



HAL
open science

Compensatory movement of the tongue for speech production with or without masking noise

Morgane Bourhis, Pascal Perrier, Christophe Savariaux, Takayuki Ito

► To cite this version:

Morgane Bourhis, Pascal Perrier, Christophe Savariaux, Takayuki Ito. Compensatory movement of the tongue for speech production with or without masking noise. SMC 2022 - 8th International Conference on Speech Motor Control, Aug 2022, Groningen, Netherlands. . hal-03878063

HAL Id: hal-03878063

<https://hal.science/hal-03878063>

Submitted on 29 Nov 2022

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.

COMPENSATORY MOVEMENT OF THE TONGUE FOR SPEECH PRODUCTION WITH OR WITHOUT MASKING NOISE

Morgane Bourhis¹, Pascal Perrier¹, Christophe Savariaux¹, Takayuki Ito^{1,2}
 1: Univ. Grenoble Alpes, CNRS, Grenoble-INP, GIPSA-lab 2: Haskins Laboratories



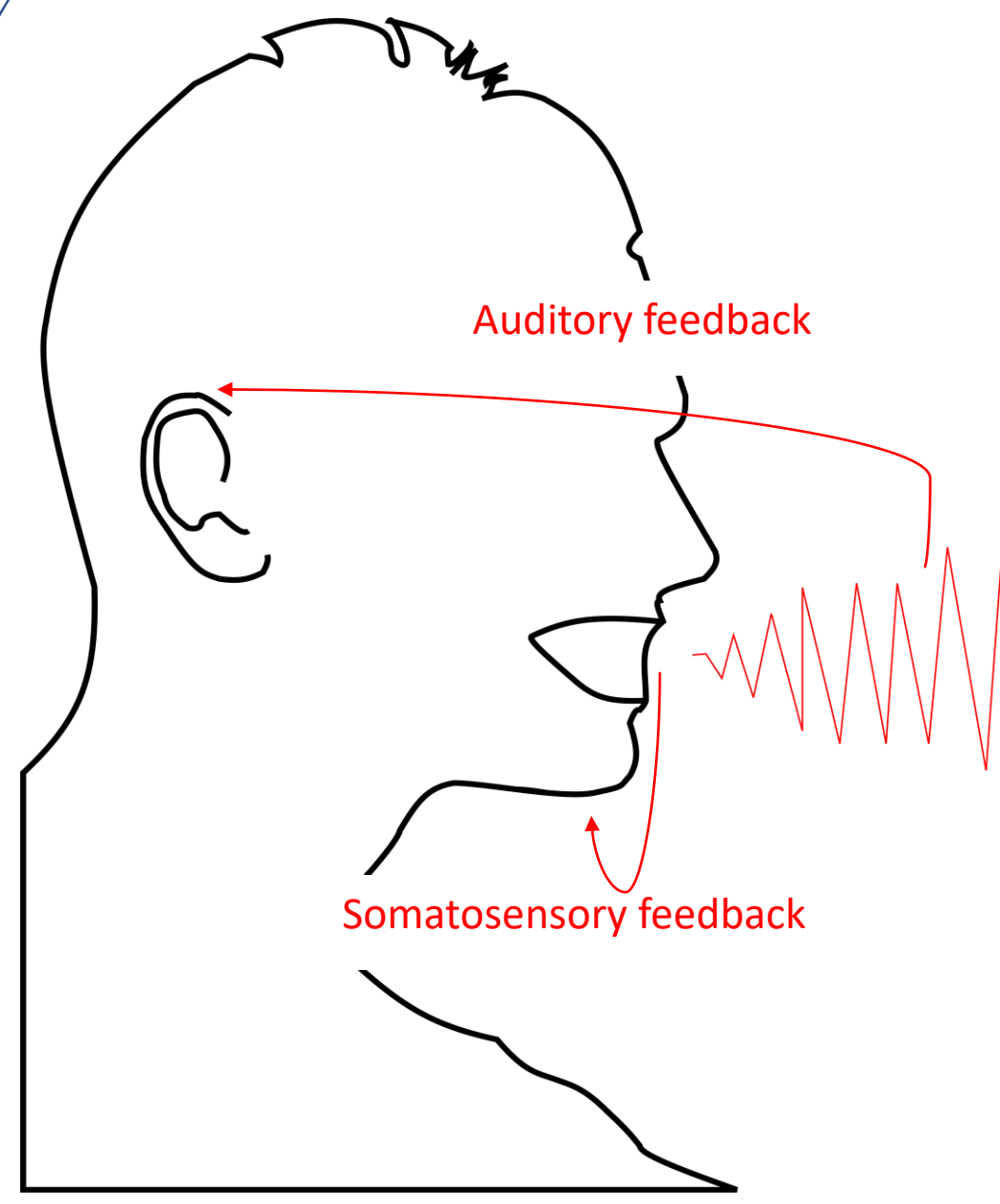
Objective
 Does a perturbation of the tongue during speech production induce compensatory response in the absence of auditory feedback?

