Cognitive and auditory factors underlying the ability to understand speech-in-noise: clinical implications for diagnosis and rehabilitation

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CHSCOM2017 Linköping, Sweden, 18 June 2017

Early Indicators of Noise Injury

STUDY DESIGN

Behavioural	Electro-physiology	Hearing Experiences
• 122 participants • Online survey • Audiometry • Auditory processing • Cognitive skills	• 62 participants • Five tests [CAEP's, IRN, speech ABR, click ABR, EFR] • Designed to support behavioural measures	• 52 participants • Interviews & online survey • Exploring listening difficulties, impacts and strategies

Results

BEHAVIOURAL

X No clear link between participants' lifetime noise exposure and performance on auditory processing (AM, TFS, TEN) or speech-in-noise tasks (LISN-S, NAL-DCT).

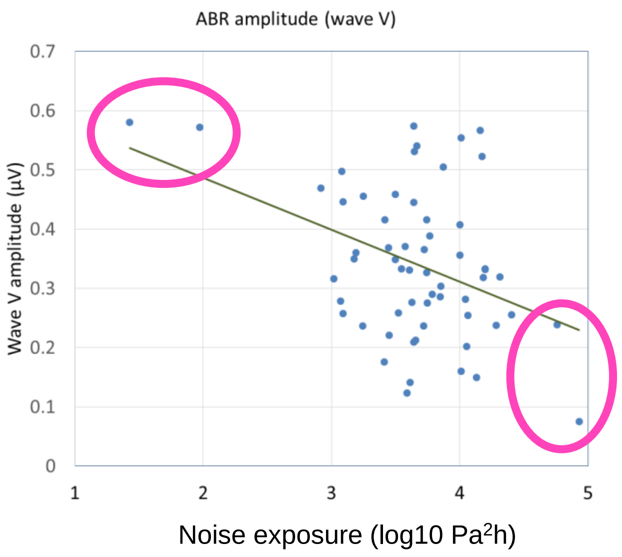
- Musical training *was associated* with better performance on the auditory processing tasks, but *not* on the speech-in-noise tasks.

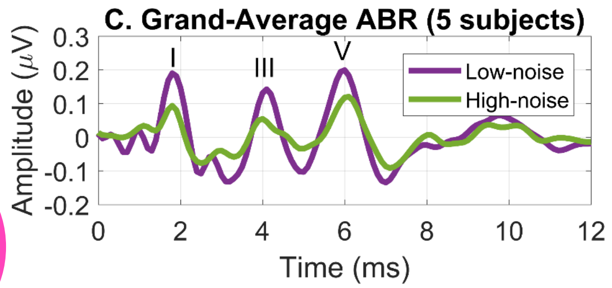
- The results indicate that:
  - sentence closure skills (TRT)
  - working memory (RST)
  - attention (TEA)
  - extended high frequency hearing thresholds
  - medial olivocochlear suppression strength

– are related to speech-in-noise performance.

ELECTROPHYSIOLOGY

- Noise exposure and ABR amplitude





HEARING EXPERIENCES

- Inconvenience, self consciousness,
- Online communication training

Objectives

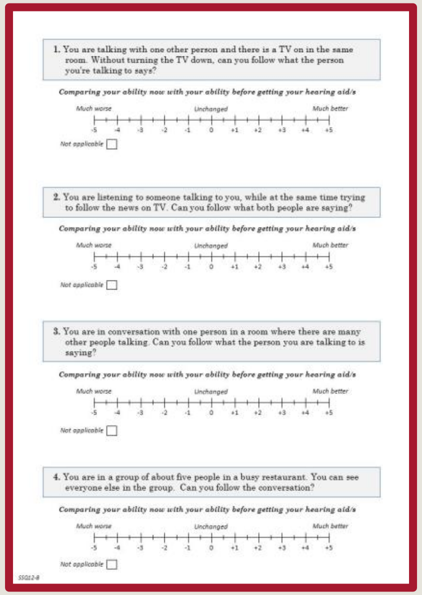
THE PROBLEM / OUR MOTIVATION

- Which factors predict the ability to understand speech in noise?

- Can we develop a clinical tool for predicting / confirming which normal hearing adults will experience difficulty understanding speech in noise?

Composite speech-in-noise score (CSS)

SELF REPORT PLUS TWO SPEECH-IN-NOISE MEASURES


1. You are talking with one other person and there is a TV on in the same room. Without turning the TV down, can you follow what the person you're talking to says?

