

OUR HISTORY



YOUR FUTURE

DOWNING COLLEGE IN THE  
UNIVERSITY OF CAMBRIDGE  
INTERNATIONAL PROGRAMME

BRAIN AND COGNITION –  
THE CASE OF LANGUAGE

NOAM TAL-PERRY

DCIP TASTER SESSION DECEMBER 2025

# WHAT IS COGNITION?

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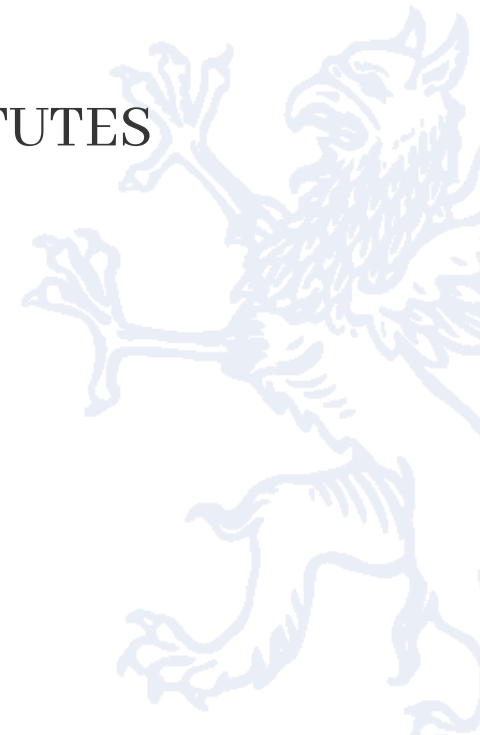


René Descartes, *Discourse on the Method*, 1637

*COGITO ERGO SUM*

*I THINK, THEREFORE I AM*

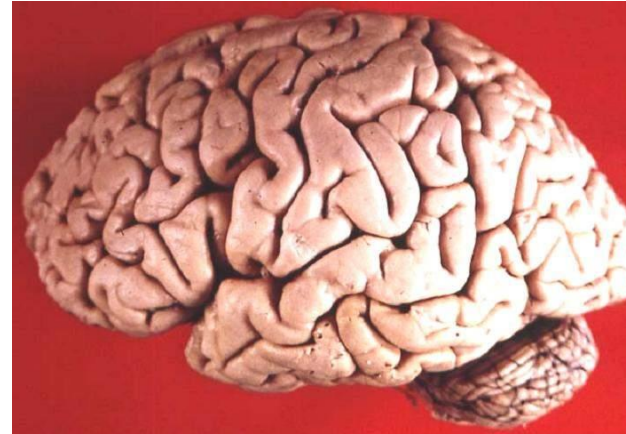
WHAT CONSTITUTES  
THINKING?



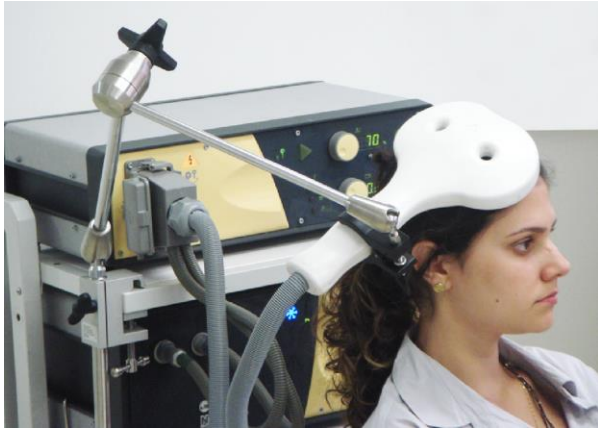
# WHAT IS COGNITION?



# WHAT IS COGNITIVE NEUROSCIENCE?



# WHAT IS COGNITIVE NEUROSCIENCE?



TMS



Functional MRI



EEG



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LANGUAGE IN THE BRAIN



For a long stretch of history, *brain lesions* in surviving persons were the only source of information on the human brain

Damage



Deficit



Inference



## Strengths

- *Direct causality*
- Necessary vs redundancy
- Dissociations and double dissociations
- Network dynamics and disconnection

