The Effects of Music and Breathing Exercises in Reducing the Physiological Symptoms of Stress

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Abstract

This study analyzes and compares several methods of reducing stress following induced anxiety events. The physiological indicators of stress measured in this study are blood pressure, heart rate, and electrodermal activity (EDA). To induce anxiety, participants underwent an abbreviated Trier Social Stress Test. Following the stress phase, one group of participants (n=10) sat in silence, one group (n=10) listened to music, and the last group (n=10) performed a breathing exercise. The largest reduction in stress based on the physiological parameters was found in the group who listened to music, however, those who performed the breathing exercise exhibited the greatest reduction in heart rate. The implications of these results can extend to help provide techniques to reduce anxiety in everyday life events that are applicable to the population. While this study suggests promising results, the fairly small sample size utilized in this particular study encourages further, larger scale experimentation to verify conclusions.

Introduction

According to the American Psychological Association, 77% of people in the U.S. regularly experience physical symptoms caused by stress ("Stress Statistics"). Stress has been associated with deleterious health effects such as suppression of the immune system and development of illnesses such as asthma, hypertension, ulcers, and acne among various other conditions (Dhabhar and Mcewen, 1997). Stress is defined as an event that threatens the stability of an individual's endocrine, physiological, and psychological homeostasis. Thus, in order for the body to maintain a dynamic psychological, physical, and physiological state of equilibrium, the maintenance of behavioral stress is vital for healthy functioning of the human body (Lazarus, 1993 and Lazarus, 2000). Specifically, at the physiological level, at the onset of a stressful event, adrenaline is released from the adrenal medulla and noradrenaline is released from the

sympathetic nerves which induces the physiological response of an increased heart rate and peripheral vasoconstriction (Selye, 1936). This "fight or flight" response alerts the brain to supply the body with more energy. (Herman et al., 2005). Stress also affects the hypothalamus-pituitary adrenal (HPA) axis by releasing a cascade of hormones from the pituitary into the bloodstream which releases cortisol from the adrenal cortex (Engert et al, 2011). Armed with the knowledge of these mechanisms, previous human health studies have assessed stress responses based on changes in blood pressure, heart rate, and electrodermal activity (Entringer et al., 2010). While many allopathic treatments are available, such as sedatives and medications, there is great motivation to discover less invasive, and more cost effective techniques to reduce and manage stress (Han et al., 2010).

Biofeedback is a technique used to cope with stress by alleviating its symptoms in a non-invasive manner while delivering a treatment that reduces or eliminates the need for medications, thus making it is a less expensive and safer option ("Biofeedback: Using Your Mind to Improve Your Health", 2013). Biofeedback involves using the mind to control body functions such as heart rate and blood pressure. It has also been used to manage stress, asthma, side effects of chemotherapy, chronic pain, constipation, high blood pressure, incontinence, irritable bowel syndrome, and Raynaud's disease. In a study by Grossman in 2001, deep breathing techniques associated with biofeedback were shown to be an active component in lowering blood pressure. Heart rate biofeedback, specifically as an intervention, involves slow breathing which has been shown to reduce physiological arousal in stressful situations, as well as a reduction in anxiety and an improvement in cognitive performance (Wells, Outhred, Heathers, Quintana, Kemp, 2012). By controlling breathing rates, autonomic nervous system functions such as heart conductance can be influenced (Brown and Gerbag, 2005).

Music therapy has also been used to decrease anxiety and discomfort for thousands of years (Buckwalter, Harstock, & Gaffney, 1985). It serves as a therapeutic manner in which to interrupt physiological stress and anxiety by synchronizing various body rhythms such as breathing, heartbeat, or speech. It can also serve as an aesthetic pleasure by the brain which causes the pituitary gland to release endorphins, producing a sense of well-being (Han et al., 2010). In a study implemented by Smolen et al in 2002, heart rate and blood pressure were measured to determine the effects of music therapy on self-reported and physiological signs of anxiety among patients undergoing a colonoscopy. Analysis of these findings showed a significant decrease in heart rate and blood pressure among the music group while remaining unchanged in the control group, providing evidence for the theory that music does play a key role in decreasing physiological symptoms of stress (Smolen, 2002).

Based on the previous research stated above, we found motivation to investigate the most effective stress reduction technique. We hope to identify differences in success between breathing exercises, calming music, or sitting in silence. As college students, we are constantly searching for methods to reduce stress. The techniques we are studying offer safe and effective alternatives, easily implemented in the daily lives of a normal human being.

The three physiological parameters measured to assess the level of stress are heart rate, blood pressure, and electrodermal activity (EDA). The baseline measurements of our subjects serve as negative controls. Measuring and comparing heart rate, blood pressure and EDA before and after two minutes of running up and down the stairs serves as our positive control, indicating that our instruments used to measure our parameters effectively measure changes that occur when stress is induced (Figure 12-15). The only exception was diastolic blood pressure, which increased following exercise, indicating it may not be an effective or immediate marker of stress.

We unanimously predict the subject in the experimental group that performs breathing exercises immediately after experiencing the stress, will return to basal levels faster than those listening to relaxing music or sitting silently following the stress.

Procedure and Methods

Subjects were asked to take a seat in the testing room while expectations and directions were given before starting the testing. After receiving informed consent, they were instructed to empty their pockets and remain seated. Using the Biopac Inc. software (serial number: NP36E01204002760), EDA sensors were attached to the middle and pointer fingers of the right hand. These sensors remained attached and active throughout the entirety of the experiment. Heart rate was measured by attaching a sensor to the pointer finger of the subjects left hand. The subject's blood pressure was taken manually with the traditional sphygmomanometer attached to the left arm. The information of the EDA sensor was automatically recorded and saved to the computer. The heart rate and blood pressure measurement were recorded and used as baseline measurements.

Subjects were then instructed that they would be given two minutes to prepare for a job interview, and were not allowed to use any electronics or tangible items to help them prepare. The stress period was modeled after the previously used Trier Social Stress Test, which has been shown to produce the most robust stress response in participants, compared to other stress tests (Engert et al., 2011). Once the instructions were given, the start of the induced stress period began. All experimenters left the room and then re-entered after the allotted two minutes. The subjects were given two and a half minutes to deliver their speech. The subjects were told to remain seated at the front of the room while the experimenters sat behind various desks and devoted all of their attention towards the subject. If at anytime the subjects stopped during their

speech, they were asked to continue speaking until the allotted three minutes had passed. Immediately following the speech, the subjects were then abruptly instructed to count backwards from 1,022 in intervals of 13 for 2 consecutive minutes. When the subject made a mistake, they were told to restart at 1,022. Immediately following the induced stress period, the subjects' physiological measurements of blood pressure and heart rate were again taken - this marked the end of the induced stress period. Participants were next randomly assigned to one of the three experimental conditions: sit in silence with headphones on, listen to music with headphones on, or do the breathing exercise with the headphones on. The duration for each was three minutes, and the subjects were left alone in the room. This marked the beginning of the relaxation period. In the listening to music condition, music was played through headphones from the phone application "Relax Melodies" that featured slow piano music. For the breathing exercise, breathing instructions were played through the phone application "Breathe2Relax" through headphones.

Following this period, final blood pressure and heart rate measurements were taken, after which the subjects were disconnected from the EDA sensors. This marked the end of the relaxation period. The subjects were then given a short questionnaire to complete that asked their age, gender, their self-report anxiety level during experiment, their current anxiety level (both on scales from 1-10; 1 = no anxiety, 10 = high anxiety), and what methods they normally used to relax after a stressful event. This concluded the experiment; the subjects were thanked for their time and dismissed.

We have encountered a few minor problems while designing and conducting our experiment, but we have managed to come up with solutions that keep the integrity of our experimental design. One of the first problems that arose was finding the correct type of music

and relaxation to use that complemented our experiment. For example, we had difficulty determining if we wanted vocals in the music experimental group or if the words or subject's preferences for particular artists would impact our data. Also, we had to determine what the format for our mediation experimental group would be (if it would include background music and/our guided breathing). In the end, we decided that our music should have no vocals and our meditation should be guided with no background music to interfere. Another challenge we faced was, in order to optimize the number of subjects tested, the amount of time with each subject restricted the methods that we used to induce stress. Specifically, the previously published Trier Social Stress Test utilizes fifteen minutes of induced stress, while our project utilized a shortened version in order to optimize the number of subjects we are able to assess. Thus, because stress is induced for a shorter amount of time, there is a chance that some subjects would not receive a sufficient amount of time to produce significant changes in the variables measured. In addition, the type of stressors used in the Trier Social Stress Test in our project included making a speech and counting backwards in large intervals and these methods may not create the same stress results in each subject based on their individual personalities and experience. Another problem we encountered was how other unexpected variables such as light, headphones on ears, and closing eyes versus open eyes could possibly influence our results specifically for the exercises after the period of stress. In attempts to minimize the effects of these variables, we decided as a solution to have all subjects from each of the three exercises have headphones placed over their ears, eyes remain open and lights remain on. One problem we encountered while formulating our positive controls was that by using the isotonic gel for the EDA measurement the second time, after stress was induced by running up/down flights of stairs for 2 minutes, the EDA measurement showed a drastic decrease.