Comparing your ability now with your ability before getting your hearing aid/s

Much worse — Unchanged — Much better

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

Not applicable ☐

2. You are listening to someone talking to you, while at the same time trying to follow the news on TV. Can you follow what both people are saying?

Comparing your ability now with your ability before getting your hearing aid/s

Much worse — Unchanged — Much better

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

Not applicable ☐

3. You are in conversation with one person in a room where there are many other people talking. Can you follow what the person you are talking to is saying?

Comparing your ability now with your ability before getting your hearing aid/s

Much worse — Unchanged — Much better

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

Not applicable ☐

4. You are in a group of about five people in a busy restaurant. You can see everyone else in the group. Can you follow the conversation?

Comparing your ability now with your ability before getting your hearing aid/s

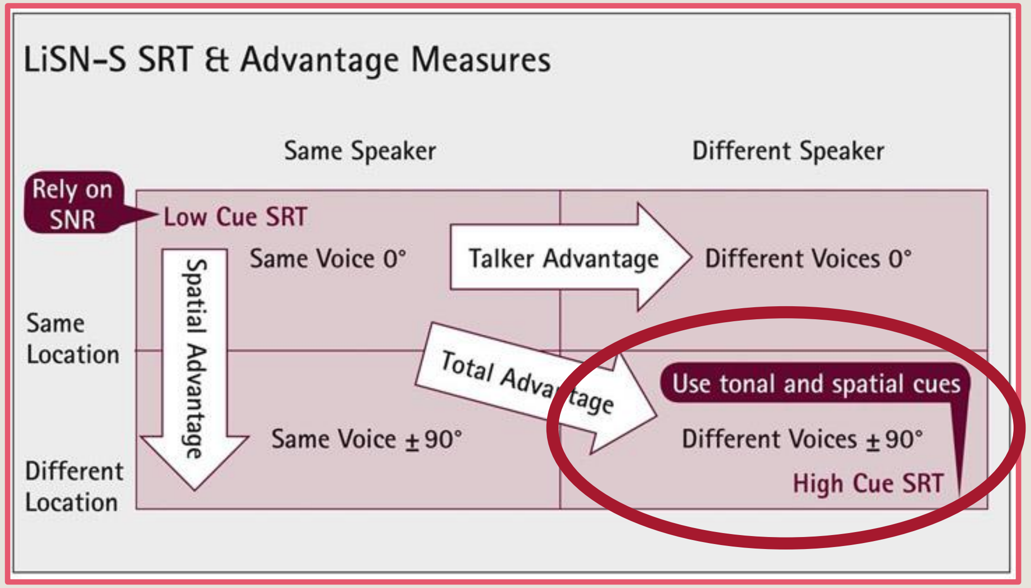
Much worse — Unchanged — Much better

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

Not applicable ☐

SSQ12-B

SSQ12 speech items



LiSN-S

NAL-DCT

CSS used to identify LOW and HIGH performing subgroups

Composite speech-in-noise score (CSS)

LOW AND HIGH PERFORMING GROUPS

No differences

= Education
= Exposure to ototoxic chemicals
= Noise exposure
= Musical training
= Amplitude modulation (4 Hz)
= MOCR strength
= Non-verbal intelligence

Significant differences

✓ Age
✓ Gender
✓ Hearing level (LF, HF, EHF)
✓ Temporal fine structure (TFS1)
✓ Amplitude modulation (90 Hz)
✓ TRT
✓ Attention
✓ Working memory

