Journal of Emerging Investigators

# The effect of music on heart rate

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**Summary:**
**"Does music actually touch your heart?" Yes, it actually does. It has been shown that fast paced music increases heart rate and slow paced music decreases heart rate. The purpose of our experiment was to determine whether or not the two different kinds of music affect heart rate of adults in a high school setting. Thirty subjects above the age of 18 years were chosen randomly from the school. They were required to listen to two different songs with one being slow and the other being fast and upbeat, for a time period of 2.5 minutes each. The subject's heart rate was taken before and after each song (4 times total) with a resting period of 1 minute between songs to allow the heart rate to recover back to a steady state. We hypothesized that slow music would decrease heart rate whereas fast music would accelerate it. The results at the end of our experiment showed that 93% of subjects experienced a decrease in heart rate following the slow song and 100% of subjects experienced an increase in heart rate following the fast song. We concluded that there is, indeed, a relationship between music and heart rate.**

**Received:** Oct 10, 2012; **Accepted:** Jan 28, 2013; **Published:** Apr 25, 2013



## Introduction

Today, music plays a major role in our day-to-day lives. The continuing expansion of the purpose of music beyond its conventional use of simply listening for entertainment provides many benefits to human life and behavior (1, 2). One of the biggest discovered human behaviors to be affected by music is heart rate (3, 4, 5). The heart is a vital organ and continuously pumps blood through the human body in a rhythmic pattern. The heart pumps blood at a constant rate, which differs from person to person. However, this rate is controlled by the autonomic nervous system (6). This system consists of two types of nerves: the sympathetic nerves and the parasympathetic nerves. The stimulation of sympathetic nerves increases heart rate, while the stimulation of parasympathetic nerves decreases heart rate (6). Oftentimes certain natural and artificial stimuli are applied to the human body, such as stress, sleep, caffeine, yoga, and exercise. When these different stimuli reach the body, they affect the two types of nerves, resulting in a change in heart rate.

One stimulus that has come to the general population's attention more recently is music. In 2005, a study conducted in the UK and Italy showed that heart rate, along with blood pressure, increased while subjects listened to music with a faster, irregular tempo (7). The effects of music can also be taken into the attempts to lower heart rate. A study conducted in 2003 showed that patients who listened to their choice of music experienced significantly lower heart rates (8). In another study, conducted on 40 women, timed puzzles were given to them and their anxiety level and heart rate was measured while listening to different songs. This study concluded that the song "Weightless" was 11 percent more relaxing than the other songs used in the study and it decreased the heart rates to 35 percent lower than the resting heart rate (9).

As stated before, music is not only present in our day-to-day lives but is also appearing more in the field of medicine. Health care workers spend a lot of money each year on sedatives given to patients. The introduction of slow and lower-beat music in medical settings could reduce the amount of sedatives needed thereby reducing the overall cost (10). Not only will it help hospitals save money, but it would also reduce the patients' exposure to unnecessary drugs and would lessen the risk of side-effects that are sometimes associated with the sedatives. On the other hand, the introduction of up-beat songs into a fitness center or athletic environment would enhance the performance of competitive athletes or even help motivate regular people to improve their health and exercise (11).

The song "Weightless" has been called the "most relaxing song of 2011" and the song "Worldwide Choppers" is a type of fast-pace rap song. It has been shown by previous studies that fast paced songs increase heart rate and slow paced songs like "Weightless" decrease heart rate. But whether this holds true in a high school setting is not known. We wanted to investigate the effects of these two songs on the heart rate of adults in a high school setting. We hypothesized that music with a slow tempo (song "Weightless") would decrease heart rate and fast music (song "Worldwide Choppers") would increase heart rate in human subjects in a high school setting. We specifically tested whether these two different types of music affected the heart rate of a group of men and women of various ages within the high school setting and also if gender and age influenced this

response.

After completing the experiment, our hypothesis was reaffirmed and our question was answered with: yes, the song "Weightless" decreases heart rate and the song "Worldwide Choppers" increases heart rate in a high school setting. On average, people experienced a faster heart rate when listening to music with a faster beat compared to listening to music with a slower beat. Males and younger people (<35 years of age) experienced a larger change in heart rate compared to females and older people.

