A Comprehensive Hearing Profile of College Marching Band and Orchestral Students – Preliminary Results

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INTRODUCTION

- Excessive, long-term exposure to music (such as the music and noise that college marching band and orchestral students often encounter) can result in various degrees of sensorineural hearing loss ranging from mild, moderate to severe or profound hearing loss.
- Some individuals may even seem to have normal hearing, as determined by a pure-tone audiogram.
- Recent studies (Plack et al., 2016; Prendergast et al., 2017) have demonstrated that some individuals may have a very slight amount of hearing loss that is undetectable by a pure-tone audiogram.
- This kind of early hearing loss that is undetectable by a pure-tone audiogram is called a **hidden hearing loss** (meaning that it is hidden from a pure-tone audiogram).
- Previous studies have evaluated the effectiveness of detecting hidden hearing loss by examining the participants' brain waves through the presentation of sounds with different intensities and frequencies.
- However, it remains unclear whether hidden hearing loss can be detected by using a spectrum of behavioral and electrophysiological measurements.
- Frequency following response reflects synchronized neural activity within the brainstem at specific frequencies (Skoe & Kraus, 2010). Whereas auditory brainstem response demonstrates the onset response of the auditory nerve.
- The goal of this study was to develop a comprehensive test battery, with an attempt to detect the presence of hidden hearing loss for college marching band and orchestral students who had a history of excessive music/noise exposure.
- As hidden hearing loss is defined, we hypothesized that both musicians and non-musicians will have pure-tone audiogram thresholds and otoacoustic emissions within normal limits.
- Through subcortical measurements, Auditory Brainstem Responses and Frequency Following Responses, we hypothesized that musicians would have decreased responses, in amplitude, due to excessive amount of noise exposure affecting cranial nerve VIII.

METHODS

Participants

- Ten musicians (4 males, 6 females, 22 ± 8 years old)
  - Ohio University undergraduate student or graduate student who participates in concert band, orchestra, jazz band, marching band, or similar ensemble.
  - Did not wear hearing protection
- Ten non-musicians (1 male, 9 females, 23 ± 5 years old)
  - No history of participation in concert band, jazz band, rock band, marching band, or similar ensemble.
- Native English speakers
- Normal hearing sensativity

Lutman Noise Exposure Questionnaire

Procedure
- Participant completes the subjective measure
- Used to evaluate noise exposure throughout his or her life span with respect to:
  1. Duration
  2. Characteristics
  3. After affects
  4. Hearing protection

Questionnaire Analysis
- The only "noisy" activities taken into account were those when the participant did not wear hearing protection.
- Total number of hours were calculated throughout participants' life span.

Otoacustic Emission (DPOAE)

DP Frequencies
- 469, 609, 938, 1266, 1969, 2578, 3844, and 5063 Hz

Device
- Scout Navigator Pro

Procedure
- Recorded in a sound both
- Stimuli presented in right ear

Pure-Tone Audiogram

- 250, 500, 1000, 2000, 3000, 4000, 6000 and 8000 Hz

Subcortical Measurement (Auditory Brainstem Response, ABR)

Stimulus
- Acoustic clicks at a rate of 11.30 clicks/s
- Stimulus intensity: 70 dB nHL

Procedure
- Two-channel recording
- Channel 1: Three gold-plated electrodes (high forehead, low forehead, right mastoid)
- Channel 2: TipTrode in right ear canal
- Participant resting or fast asleep
- Presentation of sound in the right ear
- 8000 accepted sweeps

ABR Data Analysis
- Latencies and amplitudes of Waves I, III, and V were identified

Subcortical Measurement (Frequency Following Response, FFR)

Stimulus
- Acoustic tone complex: 250 Hz and harmonics (up to 5000 Hz)
- Duration: 40 ms
- Rise/Fall time: 10 ms
- Rate: 11.76 stimuli/s
- Presentation: 55 dB nHL

Procedure
- Two-channel recording
- Channel 1: Three gold-plated electrodes (high forehead, low forehead, right mastoid)
- Channel 2: TipTrode in right ear canal
- Participant resting or fast asleep
- Presentation of sound in the right ear
- 8000 accepted sweeps

FFR Data Analysis
- All data was analyzed through MATLAB
- Spectral amplitudes at 250 Hz, 500 Hz, 750 Hz, and 1000 Hz were identified.