Introduction

Sensory feedback for speech production

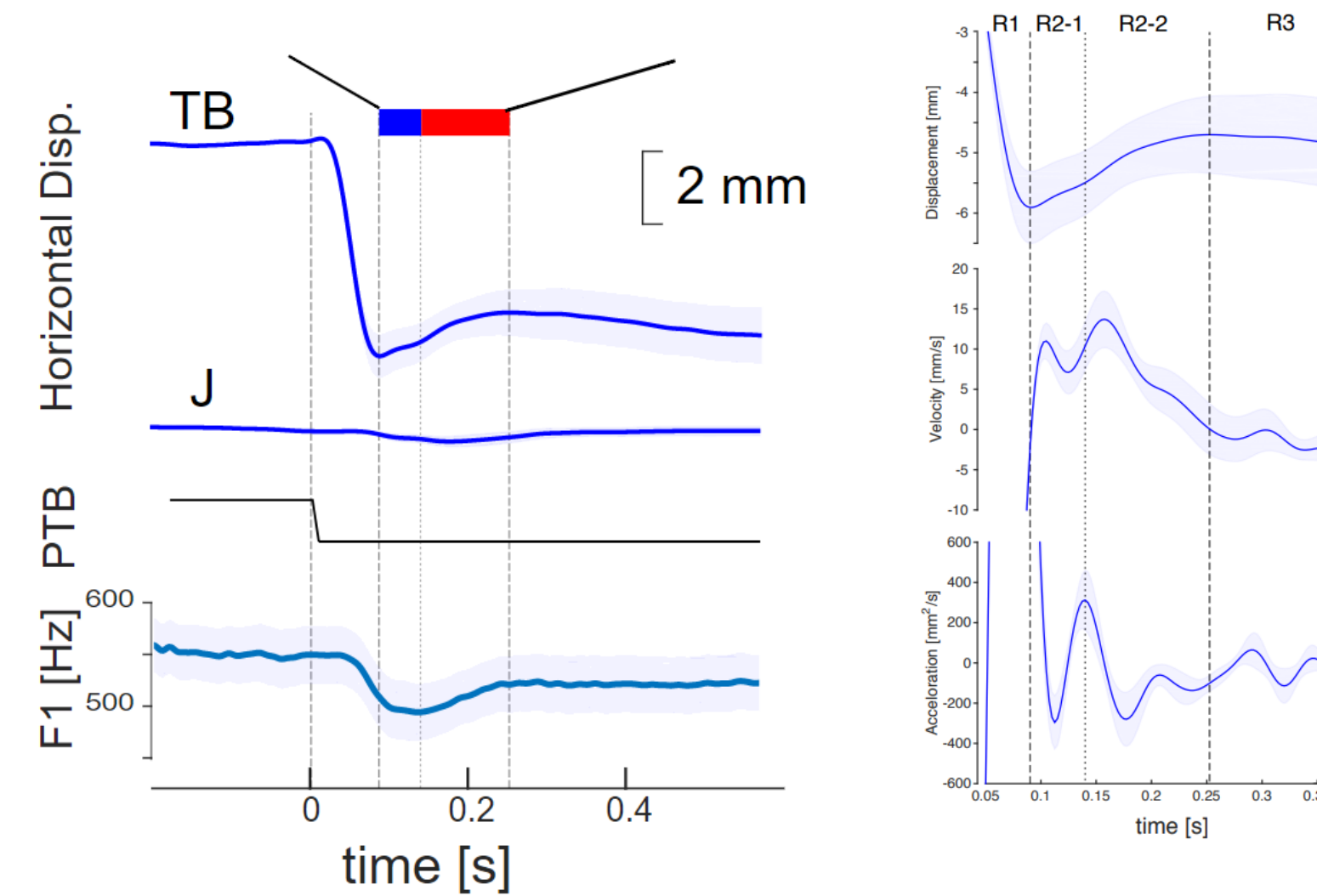
Somatosensory and auditory inputs play an important role in speech production (Guenther and Hickok, 2015).

