Speech-in-noise screening tests by internet;

improving test sensitivity for noise-induced hearing loss

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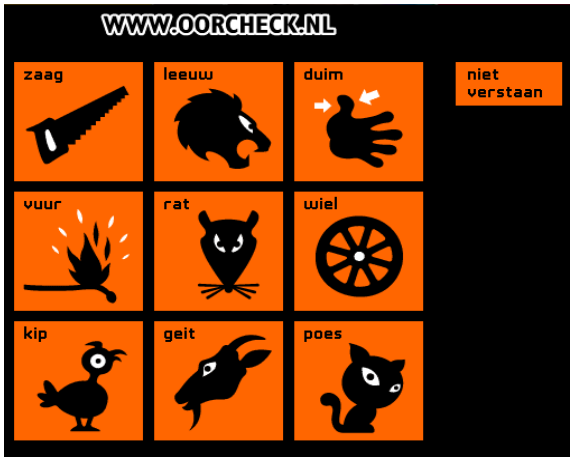
Speech-in-noise screeningtests

- Screeningtests:
  - National Hearing Test by telephone *(Smits et al. '04)*
  - Online speech-in-noise tests
    - → Objective test
    - → Easy to administer

Oorcheck (OC) *(developed by LUMC)*

- Broadband stationary noise
- 9 CVC words, 27 stimuli
- Target group: youngsters (12-24 yrs)



Oorcheck

Aims at young population

- Risk for hearing loss after exposure to loud music
- Raising awareness about hearing loss

However, NIHL does not greatly affect SRT in stationary noise *(Smoorenburg 1992)*

- Closed set of speech stimuli
- Hearing threshold levels at low and middle frequencies are (near) normal

Objectives of this study

1. Investigate the potential of Oorcheck to discover NIHL in an early stage

2. Examining ways to enhance the test sensitivity for mild NIHL using different forms of noise modifications

→ Make existing speech-in-noise screening tests (like Oorcheck) applicable for NIHL

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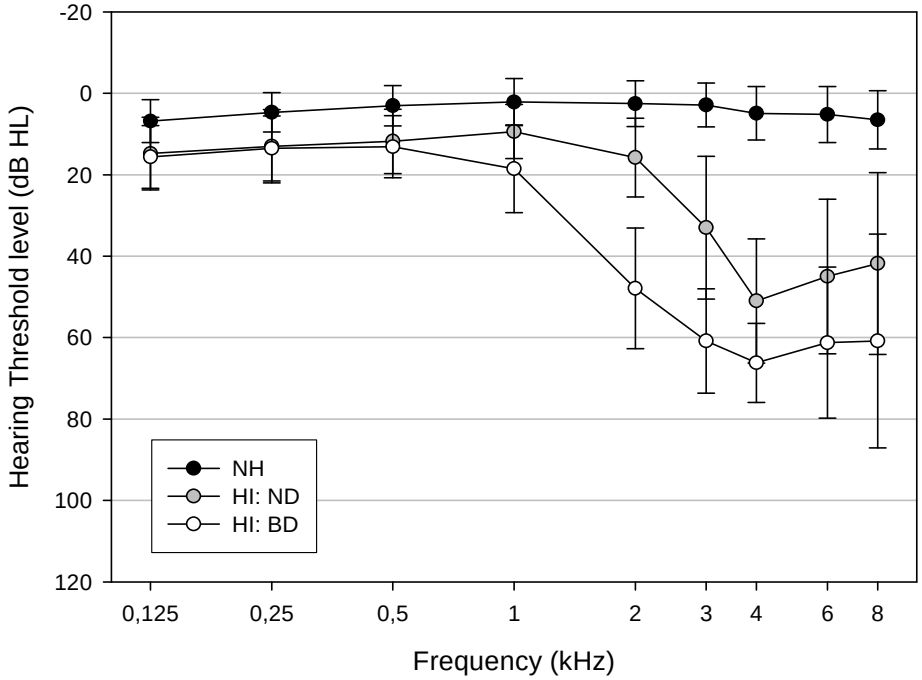
Subjects

n=100 (2 excluded)

