Effects of Controlled Meditation on Stress Response Elicited by a Timed Mathematics Test

Adrianna Doucas, Jake Pagel, Jordyn Robl, Natalie Olander

University of Wisconsin-Madison Department of Physiology
Physiology 435
Lab 301, Group 15

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Abstract

In daily life, human beings encounter a number of different stressors that elicit a physiological response. Previous studies have demonstrated that mindfulness meditation is effective in reducing the physiological stress response. The purpose of this study was to determine the ability of mindfulness meditation to reduce the body's stress response. The stress response was induced in all participants via a timed multiplication test, enhanced with elements of competition and monetary incentives. The experimental group underwent a three minute guided meditation prior to the test, whereas the control group did not, and the stress responses of the two groups were then compared and analyzed. The study was conducted in three stages. In stage one, baseline heart rate, respiration rate, and electrodermal activity measurements were recorded for each of the 46 participants for one minute. In stage two, recording was paused and 23 participants simply sat for three minutes, while the other 23 participants listened to a three minute guided meditation. Group assignments were random. In stage three, each participant completed a two-minute timed multiplication test while competing against a member of the research team. Heart rate, electrodermal activity, and respiration rate recording resumed during stage three. After testing of all 46 participants, average changes in heart rate, respiratory rate, and electrodermal activity were calculated, with the change referring to the difference between baseline measurements and measurements taken during the first minute of the timed test. Differences in the three variables were attributed to the effects of mindfulness meditation prior to the test. The average change in heart rate, measured in beats per minute, was found to have a statistically significant increase in the meditation group compared to the non-meditation group, suggesting meditation is correlated with an *increased* stress response, opposite the hypothesis. Neither electrodermal activity nor respiratory rate were found to have statistically significant differences when comparing average changes between the groups.

Introduction

The effect of meditation on the human body's ability to maintain homeostatic levels during exposure to stressful stimuli has been debated extensively, ranging from the possible benefits of mindfulness meditation in reducing interference from negative thoughts to more traditional meditations that have helped humans deal with stress for centuries. Mindfulness meditation is described as a technique that "emphasizes the detached observation or witnessing of perceptions, sensations, cognitions, and emotions as they arise moment to moment in the field of awareness. In mindfulness practice, no event (e.g., the wandering of the mind) is considered a distraction; rather, it is simply another object to be observed or witnessed" (Astin, 1997). Mindfulness meditation has been shown in numerous studies to be effective in stress reduction (Astin, 1997).

Mindfulness-based stress reduction is a program that utilizes mindfulness meditation practices to benefit an individual's physical and psychological health (Boaler, 2014). Today, a common method of conducting mindfulness meditation is through the utilization of mobile applications, in particular, the Headspace application. Headspace is the highest-scoring mindfulness-based iPhone application as of 2015 (Martman, Bell, & Sanderson, 2018). Mindfulness-based stress reduction has also been shown to be effective in relieving symptoms of depression, anxiety, and psychological distress. A meta analysis conducted in 2004 discovered that mindfulness meditation has frequently been found capable of improving the coping styles of individuals when presented with stressful stimuli. The meta analysis also found mindfulness meditation to be beneficial in coping with more chronic versions of stress, such as those induced by physical or mental illness (Grossman, Niemann, Schmidt, & Walach, 2004). This study aims to verify the conclusions of the aforementioned meta analysis regarding the benefit of

mindfulness meditation in the context of acute stress. In this study, the acute induced stress will be elicited through competitive parameters and a timed math test.

Timed mathematics tests are commonly employed at the elementary and middle school levels, and there have been numerous studies demonstrating a significant emotional stress response to these timed tests (Boaler, 2014). A 2007 study investigating the effects of a timed mathematics test on the stress levels of sixth-grade participants revealed that if the subject's first test was timed (in a sequence of five timed or untimed tests), the participant experienced heightened anxiety levels (Tsui & Mazzocco, 2007). This reveals the ability of timed tests to elicit a significant stress response from participants, and this stress response has been shown to cause poorer performance during these tests.

This study aims to investigate the possible benefits of using a mindfulness-based meditation mobile application, such as Headspace, prior to taking a timed mathematics test, in an effort to determine whether these meditation apps could be used to reduce testing anxiety in a variety of settings. The three physiological variables measured and analyzed in this study were heart rate, electrodermal activity, and respiratory rate. A study published by Schubert *et al.* established the relationship between acute induced stress and an increased heart rate. Participants were asked to deliver a speech to a video camera, and their resulting heart rate values were compared to baseline. The study found a statistically significant increase in heart rate due to the acute stress induced by the act of delivering their speech, thus establishing the ability of induced stress to increase heart rate as a physiological variable (Schubert, Lambertz, Nelesen, Bardwell, Choi, & Dimsdale, 2008).

