The Effect of Noise Exposure on Adult Speech Perception

Elizabeth D. Purdy, Joanna H. Lowenstein, and Susan Nittrouer

Department of Speech, Language, and Hearing Sciences, University of Florida

STATEMENT OF PROBLEM

The overarching hypothesis is that specialized auditory functions that are suprathreshold in nature allow processing of acoustic speech signals so that (1) the listener can recover speech from noisy backgrounds in an efficient manner; and (2) recover and assemble the acoustic cues that define phonemic segments; this task is typically termed *phonological awareness*. The suprathreshold functions of interest involve both *spectral* and *temporal* processing. (1) Deficits in these functions should especially impair a listener's ability to recover speech from noisy backgrounds because of diminished spectral resolution or diminished abilities to listen in brief dips in the noise. (2) Deficits in these functions should interfere with a listener's ability to maintain and access phonemic categories because of degradation in both the spectral and temporal acoustic structure that define those categories.

SIGNIFICANCE

This work extends our understanding of the suprathreshold functions that support discrimination/sensitivity of speech perception in noise in those with normal auditory thresholds, even if they have noise exposure damage. This research can provide a more robust background for specific and efficient diagnostic testing. In clinical adult cases, some with normal auditory sensitivity fail to recognize speech in noise well, while others with poor auditory sensitivity manage to compensate to a greater extent than would be predicted based on their hearing loss. Thus, there are perceptual processes that go beyond simple sensitivity to acoustic cues; understanding those processes could help us refine our diagnostic batteries.

QUESTIONS ASKED

1. **Do adults with noise exposure have deficits understanding speech in noise and in recognizing phonological structure?**
2. **Can the injury incurred by the auditory system that leads to those deficits be measured by one or more clinical tests?**

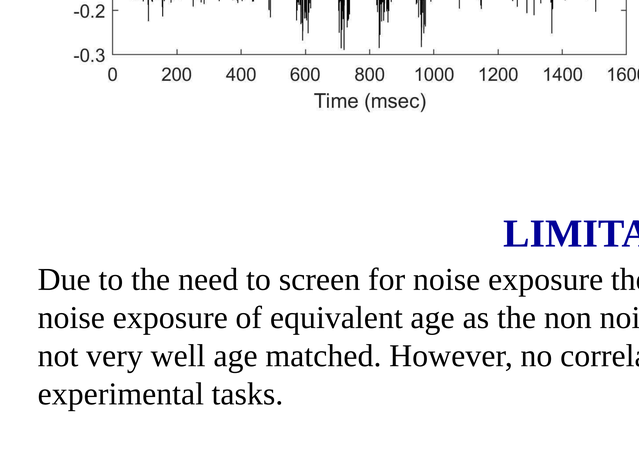
METHODS

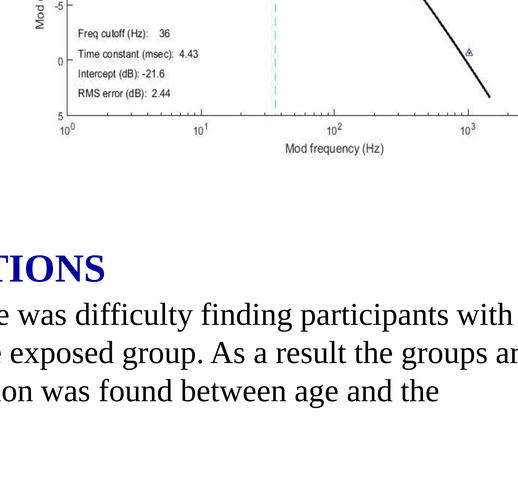
Participants

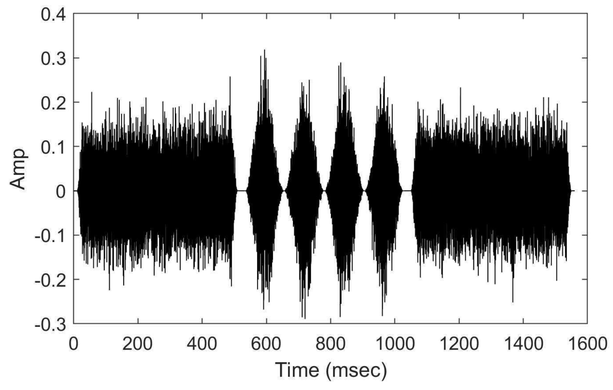
Group	Number	Age Range & Mean
No Noise Exposure	10	Range – 20-56 Mean - 22.5
Noise Exposure	7	Range – 39-59 Mean – 58