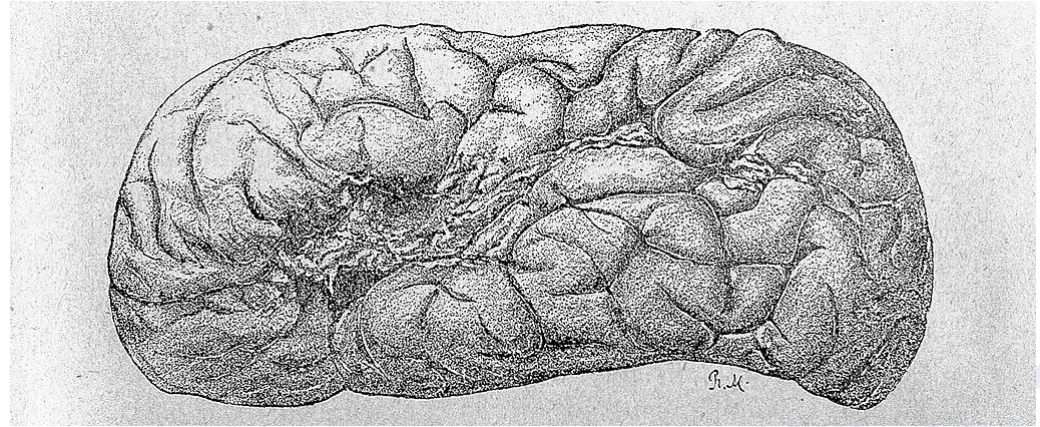
Brain-injured and neurodegenerative patients continue to inform neuroscience today



# LESION STUDIES IN LANGUAGE



Paul Broca (1824-1880)



Brain of Louis Victor "Tan" Leborgne



Dronkers et al. (2007)

Aphasia - impaired language processing caused by brain damage



# NON-FLUENT APHASIA



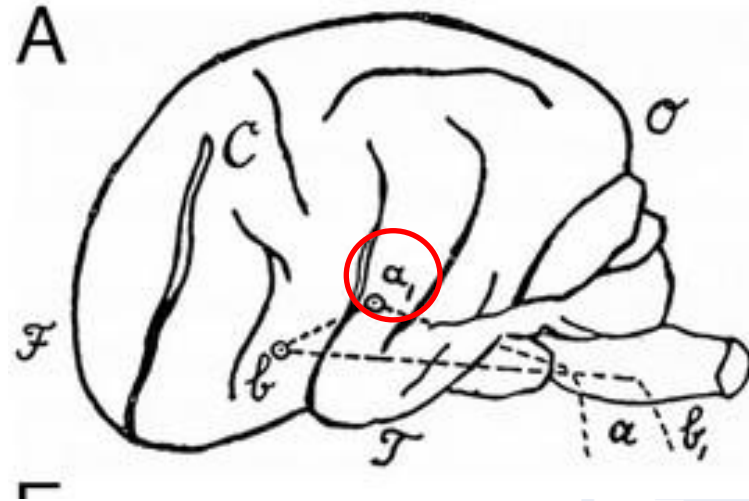
[Link to video](#)



# LESION STUDIES IN LANGUAGE



Carl Wernicke (1848-1905)



Rahimpour et al. (2019)



# FLUENT APHASIA



[Link to video](#)