RESULTS

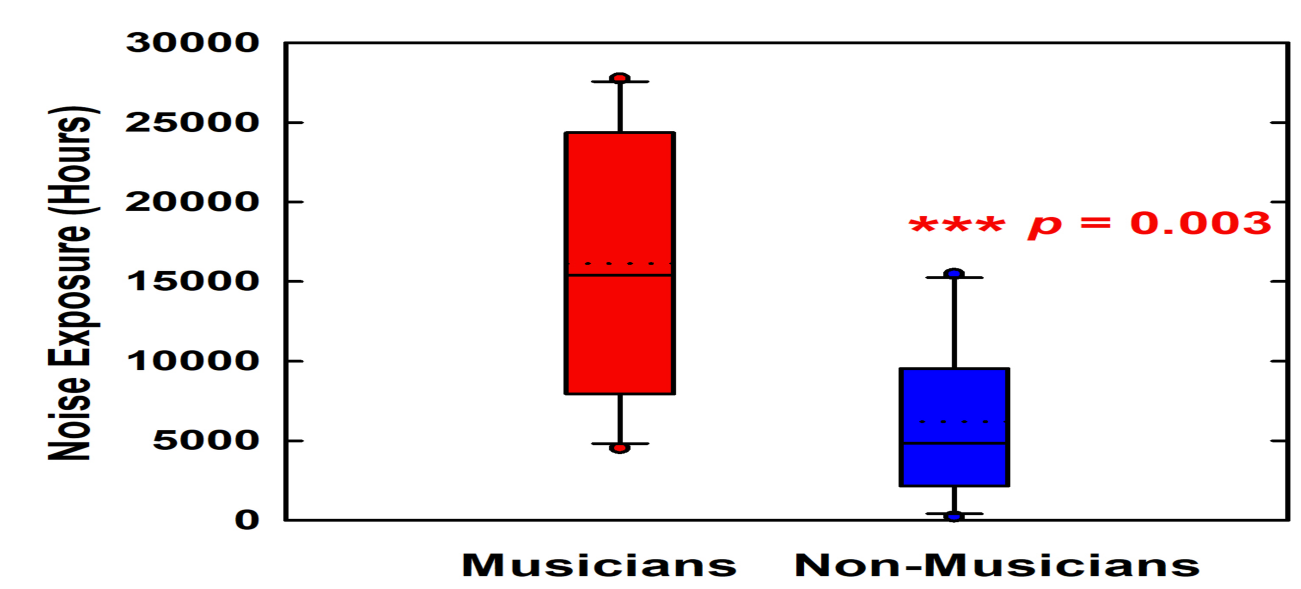

Figure 1: The amount of noise exposure (hours) reported for musicians was significantly larger than non-musicians.

