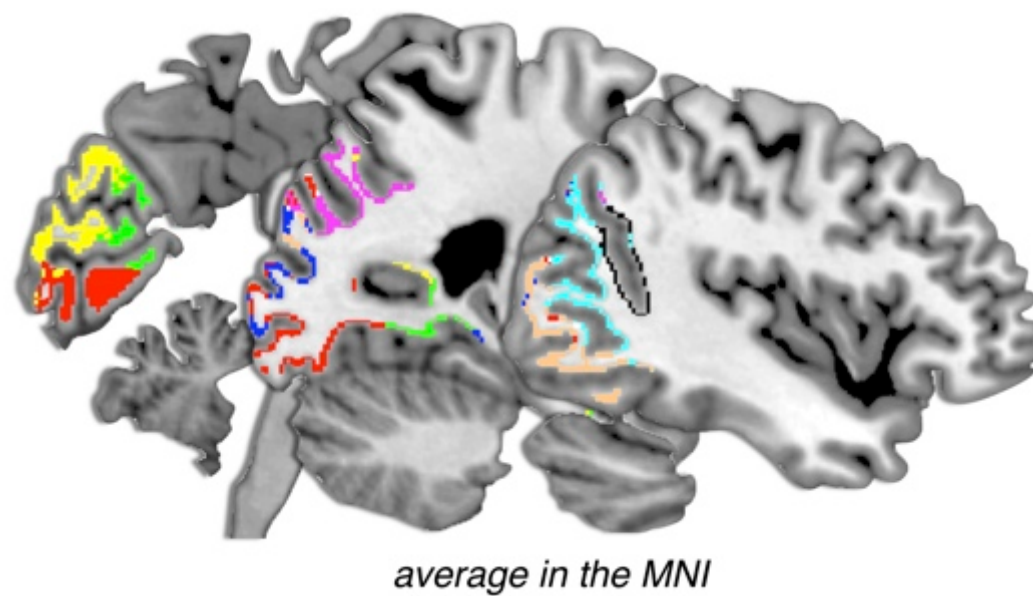
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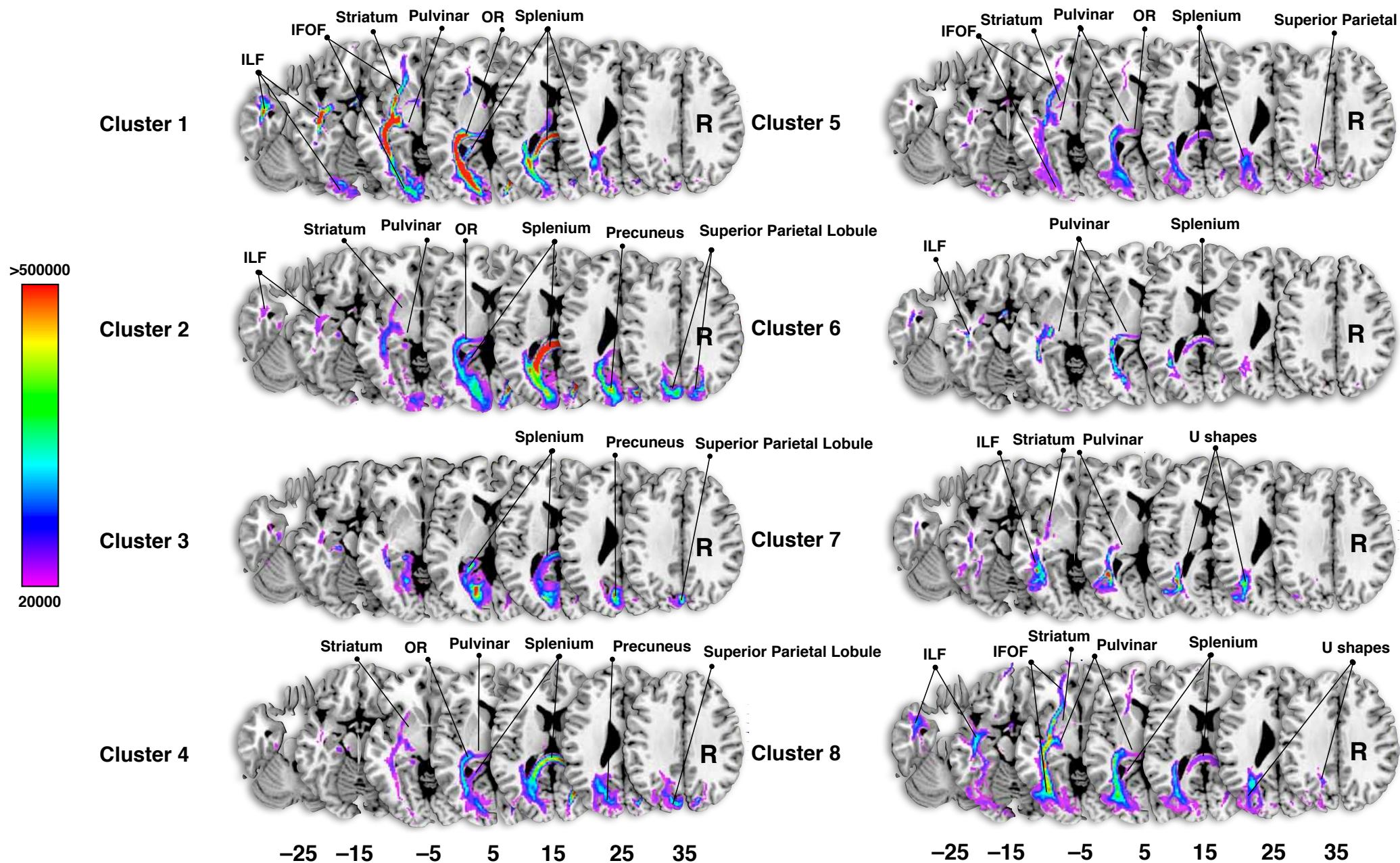


