

## INTRODUCTION

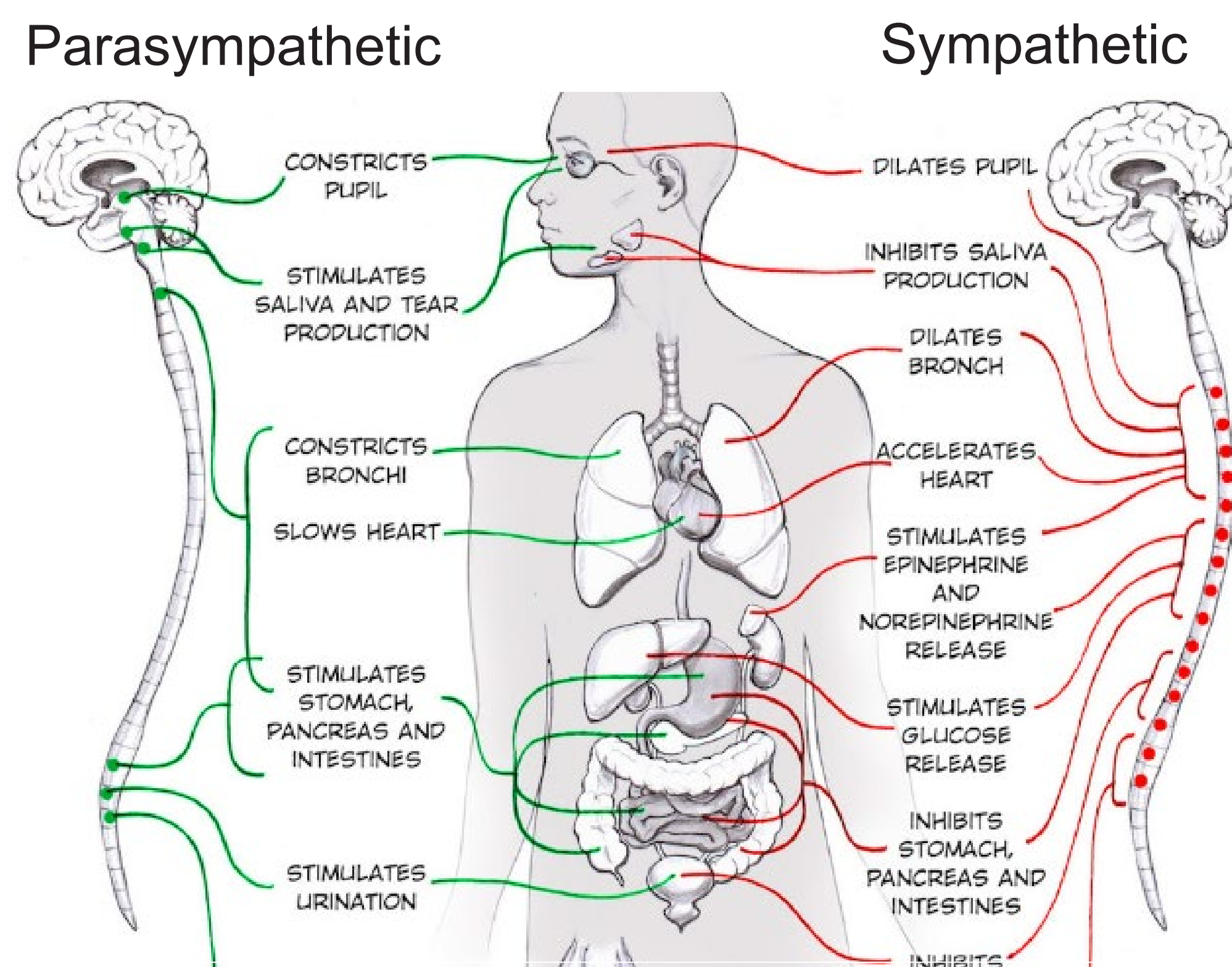
- 1 in 5 adults are diagnosed with mental illness
- Music therapy is a widespread practice for improving mental health
- 57% of Americans use music for self-relaxation
- Music can be used to regulate emotions. However, music is also very abstract, and the impact of each musical piece can vary significantly from person to person

## RESEARCH OBJECTIVES

- Investigate the influence of low-level music features on physiological response
- Develop a personalized music recommendation system using the identified music features and physiological feedback

## BACKGROUND

### Autonomic Nervous System (ANS)



Source: [https://backyardbrains.com/experiments/Sympathetic\\_Nervous\\_System](https://backyardbrains.com/experiments/Sympathetic_Nervous_System)

