The Activation of the Acoustic Reflex and its Effect on Middle Ear Function

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Introduction

- Repeat of the final study in the PhD dissertation of Udit Saxena (Saxena, 2014)
  - Pilot study due to a pending ethics application
- Acoustic reflex activation and its effect on middle ear function
  - Wide band absorbance in acoustic reflex growth functions (ARGFs)
- Completed at the National Center for Audiology, Elborn College, UWO

Acoustic Reflex and Middle Ear Absorbance

- **Acoustic reflex:** an involuntary contraction of the stapedius muscle of the middle ear in response to high-level acoustic stimuli (McGregor et al., 2018)
  - May assist in improving speech perception in the presence of noise, a common complaint in individuals with auditory processing disorder (APD)
- **Acoustic reflex threshold (ART):** the minimum stimulus intensity at which contraction of the stapedius muscle can be measured from changes in middle ear impedance (Saxena, Allan, & Allen, 2017)
  - Considered the most common acoustic reflex parameter used for clinical and research purposes (Awang et al., 2019), especially valuable in the diagnosis of middle ear and retrocochlear disorders (Guest et al., 2019)

Acoustic Reflex and Middle Ear Absorbance

- **Middle ear absorbance:** provides an estimate of sound energy being absorbed by the middle ear across frequency (Saxena, 2014)
  - A change in absorbance over different frequencies can be used to show the effect of the reflex on middle ear function
- Can be used to describe how effectively sound energy is being transmitted through the middle ear, with relation to the sound energy of the incident sound
- Measuring absorbance through the middle ear with regards to an individual's ART is one method that can be used demonstrate the effect of acoustic reflex activation on middle ear function

Methods

- 4 normal hearing adults
- All participants had normal otoscopic examination and normal hearing thresholds, as well as no history of neurological disorder
- Absorbance was measured in the resting state and while activating the reflex at three reflex activator intensity levels
  - Acoustic reflex threshold (ART), ART + 5 dB, ART + 10 dB
- Tested both ipsilaterally and contralaterally
  - Previous study only looked at contralateral acoustic reflexes

Results – Absorbance Change over Frequency

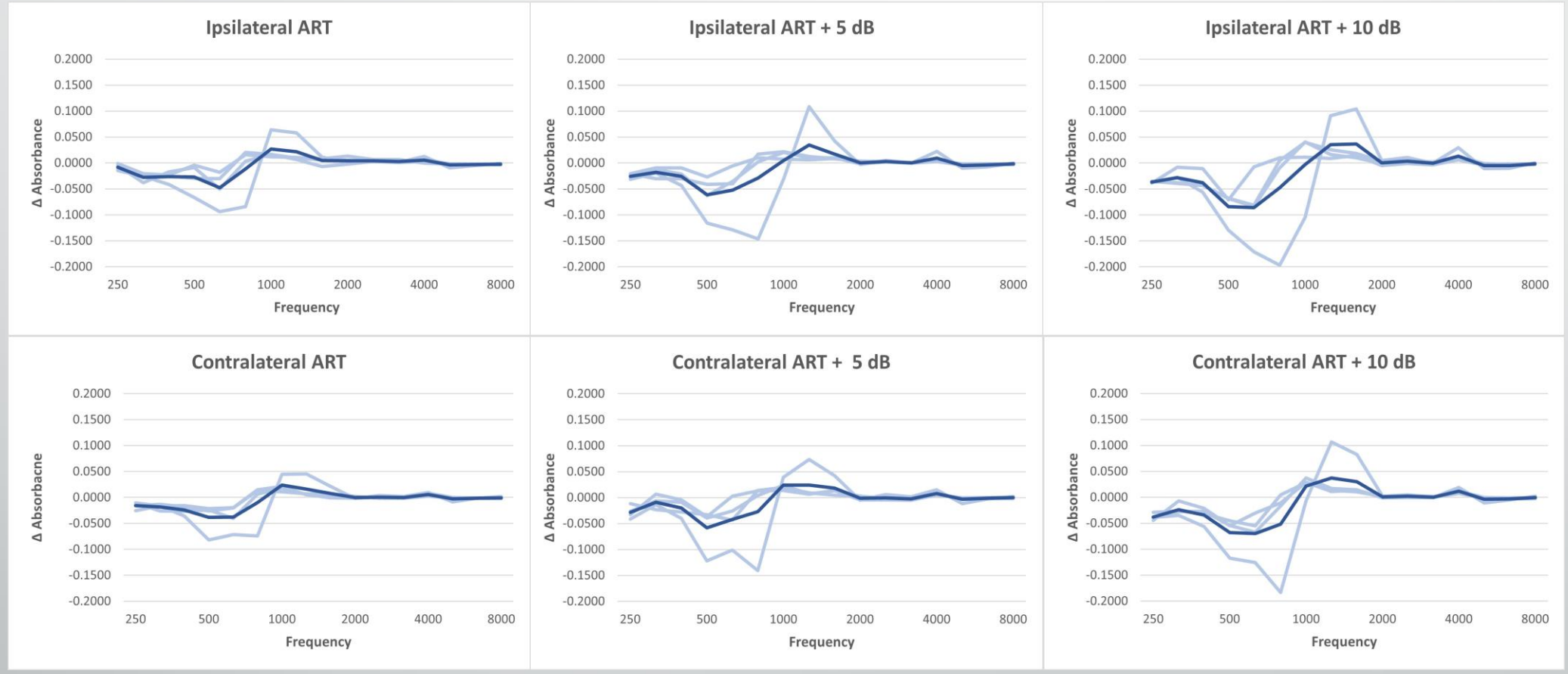

Figure 1: Average change in absorbance measured with and without activation of the acoustic reflex in the ipsilateral (uncrossed) and contralateral (crossed) conditions. Group average change in absorbance is represented by the dark blue line, whereas individual data with light blue lines.