c

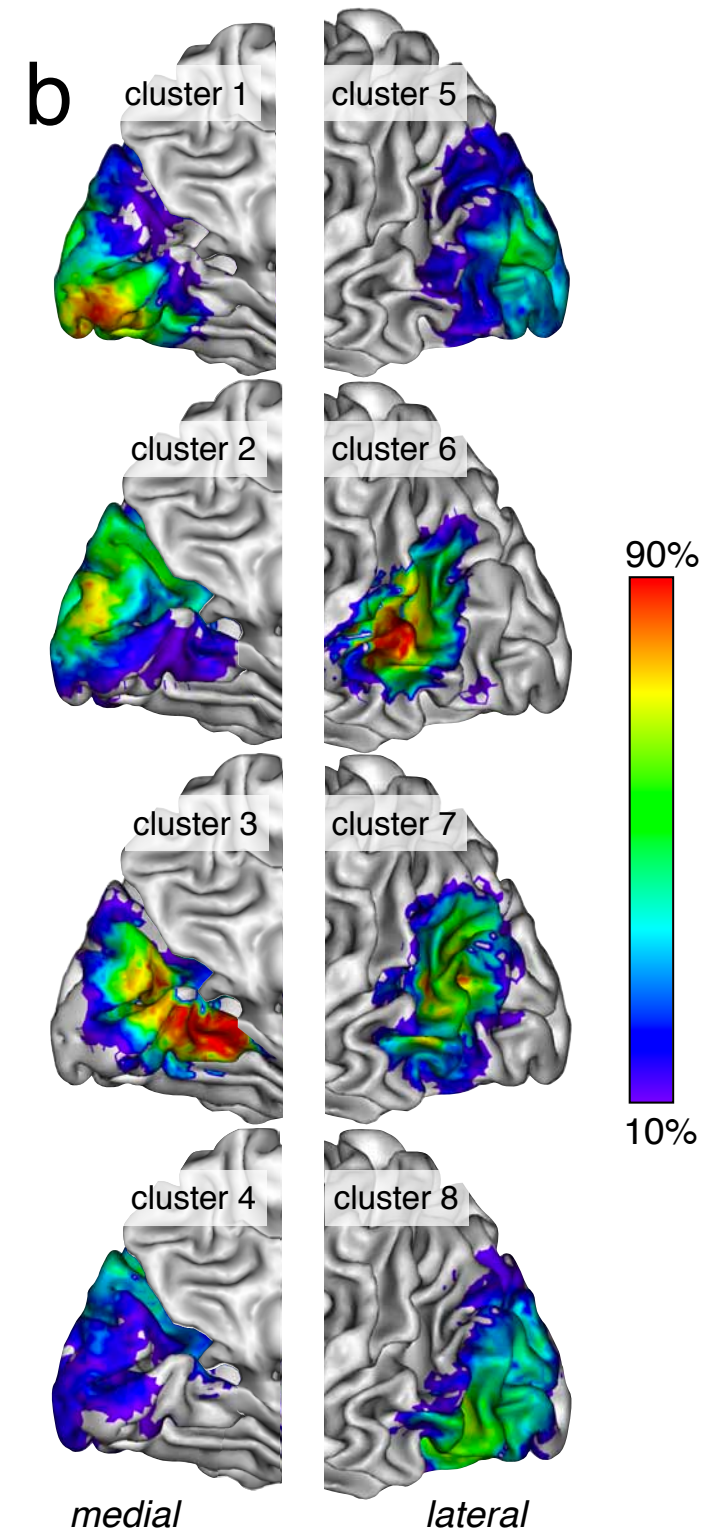
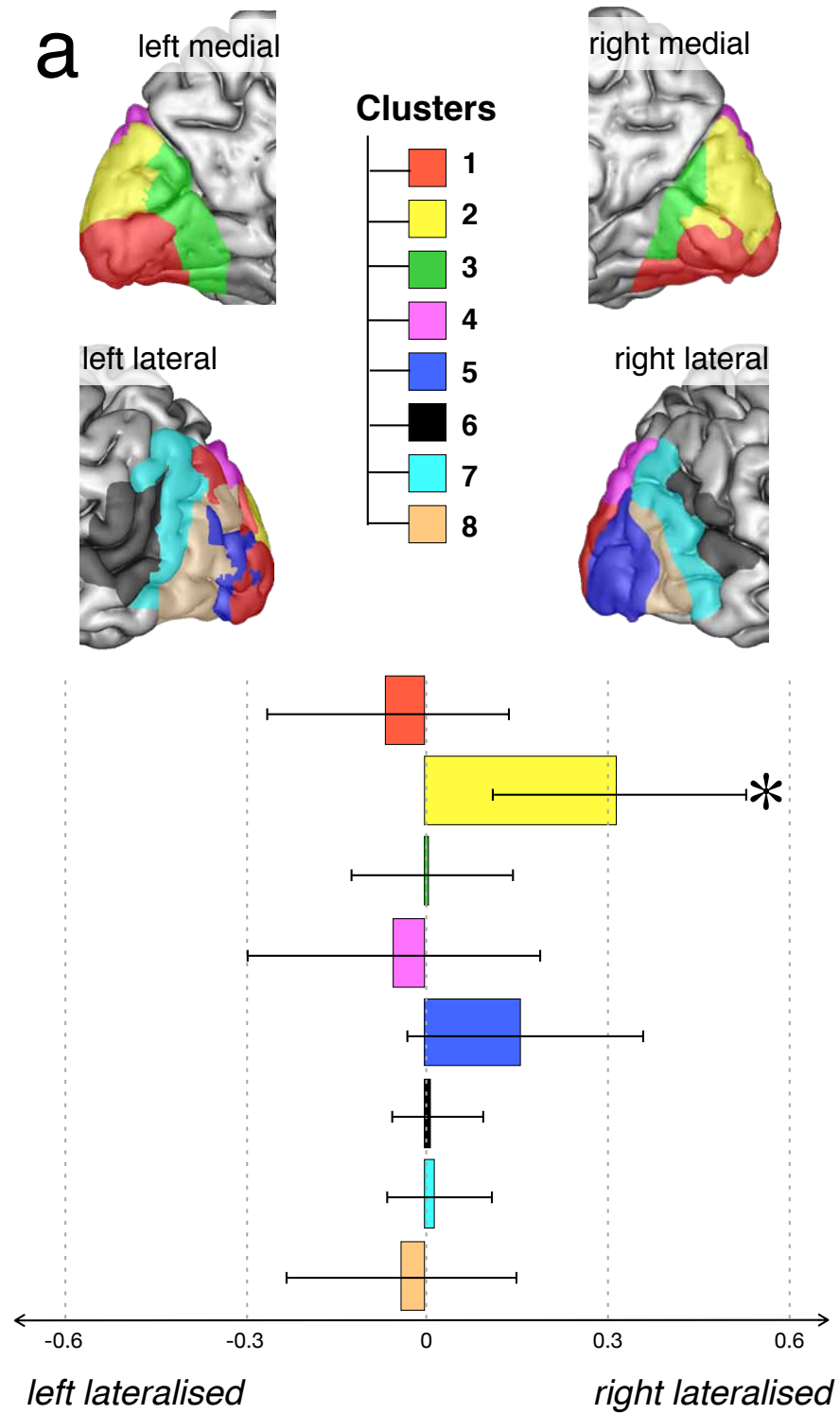