NH: 49 (age 27 yrs ± 8.5)
with HTLs ≤ 15 dB HL

HI: 49 (age 56.3 yrs ± 9.4)
- 25 with narrow dip (ND)
- 24 with broad dip (BD)
  HTL_{2kHz} affected



Test procedures

- Adaptive procedure *(Plomp & Mimpen 1979)*
- SRT: snr of 50% correct word recognition
- Fixed noise level
- Presentation level SRTq + 20 dB with minimum of 65 dB(A)
- Monaural presentation through headphones
- Tested twice (test and retest)

Test sensitivity for NIHL

Average SRTs Oorcheck

NH:		-12.0 (1.7)
HI:	*ND*	-10.7 (3.0)
	BD	-8.4 (2.4)

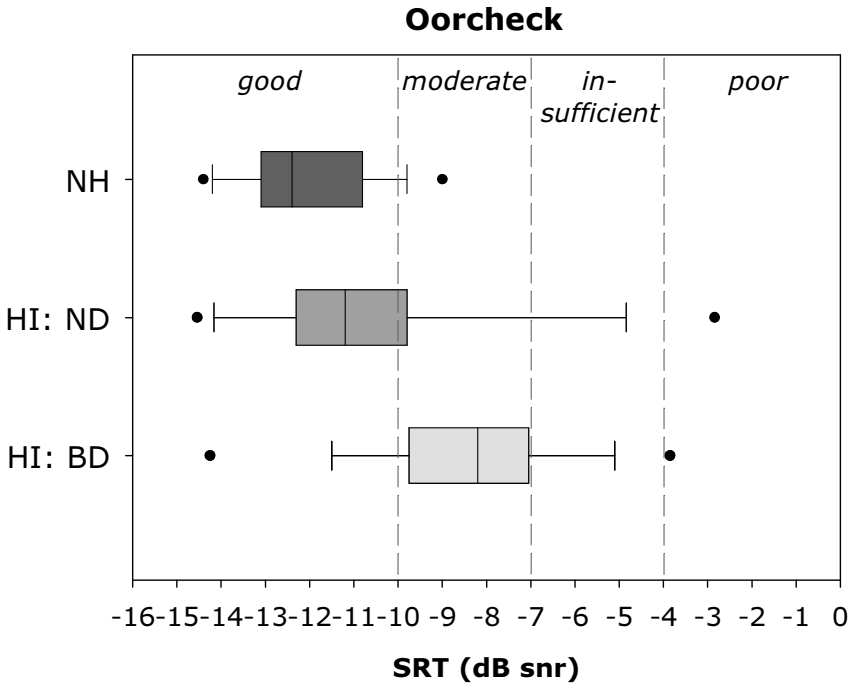
Sensitivity 51%

→ 49% of HI is classified as NH

Specificity 90%

→ 10% of NH is classified as HI

Test-retest sd: 1.3 dB



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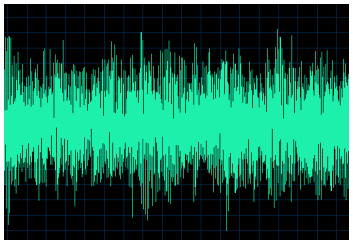
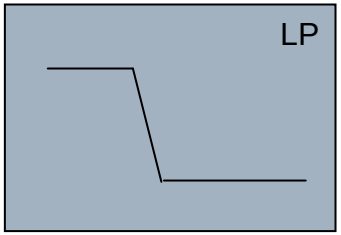
Noise modifications

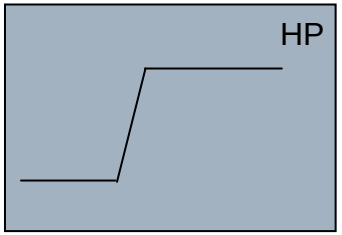
- Spectral filtering
  - Low pass filtered noise →
    Less masking of high frequencies
- Temporal modulation
  - NH benefit more from interrupted noise than HI
    (e.g. De Laat & Plomp 1983, Festen & Plomp 1990, Versfeld & Dreschler '02)
- Both types of modifications combined
- Noise parameters were based on model predictions (ESII) and pilot measurements