Results

Due to the smaller sample size acquired in our experiment, running a paired Wilcoxon statistical test would not have been an effective way to analyze our data. Thus, alternatively, we have determined the means and standard deviations for each of the groups of participants in the three conditions of silence, breathing, and listening to music.

<u>Heart Rate</u>

The mean baseline heart rate of all our participants (n=30) was 67.30 beats per minute (bpm) with a standard deviation of 8.51 bpm. After the stress phase, the mean heart rate rose to 72.03 bpm with a standard deviation of 11.99 bpm and the average heart rate after the exercises was 69.53 bpm with a standard deviation of 9.043 bpm (Figure 1 and Figure 2).

For the subjects who sat in silence after the stress phase (n=10), the mean resting heart rate was 69.70 bpm with a standard deviation of 7.95 bpm and the mean heart rate after induced stress was 72.10 bpm with a standard deviation of 10.44. Therefore, for participants who sat in silence, their average heart rate decreased by 2 bpm from the stress phase to the end relaxation state (Figure 2).

For participants who completed the breathing exercise (n= 10), the average mean resting heart rate was 66.3 bpm with a standard deviation of 9.63, after the stress phase, the average heart rate rose to 74.8 bpm with a standard deviation of 13.34 bpm. After the breathing exercise, the mean heart rate fell to 70.80 bpm with standard deviation of 6.27 bpm (Figure 2). The heart rate after the breathing exercise decreased by 4 bpm from the heart rate during the stress period.

For those who listened to music after the stress phase (n=10), the mean resting heart rate was 65.90 bpm with a standard deviation of 9.63 bpm; the mean heart rate after induced stress was 69.20 bpm with a standard deviation of 12.60 bpm. The mean heart rate after listening to

music was 67.70 bpm with a standard deviation of 10.21 bpm. The average heart rate decreased by 1.5 bpm from the stress phase after listening to music (Figure 2).

In addition, the percent change for the stress-baseline as well as the silence, music and breathing exercises compared to the stress in terms of heart rate measurements can be seen in Table 11. Specifically, the negative and positive percent change for each can be indicated and sample size (n=) can be defined.

Systolic Blood Pressure

Regarding blood pressure, the average baseline systolic blood pressure (n= 30) was 122.87 mmHg with a standard deviation of 15.15 mmHg (Figure 3, Figure 4). The average baseline diastolic (n=30) was 78.13 mmHg with a standard deviation of 8.80 mmHg (Figure 5, Figure 6). The average baseline mean arterial blood pressure (MABP; n= 30) was 93.04 mmHg with a standard deviation of 10.26 mmHg. After stress, the systolic mean (n= 30) rose to 129.87 mmHg, standard deviation of 18.83 mmHg. The after stress diastolic mean (n= 30) measurement rose to 80.90 mmHg and standard deviation of 11.75 mmHg. The after stress MABP average (n= 30) was 97.22 mmHg with a standard deviation of 13.12 mmHg.

For participants who sat in silence after the stress phase (n= 10), their mean baseline systolic blood pressure was 121.6 mmHg with a standard deviation of 14.56 mmHg; after the stress phase, the mean systolic blood pressure was 126 mmHg with a standard deviation of 20.8 mmHg. After sitting in silence, the mean systolic blood pressure fell to 125.6 mmHg with a standard deviation of 23.24 mmHg. The average systolic pressure decreased by 0.4 mmHg from the stress phase to after sitting in silence (Figure 3 and Figure 4).

For participants who listened to music (n= 10), their mean resting systolic blood pressure was 121.8 mmHg, with a standard deviation of 18.46 mmHg. After the stress phase, their mean

systolic pressure was 135 mmHg with a standard deviation of 22.36 mmHg. After these participants listened to music, their average systolic blood pressures fell to 121.6 mmHg with a standard deviation of 16.78 mmHg. The difference from the stress phase to post-relaxation phase was -13.4 mmHg.

For participants who completed the breathing exercise (n= 10), their average baseline systolic blood pressure was 125.2 mmHg with a standard deviation of 13.33 mmHg. After the stress phase, the average systolic blood pressure rose to 128.6 mmHg with a standard deviation of 12.74 mmHg. After completing the breathing exercise, the mean systolic pressure dropped to 125.1 mmHg with a standard deviation of 16.20 mmHg; the drop in systolic pressure from the stress phase to post relaxation was -3.5 mmHg (Figure 4). In addition, the percent change for the the silence, music and breathing exercises compared to the stress in terms of systolic blood pressure measurements can be seen in Figure 12. Specifically, the negative and positive percent change for each can be indicated and sample size (n=) can be defined.

Diastolic Blood Pressure

In regards to diastolic blood pressure, for participants who sat in silence (n= 10), their average baseline diastolic blood pressure was 76.5 mmHg with a standard deviation of 9.44 mmHg. Following the stress phase, their mean diastolic pressure rose to 81.5 mmHg with a standard deviation of 12.96 mmHg. After the relaxation phase, their mean diastolic pressure fell to 75.4 mmHg with a standard deviation of 12.59 mmHg. The diastolic blood pressure from the stress phase to the end of relaxation decreased by 6.10 mmHg (Figure 5 and Figure 6).

For participants who listened to music (n= 10), their average baseline diastolic pressure was 79.4 mmHg with a standard deviation of 8.75 mmHg. After the stress phase, the average diastolic pressure rose to 80.9 mmHg with a standard deviation of 11.47 mmHg. Following

listening to music, the mean diastolic pressure fell to 77 mmHg with a standard deviation of 14.15 mmHg. This was a difference of -3.90 mmHg from the stress phase to the end of the relaxation phase.

For participants who completed the breathing exercise (n= 10), their average resting diastolic blood pressure was 78.5 mmHg with a standard deviation of 8.87 mmHg. After the stress phase, their mean diastolic blood pressure rose to 80.3 mmHg with a standard deviation of 12.01 mmHg. Following the breathing exercise, the average diastolic blood pressure fell to 78.4 mmHg with a standard deviation of 10.05 mmHg. The diastolic blood pressure from the stress phase to after the breathing exercise decreased by 1.9 mmHg (Figure 5 and Figure 6). In addition, the percent change for the the silence, music and breathing exercises compared to the stress in terms of diastolic blood pressure measurements can be seen in Figure 12. Specifically, the negative and positive percent change for each can be indicated and sample size (n=) can be defined.

Mean Arterial Blood Pressure (MABP)

In regards to mean arterial blood pressure (MABP), for participants who sat in silence during the relaxation phase (n= 10), their average baseline MABP was 91.53 mmHg with a standard deviation of 10.62 mmHg. After the stress phase, their average MABP was 96.33 mmHg with a standard deviation was 15.14 mmHg. Following the relaxation phase, the mean MABP fell to 92.13 mmHg with a standard deviation of 15.29 mmHg. The MABP decreased by 4.20 mmHg from the stress phase to the post-relaxation phase (Figure 7).

For participants who listened to music (n= 10), their baseline mean MABP was 93.53 mmHg, with a standard deviation of 11.36 mmHg. After the stress phase, the mean MABP rose to 98.93 mmHg with a standard deviation of 13.74 mmHg. After listening to music, the mean

MABP was 91.87 mmHg with a standard deviation of 14.20 mmHg. The difference between the stress phase and post-relaxation phase was -7.07 mmHg.

For participants who completed the breathing exercise (n= 10), their average resting MABP was 94.07 mmHg with a standard deviation of 9.65 mmHg. The mean MABP after the stress period was 96.4 mmHg with a standard deviation of 11.49 mmHg. The mean MABP after the breathing exercise was 93.97 mmHg with a standard deviation of 10.12 mmHg. The average MABP decreased by 2.43 mmHg from the stress phase to the post-relaxation state (Figure 8).

The percent change for MABP for stress compared to baseline, and silence, music, and breathing exercises compared to stress are indicated in Figure 13. This figure also indicates the sample size (n=) for each category.

Electrodermal Activity (EDA)

In terms of electrodermal activity (EDA), measured in microsiemens, the mean baseline for all participants was 9.37 microsiemens with a standard deviation of 4.059 microsiemens. After the stress phase, the mean EDA was 9.28 microsiemens with a standard deviation of 3.71 microsiemens and the mean measurement after stress was 9.02 microsiemens with a standard deviation of 4.31 microsiemens (Figure 9). However, 17 of the 30 participants experienced a percent change increase in EDA with a mean of 13.3% (Figure 12).

For participants who sat in silence after the stress phase (n=10), the mean baseline EDA was 9.01 microsiemens with a standard deviation of 2.14 microsiemens, the mean value after induced stress was 9.41 microsiemens with a standard deviation of 1.39 microsiemens, and the mean value after sitting in silence was 9.12 microsiemens with a standard deviation of 1.30 microsiemens (Figure 10).

