Unilateral Hearing Loss: Characterising the deficit in real-world environments

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Introduction

The impact of unilateral hearing loss (UHL) cannot be predicted by the audiogram alone[1] and the success of amplification varies amongst individuals[2]. Currently, the literature on UHL is sparse. Consequently, clinical guidelines specific to this condition treat all cases of UHL under a broad umbrella[3]. This often results in differing approaches to treatment from one clinician to another, leading to poorly targeted treatment and potentially substandard outcomes.

Aim. To assess and quantify the functional deficits experienced by adults with UHL in a real-world (full-sphere, 3D surround sound array) environment.

Methods

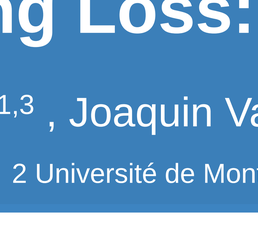
Participants

Unilateral hearing loss (n = 16)

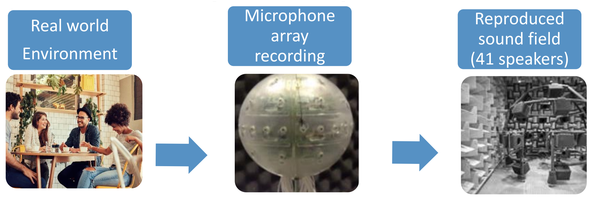
- Mean age = 51.9 y ± 15.6

Control group (n= 16 adults)

- Normal hearing ($PTA_{0.5\text{-}4k}$ ≤20 dB HL) in both ears
- Mean Age = 37.2 y ± 19.5



Simulated Cafeteria (Ambisonic) Environment:



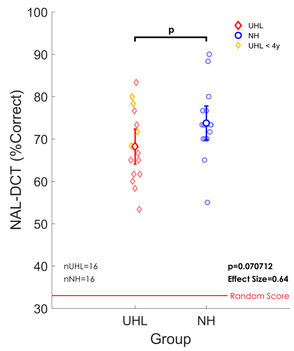
Measures

1. The NAL-Dynamic Conversations Test (NAL-DCT)[4]: dynamic, realistic speech-in-noise comprehension test with head tracking (InertiaCube™Intersense™)
2. NAL-Reaction Time Digit Test (Listening fatigue)
3. Functional listening: Speech, Spatial & Qualities of Hearing (SSQ12) and Social Participation Restriction (SPaRQ)[5] self- report questionnaires
4. Functional listening measured by ecological momentary assessment (EMA).

Results

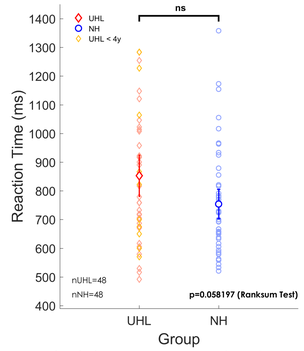
Unilateral hearing loss versus Normal hearing listeners

1. Realistic speech comprehension (NAL-DCT score)



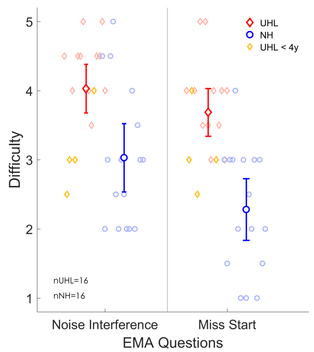
UHL group had lower % correct scores on average than NH on the NAL-DCT (0 dB SNR). however, this was not significant. ANCOVA showed no significant effect of age p>0.8).

2. Listening Effort (Reaction Time scores)



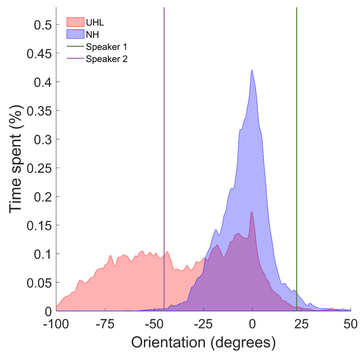
UHL group had slower mean reaction times on average than the NH group, however, this was not significant. ANCOVA showed no effect of age on reaction time (p>0.69).

3. Real-world listening reports (EMA survey questions)



Two EMA survey questions (1. noise interference with listening ability and 2. missing the start of what is being said when conversation switched between talkers) were strongly correlated to the NAL-DCT score. Significant differences between UHL and NH groups found for traditional self-report questionnaires (SSQ12, SPaRQ) and EMA.

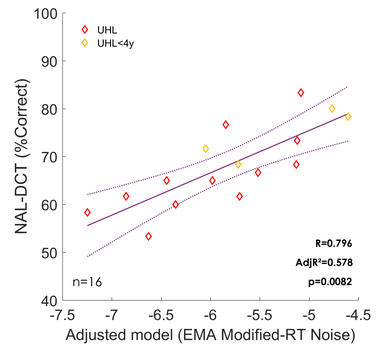
4. Head Movement (Time spent in every orientation)



The head tracking data showed large behavioural difference between UHL and NH group. A significant amount of additional movement was performed by the UHL group during NAL-DCT test (p=0.001).

Predicting speech comprehension

Listening effort (RT scores) and Functional listening (via EMA select questions) together form a reliable model to predict realistic speech-in-noise comprehension (NAL-DCT).



Conclusions

1. Borderline significant differences between UHL and NH groups for NAL-DCT and Reaction Time. EMA, SParQ and SSQ12 functional listening questionnaires were sensitive to the UHL/NH difference.
2. Head Tracking Data showed greater head movement in the UHL group than NH group.
3. EMA showed a higher correlation to the NAL-DCT score than traditional self-report questionnaires.
4. A better understanding of UHL deficit in the real-world environment has lead to a potential model to predict realistic speech comprehension in noise.

References

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