Similarly, a 1980 study conducted by Suess *et al.* placed participants under acute stress conditions by threatening them with an electric shock, and it was found that respiration rate had a statistically significant increase under these conditions (Suess, Alexander, Smith, Sweeney, & Marion, 1980). Lastly, Possado-Quintero *et al.* measured electrodermal activity of scuba divers while the divers experienced the acute stress-inducing effects of high pressure and low temperature at deep water levels. It was found that these scuba divers showed an increased electrodermal activity level, therefore establishing electrodermal activity as an effective measure of sympathetic nervous system activity during stressful events (Posada-Quintero, 2017). The aforementioned studies establish respiration rate, heart rate, and electrodermal activity as effective indicators of a body experiencing acute stress. Therefore, these three variables were deemed appropriate measures of acute stress in the present investigation.

Materials

In order to determine the effects of guided meditation on the body's stress response in testing conditions with time constraints and competitive elements, three variables were tested. The three variables observed were respiration rate (RR), electrodermal activity (EDA), and heart rate (HR). Three different measurement devices were used. Respiration rate was measured utilizing a respiratory belt (Model: SS5LB) Biopac Systems, Inc. Goleta, CA. Heart rate was measured using a Biopac Electrode Lead set (Model: SS2L), Biopac Systems, Inc. Goleta, CA, which was then connected to Biopac Disposable Electrodes (Model: EL503), Biopac Systems, Inc. Goleta, CA. Heart rate was recorded in beats per minute (BPM). Electrodermal activity (EDA) was recorded using an Electrode Pulse Transducer (Model: SS3LA), Biopac Systems, Inc. Goleta, CA, and the Electrode Pulse Transducer was prepared using Biopac Isotonic Recording

Electrode Gel, Biopac Systems, Inc. Goleta, CA. Electrodermal activity was quantified via skin conductance and recorded in units of microsiemens. Data were analyzed and recorded using Biopac Student Lab System (BSL 4 software, MP36), and the Biopac Systems, Inc. Student Manual was consulted for equipment instructions and procedures (Biopac Systems Inc. ISO 9001:2008). The Headspace: Meditation application (V. 1.15.1, ©2018 Headspace Inc.) was utilized for a three minute guided meditation period prior to each mathematics test in the experimental, meditation group. All participants were instructed to complete the same difficult multiplication facts worksheet consisting of 100 problems, retrieved from Math-Drills.com, ©2005. An example of the multiplication facts worksheet is given under **Figure 6.** Three gift cards were displayed as a simulated incentive to intensify the desire to succeed in competition, thus increasing the stress response. The gift cards were presumably redeemable at Madison-area locations for $10.00 each (*Starbucks*, *Collectivo*, *Panera*).

Methods

Participants

46 participants between 18 and 30 years of age who were currently enrolled in the Physiology 435 course at the University of Wisconsin-Madison were selected on a voluntary basis for this study. The entirety of the data collection of the study was conducted at the University of Wisconsin-Madison Medical Sciences Center. All participants read and signed a consent form prior to participation that outlined the steps taken to ensure participant confidentiality and informed participants of possible adverse effects of the experiment. Any inquiries regarding the study were directed to Adrianna Doucas (adoucas@wisc.edu).

Procedure

Set-up

Preceding data collection, the Biopac Systems equipment was prepared and attached to the participant. See **Figure 2** for the proper Biopac equipment attachment. Heart rate monitoring measures were prepared by first inserting the Electrode Lead set into channel 1 of the Biopac Student Lab System, and then attaching the three electrodes directly on the skin of the participant; one electrode was placed on each of the left and right legs on the medial surfaces just above the ankle bone, and one electrode was placed on the anterior forearm of the participant's non-dominant hand, just above the wrist. Then, the three leads were attached to the Biopac Disposable Electrodes on the skin. Next, the respiratory transducer belt was placed around the subject's chest, below the armpits and above the nipple line. The transducer was inserted into channel 2 of the Biopac Student Lab System, and the belt was tightly fastened at the point of maximal expiration. The participant was asked to exhale completely before fastening the belt, and subsequently instructed to refrain from talking during respiration recording. Lastly, electrodermal activity (EDA) was monitored using an EDA transducer (SS3LA). Prior to attachment, each cavity of the transducer was cleaned and filled with Biopac Isotonic Recording Electrode Gel. The transducer was wrapped around the participants second and third digits of their non-dominant hand, and the EDA transducer was inserted into channel 3 of the Biopac Student Lab System. Only one participant at a time was in the room being tested.

