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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

New clinical profiling & fitting strategies

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

- Study design
  - BEAR TEST BATTERY
  - PTA, ACALE
  - SIMULATED HEARING AID
  - CLASSIFICATION
  - AUDITORY PROFILE
  - MATCH?
  - Optimal HA fitting

\( N = 30 \)
\( N = \sim 20 \)
Hypothesis & test battery

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

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<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

- **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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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

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