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PREPROCESSING IEEG DATA WITH MNE PYTHON

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ero del piace
sca il giorno o i giorni muoia - scorrà il
Nasca il giorno o il giorno muoia - impo luta mi ritrovi, al
o il giorno m
me ritrovi,
ah, ah
luta
o muoia

sentiero del piacere mio senti

ero del piace
sca il giorno o i giorni muoia - sentiero del
Sempre libra d'og'io Forlizzia
g'io Forlizza - muoia in gioco



Language and the brain

Wernicke, 1874

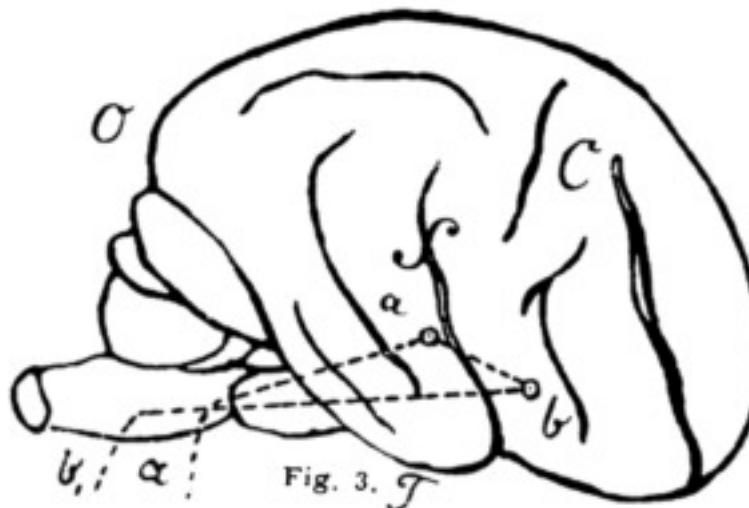
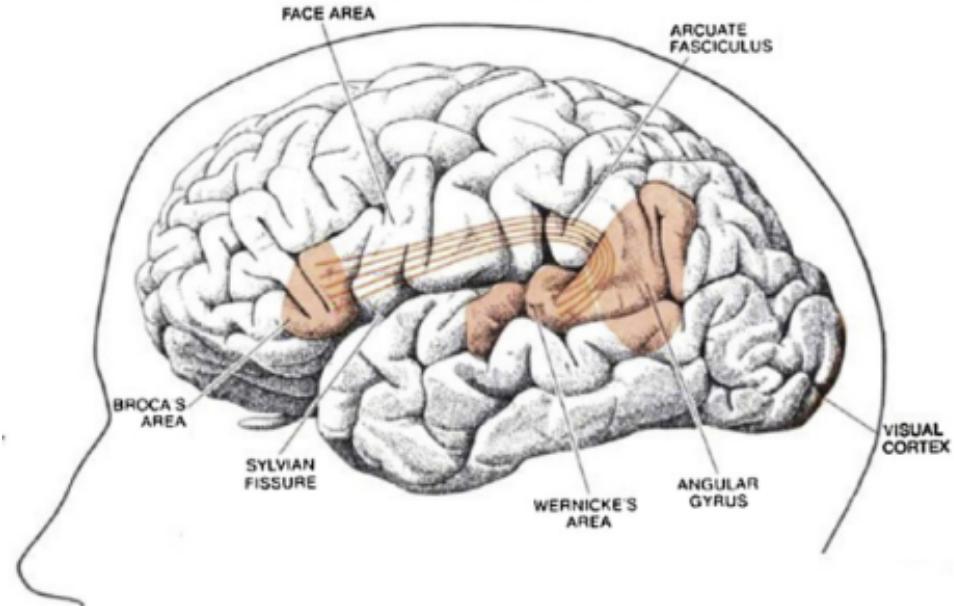