Speech somatosensory goal can be achieved even in the absence of auditory error (Tremblay et al. 2003).



Compensatory movement of the tongue

The tongue showed quick compensatory response working for stabilizing the tongue contour and maintaining the resultant produced sound (Ito et al. 2020).



This compensatory response may be driven by somatosensory feedback alone.

Methods

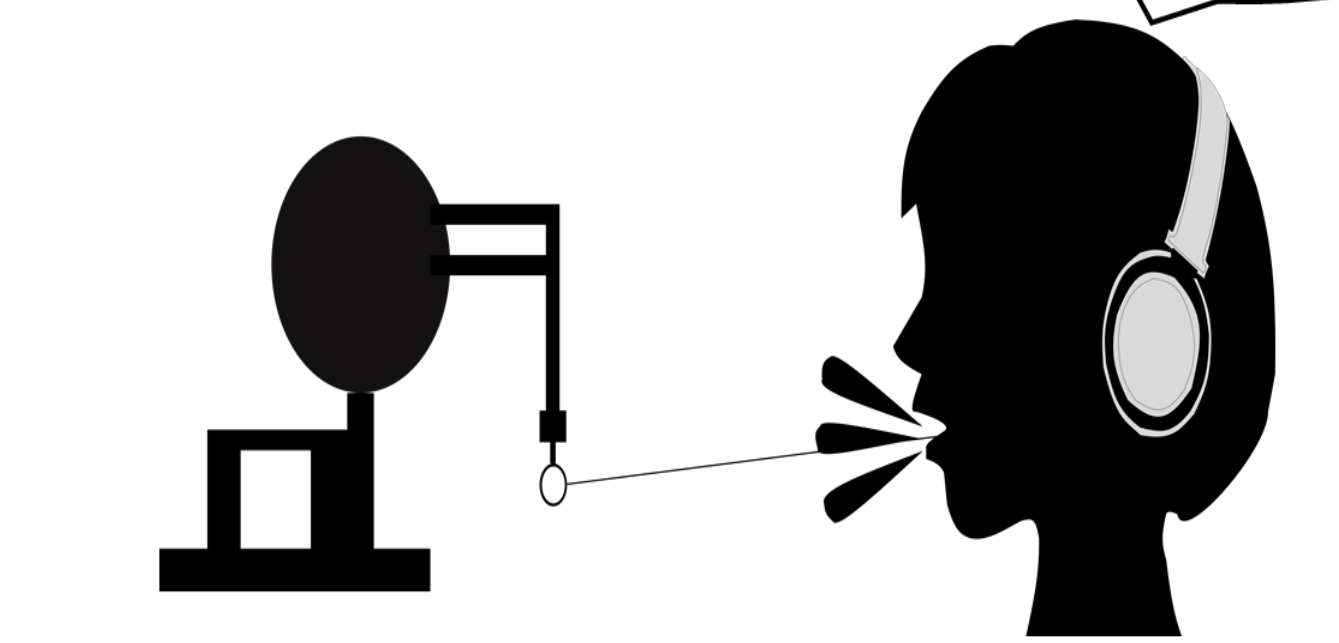
Subjects: 12 native French speakers

Trials : 3 sessions of 50 trials (+ 5 control trials)

Speech Task: whispering the vowel /e/ for 3.5 sec after the presentation of green circle.