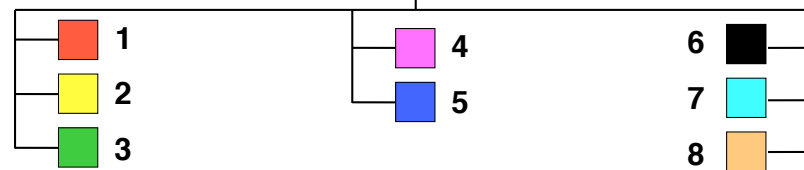
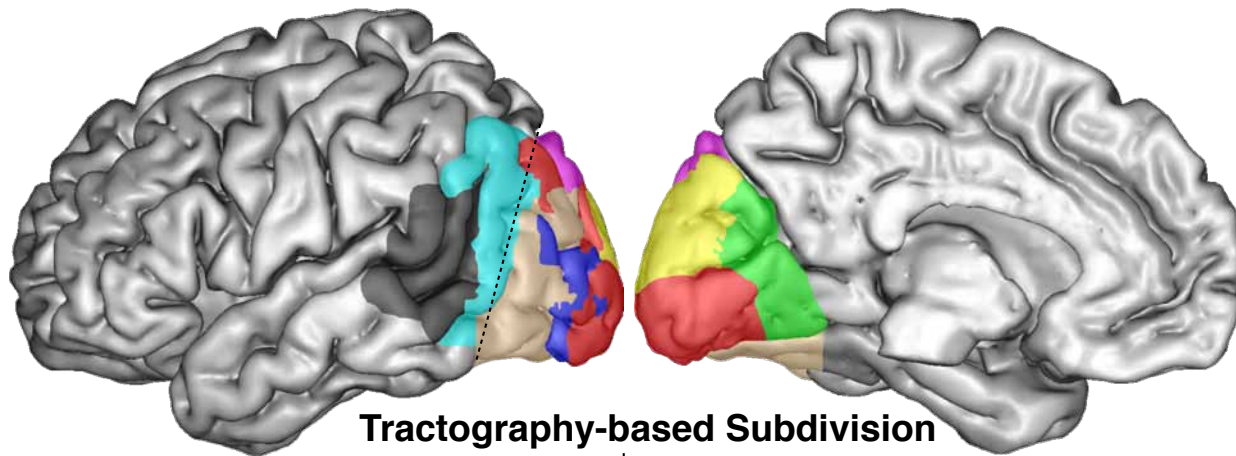
d



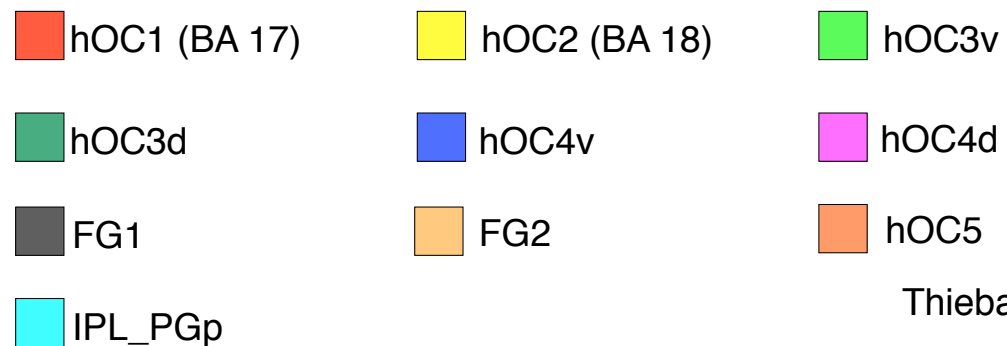
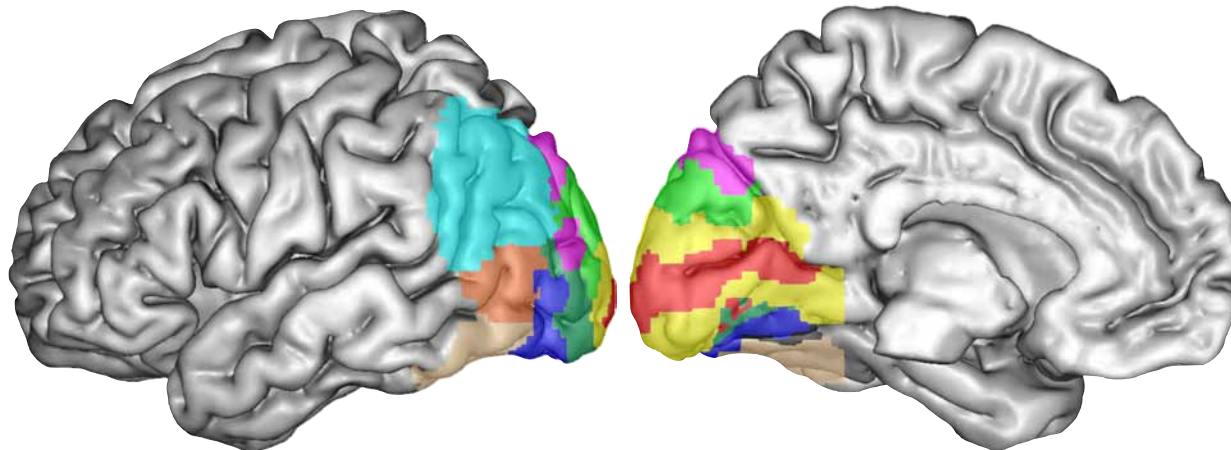


		Clusters							
		1	2	3	4	5	6	7	8
Association pathways	ILF (temporal)	+	+	−	−	−	+	+	+
	IFOF (frontal)	+	−	−	−	+	−	−	+
	SPL	−	+	+	+	+	−	−	+
	Precuneus	−	+	+	+	−	−	−	−
Commissural pathway	Splenium (opposite hemisphere)	+	+	+	+	+	+	−	+
Projection pathways	OR (lateral geniculate nucleus)	+	+	−	+	+	−	−	+
	Pulvinar	+	+	−	+	+	+	+	+
	Striatum	+	+	−	+	+	−	+	+