Stage One

Once the equipment was attached, the participant was instructed to stay seated in a chair with their legs uncrossed, and to remain silent. Baseline measurements of heart rate, respiratory rate,

and electrodermal activity level were then recorded continuously for one minute. Heart rate was measured in units of millivolts (mV), and later translated to beats per minute (BPM). Respiration was monitored and translated into units of breaths per minute, and electrodermal activity was measured in units of microsiemens. After one minute, the recording was paused.

Stage Two

This phase of the experiment differed according to whether the participant was in the non-meditating, control group, or the meditating, experimental group. No Biopac Systems measurements were recorded during this time.

Control: upon recording of baseline measurements, 23 randomly selected participants comprising the non-meditating group were individually instructed to remain seated for three minutes, and the researchers exited the room and closed the door. Only the one participant being tested was in the room during this three-minute time period, and no further instructions were provided to the participant in regards to what they should do during this time.

Experimental: the other 23 participants, comprising the experimental, meditating group, were instructed to remain seated, and were then given a pair of Beats Studio^3 Wireless Headphones with the noise cancelling function, and were asked to complete the chosen Headspace Application's three minute guided meditation sequence. Upon affirmation, the researchers exited the room and closed the door, leaving the participant alone in the room for the three-minute duration of the meditation sequence. No further instruction was provided to the participant.

Stage Three

Upon completion of *Stage Two*, the researchers reentered the testing room, and the participant, if in the meditation group, was instructed to remove the headphones. During this phase, the experimental procedure was identical for both the control and the experimental group participants. Research participants were supplied with testing materials, consisting of only a pen and a down-facing multiplication sheet. The testing procedure was then explained to the research participants, including the time constraint of two minutes, the gift card incentive, and the aspect of competition against a member of the research group. The participant was notified that their test would be scored, and the number of correct answers would be counted. Subjects were seated directly across the table from the research group member with whom they were competing against, with a divider between the two in order to prevent the research subject from seeing the answers of the competitor. Once participants affirmed they understood the testing procedures, a two-minute timer, the Biopac Systems recording, and a ticking time clock simulation YouTube video with sound were started simultaneously. The researcher, for each participant, completed and flipped over their test at the one-minute mark in order to further induce the stress of the participant. The researcher competitor created the illusion that they were quickly filling out the test by rapidly scribbling nonsensical answers. Throughout the test, the physiological responses of heart rate, electrodermal activity, and respiration rate were continuously monitored to measure the stress response of the individual throughout the testing condition. These responses were later analyzed to calculate the average change in values for each variable from resting to testing conditions. Once the test was completed, participants were disconnected from the Biopac Systems equipment. An overview of the experiment is detailed in **Figure 1**.

Data Analysis

Heart rate, respiration rate, and electrodermal activity were monitored first for one minute during *Stage One* to obtain baseline levels, and later during *Stage Two* throughout the two-minute duration of the timed testing competition. It should be noted that the baseline monitoring process was initiated before disclosing details about the experiment, in order to achieve neutral baseline levels. Heart rate was determined by counting the total number of peaks measured by the Biopac apparatus during the one-minute baseline period, as well as during the first minute of the testing condition. Electrodermal activity was measured and recorded continuously throughout the test. EDA was then averaged for the entire minute of the baseline period, as well as for the first minute of the testing condition. Respiration rate was measured and recorded in breaths per minute utilizing a BioPAC 4.0 Student through a seperate channel. Respiration rate was determined by counting the total number of respirations during the one minute baseline period, as well as during the first minute of the testing condition. The total response for each of the measurements were then compared between groups via a one-way analysis of variance test (ANOVA).

Positive Controls

To ensure functionality of the Biopac Systems equipment, all members of the investigative team conducted positive control experiments. The three parameters used to quantify stress response were heart rate, respiration rate, and electrodermal activity. Measurements of these parameters were taken on each of the five investigators first during a resting period, to get baseline measurements. These measurements are outlined in **Table 1.** Each investigator underwent the experimental testing procedure described above, under exactly the same

conditions as will the control participants, and the three parameters were measured and recorded at the same time intervals.