Tongue Perturbation: Step-wise pattern (1 N for 1 s) at TP in randomly selected 1/5 of the trials.

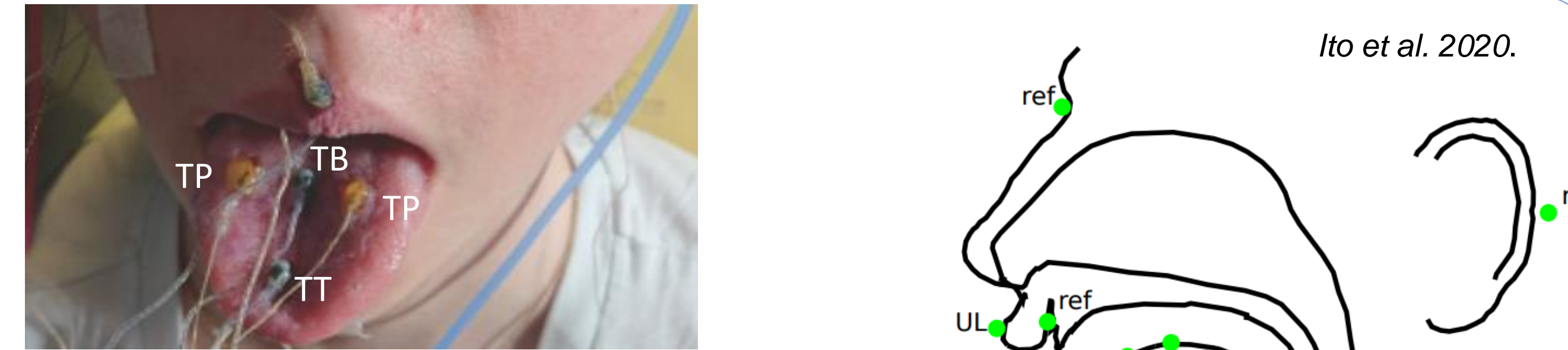
ééééé....



Perturbation condition 1/5 of the trials | Pink Noise | Silence

Auditory masking and no masking conditions were tested in random order.

