

Using the Sound Ear Check to identify childhood hearing loss



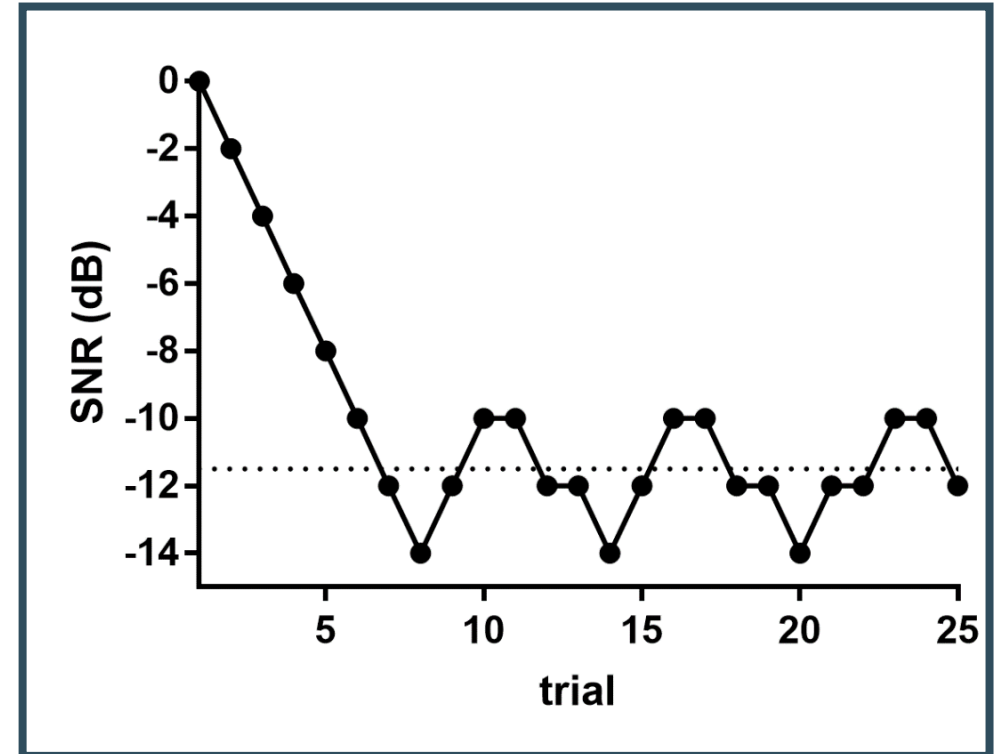
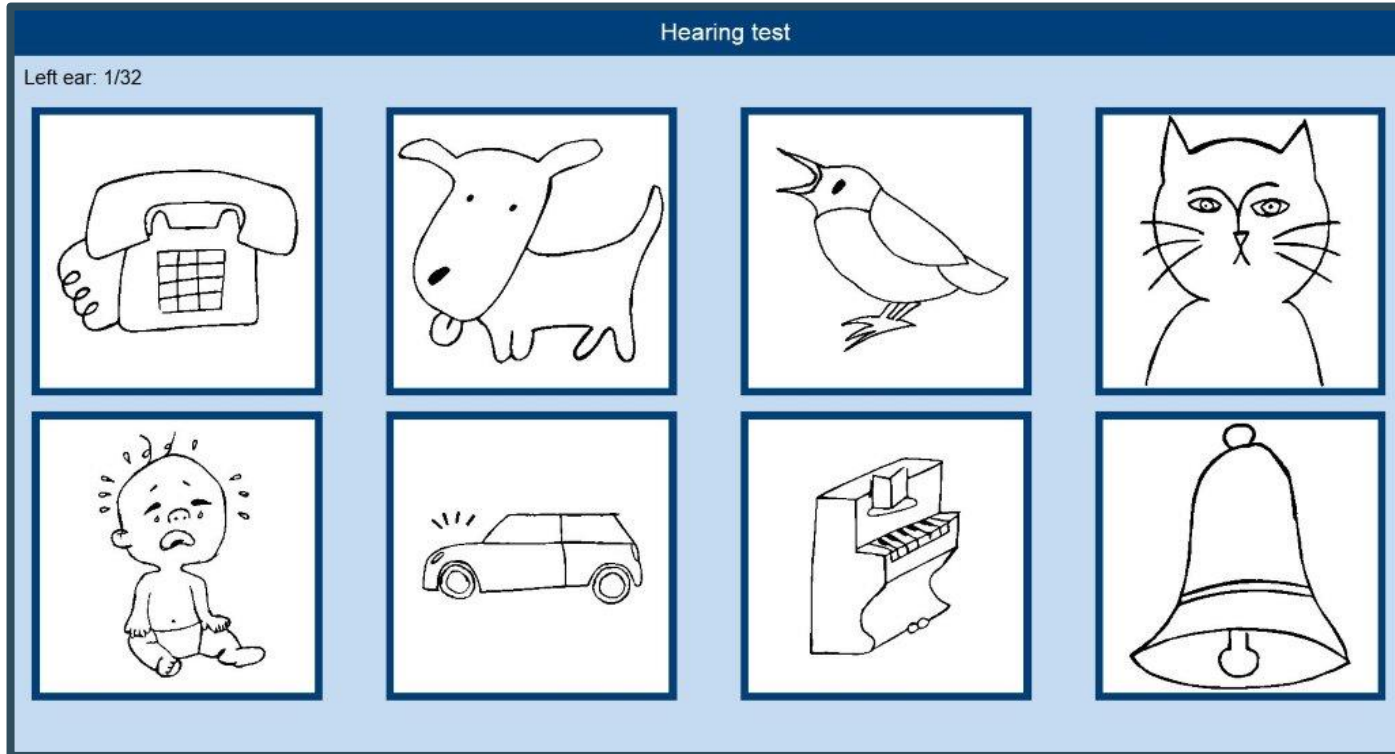
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Introduction

- Automated adaptive supra-threshold self-test on tablet
- Language independence
 - International usage?
- Possible implementation by school health services
 - School-entry?