Experimental set of noises

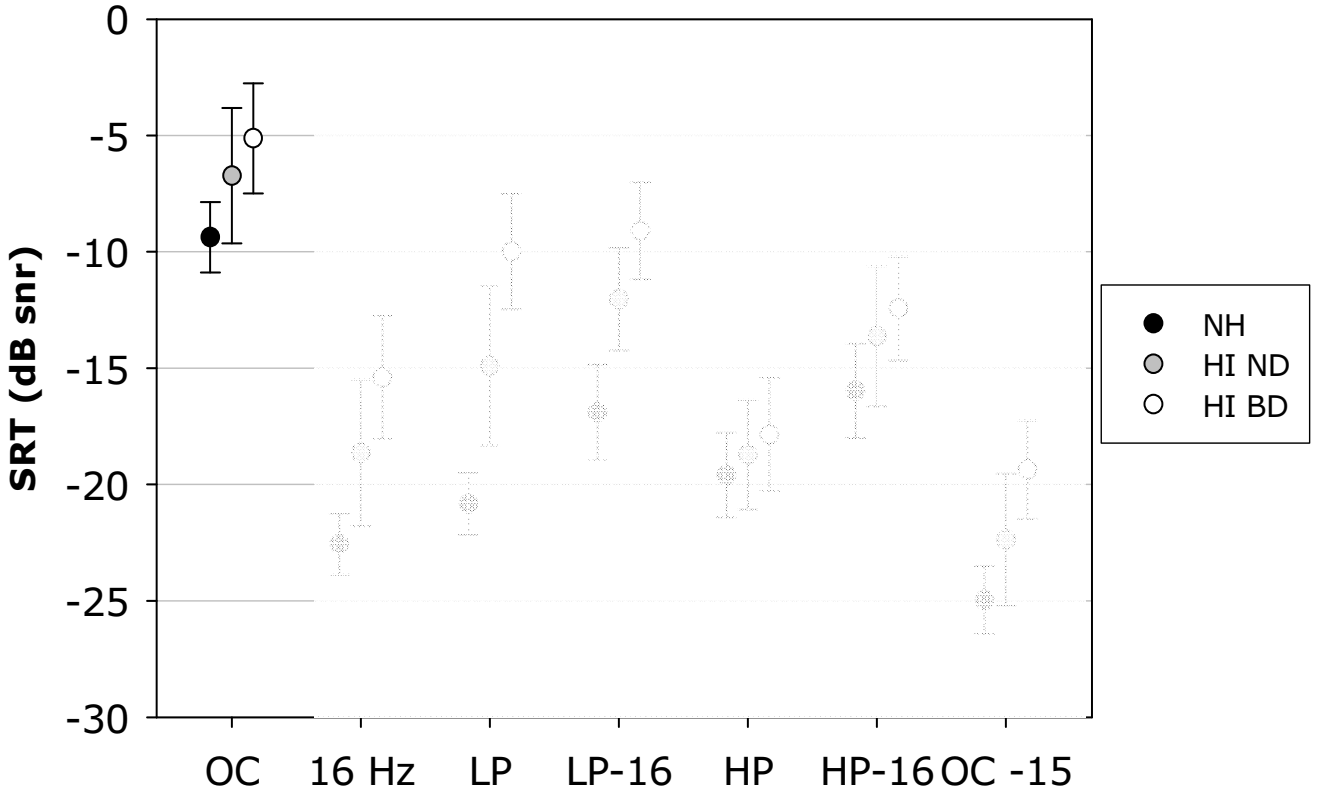
test noise	*filtering*	*modulation*	*noise floor*
Oorcheck	-	-	-
16 Hz	-	16 Hz	-15 dB
LP	LP 1.4 kHz	-	-15 dB
LP & 16 Hz	LP 1.4 kHz	16 Hz	-15 dB
HP	HP 1.4 kHz	-	-15 dB
HP & 16 Hz	HP 1.4 kHz	16 Hz	-15 dB
OC -15	-	-	-15 dB







