

## The Heart of Music

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### Abstract:

As can be inferred by our title, our project primarily focuses on exploring physiological responses to various music genres. Our project specifically examined how different genres of music—such as pop, R&B, and rock—affect our participants' heart rate. By investigating the connection between musical genres and physiological states, we aimed to comprehend how rhythmic patterns, tempo, and emotional tone influences pulse responses in individuals. Participants listened to the chosen songs from different musical genres in a controlled environment and their heart rate was recorded in real-time using a heart rate monitor. To moderate the heart rate of our participants, these individuals sat in complete silence for 5 minutes after each song played. Additionally, we took note of safety precautions before and after the experiment to ensure a smooth, calm gathering. Our results showed that the more stimulating genres of music like pop and rock had a more intense heart rate. However, we also found that personal bias towards certain genres of music can influence one's perception and heart rate. For instance, we examined an unclear relationship between people's heart rate and musical genres. This is notable because it only occurred in participant 1's results, as regardless of the difference in tempo, rhythm, and dynamics, the results remained consistent and similar. We concluded that our hypothesis was half-proven as the results from our experiment demonstrated how pop and rock had a higher heart rate, whereas a more calmer genre like R&B had a less intensive heart rate.

### Introduction/Problem/Purpose:

In this project, we investigate how music influences the physiological responses of the human body. Physiological responses refers to automatic, involuntary physical reactions to external stimuli. The involuntary reactions are controlled by the autonomic nervous system, which regulates functions such as breathing and heart rate. The autonomic nervous system consists of the sympathetic and parasympathetic branches. The sympathetic nervous system is responsible for the "flight or fight" response, often increasing heart rate, meanwhile the parasympathetic nervous system is responsible for "rest and digest" functions, thus slowing heart rate and promoting relaxation. In this initiative, these bodily changes occur when an individual listens or interacts with music. By collecting our participants' responses using hand-grip monitors that measure the activity of the heart in real time, the graphs evaluated how the different musical genres affected the autonomic nervous system. This experiment relates to two scientific areas: neuroscience and psychology. Neuroscience, the study of the brain, nervous system, and how they produce thought, behavior, and sensations entail how auditory stimuli affect an individual's body. Psychology helped us comprehend how music influenced cognition and mood, which drive psychological responses in people. These scientific principles are essential to this investigation, therefore, we will test and analyze how external stimuli influence the autonomic

nervous system of our participants. Our problem was as follows: “Is measuring an individual’s rate an effective way to test physiological responses?” The purpose of this experiment is to determine the physiological effects of the human body. Our objective is to analyze and measure variations in heart rate in response to different musical genres, with an aim in establishing a clear comprehension of the relationship between auditory stimuli and involuntary physiological responses.

#### Background:

Music is enjoyed by numerous individuals and is instrumental for human life. It has the ability to regulate mood, connect people socially, and enhance cognitive function. Furthermore, music stimulates the brain, reduces stress, improves confidence, and provides an opportunity for individuals all around to come together under one social area: music. According to Alhakin K., Enayeah M., Tamer A., Zatar M., “Music is a universal language that can elicit profound emotional and cognitive responses.” Overall, music has been a driving force in society, as it transcends language barriers and represents the world’s diverse culture. Listening to music together strengthens social bonds and group cohesions and provides artists an ability to perform their thoughts in the form of songwriting, production, and visual media.

#### Hypothesis:

Different musical genres will present changes in the heart rate. Calmer, smoother musical genres will result in a lower heart rate, as compared to the more stimulating genres such as rock.

#### Variables:

Independent Variables: Musical Genres (Pop, R&B, and Rock)

Dependent Variables: Heart Rate (measured in bpm)

Constants: The volume of the music, the serene environment of the testing room, the hand grip monitor, and the time of day the experiment was performed.

#### Materials:

- A Hand-Grip Monitor
- A Computational Device with the Venier Graphical Analysis Application
- 3 Human Participants

- An Audio Player
- A Set of Headphones
- A Computational Device with the Youtube Application and Stopwatch.
- A Quiet Testing Room
- A Chair for the Participant to sit in
- An Adult Supervisor

Procedures:

1. Ask the participant to sit calmly and quietly in a chair for 5 minutes to allow their heart rate to reach a moderate level.
2. Launch the Venier Graphical Analysis Application on a computational device.
3. Launch the Youtube Application on the second computational device.
4. Connect the hand-grip heart rate monitor to the first device and ensure its functioning properly.
5. Adjust the application settings to record the heart rate continuously for 2 minutes.
6. Have the participant hold the heart rate monitor correctly.
7. Give the participant the headphones and begin playing the pop track: APT.
8. Start the Venier Graphical Analysis Application at the same time the music video begins.
9. Record the participant's heart rate continuously for 2 minutes.
10. Save the data based on the participant's name and track playing.
11. Instruct the participant to remove the headphones and sit quietly in the controlled environment for 5 minutes to allow their heart rate to return to normal.
12. Record the 5 minutes utilizing a stopwatch on the second computational device.

13. Repeat steps 7-10 using the R&B track: Missin Out.
14. Repeat the resting period of 5 minutes (Steps 11-12).
15. Repeat steps 7-10 using the Rock track: REMEMBER.
16. After each trial is completed, analyze the results from each session.
17. Compare the results to your hypothesis.

