Open Source Audio Processing Platform--Live Workshop!

Feasibility studies

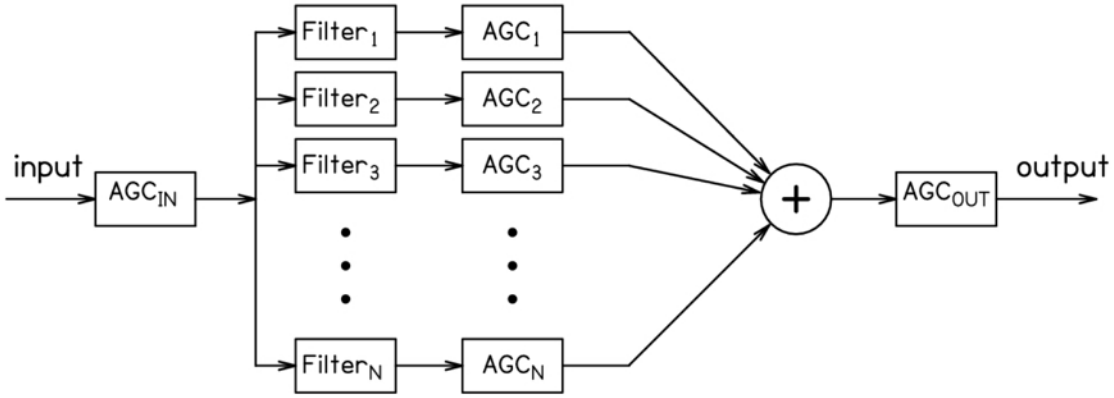
Funded by NIDCD R44 DC015445 (Creare)