## Results

The results of the experiment showing the average heart rate of subjects before and after each song are depicted in **Figure 1**. The baseline heart rate ranged between 54-96 beats per minute before the slow song with the mean being 74.1 ± 10.8. After subjects listened to the designated slow-tempo song for 2.5 minutes, the heart rate ranged between 50-90 beats per minute with a mean of 68.3 ± 10.2. This change was statistically significant with a p-value of less than 0.0001. Out of the 30 subjects, 28 experienced a decrease in heart rate, one showed no change, and one showed an increase in heart rate by 2 beats per minute. **Figure 1** also shows the data collected before and after the designated fast-tempo song. The heart rate before the fast song ranged between 54-94 beats per minute with an average of 72.5 ± 10.2. After listening to the fast song for 2.5 minutes, the heart rate of the subjects ranged between 62-110 beats per minute with an average of 81.9 ± 12. This change was also statistically significant with a p-value of less than 0.0001. As shown in **Figure 2**, 93.33% of subjects experienced a decrease in heart rate following the slow song. Of the 30 subjects tested, an incredible 100% of subjects showed an increase in heart rate after listening to the fast song.

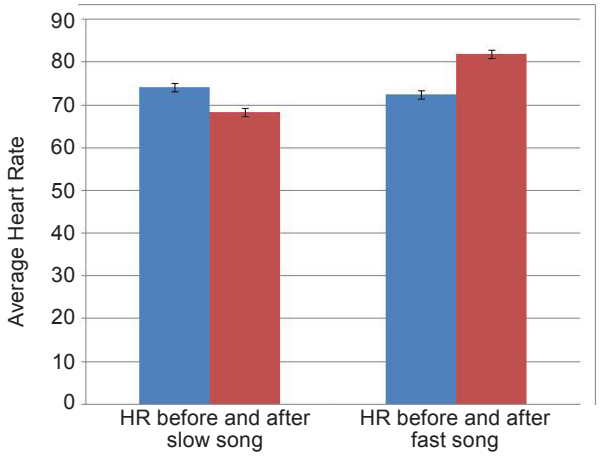


**Figure 1.** Average heart rate before and after listening to a slow song and a fast song. Blue bars represent average heart rate before listening; red bars represent average heart rate after listening to the songs. Error bars represent standard deviation. HR, heart rate.

A subgroup analysis was done based on gender and age group and the results are depicted in **Figures 3** and **4**. We had a total of 30 subjects of which 15 were males and 15 females. As shown, males experienced a greater change in heart rate after listening to both songs. **Figure 3A** shows that the average male subject showed about an 8% decrease in heart rate after listening to the slow song, while the average female showed about a 7% decrease. **Figure 3B** illustrates that the average male subject's heart rate increased by 2% more than the average female subject's heart rate. This difference in the heart rate between males and females was not statistically significant. The age group distribution was also equal in our sample. Fifteen subjects were in the age group 18-34 years and the other 15 belonged to the age group 35-50 years. As far as the relationship between age and the change in heart rate is concerned, **Figure 4** illustrates that younger subjects actually decreased their heart rate by about 4% more after hearing the slow song and increased by about 5% more after listening to the fast song, but this difference was not statistically significant.

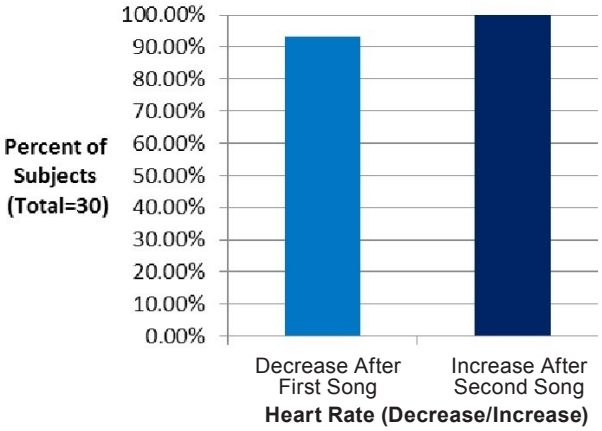


**Figure 2.** Percent of Subjects who experienced changes in heart rate after listening to the slow and fast songs.

## Discussion

After listening to the slow song, 93.3% of subjects experienced a decrease in heart rate. After listening to the faster song, 100% of participants showed an increase in heart rate. We noted an interesting trend that males and younger participants experienced greater changes in heart rate after listening to both songs than did women and older participants, even though the difference was not statistically significant. A larger sample size may be needed to show a statistically significant difference in the gender and age analysis. We discovered that the songs "Weightless" and "Worldwide Choppers" contain the possibility of decreasing and increasing heart rate,