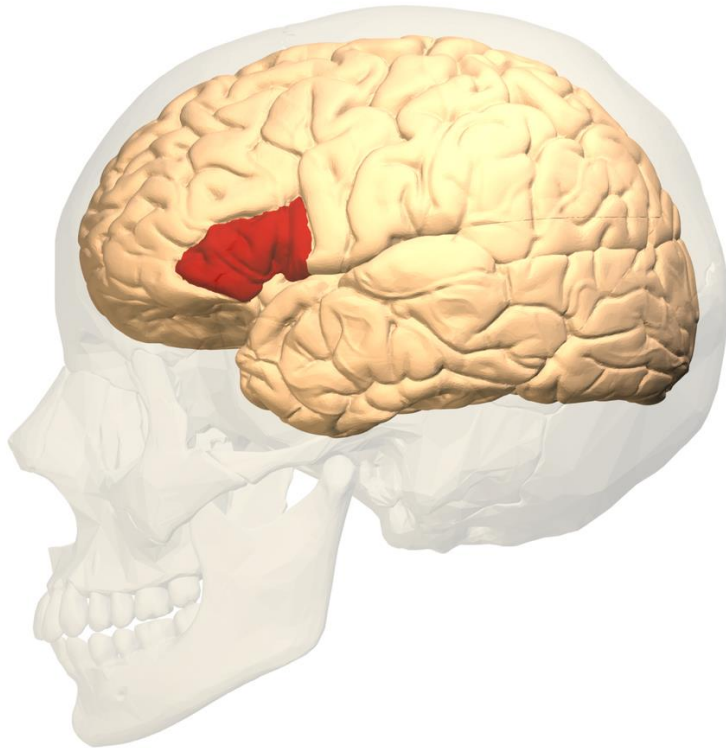


# BROCA'S AND WERNICKE'S AREAS



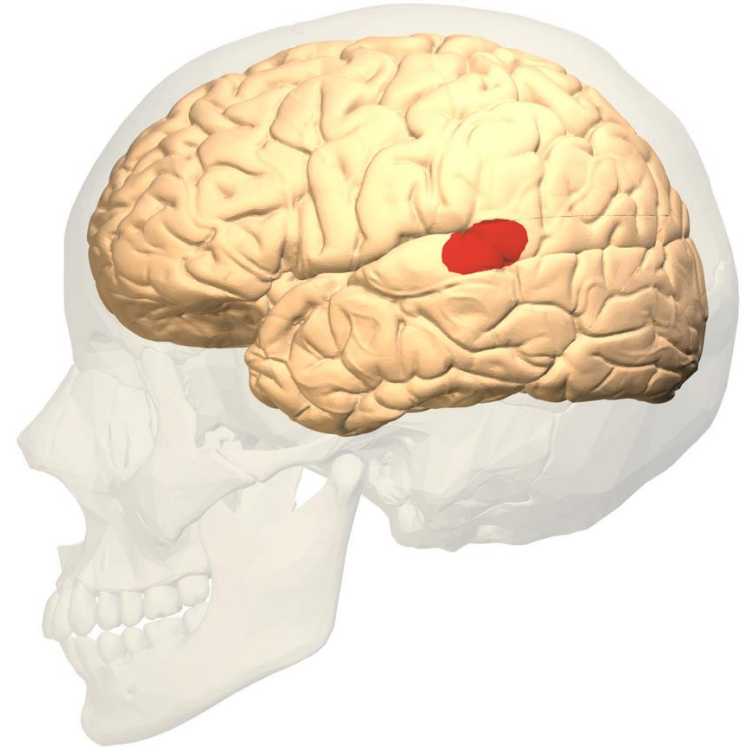
Broca's area

Language production



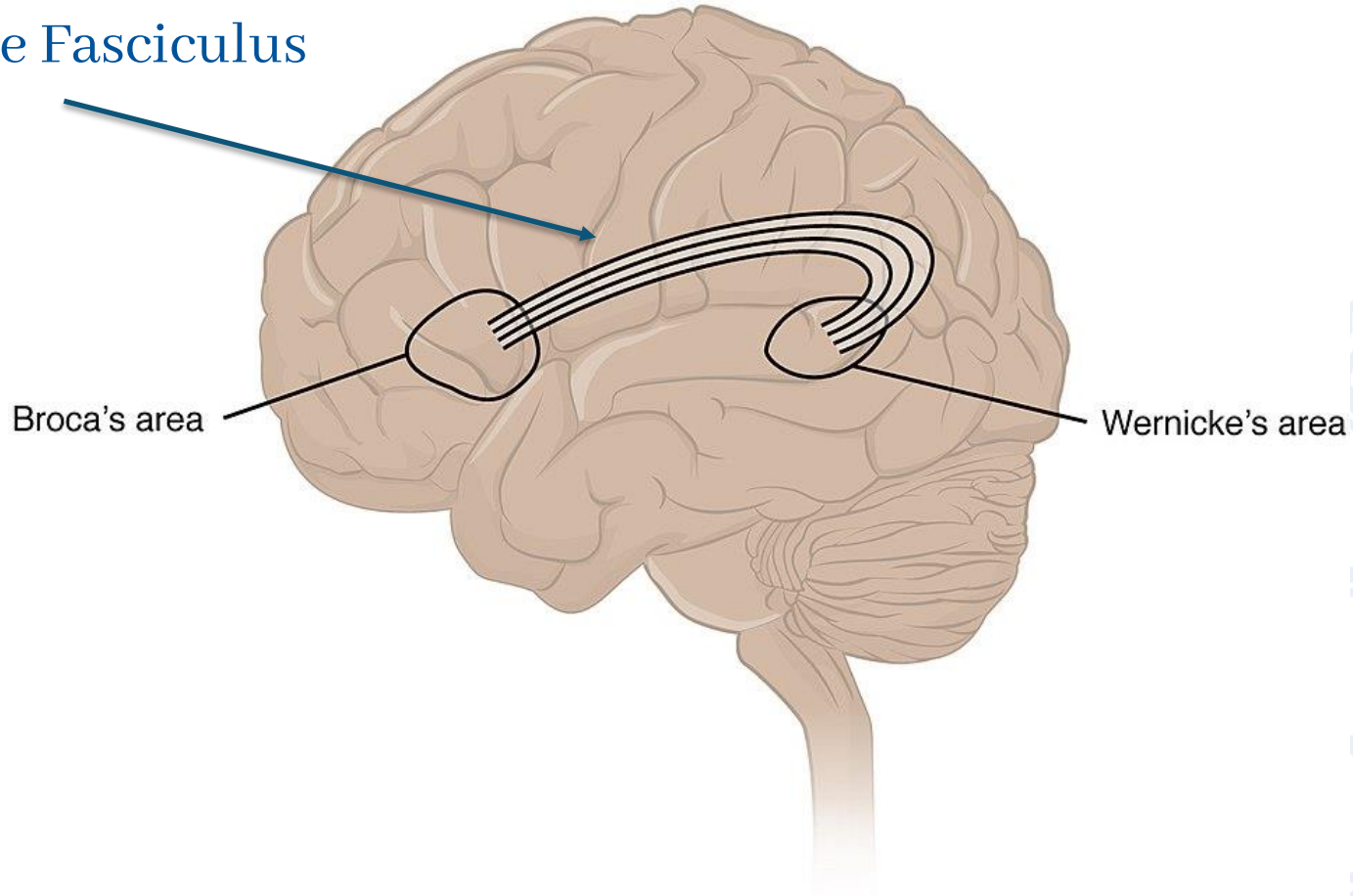
Wernicke's area

Language comprehension





## Arcuate Fasciculus



# CONDUCTION APHASIA



[Link to video](#)





For a long stretch of history, *brain lesions* in surviving persons were the only source of information on the human brain

## Strengths

- *Direct causality*