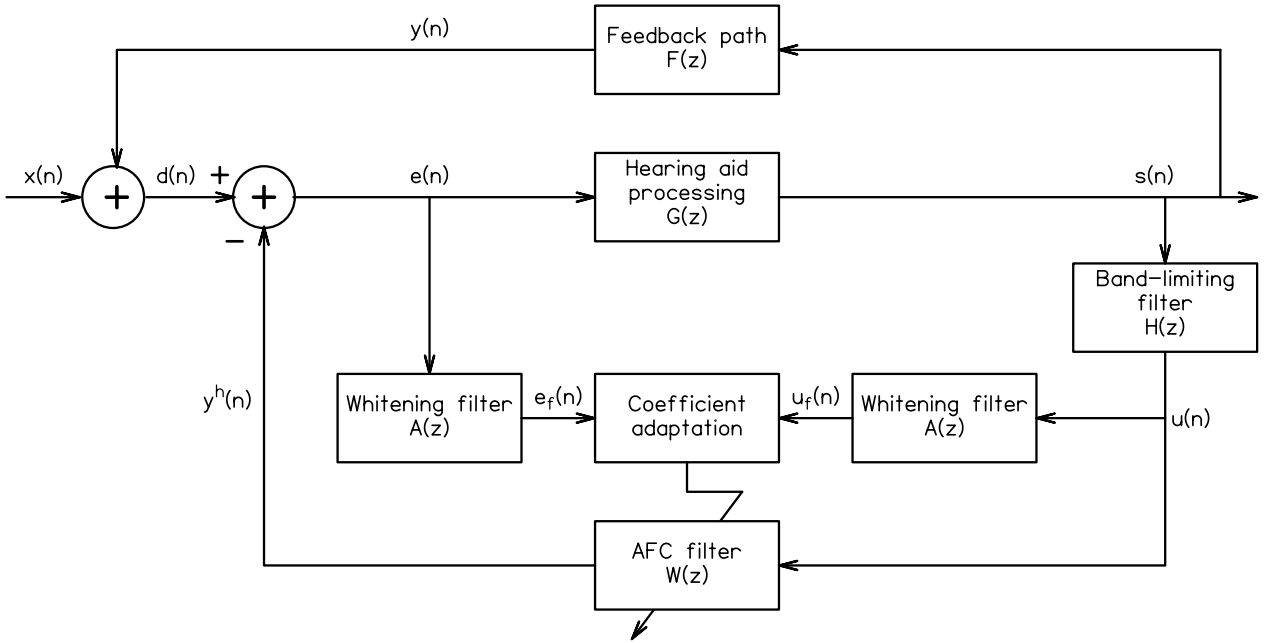
Background

- Ability to modify hearing-aid signal processing is limited
- Free and Open-Source Software (FOSS)
- Tympan Hardware
  - Teensy 3.6 microcontroller
  - 2 analog inputs/outputs
  - USB, Bluetooth, Ethernet, serial bus interface
  - Microphones
  - Uses the Arduino development environment

Tympan Hearing-Aid Algorithms

- 8-channel filterbank followed by WDRC (Alexander et al. 2015)
- Envelope peak detector (Kates 2008)
- Adaptive feedback circuit



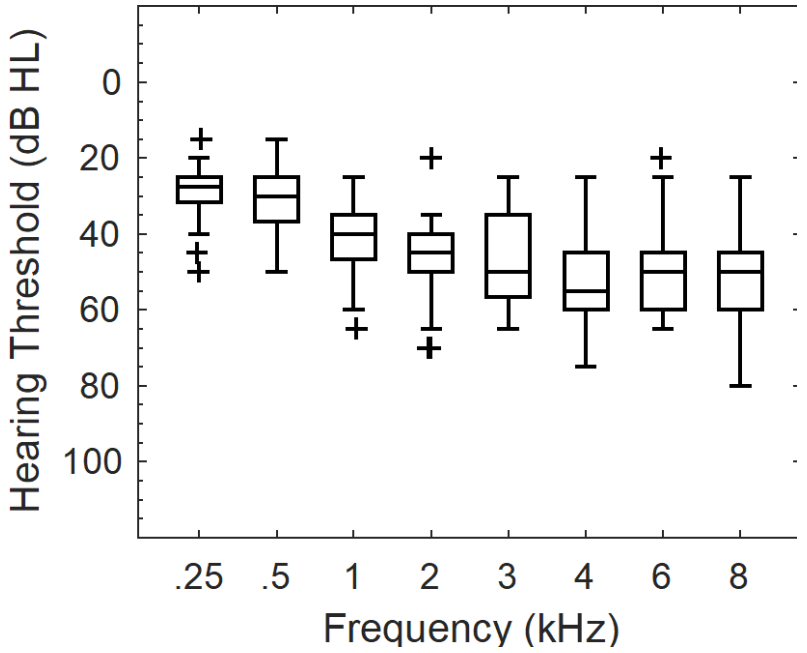


Feasibility experiments: Purposes

- Benchmark Tympan to a commercially available device
- Electroacoustic measures
  - ANSI
  - Hearing-aid speech perception index (HASPI, Kates et al. 2014)
  - Hearing-aid speech quality index (HASQI, Kates et al. 2010)
- Behavioral measures
  - AzBio sentences in 10-talker babble (Spahr et al. 2012)
  - CASPA vowel-consonant-vowel words (Mackersie et al. 2001)

Feasibility experiments: Participants

- n=21 adults
- Conditions:
  - Unaided
  - Tympan (8 ch, 5 ms AT, 300 ms RT)
  - Phonak Bolero (20 ch, 10 ms AT, 150 ms RT)
- Set to NAL-NL1, feedback manager on
- Measured added stable gain in KEMAR (50 dB HL)

