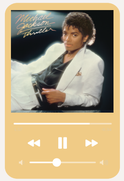
Harmonies and Heartbeats:
The Link Between Music and BPM

Chosen Songs
Major Scale - "Thriller" by Michael Jackson
Minor Scale - "To Good at Goodbyes" by Sam Smith



Introduction

It is common knowledge that music evokes various types of emotional responses, based on the intricacy of music composition. For instance, a minor scale can be defined as a sequence of notes arranged in a specific pattern, resulting in a unique tonal flavour. Unlike major scales which are generally associated with brighter and happier feelings, minor scales evoke emotions such as melancholy, introspection, longing, or even mystery. So to reinforce this theory, we have developed a scientific investigation that will track the heartbeat of individuals against major chord music and minor chord music. To conduct this investigation, we tested the heartbeats of 14 individuals, 7 boys and 7 girls, from grade 10 (15 to 16-year-olds), comparing the difference between them listening to a major scale song and a minor scale song.

Aim

The aim of this investigation is to explore if an individuals bpm (beats per minute) is influenced by the scale of music they are listening to.

Hypothesis

The hypothesis for this experiment is that the major scale of music will result in a higher BPM (beats per minute) compared to the minor scale of music

Equipment

- Headphones
- Computer to play music and record results
- Pulse oximeter

Safety and Risk Assessment

Hazard	High Volume of Headphones
Risk	Eardrums being damaged from high music volume of the headphones
Precaution	Keeping the volume at safe level and only wearing the headphones for a certain duration.

Procedure

1. Measure the participants' resting heartbeats three times and then calculate the average bpm
2. Put noise-cancelling headphones on the individual
3. Play the major-scale song
4. Measure the participant's heartbeat at 30 seconds
5. Play the minor-scale song
6. Measure the participant's heartbeat at 30 seconds
7. Repeat steps 1-6 with other individuals
8. A paired T-test was performed to see if there was a significant difference between the major and minor scale results

Variables

Independent: An individual's heartbeat compared to the music they are listening to
Dependent: An individual's heartbeat while listening to major chord or minor chord music.
Controlled:

- Volume
- Method of listening - headphones, earphones, speaker, etc
- Setting
- Type of environment

Limitations

With our investigation, accuracy problems occurred with our results as they did not conform to our given hypothesis. Each participant's heart rate differed when listening to the two sets of minor and major, but the results stayed within a consistent value, this led to the results collected not supporting our intended theory. To improve on this matter, performing the experiment when the participants base heart rate was the same before each trial. This would have resulted in more reliable and accurate set of results.

Graph and Tables

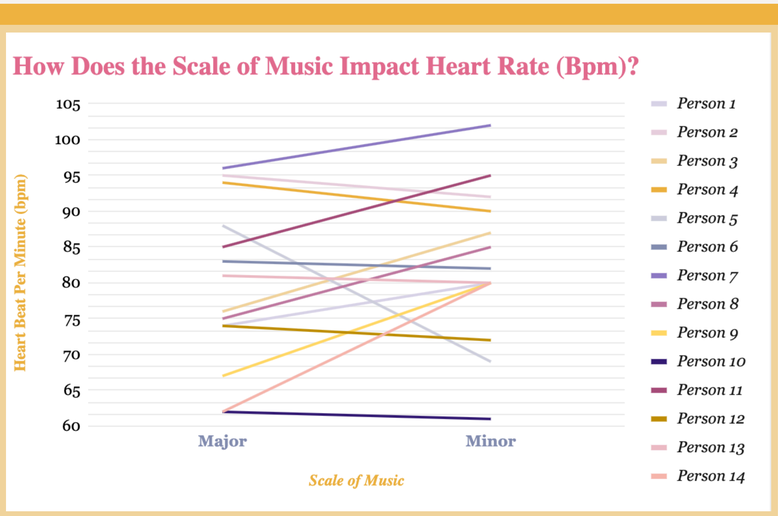


Figure 1: Graph of Results

Testing of the Major Scale Song, "Thriller - Michael Jackson"			
No. of Individual	*HeartBeat P/M Against Major Scale Song for 30 seconds*	*No. of Individual*	*HeartBeat P/M Against Major Scale Song for 30 seconds*
Person 1	**74**	**Person 8**	**75**
Person 2	**95**	**Person 9**	**67**
Person 3	**76**	**Person 10**	**62**
Person 4	**94**	**Person 11**	**85**
Person 5	**88**	**Person 12**	**74**
Person 6	**83**	**Person 13**	**81**
Person 7	**96**	**Person 14**	**72**

Table 1: Major Scale Song BPM Results

Testing of the Minor Scale Song, "Too Good at Goodbyes - Sam Smith"			
No. of Individual	*Trials of the HeartBeat P/M Against Minor Scale Song for 30 seconds*	*No. of Individual*	*Trials of the HeartBeat P/M Against Minor Scale Song for 30 seconds*
Person 1	**80**	**Person 8**	**85**
Person 2	**92**	**Person 9**	**80**
Person 3	**87**	**Person 10**	**61**
Person 4	**90**	**Person 11**	**95**
Person 5	**69**	**Person 12**	**72**
Person 6	**82**	**Person 13**	**80**
Person 7	**102**	**Person 14**	**80**

Table 2: Minor Scale Song BPM Results

Key Findings and Trends

- 50% of the participant's heart rates increased when they were listening to the minor scale song
- 4 people (28.6%) had the same heart rate of 80bpm during the 30-second mark of the minor scale song

Analysis of Results

The results showed no significant difference between the heartbeats for the major and minor scales. As our p-value (0.23) for the paired sample t-test is bigger than the standard significance level of 0.05, it shows that there is no significant difference between the data. As such, it was made evident that the music scale has no overall significance as every individual's heart rate fluctuated without any pattern, due to varying emotional reactions and external factors playing a role.

When comparing the results **(Figure 1)**, it is observed that approximately half of our participants' heart rates increased for the minor scale while the other half's heart rates decreased. The differences ranged from 1-20 bpm. Our group's reasoning for this was that the minor scale song, "Too Good at Goodbyes" was a slow and emotional song which resulted in varying responses from the participants. For instance, some of the participants had an increase in their heart rate which can be attributed to the feeling of being sad or overwhelmed whilst those whose heart rate decreased may have felt the song calming in which they began to relax.

Conclusion

In conclusion, the experiment conducted regarding the music scale compared to the heart rate of an individual proved that there is no significant change. This was proved through a paired t-test of the results, which answered 0.23, demonstrating how there was no remarkable difference. Furthermore, the hypothesis was not supported by this experiment, as the results did not prove that the major scale will cause a higher bpm; conversely, the results demonstrated that the scale of music does not matter.

Resources:

- *https://allihoopa.com/music-scales-exploring-major-and-minor-scales-in-music-theory/*
- *Tuning in: How music may affect your heart. (2021, March 30). Harvard Health. https://www.health.harvard.edu/heart-health/tuning-in-how-music-may-affect-your-heart*
- *https://www.sciencefocus.com/the-human-body/does-music-affect-our-heart-rate*
- *https://emerginginvestigators.org/articles/14-058*