



**HAL**  
open science

## The contribution of sensory-motor interactions to imagined speech

Sophie Bouton, Timothée Proix, Stéphanie Martin, Anne-Lise Giraud  
Mamessier

► **To cite this version:**

Sophie Bouton, Timothée Proix, Stéphanie Martin, Anne-Lise Giraud Mamessier. The contribution of sensory-motor interactions to imagined speech. FENS Forum 2022, Jul 2022, Paris, France. . hal-04579676

**HAL Id: hal-04579676**

**<https://cnrs.hal.science/hal-04579676v1>**

Submitted on 21 May 2024

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

## RECONSTRUCTING SPEECH USING A BRAIN-MACHINE INTERFACE

Reconstructing speech from neural activity using brain-computer interfaces could make it easier for people with severe speech production deficits to communicate.

The decoding of **imagined speech** has met with only limited success, mainly because the **neural features of covert speech** are not precisely described.

Would sensory-motor interactions be a feature to exploit?

## COMPARING SILENCE READING AND IMAGINED SPEECH

Data from 21 participants were analysed

26 participants took part in the experiment. No triggers N = 2 participants, metallic object in the mouth N = 2, task not completed N = 1

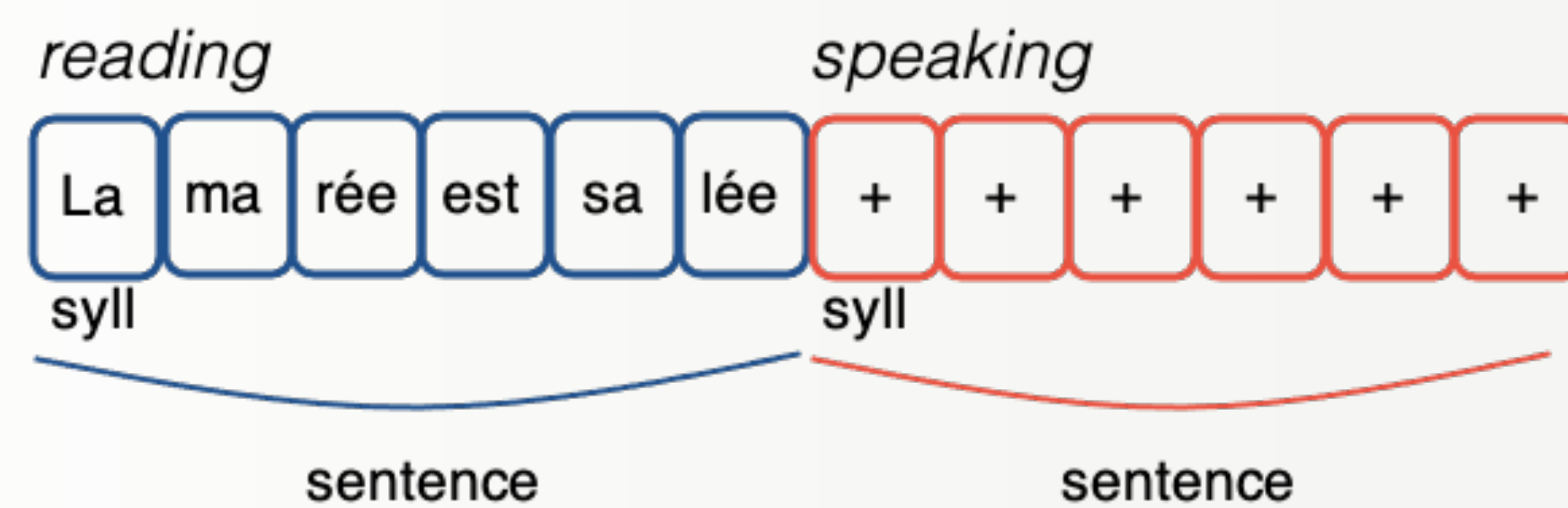
The MEG experiment consisted of a 1 h-long session.