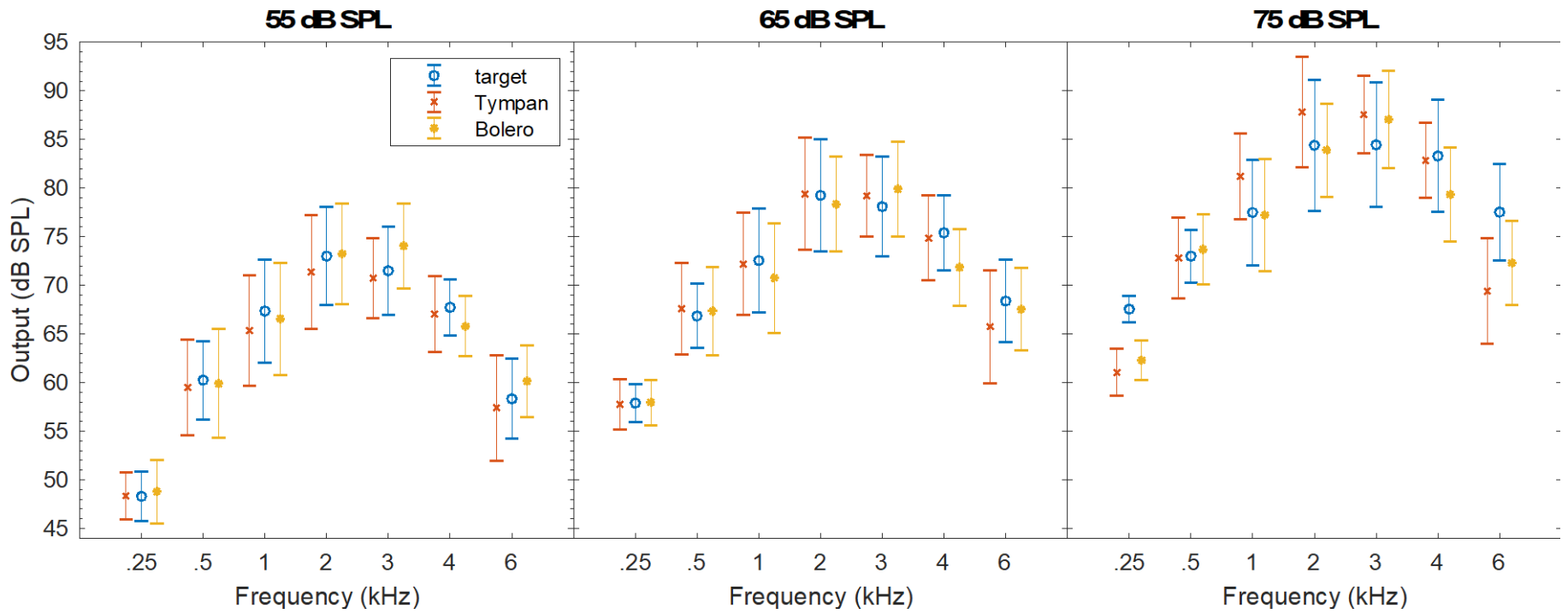


Feasibility experiments: Analysis

- Outcome variables
  - added stable gain
  - hearing-aid output levels
  - proportion correct for CASPA & AzBio
  - HASPI and HASQI scores
- Series of repeated-measures ANOVAs to examine effect of processing condition

