

Effect of music on heart rate | experiment



**ASSIGN
BUSTER**

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Background Information:

The heart is a vital organ made of cardiac muscle that pumps blood throughout the body. Heart rate is associated with the contraction of the different chambers of the heart, and is considered myogenic. As a result, the heart beat is controlled independently of the central nervous system and is instead controlled by the pacemaker, also known as the Sino arterial node. The node sends signals through nerves in the heart to other nodes such as the AV or atrio-ventricular node and these result in the contraction of the chambers (Copeland, 1991). Heart rate is the number of heart beats per unit of time, typically expressed in beats per minute or bpm. The average heart rate at rest under normal conditions of adolescents and adults is $63.3 \text{ bpm} \pm 13.1 \text{ bpm}$, with variability of $3.2 \text{ bpm} \pm 2.1$ (Leschka, 2006). Other factors also have an influence on the heart beat and heart rate such as the medulla of the brain of the hormone adrenaline.

External stimuli or external factors also result in alterations of the heart rate. These include physical and emotional factors. One type of external stimuli that is shown to have effects on the heart rate is sound, specifically music. Music is currently being considered to be used as therapy for coronary conditions as well as on anxiety (Smolen et al, 2002). In addition, music is widely prevalent in the lives of adolescents. Teenagers in this day are age are exposed to music on a regular basis and a majority of adolescents living in the United States own mp3 or I-Pods (Epperson, 2011). Also, there are music therapies available for autistic patients that show improvement in

their communication skills and behavior over time because of the certain music played in the therapy session.

Sound has been shown to have effects on the heart rate. The average volume at which adolescents listen to music is 80 decibels which is approximately 80% volume on a music player using standard headphones (Epperson, 2011). Increasing volume has been shown to increase the heart rate, and decreasing volume has been shown to lower the heart rate (Okamoto, 2011). In addition, studies have been conducted that investigate different genres of music and their effects on heart rate as well as other heart application such as blood pressure.

Personal Engagement Statement:

The reason for doing this experiment is to see to what extent are we affected by music on a physical level. The reason I decided to focus on music's physical effect is because of how it is mostly known to have a more mental and emotional effect on our mood. I want to investigate how an everyday thing like music can cause physical change in our bodies by the different type of genres that come with it. This topic idea was also influenced by the fact I have been involved in musical groups, orchestra and mariachi, since I was 12 years old. The contrast between these two distinct musical groups, one soothing and the other festive, lead me to inquire upon music's effect in general. I want to not only know the difference between classical and mariachi music, but also take into account all the other music with varied tempos.

Exploration:

The topic I will be conducting an experiment on will be the study of music's effect on our heart rate. My research question my whole experiment will be based on is: What effect does the different genres of music have on an adolescent's rested heart rate? The dependent variable of this experiment is going to be the heart rate because it will change or not due to the music, and I am going to measure the heart rate by beats per minute. My experiment's independent variable will be the genre of music since it will not depend on the other variable for change. The controlled variables of this experiment will be the music's volume, headphones used, starting heart rate, the device used to play music, and the age and gender of the test subjects.

Hypothesis:

If the music is loud and has a fast tempo, then I believe your heart rate will increase because the tempo causes people to breathe faster. However, music with a slower and softer tempo, like classical music, causes the opposite effects on your heart rate. The research that helps back my hypothesis up is how Sakamoto found, for the Journal of Sound and Vibration, that there was an increase in systolic and diastolic pressure, which are the first and second reading in blood pressure, during exposure to steady noise and music with high intensity peaks. Since heart rate and blood pressure work interchangeably, like when exercising, it is a strong indicator heart rate will be affect by the music's genre based on the research. According to a study performed in Japan, hearing classical music results in a small variance of Mayer Wave which results in the lowering of the heart rate (Mamoru,

1998). This is because the sympathetic nerve is suppressed by the sound of classical music. In addition, rapid changes in volume and fast paced tempos cause the heart rate to increase (Epperson, 2011). These elements are what techno songs are composed of, and therefore an increased heart rate can be predicted upon listening to them.

