# Temporal Fine Structure Encoding in Middle-Aged Adults: Preliminary Data

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## Speech-in-Noise Testing: AzBio Sentence Lists

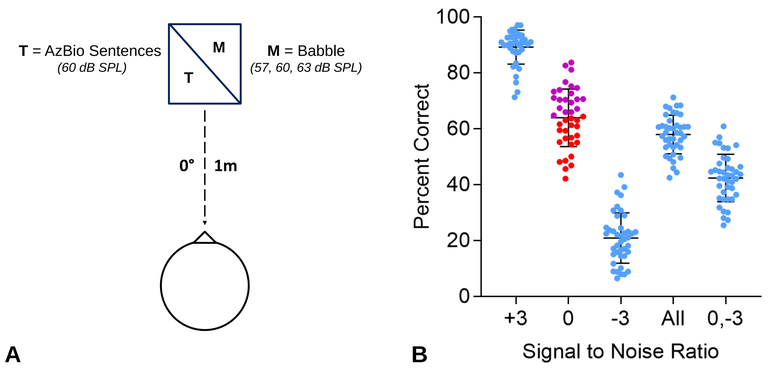


**Figure 1. A)** Schematic of loudspeaker and participant position for speech-in-noise testing. **B)** Performance at all 3 SNR conditions, the average of all three, and the average of 0 and -3 SNRs. The median score in the 0dB SNR condition (64.4%) was used to group participants into top half (purple) and bottom half (red) performers.

## Age & Audiometric Data

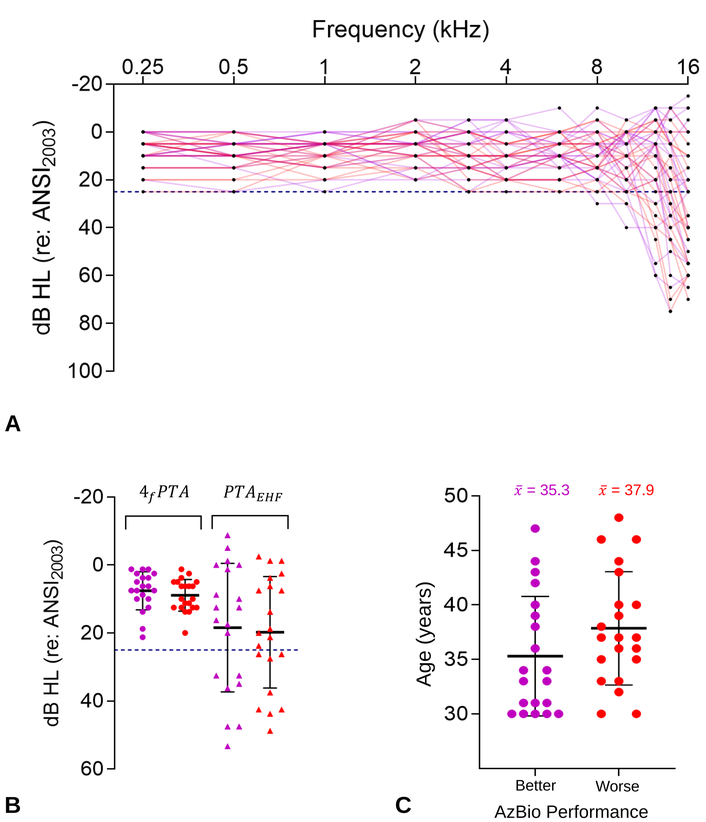


**Figure 2. A)** Right-ear thresholds from 0.25-16kHz. **B)** 4-frequency (0.5, 1, 2, 4 kHz) and extended high frequency (EHF; 10, 12.5, 14, 16 kHz) puretone averages. **C)** Age distribution. For panels B and C, participants are grouped into top and bottom half AzBio scores at 0dB SNR. For all panels, purple = top half performers; red = bottom half.

## Introduction

Difficulty understanding speech-in-noise in the absence of overt hearing loss is a longstanding puzzle in auditory research and hearing health care. As standard clinical tests remain insensitive to identifying the issue, auditory processes not engaged in existing clinical batteries must be explored. We know the ability to separate speech from noise is dependent on the auditory system's coding of the signal's temporal fine structure (TFS). This study investigates the extent to which TFS encoding influences SIN understanding. We measure TFS encoding at the peripheral, central, and perceptual levels of the auditory system using auditory evoked potentials and psychoacoustic tasks. Data is collected in middle-aged adults to survey TFS encoding in the age group where speech perception difficulties are first reported, and to limit confounds associated with aging, including reduced hearing sensitivity across standard audiometric frequencies and cognitive decline.

## Methods

### *Participants*

The presented data are from a subset of an ongoing study with a larger target sample size. **41 participants** *(mean age = 36.6 years; 21 female)* are included in this preliminary analysis. All participants were native English speakers and had bilateral thresholds ≤ 25dB across standard audiometric frequencies.