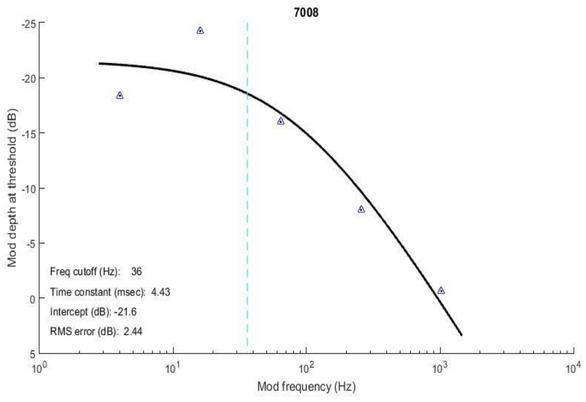
Measures

Spectral Modulation Depth Detection (SMDD)
Temporal Modulation Transfer Function (TMTF)
Phonemic Awareness (Final Consonant Choice)
Sentences in Noise (HINT)
Air Conduction Auditory Thresholds
Otoacoustic Emissions
Auditory Brainstem Responses
Noise Survey









LIMITATIONS

Due to the need to screen for noise exposure there was difficulty finding participants with noise exposure of equivalent age as the non noise exposed group. As a result the groups are not very well age matched. However, no correlation was found between age and the experimental tasks.

RESULTS

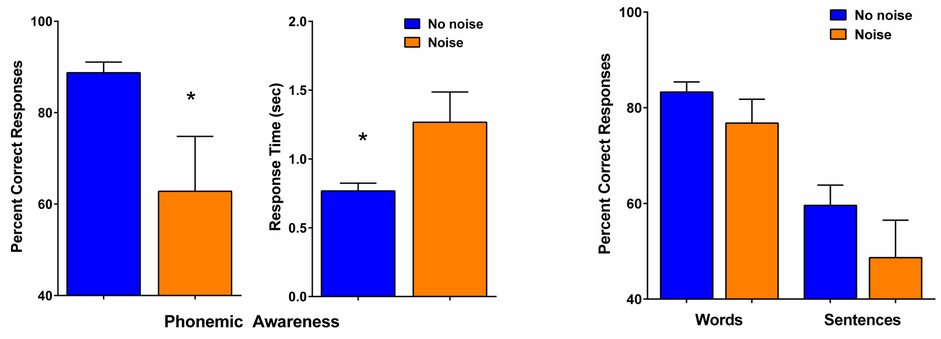


Figure 1
The Noise exposure group performed significantly more poorly on the Phonemic Awareness task, and their response times were slower than the No Noise group. There was a tendency towards poorer performance on the HINT task but differences were not significant.

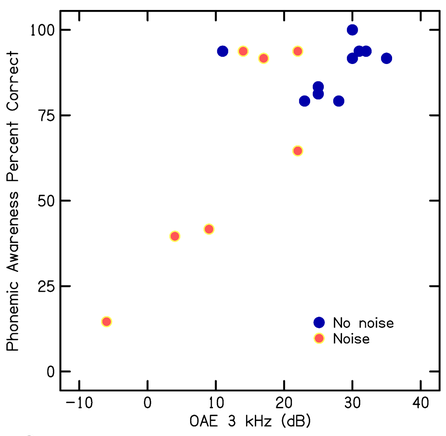


Figure 2
The greater the OAE at 3kHz the better the participants' performance was on phonemic awareness. This was significant across groups (r=.795, p<.001) and for the Noise group alone (r=.934, p=.006).