Independent Variable: The independent variable is the genre of music the subject is exposed to while their heart rate is being measured. The levels of the independent variable will include five different genres of music. These will include classical music, pop music, jazz music, techno music, and country music. These genres vary in style and tempo or speed.

Dependent Variable: Heart rate which will be measured by beats per minute

Controlled Variable: Volume of music, headphones used, starting heart rate, device used, age, gender, the quietness of room environment, and the position of subject while exposed to music.

Materials: Headphones, iPhone for the music, stopwatch, paper, calculator, and pencil.

Procedure: Data Collection will be a sample size of at least 30 trials ranging from the age of 14-18. For each age year, in total 5, there will be at least six trails for each subject that is of ever age, turning out to be 30 trials in total. My subjects will have a variety of males and females.

1. Make sure to pick a quite outside or room environment where there is minimal distractions or conversations.

2. Allow the subject to sit in the chair in an upright position, ensuring that his/her back is against the backing of the chair and his/her feet are firmly planted in the ground.
3. Place headphones in the subject's two ears, but do not play any music yet. This is to ensure that the act of wearing headphones is not an additional factor.
4. Conduct the first trial for the experimental control.
 1. Allow the subject to sit in the chair for three minutes without the addition of music to rest their heart rate as much as possible.
 2. Write down resting heart rate of subject by finding their radial pulse. (To find the radial pulse I will put my index and third finger on the subject's wrist nearest their body. I will use the pads of my fingers. Place them just below the wrist creases on the thumb side. Press lightly until I feel the blood pulsing under their skin).
 3. Once three minutes have passed, measure subject's heart by using beats per minute. In order to do this begin the stop watch after the first pulse is felt. Count the number of pulses felt until the stop watch reads 60 seconds
5. Allow the subject one minute of silence before continuing with the rest of the trials.
6. Conduct the trials involving the different levels of the independent variable.
 1. Set the volume on the iPhone to medium volume.
 2. After one minute of silence since the first pulse reading has elapsed, begin playing the pop music. (Ensure that the iPhone is set on repeat in case the song is too short. If this step is

forgotten, the song may switch and the trial will not be valid for use)

3. Allow the subject to listen to the song for three minutes on a constant volume.
4. During the three minute time interval, note any changes in heart rate when finding their radial pulse.
5. As the subject listens to the music, note changes in facial expression, skin temperature, skin color (paleness or redness), and involuntary movement as qualitative data.
6. Allow the subject one minute of silence before continuing with the rest of the trials.
7. Repeats steps 6a- 6g for all genres of music (jazz, classical, techno, and country).
7. Repeat steps 1-5 until I get a sample size of 30 trials.
8. Calculate the average for each subject and the respective genres of music in order to make a representation of the data.
9. Measure the percent change in the pulse comparing the experimental control and all genres of music bpm in order to calculate the effect of the intensity of physical effect on the heart rate.
10. Ensure collection is significant, relevant data by pooling the data. This will make sure that there is analysis even if this sample size may be too small to evaluate the effect or relationship of the study.

Safety, ethical or environmental issues:

To make sure this experiment is conducted in the safest and ethical manner, I will make sure the songs chosen are censored from any explicit language during the trials. Also, I will make sure the volume of the music is not very

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loud for the subjects to prevent any hearing injuries to take place. I will also make sure the headphones used while this experiments are always clean for each subject to prevent any possible ear infections.

Data Collection:

Qualitative:

During this experimental procedure, I noticed various qualitative observations. Each genre of music seemed to have a different effect on the subjects. Some effects were subtle, while others were more noticeable. No changes in the skin color or body temperature were noted in this experimental procedure. However, slight movements were present. During the classical music, subjects made subtle swaying movements and briefly closed their eyes like showing they were relaxed into it. During the pop and rap music, the head swaying became more “ upbeat” and the subjects smiled or lightly chuckled while their eyes were open. The rock genre and techno genres had similar movements and expression as the pop music.

