Electrophysiologic Response to Classical Music in Instrumentalists, Vocalists and Non-Musicians

Brielle McDonald

Faculty Advisors: Sarah Raskin Ph.D and Dan Lloyd Ph.D

Introduction

The purpose of this exploratory case study is to investigate the electrophysiological response to a variety of classical music in individuals with differing musical backgrounds.

This study asks the questions…

- Do individuals with different musical backgrounds and expertise have greater electrical activity in different areas of the brain when listening to classical music? If so, in which areas?
- Do musicians have a greater electrical response when listening to music that is within their area of expertise than when they listen to unfamiliar classical music?

Methods

- Participants were three individuals from Trinity College, one instrumentalist, one vocalist and one non-musician.
- Participants filled out a survey about their musical background
- An electroencephalogram (EEG) was then used to record their response to 6, 1-minute excerpts of classical music.
  - Musical stimuli were unfamiliar classical pieces from six major categories of classical music, symphonic, small instrumental ensemble (string quartet), piano, mixed vocal ensemble, female solo voice, and male solo voice
  - All excerpts were chosen to have no sudden changes in key, tempo, or melody. They all followed general rules of Western music theory and were written between 1650-1900.
- Data was analyzed using EEGLAB. An independent component analysis (ICA) and time/frequency plots and analyses were run for channels and components of interest.

Musical experience impacts the electrophysiological response to classical music

Individuals of varying musical backgrounds had the greatest electrical response in the same areas of the brain.

Musical stimuli that aligns with the musicians current musical practice had the greatest electrical response

- The vocalist responded most strongly to the solo vocal piece
- The instrumentalist who has recently been singing more than they play responded most strongly to the vocal pieces

Discussion

Non-Musician

- Greatest electrical activity in frontal electrodes (F3, F1, FZ, FC3, FC1) (figure 1)
- There was an increase in the prevalence of gamma waves between 160-180 seconds, 190-210 seconds and 290-310 seconds, where the stimuli were the female solo vocal piece, piano piece, and string quartet piece respectively (figure 2)

Instrumentalist

- Greatest electrical activity in frontal-central electrodes (F5, F3, F1, FZ, FC5, FC3 FC1) (figure 3)
- There was an increase in the prevalence of gamma waves between 50-70 seconds, 110-130 seconds, 160-200 seconds, and 290-310, where the stimuli were the mixed vocal piece, the symphonic piece, the female solo vocal piece, and the instrumental string quartet piece respectively (figure 4)
  - The highest percentage of the gamma wave frequency band was produced during the female solo vocal piece,

Vocalist

- Greatest electrical activity in frontal-central electrodes (F5, F3, F1, FZ, FC5, FC3 FC1) (figure 5)
- There was an increase in the prevalence of gamma waves between 50-70 seconds, 100-130 seconds, 160-200 seconds, and 290-310, where the stimuli were the mixed vocal piece, the symphonic piece, the female solo vocal piece, and the instrumental string quartet piece respectively (figure 6)
  - The highest percentage of the gamma wave frequency band was produced during the female solo vocal piece, an operatic aria

Results

Non-Musician

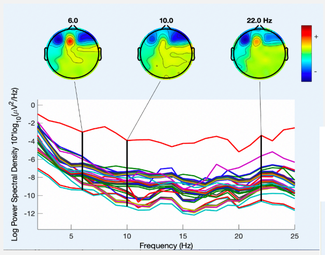

Figure 1: Channel Spectral density map for non-musician

- No musical training
- Currently listens to classical music ~2 hours/week

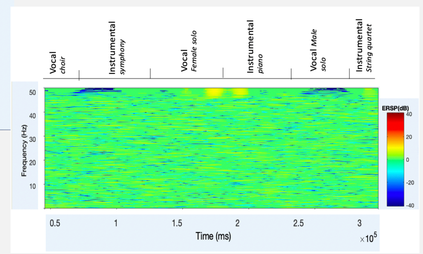

Figure 2: Time/frequency plot of IC1 for non-musician

Instrumentalist

with vocal experience

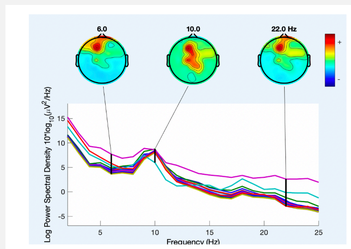

Figure 3: Channel Spectral density map for instrumentalist

- 12 years of instrumental training (piano, clarinet, saxophone)
- 2 years of choral experience
- Currently sings 4-6 hours/week, more than they play

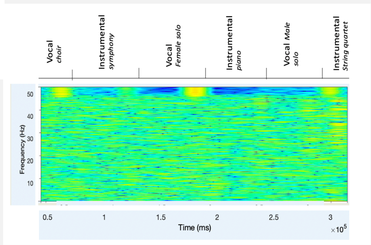

Figure 4: Time/frequency plot of IC1 for instrumentalist

Vocalist

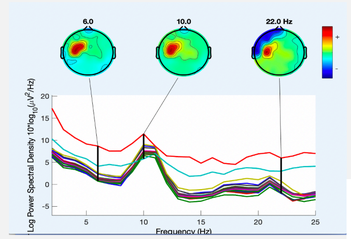

Figure 5: Channel Spectral density map for vocalist

- 14 years of choir/musical theatre experience
- 10 years of voice lessons
- Currently sings 12-14 hours/week

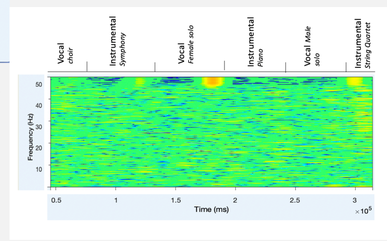

Figure 6: Time/frequency plot of IC1 for vocalist