Hearing aid processing strategies for listeners with different auditory profiles

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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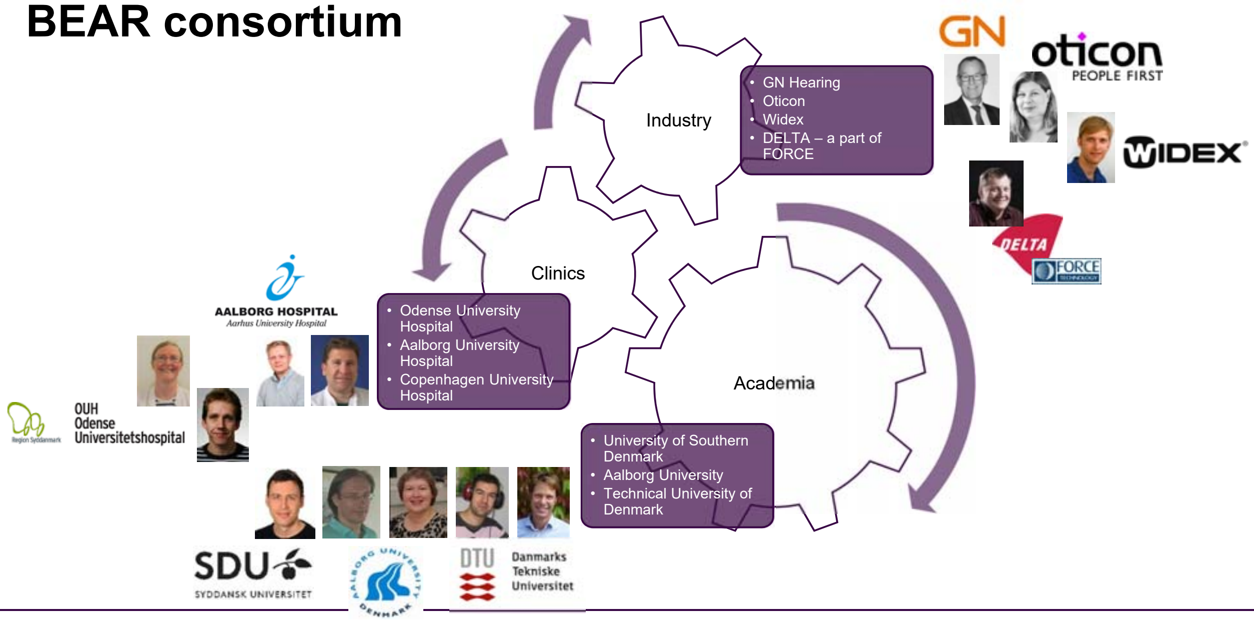
BEAR consortium



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

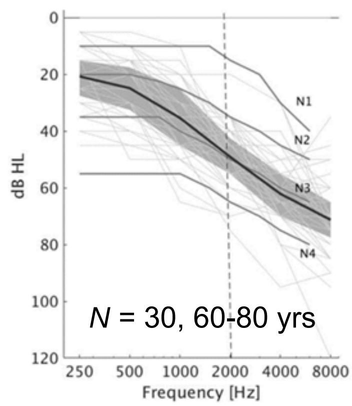
Phase 2: Apply new methods
- WP4: Validation of new fitting strategies (field study)
- WP5: Subpopulations with abnormal aided benefit

Phase 3: Evaluate and iterate
- WP6: Improved clinical efficiency
- WP7: Patient-driven diagnostics and fitting

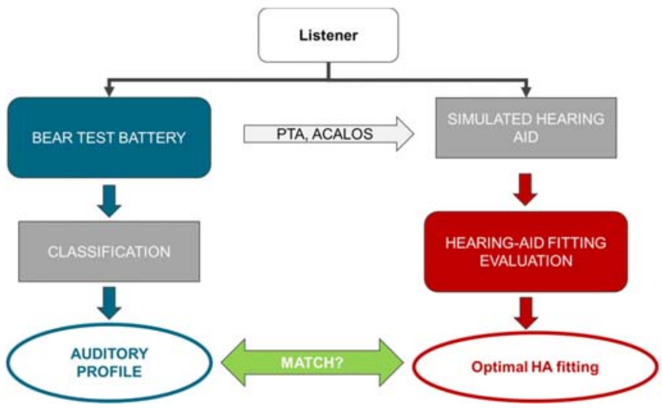
Phase 4: Implement and disseminate
- WP8: Revised standards for diagnostics and fitting