- Necessary vs redundancy
- Dissociations and double dissociations
- Network dynamics and disconnection

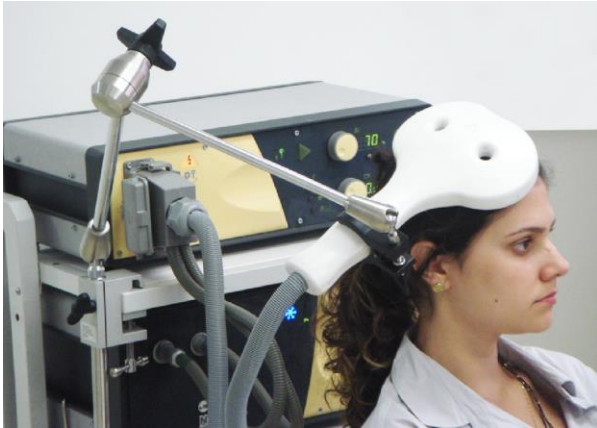
## Limitations

- Happenstance
- Post-mortem (early days)
- Compensation
- Dispersed damage

Brain-injured and ill patients continue to inform neuroscience today, in a branch of Psychology called Neuropsychology



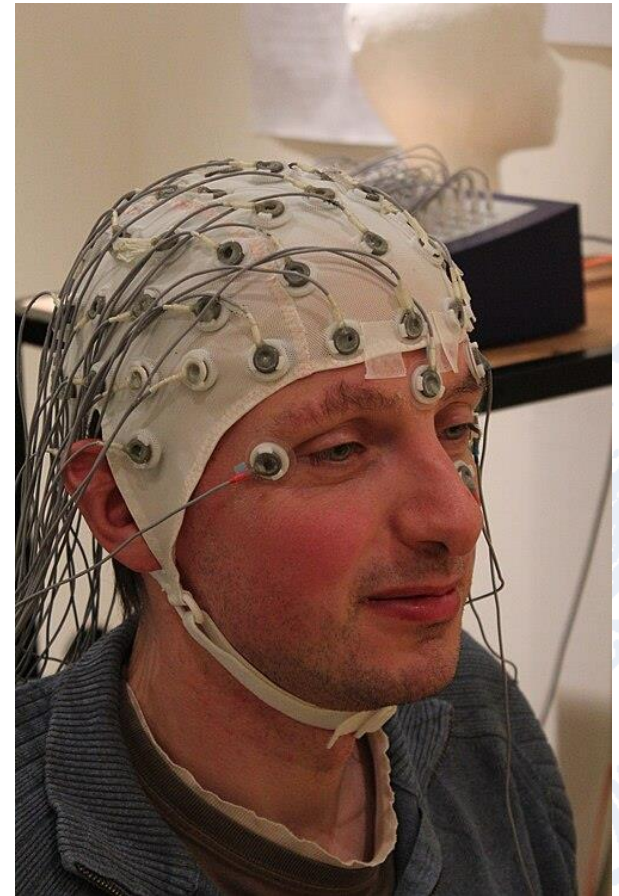
# MODERN LINGUISTIC NEUROSCIENCE APPROACHES