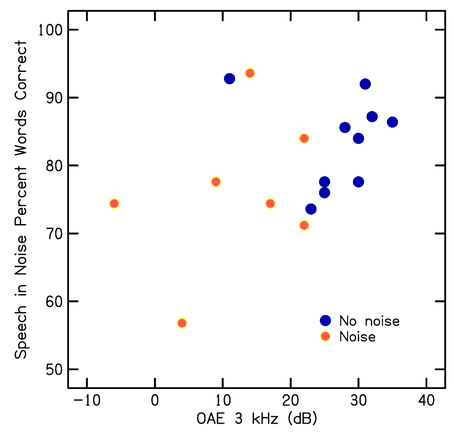


Figure 3
The greater the OAE at 3kHz the better the participants' performance was on the HINT. This was significant across groups (r=.548, p=.028)

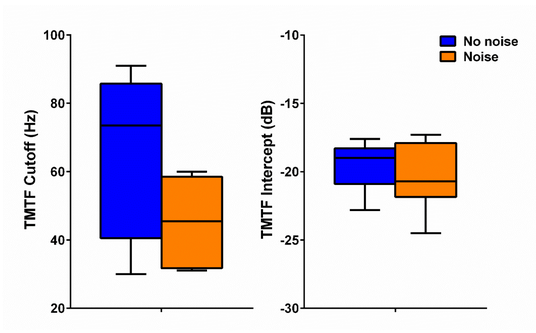


Figure 4
The TMTF cutoff frequency is reduced in Noise group, but the TMTF intercepts didn't differ based on noise exposure.

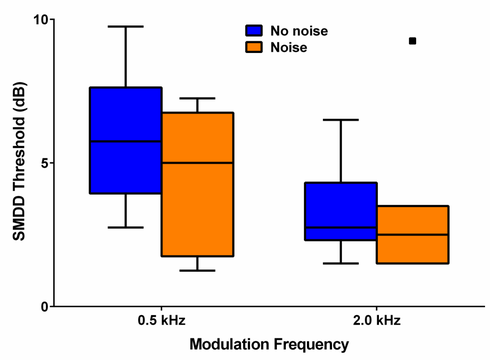


Figure 5
Participants in the Noise group performed slightly better than those in the No Noise group in both SMDD conditions.

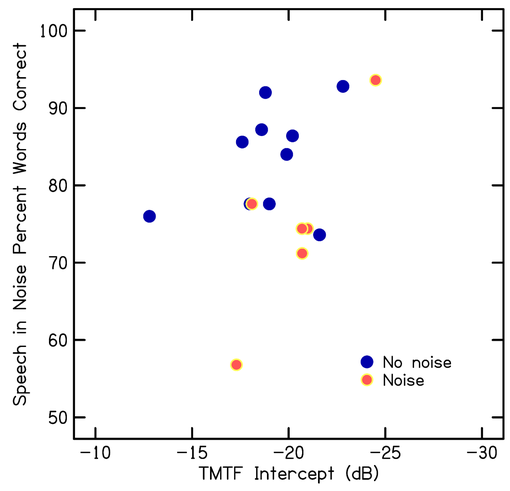


Figure 6
HINT word percent correct correlated significantly with the TMTF Intercept for the Noise group (r=-.833, p=.039).

The 1kHz air conduction (AC) threshold correlated significantly with SMDD and TMTF. For the no noise group, the 1kHz Right AC correlated significantly with SMDD 0.5 (r=-.733, p=.016) and with TMTF Intercept (r=.653, p=.041). For the Noise exposed group, the 1 kHz Right AC correlated significantly with SMDD 2 (r=.880, p=.021) and the 1kHz Left AC correlated significantly with TMTF Cutoff (r=-.918, p=.010).

CONCLUSIONS

Results show that the two groups differed on their phonemic awareness. The Noise exposure group performed more poorly and were slower at completing the task. There was a trend towards poorer performance on the HINT task based on noise exposure. Both phonemic awareness and HINT correlated significantly with the 3 kHz OAE. The Noise exposure group had lower TMTF but there was almost no difference in the TMTF intercept. There was a significant correlation between the TMTF intercept and HINT for the Noise exposure group. The correlations that were found between the AC thresholds/OAEs and the experimental tasks suggest that noise exposure affects performance on speech tasks, and that performance can be directly correlated to different measures of auditory perception.

ACKNOWLEDGEMENTS

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