New clinical profiling & fitting strategies

- Participants
  - Aim: $N = 2 \times 30$ habitual HA users



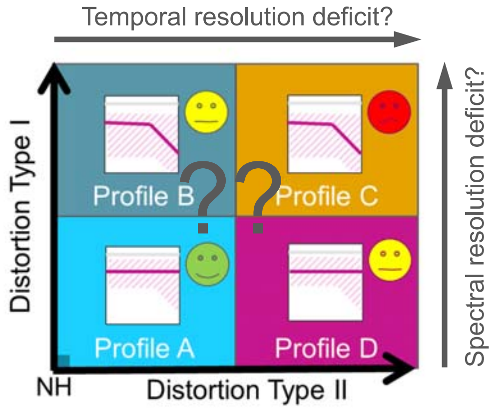
- Study design

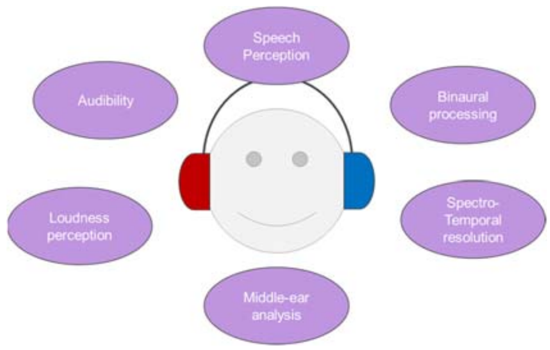


N = 30 N = ~20

Hypothesis & test battery

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

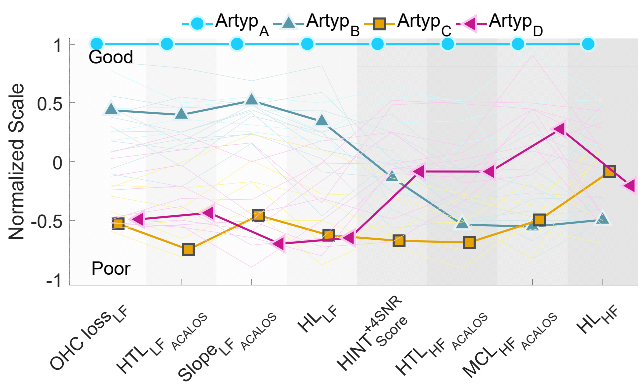




(Sanchez-Lopez *et al*, IHCON 2018)

Auditory profiling

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



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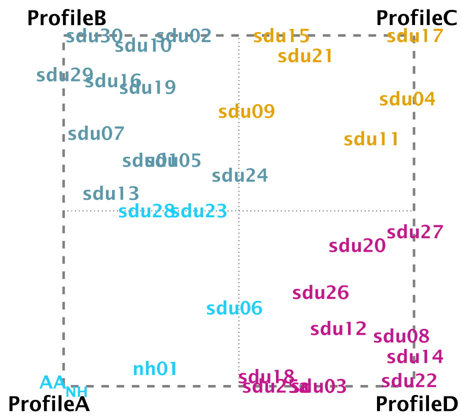
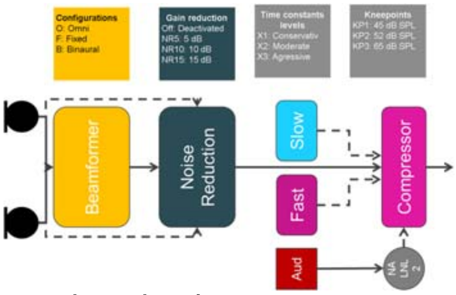


HA fitting evaluation

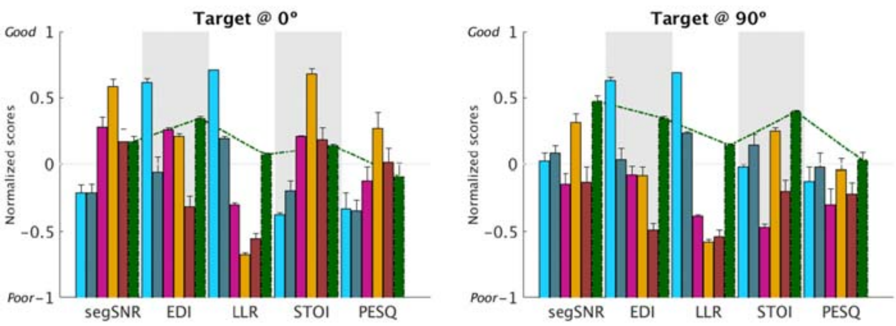
- Test setup: Virtual acoustics, ‘realistic’ HA simulator



- 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



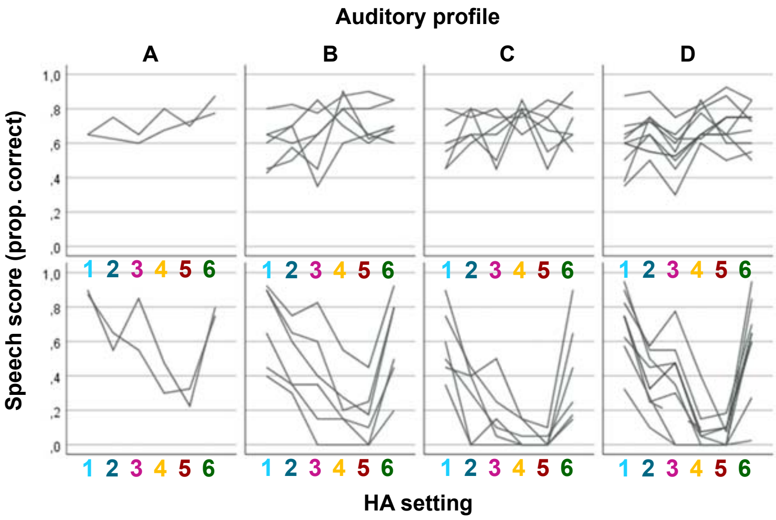
(Sanchez-Lopez *et al*, Euronoise 2018)

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

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



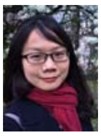
- Preliminary statistics
  - Spatial condition, HA setting, spatial condition × HA setting: all $p < .0001$
  - Auditory profiles: ???

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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