Hearing aid processing strategies for listeners with different auditory profiles

Insights from the BEAR project

Wu, Mengfan; El-Haj-Ali, Mouhamad; Sanchez Lopez, Raul; Fereczkowski, Michal; Bianchi, Federica; Dau, Torsten; Santurette, Sébastien; Neher, Tobias

Publication date:
2018

Document version
Final published version

Citation for published version (APA):
Hearing aid processing strategies for listeners with different auditory profiles: Insights from the BEAR project

Mengfan Wu¹, Mouhamad El-Haj-Ali¹, Raúl Sanchez-Lopez², Michal Fereczkowski², Federica Bianchi², Torsten Dau², Sébastien Santurette² & Tobias Neher¹

¹ Institute of Clinical Research, University of Southern Denmark
² Hearing Systems, Technical University of Denmark

BEAR consortium

• Odense University Hospital
• Aalborg University Hospital
• Copenhagen University Hospital
• University of Southern Denmark
• Aalborg University
• Technical University of Denmark
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

New clinical profiling & fitting strategies

- Participants
  - Aim: $N = 2 \times 30$ habitual HA users
  - $N = 30$, 60-80 yrs

- Study design
  - $N = 30$
  - $N = \sim 20$
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?
Distortion Type I
Distortion Type II
Profile A
Profile B
Profile C
Profile D
NH

Beyond audibility: Supra-threshold distortions (e.g. Plomp, JASA 1978)

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>Auditory profile</th>
<th>Speech score (prop. correct)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>B</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>C</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>D</td>
<td>1 2 3 4 5 6</td>
</tr>
</tbody>
</table>

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

---

9 – Neher et al, IHCON 2018

10 – Neher et al, IHCON 2018
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