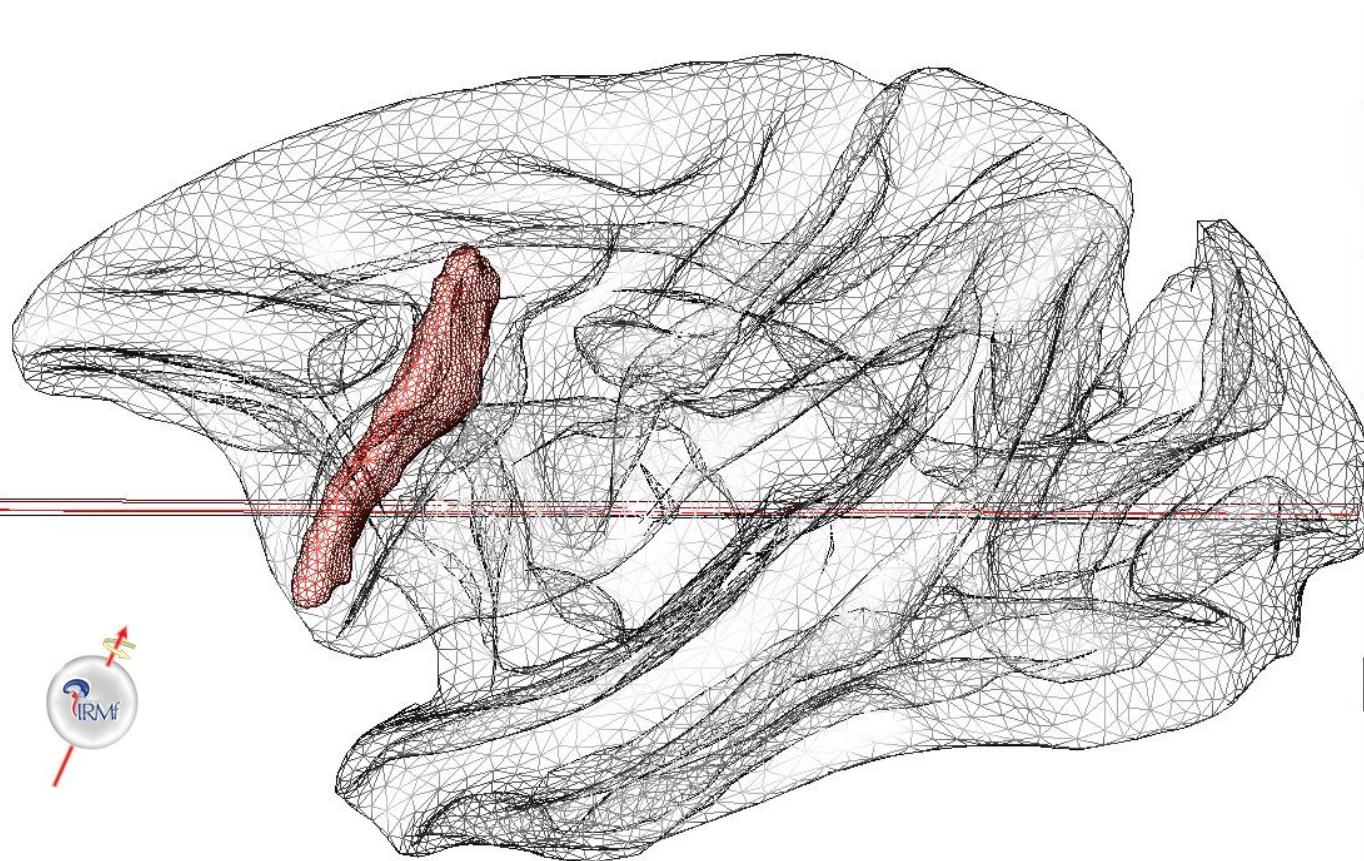
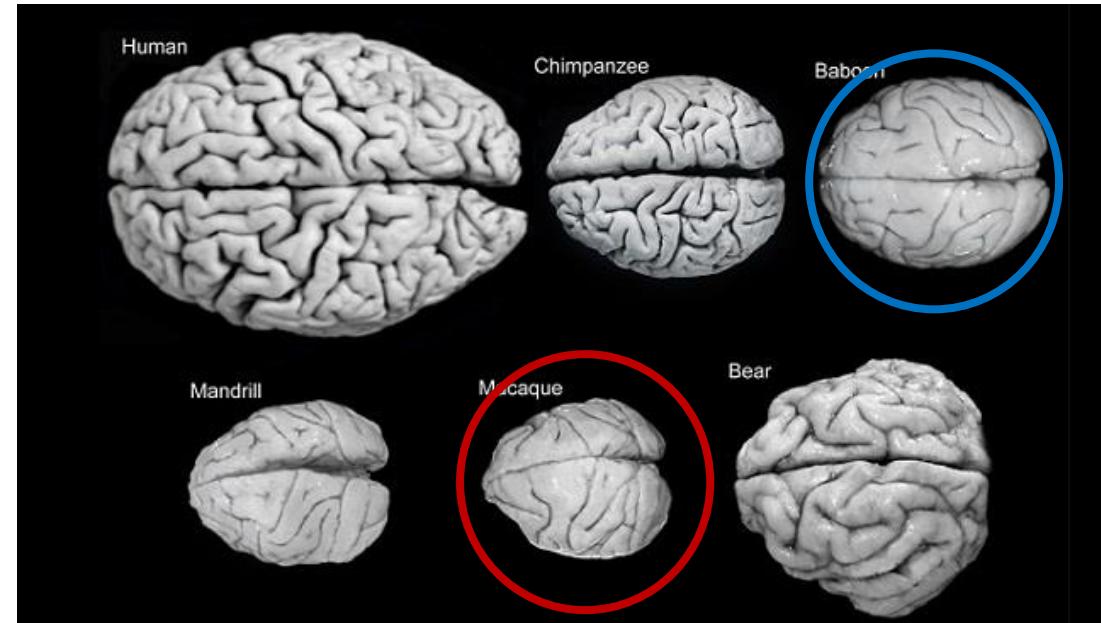


The Neurocorrelates of Gestural Communication in Baboons

Yannick Becker (PhD student, supervisor: Adrien Meguerditchian + Olivier Coulon)



Baboon Brain vs. Macaque Brain



-in average x2 larger (*Macaca mulatta*)

-larger degree of gyration

-contains all primary sulci

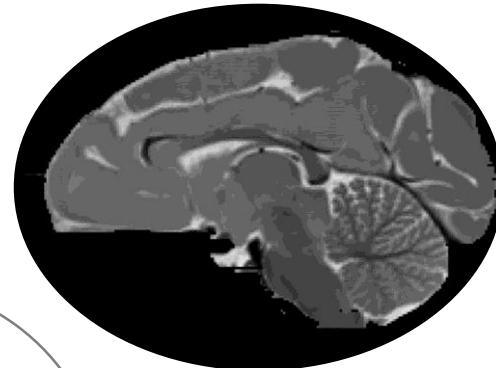
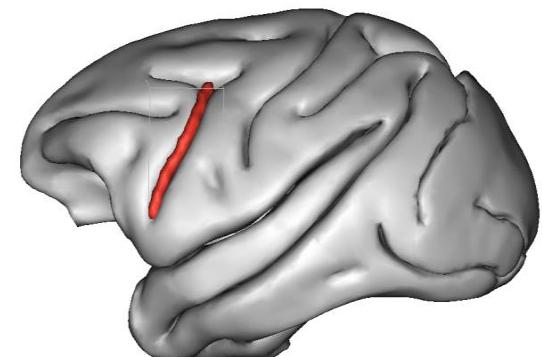
DeFelipe, 2011
Leigh et al., 2004
Rogers et al., 2010

MRI databanks: Adult and new-born baboons



In
Rousset

N=106
T1w/T2w
Resting State
Vocal tract



N=30 (t0),
15 (t1)
T1w/T2w
Resting
State
DWI



ERC « GestImage », P.I Adrien Meguerditchian

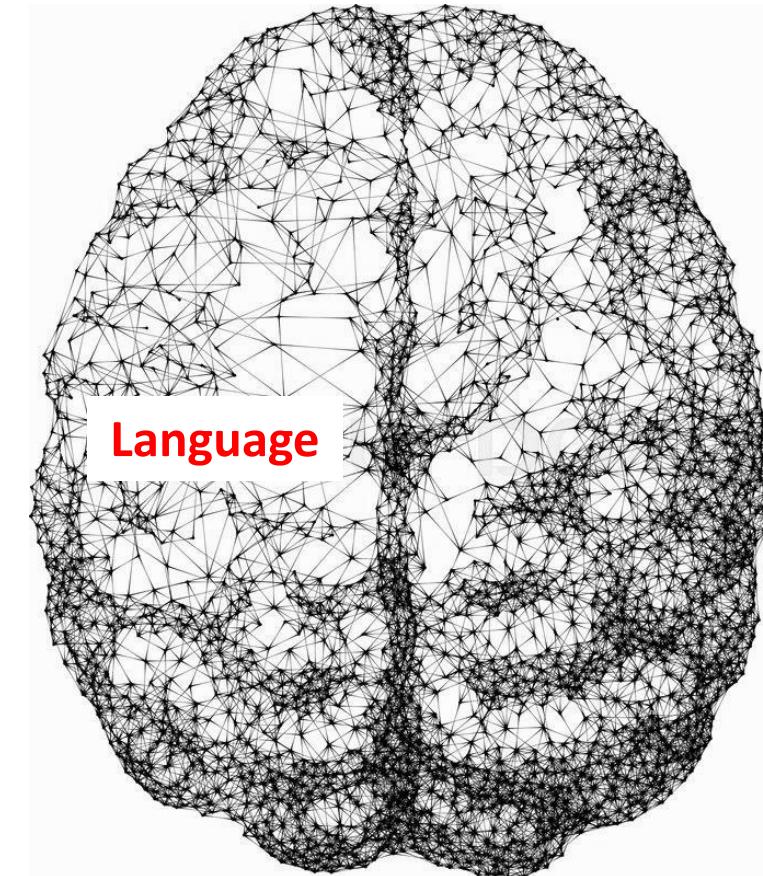


(Vocal) language

Definition:

Hu·man be·ing• n. a man, woman, or child of the species *Homo sapiens*, distinguished from other animals by superior mental development, **language**, and upright stance

The Oxford Pocket Dictionary of Current English, Oxford University Press 2009



Human: Left hemispheric brain specialisation for language
Crow, 2002; Hopkins, 2007; Meguerditchian, 2008

Gestural Communication in human:

Intentionnel communication in children:

-Gesture (eg. pointing before speech)
(Iverson & Goldin-Meadow, 2005)

Gesture in aphasia therapy (stroke patients)

(Hanlon, 1990; A.Trebuchon (Timone))

Sign language:

-similar phonological, morphological and
syntactical properties
-same brain structures + asymmetries

(Emmorey, 2002)



Vocalisation in monkeys:

Production:

- Small repertoire of calls
- Limited acoustic modifiability
- Few call combinations

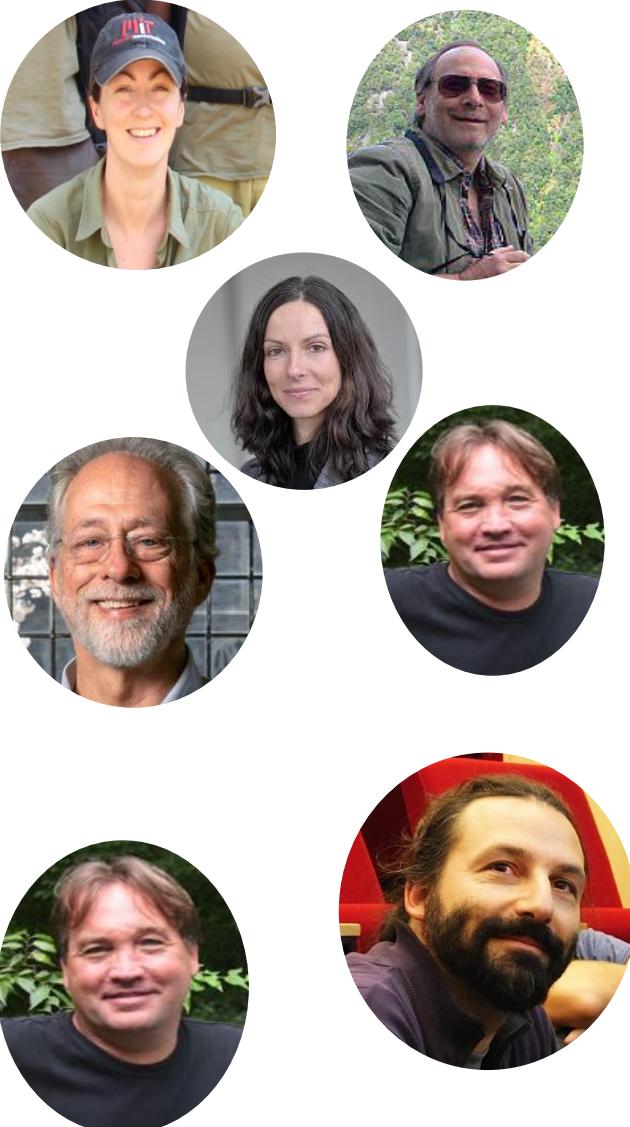


Perception:

- Almost open-ended ability to learn new sound-meaning pairs
- Meaning is learned; depends on experience
- Hear call combinations routinely
- Integrate information from call, context, and memory to yield a large repertoire of meanings

Cheney+Seyfarth, 2017

Gestural communication in primates: Shared language properties



-Intentional
-Referential
-Flexible

Hobaiter, Byrne, Liebal,
Tomasello, Hopkins, Leavens etc.

-Right hand bias for
communicative
gesture

Meguerditchian, 2008

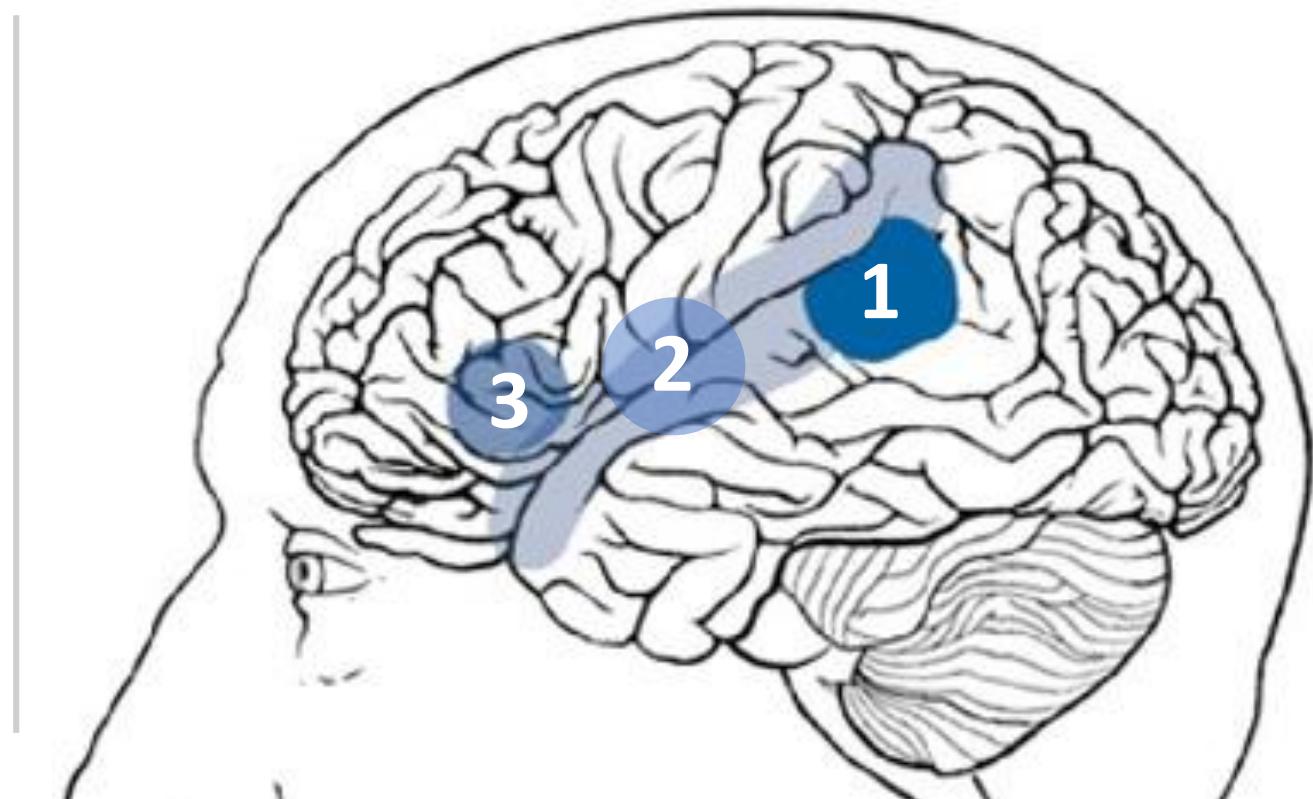
"The Perisylvian Language Network"

A play in three Acts

Act I: Wernicke's Area

Act II: The Insula

Act III: Broca's Area



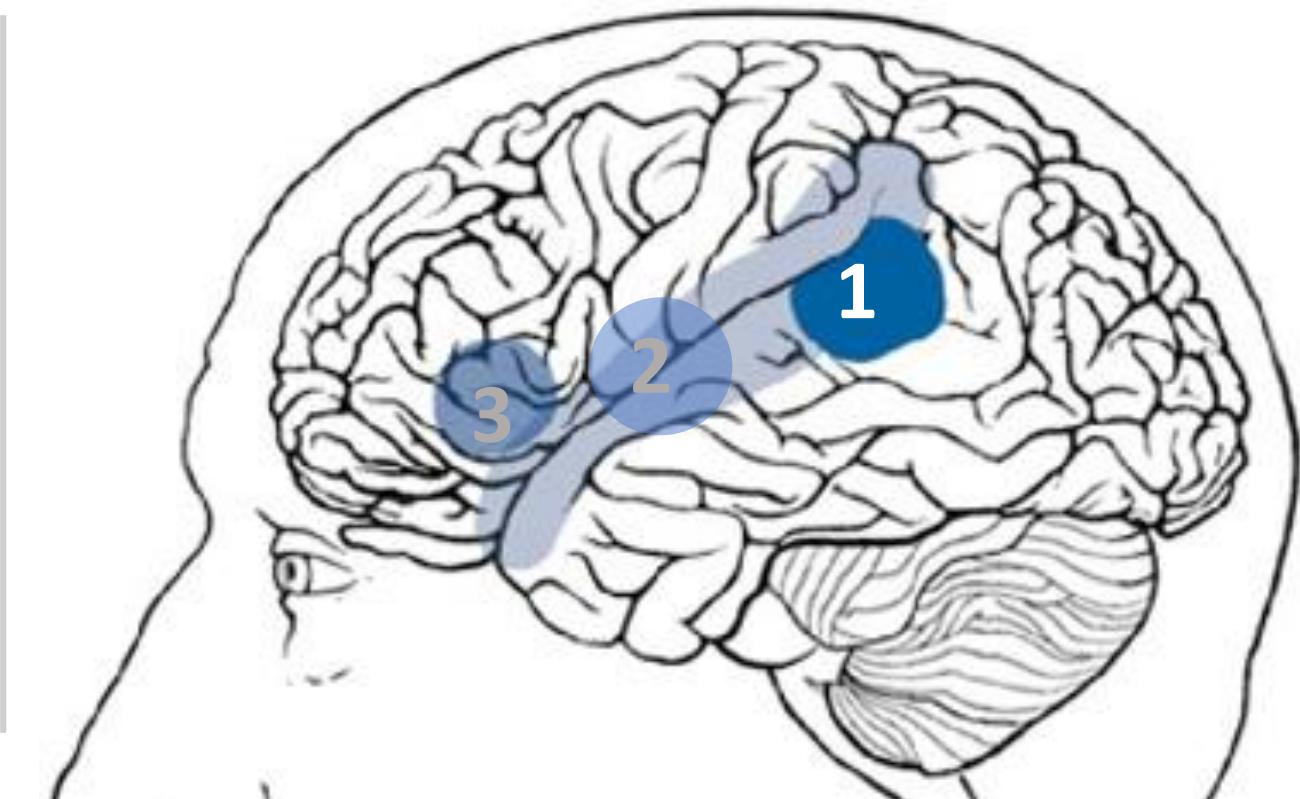
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A play in three Acts