For participants who did the breathing exercise after the stress phase (n=10), the mean

baseline EDA was 10.02 microsiemens with a standard deviation of 5.98 microsiemens, the mean value after induced stress was 10.19 microsiemens with a standard deviation of 6.37 microsiemens, and the mean value after the breathing exercise was 9.741 with a standard deviation of 6.950 microsiemens.

For participants who listened to music after the stress phase (n=10), the mean baseline EDA was 9.01 microsiemens with a standard deviation of 3.47 microsiemens, the mean value after induced stress was 8.24 microsiemens with a standard deviation of 3.53 microsiemens, and the mean value after listening to music was 8.19 microsiemens with a standard deviation of 2.91 microsiemens (Figure 10). In addition, percent change calculations indicate our stress and relaxation exercises caused a change, both positive and negative, in participants' electrodermal activity (Figure 12).

Discussion

Overall, the stress phase was successful in elevating heart rate. The breathing exercise was the most successful method of decreasing heart rate following stress; participants who performed the breathing exercise exhibited the largest decrease in heart rate from the stress phase to the post-relaxation state. The next largest decrease in heart rate was found in the silence group, then the group who listened to music. This is in accordance with our expectation that breathing would be the most effective at decreasing heart rate.

In regards to the blood pressure measurement, again the stress phase was successful at increasing blood pressure, both systole and diastole, demonstrating the stress caused sufficient anxiety for the participants. All of the post stress phase methods lowered the systolic and diastolic blood pressures from their stress levels. Those who listened to music, however, experienced the largest drop in systolic blood pressure, which brought the mean lower than that

of the baseline measurement. In terms of diastolic blood pressure, the participants who sat in silence during the relaxation phase exhibited the greatest decrease from the stress phase to the post-relaxation state. All groups, however, exhibited a post-relaxation diastolic blood pressure lower than that of baseline. Those who listened to music exhibited the next largest drop in diastolic blood pressure, followed by those who performed the breathing exercise.

For mean arterial blood pressure (MABP), participants who listened to music exhibited the greatest decrease in MABP from the stress phase to after listening to music. The second largest decrease was seen in the group who sat in silence, followed by the breathing group.

In relation to electrodermal activity (EDA), unlike the other measurements, the stress phase did not result in a significant change from the baseline reading. However, the majority of the participants ended up displaying an increase in percent change of EDA, suggesting an increase in stress level. Those who listened to music after being stressed showed the greatest reduction in average EDA, followed by those who sat in silence. The group who sat in silence and the group who listened to music both showed lower EDA levels after the relaxation phase compared to the baseline levels. Participants who performed the breathing exercise, however, exhibited a higher EDA level than all the other groups. Their final EDA levels were also higher than the EDA baseline mean. This can be explained because deep breathing causes a general phasic sympathetic release, causing a small increase in sweating (BIOPAC Systems Inc., 2008). The increase in sweat then leads to an increase in electrical conductivity resulting in the increase in EDA, which makes the EDA measurements for breathing exercises fairly skewed as a measurement of relaxation of the individual.

From our results, it is indicative that listening to relaxing music, such as slow piano music, may help lower physiological effects of increased stress and anxiety. This could be

potentially helpful to college students who experience high levels of stress from exams. However, we do not believe that it would be beneficial for the entire class to play music through the duration of an exam. Every student has their own methods of studying and test taking, making it difficult to accommodate each and every student. We do believe, though, that students should listen to relaxing music before and after exams in order to help calm their nerves. It could also be used as an effective method to reduce stress before and after job interviews. Our study does not necessarily disregard breathing exercises and sitting in silence as effective means for relaxation, but it does imply that listening to calm music would be the most effective based on the results from our short term study.

There are a few limitations of our study in its broad application to the real world. The breathing exercise was accessed through an application on a phone, which may not be accessible to all people in search of stress reduction methods. In addition, because of the confines of the lab setting the relaxation exercise was conducted in the same chair the stress was conducted in and subjects remained connected with the EDA wires which may have disabled subjects from obtaining the full benefits of breathing exercises. Also, the benefits associated with breathing exercises may depend on an individuals experience with breathing and meditative practices. This would indicate that breathing relaxation techniques could possibly be a learned trait, and the full potential of benefits would be better received through practice. Thus, based on the design of this specific experiment involving exercises administered in a short time span, the findings indicate that listening to relaxing music may be the most effective at decreasing physiological symptoms of stress, such as heart rate, blood pressure, and electrodermal activity.

Qualitative information was gathered from participants upon completion. Exercise followed by breathing and listening to music were the most popular answers when participants

were asked how they coped with stress (Figure 13). Further research should be done to explore and explain if one of these mechanisms works best when dealing with stress and the underlying physiological mechanisms that accompany these responses. Overall the responses shared an underlying theme; perform a task that will allow you to focus your attention away from the stressor. The study of the relationship between the mental compartment and physical compartment of the body is an excellent area for future research; by better understanding these relationships, we can better respond and reduce overall stress levels.

Tables and Figures

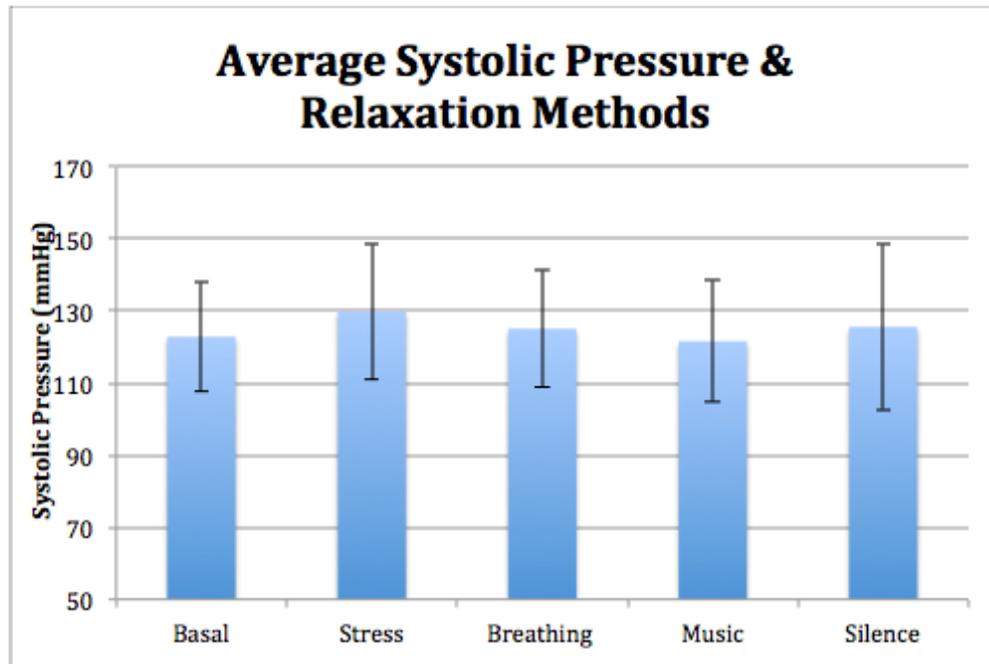**Figure 1: Mean heart rates of baseline, stress phase, and experimental conditions with standard deviation bars.** Basal (n=30), Stress (n=10), Breathing (n=10), Music (n=10), Silence (n=10).
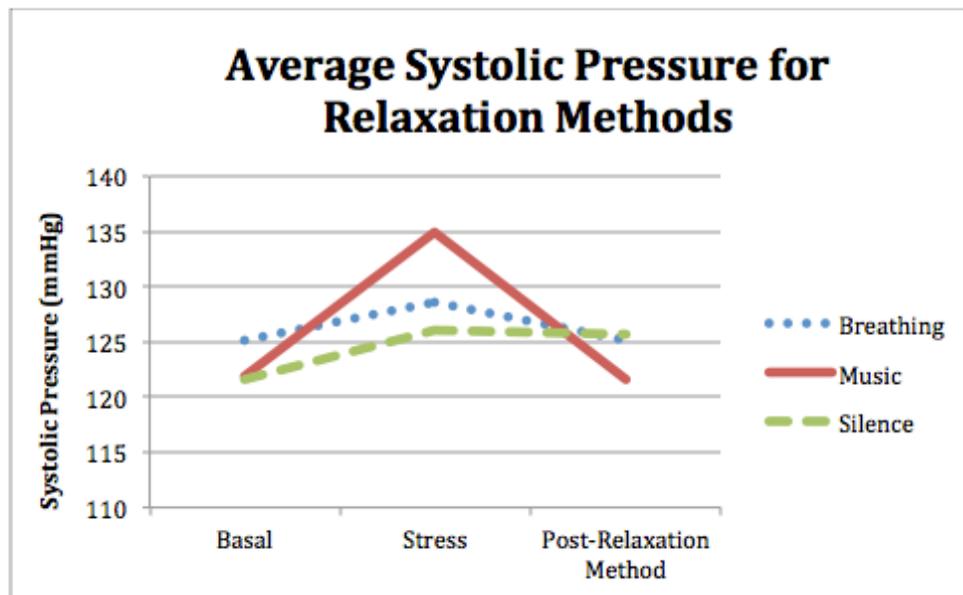