Averages and standard deviations for resting heart rate, respiration rate, and electrodermal activity across all five investigators (n=5) were calculated to be 80.8 +/- 19.058 beats per minute, 10.8 +/- 1.643 breaths per minute, and 10.966 +/- 5.152 microsiemens, respectively. Averages during the testing procedure were obtained to be 95.2 +/- 19.473 beats per minute, 15 +/- 1.225 breaths per minute, and 11.177 +/- 4.397 microsiemens. The changes in each variable from rest to testing conditions were then calculated for each investigator, and the changes for each respective variable were subsequently averaged across all investigators, and standard deviations calculated. The average changes in heart rate, respiration rate, and electrodermal activity from resting to testing conditions were calculated to be 14.4 +/- 10.431 beats per minute, 4.2 +/- 1.798 breaths per minute, and 0.211 +/- 1.492 microsiemens, respectively. The positive control data observed all three parameter averages to increase following initiation of the stress response, as expected, thus indicating the equipment used in the experiment is indeed effective at measuring changes in the three physiological parameters being tested.

Negative Controls

The initial values of electrodermal activity, respiratory rate, and heart rate taken before initiating the experimental process for each participant functioned as the negative control and baseline. These measurements functioned to ensure the validity and functionality of the Biopac instruments, and established a comparable value for each of the physiological measurements that could be compared with physiological measurements after meditation and during different

phases of the testing process. The differences in these phases' physiological measurements will shed light on the ability of meditation to assuage the induced stress levels that arise with a timed competition under testing conditions.

Results

The results are summarized in **Table 1**, **Figure 3**, **Figure 4**, and **Figure 5**. Additional results are further detailed below. The results are reported in mean ± standard deviation.

Heart Rate

Numerical averages were found for the change in heart rate between baseline and testing conditions for both study groups. The change refers to the difference between the results obtained during baseline readings and the results obtained during the first minute of the timed test. In the non-meditation group, heart rate increased by an average value of 13.826 beats/min (SD=11.723). The meditation group had an average increase of 24.5 beats/min (SD=17.157). A one-way analysis of single variance test (ANOVA) was completed to find a p-value of 0.01693. In reference to $p < 0.05$, these results are statistically significant, indicating a statistically significant increase in the meditation group compared to the non-meditation group. These values are outlined in **Figure 2**, **Figure 3**, and **Table 1**.

Electrodermal Activity

Numerical averages were found for the change in electrodermal activity for both study groups, measured in microsiemens. The values outlined in **Figure 4** and **Table 1** refer to the difference between the baseline results and the results taken during the first minute of the timed test. In the non-meditation group, electrodermal activity increased by an average value of 2.687 microsiemens (SD=2.812). In the meditation group, electrodermal activity increased by an

average value of 2.724 microsiemens (SD=3.219). A one-way analysis of variance (ANOVA) test was completed, giving a p-value of 0.966564, indicating no statistically significant difference between the average increases of the meditation and non-meditation treatment groups.

Respiratory Rate

Numerical averages were found for the average change in respiratory rate, measured in breaths/minute. These values are outlined in **Figure 5** and **Table 1.** The difference in this instance refers to the difference between the baseline values and the values taken during the first minute of the timed test. In the non-meditation group, respiratory rate increased by an average value of 6.696 breaths/min (SD=4.617). In the meditation group, respiratory rate increased by an average value of 5.875 breaths/min (SD=4.079). A one-way analysis of variance (ANOVA) test was completed with these average values, giving a p-value of 0.521214. This indicates that there was no statistically significant difference between the average change in respiratory rate between the non-meditation group and meditation group.

Discussion

There is evidence in the scientific literature that timed exams can induce the body's physiological stress response, which has been determined to be correlated with an increased heart rate, respiratory rate, and electrodermal activity level *(as indicated in the aforementioned references)*. There is also substantial scientific evidence that mindfulness meditation can reduce the body's physiological response to both chronic and acute stressors *(previously referenced)*.

Our study aimed to investigate the application of mindfulness-meditation to reduce the physiological stress response commonly experienced by university students during exams. This could be an important and useful application, because studies have shown that experiencing

acute stress during exams can reduce performance. The intent of our research was to reveal an effective way to reduce stress during exams, and therefore, increase exam performance.