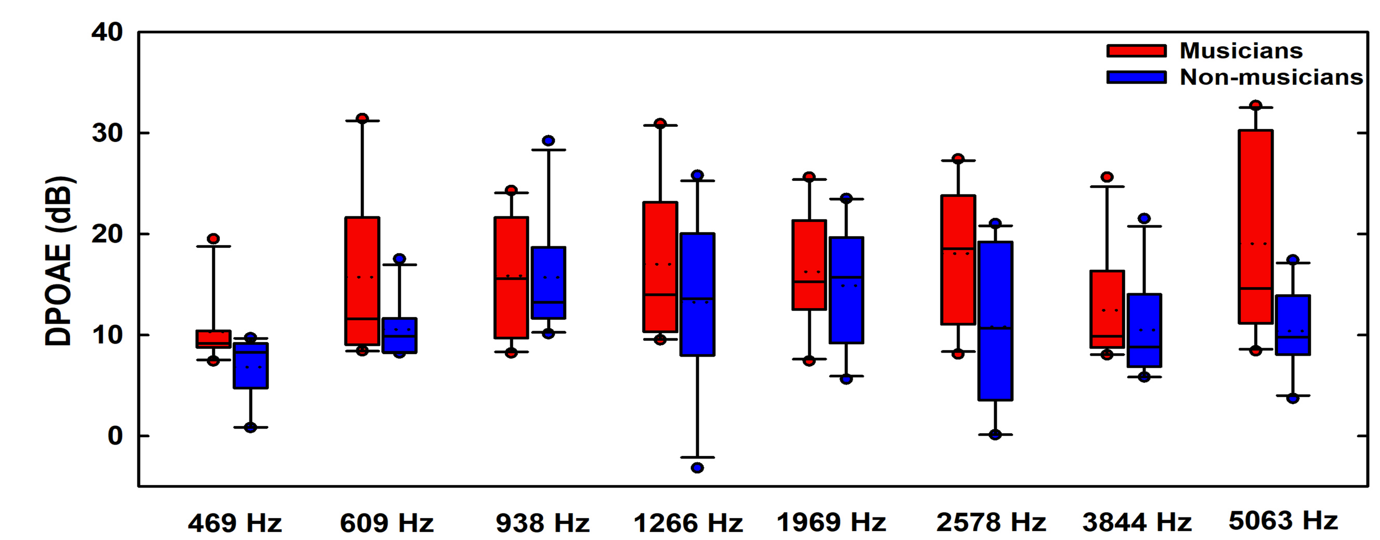

Figure 2 At all frequencies, there was no significant difference when comparing otoacustic emissions. This implied that all participants had normal outer hair cell function.

