Does musical training protect noise-exposed musicians from the consequences of 'hidden hearing loss'?

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Background

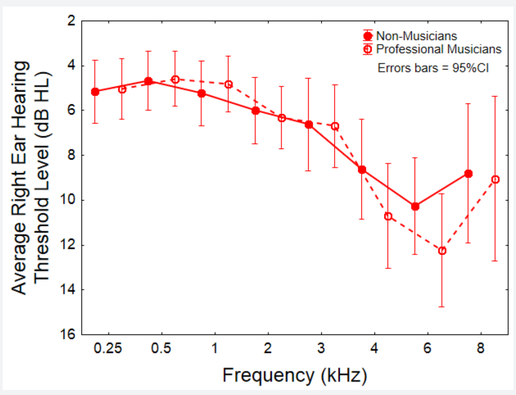
'Hidden hearing loss': noise-induced cochlear synaptopathy involving the selective loss of high-threshold auditory nerve fibres without affecting auditory thresholds, but resulting in perceptual deficits such as **difficulty understanding speech in background noise.** (Kujawa & Liberman, 2009)

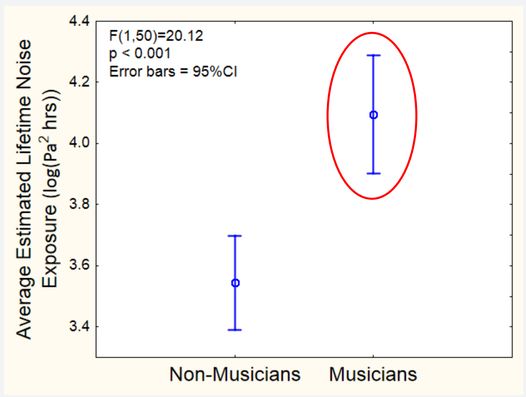
This study investigated the interaction between noise exposure and musical training, i.e., do musicians with high levels of noise exposure exhibit perceptual deficits, or does their musical training allow them to overcome any such difficulties?

Method

Professional musicians (n=20) and **non-musicians** (n=32) aged 30-55 years with normal or 'near to normal' hearing completed an online survey and comprehensive laboratory assessments. We compared their performance using one-way MANOVA.

Test Battery	Measure
Pre-appointment online survey	Listening & Hearing (SSQ12) Noise Exposure (Sound Check Australia) Musical Training (MUSE)
Audiometry	Tympanometry & Acoustic Reflexes TEN threshold elevation DPOAE
Auditory processes	LiSN-S NAL Dynamic Conversations Test (DCT) Amplitude Modulation (AM) Temporal Fine Structure (TFS1)
Cognitive measures	Kaufman Brief Intelligence Test (KBIT2) Test of Everyday Attention (TEA) Digit Span Forward & Back (DSF/DSB) Reading Span Task (RST)





Professional musicians had GREATER LIFETIME NOISE EXPOSURE

Results

Behavioural

Professional musicians and non-musicians were equivalent on:

= Age = Hearing threshold level
= Working memory = Non-verbal intelligence

Professional musicians were better at:

- ✓ **Temporal Fine Structure Test (TFS1)**
- ✓ **Amplitude Modulation (AM 4 Hz & 90 Hz)**
- ✓ **Test of Everyday Attention (TEA: Subtests 3 & 5)**
- ✓ **Listening in Spatialised Noise Sentence Test (LiSN-S)**