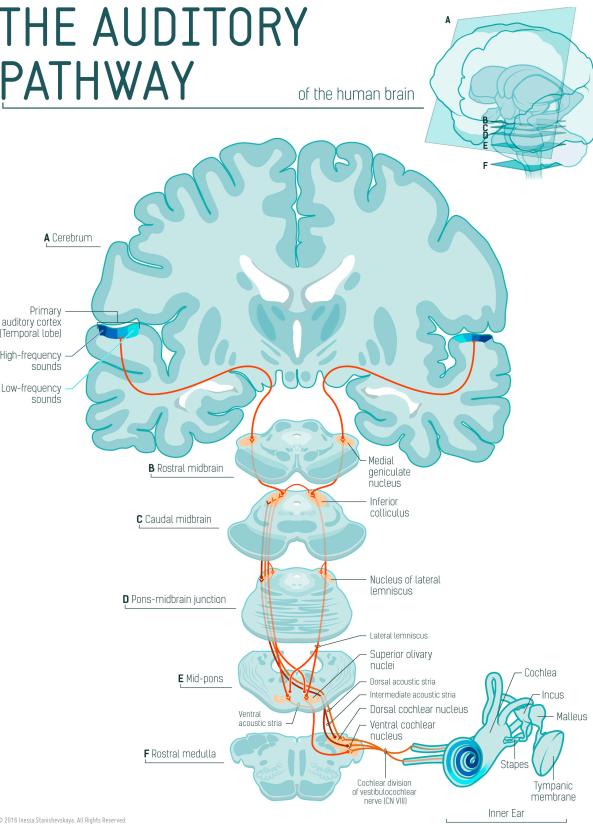
Fig. 3 [The speech areas and their connections. The "a" near the Sylvian fissure should have been designated "α".]

Geschwind, 1972





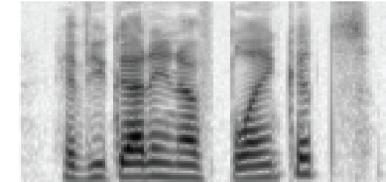
THE AUDITORY PATHWAY



Have you got enough blankets?

hiv|y gar in Af blæn kts

hivygariṇaʌblænkts



sentence

meaning

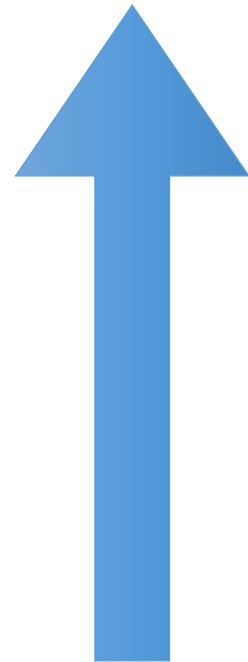
word

syllable

phoneme

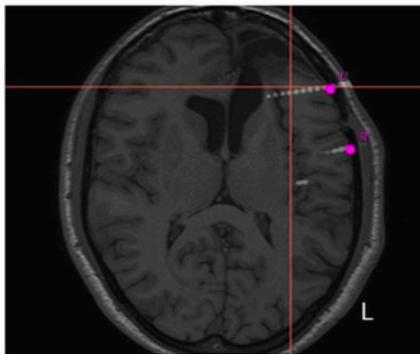
spectrot temporal
(frequency decomposition)