Sound Ear Check



Sound Reception Threshold

$$SRT = \frac{\sum_{i=9}^{25} SNR_i}{17}$$

Standard Deviation (stability)

$$SD = \sqrt{\frac{1}{17} \sum_{i=9}^{25} (SNR_i - SRT)^2}$$

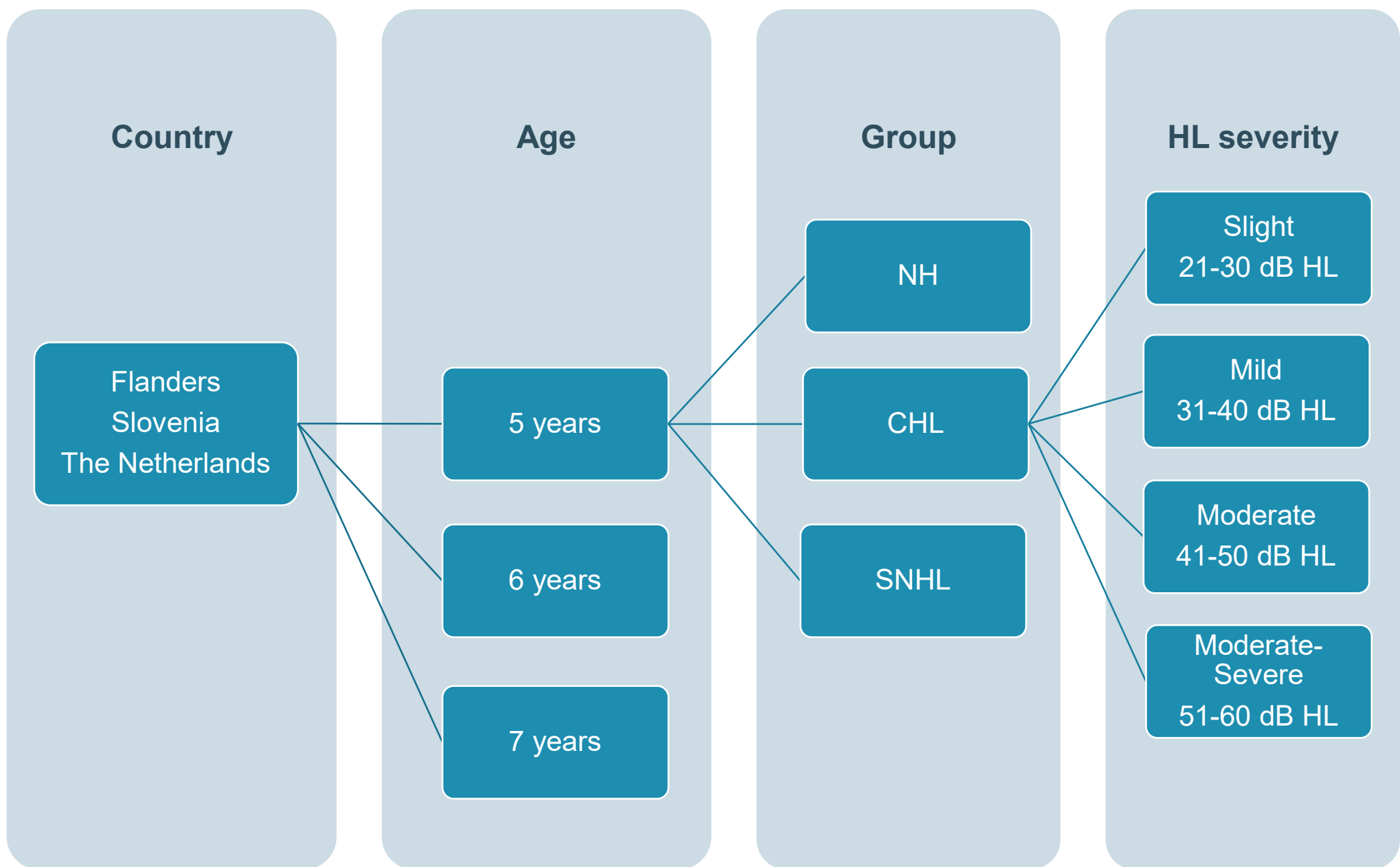
Acclimatization

24 binaural training trials

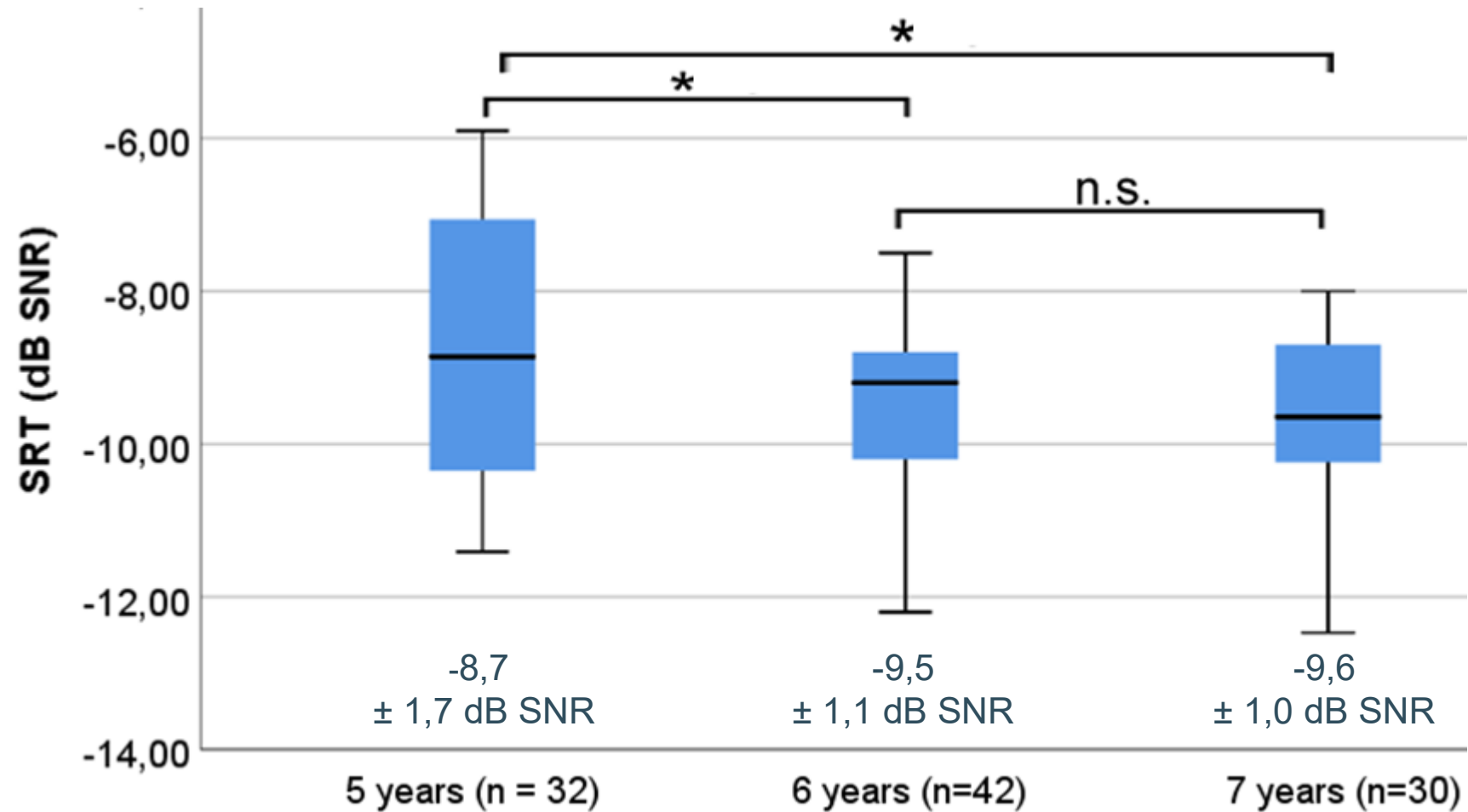
24 test trials per ear (left first)