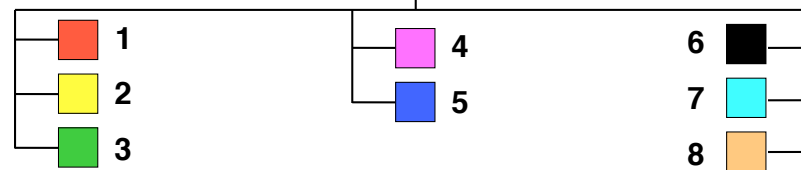
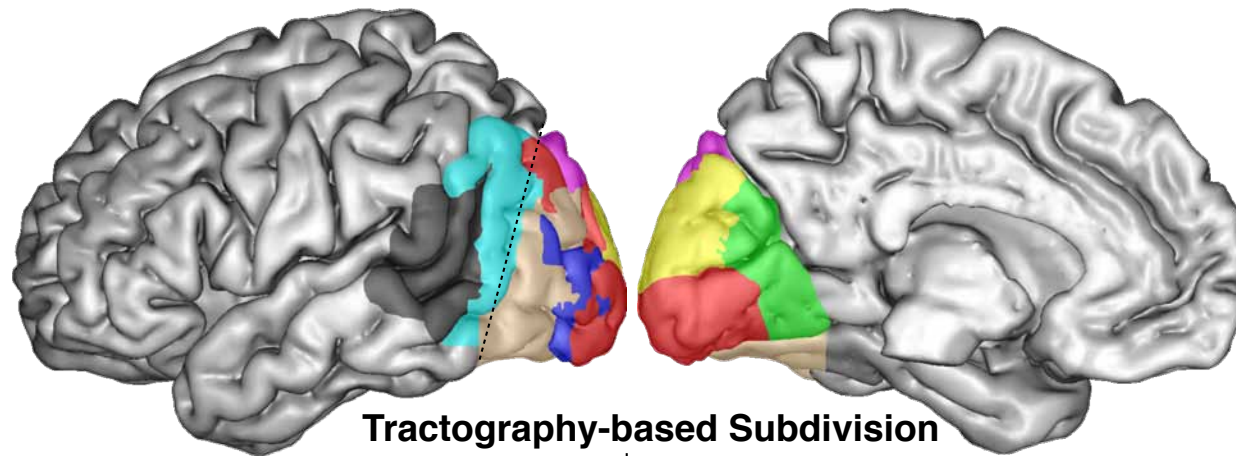




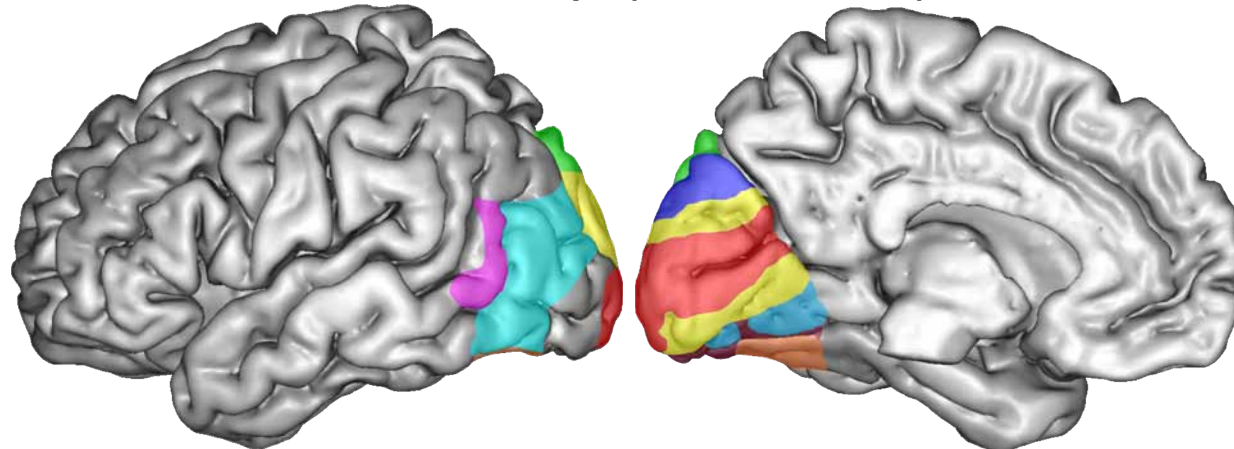
Cytoarchitectonic maps (Jubrain)

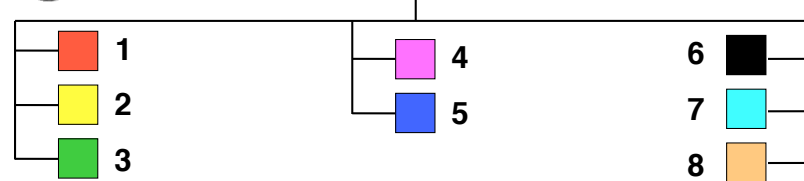
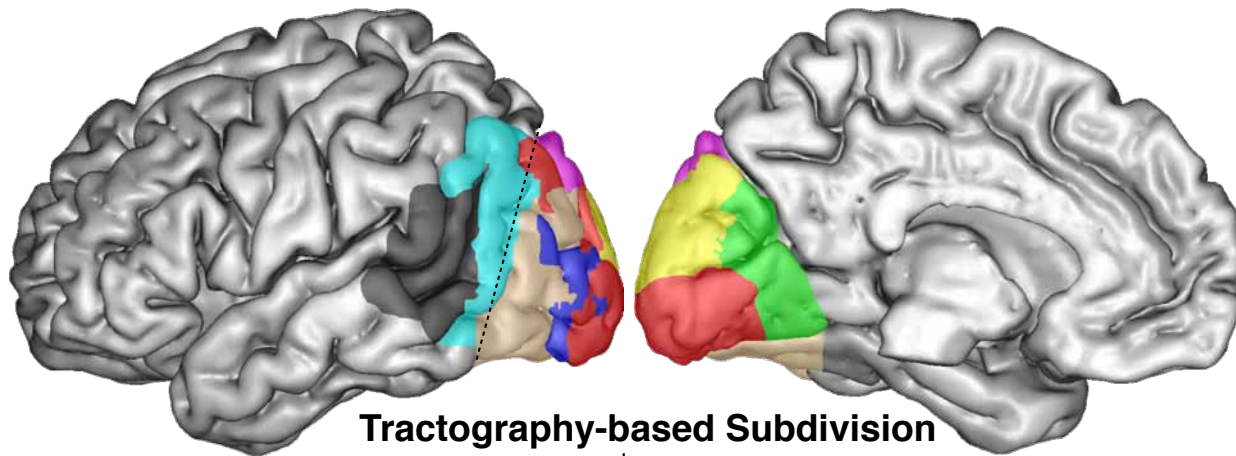