### Findings and Results:

#### Pictures:



On the left, we have one of our participants preparing for the experiment, where he takes a 5-minute prep to return his heart rate back to normal. To the right, To the left, we have a picture of our third participant listening to R&B. We measured his heart rate with the hand-grip monitors shown.

#### Data Tables:

Data for participant 1 for Pop (left), R&B (middle), and Rock (right).

Time (min)	Heart Rate (bpm)	Time (min)	Heart Rate (bpm)	Time (min)	Heart Rate (bpm)
0	100	0	111	0	100
0.2	97	0.2	109.8	0.2	107
0.4	94	0.4	106	0.4	104
0.6	98	0.6	111	0.6	106
0.8	98	0.8	105	0.8	108
1	98	1	109	1	108
1.2	98	1.2	105	1.2	108
1.4	99.8	1.4	104	1.4	99.8
1.6	99.9	1.6	107	1.6	99.9
1.8	100	1.8	104	1.8	100
2	99	2	103	2	99.8

Data for participant 2 for Pop (left), R&B (middle), and Rock (right).

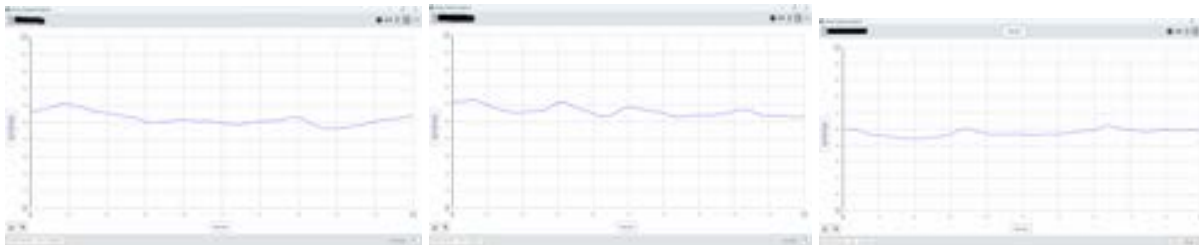
Time (min)	Heart Rate (bpm)	Time (min)	Heart Rate (bpm)	Time (min)	Heart Rate (bpm)
0	75	0	109	0	77
0.2	68	0.2	125	0.2	99
0.4	68	0.4	93	0.4	134
0.6	67	0.6	96	0.6	117
0.8	69	0.8	89.5	0.8	102
1	71	1	108	1	91
1.2	68	1.2	121	1.2	89
1.4	66	1.4	122	1.4	70
1.6	68	1.6	120	1.6	74
1.8	71	1.8	107	1.8	71
2	70	2	118	2	82

Data for participant 3 for Pop (left), R&B (middle), and Rock (right).

Time (min)	Heart Rate (bpm)	Time (min)	Heart Rate (bpm)	Time (min)	Heart Rate (bpm)
0	71	0	82	0	90.5
0.2	73.5	0.2	73	0.2	82
0.4	68.4	0.4	70	0.4	70
0.6	69.3	0.6	67	0.6	70
0.8	67	0.8	66	0.8	76
1	65.1	1	67	1	70
1.2	67.2	1.2	69	1.2	69
1.4	68.2	1.4	71	1.4	66
1.6	68.8	1.6	69.8	1.6	68
1.8	68.6	1.8	70	1.8	70
2	68.3	2	69	2	69.9

Graphs:

Data for participant 1 for Pop (left), R&B (middle), and Rock (right).



Data for participant 2 for Pop (left), R&B (middle), and Rock (right).



Data for participant 3 for Pop (left), R&B (middle), and Rock (right).



Analysis:

Using our data and results, we observed our participants' heart rates as a way to better perceive and understand the effects certain music genres have on the human body and its physiological responses. We found that, generally, more stimulating genres such as Pop and Rock evoked a more intense heart rate, as can be seen in the graphs. Our hypothesis was more or less proven, with an unclear distinction in participant 1's data across the three songs. We believe this is because of the unusual circumstances participant 1 was placed in, such as the lack of consistency between resting times prior to each song. Additionally, a person's bias or connection towards a certain genre of music can influence their perception and responses. This is a prominent confounding factor, and may have been prevalent across all graphs.

#### Conclusion:

With this information gained, we can use it and apply it to real-life situations. Music has long been a staple as a form of therapy and allows individuals to improve in cognitive and emotional ways. A lowered heart rate can often be associated with relaxation. Our data can be used in order to determine which type of music would be most suitable for individuals in therapy settings. This knowledge can be useful for music therapists in tailoring to their patient's needs.

#### Applications and Further Research:

Music is instrumental in life and is enjoyed by various individuals. Its ability to regulate mood, connect people socially, and enhance cognitive function serves one major key component: an opportunity for people to come together under one social environment. Music has always been a driving force in society as it transcends major language barriers and represents the world's diverse culture. Furthermore, music—for centuries—has allowed individuals to express

themselves through visual aesthetics and song composition. The results from this project can have numerous applications to various societal areas such as healthcare and education. For instance, in healthcare, music therapy has shown significant promise in reducing anxiety, managing pain, and improving the overall well-being of individuals with mental health conditions or chronic illnesses. In educational settings, incorporating music can boost creativity and foster emotional support amongst students. In addition, music provides a platform for youth to build identity, community, and relationships. As society continues to change drastically, the role of music will be even more crucial. This project highlights the importance of music and emphasizes its potential to serve as a tool in future scientific or societal areas.

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