Act I: Wernicke's Area

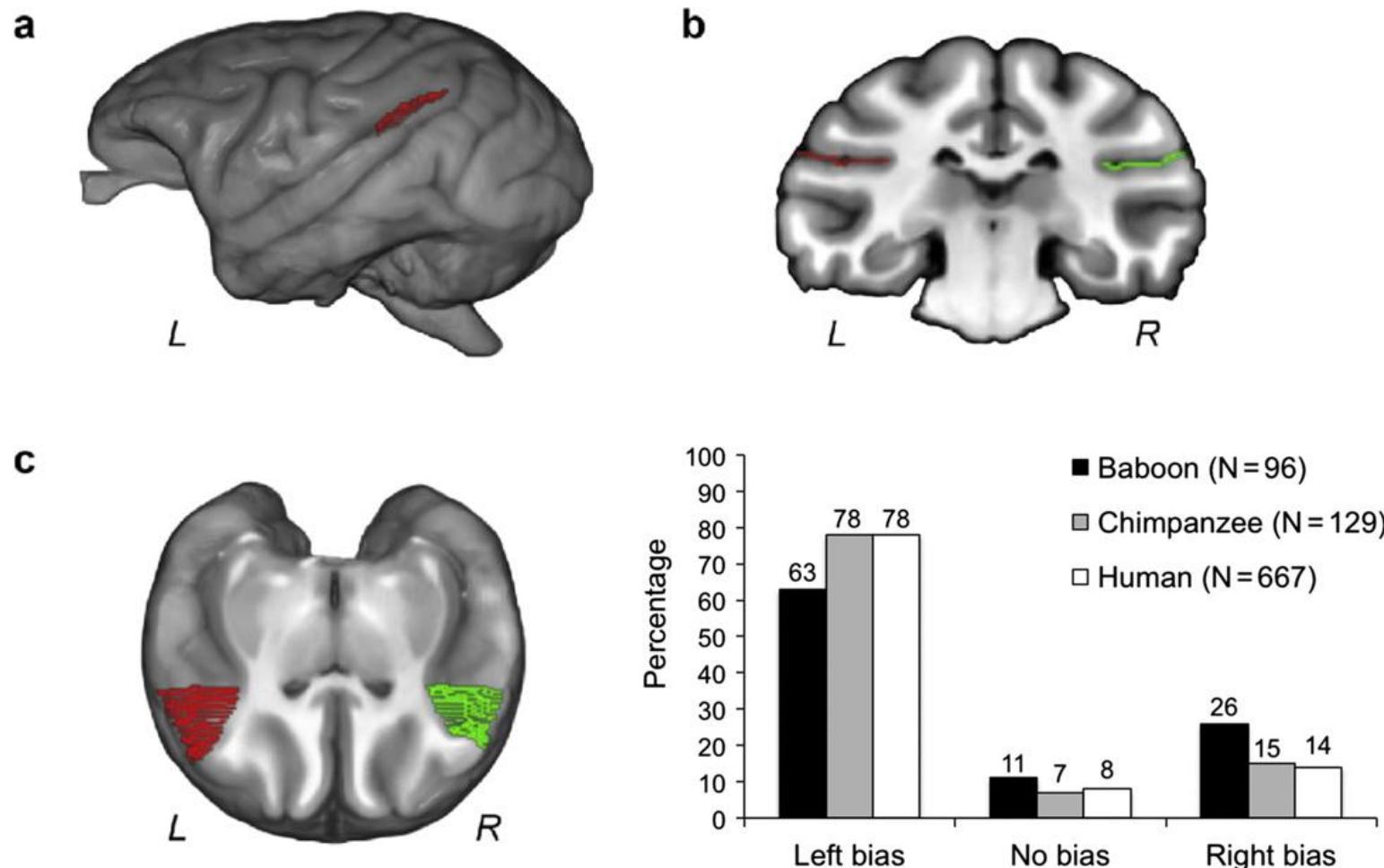
Act II: The Insula

Act III: Broca's Area



1) The Planum Temporale (Wernicke's)

a) Adult Baboons (manual tracing)

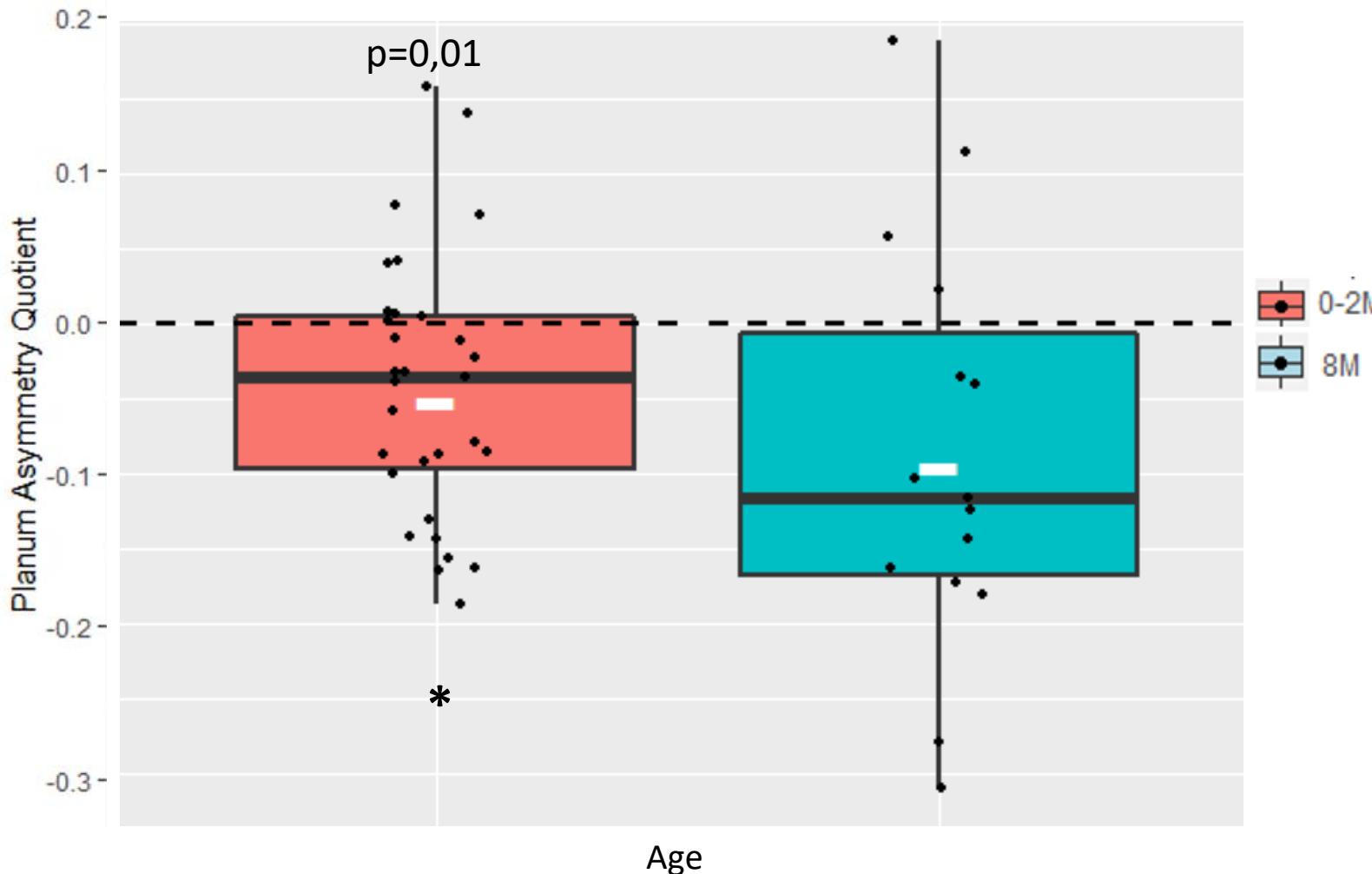


AnalyzeDirect

Marie et al. 2018

1) The Planum Temporale (Wernicke's)

