Differences in intensity discrimination predicted by self-reported speech recognition difficulty

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Many adults report hearing difficulty, especially for understanding speech in noise. For some of these listeners, hearing difficulty may be caused by auditory neuropathy (AN), a disruption or loss of auditory nerve fibers (ANFs). AN may or may not be accompanied by elevated audiometric thresholds, suggesting instead that listeners with AN have difficulty coding supra-threshold sounds. Current models suggest that AN may be caused by damage to ANFs that code intensity differences at these higher sound levels, which can result in poorer temporal coding. In turn, this can disrupt speech recognition, as temporal coding may be critical for computing certain acoustic cues in speech (e.g., voice onset time).

We predicted, therefore, that listeners with difficulty understanding speech in noise would show poorer intensity discrimination at higher sound levels, corresponding to those used in conversational speech. Listeners heard pairs of tones that differed by 1-5 dB and varied in frequency (500-4000 Hz) and overall intensity (20-70 dB SPL), and they judged which tone was louder. Self-report measures of hearing difficulty, including speech-in-noise difficulty, were obtained, along with pure tone thresholds.

We found that listeners who experience greater hearing difficulty show poorer intensity discrimination, but only at sound levels typical of those used in speech (60-70 dB SPL). Moreover, this effect was unidirectional: listeners with greater hearing difficulty showed poorer performance when the first tone in the pair was louder and better performance when the second tone was louder. Thus, the effect is driven by a difference in the point of subjective equality between the two tones, rather than a difference in the threshold. In addition, listeners' pure tone thresholds did not correlate with speech-in-noise difficulty. The results suggest that differences in intensity discrimination may provide a robust test for AN. Implications for models of AN and diagnostic tests will be discussed.