The experiment aimed to simulate an acute stress situation via the administration of a brief, timed multiplication test with an added monetary incentive as well as a competitive element. This stress simulation was chosen upon the general consensus of the research group that they had experienced acute stress during such timed multiplication tests in the past. The ability of meditation to reduce this acute stress response was then tested via the use of the popular Headspace phone application's guided meditation, as it would be a realistic means of applying the use of meditation to exam-taking scenarios. It was hypothesized that participants who used the Headspace app prior to taking the timed exam would experience a reduced stress response, as manifested by a suppressed increase in heart rate, respiration rate, and electrodermal activity from baseline measurements, as compared to the control group who did not meditate.

The results of our experiment, however, did not comply with this prediction, therefore we fail to accept our hypothesis. Of the three parameters used to quantify stress response, neither average changes in respiratory rate nor average changes in electrodermal activity showed a statistically significant difference between the non-meditation control group and the experimental group that meditated before taking the timed test. We had hypothesized that the increase in electrodermal activity and respiratory rate in the meditation group would be smaller in comparison to the increase in these parameters in the non-meditation group, which we would have attributed to a lowered stress response as result of guided meditation via the Headspace application. This however, was not the case, as indicated by the p-values in **Table 2**.

The third parameter, change in heart rate, measured in millivolts and later translated to beats per minute, did present a statistically significant difference between the experimental and control groups, but in the opposite way in which we had expected. We had hypothesized that participants who used the Headspace application's guided meditation would experience a smaller increase in heart rate during the test than the participants who did not meditate. Instead, the participants who meditated actually experienced a significantly larger increase in heart rate from baseline levels compared to those who did not meditate. This could have been due to a variety of factors, one of which being the small sample size. Because only 23 participants were included in the meditation group, random chance could have caused those 23 participants to have a higher average heart rate compared to the control group.

Additionally, having participants meditate before taking the timed test could have caused them to become more aware of their physiological arousal, causing an opposite effect. If a participant is more aware of their heart rate before beginning the timed test, they may grow anxious about their increasing heart rate, therefore causing a more pronounced increase. In the same respect, after meditating, participants could have become more pressured to score well on the timed test, as despite the neutrality of the experimenters, these participants most likely inferred that we were expecting the experimental meditation group to perform better. This could have increased pressure for these participants, therefore causing a statistically significant increase in heart rate for the meditation group.

An additional possibility as to why the non-meditation group had a significantly lower increase in heart rate during the timed test as compared to the meditation group is that perhaps, during the three minute period described in *Stage Two,* these participants engaged in their own

practice of stress management. This could have included positive self-talk, deep breathing techniques, or myriad other forms of self-relaxation. It is possible that these more personalized methods of coping with and preparing for stressful stimuli are perhaps more effective for individuals than such generalized forms as the Headspace application. Further inquiry into this matter should be conducted.

Limitations

In addition to the small sample size, there were various confounding variables that could have undermined the accuracy of our study. Firstly, under our study parameters, the control group participants did not wear the noise cancelling headphones during *Stage Two* of the experiment. This effect of wearing noise-cancelling headphones or not contributed an undesired confounding variable to the study which we did not anticipate. Both study groups should have worn the headphones in order to maintain consistency in the experiment. Furthermore, a significant portion of the data were collected on the same day as Physiology 435 exams, which could have raised the baseline heart rate, respiratory rate, and electrodermal activity levels of the participants. Therefore, if participants were starting at higher baseline values on these days, they may have appeared to experience a smaller stress response. Then consequently, if we happened to conduct more tests under the meditation conditions that day, it would lower the average stress response for the meditation group. Additionally, our study assumed that participants would actively listen and participate in the meditation recording. Participants were instructed to adjust the headphones to an adequate volume level and carefully listen to the prompts, but individuals who do not have experience listening to meditation recordings may have found it difficult to receive the calming effects. This discrepancy could have led to unreliable data from the

experimental group, as individuals inexperienced or uncomfortable with recorded meditation prompts would not have received the full benefit of the meditation.

Future Directions

Future studies should be conducted with a larger, and perhaps a more diverse sample of participants, in order to possibly yield more conclusive results. Furthermore, a longer, more effective meditation program could be implemented in order to increase the potential impact of the meditation on stress reduction. Specifically, the effectiveness of the meditation session could be increased if participants were exposed to it multiple times over a period of one or two weeks so they could learn to properly utilize the meditation recording. Additionally, future studies will provide a more effective introduction to the meditation prompts, and could potentially utilize a survey to determine if the experimental group has had previous exposure to meditation applications. This would ensure that the experimental group participants would all have a similar level of comfort and exposure to meditation before beginning the experiment, allowing for a more standardized baseline.