*Causality (TMS)*



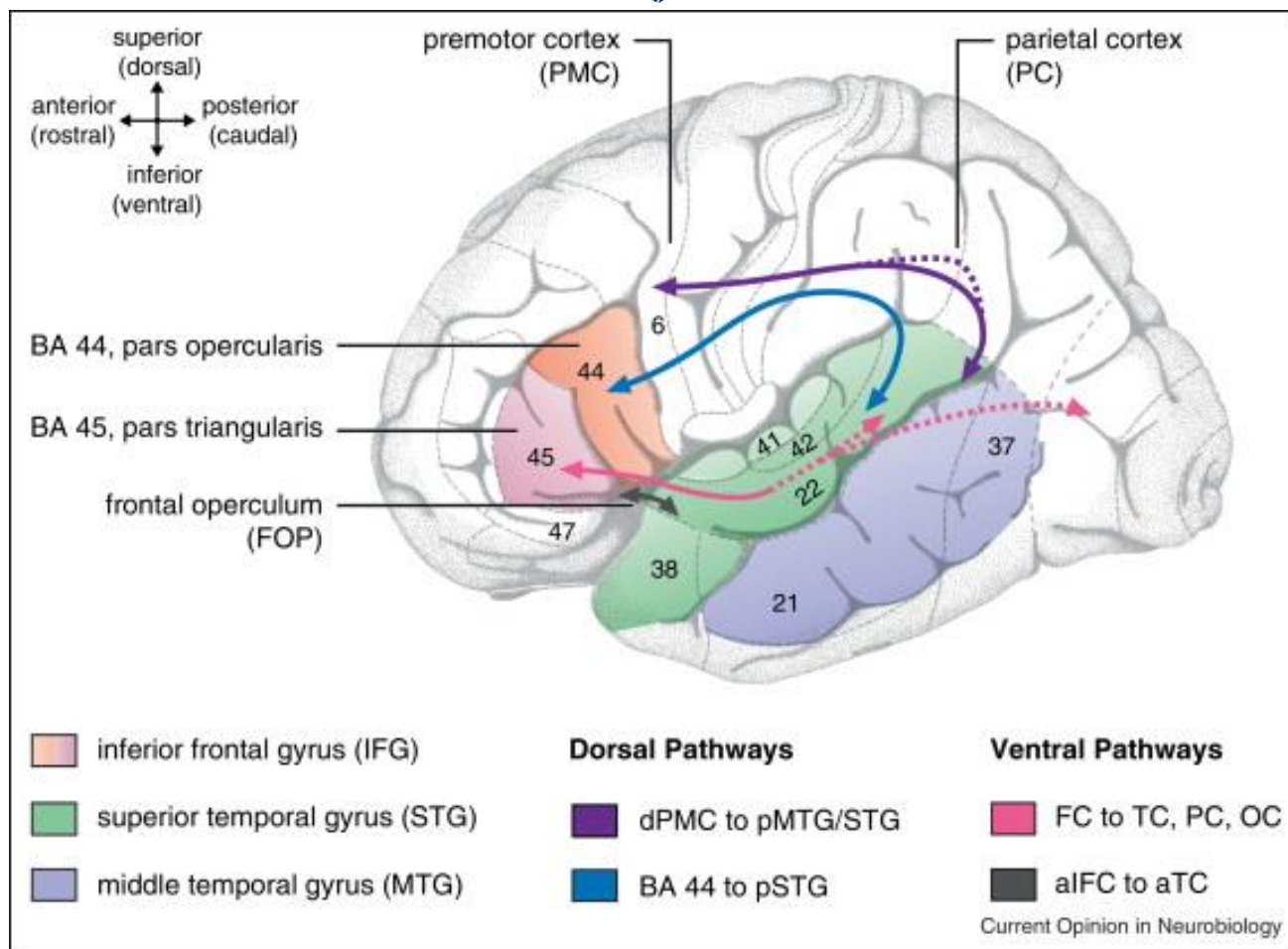
*Coverage (Functional MRI)*



*Timing (EEG)*



