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):
Hearing aid processing strategies for listeners with different auditory profiles: Insights from the BEAR project

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BEAR consortium

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

Industry

Clinics

Academia

• GN Hearing
• Oticon
• Widex
• DELTA – a part of FORCE

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2 – Neher et al, IHCON 2018
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 × 30 habitual HA users
  - N = 30, 60-80 yrs

- Study design

N = 30

N = ~20
Hypothesis & test battery

- Classification of listeners into small number of auditory profiles
- 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 profiles**
  - Preliminary statistics
    - Spatial condition, HA setting, spatial condition $\times$ HA setting: all $p < .0001$
    - Auditory profiles: ???

Auditoy profile

- 1. Omni, NR off, slow compression
- 2. Omni, strong NR, fast compression
- 3. Bin. beamformer, NR off, slow compression
- 4. Bin. beamformer, strong NR, slow compression
- 5. Bin. beamformer, strong NR, fast compression
- 6. Cardioid, mild NR, slow compression
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