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Effect of masking noise on tongue compensatory movement following a mechanical perturbation

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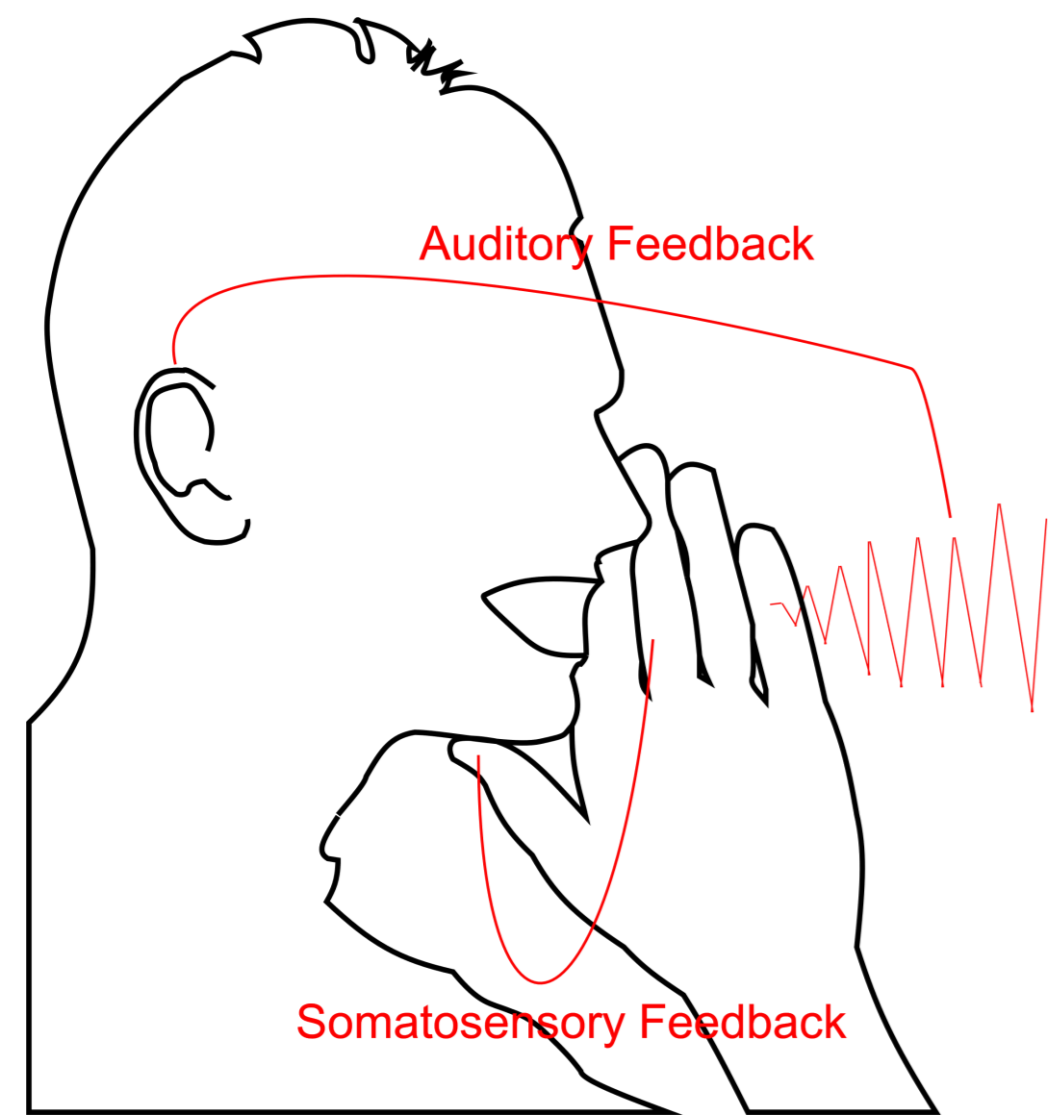
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Effect of masking noise on tongue compensatory movement following a mechanical perturbation

