

Characterizing Misophonia-Related Brain Activity Using fNIRS – A feasibility study

OCT 2026
Poster ID: 802

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BioRxiv: <https://doi.org/10.64898/2026.08.30.748122>

1 Introduction

Misophonia is a decreased tolerance to specific “**trigger**” sounds: i.e., **chewing**, **breathing**, that elicit strong negative emotional, physiological, and behavioral responses.

A prior fMRI study¹ linked trigger sounds to **orofacial motor activation**, with activation level scaling with misophonic distress.

However, the MRI environment is poorly suited for studying auditory responses in misophonia:

- **Loud scanner noise** (90–120 dB) contaminates auditory stimuli²
- **Enclosed bore** heightens anxiety³
- **Non-portable & expensive** limiting its potential for future clinical deployment.

We propose **functional near-infrared spectroscopy (fNIRS)**:

quiet, portable, relative cheap device as an alternative, to determine whether activation in the **orofacial motor area** could be detected.



2 Method

Participants: 10 adults with minimal to mild misophonia symptoms (age 22.7 ± 5.5), normal hearing screened at 20 dB HL (250–8000 Hz), no neurological history.

Experimental Paradigm: During the task, participants heard three categories of sounds (Fig. 1). After each 15s sound, participants rated sound annoyance and antisociality (Fig. 2). We presented 126 trials (42 per category) across five ~11min sessions. fNIRS, EDA, PPG were simultaneously recorded.

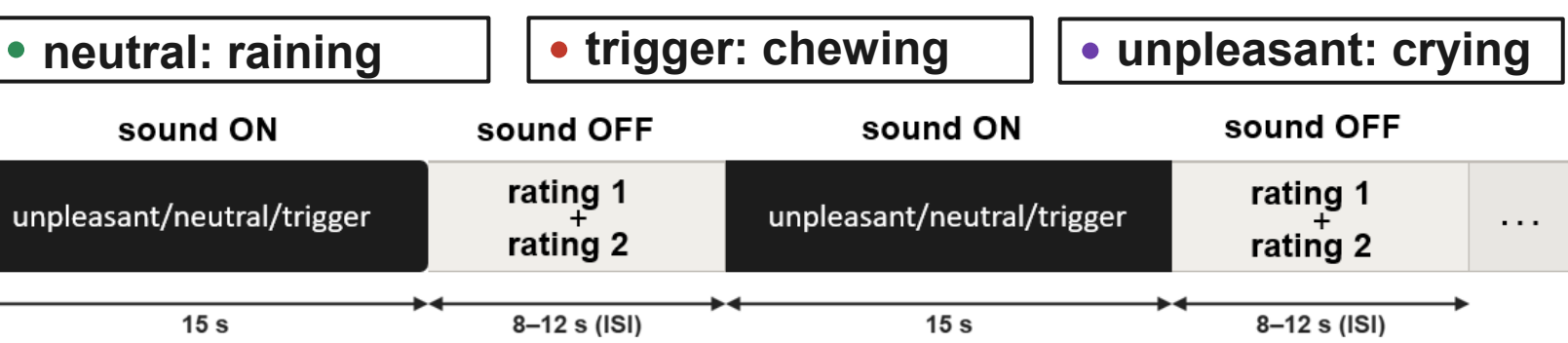


Fig. 1 Experimental design. A block design was used in which sounds were presented for 15s. After listening to each sound, participants gave two ratings on a scale of 1 to 5.

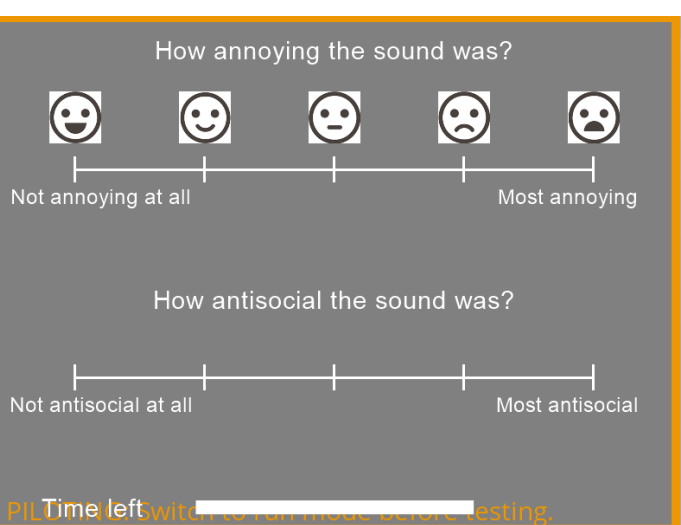


Fig. 2 Rating window during the experiment.

