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Insights from the BEAR project

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

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BEAR consortium

Industry

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

Clinics

• Odense University Hospital
• Aalborg University Hospital
• Copenhagen University Hospital

Academia

• University of Southern Denmark
• Aalborg University
• Technical University of Denmark

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

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

Study design
**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?**

**Spectral resolution deficit?**

(Sanchez-Lopez et al, IHCON 2018)

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**Auditory profiling**

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

(Sanchez-Lopez et al, IHCON 2018)
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
    - Omni, NR off, slow compression
    - Omni, strong NR, fast compression
    - Bin. beamformer, NR off, slow compression
    - Bin. beamformer, strong NR, slow compression
    - Bin. beamformer, strong NR, fast compression
    - Cardioid, mild NR, slow compression

(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<sub>50</sub> measurements, then fixed-SNR speech recognition scores; test-retest measurements

- **Overall quality and noise annoyance**
  - Multi-stimulus comparison; SRT<sub>50</sub> + 4 dB SNR; four repetitions

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Speech-in-noise reception

- **Auditory profile**

  - A
  - B
  - C
  - D

- **Preliminary statistics**
  - Spatial condition, HA setting, spatial condition × HA setting: all p < .0001

- **Auditory profiles:** ???

- 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

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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

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