- whole-head acquisition
- recording sampling rate of 2,035 Hz
- 3 EEG channels synchronized (2 for EOG, 1 for ECG)
- Polhemus

4D Neuroimaging magnes 3600



Paradigm

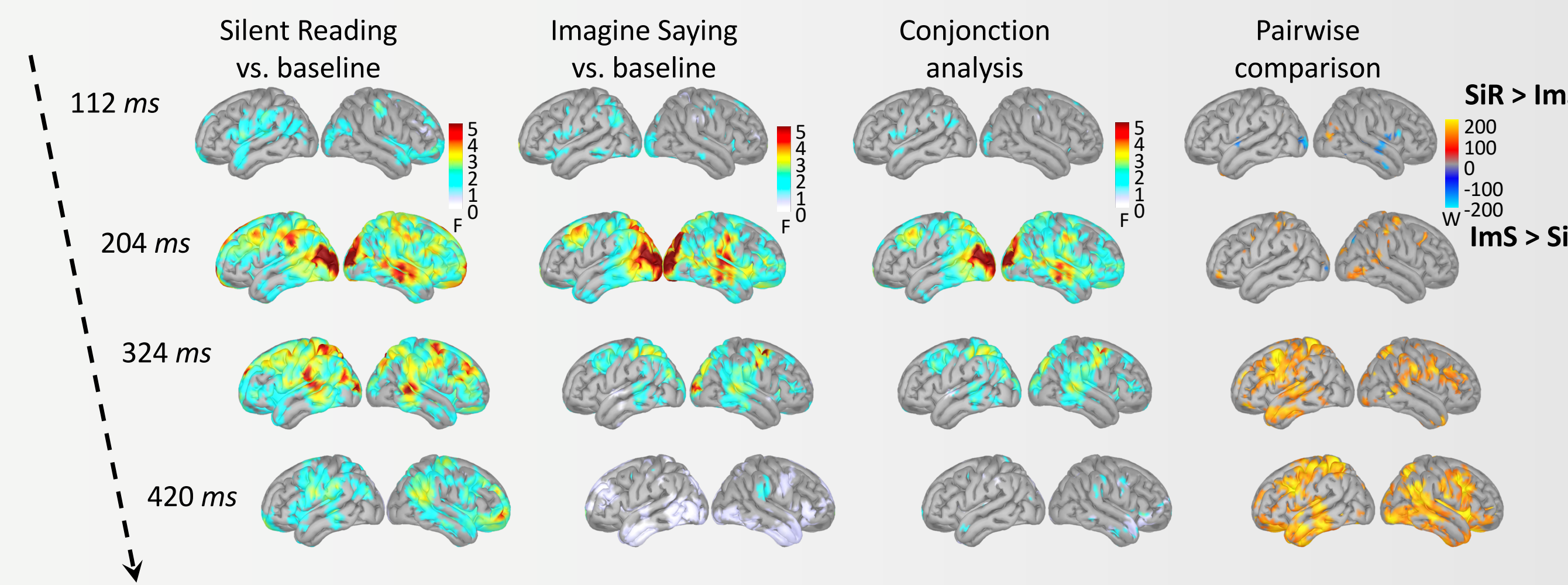