## HYPOTHESIS

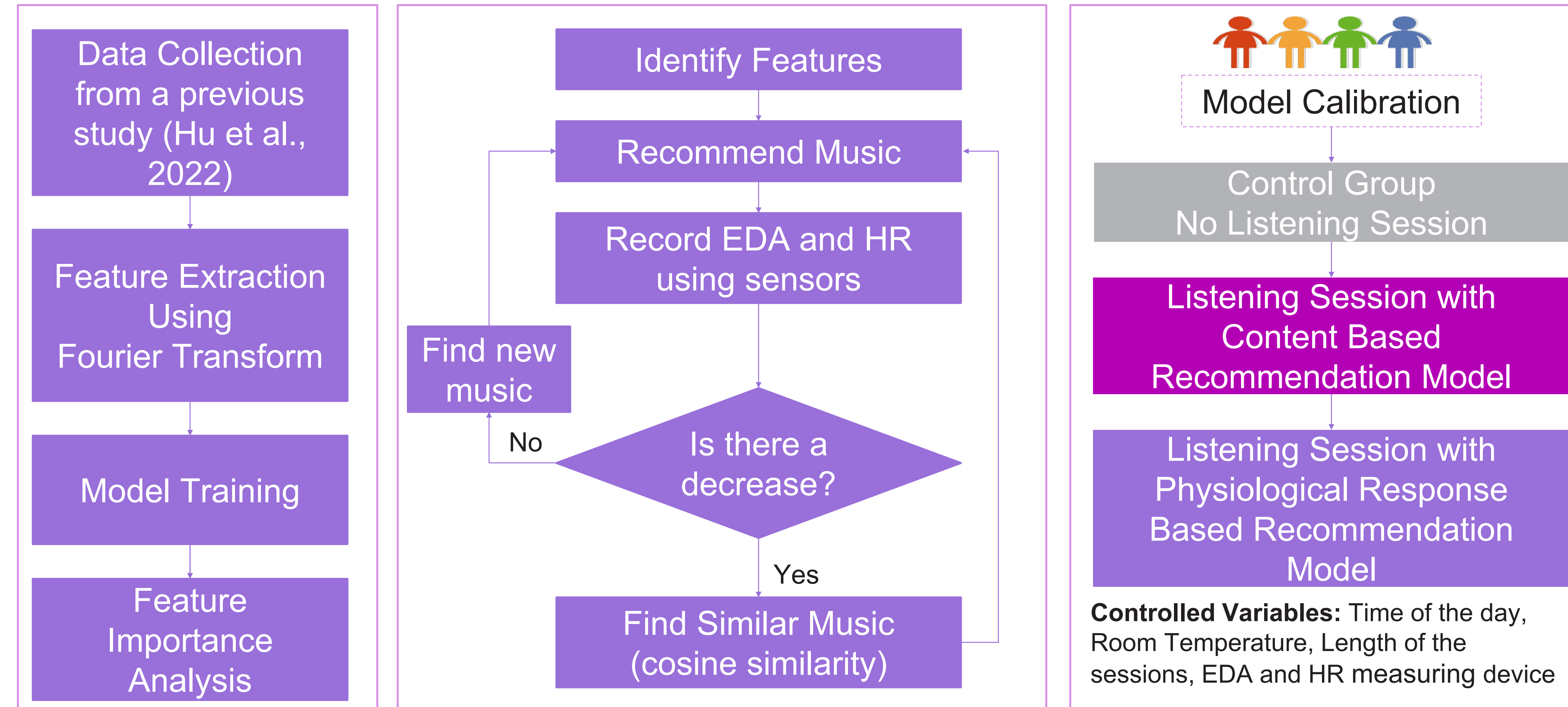
**Hypothesis 1:** The low-level time domain and frequency domain music features extracted from audio files will have significant correlations with listeners' physiological responses

**Hypothesis 2:** The personalized approach of music recommendation utilizing the key music features and physiological feedback will result in increased activation of the parasympathetic nervous system as measured by a decrease in the Electrodermal Activity (EDA in  $\mu\text{S}$ ) and heart rate (HR in BPM)