Conclusions

The results of this study did not support our hypothesis. Therefore, we conclude that the practice of meditation under the specific parameters of our study does not significantly reduce the stress response in terms of the three physiological variables examined, under timed testing conditions. The only sector of our data that reached statistical significance was the average change in heart rate, which revealed that the experimental, meditation group had a statistically significant increase in average heart rate compared to the non-meditating control group. This result was the opposite of the hypothesized situation. Further investigation into the effectiveness of generalized

meditation techniques versus self-taught, individual stress-coping mechanisms could provide beneficial insight to the academic community.

Even though the findings of this study did not shed significant light on the role of meditation in dealing with academic stress, these conclusions will hopefully add to the conversation about the role of meditation and other stress-reduction practices in the academic field and in daily life. Further insight into the topic of stress reduction is crucial to maintaining the health and well-being of students, professionals, and the general population in the increasingly competitive and rigorous nature of everyday life.

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Tables

Table 1: Table summary of positive controls conducted on group members in order to ensure functionality of the Biopac instruments. Positive control measurements from group members were measured during the two minute timed math test under the same conditions as the non-meditation experimental group. Positive control measurements were compared to the baseline values of experimental participants from both treatment groups in order to ensure the Biopac instrument's ability to detect increases in physiological variables.

Group Member	Heart Rate Positive Control (bpm)	Difference from Negative Control (bpm)	EDA Positive Control (microsiemens)	Difference from Negative Control (microsiemens)	Respiratory Rate Positive Control (breaths/min)	Difference from Negative Control (breaths/ min)
A	96	18.884	5.334	0.749	15	1.663
B	72	-5.116	9.275	4.69	13	-0.338
C	124	46.884	13.276	8.691	15	1.663
D	100	22.884	17.1	12.515	16	2.663
E	84	6.884	10.9	6.315	16	2.663

Table 2: Summary of experimental data. Positive averages indicate an increase in the respective values from baseline measurements to measurements taken during the first half of the timed test. P-values found indicate a statistically-significant increase in the average change in heart rate in the meditation group compared to the non-meditation group. P-values for electrodermal activity and respiratory rate indicate no statistically significant difference between the two groups.

Group	Average Change in HR (bpm)	Standard deviation	Average change in EDA (microsiemens)	Standard Deviation	Average change in RR (breaths/min)	Standard deviation
No Meditation Group (n=23)	13.826	11.723	2.687	2.812	6.696	4.617
Meditation Group (n=23)	24.5	17.157	2.724	3.219	5.875	4.079
P-values		0.016963		0.966564		0.521214

Figures and Legends

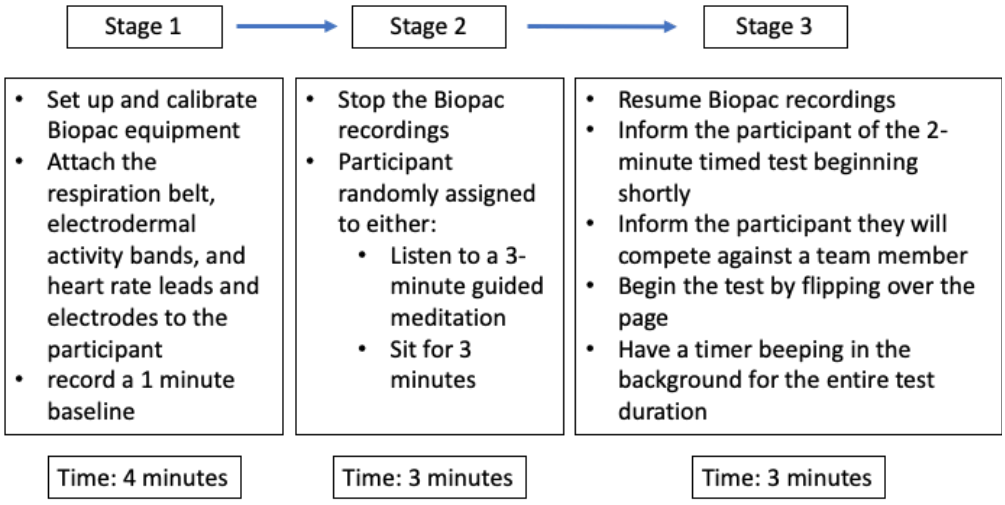


Figure 1. Experimental design overview. The biopac recordings included heart rate, respiration rate, and electrodermal activity. All participants performed all three stages. Twenty three participants meditated and twenty three participants did not meditate.