Syllabic stimulation sampling rate: 1.25 Hz

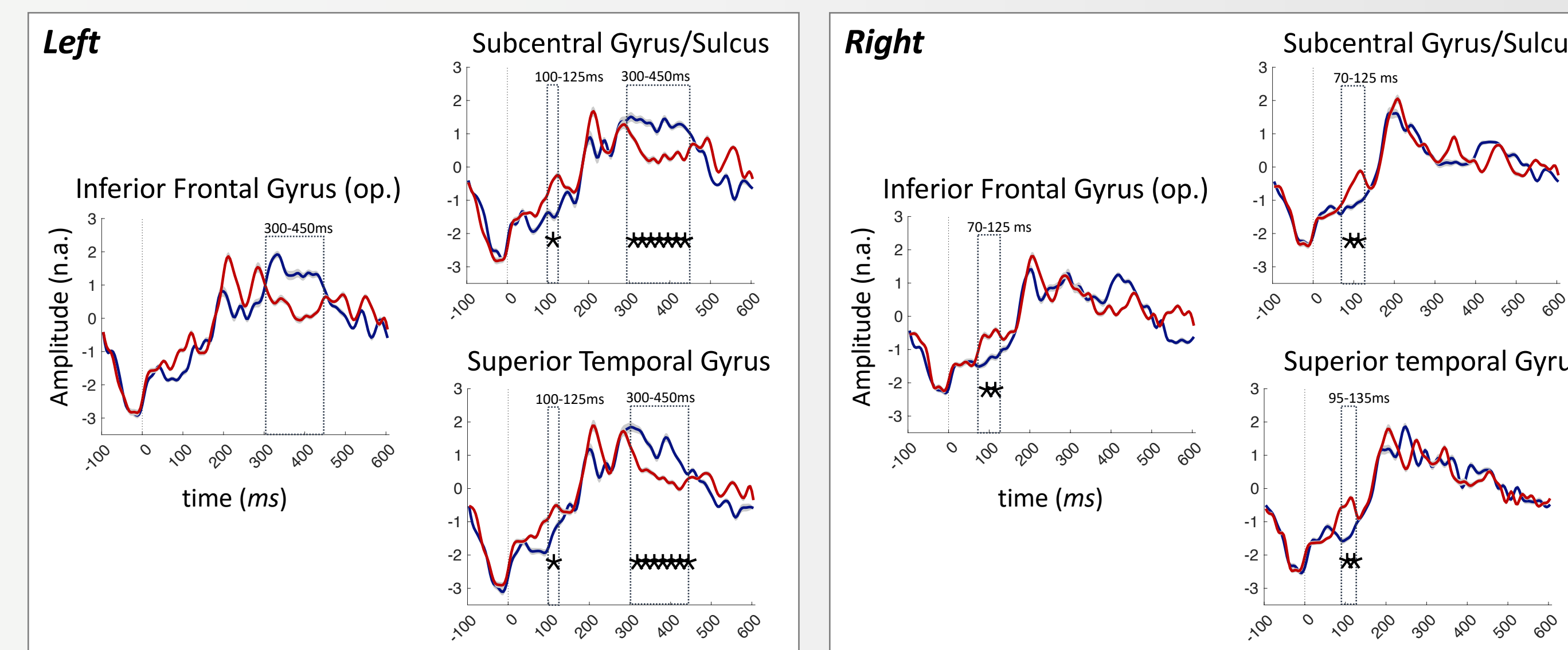
Hypothesis

The coupling between the **sensory-motor systems** is at the origin of the activation of syllabic and phonemic representations of **silent speech**.