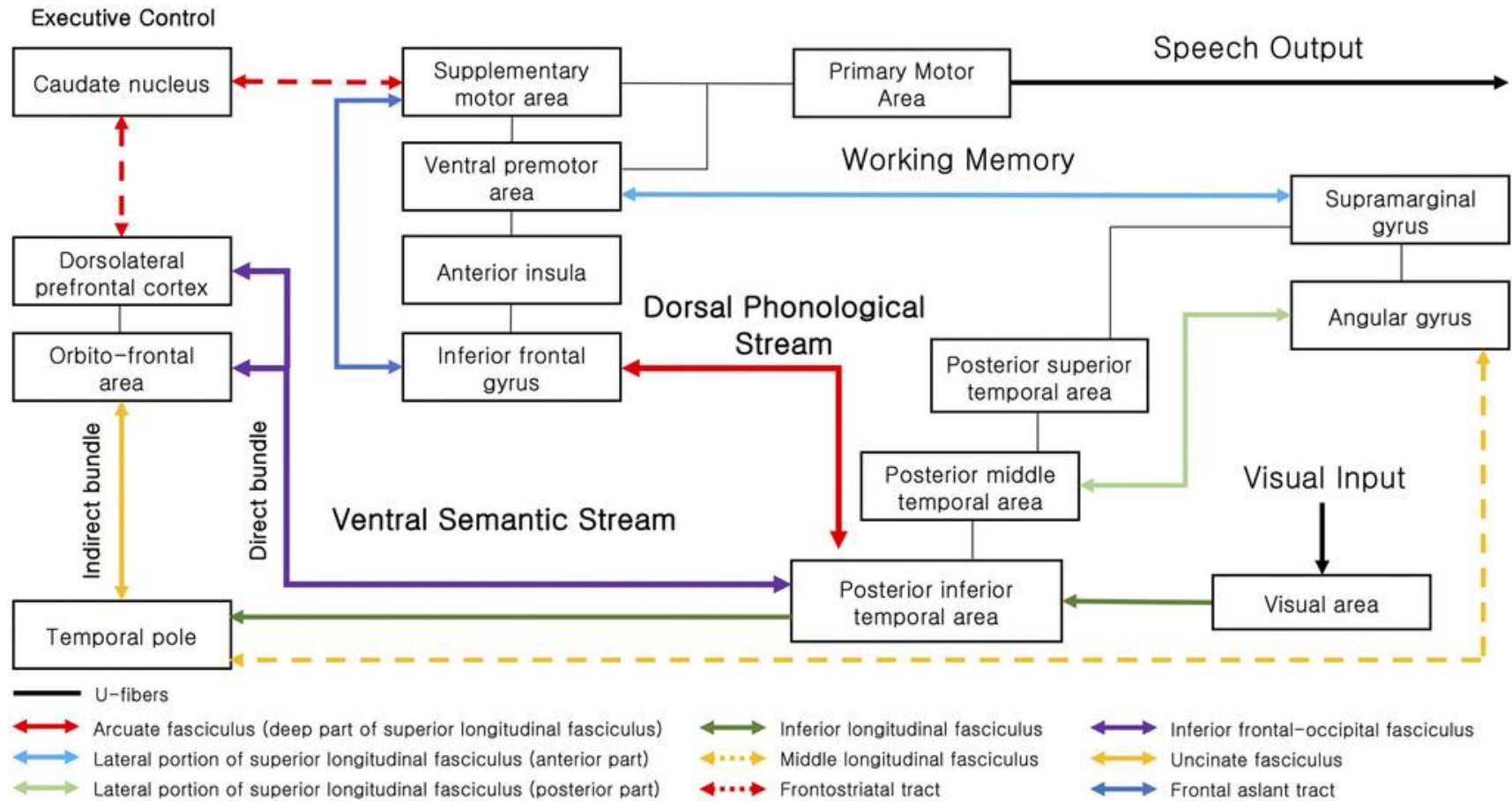
# LANGUAGE NETWORK



Friederici & Gierhan (2013)



