P086

AUDITORY IMPLANTS

How Frequency-based Processing May Help Clinicians Improve Sound Quality Perception in Cochlear Implant Users

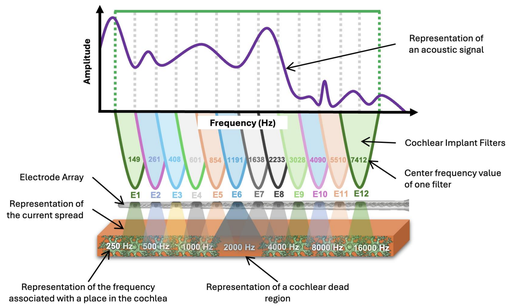
L. Villejoubert [1], N. Haywood [1], L. Picinali [2], K. Faulkner [3], D. Vickers [1].

[1]***University Of Cambridge*** *- Cambridge (United Kingdom),* [2]***Imperial College London*** *- London (United Kingdom),* [3]***Oticon*** *- Ballerup (Denmark)*

Abstract

The importance of **sound quality** in cochlear implants (CI) has gained attention in recent years. While many CI users exhibit speech recognition performance close to that of normal-hearing listeners in quiet conditions, they often report poor sound quality, particularly for music.

The contribution of CI technology to this sound quality degradation is well documented; however, little is known about the contribution of individual "**frequency-to-place factors**" such as the electrode array insertion depth (AID), frequency-to-place mismatch (FTPM), and electrode-neuron-interface (ENI) quality.



The goal of this project is to develop innovative testing methods to explore the impact of these factors on sound quality perception, which could ultimately offer clinicians insights to improve CI users' listening experiences. The study focused on **post-lingually deafened** adult CI users with at least 12 months of listening experience. Two experiments were conducted:

- **The first experiment** explored how shifting the **first formant (F1)** affects sound quality, aiming to identify the F1 shift in frequency that optimizes sound quality for each individual.
- **The second experiment** examined the sound quality associated with different electrodes for **chords perception**, attempting to isolate the contribution of each electrode to the overall sound perception.

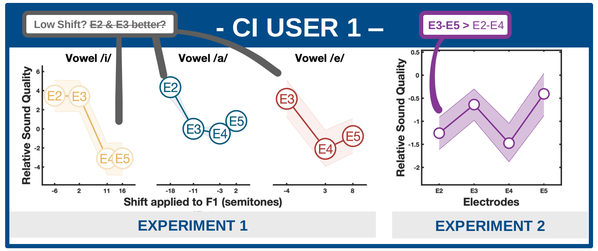
The results revealed different patterns across participants in both experiments. Specifically, different F1 shifting values were found to induce optimal sound quality for each participant, suggesting variability in how individuals adapt to FTPM and/or differences in the quality of the ENI. However, the second experiment did not help us to clearly differentiate between these two factors.

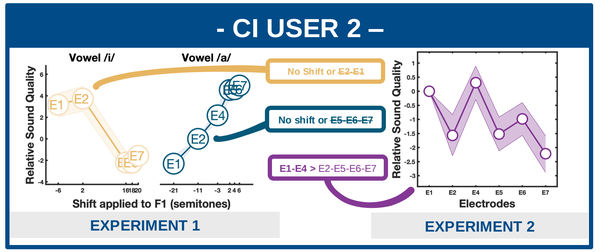
Further analysis will be required to better understand these individualized response patterns by examining their relationships with performance, electrode array positioning, and the tonotopic FTPM. The findings are expected to provide valuable insights for enhancing sound quality for CI users, particularly in challenging auditory environments.

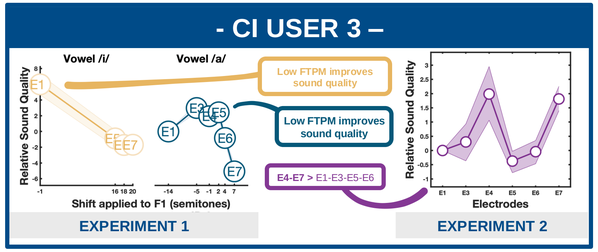
Frequency-to-place mismatch (FTPM) refers to the difference between the acoustic frequency information conveyed by a given electrode and the frequency corresponding to the tonotopic location stimulated by that electrode.

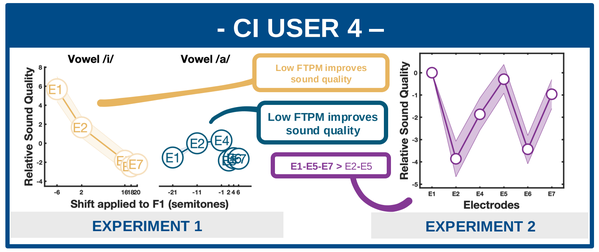
Electrode Neuron Interface (ENI) quality refers to the effectiveness of transmission between a given stimulating electrode and the neuronal interface it stimulates.

Results









Objectives

MAIN GOALS

Develop testing methods to explore the relationship between sound quality and individual frequency-to-place factors

SUB GOALS

EXPERIMENT 1

Evaluate the adaptation to FTPM and the quality of the ENI quality using a shifted signal

EXPERIMENT 2

Evaluate the ENI quality using chords

Conclusion

EXPERIMENT 1
FORMANT SHIFTING

Different shifts

?

Different ENI quality profiles

EXPERIMENT 2
CHORDS QUALITY

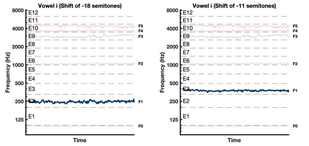
NEXT STEPS

Compare these data with performance metrics, electrode array positions and tonotopic FTPM

Method and material

EXPERIMENT 1

STABLE VOWELS → F1 SHIFTING → PAIRED COMPARISONS → BAYESIAN ANALYSIS → SOUND QUALITY RANKING



EXPERIMENT 2

PIANO CHORDS → ROOT VS INVERSED → PAIRED COMPARISONS → BAYESIAN ANALYSIS → SOUND QUALITY RANKING

19›22 September 2024

Paris, France

CNIT Paris La Défense