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 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

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)

Temporal resolution deficit?
Spectral resolution deficit?

Distortion Type I
Distortion Type II

Profile A
Profile B
Profile C
Profile D

(Sanchez-Lopez et al, IHCON 2018)

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

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

- Neher et al., IHCON 2018