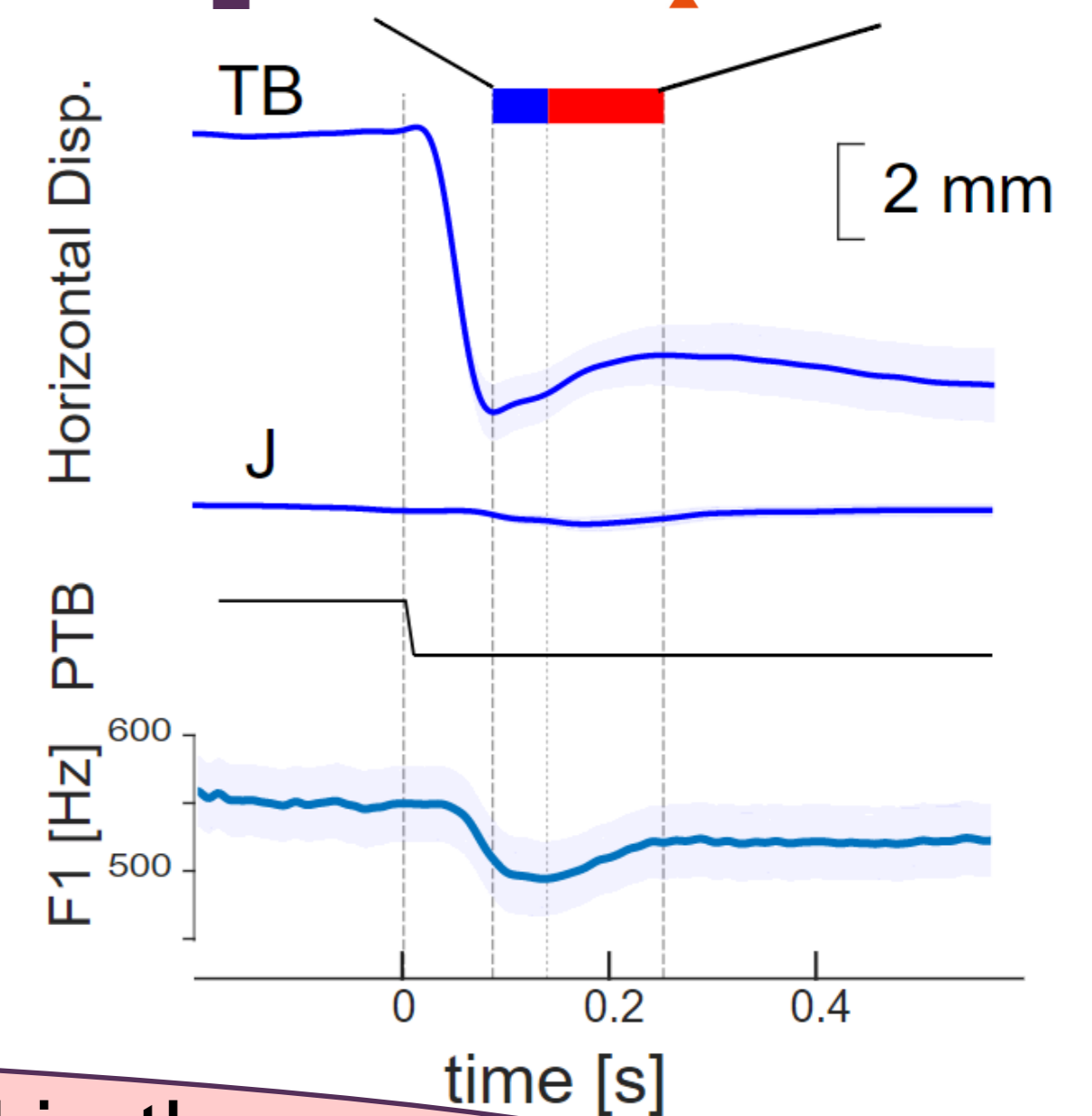
Introduction

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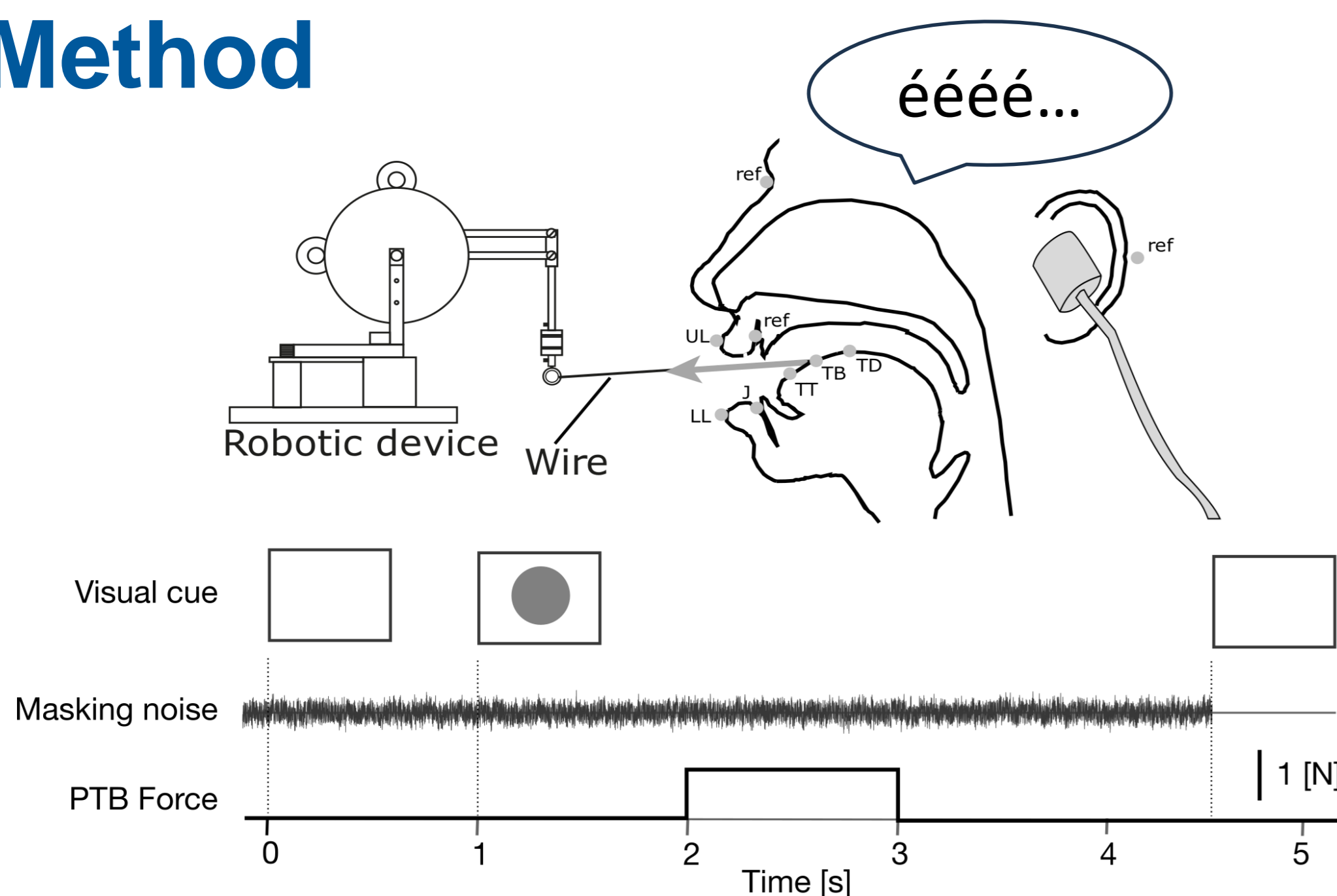
Somatosensory and auditory inputs play an important role in speech production (Guenther and Hickok, 2015). During speech, somatosensory error is corrected even in the absence of auditory error (Tremblay et al. 2003).