Thiebaut de Schotten et al Cortex (2014)

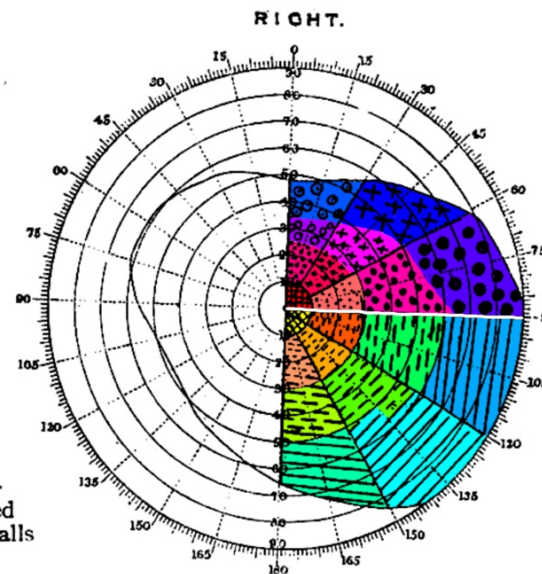
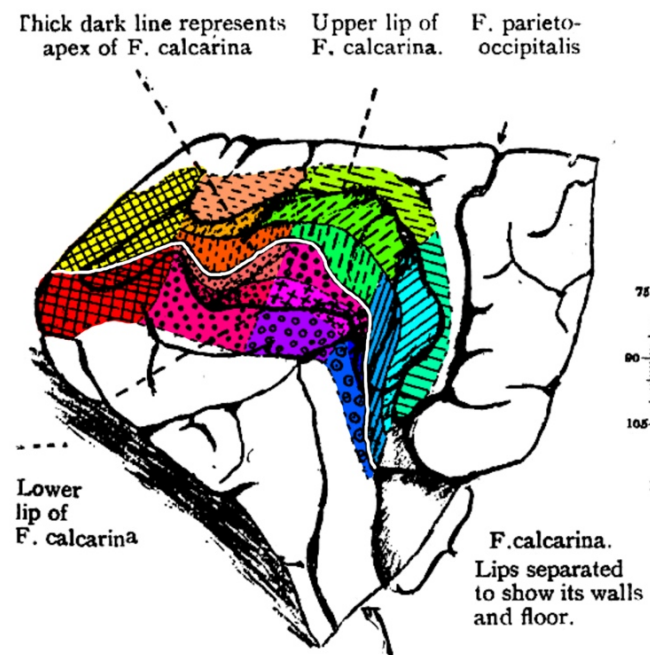


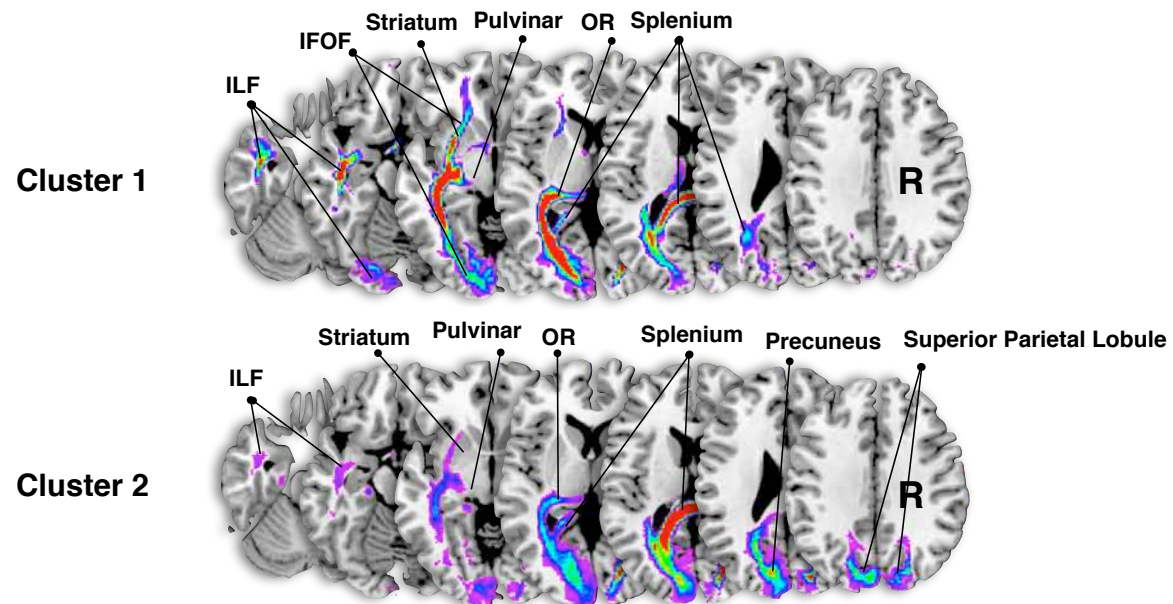
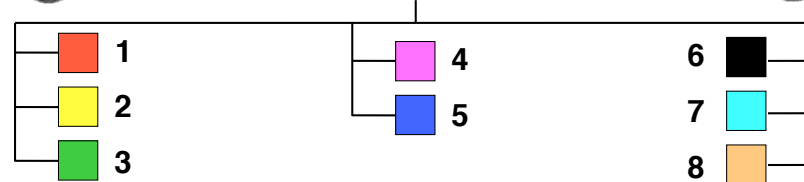
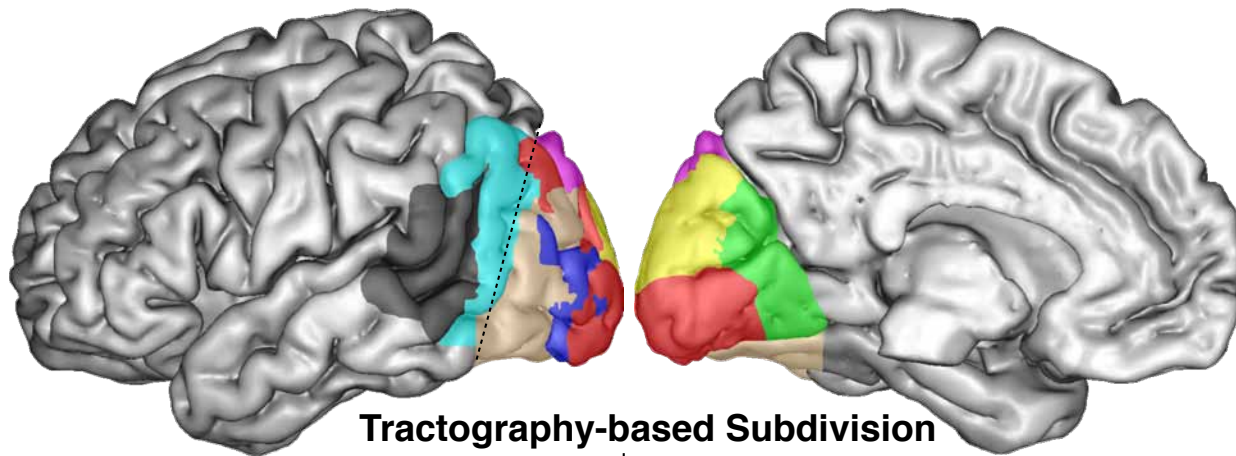
‘Functional’ maps (Van Essen 2004)