Research aims

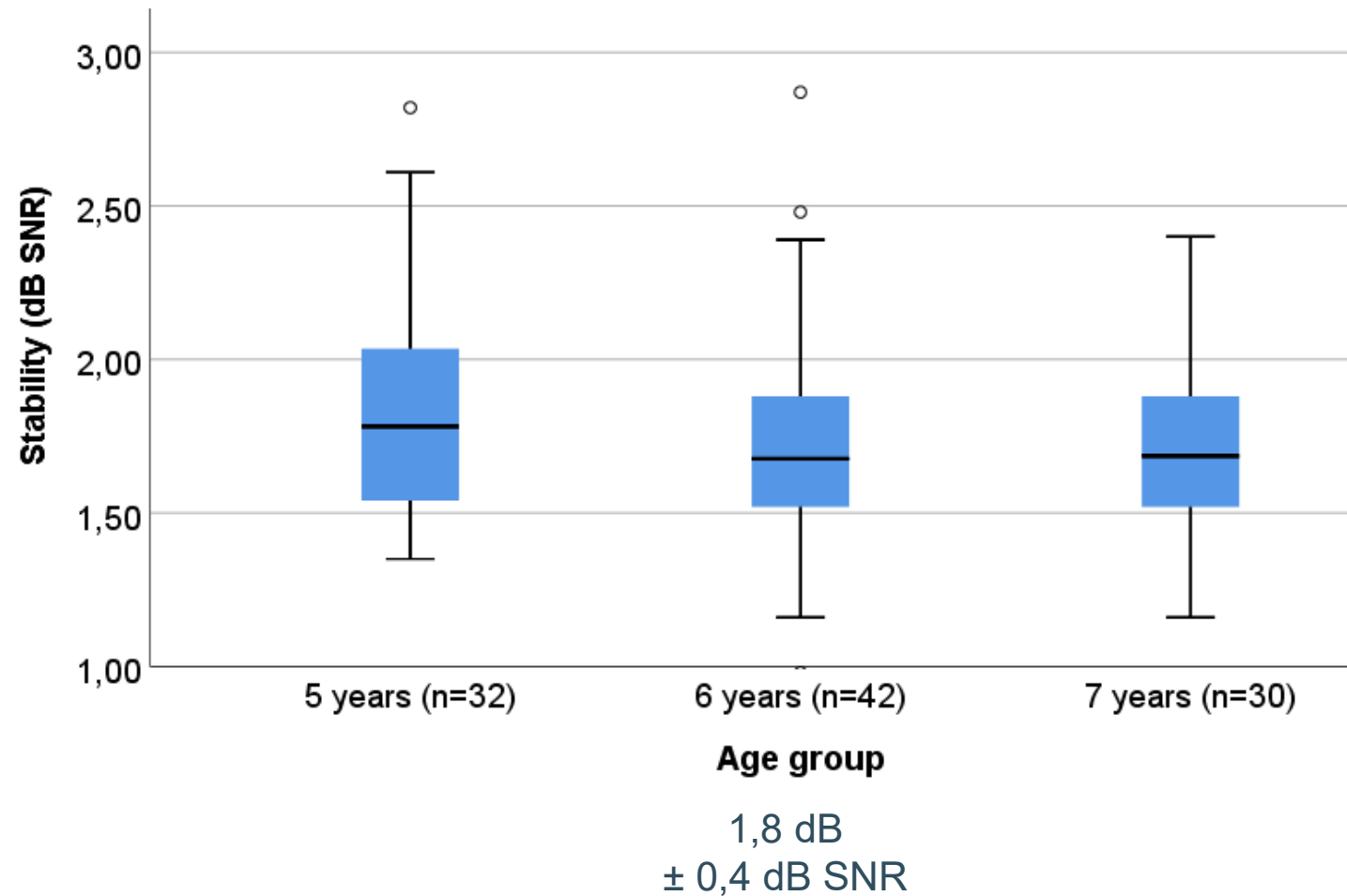
- Sound reception threshold (SRT): reference values & age effect (NH)
- Reliability (NH)
- Validity
 - Relation to pure tone audiometry
 - Diagnostic accuracy: sensitivity and specificity
 - Conductive hearing loss (CHL)
 - Sensorineural hearing loss (SNHL)
- Feasibility in young school-age children
- Agreement across countries