## ERP – Analyses

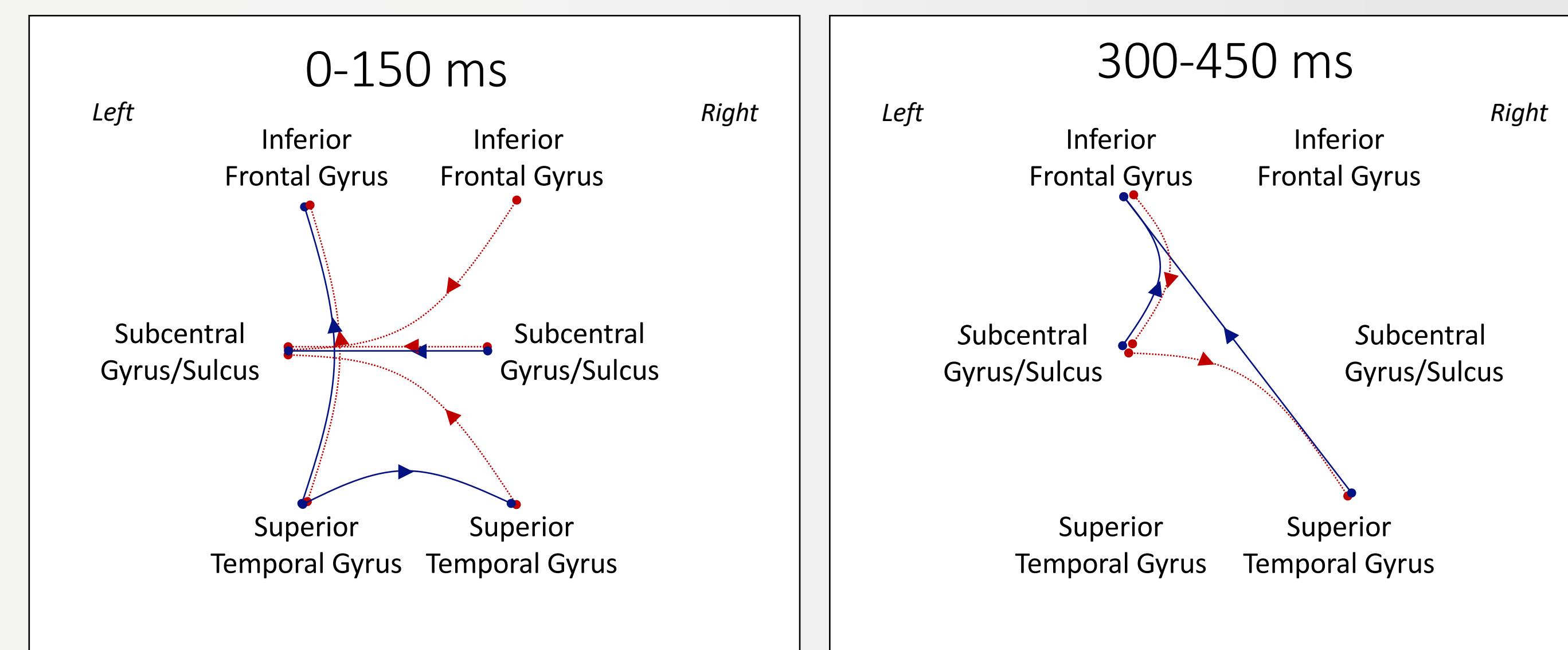


Regions of interest



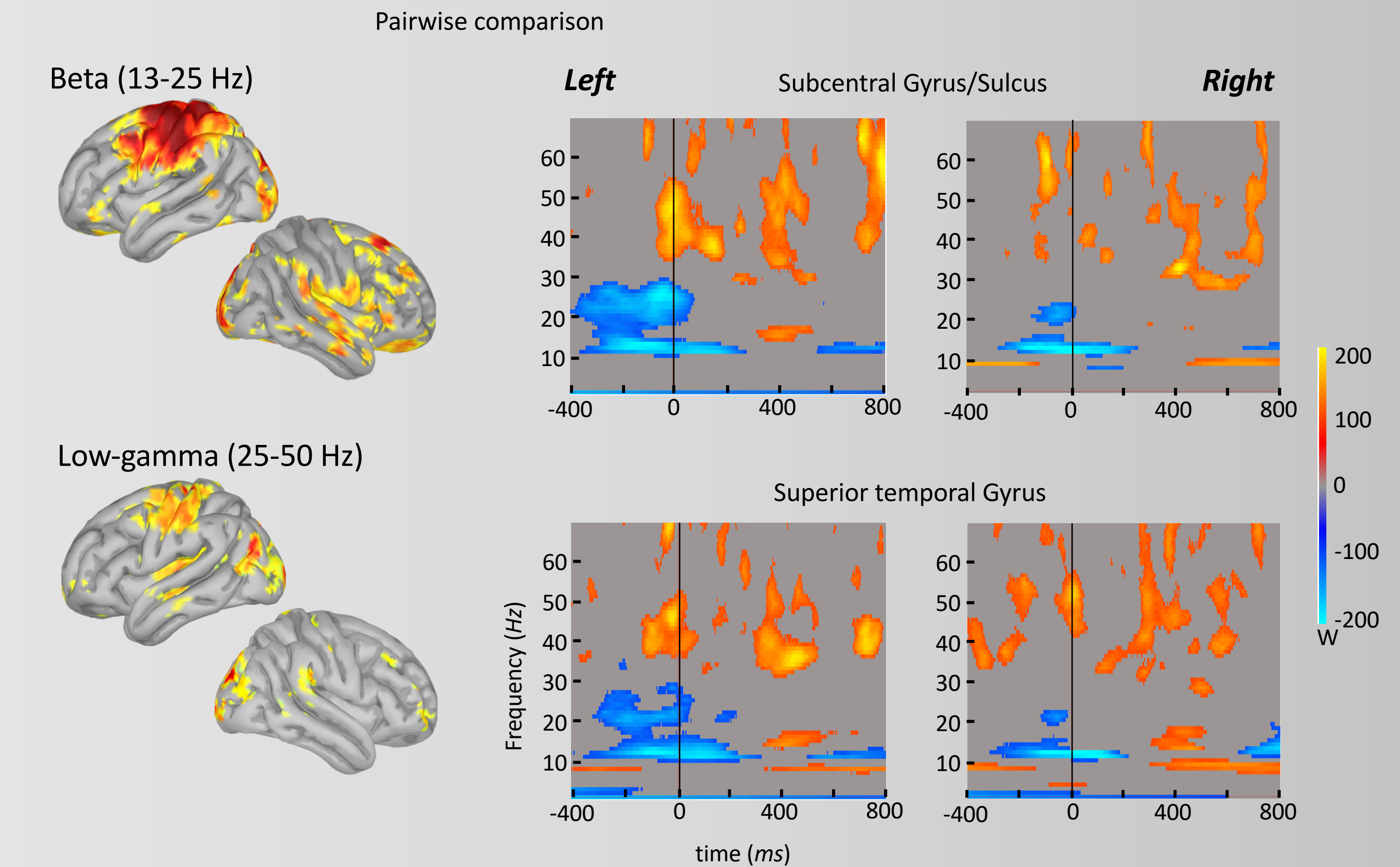
Silent Reading  
Imagine Saying

## Connectivity – granger analysis



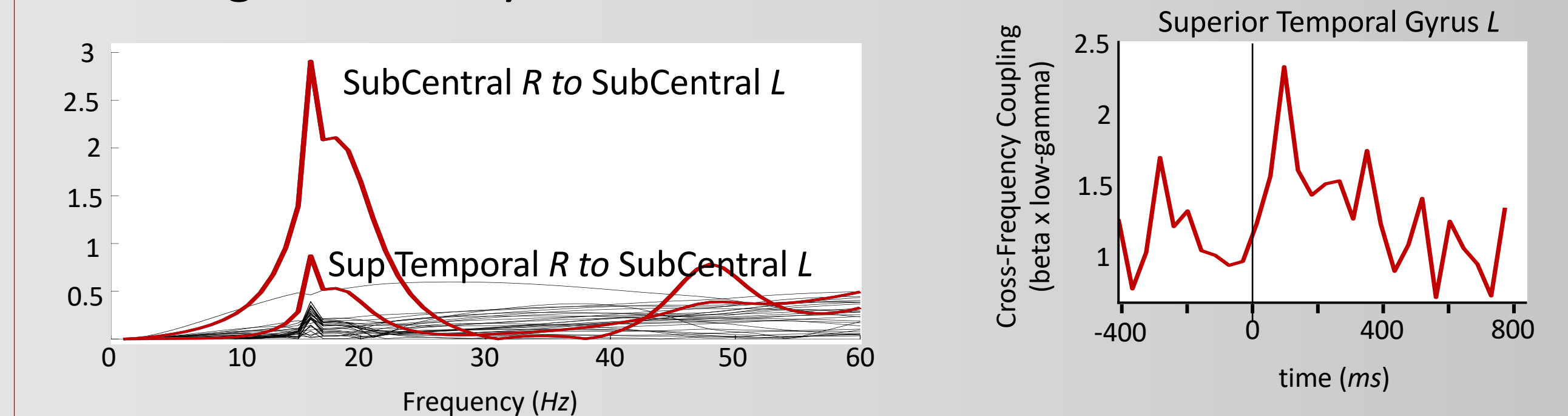
**Temporal and motor** areas show an earlier evoked response, and a stronger **early** information transfer in the **Imagine Saying** condition compared to the Silent Reading condition

## TF – Analyses



The production of **imagined speech** is associated with bursts of **beta (13-25 Hz)** neural oscillations in the **sensory and motor** areas.

## Granger Causality



In the **imagined speech** condition the propagation of information between motor and sensory areas is based on a **cross-frequency coupling** between beta and low gamma frequencies.

**Acknowledgments.** This work was funded by EU FET-BrainCom project (A-L. G.), and is supported by grants RD-2016-R (the Fondation pour l'Audition to S.B.) and 193542 (Swiss National Science Foundation career grant to T.P.).