respectively in adults in high school setting. Why do we think that changing the tempo of the music affects the heart rate? When we listen to music, our brain catches the rhythm and sends signals to different organs of the body, including the heart (12). The heart then beats to the tempo of the music, and that is why it slows down when the tempo is slow and accelerates when the tempo is fast. The music of the song "Weightless" was created by the Marconi Union band after working with sound therapists. The song's rhythm begins with a beat of 60 beats per minute and then falls gradually to 50 beats per minute. Lyz Cooper, founder of the British Academy of Sound Therapy, believed that the heart rate slowly comes down to match the beat (9).

A few factors may have influenced the results. Before the heart rate is taken, typically subjects are required to not eat food for an hour before being tested because the digestion of food requires energy and forces the heart to work harder (13). Also, subjects are usually required to sit in a chair for about 15 minutes before their heart rate is taken to minimize the effects of walking on the heart. In our experiment, it was impractical to ask teachers, students, and faculty members in a school environment not to eat prior to being tested. We do not know if the subjects ate within the hour prior to the experiment. However, we did make subjects sit in a chair for about 15 minutes prior to being tested while they read and signed the paperwork (Human Consent Forms and Photo Usage Forms) and waited for their turns. We also minimized the sources of error by only having one of us perform the testing of the heart rate of the subjects. We used two fingers to count the pulse rate at the subject's wrist for 30 seconds and multiplied that number by 2 to get the pulse rate for 1 minute. A stopwatch was used for timing. Using two fingers to count the pulse on the wrist of subjects is effective; however, using a heart rate machine under ideal conditions is the most effective way to test heart rate. This difference could have had a minute impact on the results that included finding the percentage change in heart rate. In addition, we performed all of the experiments in the same room. This room was empty, quiet, and had minimal distractions. Lastly, the fact that we were in school may have been a factor in the experiment. High school, specifically, is a high stress environment for many teachers and faculty members and that extra stress may have had an impact on our experiment.

This experiment is extremely applicable to the real world as well. The slow song could potentially be used to lower the stress and anxiety of listeners while the fast song could possibly increase the heart rate and get the listener "pumped up" if necessary. For example, in a doctor or dentist's office prior to a major or minor surgery, the patient often gets anxious, nervous, and maybe

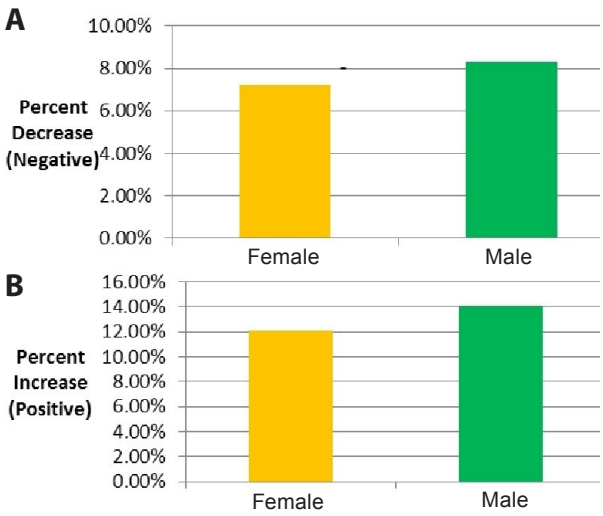


**Figure 3.** Average percent change in heart rate experienced by females and males after listening to the slow and fast song. Yellow bars represent the average percent change in heart rate experienced by females and green bars represent average percent change in heart rate experienced by males. **A**: This represents the average percent decrease in heart rate experienced by females and males after listening to the slow song. **B**: This represents the average percent increase in heart rate experienced by females and males after listening to the fast song.

even scared. The slow song playing in the background could help to relieve some of the tension and act as a soothing agent for these nervous patients (14,15,16). An extremely beneficial usage for this procedure would be in an operation room. Doctors can use this "holistic" form of treatment that doesn't contain chemicals to reduce the patient's heart rate in a more natural way, decreasing the necessity of sedatives prior to the operation (10,17). These holistic medicines will not only save the hospital money, but could also decrease the amount of side effects from sedatives. On the flip side, a fast song could be used to spur an adrenaline flow for an athlete who needs to be in "game mode" before the game actually starts or for a bodybuilder in need of motivation prior to a hard workout (11). The applications of faster and upbeat songs are not limited to athletic events, however, as different people will always have different ways to feel comfortable.