b) New-born Baboons



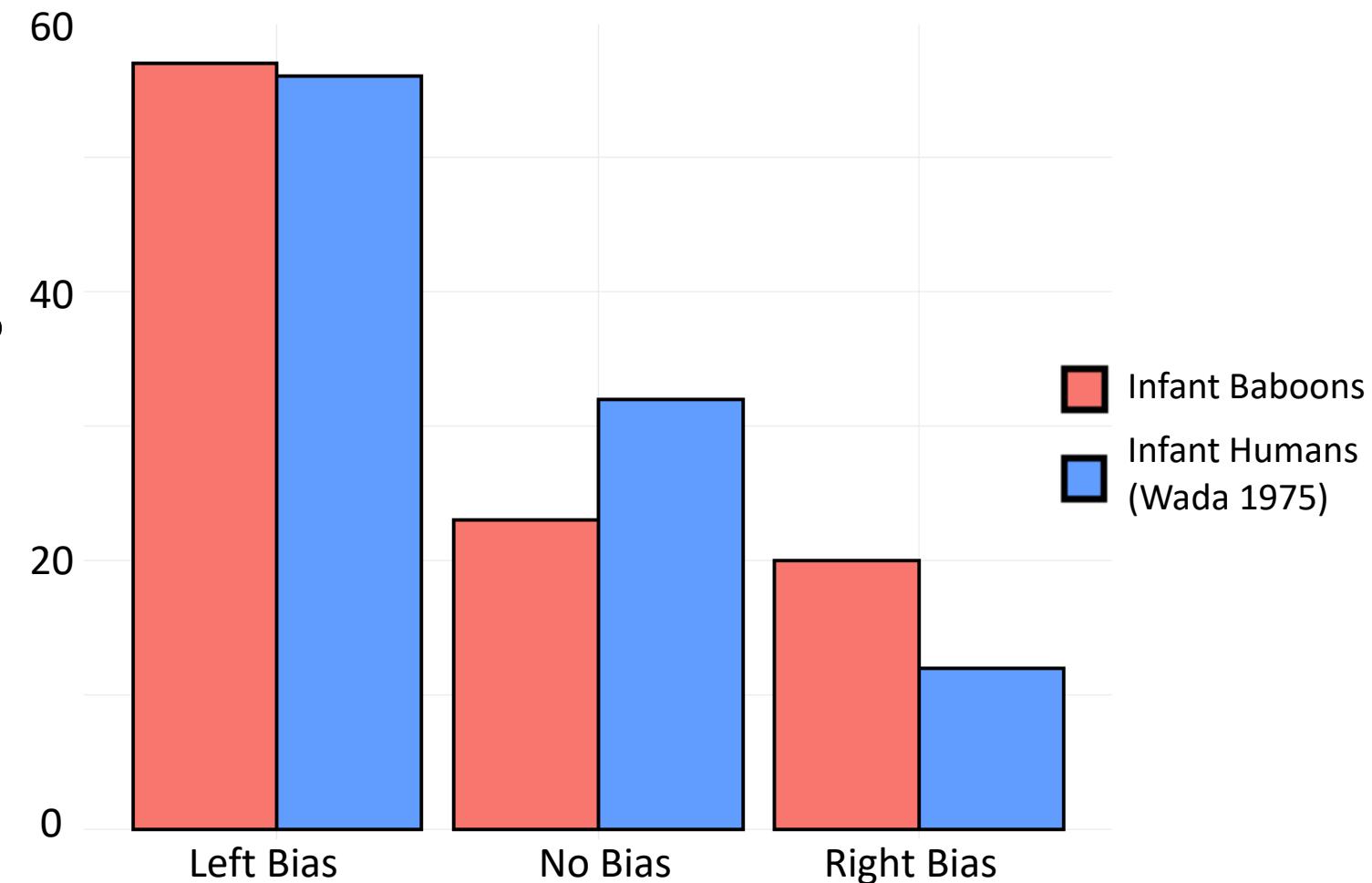
The planum temporale asymmetry:

- is genetically determined
- increases during development



1) The Planum Temporale (Wernicke's)

b) New-born Baboons



The distribution of PT asymmetry is similar between baboon- and human infants

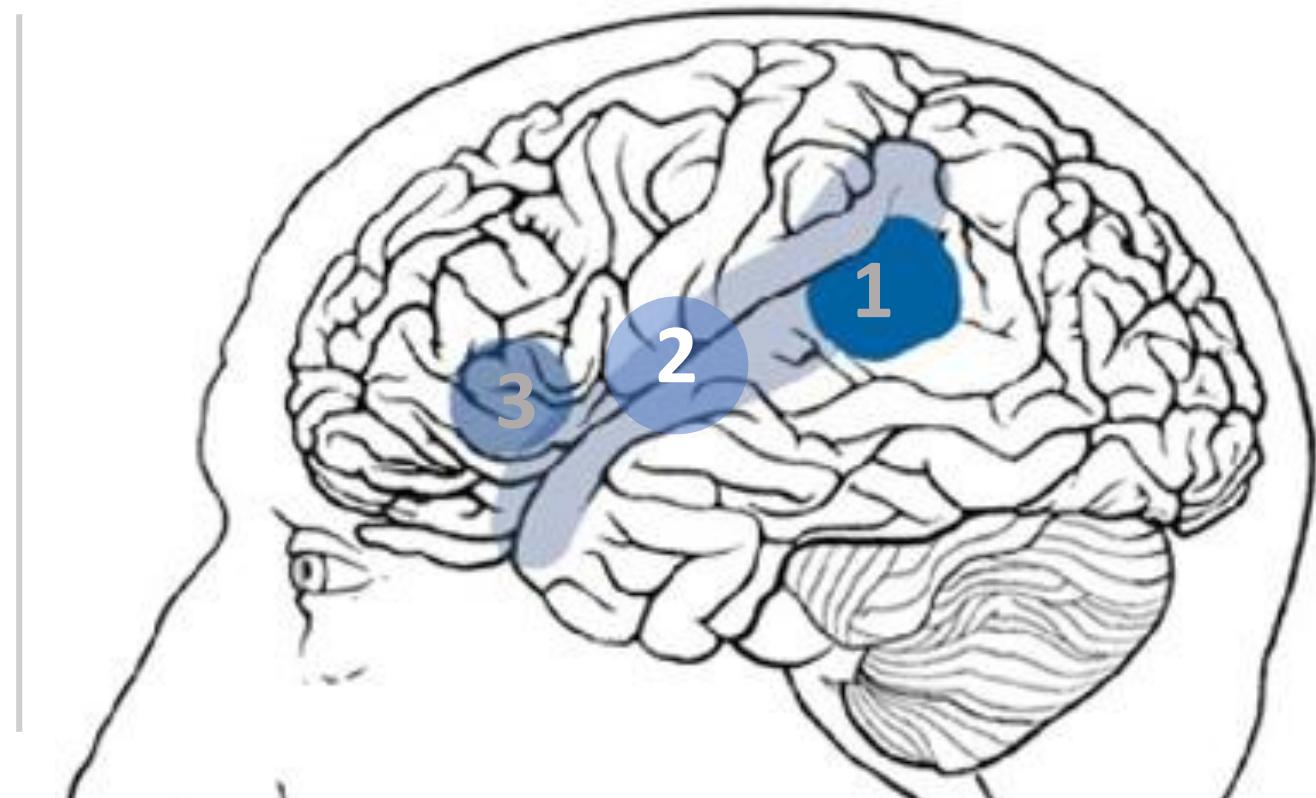
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2) Insula (Eloise Disarbois)