Figure 2: Change in heart rate of each experimental condition. Heart rate decreased by 2 bpm from stress to post sitting in silence relaxation method (green), heart rate decreased by 4 bpm from stress to post breathing exercise method (blue), and heart rate decreased by 1.5 bpm from stress to post-music listening method (red).
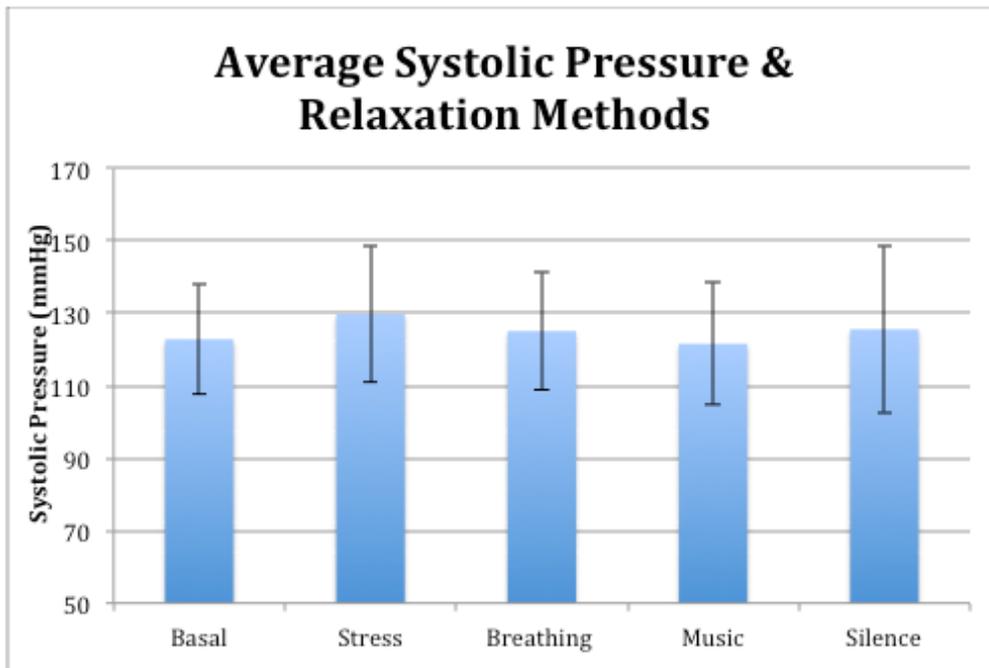
Figure 3: Mean systolic blood pressure for baseline, stress phase, and each experimental condition with standard deviation bars. Basal (n=30), Stress (n=10), Breathing (n=10), Music (n=10), Silence (n=10).
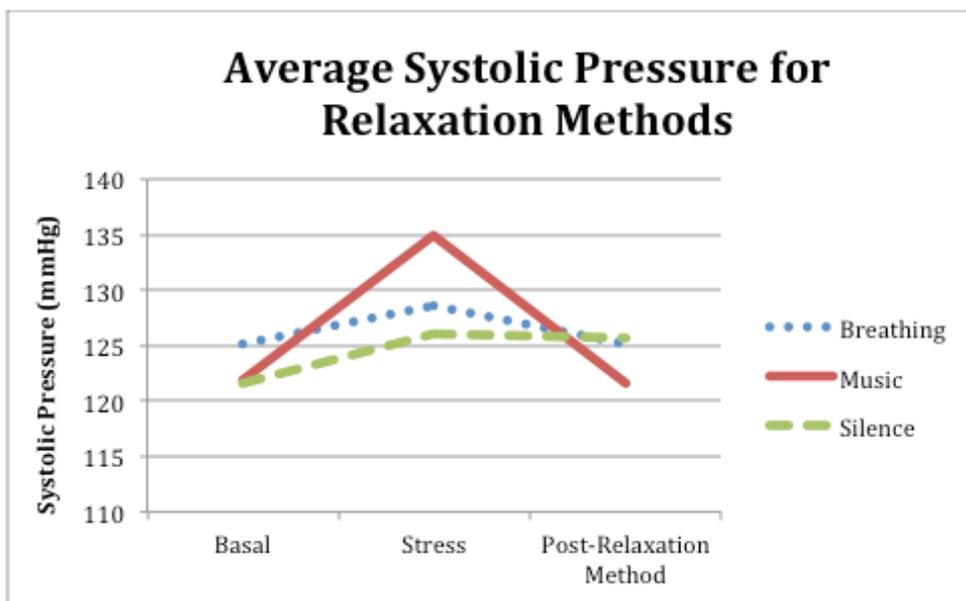

Figure 4: Change in systolic blood pressure for each of the experimental conditions. The systolic pressure from stress to post sitting in silence method decreased by 0.4mmHg, the systolic pressure from stress to post listening to music method decreased by 13.4mmHg and the systolic pressure from stress to post breathing exercise method decreased by 3.5 mmHg.

Figure 3: Mean systolic blood pressure for baseline, stress phase, and each experimental condition with standard deviation bars. Basal (n=30), Stress (n=10), Breathing (n=10), Music (n=10), Silence (n=10).

Figure 4: Change in systolic blood pressure for each of the experimental conditions. The systolic pressure from stress to post sitting in silence method decreased by 0.4mmHg, the systolic pressure from stress to post listening to music method decreased by 13.4mmHg and the systolic pressure from stress to post breathing exercise method decreased by 3.5 mmHg.
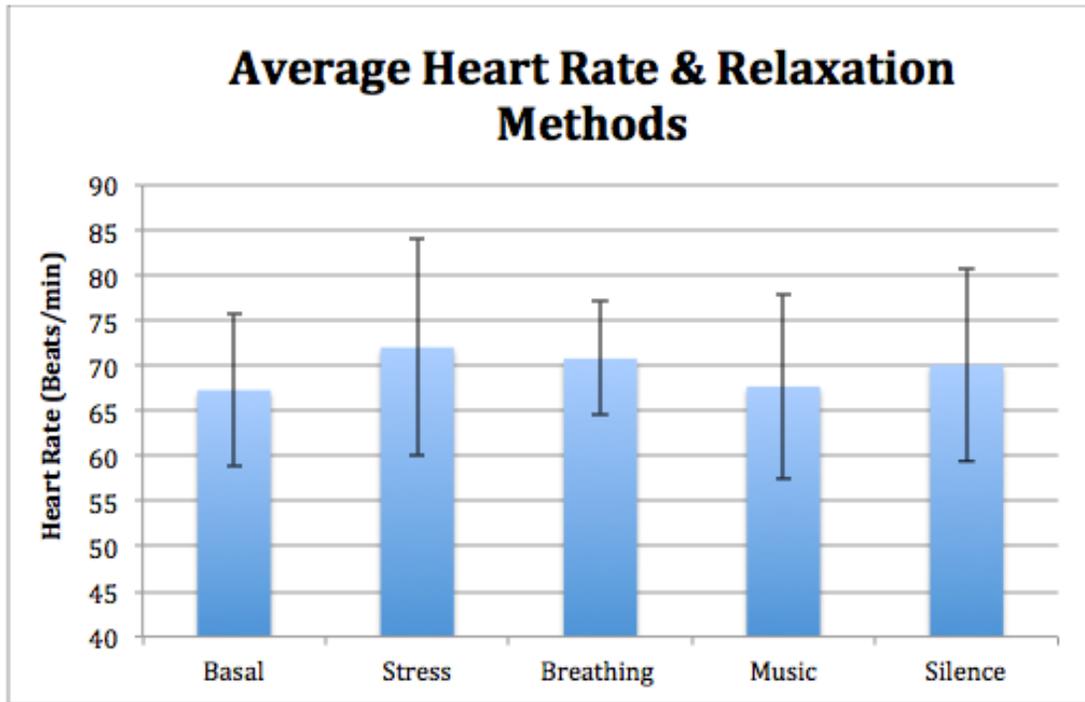
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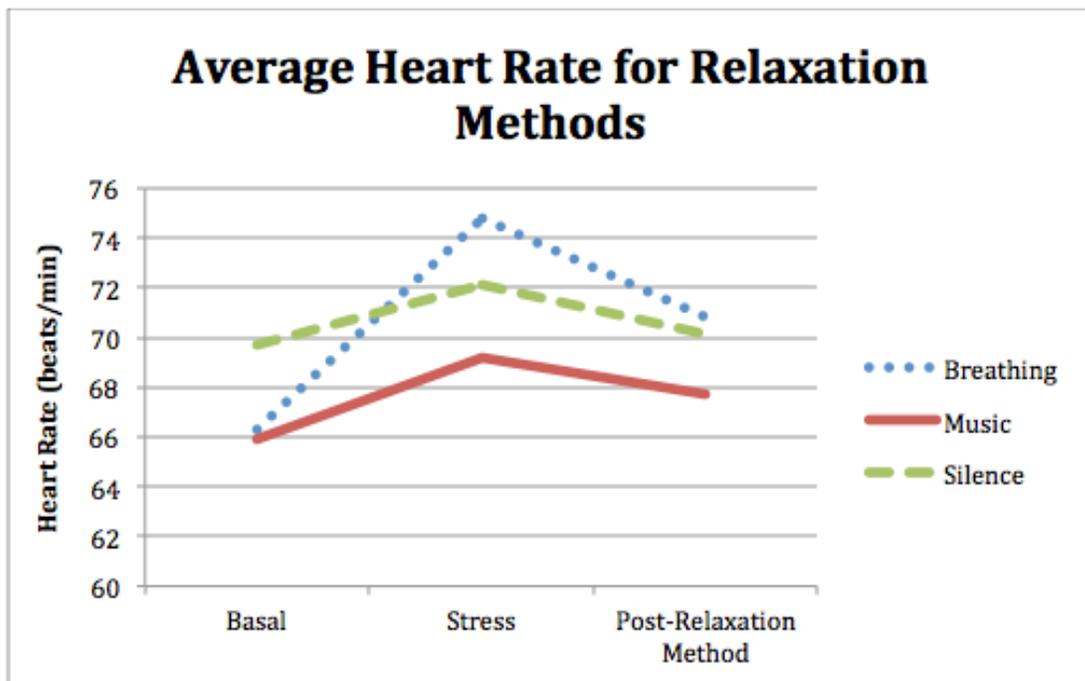