Fig. 3 fNIRS probe. (a) 2D layout: sources, detectors, channels. (b) 3D registration on the cortical atlas, bilateral orofacial motor cortex.

Fig. 4 EDA and PPG sensors. (a) EDA sensors. Attached to middle and ring fingers (non-dominant hand). (b) PPG sensor. Attached to earlobe.



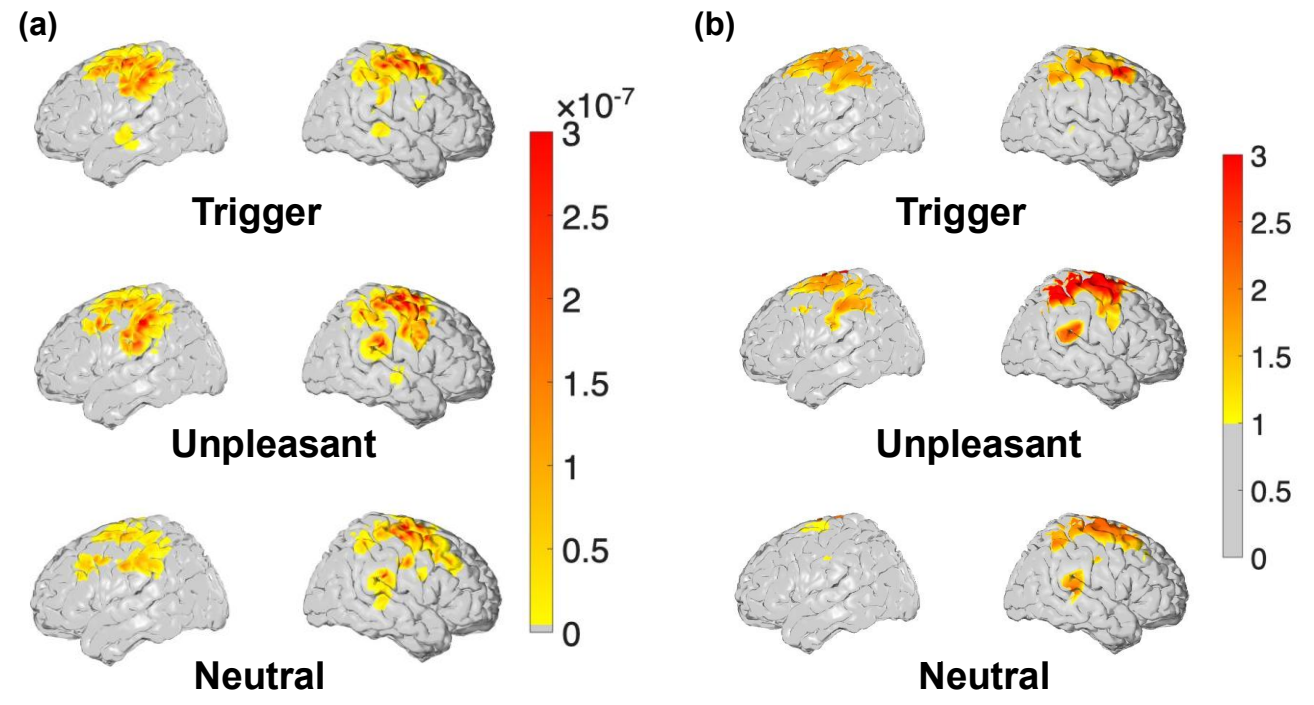
3 Results

1 fNIRS Results

fNIRS group results indicate greater brain responses during the unpleasant and trigger sounds compared to the neutral sound.

Fig. 4 Brain activation evoked by sound categories.

(a) Group-average HbO during sound categories. (b) T-statistic map during each sound categories, derived from linear mixed-effects models.



2 EDA Results

Five EDA features (nSCR, AmpSum, Tonic SCL, PhasicMax, iSCR) were modeled with linear mixed-effects models. **No significant effect of sound category** was observed (all $p > 0.05$).