# IMPROVING MENTAL HEALTH USING ARTIFICIAL INTELLIGENCE-POWERED MUSIC THERAPY

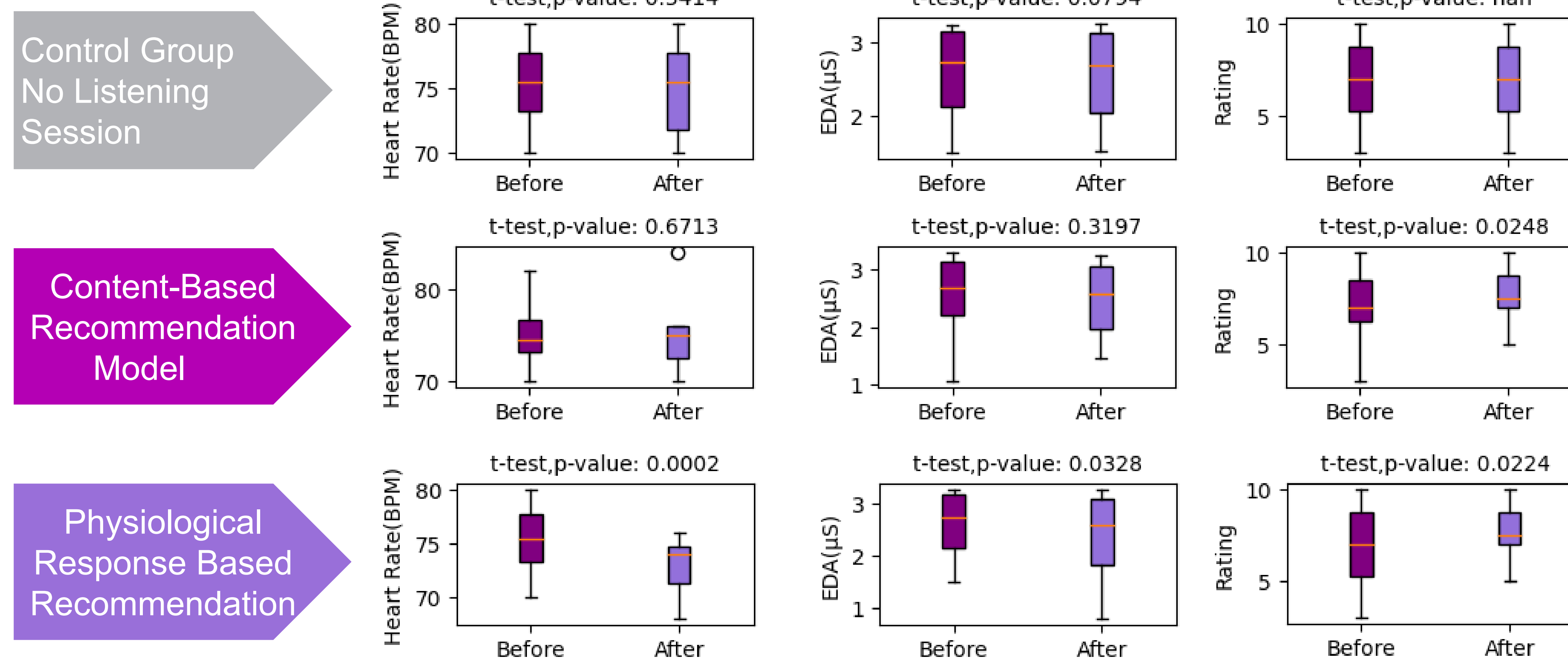
## PROCEDURE

### Analyze Music Features Build Music Recommendation System Within Subject Experiment Design

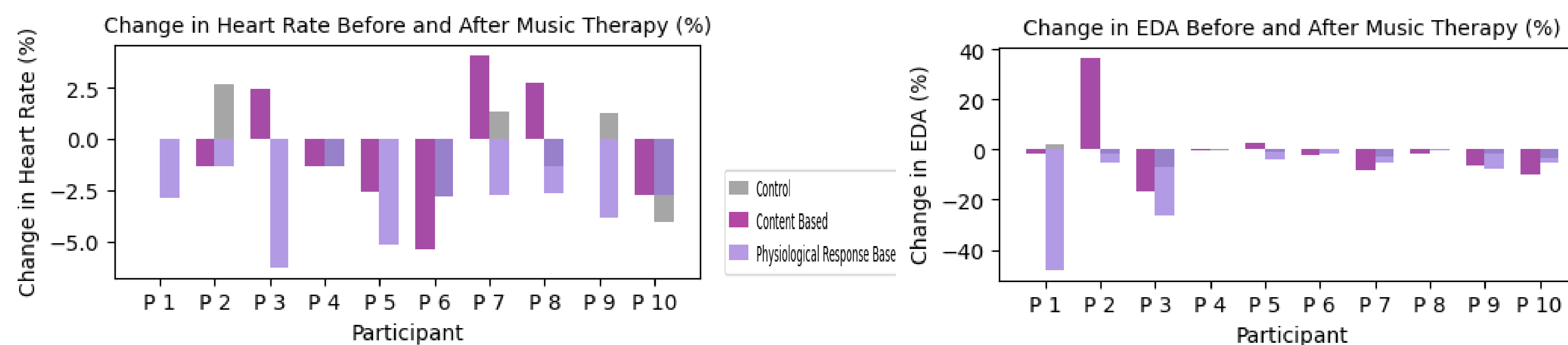


## RESULTS AND DATA ANALYSIS

### Box Plots of Heart Rate and EDA Before and After Listening Sessions



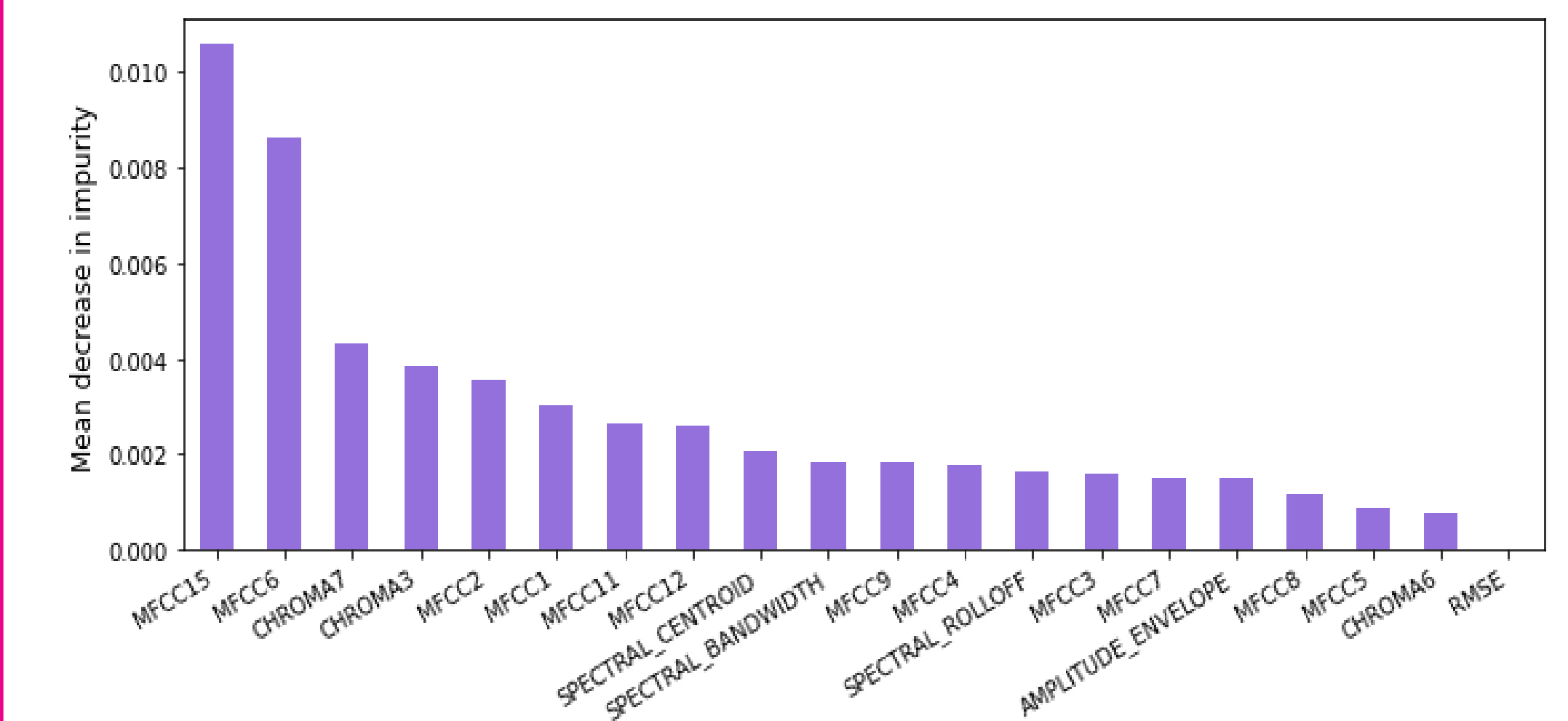
### Comparison of Listening Sessions



## DISCUSSIONS

- Gini impurity index of the generalized Gradient Boosting model showed that MFCC, Chroma, RMSE, and Spectral Bandwidth were some of the important features
- Experiment results shows a clear pattern where the EDA and HR values were consistently lower during the physiological feedback-based sessions compared to the regular content-based sessions and the session with no music (control group)

### Feature Importance (Gini Impurity)



## CONCLUSION

- As per the Gini impurity index, some of the music features had a strong correlation with the physiological response, thus partially supporting the first hypothesis
- The mean difference between the baseline and the end of the session was statistically significant ( $p < 0.5$ ) supporting the second hypothesis
- The subjective ratings did not change significantly between the two recommendation models

## FUTURE WORK & APPLICATIONS

- Explore the inclusion of electroencephalograph (EEG) brain waves as an additional feature in the analysis and feedback process
- Validate the findings by using a larger and more diverse music database

### Applications

- The ability to identify the physiological impacts of music can be useful in the advancement of therapeutic approaches
- Personalized music recommendations can help with self-relaxation to improve mental health

**NOTE:** All images and graphics were created by the researcher unless otherwise noted.