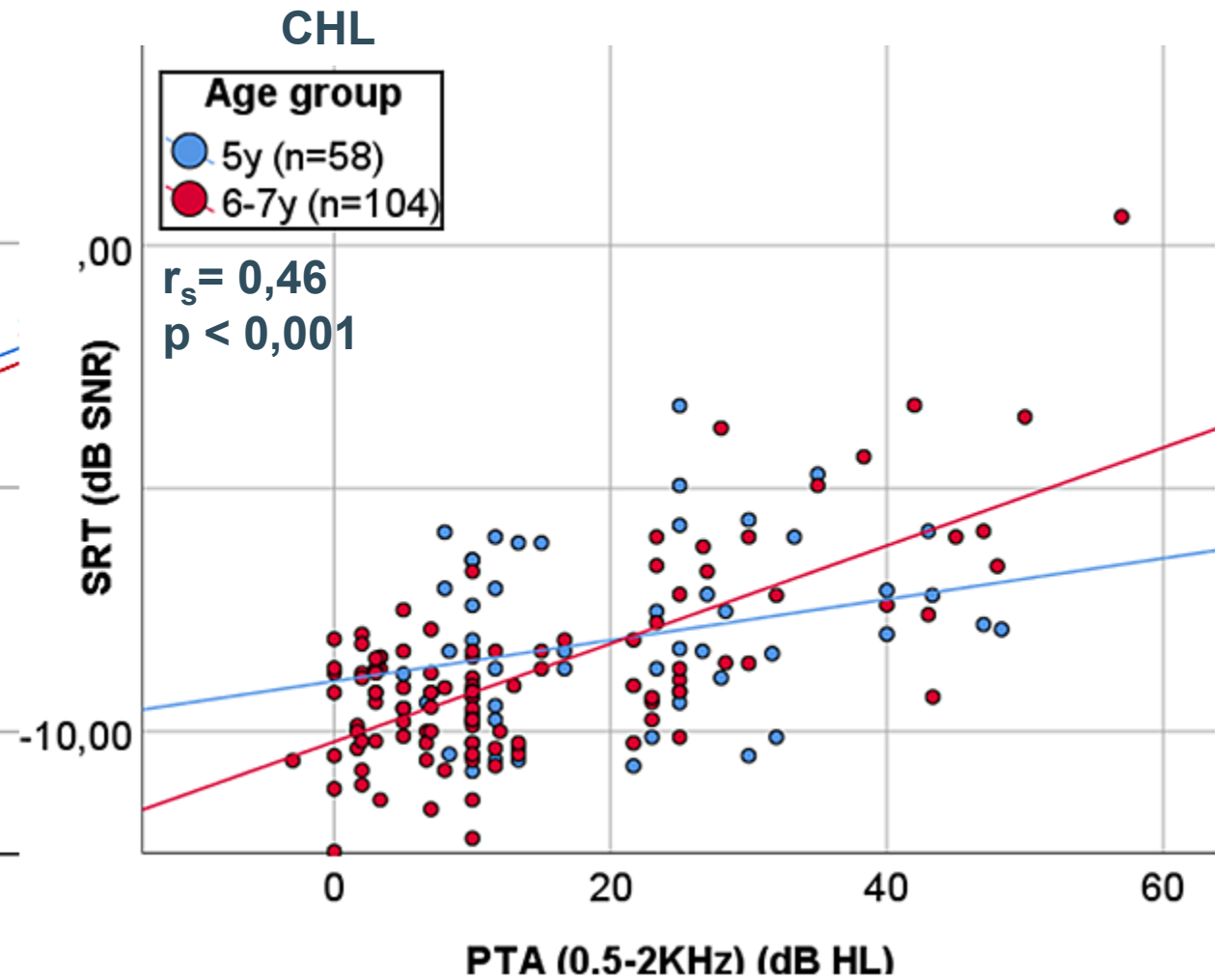
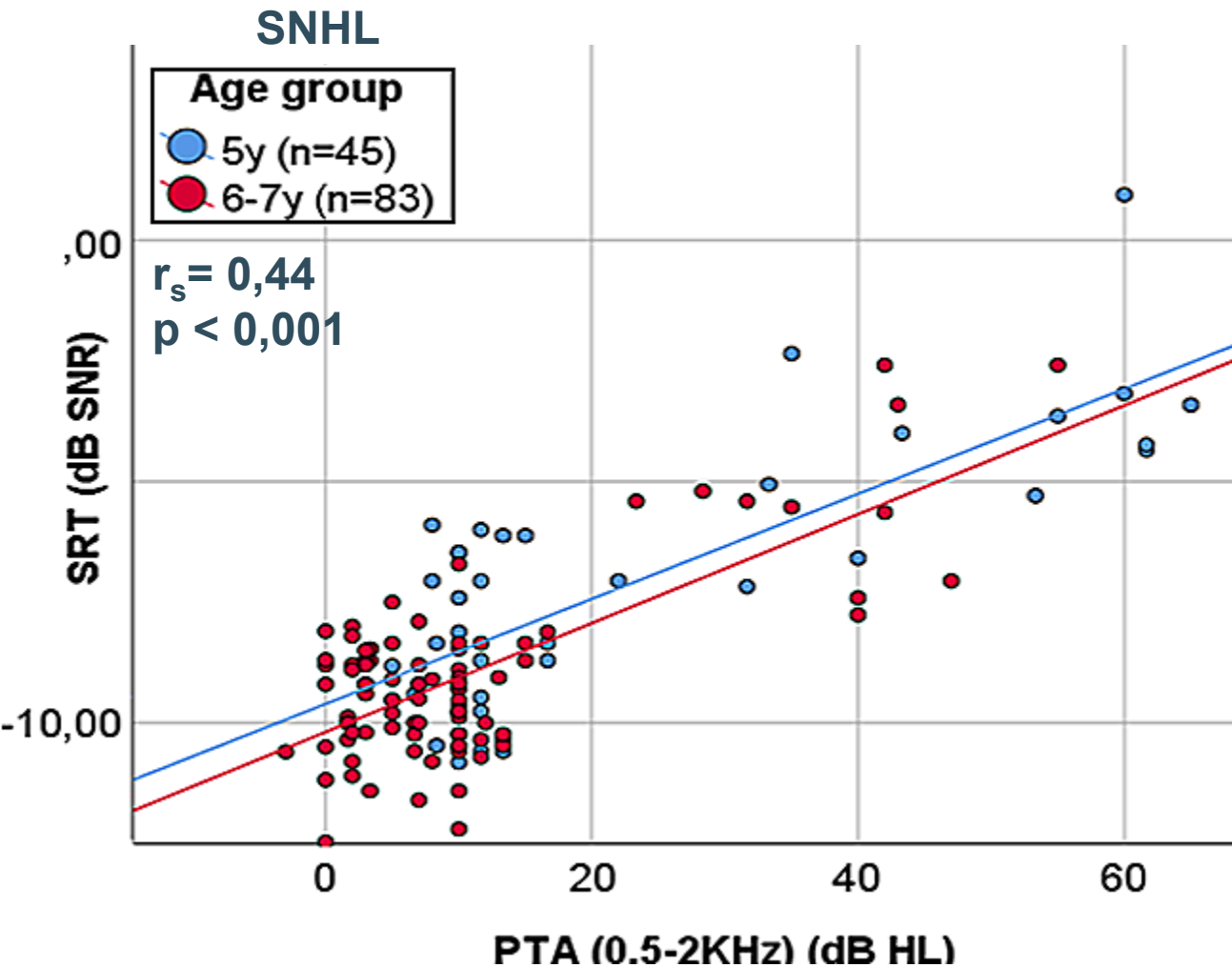
SRT reference values & age effect



Reliability: stability (SD)