a) Adult Baboons

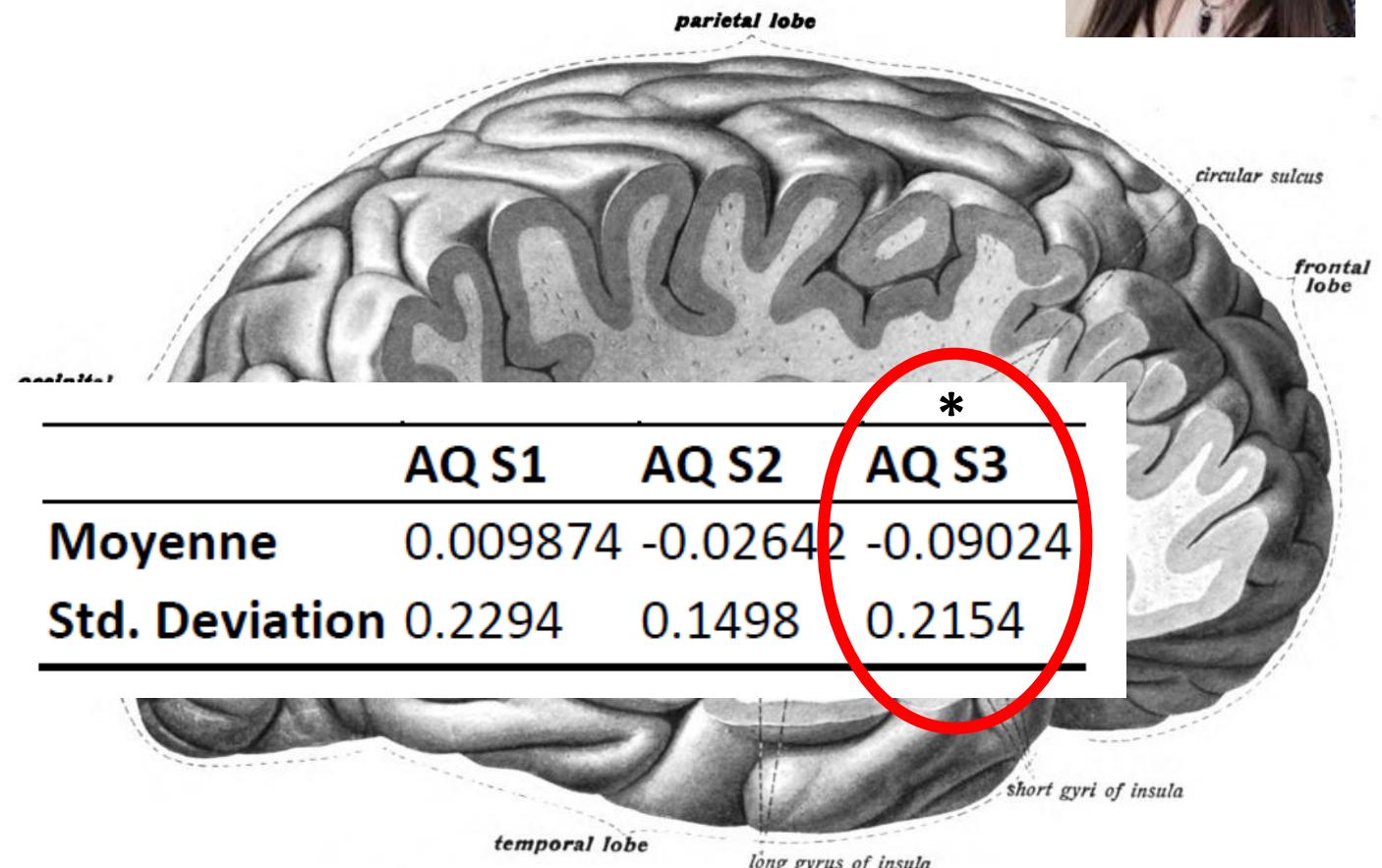
(anterior)
Insula



-Language processing, production, comprehension (Ardila et al. 2013)

- Size bias = predictor for fonc. language specialised hemisphere (Keller, S.S. et al., 2011)

-Link: struc. asym and lat. gesture + language (Bidula+Kroliczak 2015)



2) Insula

b) New-born Baboons



Sujet	AQ
Noé	-0,0946554
Océane	-0,1959976
Omelette	-0,2111148
Omerta	-0,0791708
Orage	0,10121908
Ozone	-0,1278866
Moyenne	<u>-0,1012677</u>

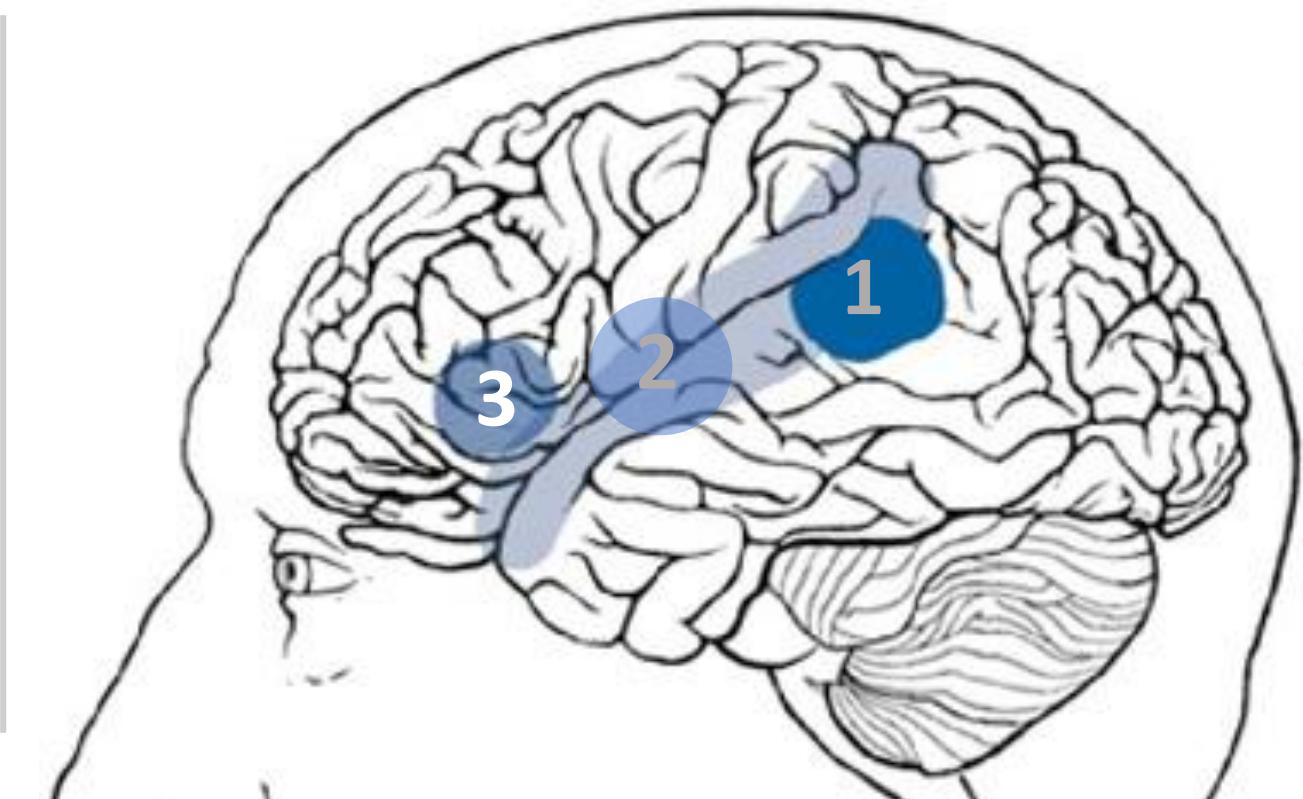
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IFG (Broca's area)

multimodal motor integration
including gesture and mouth
movements (Gentilucci &
Volta, 2008)