Quantitative:

Table1: Displays heart rates (bpm) of ten subjects during resting heart rate, classical, pop, country, jazz, and techno hearings for six trials.

	Restin	Classic	Pop	Countr	Jazz	Techn
Subjects	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
	(bpm ±1.0)	(bpm ±1.0)	(bpm ±1.0)	(bpm ±1.0)	(bpm ±1.0)	(bpm ±1.0)
Subject 1	61	60	74	63	68	75

t 1

(14

years

old)

2 63 61 72 61 69 73

3 63 60 75 60 69 74

Subjec

t 2

(14 4 64 57 73 60 67 74

years

old)

5 62 57 75 59 69 76

6 63 58 74 59 70 75

Subjec

t 3

(15 1 62 62 70 62 72 73

years

old)

2 62 61 71 62 73 75

3 63 61 70 60 71 76

Subjec

t 4

(15 4 63 63 69 58 74 72

years

old)

5 63 62 67 60 74 71

6 62 63 68 57 73 71

Subjec

t 5

(16 1 63 61 76 59 72 74

years

old)

2 65 62 74 59 71 77

3 65 60 76 61 72 76

Subjec

t 6

(16 4 65 59 75 62 74 75

years

old)

5	66	61	73	60	73	76
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6	64	59	74	63	75	78
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Subjec

t 7

(17	1	62	60	75	57	70	78
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years

old)

2	61	62	73	56	72	75
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3	63	64	77	58	69	76
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Subjec

t 8

(17	4	64	64	72	60	75	73
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years

old)

5	64	63	68	63	73	72
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6	66	64	71	59	77	72
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Subjec 1	60	58	76	58	73	73
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t 9

(18

years

old)

2 59 61 74 56 70 73

3 59 59 75 59 74 71

Subjec

t 10

(18 4 63 59 69 62 72 72

years

old)

5 67 60 72 58 71 70

6 65 57 71 60 71 73

I conducted the mean of the different bpm values for resting and the five genres of music (classical, pop, country, techno, and jazz) for each of the five subjects. This statistic allowed me to observe the average heart rate of each subject under the influence of the different music genres. Through this analysis, I was able to collocate the data and compare the differences in the bpm for each music genre. It gave me the ability to determine if a certain genre caused a larger average bpm for the subject and how it changed based on the intensity of the genre.

I conducted the range of bpm of all six trials for each type of exercise. This statistic allowed me to identify the difference between the maximum value and the minimum value for bpm during each music listening. It gave me the

ability to determine the distribution of my data for each different genre of music. Due to its small number, this value showed me that my average bpm for each exercise was overall pretty consistent, and did not fluctuate greatly during the three trials for each age section.

I conducted the standard deviation of heart rate bpm from all six trials for each genre of music conducted. This statistic allowed me to obtain a more detailed and accurate estimate of the dispersion in the data values because one outlier can greatly exaggerate the data in the range, therefore making it inaccurate. The standard deviation showed me the relation of the bpm for all three trials to its mean value. Since it was a small value, it showed me that the bpm levels stayed mainly constant throughout the trials with a small dispersion of data. I conducted a percent change in order to determine the change in my bpm values between each genre of music and resting. By doing so, I analyzed by how much of a difference (bpm) value there was for each genre of music compared to resting. This was done to see if there was a significant increase or decrease in the bpm values between the genres of music and resting.