Figure 2: Change in heart rate of each experimental condition. Heart rate decreased by 2 bpm from stress to post sitting in silence relaxation method (green), heart rate decreased by 4 bpm from stress to post breathing exercise method (blue), and heart rate decreased by 1.5 bpm from stress to post-music listening method (red).
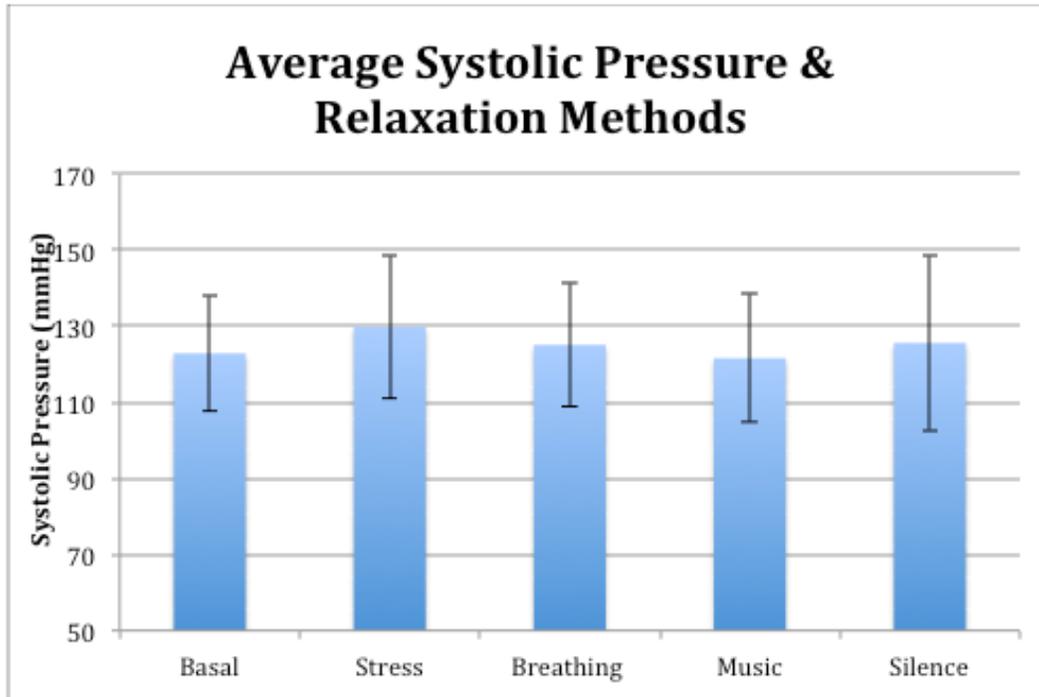
Figure 3: Mean systolic blood pressure for baseline, stress phase, and each experimental condition with standard deviation bars. Basal (n=30), Stress (n=10), Breathing (n=10), Music (n=10), Silence (n=10).
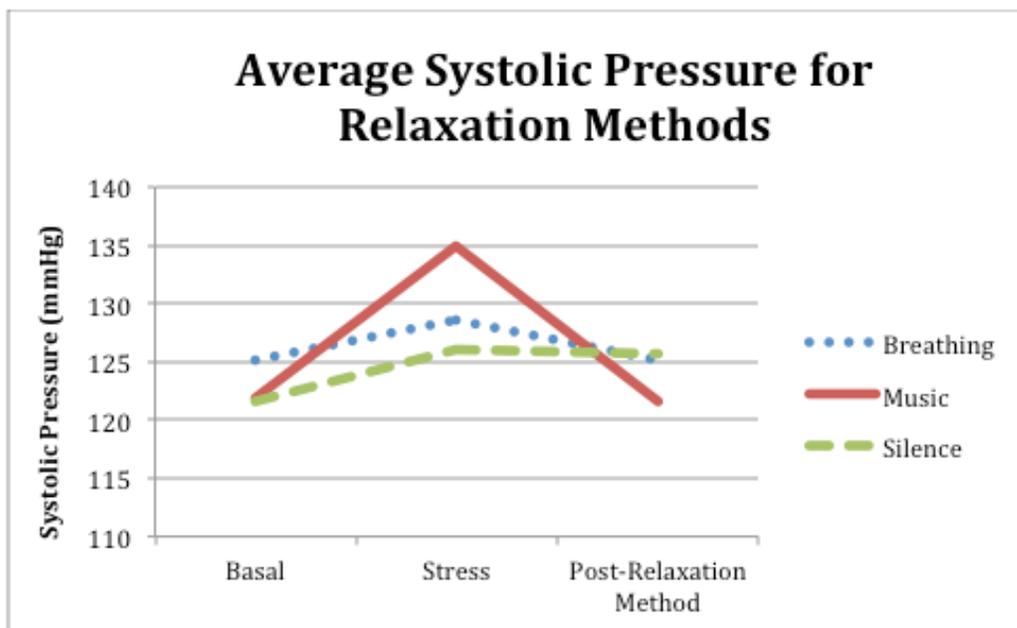