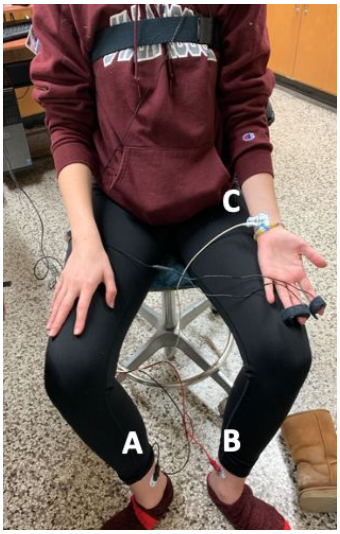
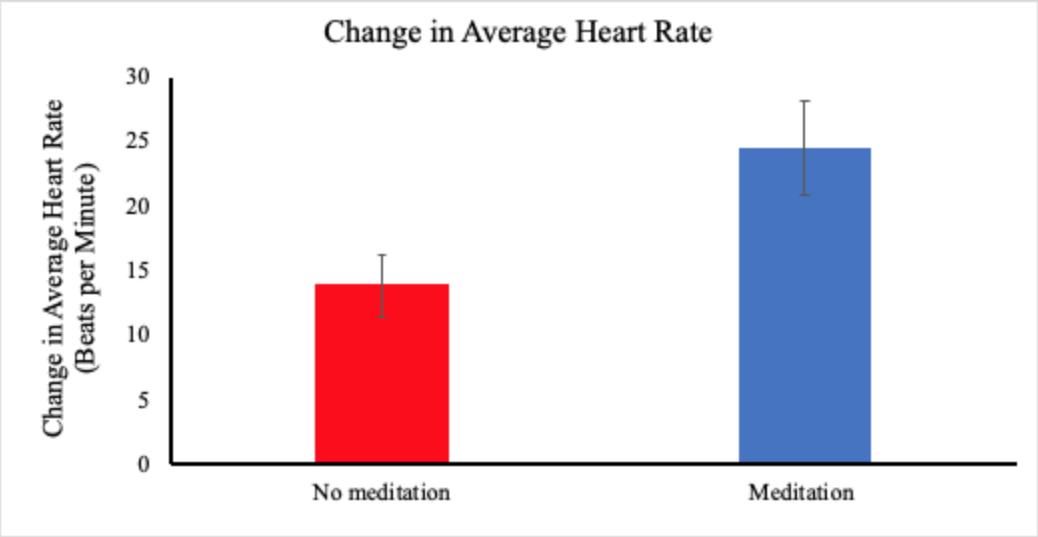


Figure 2. Example set up for a participant. The black lead was connected to electrode A, the red lead to electrode B, and the white lead to electrode C. EDA monitor placed on participant's non-dominant hand in order to not interfere with writing. Respiratory belt secured upon patient exhalation and tightened adequately.



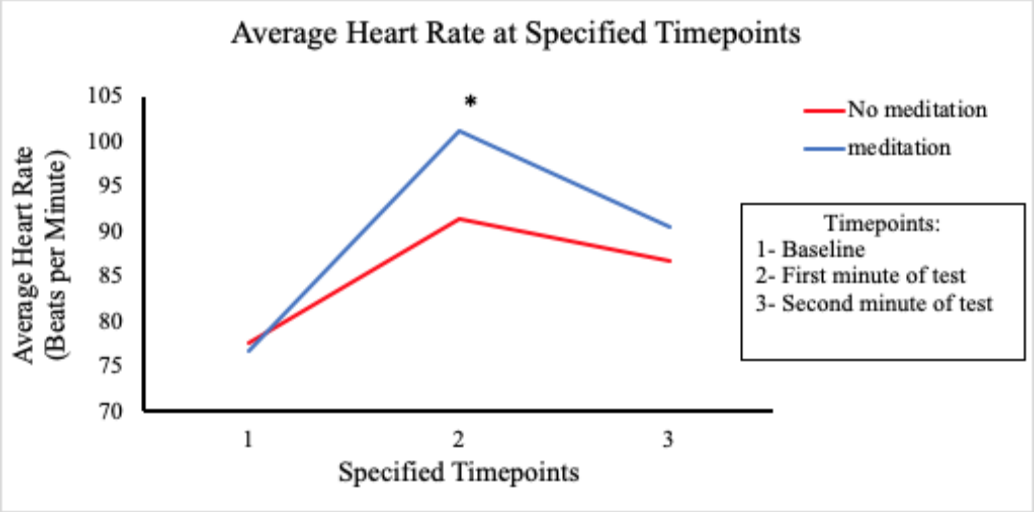


Figure 3: Graphs representing the effects of the 3-minute guided meditation on the resulting change in average heart rate. Change in this instance refers to the difference between baseline values and values taken during the first minute of the timed test. P value of 0.016963* indicates a significant difference at $p < .05$, but the data indicate a higher average heart rate for the meditation participants. Error bars reported in relation to standard error on the bar graph. The average heart rate at specified time points between the groups was detailed in the line graph.

