

# Multitrack mixing transforms and their implications on normal hearing and hearing impaired listeners

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## Introduction & Hypothesis

- Studies allude to the idea that cochlear implantees may require bespoke mixes.
- This study investigates level and spectral mixing preferences of a sample of Normal Hearing (NH) and Hearing impaired (HI) in experiment 1.
- In experiment 2, we investigate the same only on HI participants with and without their bilateral hearing aids.
- **We hypothesize that preferences of NH (Normal hearing) and HI (Hearing impaired) listeners is significantly different.**
- **Hearing aid use affects such preferences significantly.**

## Methods

### Control audio effects (Cn)

Lead-to-Accompaniment-Ratio (LAR), Spectral Balance (SPBal)

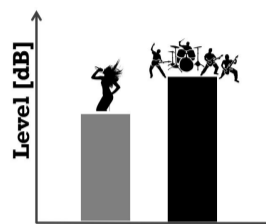


Fig 1. Lead-to-Accompaniment Ratio

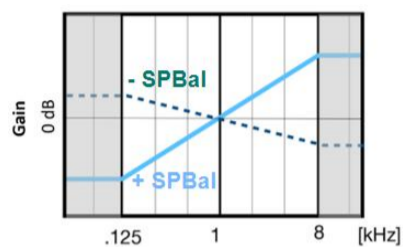


Fig 2. Spectral Balance filter magnitude response

### Transformed mixing effects (Tr)

EQ-transform (EQTran) as a percentage of the original or factory mix.

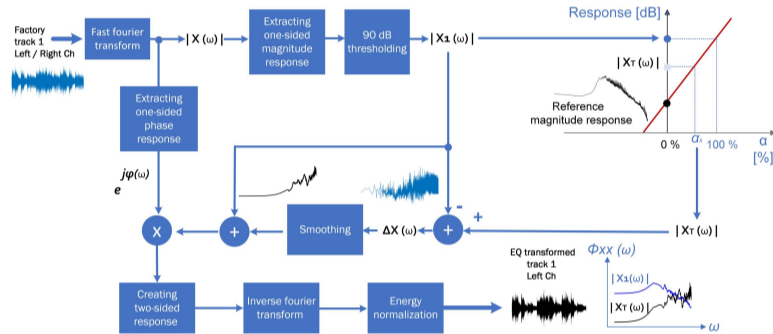


Fig 3. EQ transform method.

### Experiment - 1

- 10 x 8 second tracks per block only from the Medley Database.
- Blocks and track presentations randomized.
- Participants move virtual dial for control and transform effects to change in real-time to choose preferred effect.

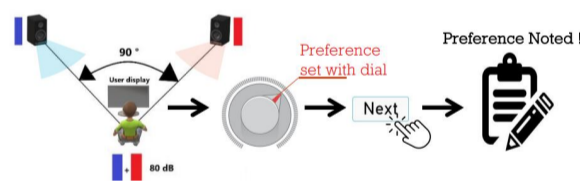


Fig 4. Experiment procedure.

- 26 Normal Hearing (NH) (HL < 25 dB), 10 Mild Hearing Impaired (HI) (25 ≤ HL < 40 dB), and 10 Moderate to Severely (Mod-Sev) HI (HL ≥ 40 dB).

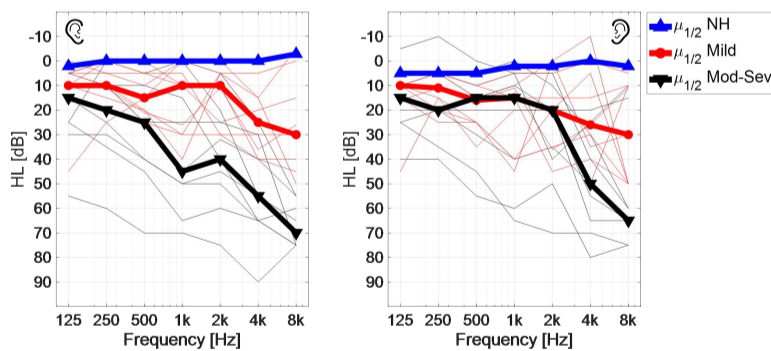


Fig 5. Median HL plots for Listening Test 1.

### Experiment - 2

- Same procedure and implementation as experiment 1.
- **Only conducted on bilateral Hearing Aids (HA) users.**
- Two phases, in one with HA and the other without HA.
- 11 Participants (1 Mild HI and 10 Mod-Sev HI).