3) Broca's Adult Baboons

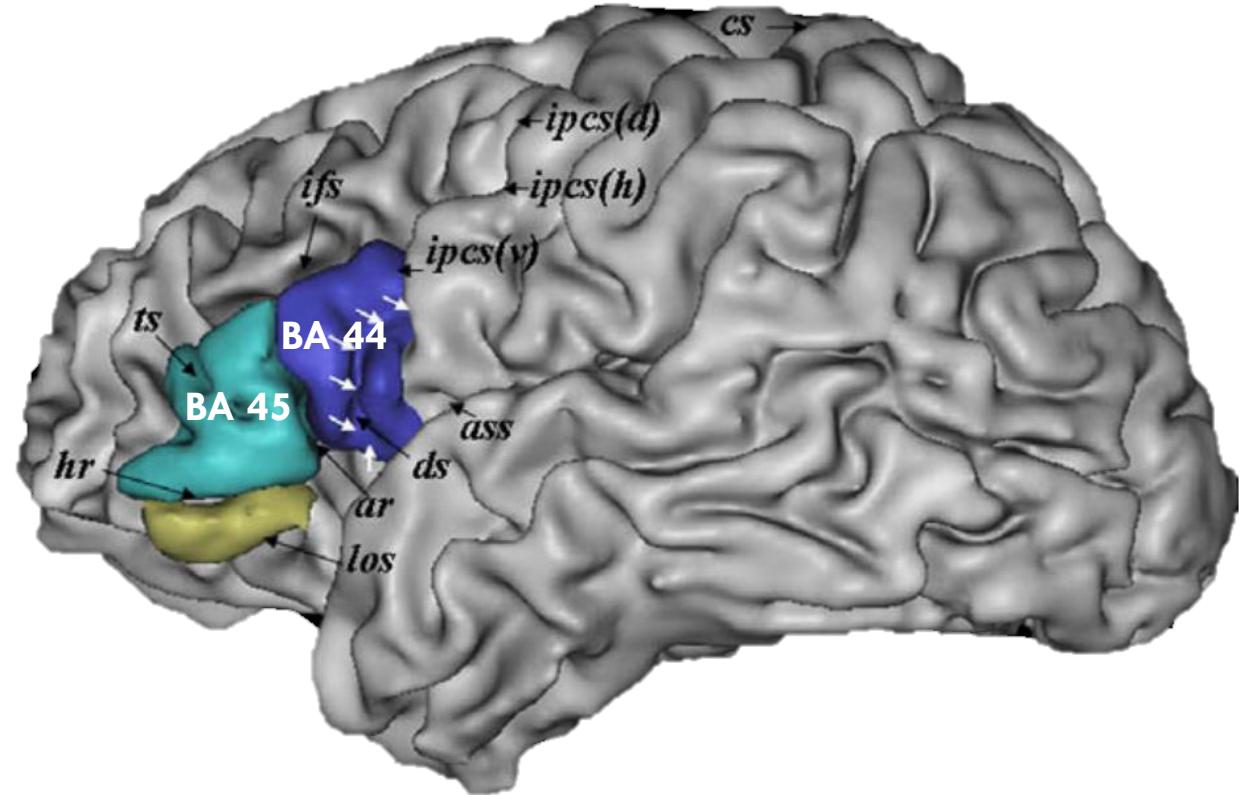


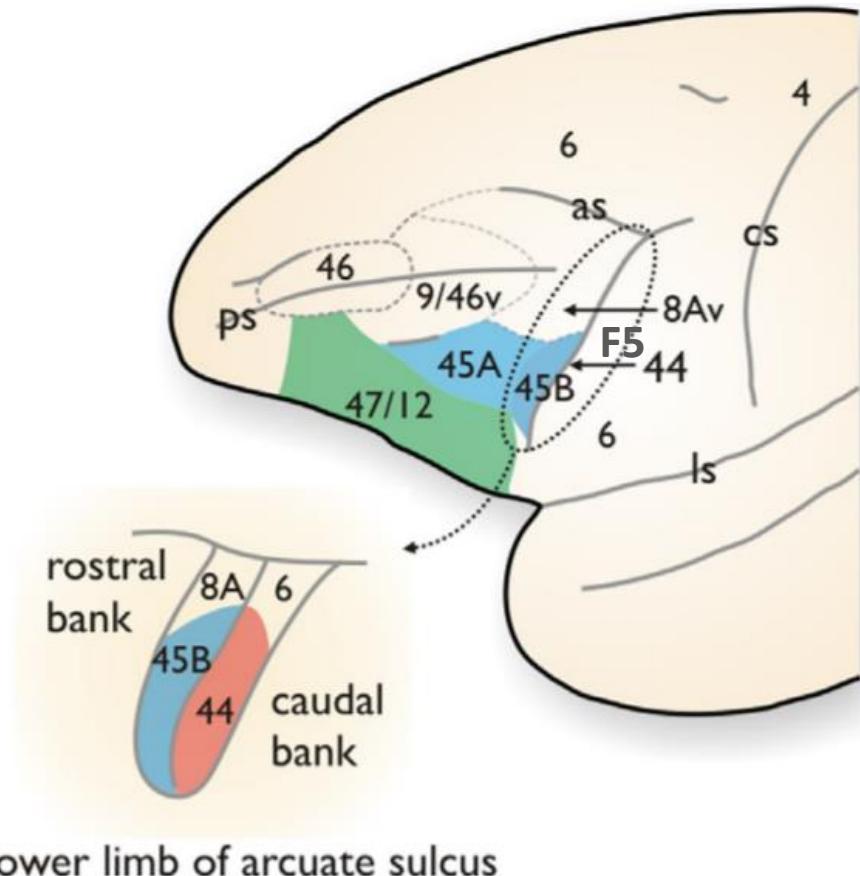
Illustration from Keller, 2009

Ifs: inferior frontal sulcus, ipcs: inferior precentral sulcus, los: lateral orbital sulcus

2) Broca's Area Adult Baboons

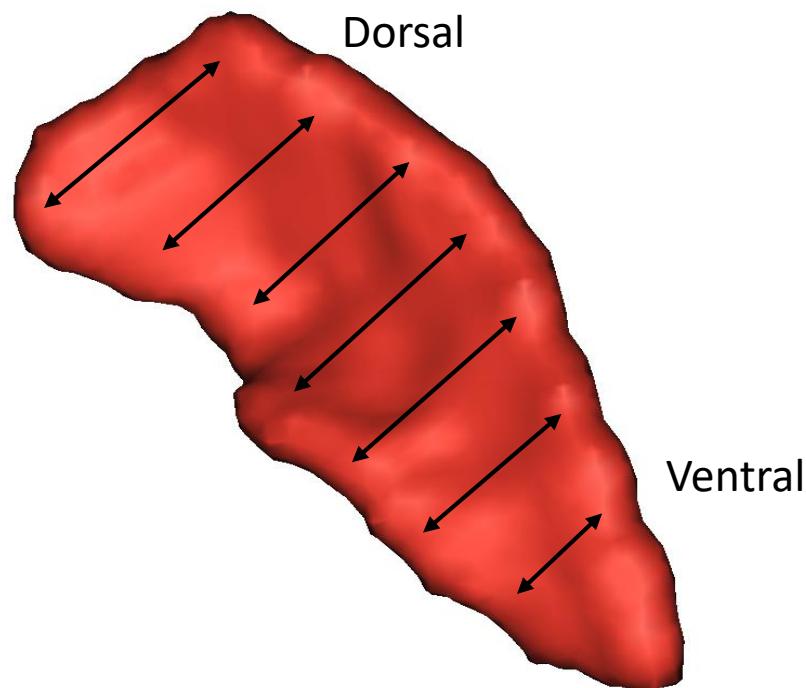
Macaque cytoarchitecture

as: Arcuate Sulcus (pre-central inf. Homologue), Brodmann 44 (and 45) = Broca's area. Note: F5. Image based at Frühholz et al., 2013

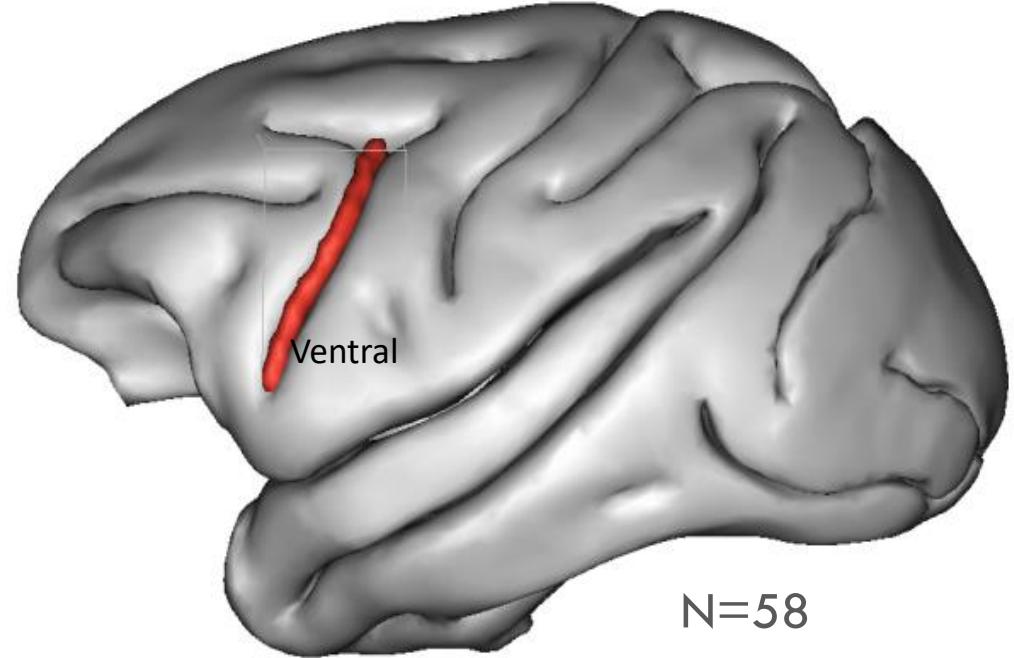


Petrides, 2005; Ferrari, 2003

Inf. Arcuate Sulcus' depth (BrainVisa)



<http://brainvisa.info/>



Localisation of the inf. arcuate sulcus in the baboon brain

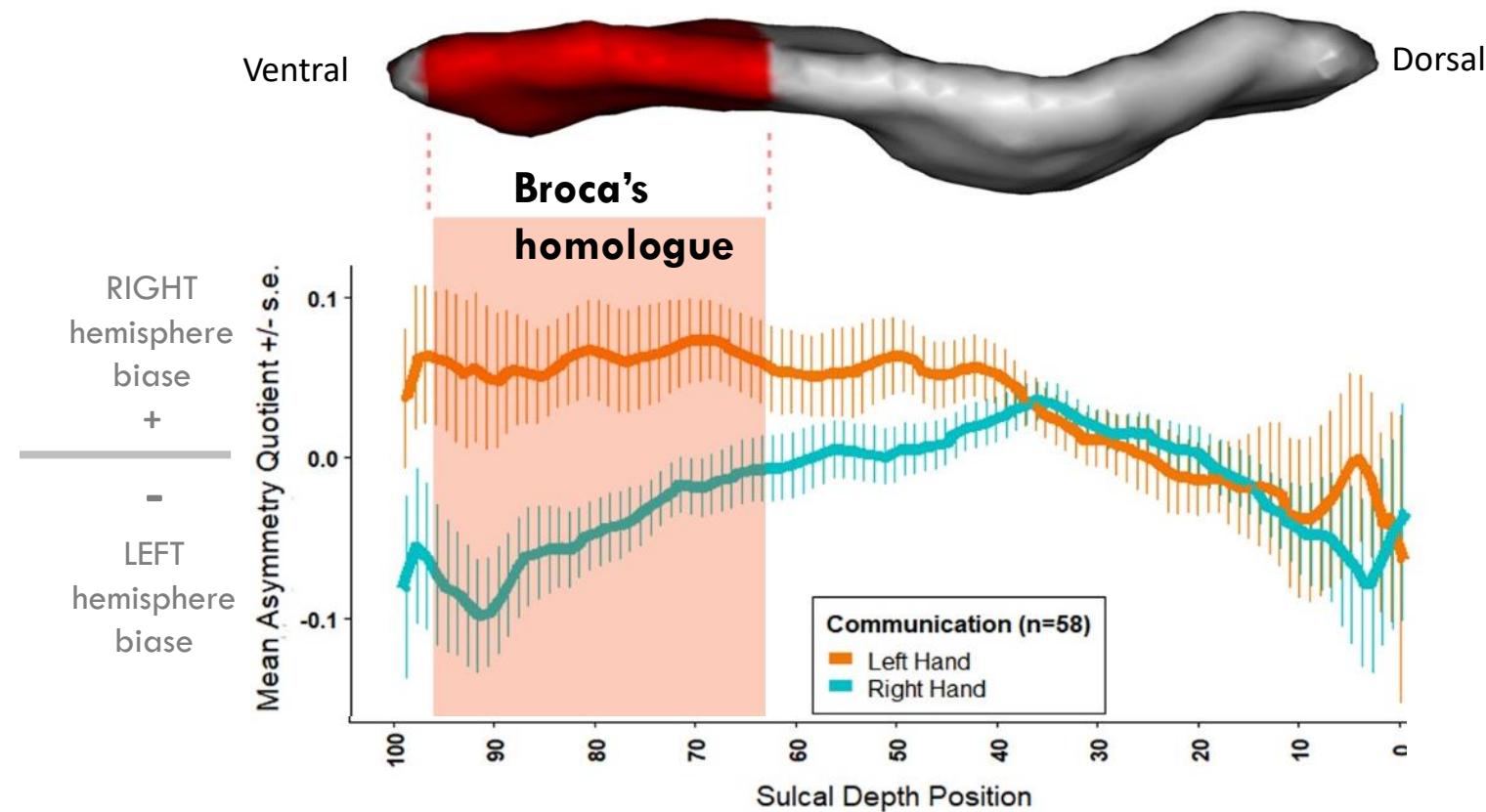
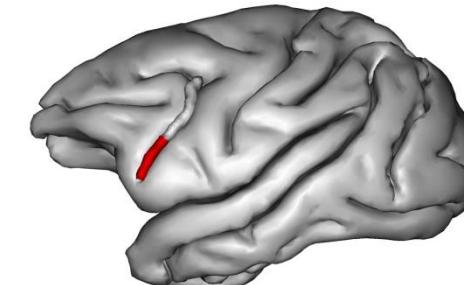
+