The tongue showed quick compensatory response for stabilizing the tongue contour and maintaining the resultant produced sound (Ito et al. 2020). This compensatory response can be driven by somatosensory feedback alone.



Can the compensatory response of the tongue during speech production be changed in the absence of auditory feedback?

Method



Participants: 12 native speaker of French.

Speech task: sustain whispered sound of the /e/ with 150 repetitions.

Auditory conditions: (1) auditory masking (2) no masking.

Tongue perturbation: 1 N of the force with stepwise shape for 1 [s].

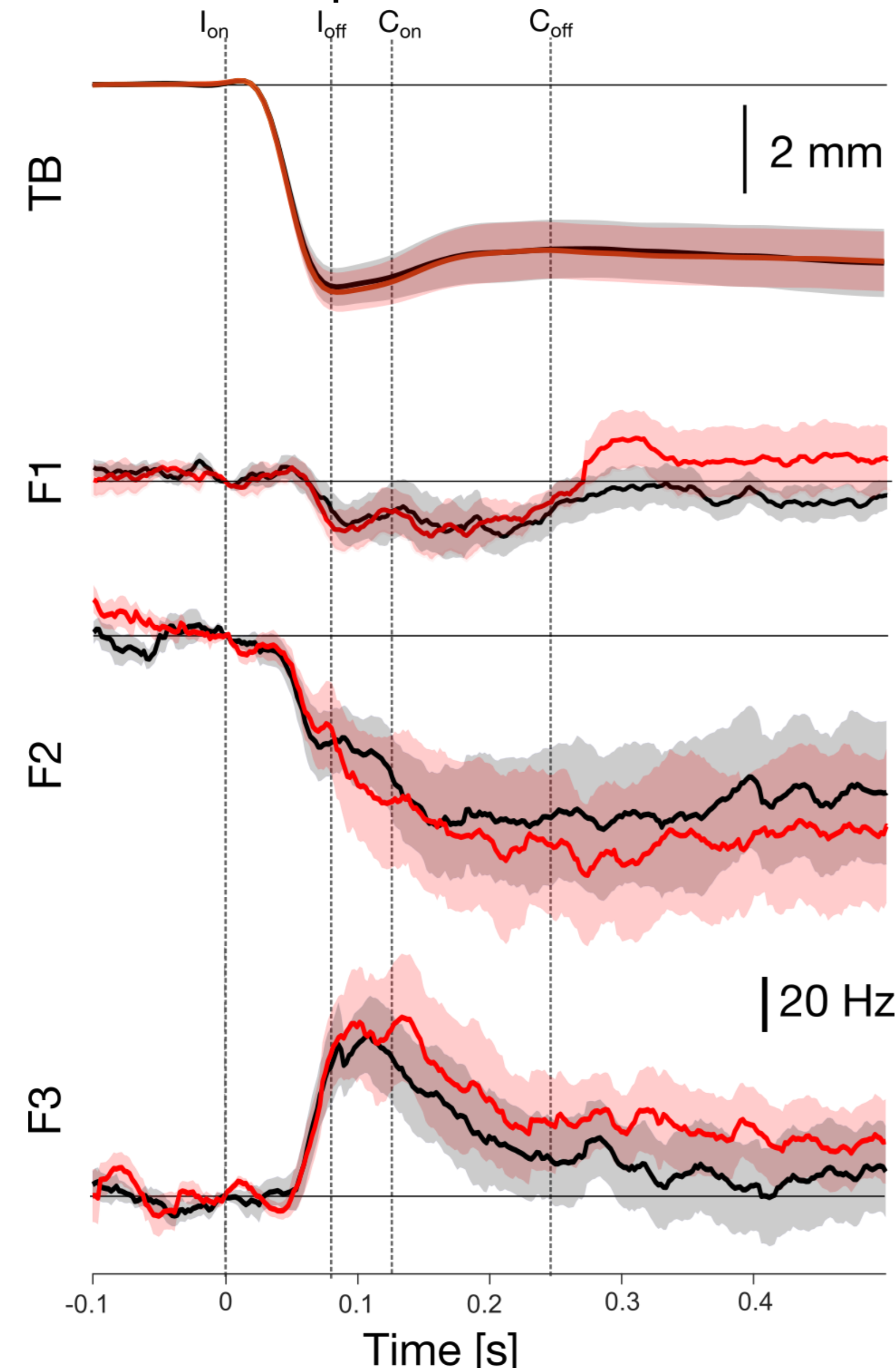
Articulatory measurements: tongue tip, blade and dorsum (TT, TB and TD), jaw (J), upper and lower lip (UL and LL), 4 references (ref: upper incisor, left and right mastoid, and nasion)