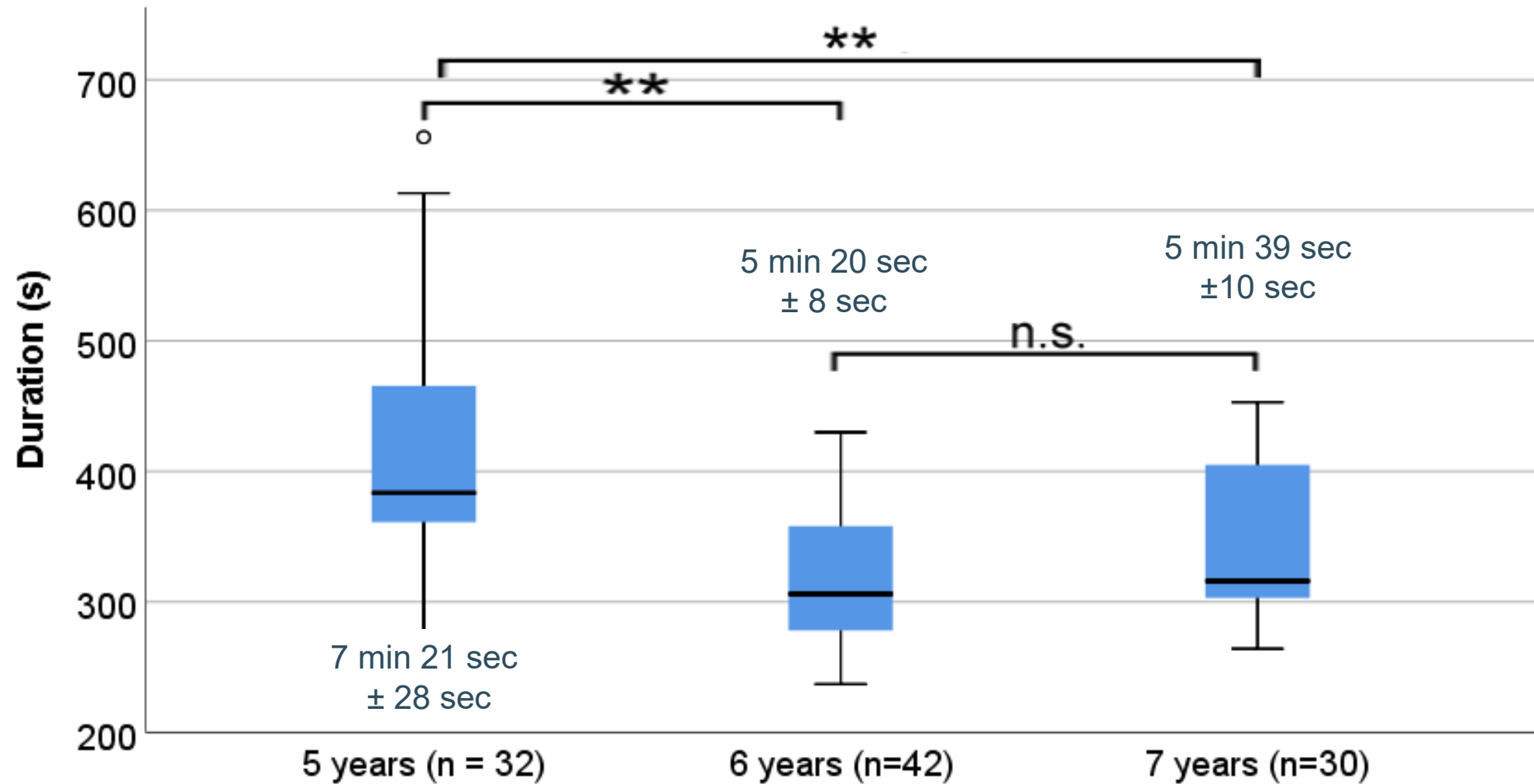
Validity: SRT-PTA relation



Validity: diagnostic accuracy

		SNHL			CHL		
PTA _{0.5-2kHz}		5y	6-7y	All	5y	6-7y	All
> 20 dB HL	AUC	0,94**	0,96**	0,98**	0,63	0,83**	0,80**
	Cutoff (dB SNR)	-6,8	-7,8			-8,8	
	Sensitivity	0,86	1,00	0,96		0,72	76
	Specificity	0,77	0,97	0,89		0,76	70
> 30 dB HL	AUC	0,95**	0,98**	0,97**	0,67	0,93**	0,86**
	Cutoff (dB SNR)	-6,8	-7,8			-7,8	
	Sensitivity	0,83	1,00	1,00		0,92	0,86
	Specificity	1,00	0,95	0,88		0,91	0,82
> 40 dB HL	AUC	0,94**	0,97**	0,96**	0,68	0,90**	0,85**
	Cutoff (dB SNR)	-5,6	-7,8			-7,7	
	Sensitivity	0,89	1,00	0,94		0,89	0,80
	Specificity	0,93	0,93	0,88		0,88	0,80

