P030

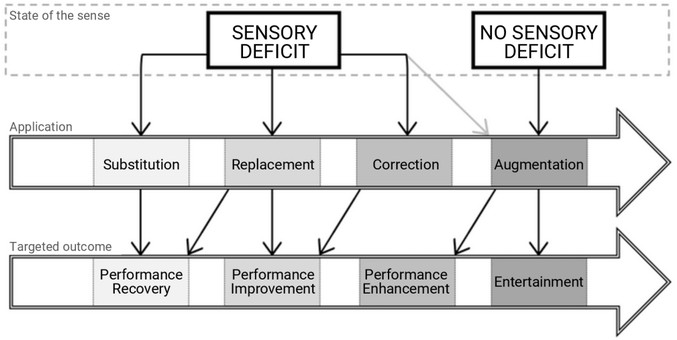
Psychophysics & Music Perception

Enhancing Auditory Perception through Tactile Stimulation

A Comparative Study of Auditory, Tactile, and Multimodal Timbre Perception and Music Recognition

Background

The **Multichannel Vibrotactiles Gloves**[1,2] are designed according to the **conceptual framework** of Sharp (2023)[3]

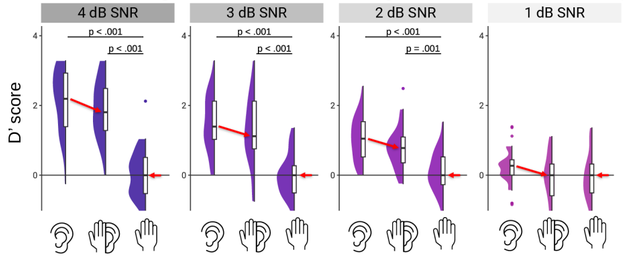


Music in Noise (N = 29)

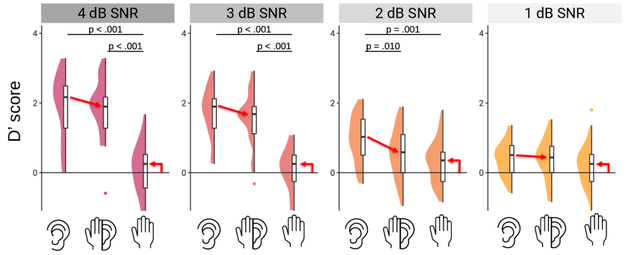
No multimodal benefits:
Audio only ≥ Audio + Tactile

No tactile performance:
Tactile only remains near chance level

Melody recognition scores at four signal-to-noise ratios (SNR)

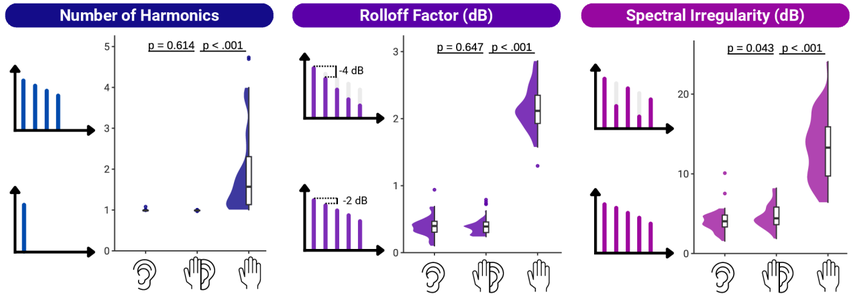


Rhythm recognition scores at four signal-to-noise ratios (SNR)

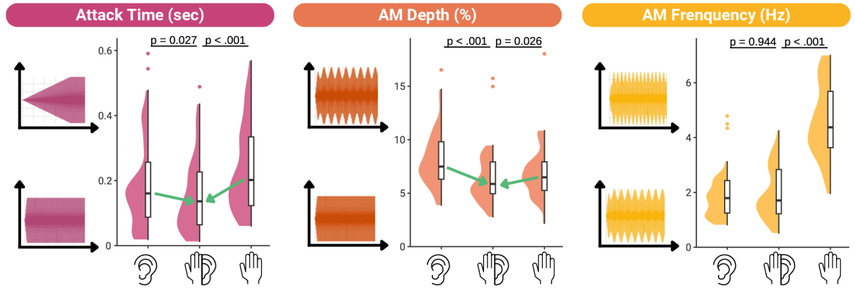


Timbre (N = 39)

Spectral attributes of timbre can be **discriminated** using only the ***vibrotactile*** modality



Temporal attributes of timbre have more **similar** ***auditory*** and ***vibrotactile*** discrimination thresholds



However, ***vibrotactile*** discrimination thresholds are **much higher** than ***auditory*** or ***audio + tactile*** thresholds

In contrast

For **Attack time** and **AM depth**, there is a small but significant **multimodal gain** for ***audio + tactile*** discrimination thresholds

Methods

Participants
Normal-hearing healthy controls
Any degree of musical expertise

Conditions → *randomized order*
Audio only
Audio + Tactile together
Tactile only (+ auditory noise)

Music in Noise
Music in Noise Test[4]
Same/Different

Timbre
ABX test
Adaptative staircase procedure (QUEST+)

Conclusion (Music in Noise)

Simply transmitting the audio signal as vibrations does **not improve music perception**, although participants still reported **subjective benefits** for music appreciation.

Since the tactile modality **doesn't seem able** to process such complex information, we need to develop **new signal processing strategies** that capitalize on the inherent abilities and limitations of the tactile modality.

Conclusion (Timbre)

To guide this process, we investigated if the tactile modality could discriminate complex sounds based on the acoustic properties typically involved in timbre perception.

We found that **spectral attributes** can be discriminated with vibrations, but at much higher thresholds then for hearing. However, **temporal correlates** of timbre are easier to perceive through vibrations alone.

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1. Sharp et al. (2023) U.S. Patent, 64/494, 295
2. Chauvette et al. (2024). *Under review*
3. Sharp. (2023). CHBAH, 100029
4. Coffey et al. (2019). *Front. Neurosci.* 13:199

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RBIQ RÉSEAU DE BIO-IMAGERIE DU QUÉBEC
CRBLM Centre for Research on Brain, Language and Music
WCA World Congress of Audiology 19-22 September 2024 Paris, France