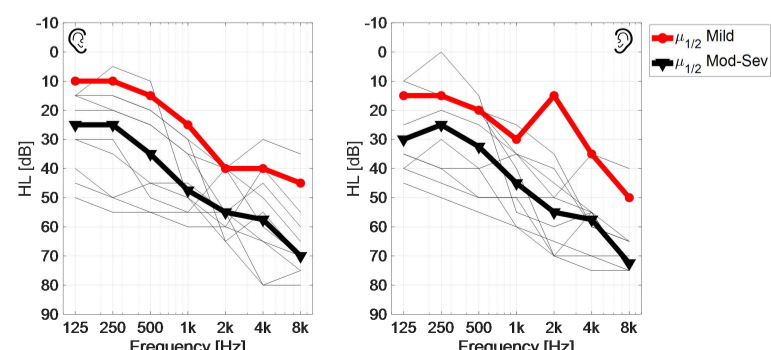


Fig 6. Median HL plots for Listening Test 2.

## Results (Experiment - 1)

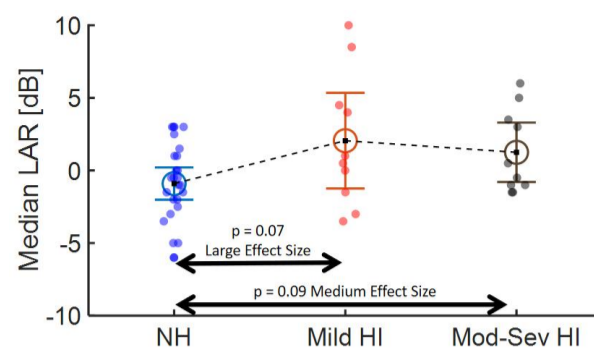


Fig 7. Median LAR preferences of the groups in Experiment - 1.

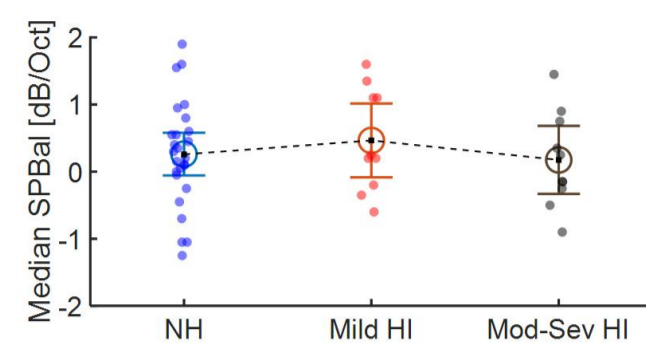


Fig 8. Median Spectral Balance preferences of the groups in Experiment - 1.

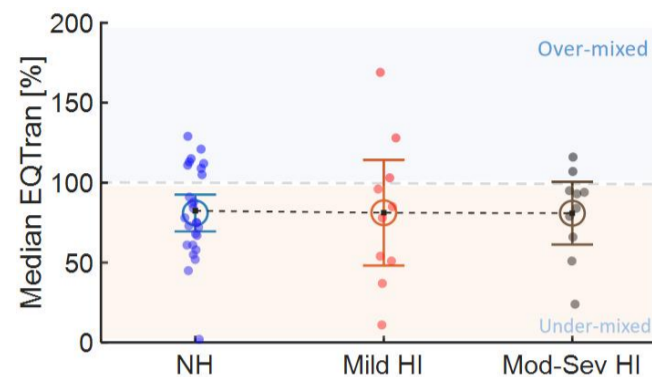


Fig 9. Median EQ Transform preferences of the groups in Experiment - 1.

## Results (Experiment - 2)

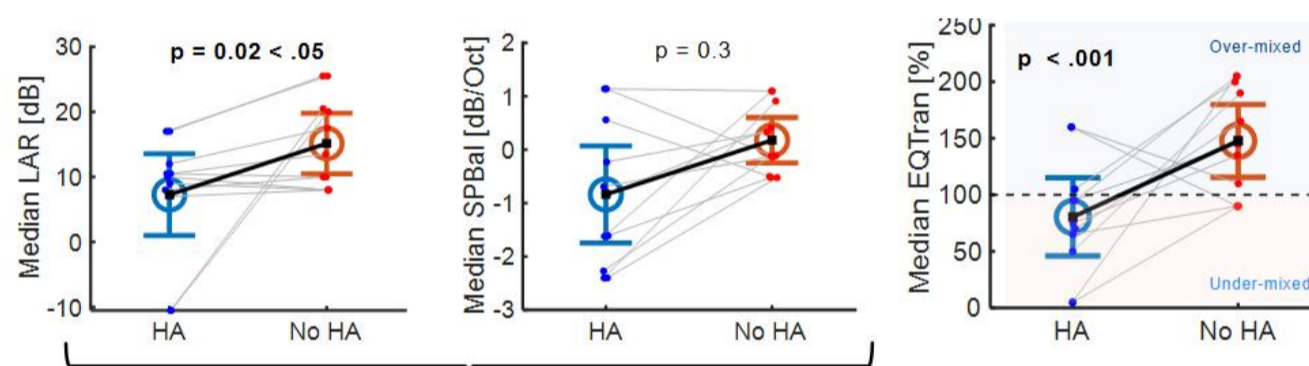


Fig 10. Median preferences of parameters of the groups in Experiment - 2 with and without Bilateral Hearing Aids (HA).