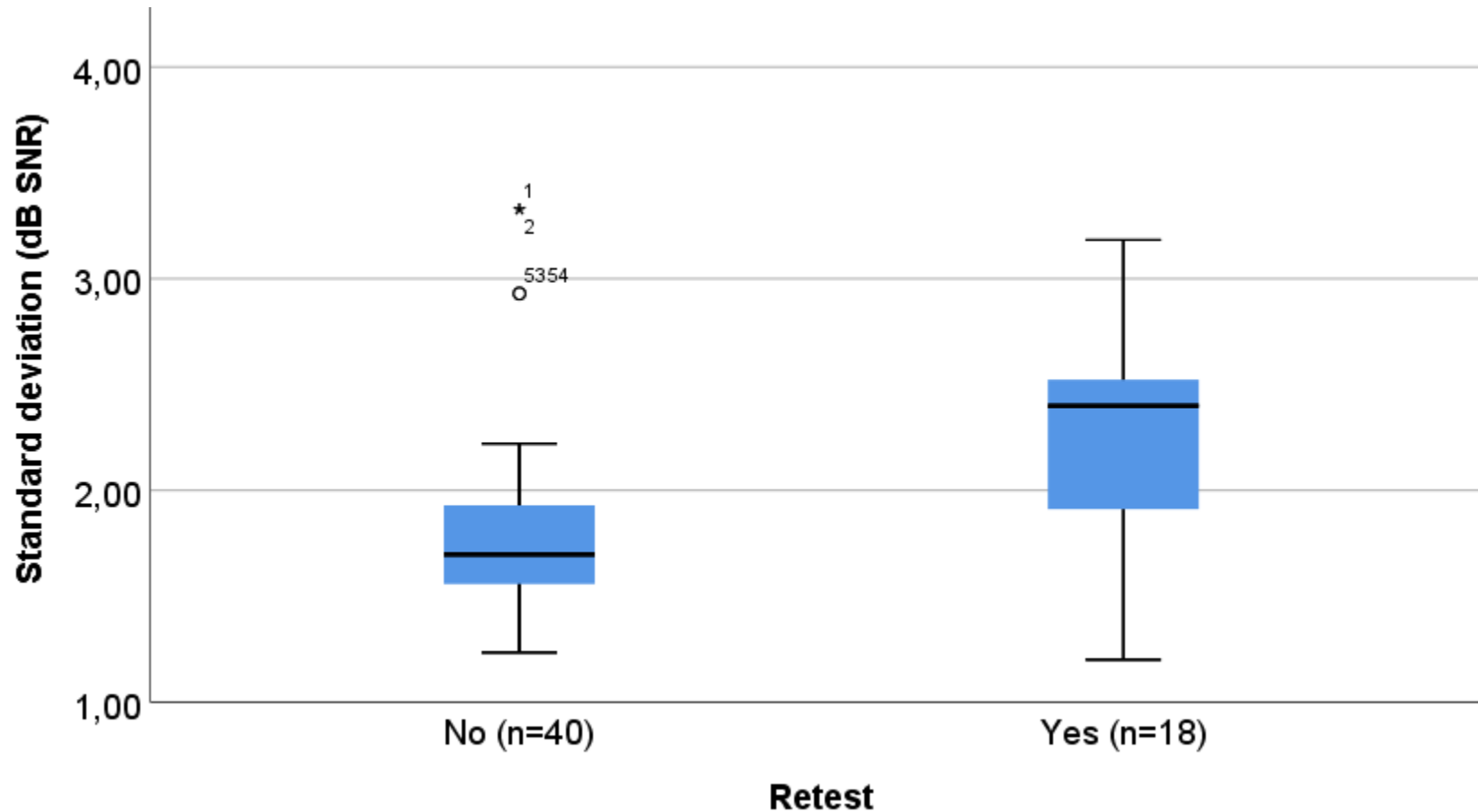
Feasibility: duration



Feasibility: retests

- Retest: 1/5 children (46% left ear, 54% right ear)*
 - 5y: 25%, 6y: 20%, 7y: 17%
 - 5/6 retests are reliable**
 - test feasible in 96% of the children
- Not fully trained?
- Attention effects?

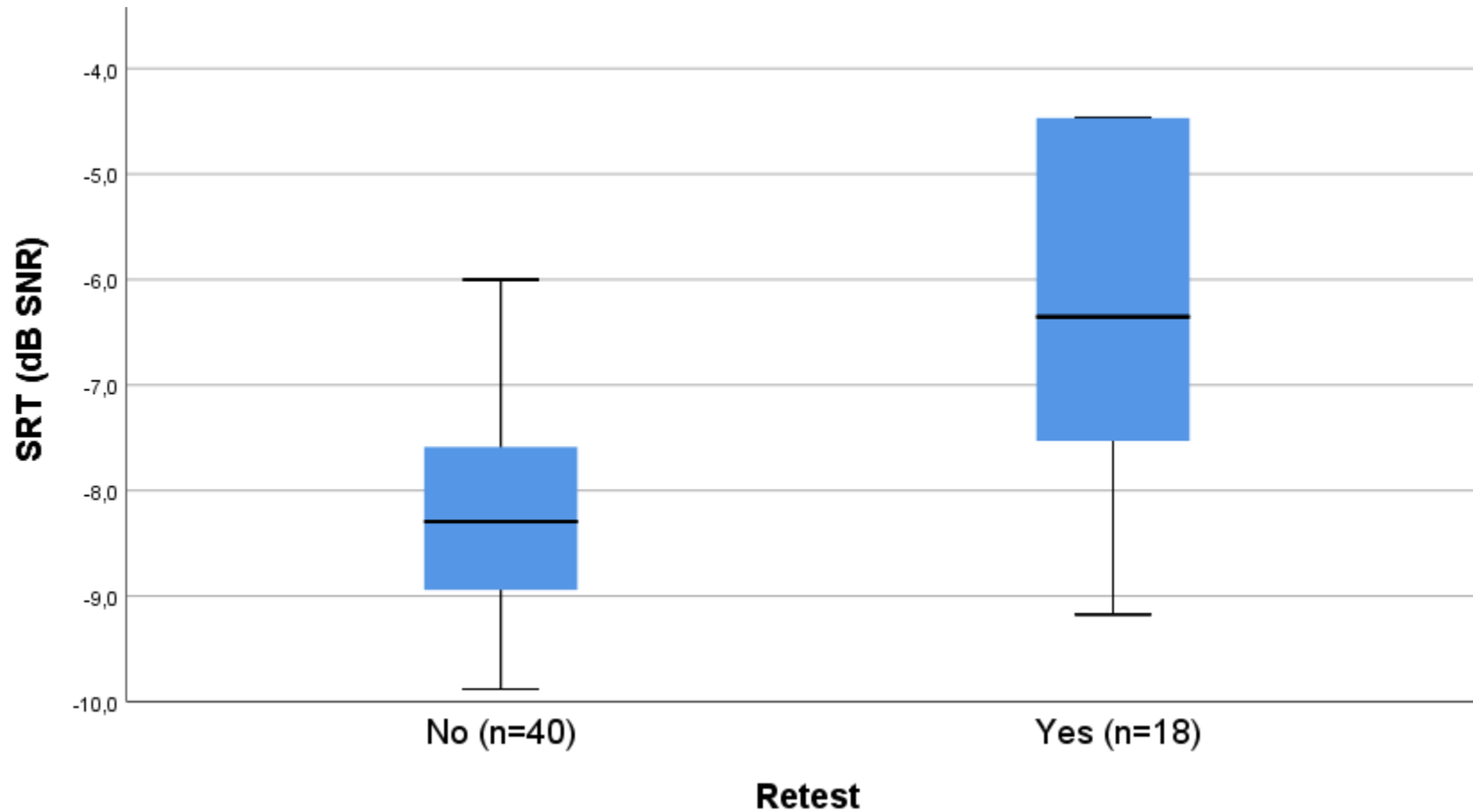
Retests: predictive value of training data