acoustic vibration

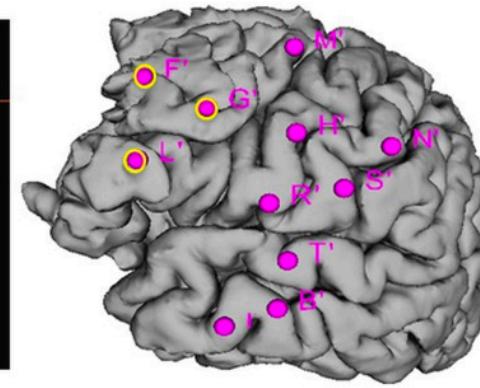




A



B



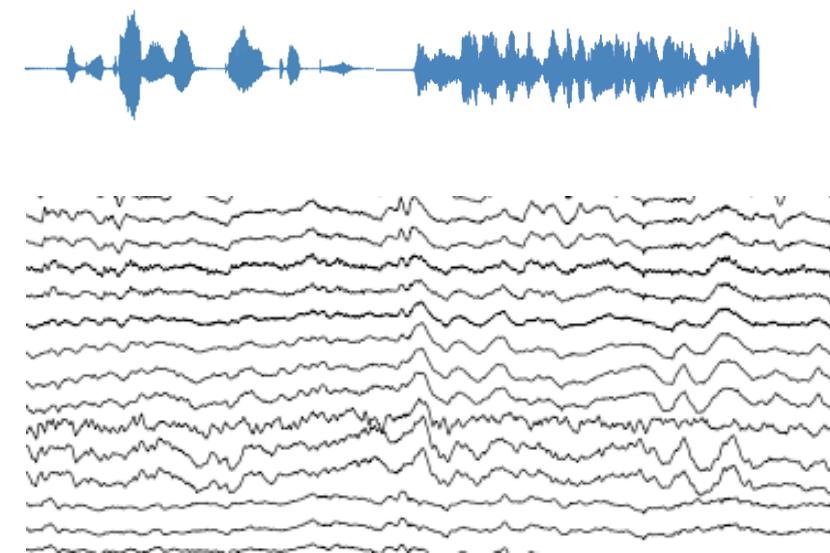
*Intracranial recordings
used clinically for seizure
localization*



a



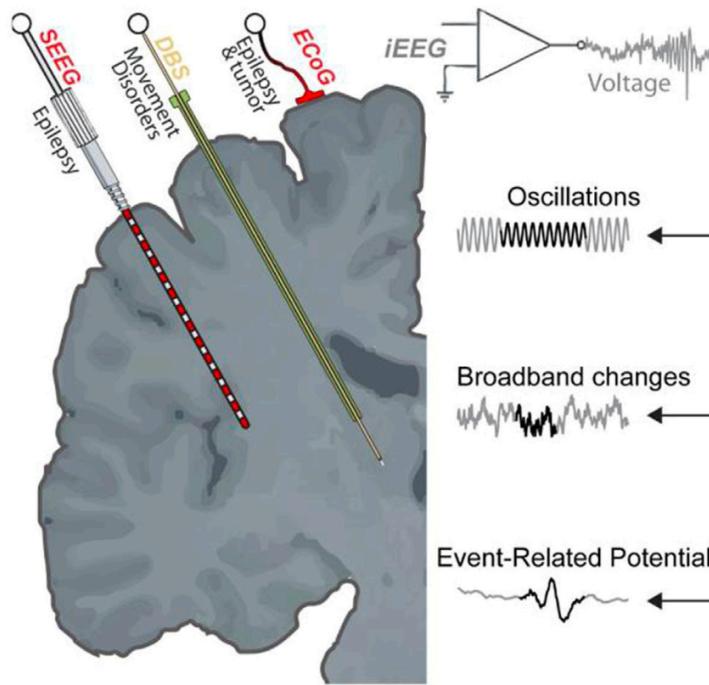
Miller Nature Human Behavior 2019



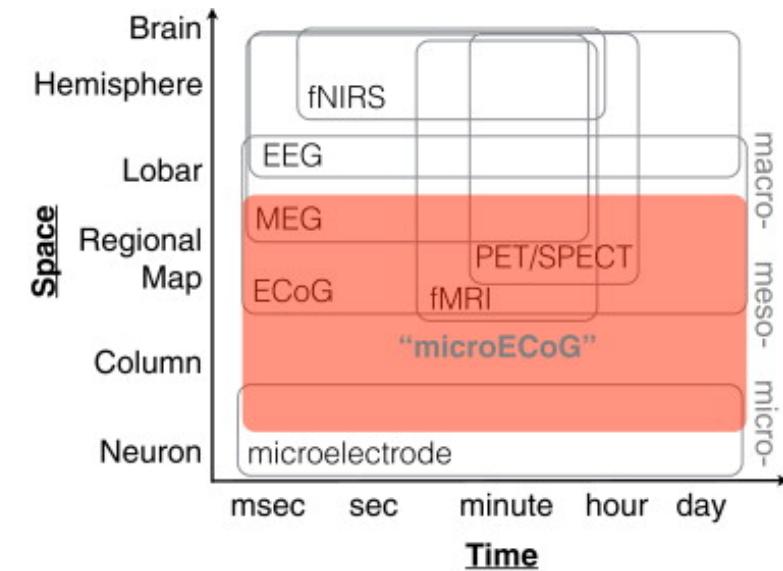
Intracranial recordings + cognitive tasks for research



How do signals differ?