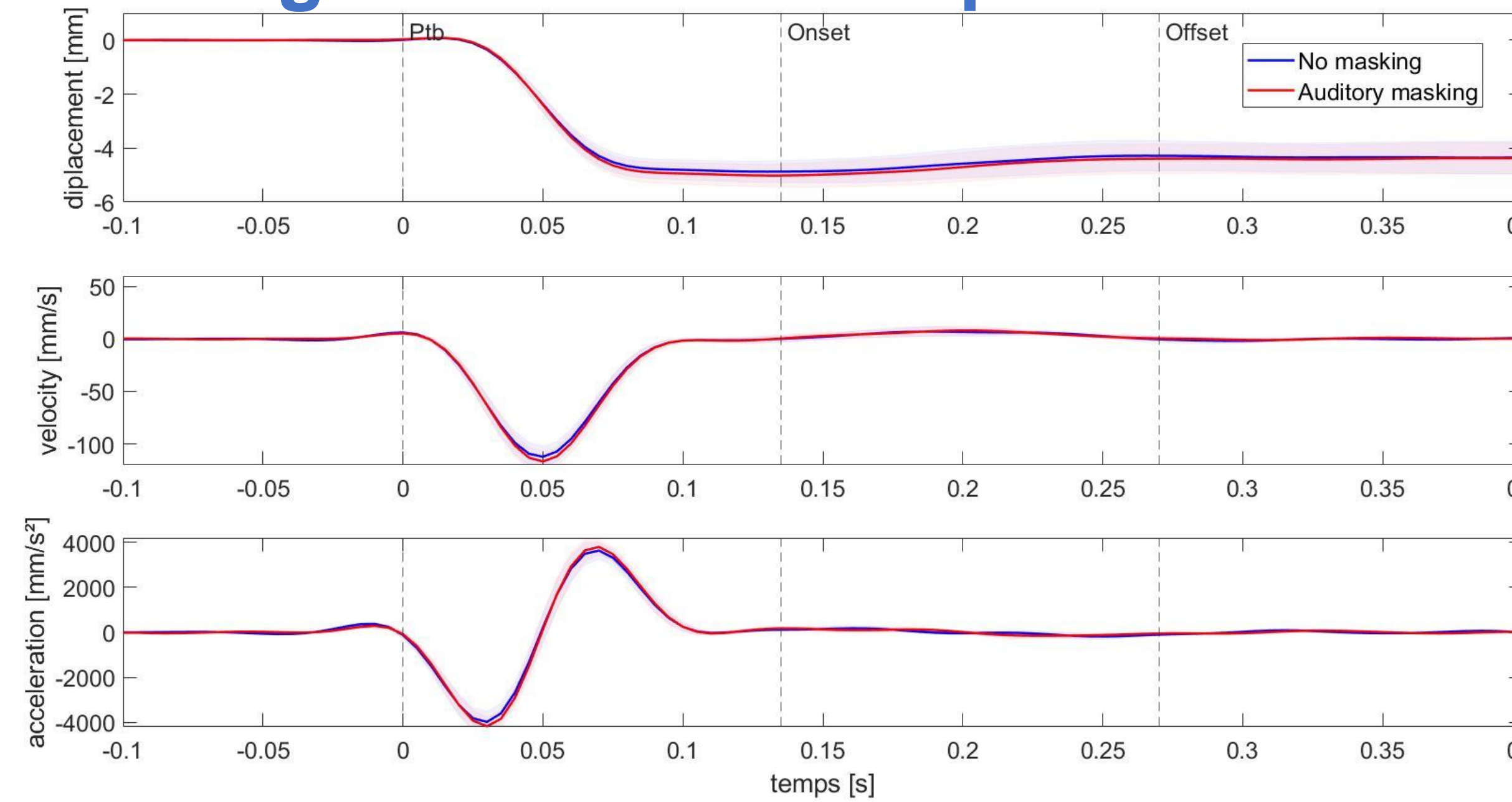
Produced sound and articulatory movement were recorded through the Wave system