# LANGUAGE NETWORK

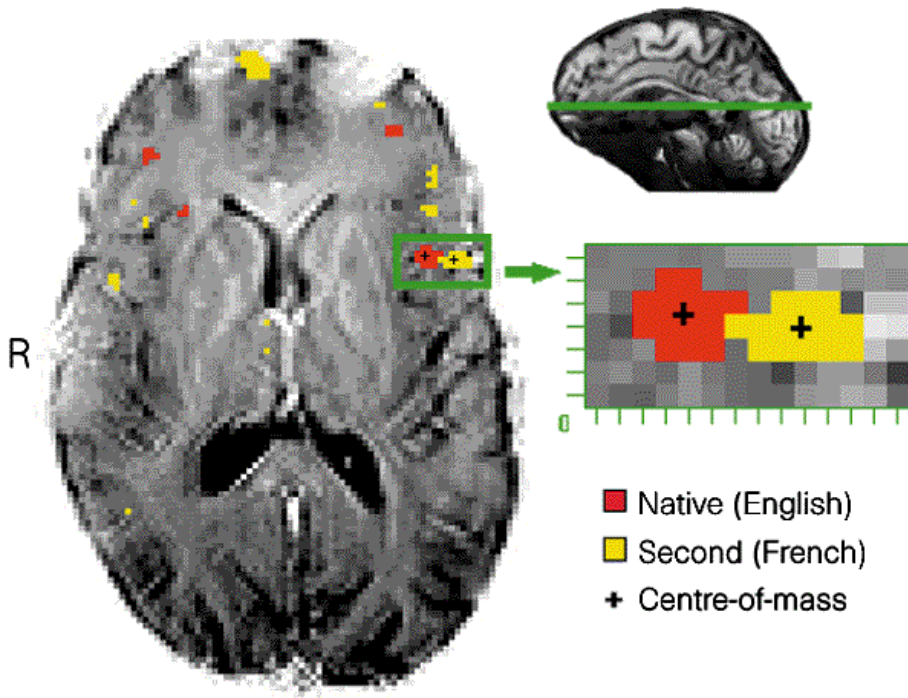


Rahimpour et al. (2019)