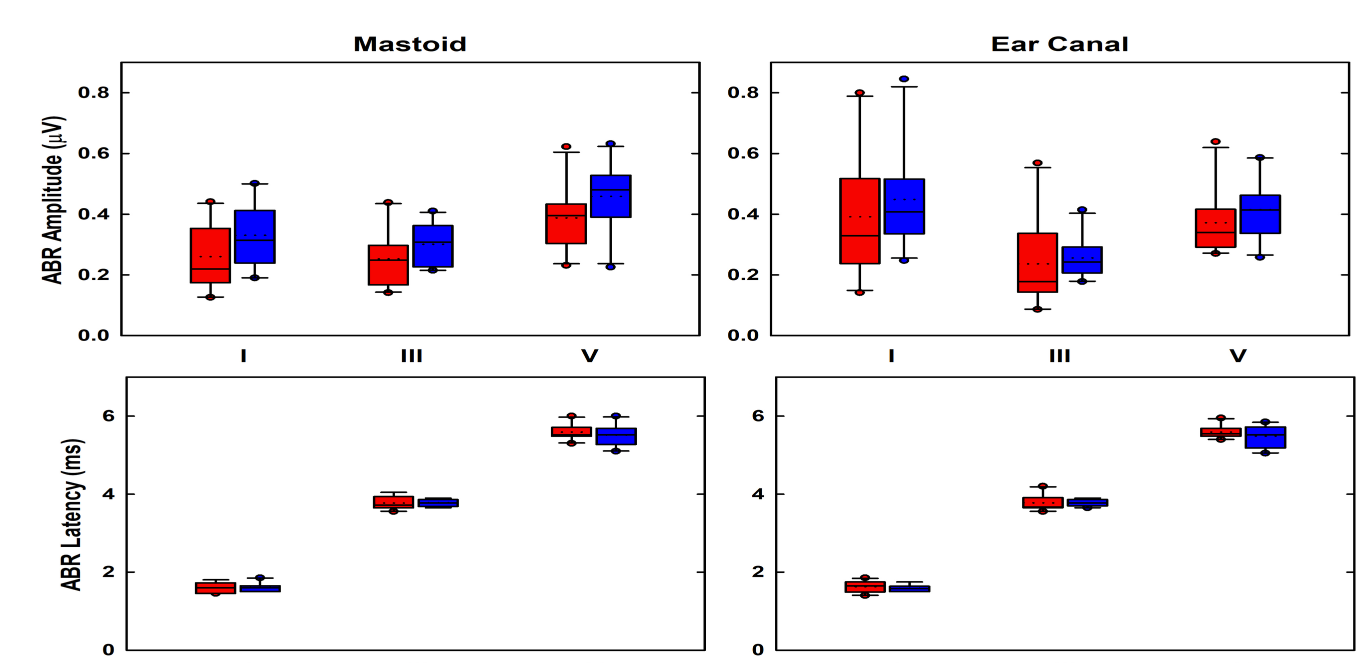

Figure 3: No significant differences were observed when comparing musicians (red) with non-musicians (blue) with respect to ABR amplitude and latencies for Waves I, III, and V.

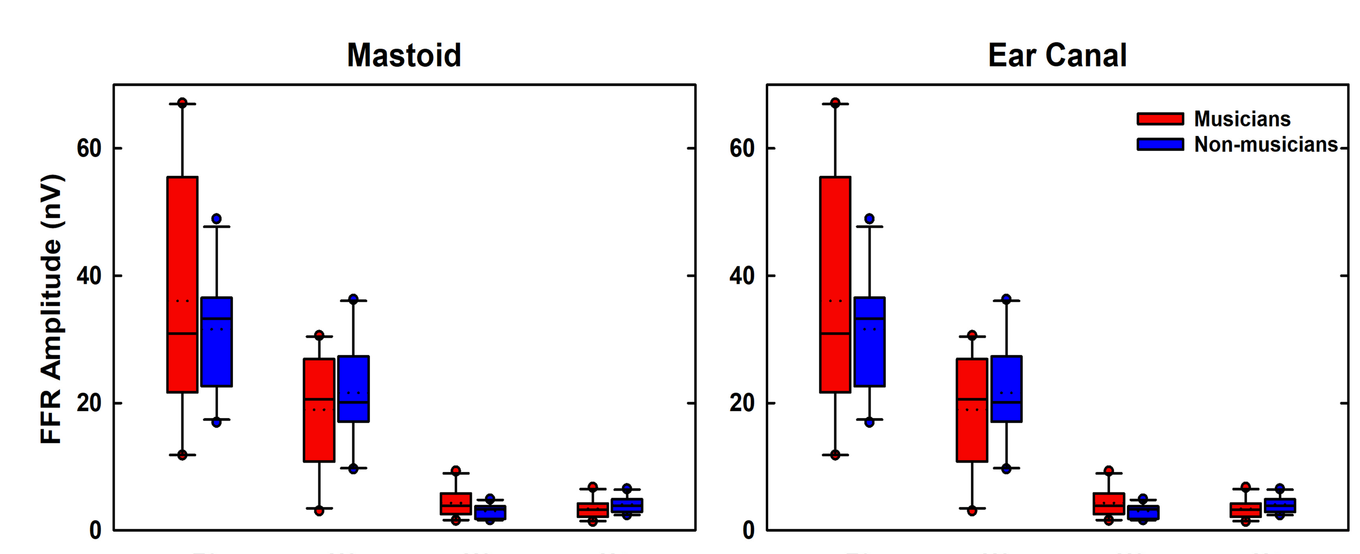

Figure 4: No significant differences were observed when comparing musicians and non-musicians' FFR amplitude at 250 Hz, 500 Hz, 750 Hz and 1000 Hz.

DISCUSSION

Changes for future of this study:

- Increase the number of participants
- Consider gender effects
- Better control of the participants' age range, and having participants report exposure within a specific time period.
- Recruit musicians from a specific section of a marching band or orchestra.

Future implications:

- Although there was no hidden hearing loss detected in this study, authors hope that the various procedures and parameters utilized in this study would contribute to future research in definitely defining and detecting hidden hearing loss in human participants.

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