Results – group differences



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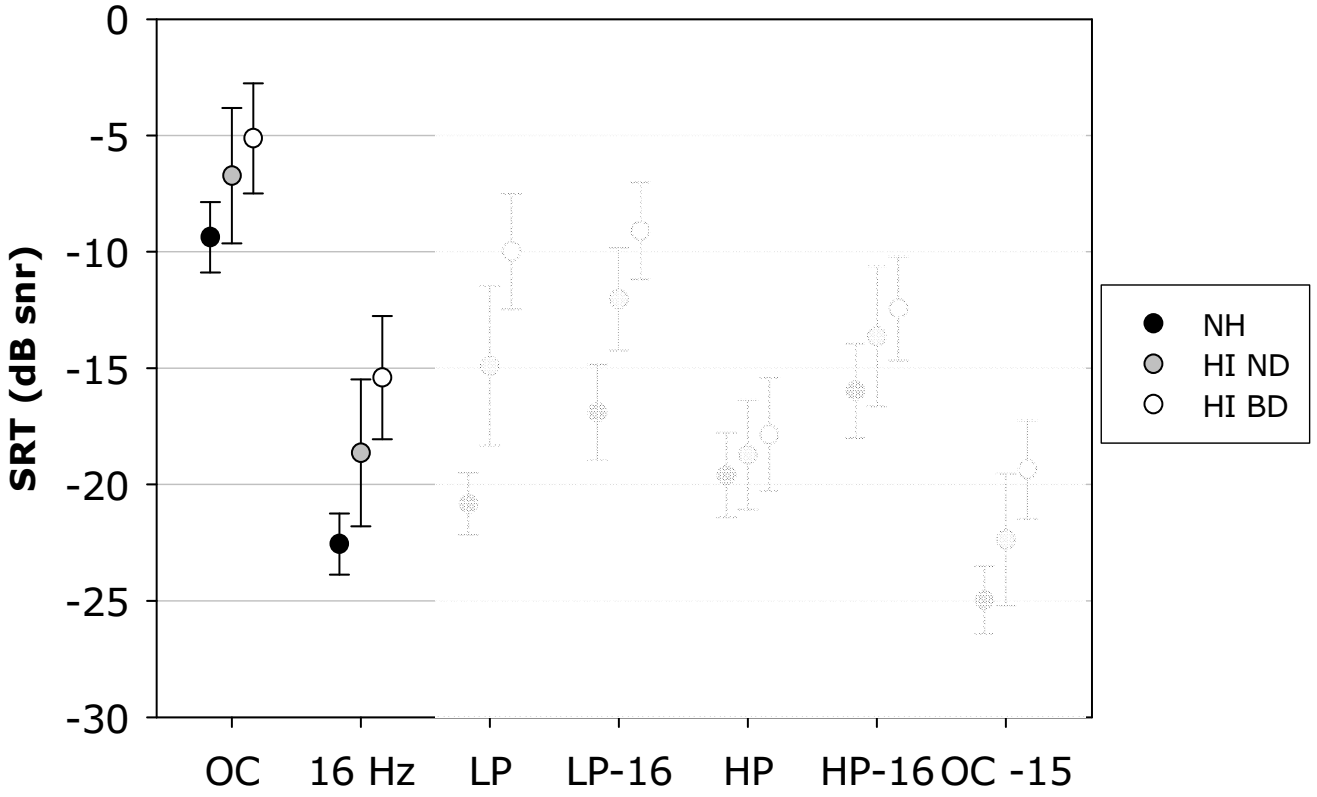

