Hearing aid processing strategies for listeners with different auditory profiles

Insights from the BEAR project

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Publication date:
2018

Document version
Final published version

Citation for published version (APA):

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Download date: 05. Apr. 2020
Hearing aid processing strategies for listeners with different auditory profiles: Insights from the BEAR project

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**BEAR outline**

- **Time frame:** 2016-2021
- **Funding:** Innovation Fund Denmark (~4.5m $), Danish hearing industry (~2.3m $), other project partners (~1m $)
- **Purpose:** Improve hearing rehabilitation through evidence-based renewal of clinical practice

**Phase 1:** Recruitment, method development
- WP1: Centralized clinical database \( (N = 2000) \)
- WP2: New aided performance measures
- WP3: New clinical profiling and fitting strategies

**Phase 2:** Apply new methods
- WP4: Validation of new fitting strategies (field study)
- WP5: Subpopulations with abnormal aided benefit

**Phase 3:** Evaluate and iterate
- WP6: Improved clinical efficiency
- WP7: Patient-driven diagnostics and fitting

**Phase 4:** Implement and disseminate
- WP8: Revised standards for diagnostics and fitting

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**New clinical profiling & fitting strategies**

**Participants**

- **Aim:** \( N = 2 \times 30 \) habitual HA users

**Study design**

- **N = 30**, 60-80 yrs

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3 – Neher et al, IHCON 2018

4 – Neher et al, IHCON 2018
Hypothesis & test battery

- Classification of listeners into small number of auditory profiles
- Beyond audibility: Supra-threshold distortions (e.g. Plomp, JASA 1978)

![Temporal resolution deficit?](Image)

Auditory profiling

- Data-driven classification based on dimensionality reduction followed by archetypal analysis (Sanchez-Lopez et al, Trends Hear, under review)
HA fitting evaluation

- Test setup: Virtual acoustics, ‘realistic’ HA simulator

- Comprehensive instrumental evaluation
  - SNR improvement, temporal and spectral distortion, speech intelligibility and quality
  - Spatially diffuse cafeteria noise, target signal from 0° or 90°, various input SNRs and standard audiograms (Bisgaard et al, 2010)

Instrumental evaluation

- Selection of six candidate settings
  - Objective: Maximize differences through the use of different HA parameter sets

(Sanchez-Lopez et al, Euronoise 2018)
Perceptual evaluation

- **Stimuli**
  - Target speech: Sentences from 0° or 90°
  - Speech-like interferer from 90° or 0°
  - Spatially diffuse cafeteria noise

- **Speech-in-noise reception**
  - Individual SRT_{50} measurements, then fixed-SNR speech recognition scores; test-retest measurements

- **Overall quality and noise annoyance**
  - Multi-stimulus comparison; SRT_{50} + 4 dB SNR; four repetitions

Speech-in-noise reception

- **Auditory profile**

<table>
<thead>
<tr>
<th>HA setting</th>
<th>Auditory profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Omni, NR off, slow compression</td>
</tr>
<tr>
<td>2</td>
<td>Omni, strong NR, fast compression</td>
</tr>
<tr>
<td>3</td>
<td>Bin. beamformer, NR off, slow compression</td>
</tr>
<tr>
<td>4</td>
<td>Bin. beamformer, strong NR, slow compression</td>
</tr>
<tr>
<td>5</td>
<td>Bin. beamformer, strong NR, fast compression</td>
</tr>
<tr>
<td>6</td>
<td>Cardioid, mild NR, slow compression</td>
</tr>
</tbody>
</table>

- **Preliminary statistics**
  - Spatial condition, HA setting, spatial condition × HA setting: all $p < .0001$
  - Auditory profiles: ????
Summary

- BEAR project: Unique constellation; large-scale approach
- Auditory profiling
  - Data-driven approach; Reasonably consistent results for two separate datasets
  - More data needed for cross-validation (incl. other audiometric configurations)
- HA fitting evaluation
  - Instrumental evaluation: SNR improvement, temporal and spectral distortion; Selection of six candidate HA settings
  - Perceptual evaluation: Preliminary data show expected effects of spatial condition and HA settings; More data needed for probing auditory profiles

Acknowledgments

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