**gnificant difference
ween both**

Mean = 1,8 dB SNR
SD = 0,8 dB SNR
∴ Mean = 2,4 dB SNR
SD = 0,24

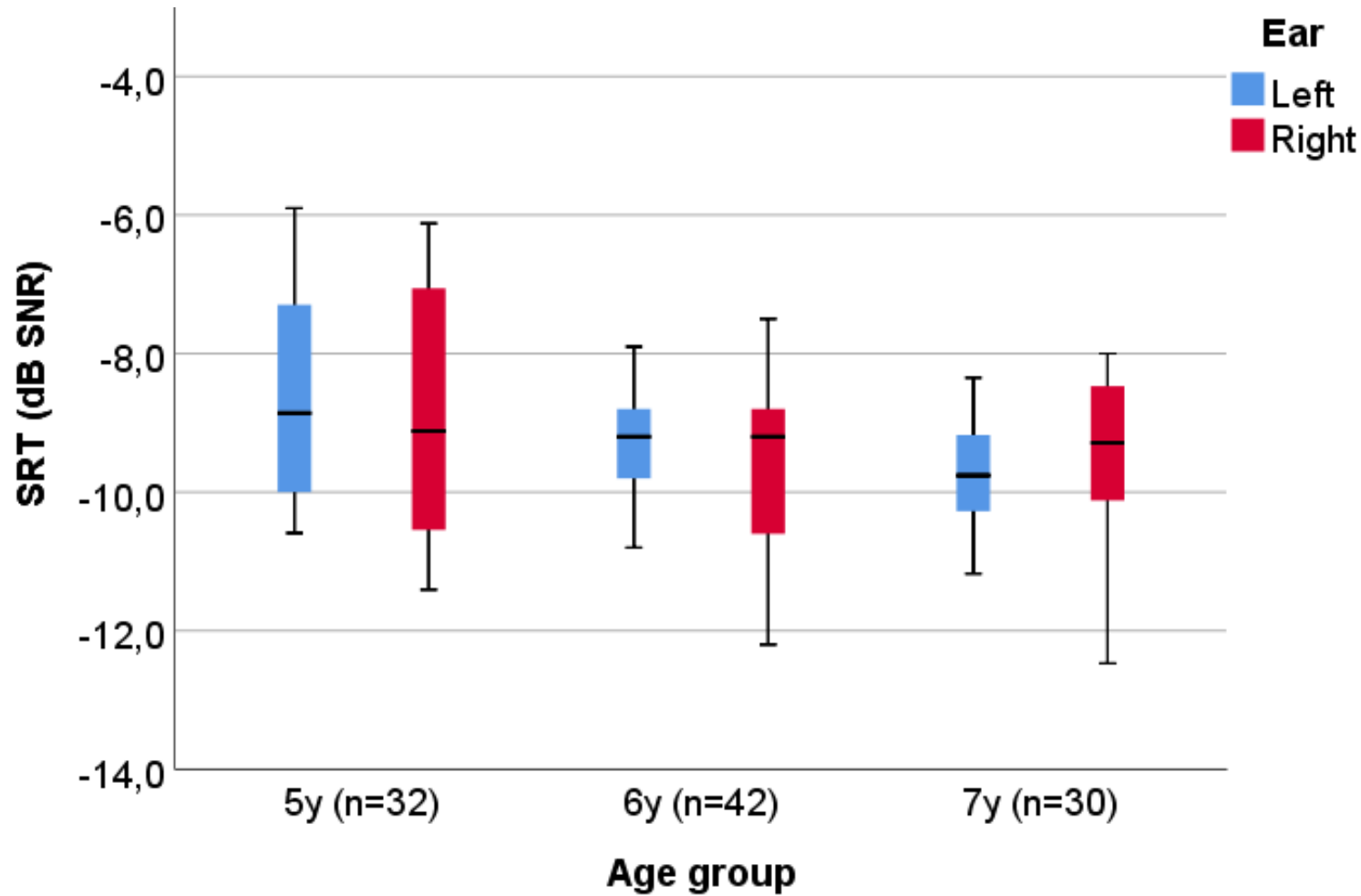
Retests: predictive value of training data



**Significant difference
between both**

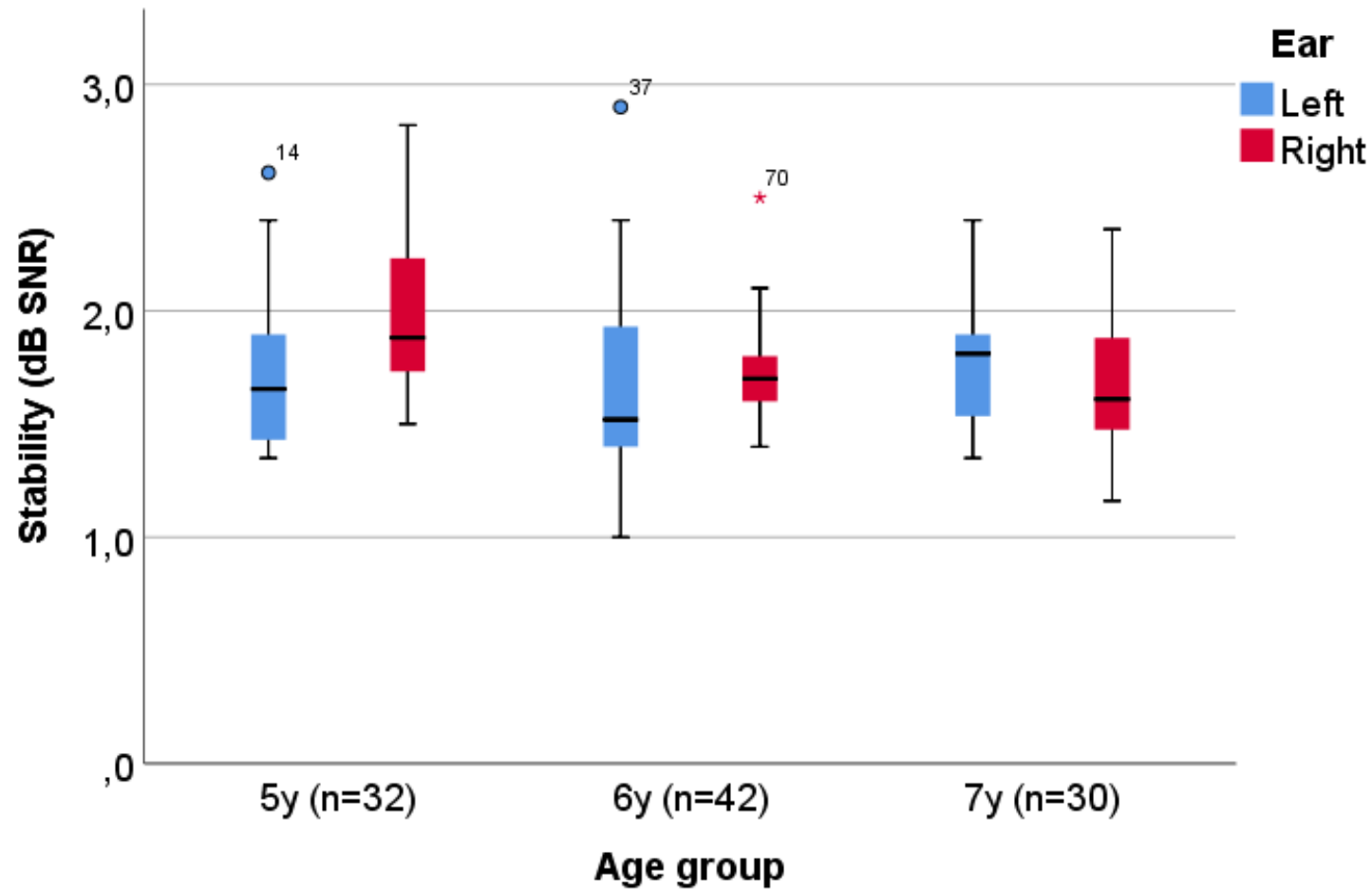
Mean = -8,2 dB SNR
SD = 0,2 dB SNR
∴ Mean = -5,2 dB SNR
SD = 0,99