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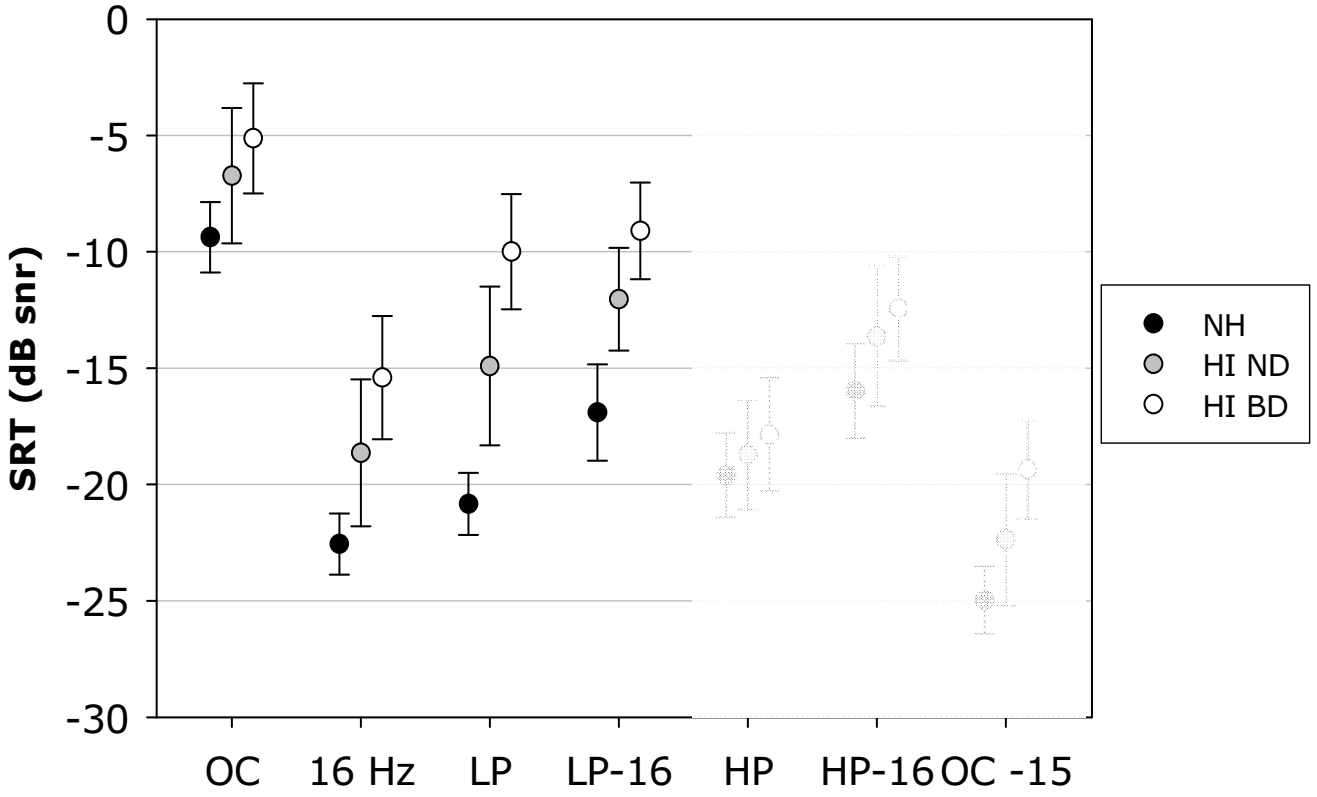