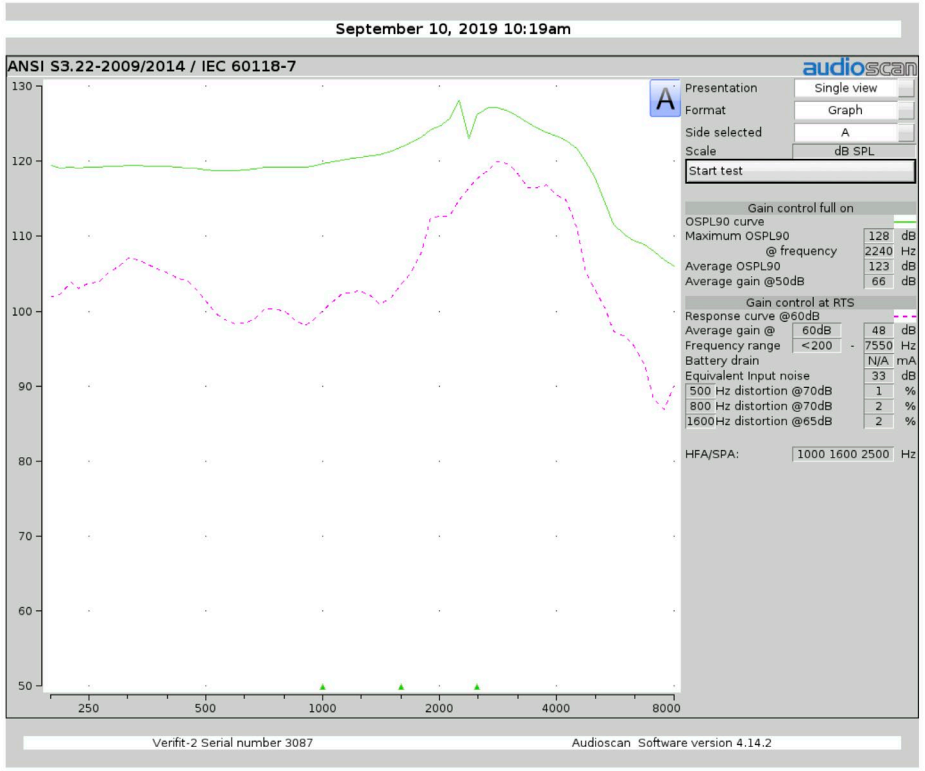
Feasibility experiments: Real ear output

- Mean added stable gain = 15.9 dB (SD=2.1)