Table 2: Displays average heart rate of ten subjects (bpm) and average data dispersion for each genre of music

Subject	Genre of Music	Average (bpm)	Range (bpm)	Standard Deviation
Subject 1	Resting	62.3	2.0	1.2

(14 years
old)

Classical	60.3	1.0	0.6
Pop	73.6	3.0	1.2
Country	61.3	3.0	1.2
Jazz	68.6	1.0	0.6
Techno	74	2.0	1

Subject 2

(14 years Resting 63 2.0 1
old)

Classical	57.3	1.0	0.6
Pop	74	2.0	1
Country	59.3	1.0	0.6
Jazz	68.6	3.0	1.5
Techno	75	2.0	1

Subject 3 Resting 62.3 1.0 0.6

(15 years

old)

Classical 61.3 1.0 0.6

Pop 70.3 1.0 0.6

Country 61.3 2.0 1.2

Jazz 72 2.0 1

Techno 74 3.0 1.5

Subject 4

(15 years Resting 62.6 1.0 0.6

old)

Classical 62.6 1.0 0.6

Pop 68 2.0 1

Country 58.3 3.0 1.5

Jazz 73.6 1.0 0.6

Techno 71.3 3.0 0.6

Subject 5

(16 years Resting 64.3 2.0 1.2

old)

Classical	61	2.0	1
Pop	75.3	2.0	1.2
Country	59.6	2.0	1.2
Jazz	71.6	1.0	0.6
Techno	75.6	3.0	1.5

Subject 6

(16 years Resting 65 2.0 1
old)

Classical	59.6	2.0	1.2
Pop	75.3	2.0	1
Country	61.6	3.0	1.5
Jazz	74	2.0	1
Techno	76.3	3.0	1.5

Subject 7

(17 years Resting 62 2.0 1
old)

Classical	62	4.0	2
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Pop	75	4.9	2
Country	57	2.0	1
Jazz	70.3	3.0	1.5
Techno	76.3	3.0	1.5

Subject 8

(17 years old) Resting 64.6 2.0 1.2

Classical	63.6	1.0	0.6
Pop	70.3	4.0	2.1
Country	60.6	4.0	2.1
Jazz	75	4.0	2
Techno	72.3	1.0	0.6

Subject 9

(18 years old) Resting 59.3 1.0 0.6

Classical	59.3	3.0	1.5
Pop	75	2.0	1

Country	57.6	3.0	1.5	
Jazz	72.3	4.0	2.1	
Techno	72.3	2.0	1.2	
Subject				
10				
Resting	65	4.0	2	
(18 years old)				
Classical	58.6	3.0	1.5	
Pop	70.6	3.0	1.5	
Country	60	4.0	2	
Jazz	71.3	1.0	0.6	
Techno	71.6	3.0	1.5	

Table 3: Displays total average bpm of all ten subjects combined, average data dispersion for each genre, and comparison of average bpm of genres and resting using percent difference

Subject	Music Genre	Total Average (bpm)	Total Range (bpm)	Standard Deviation	Percentage Difference from Resting
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Combine Resting				
d (10)	g	63	8.0	1.8
				0.0
Classical	60.6	7.0	2.0	-3.8
Pop	72.7	10.0	2.7	15.4
Country	59.7	7.0	1.6	-5.2
Jazz	71.7	10.0	2.1	13.8
Techno	73.9	8.0	1.9	17.3

Conclusion:

The results supported my initial hypothesis; however, they were not statistically significant. Initially I hypothesized that classical music would result in a lowering of the heart rate while techno music would have the most influence on raising the heart rate. According to my results, the percent difference between resting and classical music is -3.8% and the percent difference between resting and techno music is 17.3%, supporting my hypothesis. Country music also lowered the average heart rate by a lower -5.2%, while pop and jazz music heightened the heart rate by 15.4% and 13.8% respectively. The more upbeat songs such as the pop, jazz, and techno appeared to have increased the heart rates of the subjects as predicted, and the slower more relaxed songs such as the classical and country music lowered the heart rates.

This experiment can be expanded to possibly aid in the development of new therapeutic methods based for cardiac conditions based on music. It can also be used to help aid in the stressful lives of teenagers, often resulting in higher-than-normal heart rates (Smolen et al, 2002). The results of my study, although not statistically significant support the findings of other scientists researching the field. Increases in systolic and diastolic pressures during exposure to steady noise and music with high intensity peaks are present (Epperson, 2011). This would account for genres of music such as techno that have a consistent beat and high peaks of volume. The opposite can be observed for classical music that constantly changes in rhythm and lack