Behaviour

Communicative gesture



Handslap



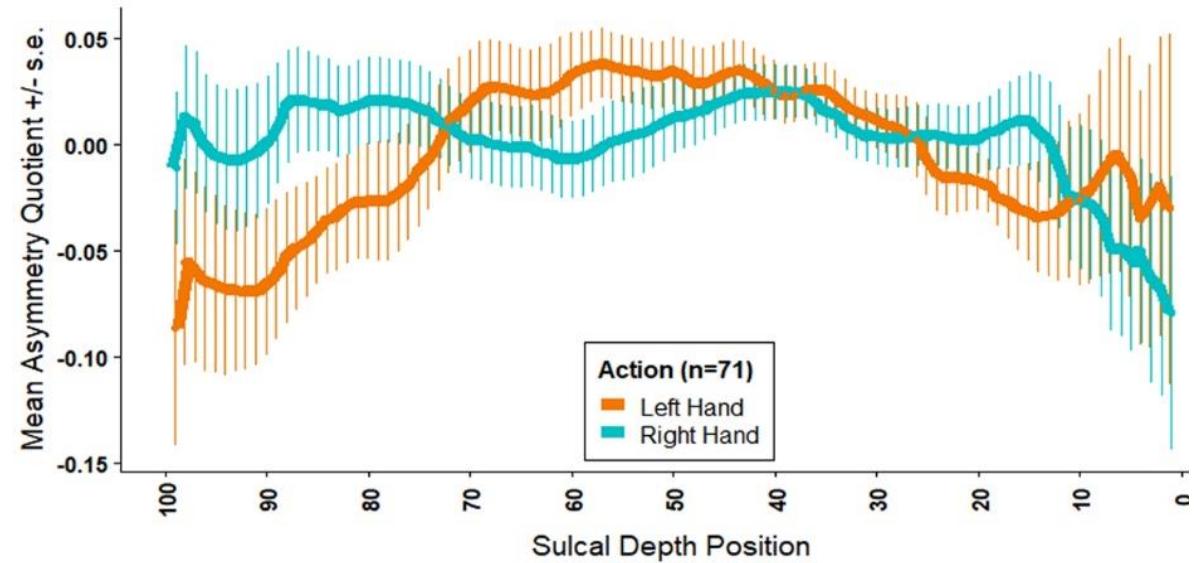
(Becker et al. 2019a, in prep.)

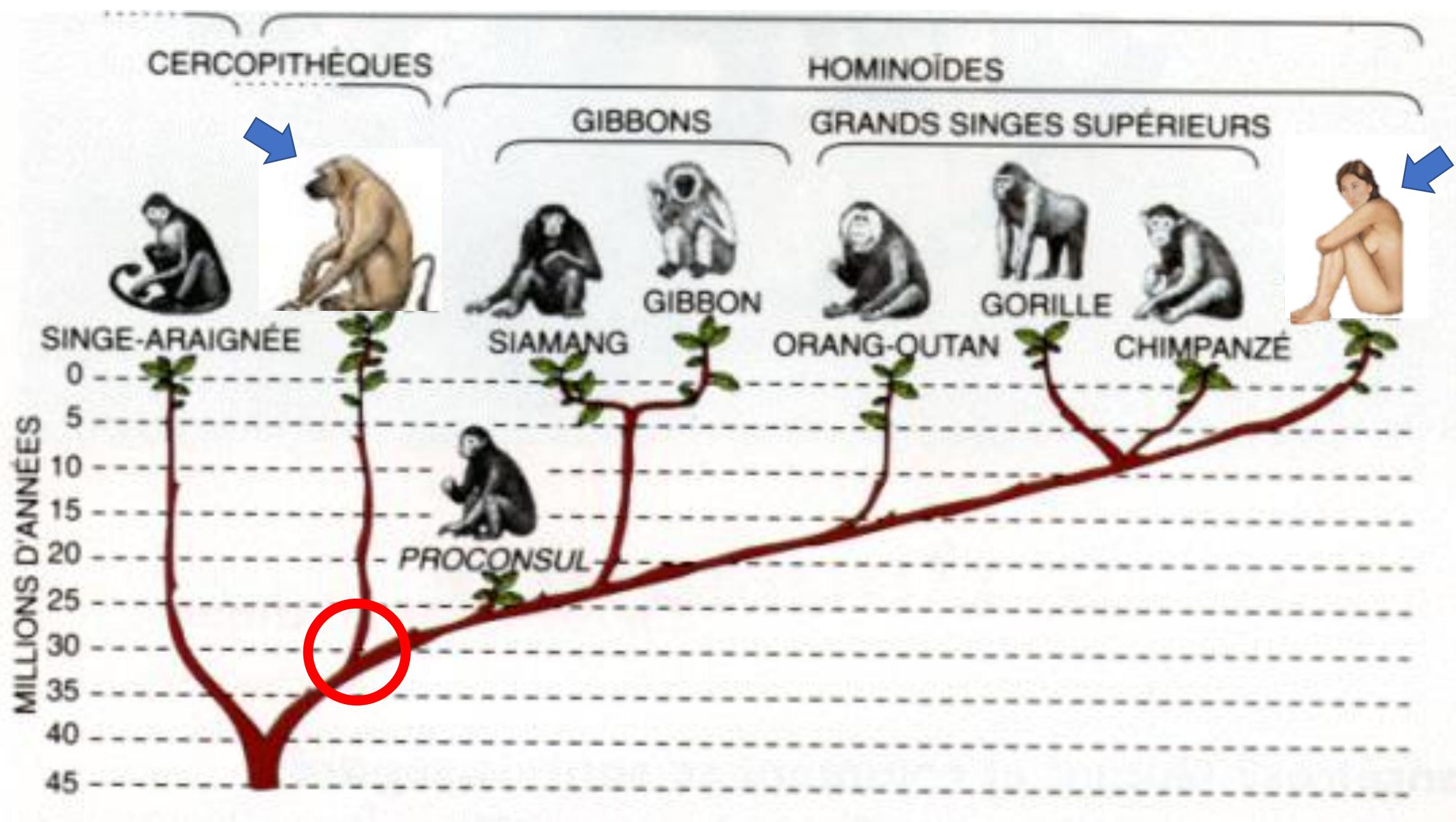
Manual Task



Non communicative action
(tube task, Hopkins, 1995)

RIGHT hemisphere bias +
- LEFT hemisphere bias





You activated
a



"The Perisylvian Language Network"

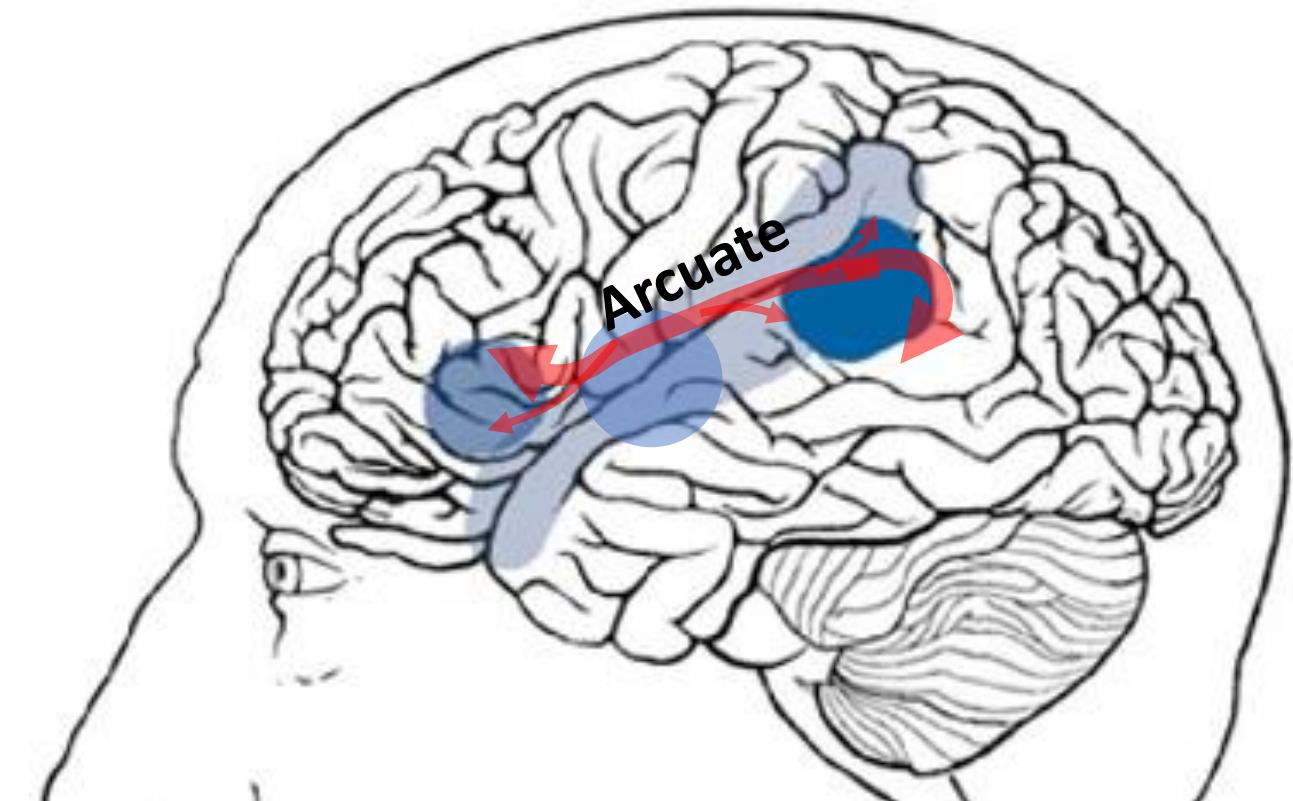
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**Appendix: the Arcuate
Fasciculus**