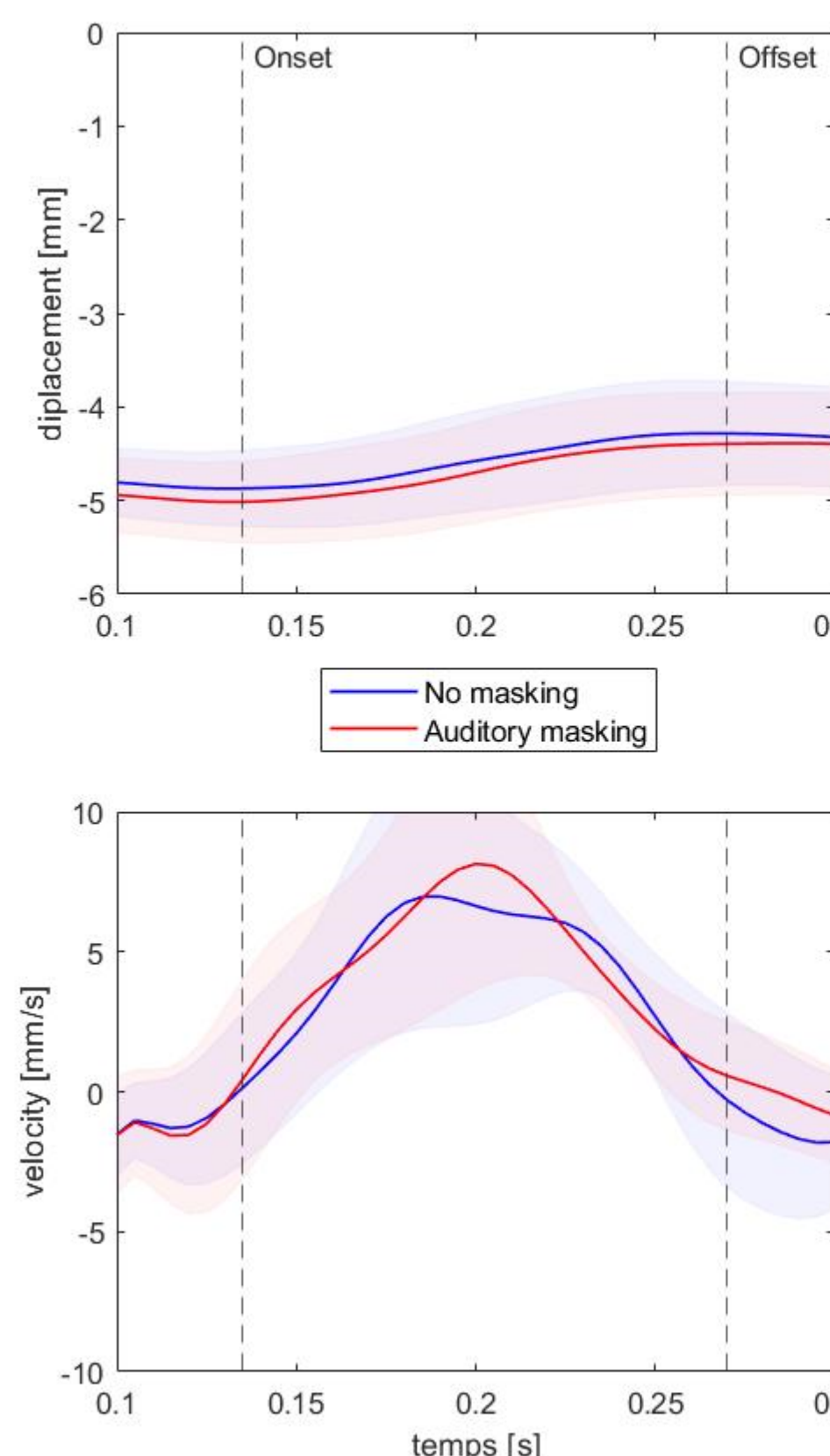
Sensor locations: Tongue Tip (TT), Blade (TB), and Dorsum (TD), Upper Lip (UL), Lower Lip(LL), and Jaw (J)
 Data were aligned at perturbation onset and were averaged across trials. Averaged movement and standard error has been calculated across subjects. A two way ANOVA on the TB position was applied in which auditory conditions and onset and peak of compensatory movement were considered as main factor. A one way ANOVA was also applied on the displacement before the perturbation.