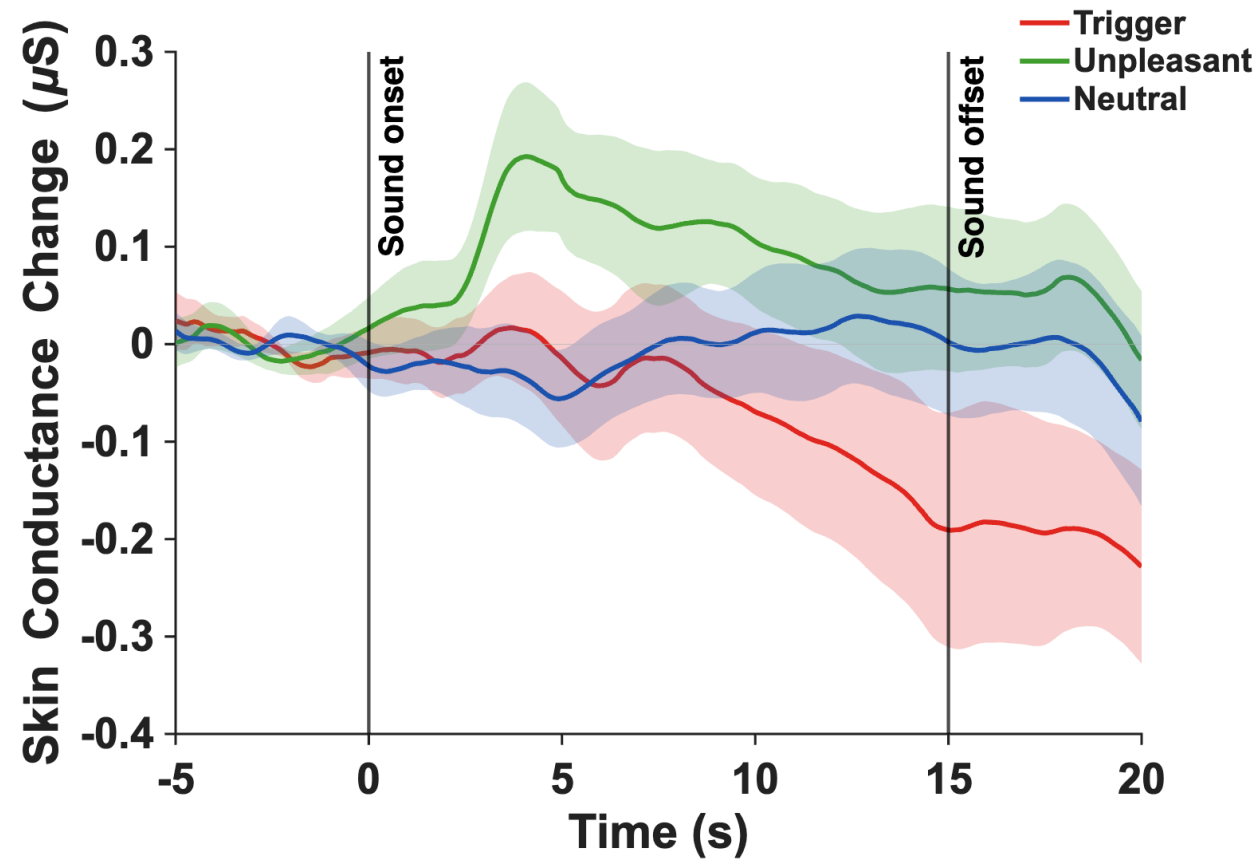


Fig. 5 Skin conductance change to sound categories. Solid lines show the group mean. Shaded areas show the standard error of the mean across participants. Vertical lines mark sound onset (0 s) and offset (15 s).

3 PPG Results

Mean heart rate (HR) was **significantly lower during unpleasant sounds** than during both neutral ($p < 0.001$) and trigger ($p < 0.01$) sounds. Trigger vs. neutral was not significant ($p = 0.22$).