Figure 4: Change in systolic blood pressure for each of the experimental conditions. The systolic pressure from stress to post sitting in silence method decreased by 0.4mmHg, the systolic pressure from stress to post listening to music method decreased by 13.4mmHg and the systolic pressure from stress to post breathing exercise method decreased by 3.5 mmHg.
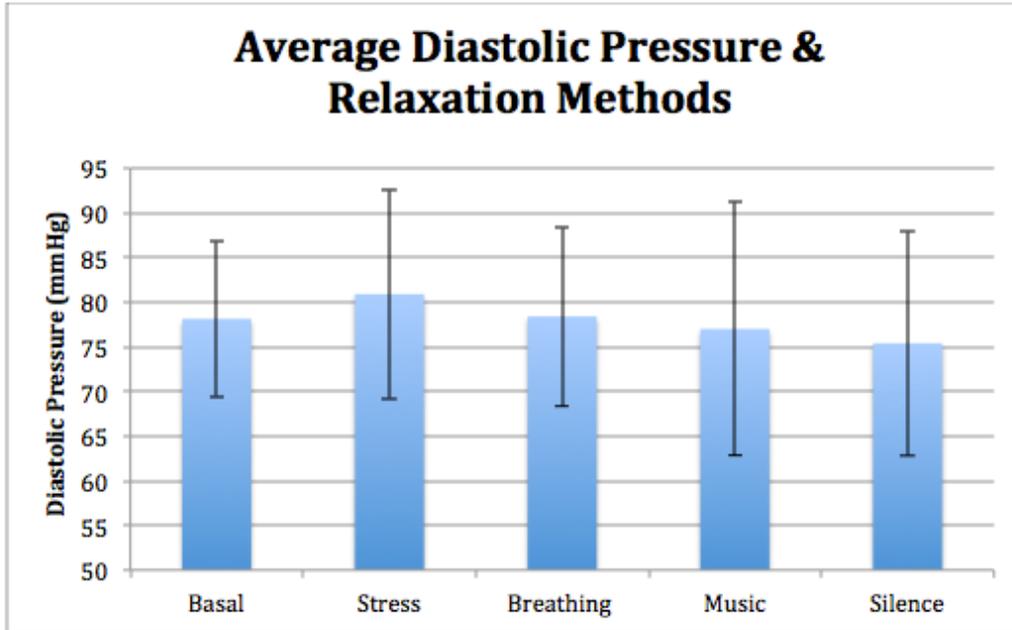
Figure 5: Mean diastolic blood pressure for baseline, stress phase, and each experimental condition with standard deviation bars. Basal (n=30), Stress (n=10), Breathing (n=10), Music (n=10), Silence (n=10).
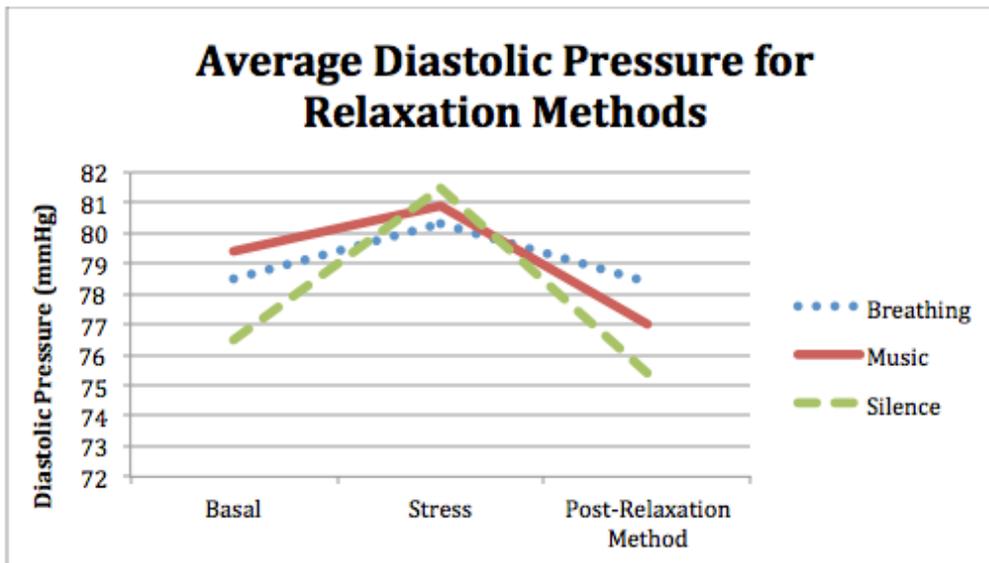

Figure 6: Changes in diastolic blood pressure for each experimental condition. The diastolic pressure from stress to post sitting in silence method decreased by 6.09 mmHg (green), the diastolic pressure from stress to post listening to music method decreased by 3.9 mmHg (red) and the systolic pressure from stress to post breathing exercise method decreased by 1.90 mmHg (blue).
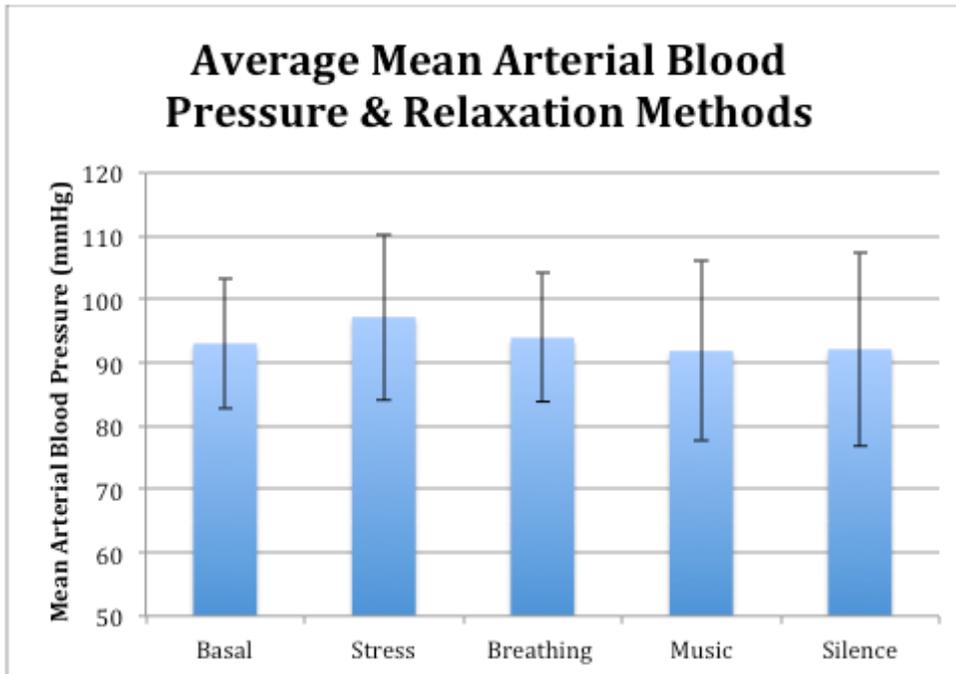
Figure 7: Average MABP for baseline, stress phase, and experimental conditions with standard deviation bars. Basal (n=30), Stress (n=10), Breathing (n=10), Music (n=10), Silence (n=10).
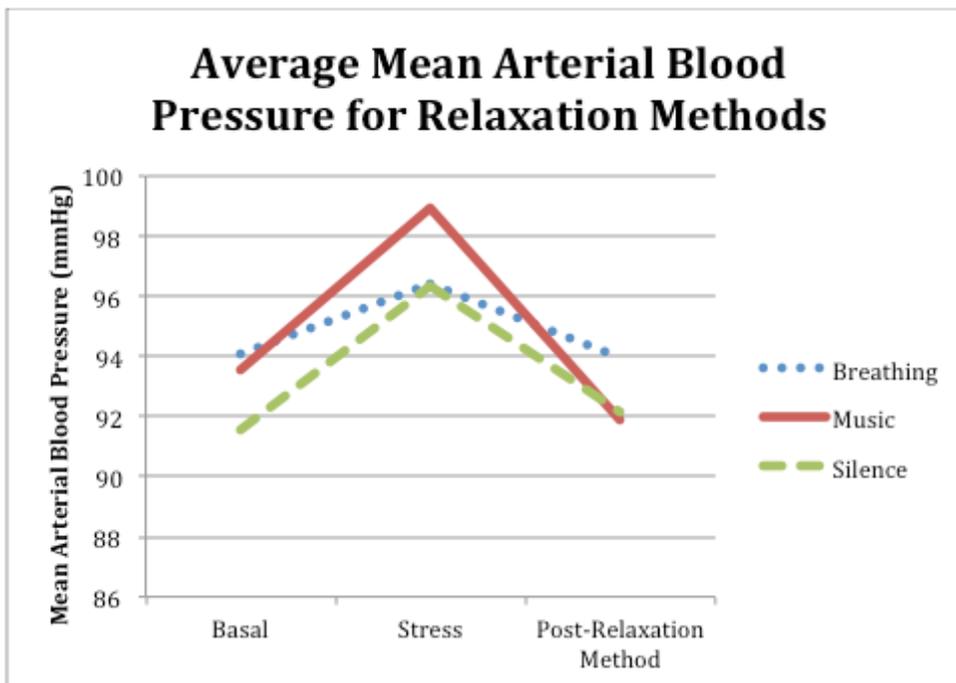