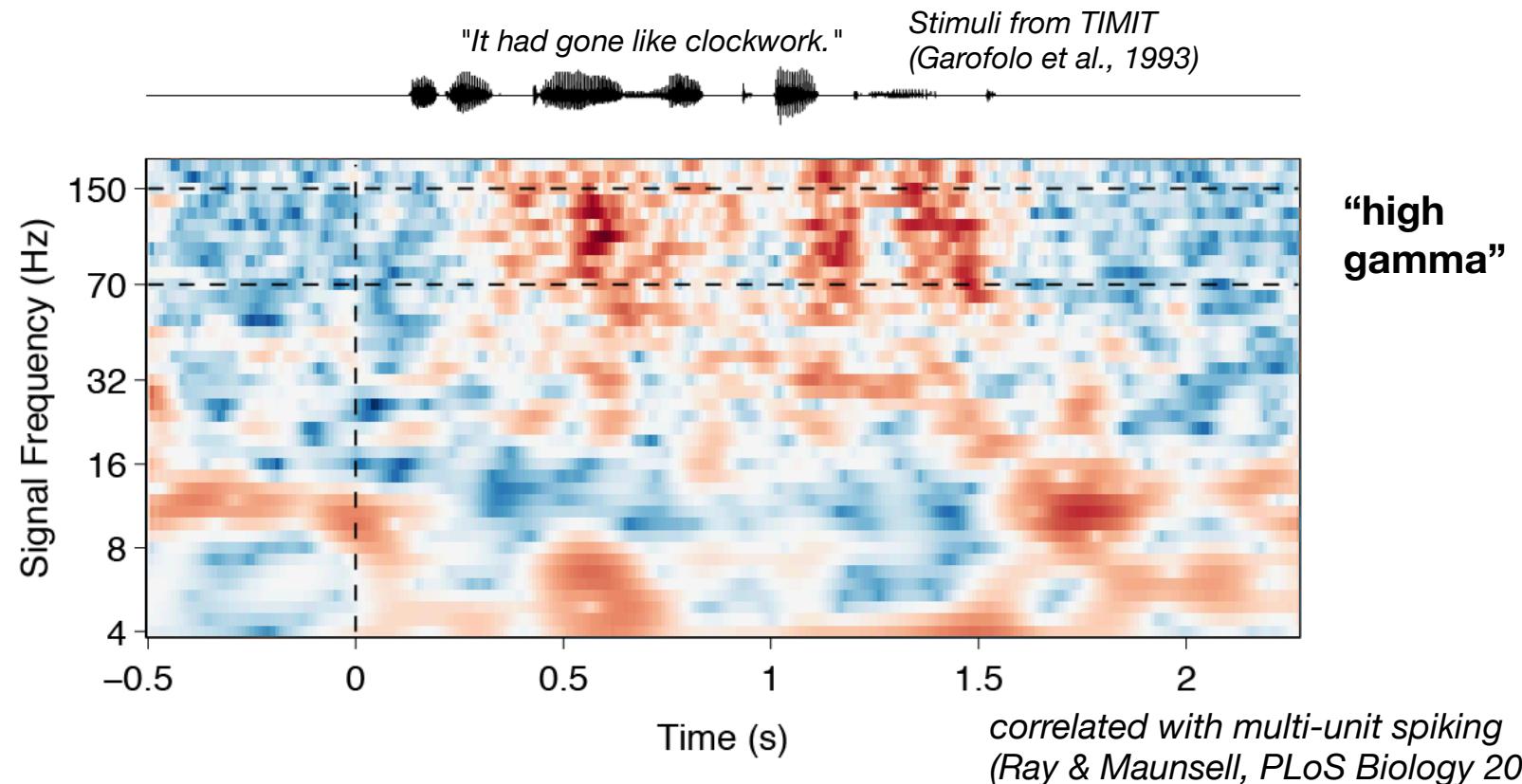
Mercier et al. *NeuroImage* 2022



Chang et al. *Neuron* 2015



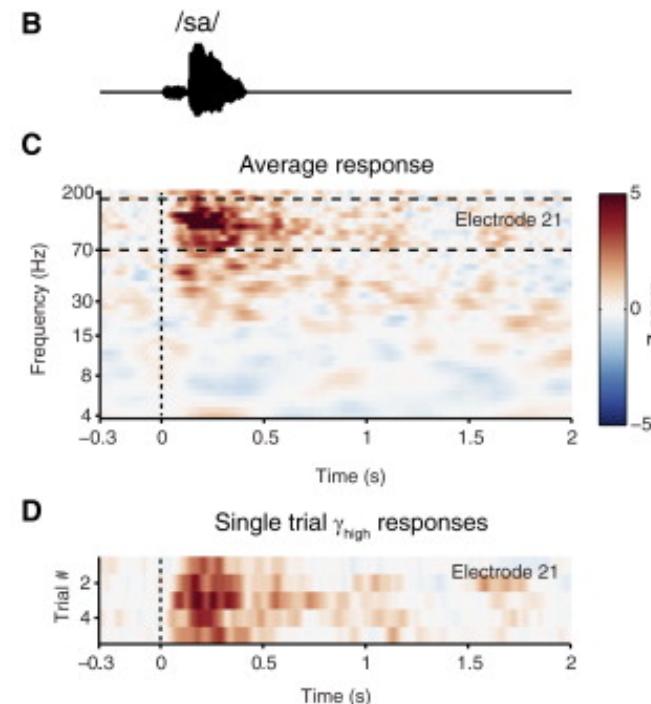
High gamma as an index of local neural activity





Advantages of intracranial recordings (iEEG)

- Can measure changes at fast timescales
 - Phonological information: /b/ vs. /p/
- You know where your signals are coming from
- Very high SNR, requires fewer trials than EEG/MEG



Chang et al. Neuron 2015



Disadvantages of intracranial recordings (iEEG)

- Coverage depends on clinical need, not your research question
- Invasive, must be done in patient populations
 - Epilepsy / tumor
- Relatively time-limited experiments / less controlled environment



Considerations when preprocessing iEEG data

- Environment is not as controlled as typical research environment
 - Background sounds!