Results

EXTENDED HIGH FREQUENCIES & WORKING MEMORY

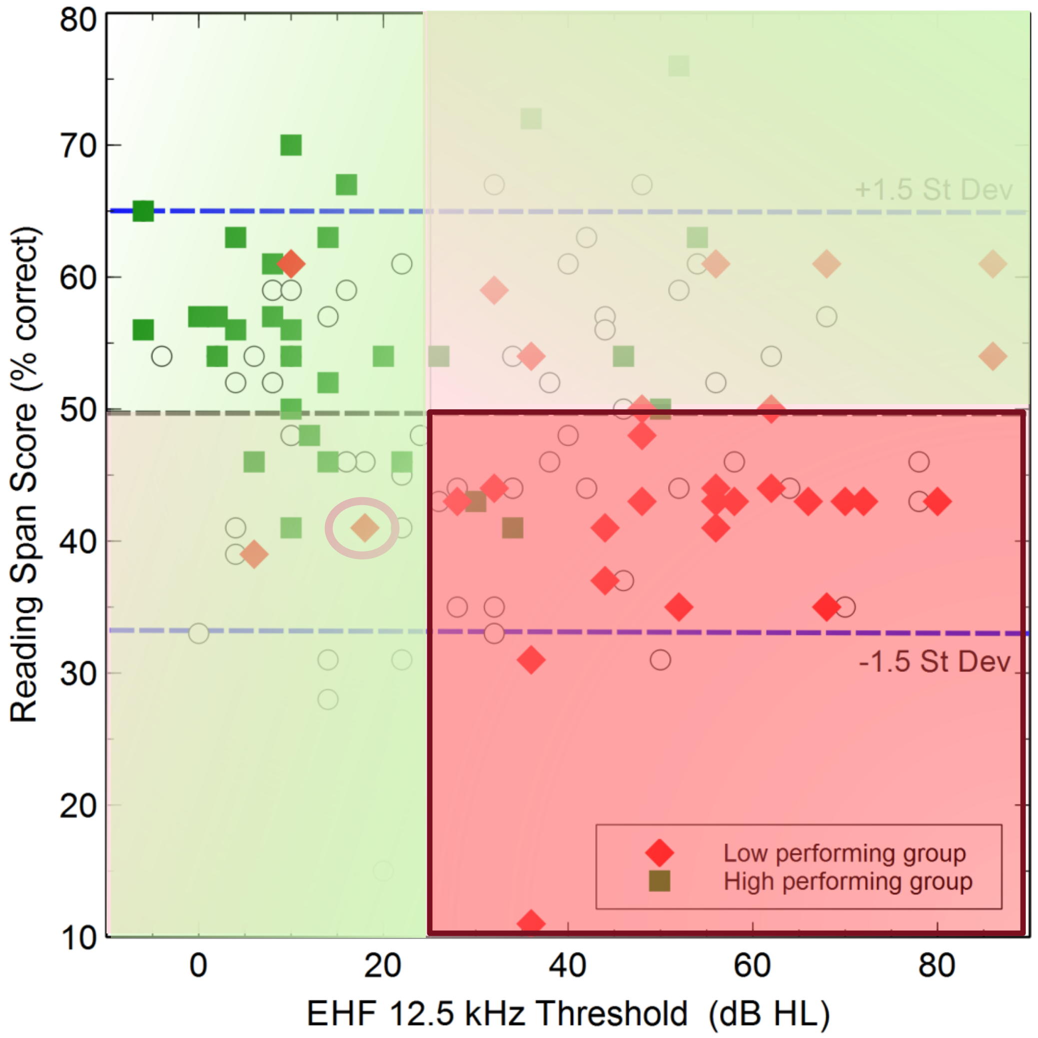
Multiple regression weights

Variable	Low Performing		High Performing			
	Mean	SD	Mean	SD	Composite Speech Score	
					b	p value
Age	48.47	6.65	42.33	4.79	-0.02	0.05
Gender (%)	♀: 37	-	♀: 63	-	-0.21	0.05
LF hearing	7.67	4.29	5.10	3.84	-0.01	0.47
HF hearing	14.53	8.35	8.58	6.14	-0.01	0.54
EHF hearing	36.96	19.96	11.06	9.57	-0.01	**0.0062**
TFS	66.65	44.04	36.46	25.36	-0.0023	0.08
AM90	-22.93	4.31	-25.11	3.91	-0.01	0.53
TRT	61.00	2.70	58.59	3.21	0.0004	0.06
Attention (TEA)	7.13	2.05	8.35	2.03	-0.01	0.70
Working memory (RST)	44.82	10.47	55.68	8.98	0.02	**0.0006**

Model Strength ($r^2 = .46$, $p < .001$)

Preliminary diagnostic criterion

TRANSLATING OUR RESULTS TO THE CLINIC



Low performers:

- 12.5 kHz threshold ≥ 25 dB HL
- Reading span score below mean

High performers:

- 12.5 kHz threshold ≤ 25 dB HL
- Reading span score above mean

Individual case

WHY IS THIS PARTICIPANT A LOW PERFORMER?

Rehabilitation options

DEVICES AND/OR WORKING MEMORY TRAINING

- **No action**
- **Training**
  - easy to do & achievable
  - feedback
  - sustainable
- **Devices**
  - extended bandwidth,
  - assistive listening, smart phone apps
- **Reduce the noise source**

https://www.flickr.com/photos/buckaroobay/3721809183

Thank you for listening!

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Financial support: National Health & Medical Research Council (APP 1063905); Australian Government Department of Health; Hearing Industry Consortium.