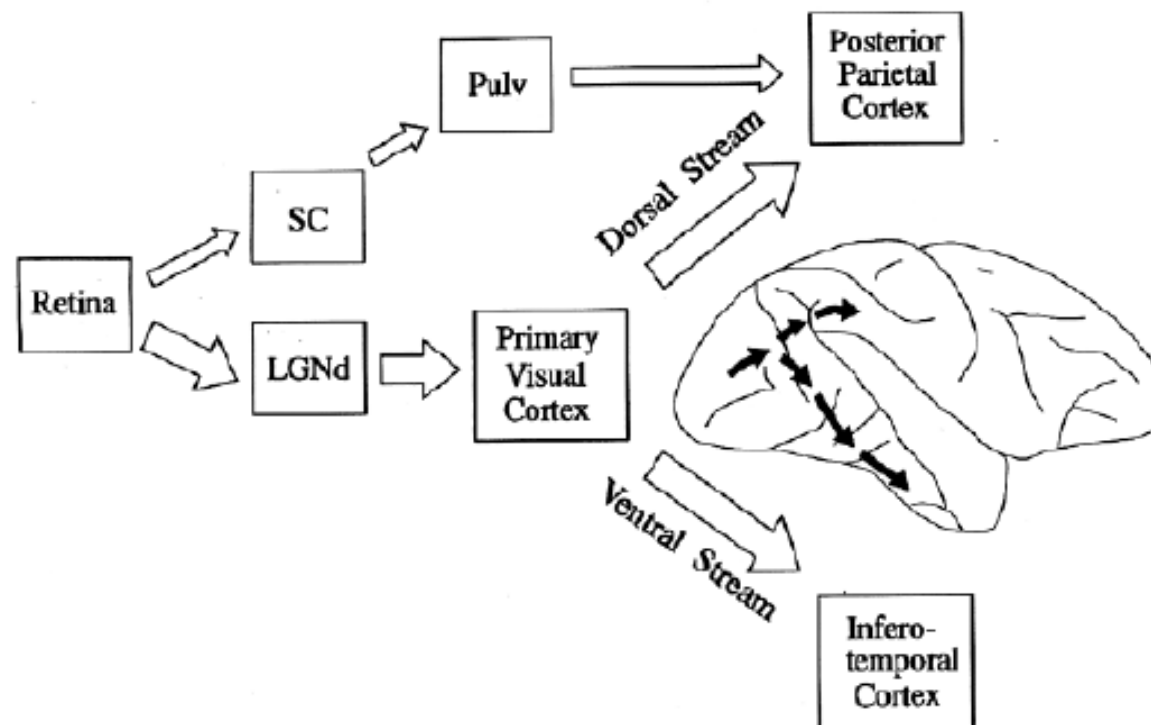
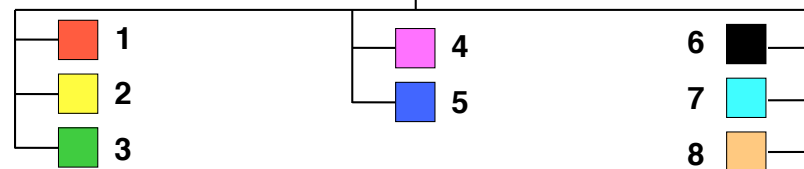
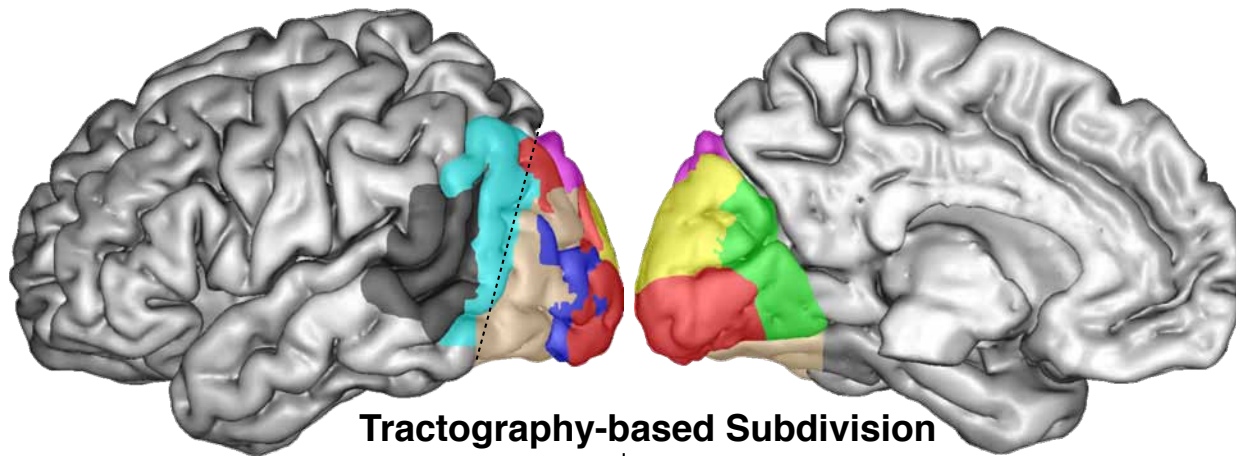