- Where electrodes are located
- How electrodes are plugged into amplifier is important for (re)referencing
- Sources of electrical noise
- Acquisition sampling rate is important if you want high frequency activity





Different types of iEEG artifact

- Motion artifact
- Epileptiform artifact
- Chewing/jaw artifact
- VNS artifact (vagus nerve stimulator)



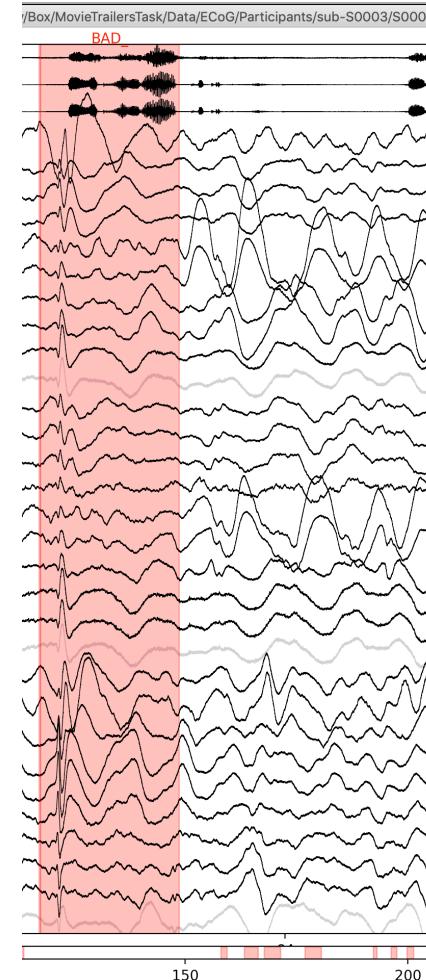
Seizure activity (left)





Spike wave

- An example of an epileptiform artifact - fast spike followed by a slow wave





VNS artifact

- Periodic, often at a different frequency from line noise or other artifacts



Tutorial

- We will load iEEG data with and without BIDs metadata
- Plot power spectrum
- Plot raw data and look for bad channels and artifacts
- Convert to high gamma analytic amplitude
- Plot evoked data