### *Data Collection*

- Conventional air conduction puretone audiometry 0.25-16kHz
- AzBio Sentence Lists; Colocated at +3, 0, -3 dB SNR
- Dichotic Frequency Modulation detection task
- Electrocochleography to alternating click, presented at two rates
- Frequency Following Response to a 40ms /da/ stimulus. A fast Fourier transform was applied from 19.5-44.2ms to calculate the magnitude of response at the fundamental frequency.

### *Data Analysis*

The median AzBio score at 0dB SNR was used to split the dataset into a top-half and bottom-half of performers. Comparisons using descriptive statistics were made across these two groups.

## Summary & Conclusion

In this dataset, we observed a wide range of AzBio performance at 0dB SNR. When comparing the top- and bottom-half performers in this condition across measures of TFS encoding, the most notable difference between groups is found in the dichotic FM detection thresholds, where the bottom-half performers had higher (worse) thresholds on average. There appear to be minimal to no differences between groups in physiologic measures of peripheral and central TFS encoding. Moreover, the high variability observed in extended high-frequency thresholds does not appear to influence performance, at least in the style of comparison done here. More in-depth analyses will ensue once the target sample size is met for sufficient statistical power.

## Peripheral TFS Encoding: Compound Action Potential

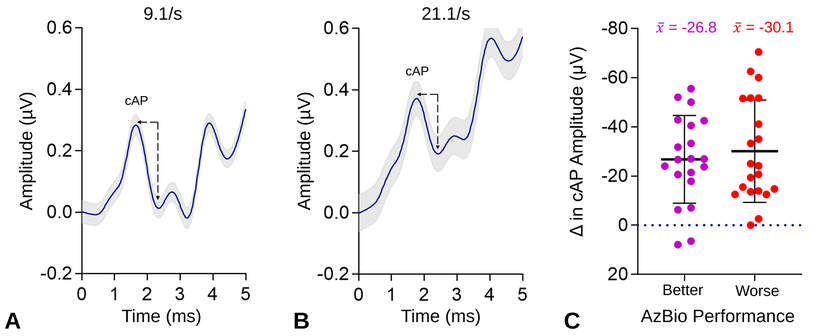


**Figure 3.** Grand average waveforms (n = 41) of electrocochleography responses to 100-μs 90dB SPL alternating click presented at **A)** 9.1/s and **B)** 21.1/s. Shaded grey regions = SEM. Black arrows indicate the peak and trough used to measure cAP amplitude. **C)** Change in cAP amplitude as a function of increasing click rate, grouped by top half (purple) and bottom half (red) AzBio scores at 0dB SNR.

## Central TFS Encoding: Frequency Following Response

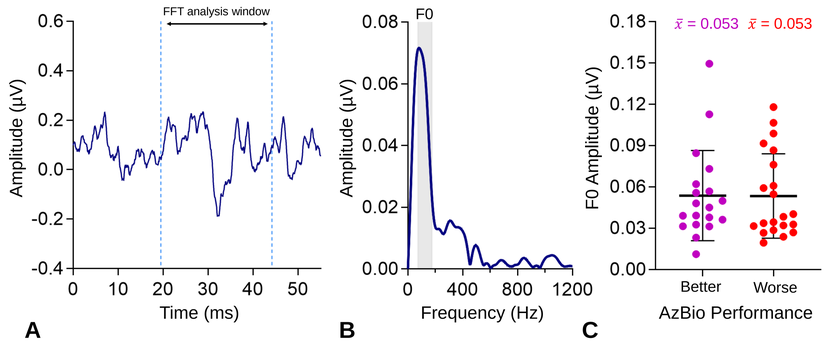


**Figure 4. A)** Representative trace of a single participant's response to /da/ **B)** Fast Fourier transform plot of the same participant's response **C)** Response magnitude to F0 (75-175Hz), grouped by top half (purple) and bottom half (red) AzBio scores at 0dB SNR.

## Perceptual TFS Encoding: Dichotic FM Detection

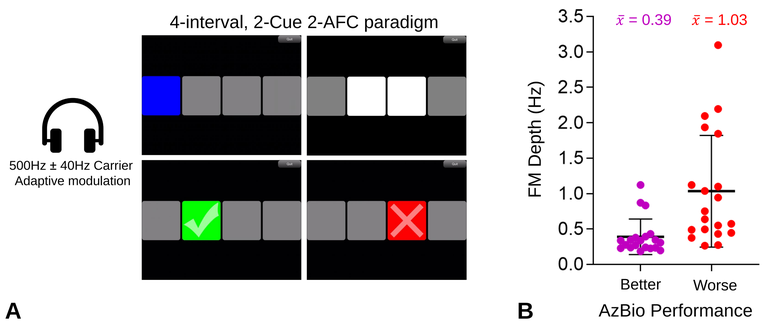


**Figure 5. A)** Schematic of dichotic FM detection task. **B)** Distribution of dichotic FM thresholds, grouped by top half (purple) and bottom half (red) AzBio scores at 0dB SNR.