Lesion based (Holmes 1918)







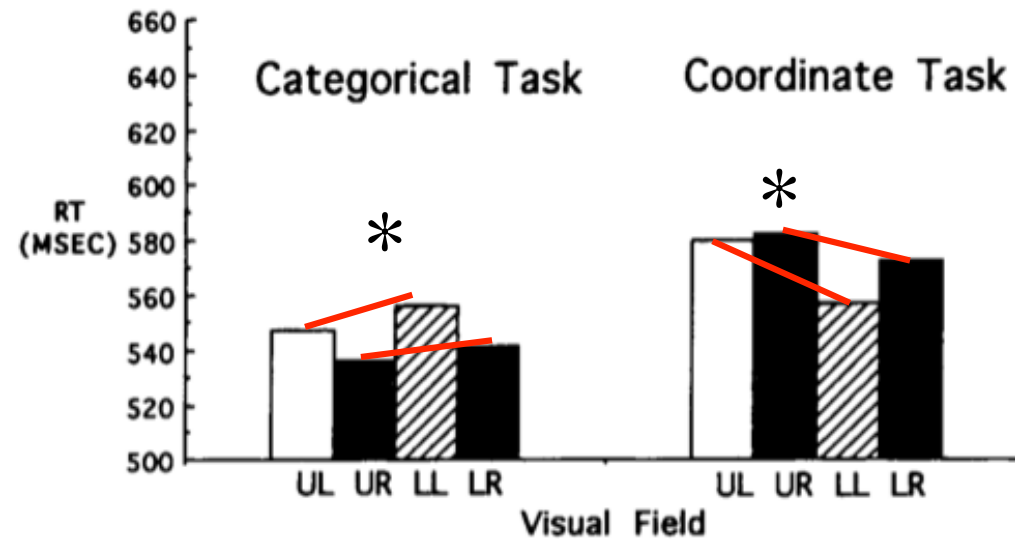
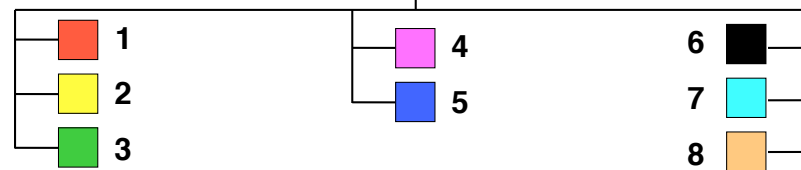
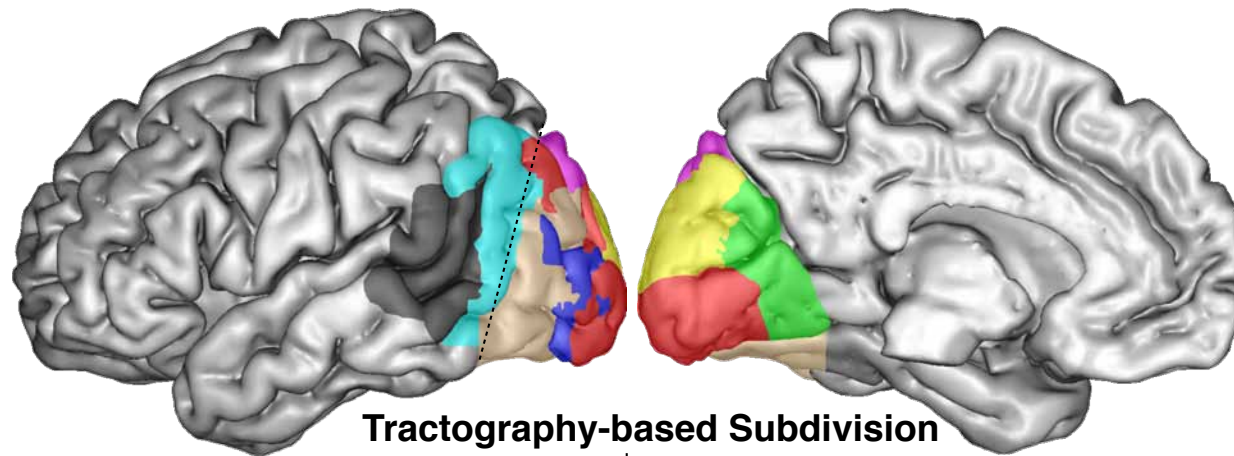


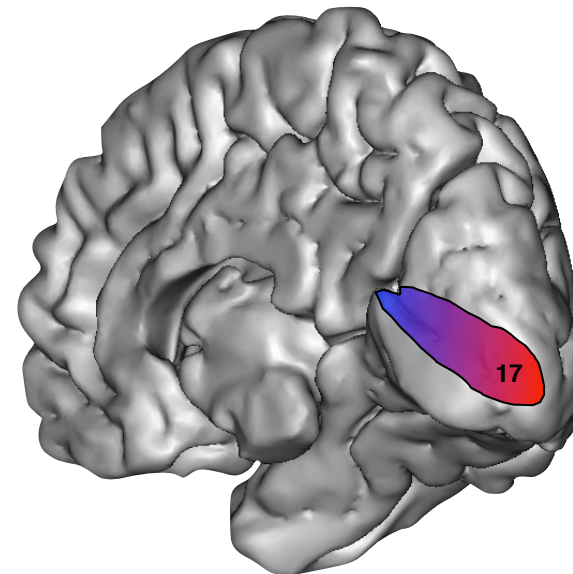
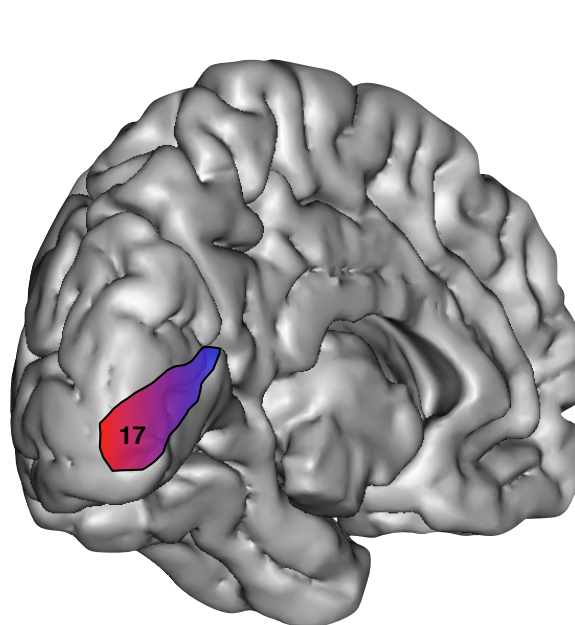
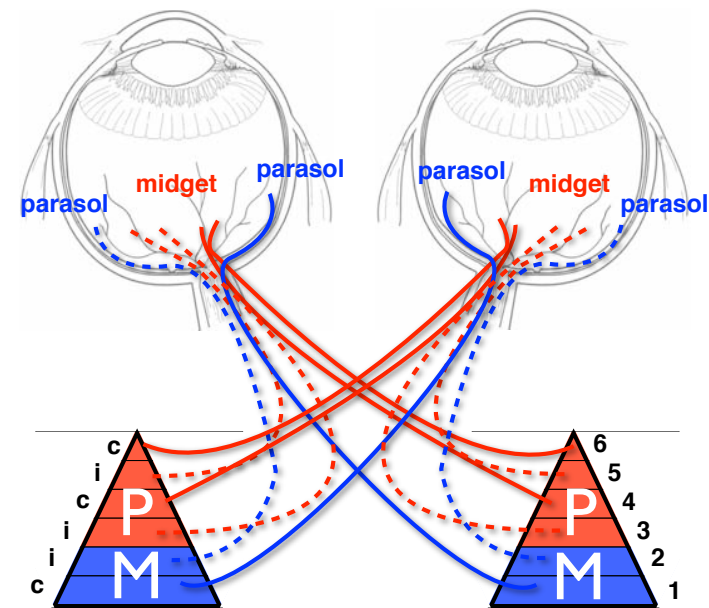
Figure 1. Reaction time (RT) performance for categorical and coordinate tasks across four visual fields for Experiment 1 (top) and Experiment 2 (bottom). UL, upper left visual field; UR, upper right visual field; LL, lower left visual field; LR, lower right visual field.