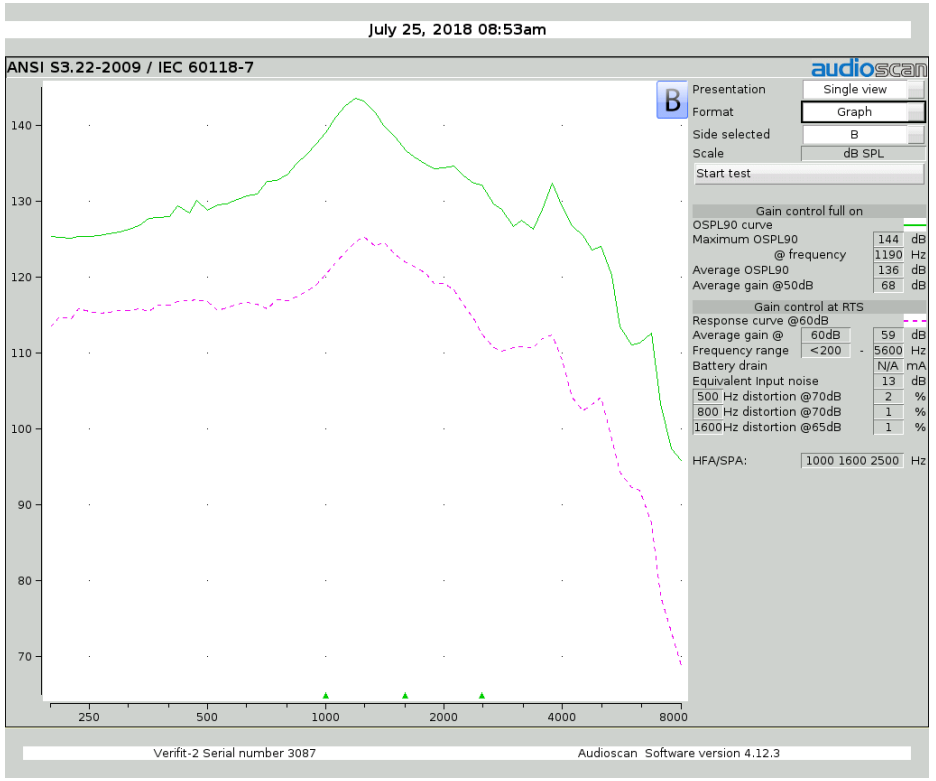


Feasibility experiments: ANSI

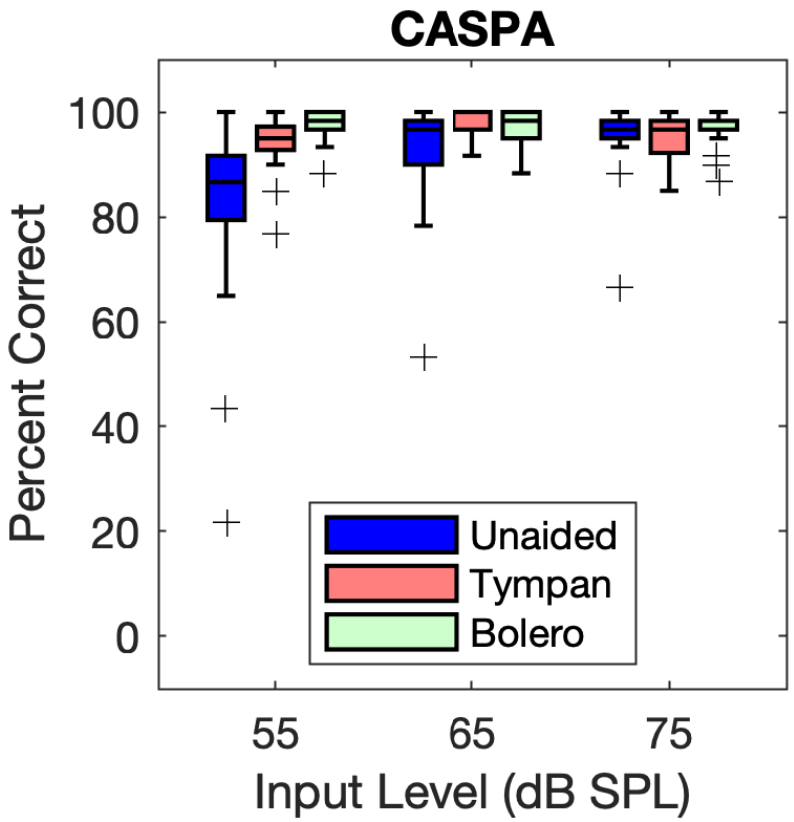
Tympan

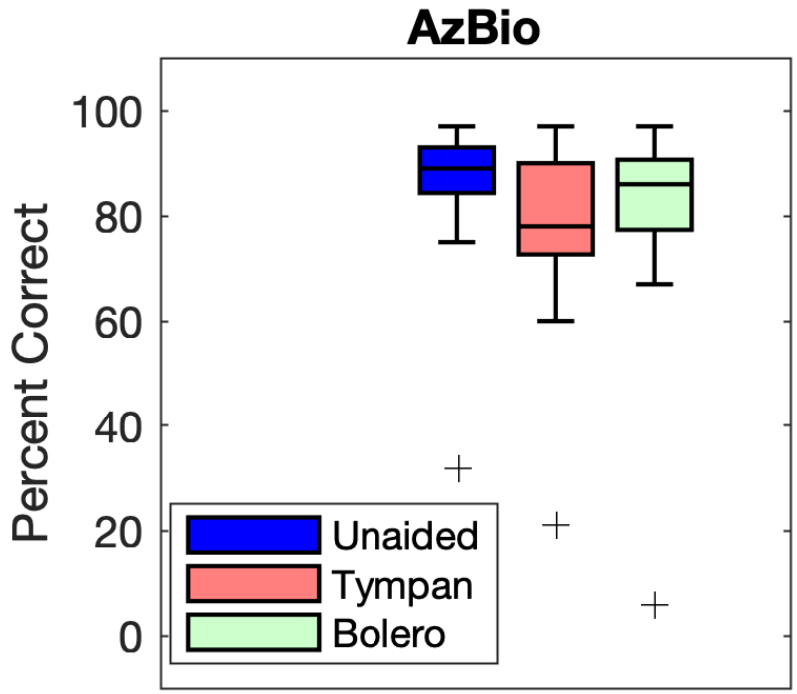


Bolero

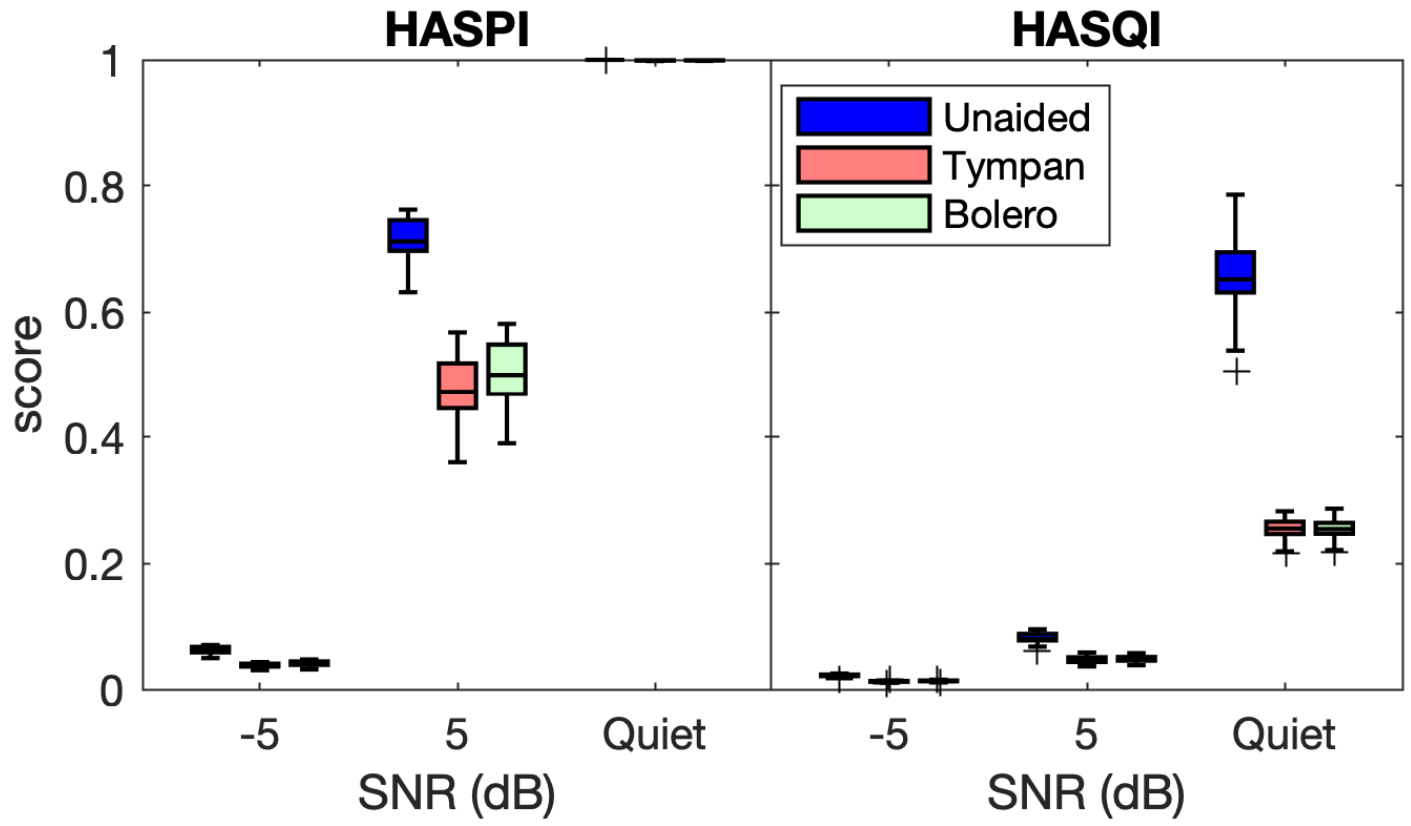


Feasibility experiments: Speech recognition



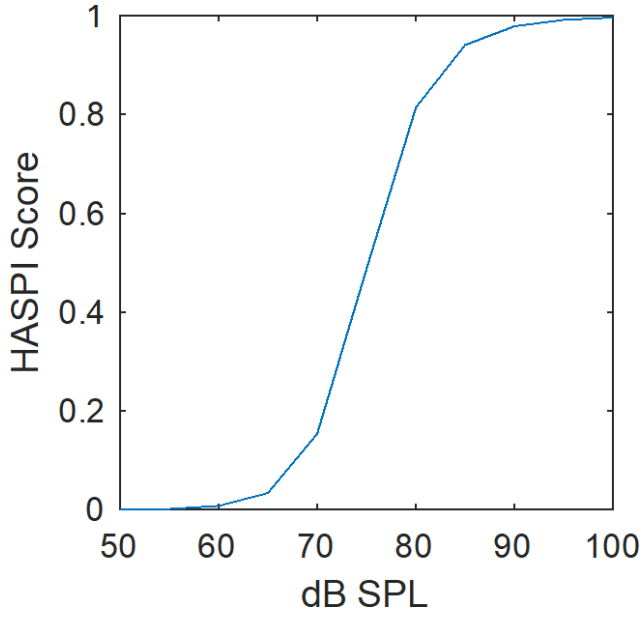


Feasibility experiments: HASPI/HASQI