Figure 8: Changes in MABP for each experimental condition. MABP decreased by 4.20 mmHg from stress to post sitting in silence relaxation method (green), heart rate decreased by 2.43 mmHg from stress to post breathing exercise method (blue), and heart rate decreased by 7.07 mmHg from stress to post-music listening method (red).
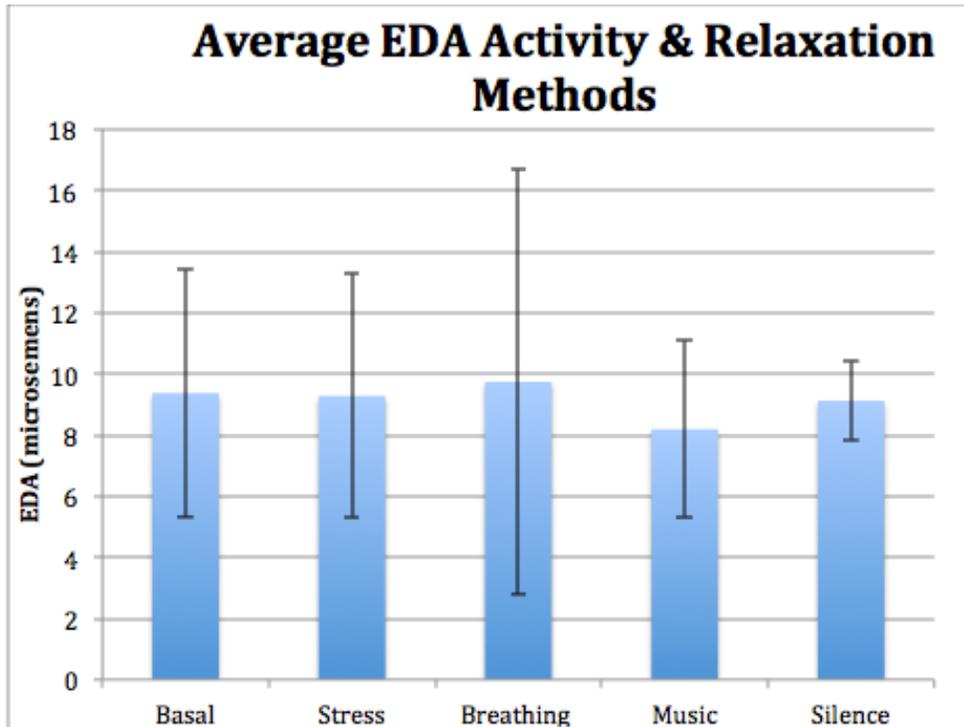
Figure 9: Mean Electrodermal activity (EDA) for baseline, stress phase, and experimental conditions with standard deviation bars. Basal (n=30), Stress (n=10), Breathing (n=10), Music (n=10), Silence (n=10).
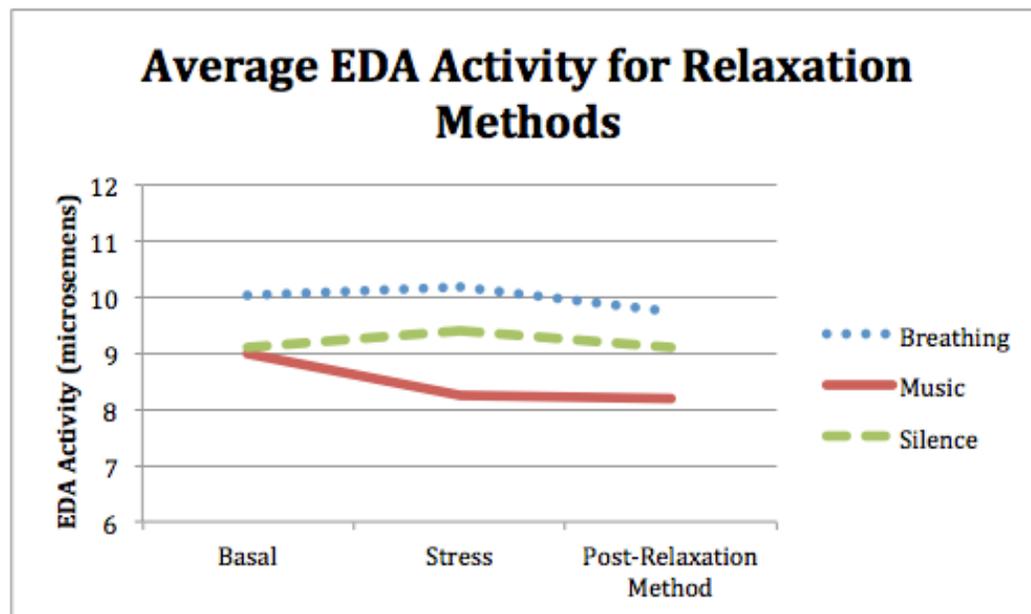
Figure 10: Changes in electrodermal activity (EDA) for each experimental condition. EDA decreased by 0.45 microsiemens from stress to post sitting in silence relaxation method (green), heart rate decreased by 0.47 microsiemens from stress to post breathing exercise method (blue), and heart rate decreased by 0.29 microsiemens from stress to post-music listening method.

Percent Change for Heart Rate

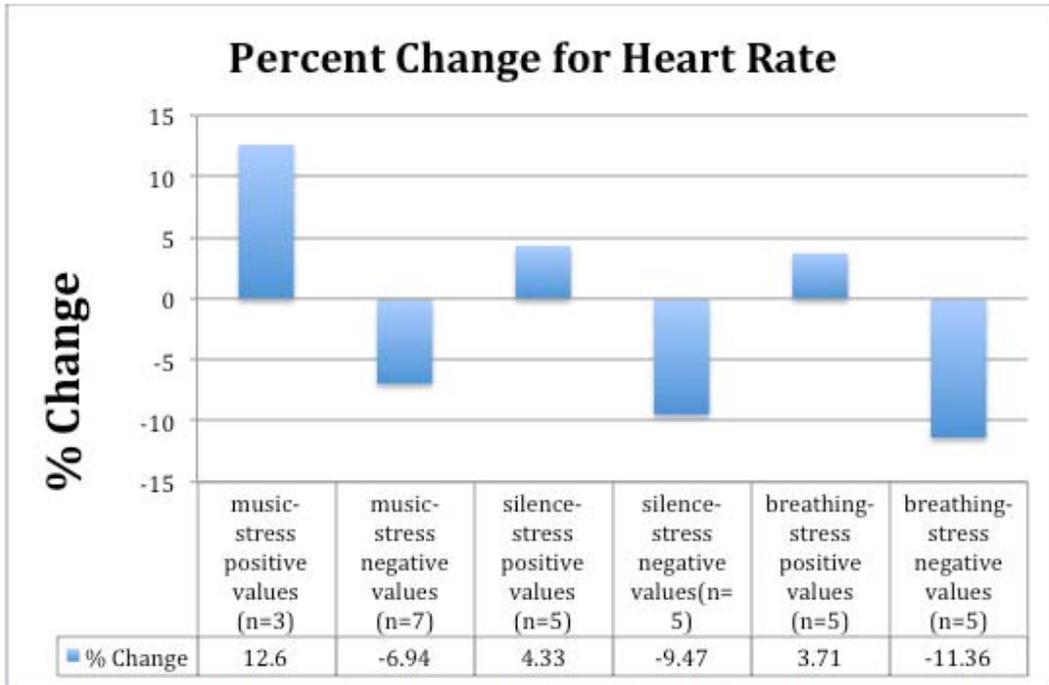|	music-stress positive values (n=3)	music-stress negative values (n=7)	silence-stress positive values (n=5)	silence-stress negative values(n=5)	breathing-stress positive values (n=5)	breathing-stress negative values (n=5)
% Change	12.6	-6.94	4.33	-9.47	3.71	-11.36

Table 11. Heart rate percent change from stress to each post-relaxation exercise group (music, silence and breathing). Positive and negative average percent change values separated and defined by sample size.

Percent Change for Blood Pressure

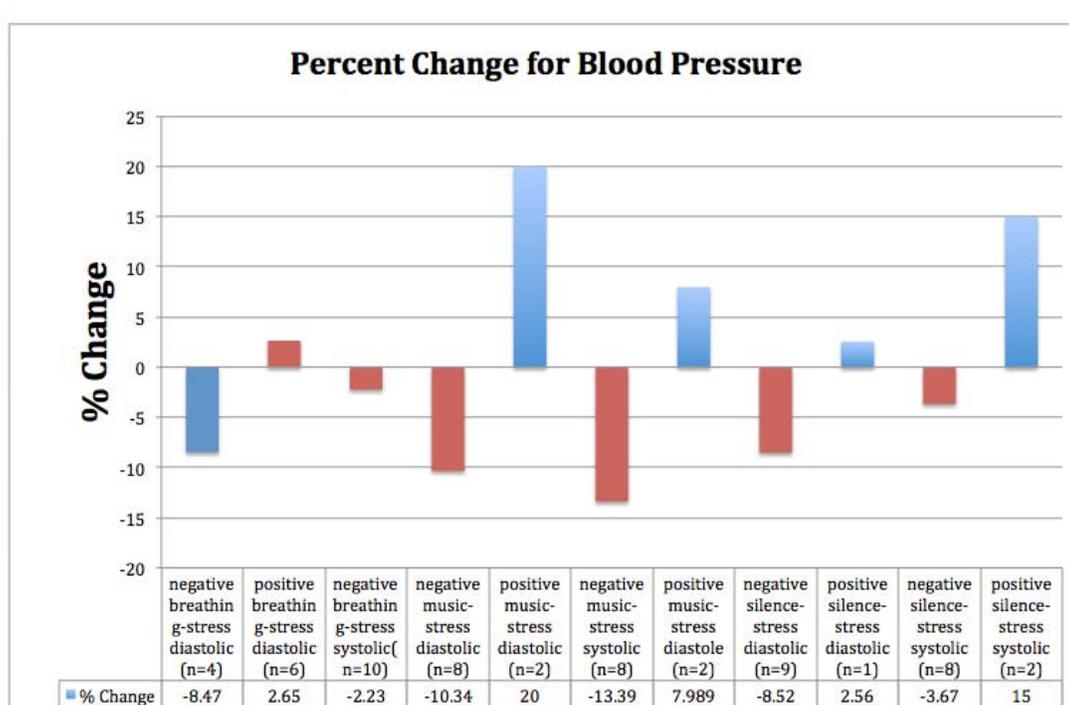|	negative breathing-stress diastolic (n=4)	positive breathing-stress diastolic (n=6)	negative breathing-stress systolic(n=10)	negative music-stress diastolic (n=8)	positive music-stress diastolic (n=2)	negative music-stress systolic (n=8)	positive music-stress diastole (n=2)	negative silence-stress diastolic (n=9)	positive silence-stress diastolic (n=1)	negative silence-stress systolic (n=8)	positive silence-stress systolic (n=2)
% Change	-8.47	2.65	-2.23	-10.34	20	-13.39	7.989	-8.52	2.56	-3.67	15