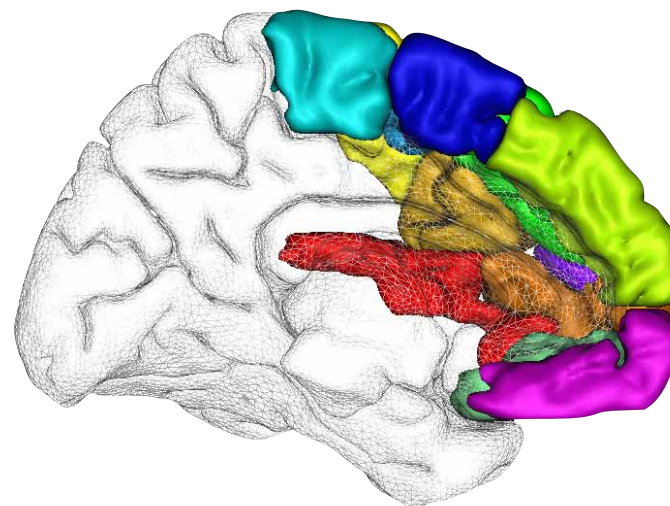
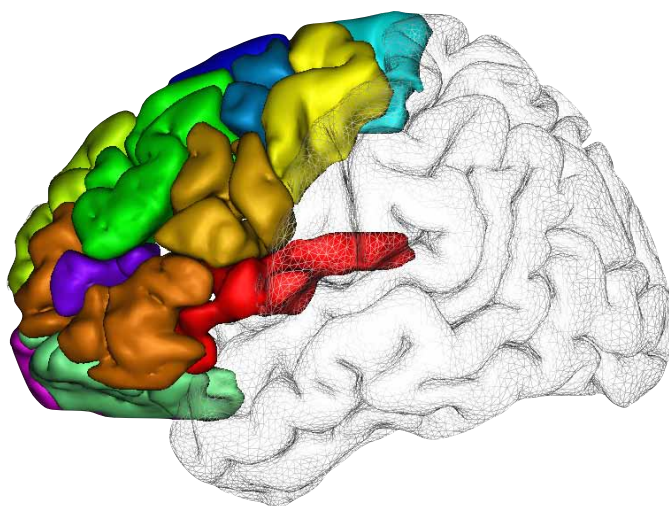
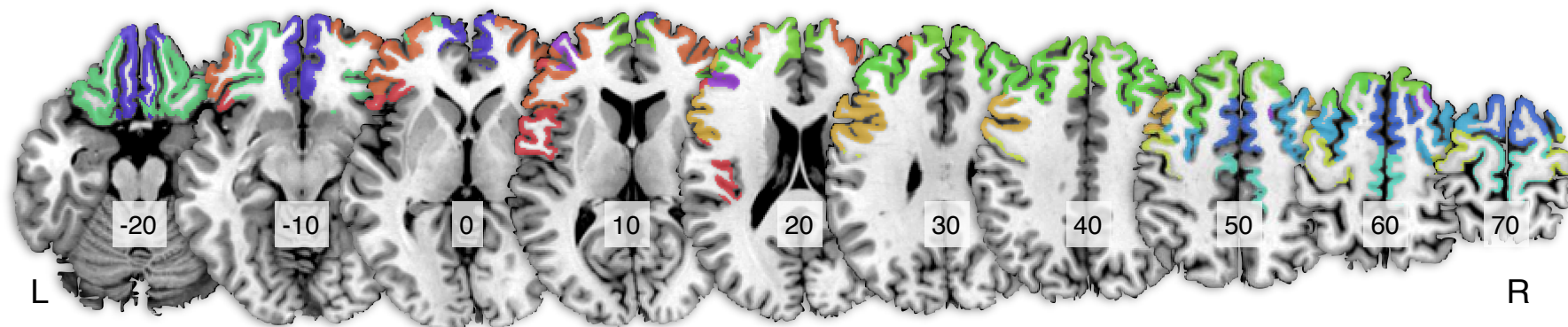
Midget (parvocellular)
1.0 mm 3.2 mm 5.6 mm

Parasol (magnocellular)
1.0 mm 3.2 mm 5.6 mm

Retina

LGN
parvo
magno





Captions

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12

Take home message

- BIG limitation due to the quality of the dataset and the tractography used.
- GOOD correspondence with the functional anatomy of the brain
- BAD correspondence with cyto,myelo, resting architecture of the brain.

Future directions

- Optimization of the processing time
- Optimization of the parcellation with Richardson Lucy Spherical Deconvolution algorithm
- Release of an automatic toolbox