Results

Averaged horizontal displacement at TB



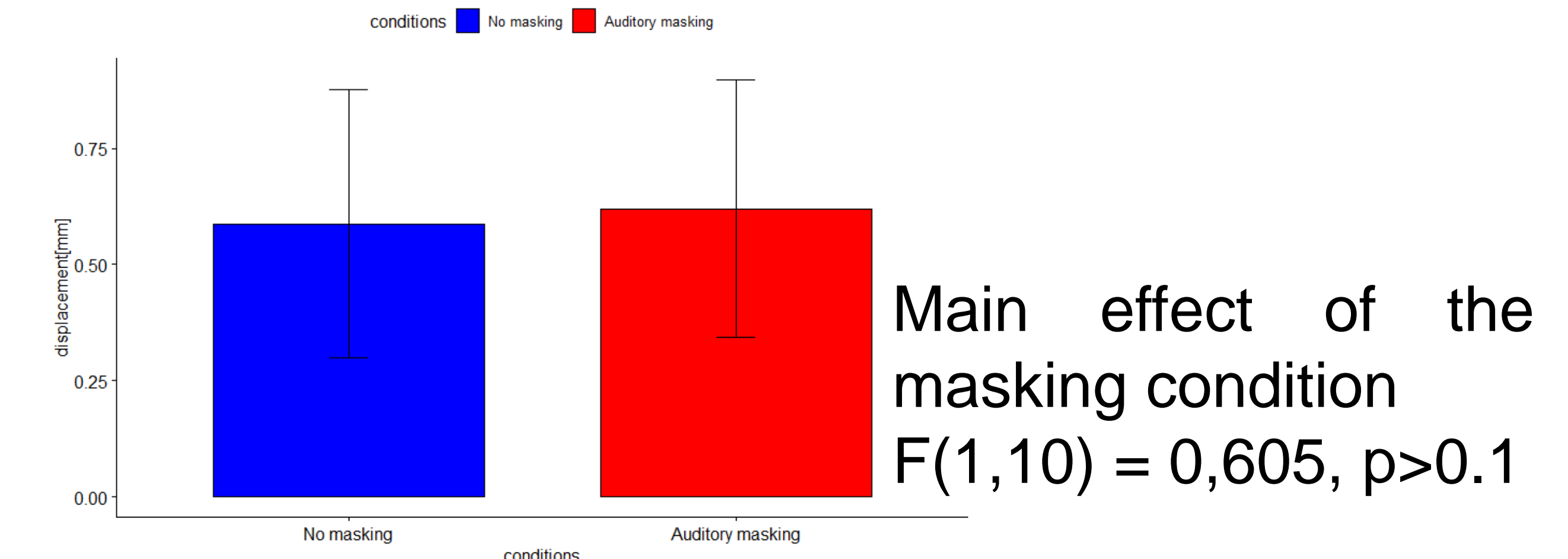
Magnified view between 100 and 300 ms



The responses were similar to the ones in Ito et al (2020). Difference between onset of compensatory movement and peak of compensatory movement were significant ($F(1,10)=10.279$, $p<0,05$) indicating that The compensatory responses were induced.

The position at TB was not significantly different between the no masking and auditory masking condition before the perturbation ($F(1,10)=0,05$, $p>0,1$).

Amplitude of the compensatory responses



Main effect of the masking condition $F(1,10) = 0,605$, $p>0.1$
The responses were similar in with and without auditory masking conditions.

Conclusion & perspectives

Compensatory movements were induced regardless of auditory masking.

The current compensatory response can be not of auditory-basis, but of somatosensory-basis.

Further analysis of produced speech sound and kinematic movement are required.

We will further investigate the current hypothesis by studying on hearing impaired participants, which is equivalent with the current experimental condition, and deafferented subjects, who lost somatosensory feedback.

References

- Guenther, F. H., & Hickok, G. (2015). Role of the auditory system in speech production. In Handbook of Clinical Neurology (1st ed., Vol. 129). Elsevier B.V. <https://doi.org/10.1016/B978-0-444-62630-1.00009-3>
- Ito, T., Szabados, A., Caillet, J. L., & Perrier, P. (2020). Quick compensatory mechanisms for tongue posture stabilization during speech production. Journal of Neurophysiology, 123(6), 2491–2503.
- Tremblay S, Shiller DM, Ostry DJ (2003) Somatosensory basis of speech production. Nature 423:866–869.

Funding

This work was supported by Agence Nationale de la Recherche (ANR-21-CE28-0022) and National Institute on Deafness and Other Communication Disorders (R01-DC017439).

Contact

Morgane.Bourhis@Grenoble-inp.fr