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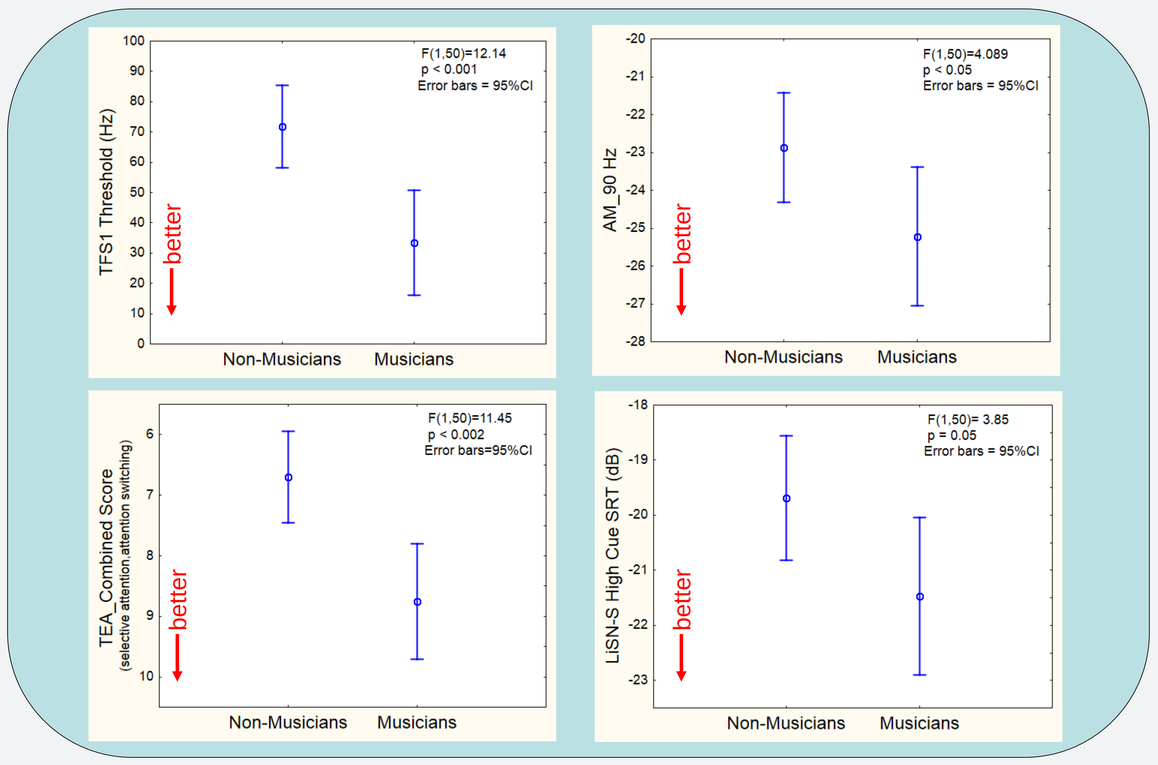
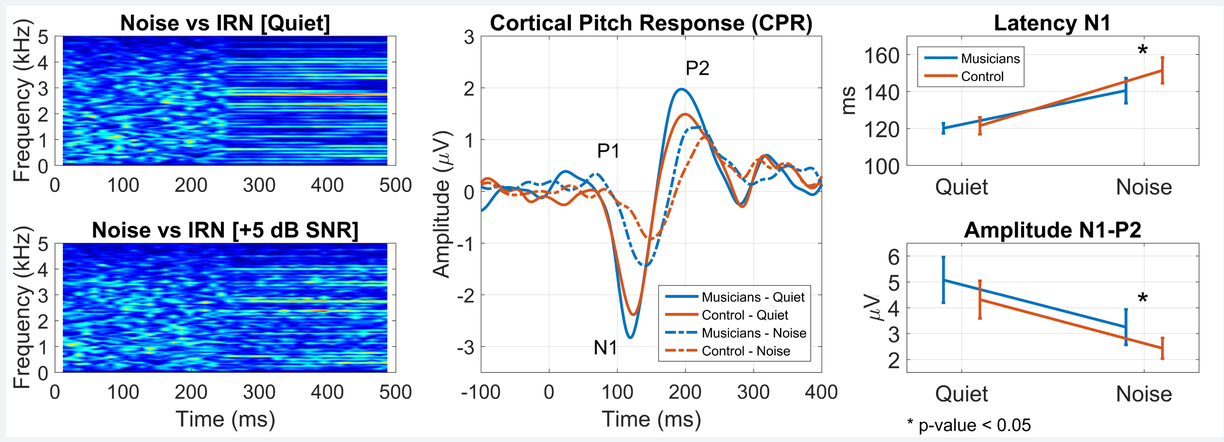
Results continued..



Electrophysiology (preliminary)



Iterated ripple noise (IRN) stimuli of a strong pitch (64 iterations) were presented in quiet and in noise at +5 dB SNR to elicit the cortical pitch response. Musicians had a more robust response when the stimulus was presented in noise: amplitudes were significantly larger and the latency shift of the N1 component was less marked.

Conclusion

Despite having more noise exposure, professional musicians outperform non-musicians on speech-in-noise and temporal processing tasks. Musical training is associated with improved temporal processing and finely tuned attentional skills, both of which seem to help musicians overcome any deficits caused by noise exposure.

Implications and future directions

- ➢ *Is the musicians' advantage mostly attention based?*
- ➢ *If yes, can music-based attentional training improve speech-in-noise performance for those with suspected hidden hearing loss?*

References

Kujawa and Liberman (2009). Adding insult to injury: cochlear nerve degeneration after "temporary" noise induced hearing loss. *The Journal of Neuroscience, 29(45), 14077-14085*.

Parbery-Clark, Skoe, Lam and Kraus (2009). Musician enhancement for speech-in-noise. *Ear and Hearing, 30(6), 653-661*.