Data preprocessing:

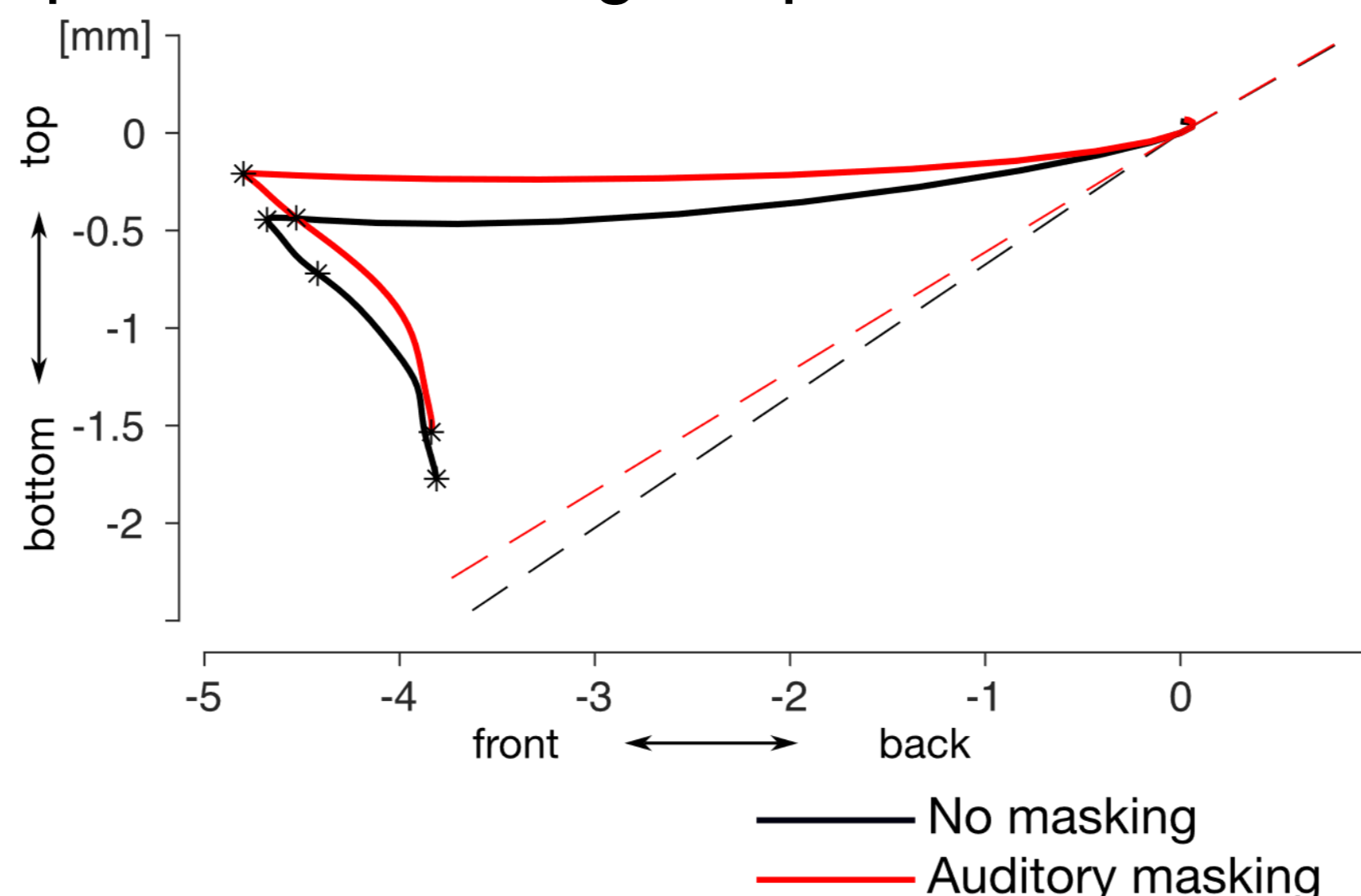
- Movement: (1) Head movement correction (2) Data alignment at the perturbation onset (3) Removal of jaw movement data from the tongue data.
- Speech sound: Extract three formants (F1, F2 and F3).