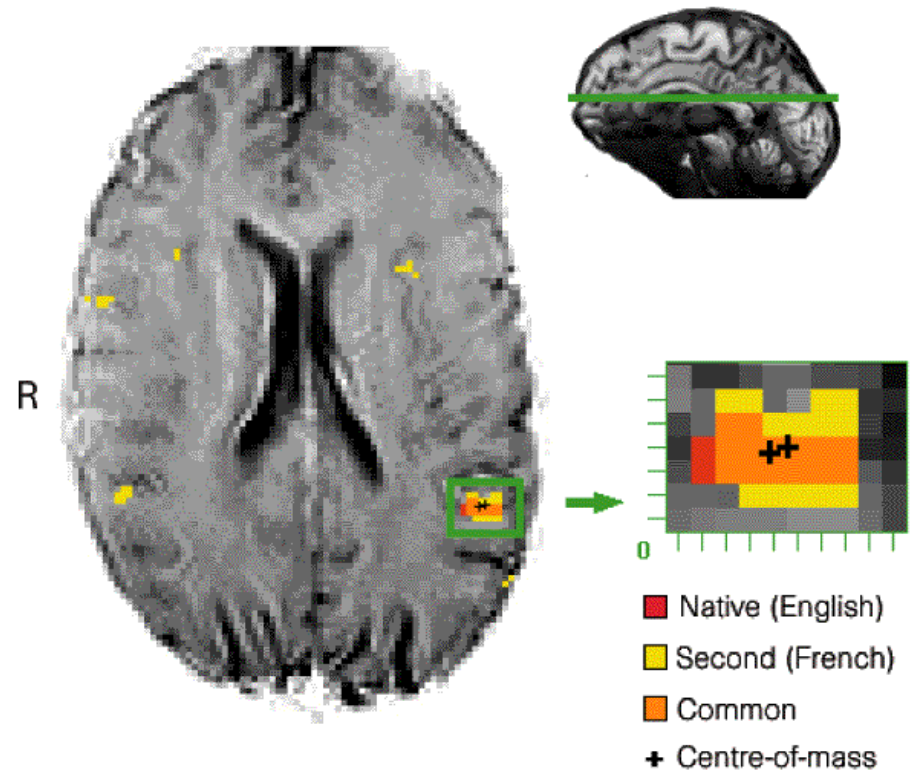




## Broca's area Late bilinguals



## Wernicke's area

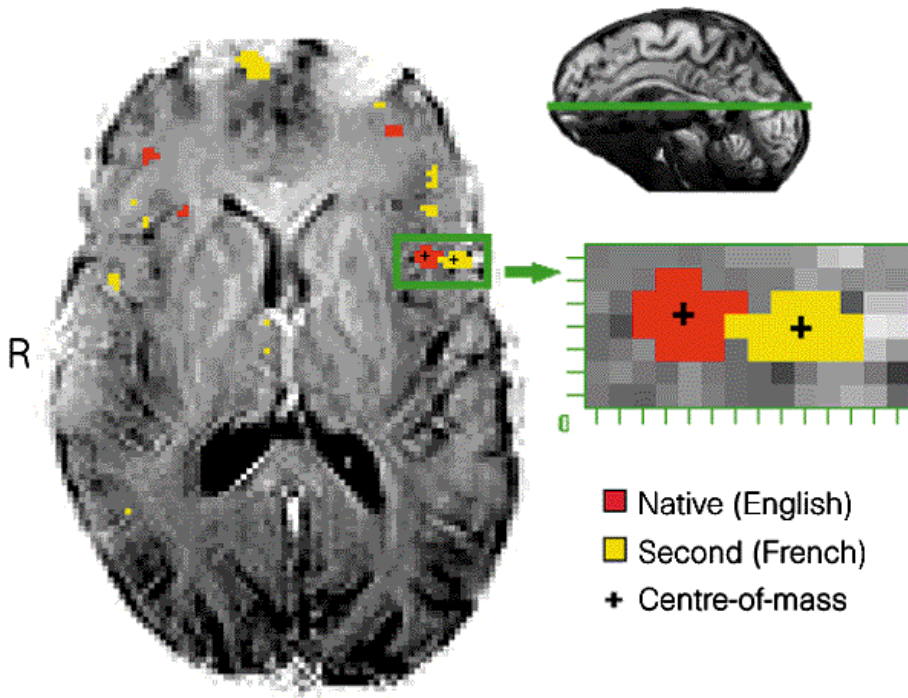


Kim et al. (1997)

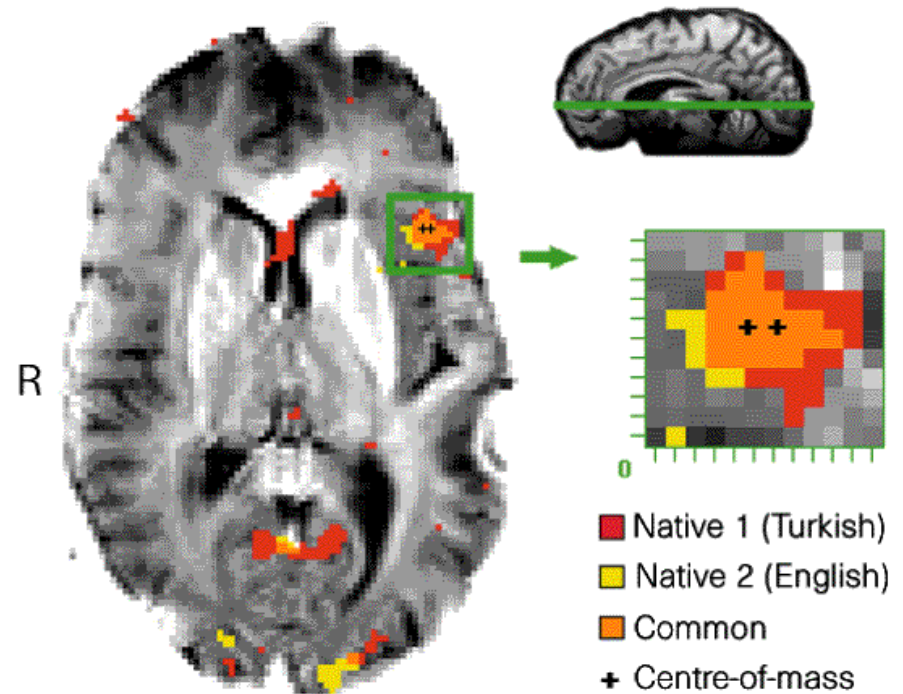




## Broca's area Late bilinguals



## Broca's area Early bilinguals



Kim et al. (1997)





How does the brain combine words into sentences?

What role do brain pathways play in meaning and grammar?

What are the structural and functional deficits underlying language impairments?

What can we learn from animals and AI?



# YOU ARE INVITED TO JOIN US

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- Learn more about key cognitive functions

Vision & perception, attention, memory, language,  
decision making, memory, time perception,  
and consciousness

- Delve into the underlying brain areas
- Understand the research methods used
- Explore classic and modern studies
- refine your critical thinking

