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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

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

Industry

Clins

Academia

SDU

DTU

Odense University Hospital
Aalborg University Hospital
Copenhagen University Hospital

GN Hearing
Oticon
Widex
DELTA – a part of FORCE

AALBORG 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

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**New clinical profiling & fitting strategies**

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

- **Study design**
  - $N = 30$
  - $N \approx 20$
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
  - 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 $0^\circ$ or $90^\circ$, 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<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
    - Speech score (prop. correct)
    - HA setting
  
  - B
    - Speech score (prop. correct)
    - HA setting
  
  - C
    - Speech score (prop. correct)
    - HA setting
  
  - D
    - Speech score (prop. correct)
    - HA setting

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

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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

Cardio, 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

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Mengfan Wu  Mouhamad El-Haj-Ali  Raúl Sanchez-Lopez

Federica Bianchi  Michal Fereczkowski  Torsten Dau  Sébastien Santurette