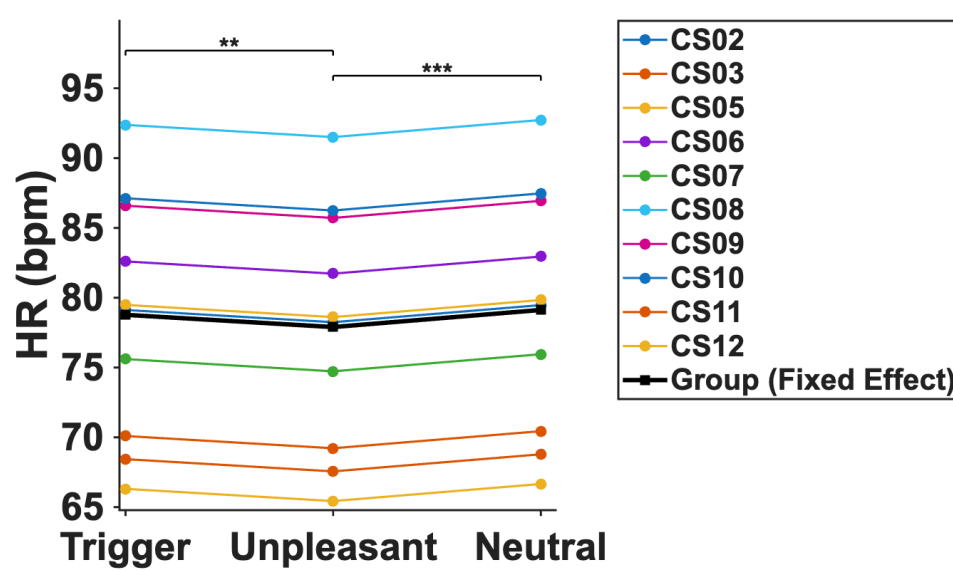
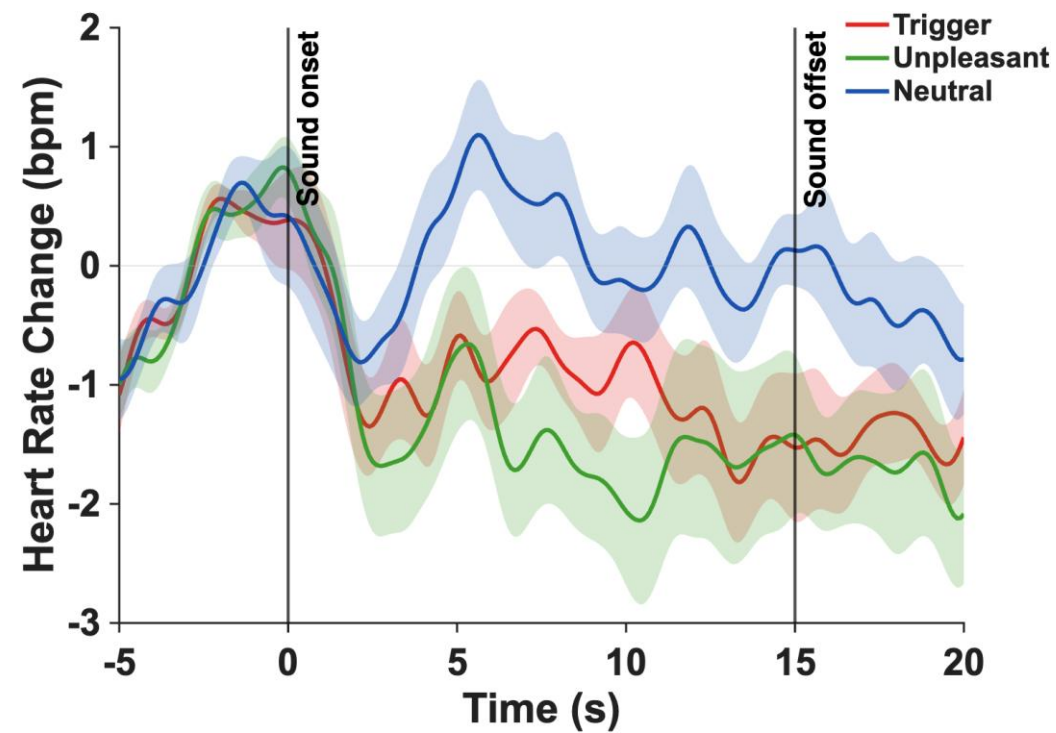


Fig. 6 Mean HR by sound categories. Thin colored lines represent individual HR across neutral, trigger, and unpleasant sounds. Thick black line indicates the group-level fixed effect derived from the linear mixed-effect model.

Fig. 7 HR change to sound categories. Solid lines show the group mean. Shaded areas show the standard error of the mean across participants. Vertical lines mark sound onset (0 s) and offset (15 s).



4 Conclusion

Overall, the results indicate **greater brain responses** during the unpleasant and trigger sounds compared to the neutral sounds. This study **validated the feasibility of using fNIRS to study misophonia**.

Future studies will utilize this paradigm to collect data on participants with misophonia and conduct comparison analysis with **age- and sex-matched controls**.

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