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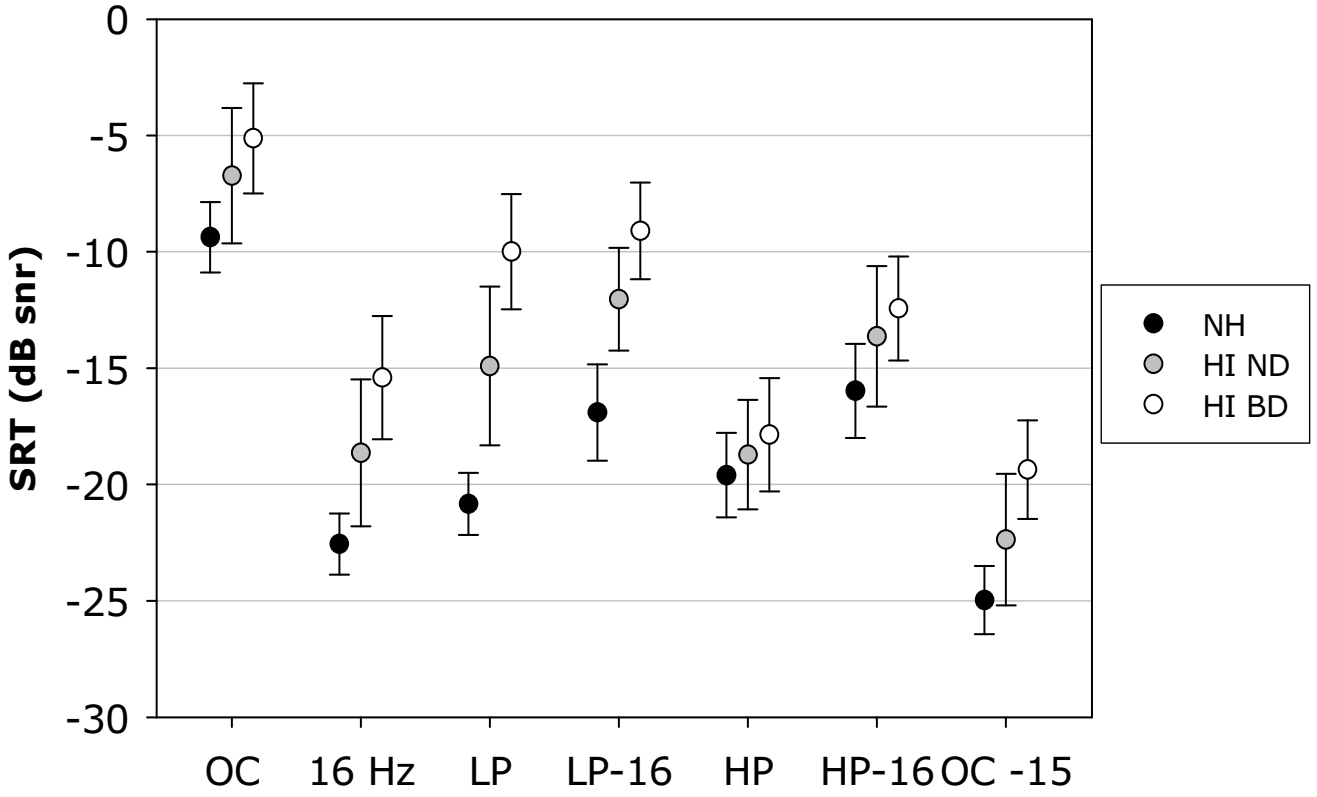