Appendix: The Arcuate Fasciculus

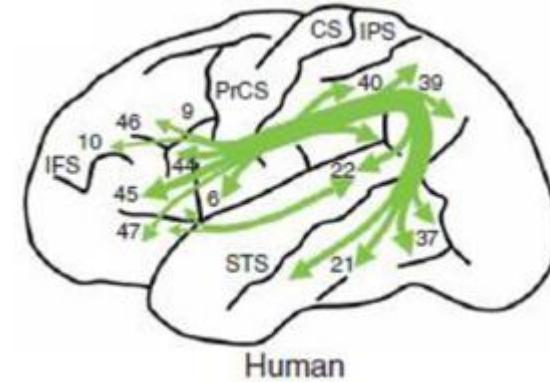
(numerous methods: FA, nbr of streamlines, VBM etc.)

- **Left lateralized in humans (Buchel, 2004)**

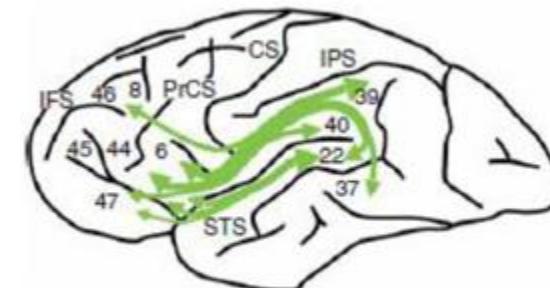
- **Same in human infants (Dubois, 2009, 2016)**

- **Same in adult chimps (Rilling, 2011)**

- **No Asymmetry in adult monkeys (Eichert, 2019)**

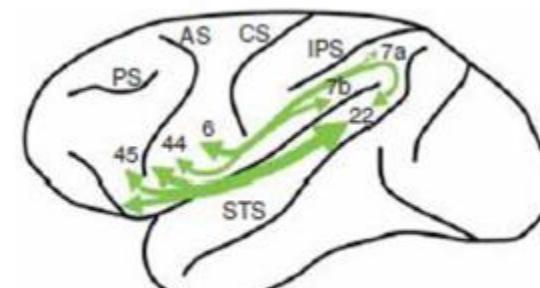


Human



Dorsal and ventral
« language » pathways

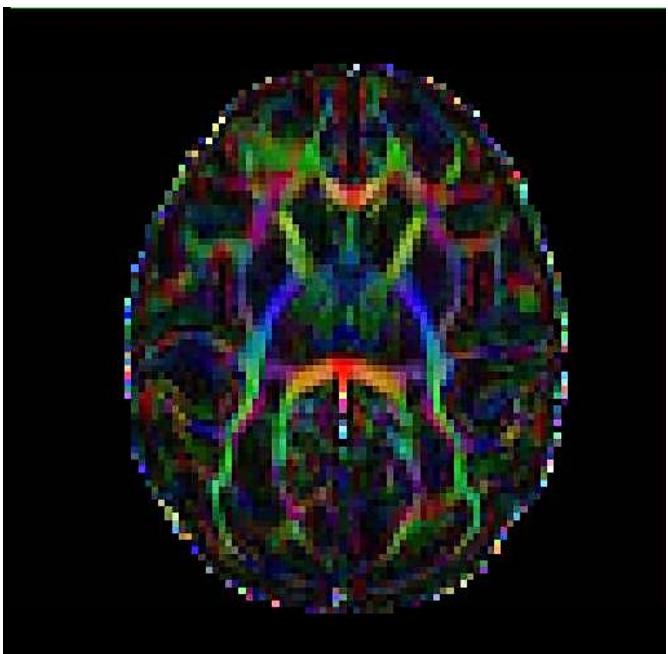
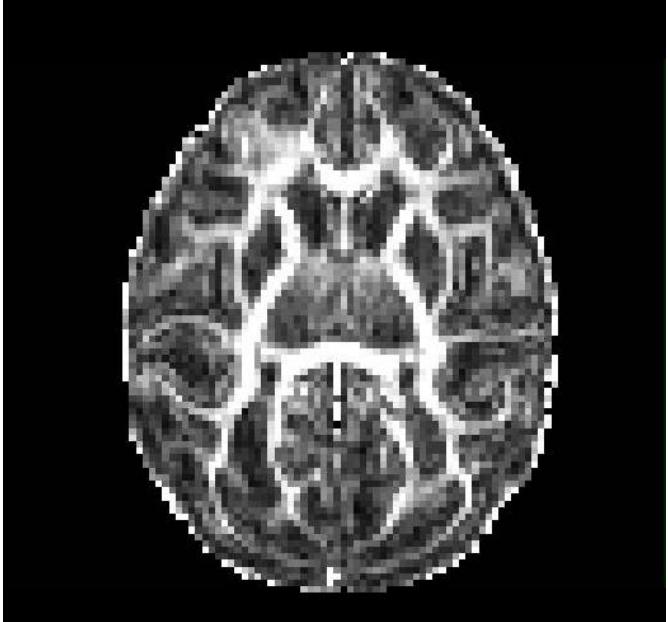
Chimpanzee



Macaque

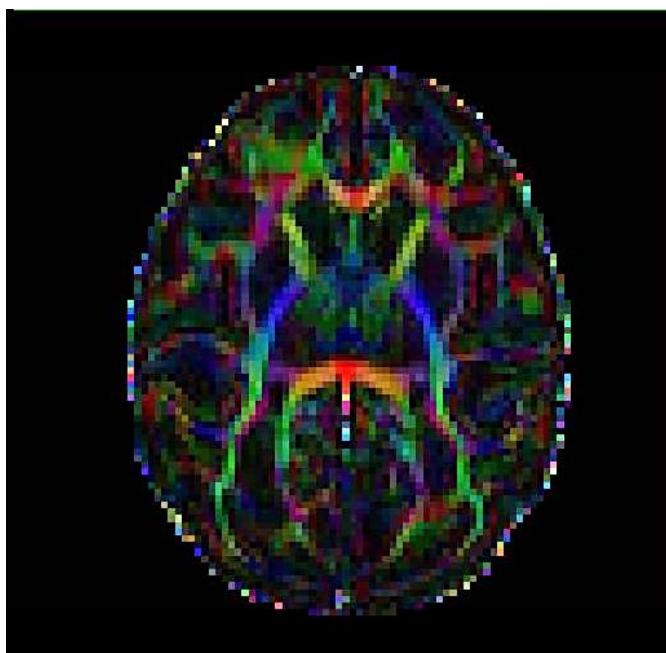
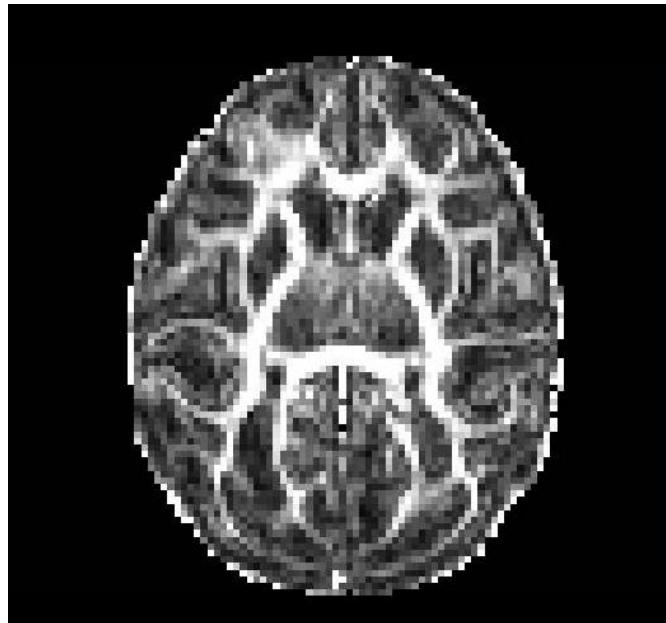
(Rilling, 2008)

**First FA
maps
of
new-born
baboons**



Very precious help from:

Olivier Coulon
Julien Sein
Kep Kee Loh
Alex Pron



First FA
maps
of
new-born
baboons

Lateralization of the Arcuate Fasciculus in new-born baboons?

- 1) a) Preprocessing: BrainVisa (**Diffuse** toolbox – mainly FSL functions)
 - Eddy
 - TopUp
 - Mask (fsl bet)b) DTI : FA/MD maps
- 2) Tractography: **Mrtrix**
Multi-Shell Multi-Tissue Constrained Spherical Deconvolution (MSMT-CSD)

Thank you very much
for your attention!