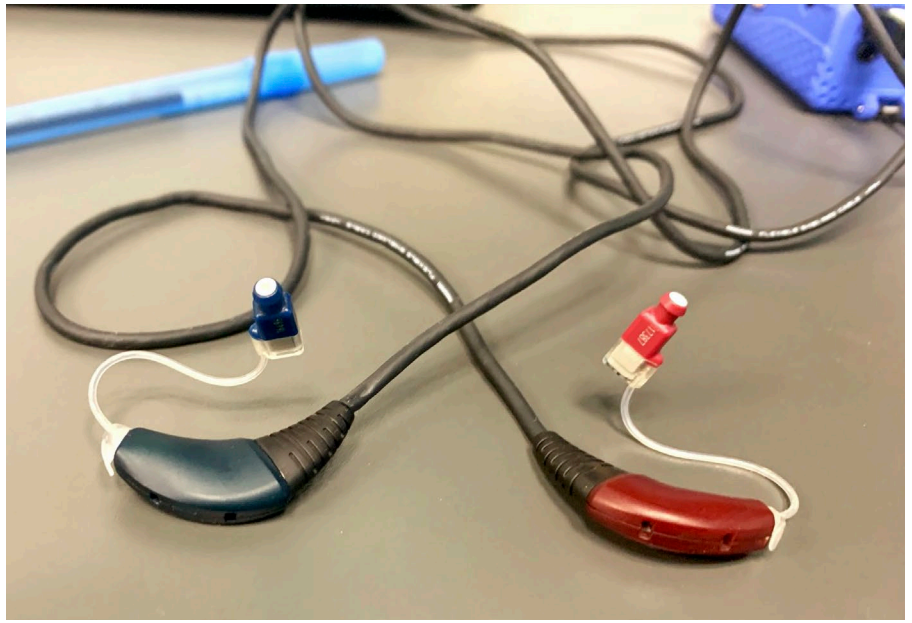
Discussion

- Added stable gain (15.9 dB) consistent with prior work
- HASPI predicted
  - better unaided speech recognition: HA noise, feedback management
  - 100% recognition in quiet: floor effect
- Higher equivalent input noise likely due to microphone noise
  - May have contributed to lower HASPI score



Future work

- Manipulate feedback cancellation parameters to test effects on added stable gain / sound quality
- RIC earpiece
  - I/O measurements
  - Nonlinear frequency compression
  - Directional performance



Thank you!

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I/O and directional measurements