Delving into ‘hidden hearing loss’: Results from a large-scale behavioural investigation

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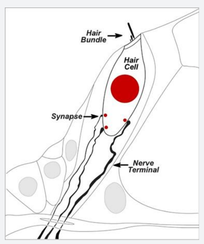
Background

Some adults report problems understanding speech in background noise yet their audiograms are clinically normal. Animal studies suggest this may result from noise-induced damage to synaptic connections between auditory nerve fibres and inner hair cells. Although this has not been demonstrated in humans, the term ‘**hidden hearing loss’** has been coined to describe the perceptual difficulties with which noise-exposed people commonly present.

This study investigated hidden hearing loss in adults, and examined **whether there is a relationship between levels of noise exposure and auditory processing difficulties.**

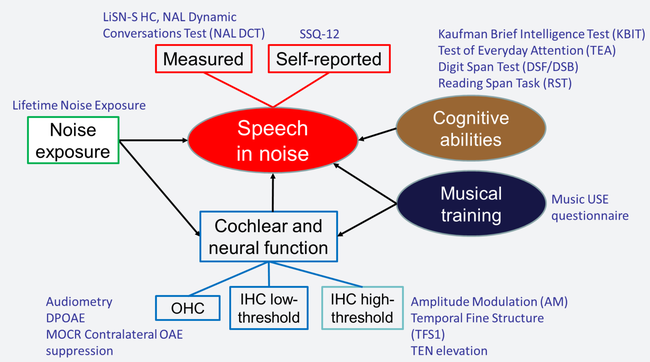


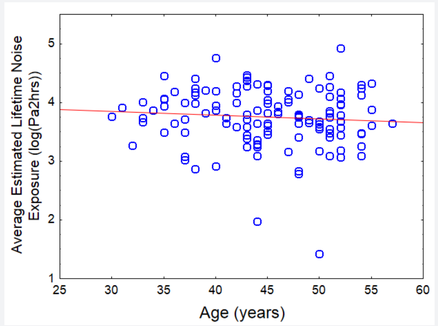
Kujawa and Liberman (2009)

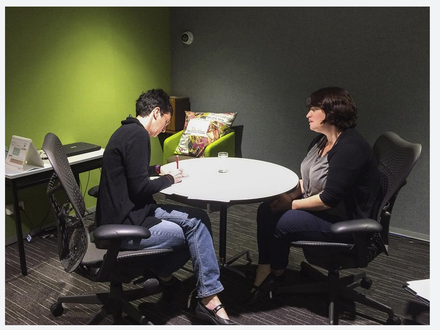
Method

Participants: adults (n=124) aged 30-57 years with normal or ‘near to normal’ hearing.

Tests: pre-appointment online survey, audiometry, auditory processing plus cognitive measures.







Lifetime noise exposure was calculated as total workplace and leisure noise exposure with adjustments made for reported use of hearing protection.

We developed a model with 19 predictor factors and calculated Pearson correlation coefficients followed by a multiple linear regression analysis to examine how each factor related to 3 functional outcome measures: self-reported difficulty (SSQ12); and speech-in-noise performance (LiSN-S HC and NAL DCT).

Results and conclusions

Only statistically significant results are shown p<0.05

Main finding: there was no significant relationship between overall lifetime noise exposure and processing of speech in noise or tests of temporal auditory processing.

Other findings: There were a number of weak but significant results which suggest how to characterize hidden hearing loss and provide clues for future research.

AGE: older participants reported more listening difficulty and performed worse on LiSN-S HC and NAL DCT.

EXTENDED HIGH FREQUENCY (EHF): participants with poorer EHF hearing reported more listening difficulty and performed worse on LiSN-S HC and NAL DCT. Perhaps EHF hearing is an early indicator that inner hair cell synaptic damage has been sustained.

Correlations and multiple regression weights

	Mean	SD	SSQ12_Total Score			LiSN-S HC			NAL DCT		
Variable			r	b	β	r	b	β	r	b	β
Age	45.0	6.3	-0.20			0.28			-0.30		
Tinnitus	0.2	0.4									
Ototoxicity	0.4	0.5				0.21					
Hyperacusis	0.3	0.5									
TTS	0.5	0.5									
Music training	4.2	3.0									
Music production	35.0	67.0									
MOCR	41.2	10.6	0.28	0.04	0.26						
Low-freq hearing	6.2	4.6				0.28					
High-freq hearing	10.1	7.9				0.35					
Ext-high freq hearing	22.7	17.7	-0.20			0.36			-0.37	-0.18	-0.39
Attention (TEA)	7.9	2.0				-0.20			0.23		
Digit Span	10.3	2.0				-0.20					
Reading Span	48.7	11.2		0.03	0.24	-0.27			0.40	0.22	0.32
Noise exposure	3.8	0.5									
TFS	53.9	41.7				0.22	0.02	0.23	-0.27	-0.05	-0.28
Amp mod 4Hz	-24.6	3.8				0.22					
Amp mod 90Hz	-24.1	3.9									
TEN elevation	0.3	2.7									

LiSN-S HC Model Strength (r^2=.38,p<.002) DCT Model Strength (r^2=.44,p<.01)

MOCR: participants with lower MOCR strength reported more listening difficulty. Perhaps the ability to suppress noise, not just detect a signal, is crucial to effective listening in noise.

ATTENTION and MEMORY: participants with better attention and working memory scores performed better on LiSN-S HC and NAL DCT. Perhaps attention and memory compensate for any auditory deficits and/or noise damage.

TFS: participants with poorer TFS thresholds performed worse on LiSN-S HC and NAL DCT

The LiSN-S HC and NAL DCT models explained a significant proportion of variance, while the SSQ12 model did not. Therefore the model for self-report was less effective than the model for the objective measures. This is not surprising given that the SSQ12 is a self report measure focused on speech and non-speech hearing experiences

References

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