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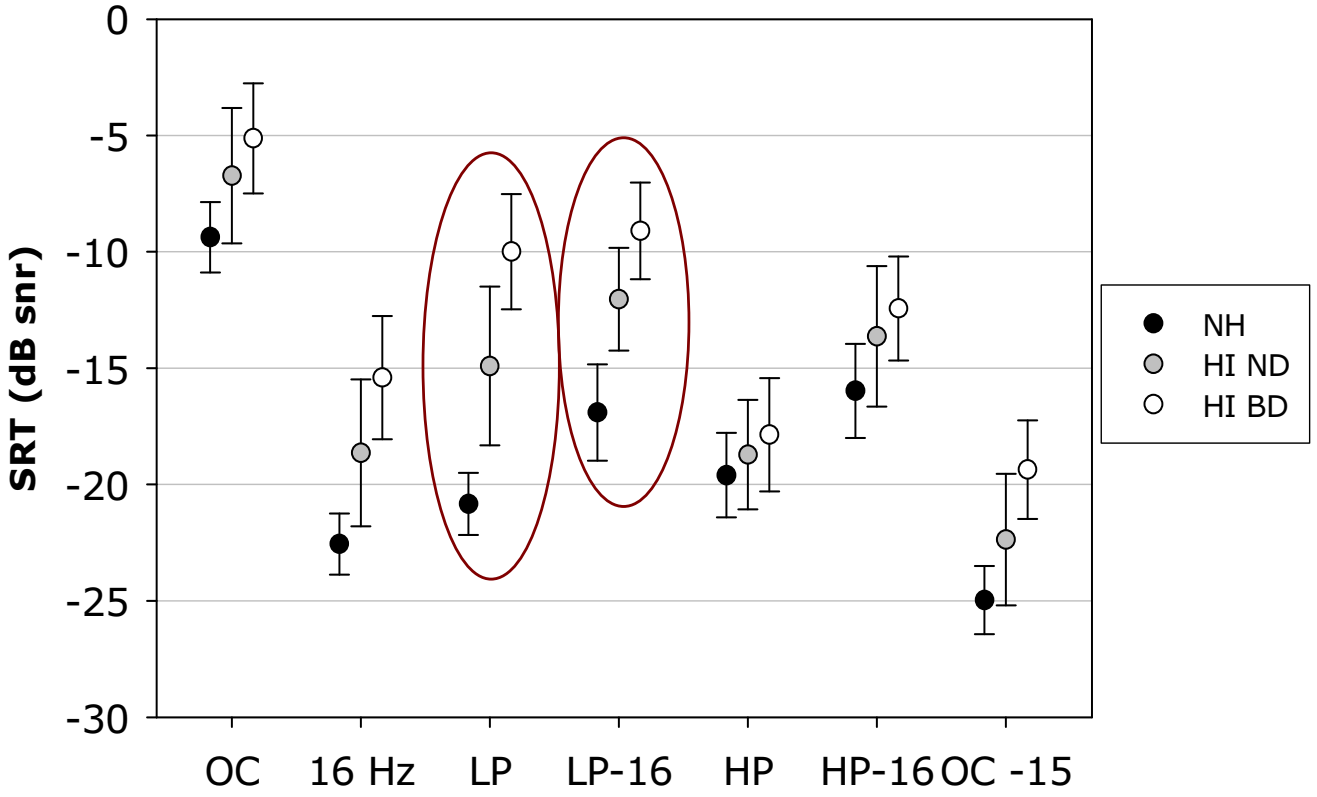
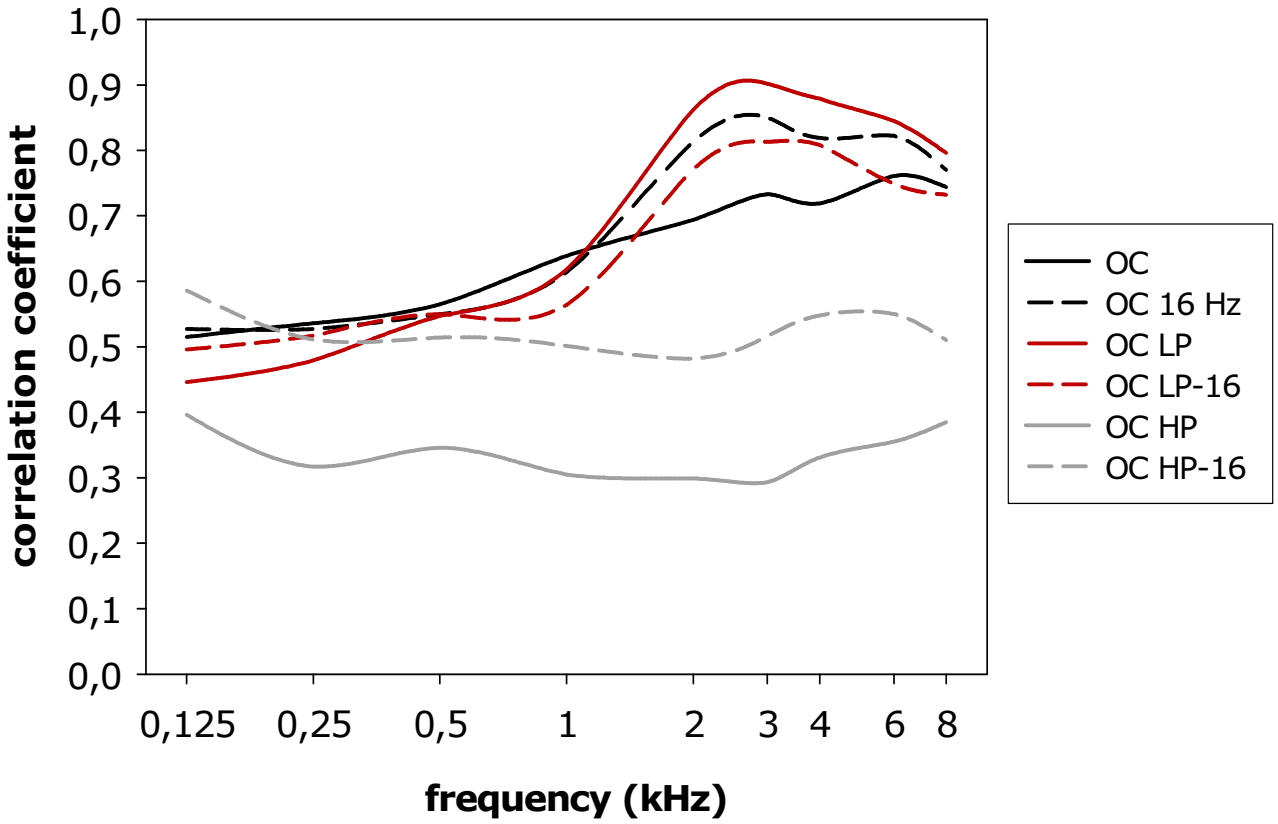