Results

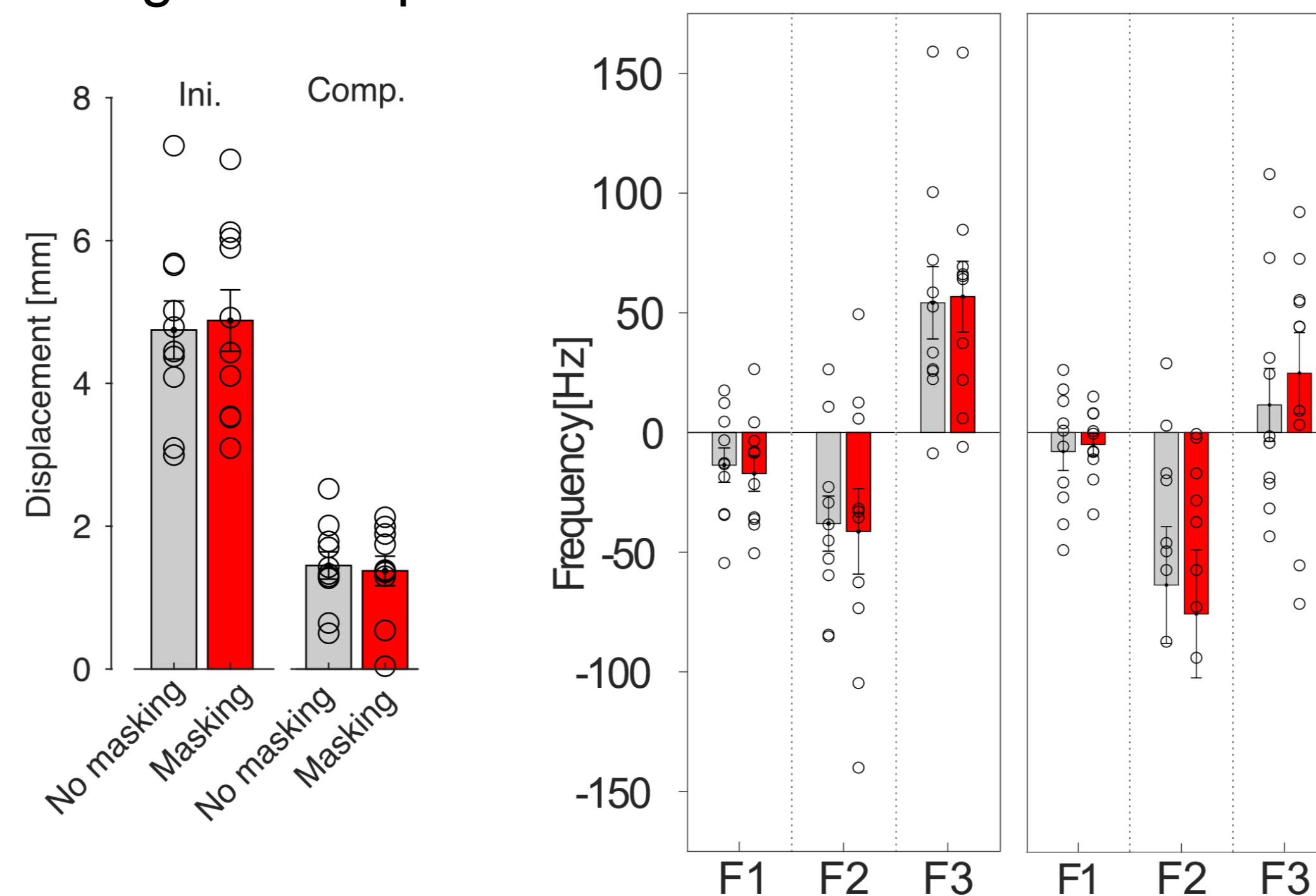
Horizontal displacement and formants



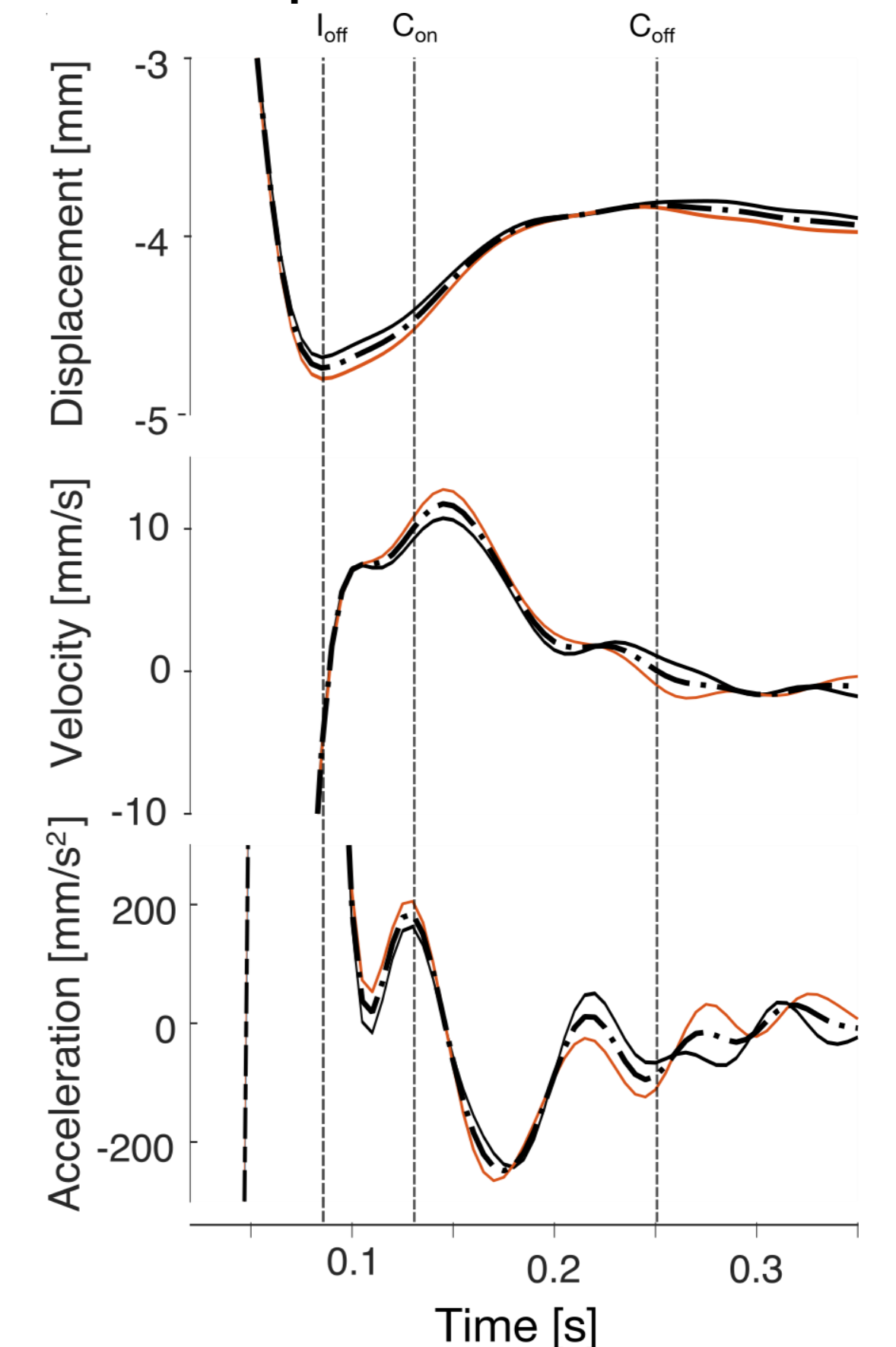
Displacement in sagittal plane



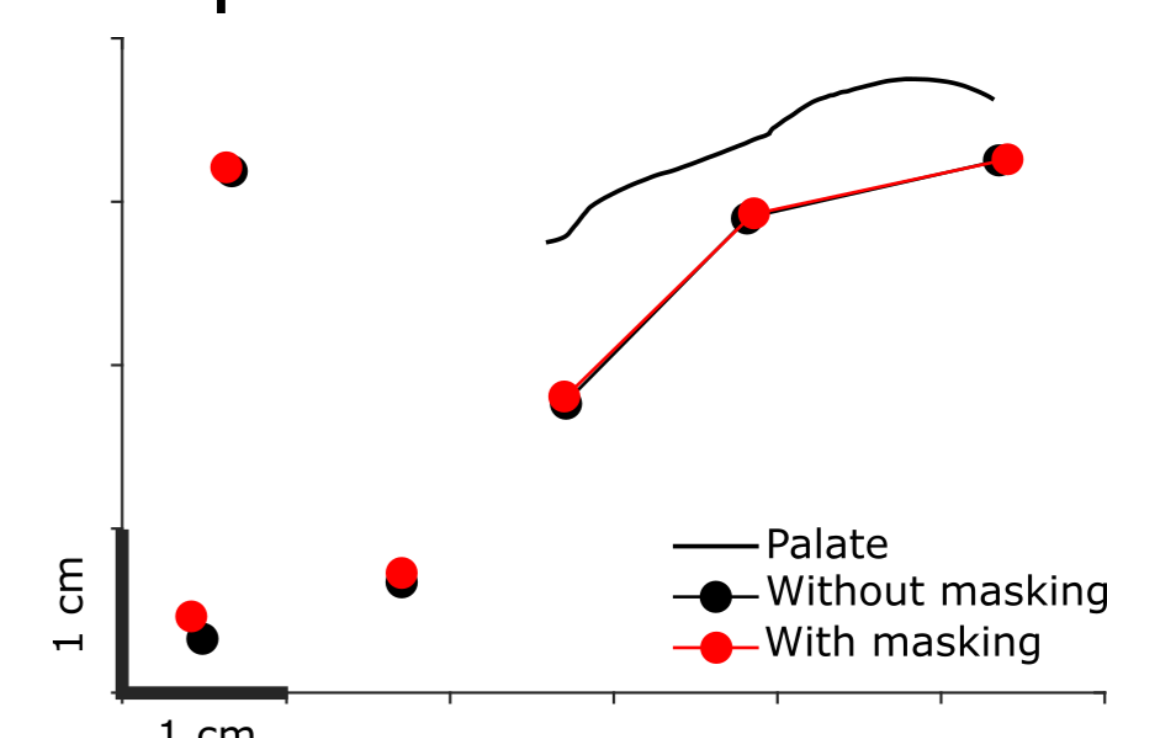
Changes in displacement and formants



Focused time points



Representative articulatory configuration before the perturbation



Summary

- Compensatory response of the tongue was induced as shown in the previous study.
- There was no significant difference in both displacement and speech sound between two auditory conditions ($p > 0.1$ in all comparisons).

➔ Little of no contribution of auditory feedback for the current compensatory response.

Bibliography

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.

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