Figure 12: Blood pressure percent change from stress to each post-relaxation exercise group (music, silence and breathing). Both diastolic and systolic and positive and negative average percent change values separated and defined by sample size. Red colored bars defines the groups with the largest sample size, thus indicating the most significant information, while the blue bars indicate sample groups of sizes (n=1-n=4), less significant when examining the trends.
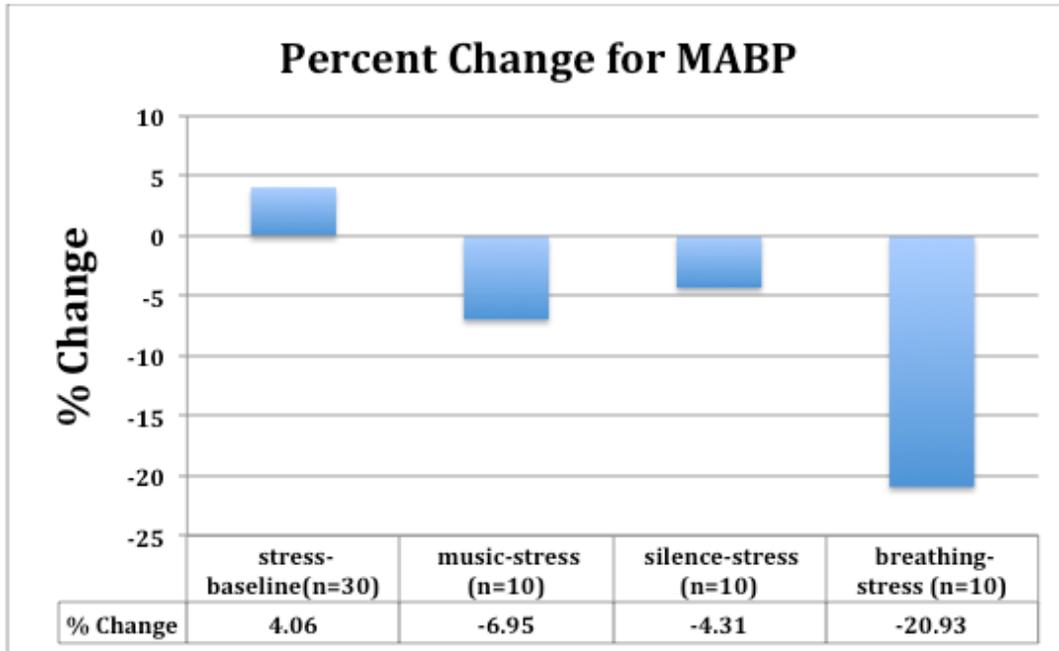
Percent Change for MABP

% Change	stress-baseline(n=30)	music-stress (n=10)	silence-stress (n=10)	breathing-stress (n=10)
% Change	4.06	-6.95	-4.31	-20.93

Figure 13: Mean Arterial Blood Pressure (MABP) percent change from stress to each post-relaxation exercise group (music, silence and breathing). All average percent change values were negative and defined by sample size.
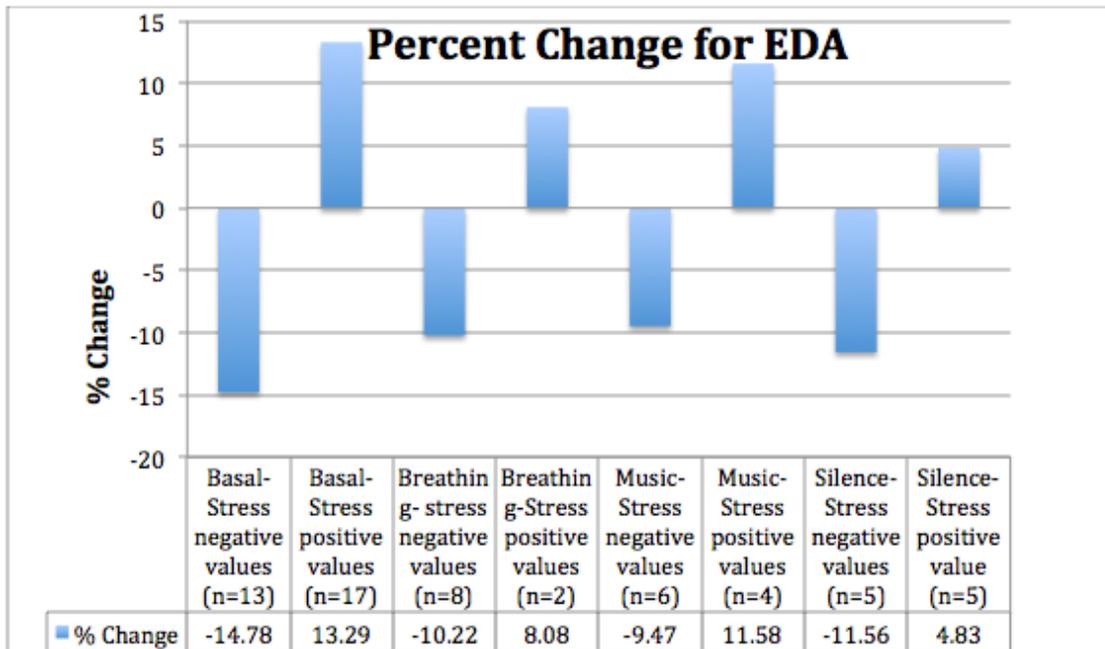
Percent Change for EDA

	Basal-Stress negative values (n=13)	Basal-Stress positive values (n=17)	Breathing-stress negative values (n=8)	Breathing-Stress positive values (n=2)	Music-Stress negative values (n=6)	Music-Stress positive values (n=4)	Silence-Stress negative values (n=5)	Silence-Stress positive value (n=5)
% Change	-14.78	13.29	-10.22	8.08	-9.47	11.58	-11.56	4.83

Figure 14: EDA percent change from basal to stress and from stress to each post relaxation exercise (music, silence and breathing). Both positive and negative values are shown with sample sizes given.
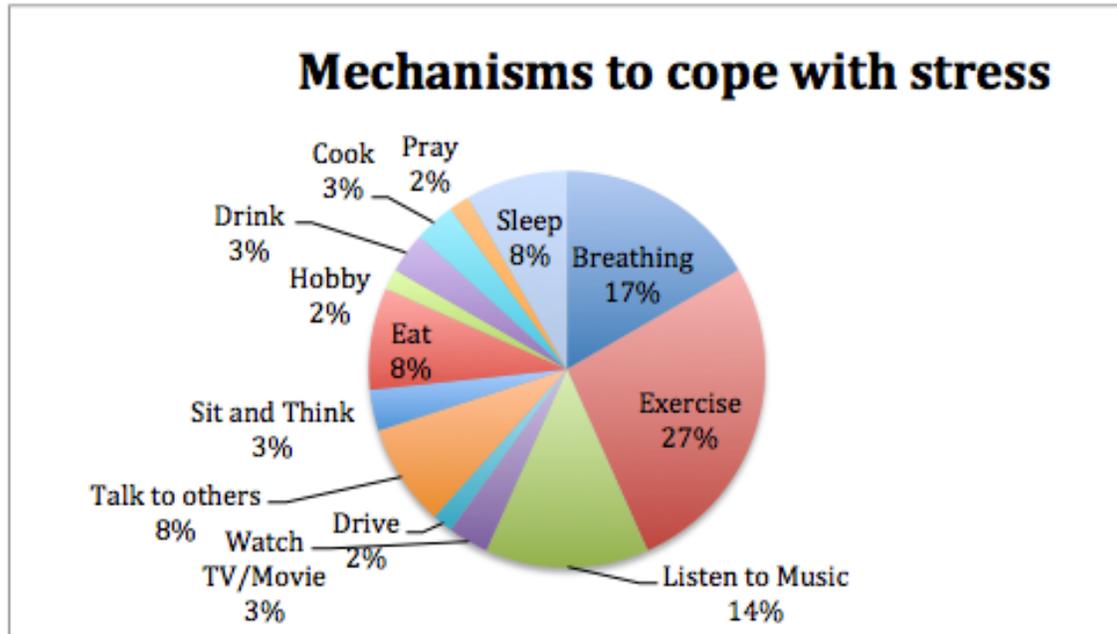
Figure 15: Reported responses for "mechanisms to cope with stress" by subjects through a questionnaire format. The three most represented groups are Exercise, Breathing, and Listening to Music.

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