Speech intelligibility in noise for listeners with single-sided deafness with and without a cochlear implant in the contralateral ear

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INTRODUCTION

- Individuals with single-sided deafness (SSD) rely only on monaural acoustic hearing and have difficulty functioning in complex acoustic environments.
- Clinical interest in providing a cochlear implant (CI) in the deaf ear of individuals with SSD (SSD-CI) both to suppress tinnitus and to aid hearing is increasing.
- There is growing evidence to suggest that having a CI combined with a normal-hearing (NH) ear leads to improved sound localization ability and speech understanding in noise (1-3), however, current measurement techniques are not able to effectively quantify the subjective benefits reported by SSD-CI patients (2).
- Pupilometry, or using an eye tracker to objectively measure pupil dilation, is one method that can be used to quantify changes in listening effort over time.

The aim of this study is to look at speech intelligibility outcomes for SSD patients by merging two approaches: 1) calculating percent correct scores while, 2) measuring change in pupil dilation, to objectively quantify changes in listening effort over time and across conditions.

METHODS

Participants
- 7 participants with SSD (NH thresholds in contralateral ear)
- 5 participants tested prior to receipt of CI (and will be tested again after receiving a CI)
- 2 participants tested ≥ 1 year post CI

Stimuli
- Male Target (♂) IEEE Sentences spoken by a male talker
- Interferers (♀) A2BIO Sentences, spoken by two different male talkers
- Presentation level = 65dB SPL. If time allowed, target level was adjusted and testing completed at -5 and +5 SNR

Configurations

- 1) Quiet
- 2) Front
- 3) Asymmetrical NH
- 4) Asymmetrical Deaf
- 5) Symmetrical

Task
- Percent correct was measured in five configurations (see Fig. 1)
- Pupil dilation was measured during those same trials using an Eyelink 1000 eye tracker
- Participants listened with the NH ear alone (Acoustic Only)
- The 2 SSD-CI participants also listened bilaterally with the CI and NH ear (Acoustic+CI)

RESULTS

<table>
<thead>
<tr>
<th>Conditions</th>
<th>SSD subjects prior to receiving a CI: Acoustic Only</th>
<th>SSD-CI subjects tested at 0 SNR Acoustic Only and Acoustic+CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acoustic Only (SNR 0)</td>
<td>Acoustic Only (28.7%)</td>
<td>Acoustic Only (70.65%)</td>
</tr>
<tr>
<td>Acoustic+CI (SNR 0)</td>
<td>Acoustic+CI (43.3%)</td>
<td>Acoustic+CI (57.9%)</td>
</tr>
</tbody>
</table>

DISCUSSION

1. Adding a CI to a NH ear, i.e. providing a unique form of bimodal hearing with one NH ear and one electric ear, could have various consequences on speech understanding and listening effort. Preliminary data are shown from 5 SSD Acoustic Only (pre-surgical), and 2 SSD-CI (post-surgical) subjects.

2. Combining a CI with a NH ear improves speech intelligibility when the interferer is located on the same side as the ear with normal hearing, suggesting the subjects were able to use the CI meaningfully to understand speech.

3. Pupil dilation as a proxy for listening effort adds to our understanding of speech intelligibility scores and reveals differences between subjects.

4. Further work is needed to better understand the relationship between localization, speech understanding, and listening effort in SSD-CI patients.

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REFERENCES