Attention effects



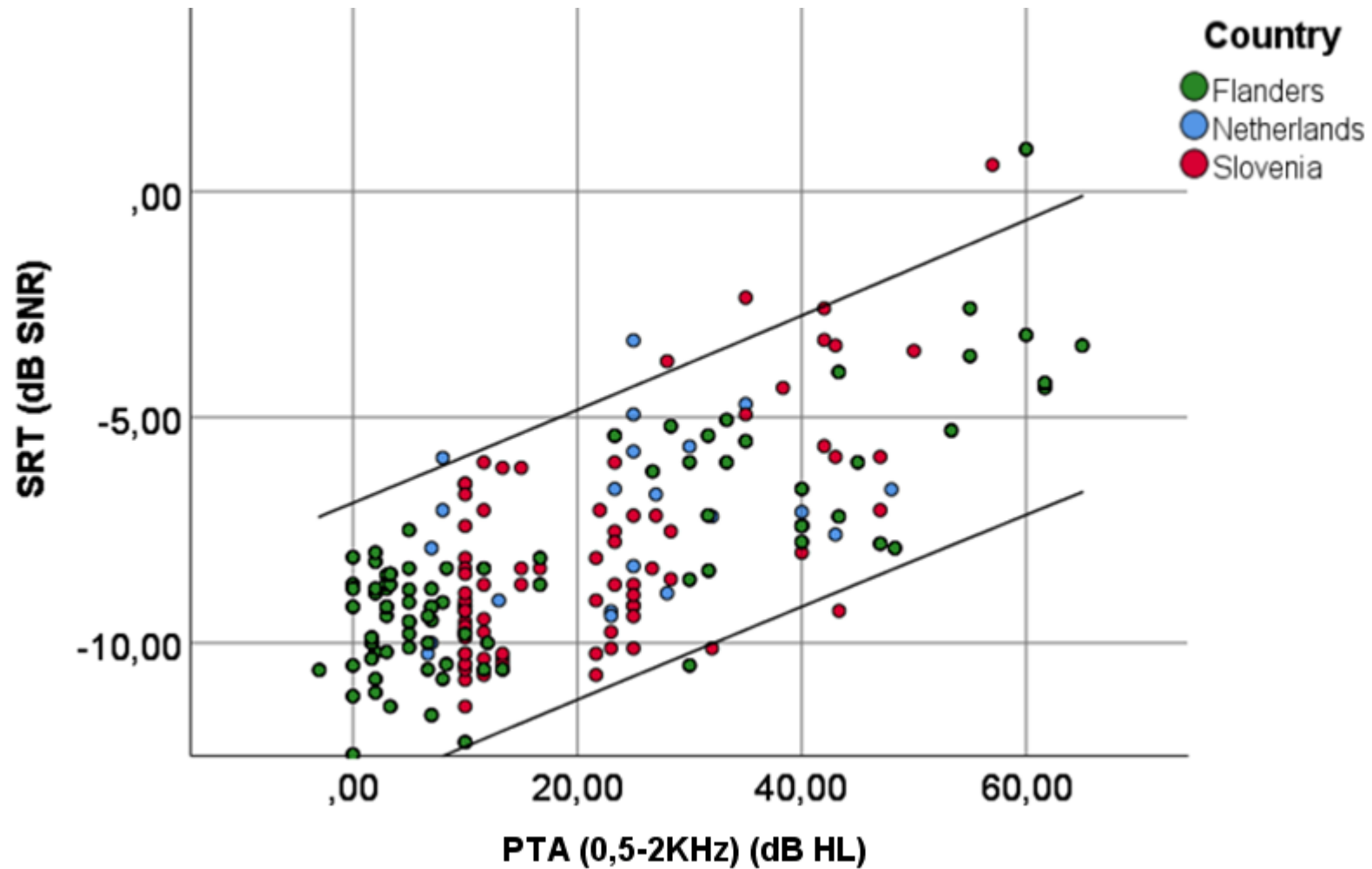
- No differences in first and second tested ear
- No age-related differences

Attention effects?



- No differences in first and second tested ear
- No age-related differences

SRT agreement across countries



Comparison of test parameters

	Flanders + Netherlands (n=10)	Flanders + Netherlands (n=54)	Slovenia (n=16)	Slovenia (n=24)
Age (year)	5	6-7	5	6-7
SRT (dB SNR)	-8,9 ± 0,5	-9,5 ± 0,2	-8,2 ± 0,4	-9,5 ± 0,2
SD (dB SNR)	2,0 ± 1,3	1,8 ± 0,5	1,8 ± 0,9	1,7 ± 0,7
Duration	10 min 14 sec ± 55 sec	5 min 9 sec ± 7 sec	6 min 1 sec ± 10 sec	6 min 19 sec ± 8 sec
Retests (%)	37	22	12	13

Confusions

Flanders & Netherlands

%	Telephone	Dog	Bird	Cat	Baby	Car	Piano	Bell
Telephone	69	4	3	5	7	4	7	5
Dog	3	75	4	6	5	2	3	2
Bird	7	3	73	3	6	1	7	1
Cat	3	3	1	83	3	1	4	2
Baby	5	2	2	20	62	1	6	3
Car	6	2	1	4	3	78	4	3
Piano	6	3	4	3	2	2	77	3
Bell	3	3	2	5	5	4	9	71

Confusions

Slovenia								
%	Telephone	Dog	Bird	Cat	Baby	Car	Piano	Bell
Telephone	68	3	7	5	4	4	4	6
Dog	8	68	3	5	8	3	3	3
Bird	5	3	71	5	2	6	7	3
Cat	3	3	2	80	6	3	1	3
Baby	2	3	5	8	74	4	3	1
Car	5	3	2	3	7	71	8	3
Piano	8	3	3	3	2	8	73	1
Bell	3	0	3	3	2	8	8	74

Conclusions

- 5y \neq 6/7 y
- High sensitivity and specificity possible
- SHL > 20 dB HL and CHL >30 dB HL detectable
- Cat – baby confusions
- Large number of retests
- Explanation necessary

Next steps: for discussion

- Changes to reduce number of retests
- Extend study Pilot 1: more data? Publication?
 - NI: 15 SHL, FI: 15 SHL+10 CHL, Romania?
- Preparation Pilot 2 & Grand study?
 - New stimuli?
 - Other protocol: at fixed SNR?