One of the limitations of our study was the sample size. We would like to repeat the study with a larger sample size from a heterogeneous group. Also, since reproducibility is important in research, we would test each person multiple times on different days to reduce the variability in results. We would also include a negative control in the experiment by including subjects who are given headphones but do not listen to any music. This study can be made single-blinded by blinding the person measuring the pulse rate. If that person does not know

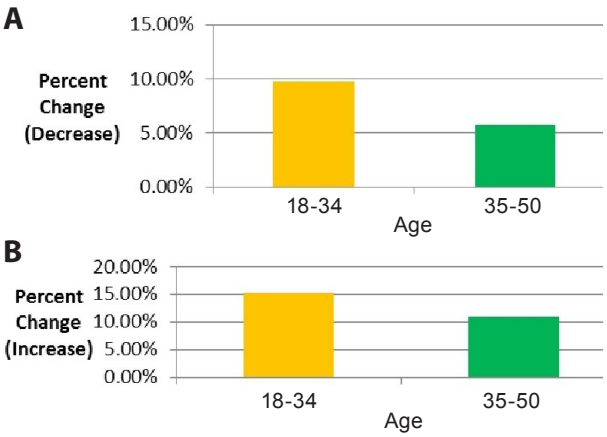


**Figure 4.** Average percent change in heart rate experienced by different age groups after listening to the slow and fast song. Yellow bars represent the average percent change in heart rates experienced by subjects within the age range 18-34 years and green bars represent the average percent change in heart rates experienced by subjects within the age range 35-50 years. **A**: This graph represents the average percent decrease in heart rate experienced by different age groups after listening to the slow song. **B**: This graph represents the average percent increase in heart rate experienced by different age groups after listening to the fast song.

the type of music the subjects listened to, it would take his/her bias affect out of the results. In addition to testing heart rate, we would also seek to test respiration rate and blood pressure as well. We would try to test people in a hospital where medical equipment would be used to test heart rate, respiration rate, and blood pressure before and after each song.

## Methods:

The research protocol was examined and approved by the Scientific Review Committee of Centerville High School (committee for research involving human subjects) and informed consent was obtained from the subjects. We conducted our experiment on 30 subjects, varying in gender (15 males and 15 females) and age (15 subjects in age group 18-34, 15 subjects in age group 35-50). The experiment was performed in controlled settings for all 30 subjects. Subjects were required to come to the Centerville High School Conference Room at any time during the school day. They were required to sit down in a quiet area with minimal distractions. They read and signed the Human Consent Form and Photo Usage Form. We then checked the subject's baseline heart rate and proceeded to have the subject listen to the slow-tempo song "Weightless" for approximately 2.5 minutes. The song "Weightless" is composed by the Manchester band Marconi Union. Then, we checked the subject's heart rate again. After giving a minute rest period so that the subject's heart rate could return back to a normal pace, we once again checked it before we played the second (fast tempo) song "Worldwide Choppers" composed by Michael Summers. The song was played for 2.5 minutes and the heart rate of each subject was checked again. The total time needed per subject was approximately 10 minutes, not including the waiting time, which varied for each subject.

Each subject's heart rate was tested by using two fingers to locate the subjects' pulse on their left wrist and counting the number of beats in a 30-second time period. Then, the pulse rate was multiplied by 2 to get the beats per minute, the standard measurement of heart rate. A stopwatch was used for timing. The pulse rate of all the subjects was checked by the same person to eliminate any sources of error. The subjects listened to the songs using Sony Headphones. The headphones and volume of the music were kept constant throughout the experiment. The volume was kept at half the bar on a standard iPod Touch. The headphones were sanitized using disinfecting wipes and given to the next subject for testing. The percent change in the heart rates of male and female subjects were calculated separately after listening to the slow song and after listening to the fast song. Then the mean of that value was calculated and is depicted in **Figure 3**. Similar calculations were done for the two different age groups (18-34 years and 35-50 years) and the average percent change in the heart rate is shown in **Figure 4**. The p-values were calculated using the student's t-test for subgroup analysis (unpaired data) and the paired t-test for paired data (heart rate before and after listening to the 2 songs).

## Acknowledgments

The authors would like to thank Dr. Sangeeta Agrawal for her helpful contributions during the research project.

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