## Results (Pooled)

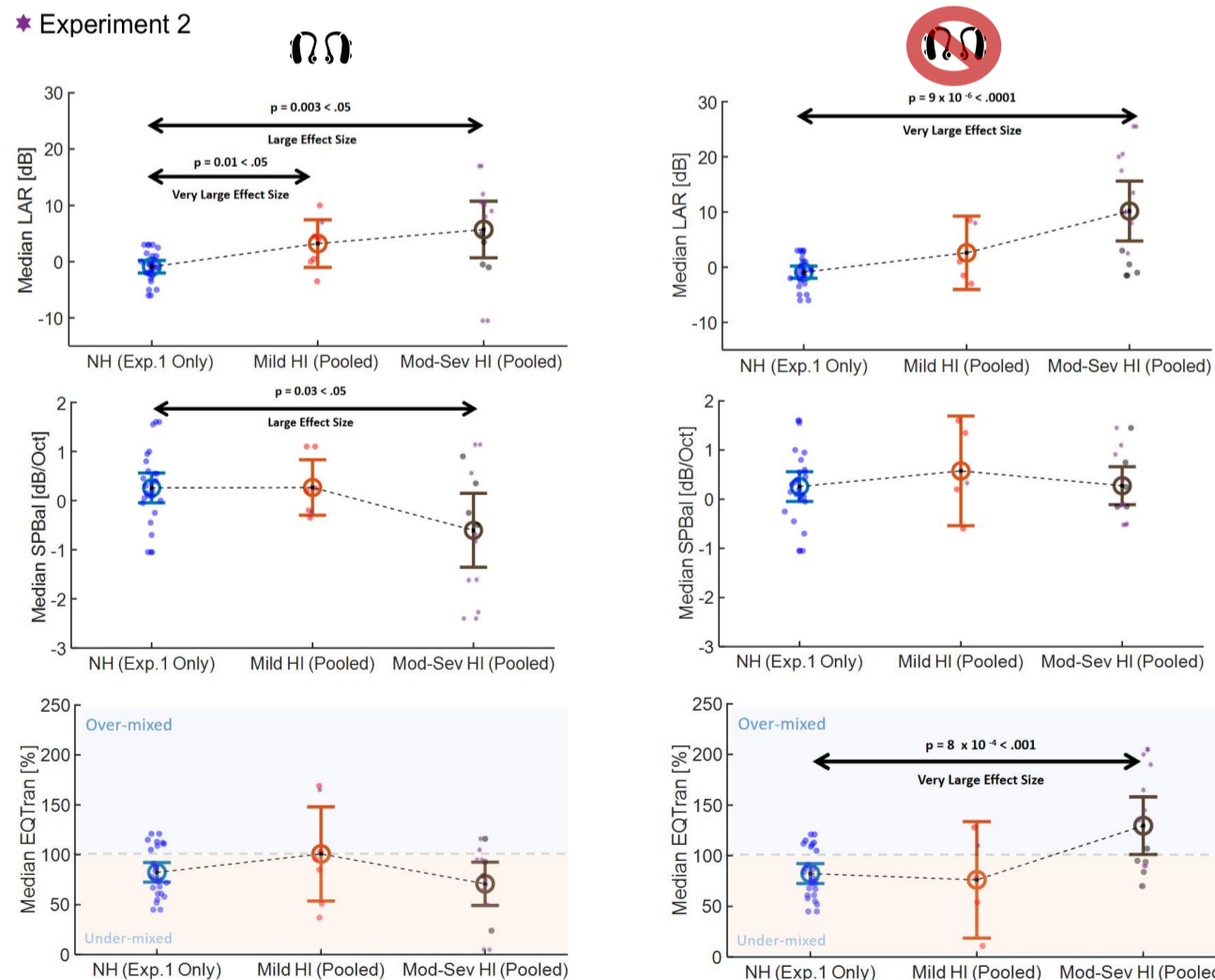


Fig 11. Median preferences of parameters of the groups in both experiments.

## Conclusion

- Trends point to elevated LAR preferences among HI (both groups) - with bilateral HAs.
- Undermixing in Equilization preferred by all three groups when considering HIs with bilateral HAs on.
- This changes significantly so with the removal of HAs in the Moderate to Severe HA group with them preferring over-mixing.
- Reduced LAR, EQ-Transform, and Spectral Balance preference in mixes among the HI, with HAs.