Results - Magnitude

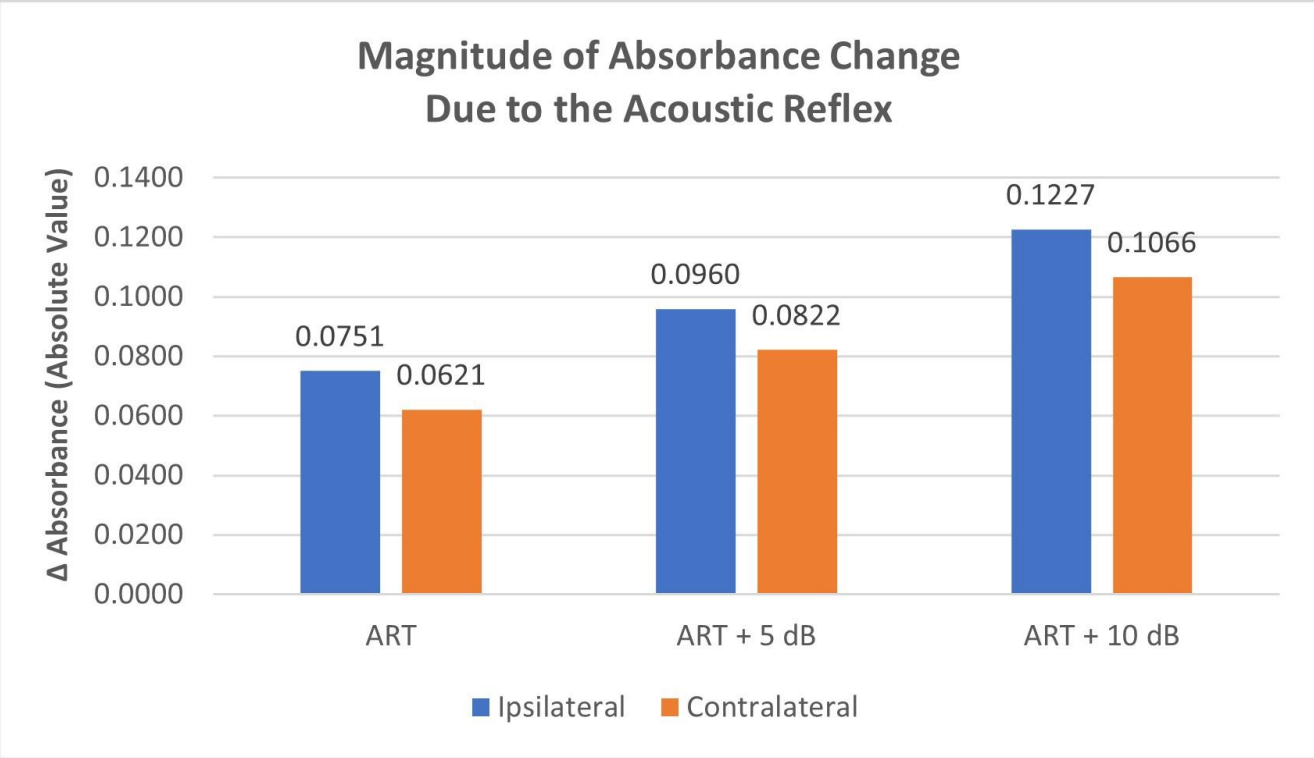

Figure 3: Absolute value of the magnitude of absorbance change in both conditions for each of the three acoustic reflex threshold intensity levels.

Discussion

- Middle ear absorbance influences the transmission of sound through the middle ear to the oval window
- The decrease in absorbance at low frequencies (due to the acoustic reflex) may be helpful in speech perception, most notably in the presence of noise
  - Decreased absorbance = increased reflectance; noise prevalent at low frequencies
  - Children with APD often have problems understanding speech in the presence of noise
- Data displayed a notable contrast between ipsilateral and contralateral middle ear absorbance values as a result of the acoustic reflex, consistent with previous studies
  - Ipsilateral ARTs were approximately 5 dB lower than contralateral ARTs
  - There was a larger acoustic reflex magnitude in the ipsilateral condition in all three reflex activator levels

Conclusion

- When the acoustic reflex is activated, low frequencies are attenuated as the middle ear acts as a high pass filter
  - Decrease in absorbance leads to an increase in reflectance
- This can improve the signal to noise ratio which results in the reduction of the negative effects of noise associated with speech perception
- Abnormal or absent acoustic reflexes in children with suspected APD may inhibit the ability of the middle ear to filter out noise
- Previous study only looked at the contralateral, potentially weaker pathway
- Sets the groundwork to repeat the study in the future with a larger sample size

References

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