Results - frequency dependence

Correlations between individual SRTs and HTLS
→ Highest correlation for LP noise and 2-6 kHz



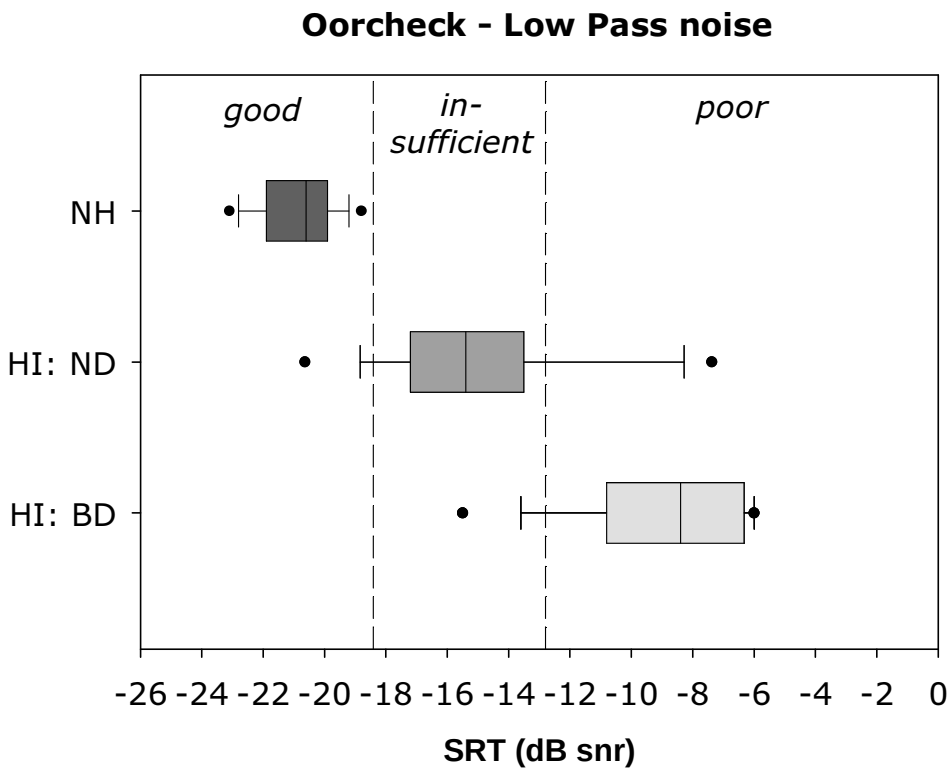
Validation of OC LP

Test-retest reliability:

- sd 1.3 dB
- this is similar to the original test

Sensitivity & specificity:

- sensitivity 95%
  specificity 98%



Discussion

- To be investigated further:
  - Extrapolation of lab results
    - ambient noise
    - system settings
    - transducers
  - Level dependency

Conclusions

1. The original Oorcheck showed only small differences between NH and HI subjects with mild NIHL (narrow dips)

2. Hearing-impaired subjects deviated more clearly from normal performance when using low-pass filtered masking noise

This suggests that this noise condition is more sensitive to discover NIHL in an early stage

Generalization

We expect that the approach used will be valid for other types of speech-in-noise tests as well

If this can be proven, manipulation of the masking noise will increase the sensitivity and specificity with respect to NIHL for different types of speech-in-noise screening tests

Thank you!

Aknowledgements:
Colleagues from LUMC (Dr. Jan de Laat)
Colleagues from UMCN St Radboud (Prof. Ad Snik)
Koenraad Rhebergen
Celine Jacobs