The applicability of an online speech-in-noise screening test in occupational hearing conservation
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Online speech-in-noise testing promises to be a valuable tool for hearing screening in large groups. They offer easy accessibility, low requirements and a broad applicability. Using a low-pass filtered masking noise makes the test more sensitive to discover NIHL. However, noise filtering leads to less accurate results when applied in domestic screening. Future research focuses on improving test reliability, in order to develop a reliable internet-based hearing screening for domestic use.

Early detection of NIHL is a crucial element in hearing conservation programs. Internet-based speech-in-noise applications offer new approaches of self-screening. Easily accessible online test can be performed at any given time. Simple domestic usage will raise the participation rates. This is especially beneficial in transient workforces such as in construction industry.

Aim of this research: a reliable online speech-in-noise screening instrument to detect NIHL

1. Earcheck

Earcheck is a Dutch speech-in-noise test
- 9 CVC words presented in masking noise (Fig. 1)
- Adaptive procedure in 2 dB steps
- Speech reception threshold (SRT):
  - SNR of 50% correct word recognition
- Masking by low-pass filtered masking noise (LP)
  - Cut-off frequency 1.4 kHz, noise floor at –15 dB

2. Evaluating and improving test sensitivity

The use of a low-pass filtered noise instead of a broadband noise stimulates the use of high frequency speech information. A lab study shows that LP noise gives a better discrimination between normal hearing (n=49) and NIHL (n=49) subjects without a reduction in reliability.

- **Original Earcheck - broadband noise**
  - Sensitivity: 51%
  - Specificity: 90%
  - Correlation SRT-PTA3,4,6: 0.62
  - SE of measurement: 1.24 dB
  - Correlation test-retest: 0.76
  - Learning effect: 0.82 dB

- **Earcheck - Low Pass filtered noise**
  - Sensitivity: 95%
  - Specificity: 98%
  - Correlation SRT-PTA3,4,6: 0.92
  - SE of measurement: 1.25 dB
  - Correlation test-retest: 0.93
  - Learning effect: 0.71 dB

3. Domestic implementation of Earcheck

Due to the noise filtering, uncontrollable parameters can influence test outcomes when performed at home
- Normal hearing subjects (n=10) show poorer performance at home than in lab (Δ = -1.0 dB)
- Hearing-impaired performance (n=20) increases at home compared to lab (Δ = 1.1 dB)
- This benefit increases with growing severity of NIHL (r=0.56)

Although spectral differences due to different sound cards and headphones may play a role, the most likely cause is the effect of presentation level.

4. Applicability of Earcheck in occupation hearing conservation

Field study
- 210 noise-exposed construction workers, different degrees of HL (from NH to severe NIHL)
- Data are collected online, headphones are provided
- Comparison with occupational screening audiogram

- **Test characteristics**
  - Cut-off to detect PTA3,4,6 > 25 dB HL: -17.2 dB
  - Sensitivity: 68%
  - Specificity: 71%
  - Correlation SRT-PTA3,4,6: 0.58
  - SE of measurement: 1.63 dB
  - Correlation test-retest: 0.74
  - Learning effect: 1.60 dB

Discussion test results
- Comparison to less accurate screening audiogram
- Study population had less hearing loss than in lab study
- Greater learning effect due to first tests → improve instruction / incorporate practice trials