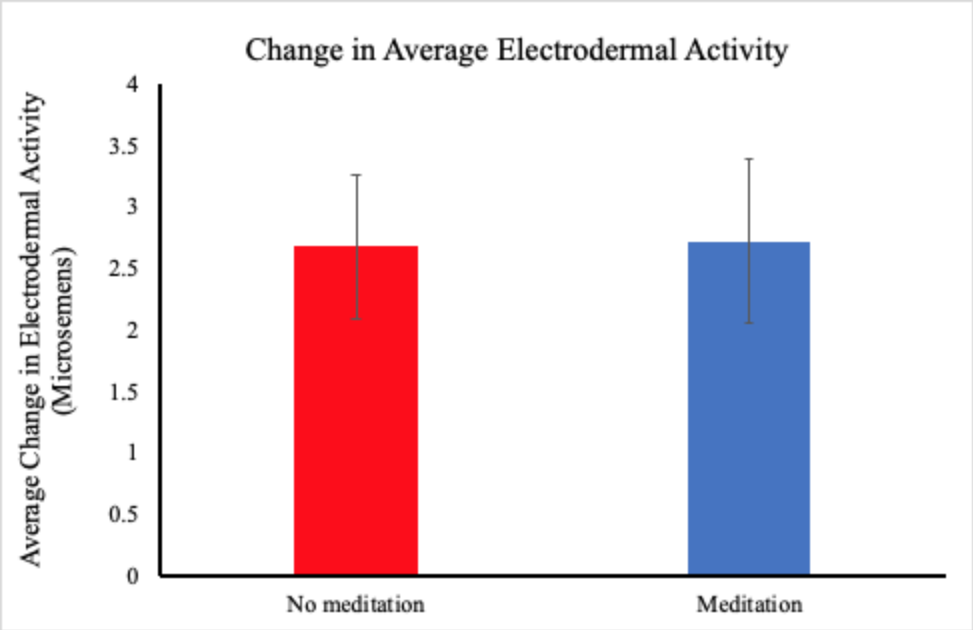


Figure 4: Graph representing the change in average electrodermal activity resulting from the presence of no meditation or no meditation, measured in microsiemens. Change in this instance refers to the difference between baseline values and values measured during the first minute of the timed test. P value of .966564 indicates no statistical significance at $p < .05$. Error bars reported in relation to standard error.

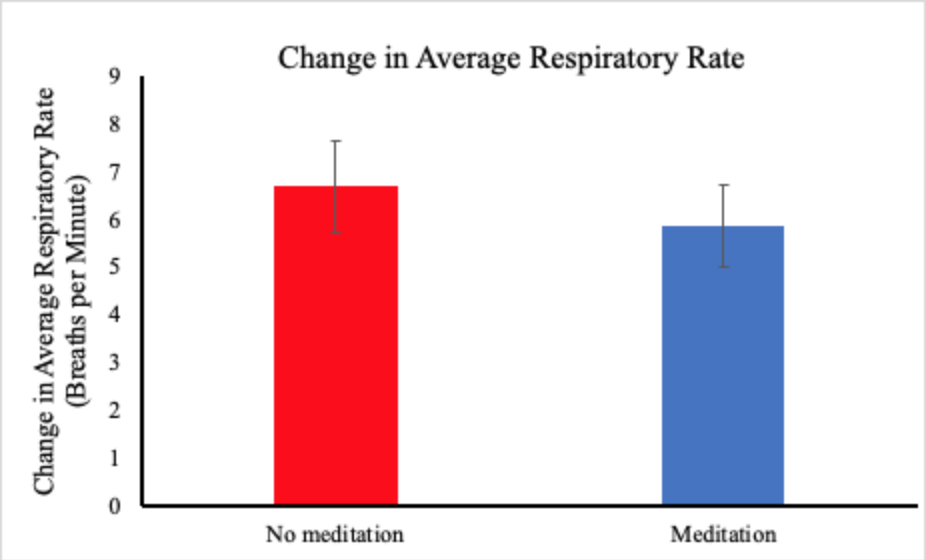
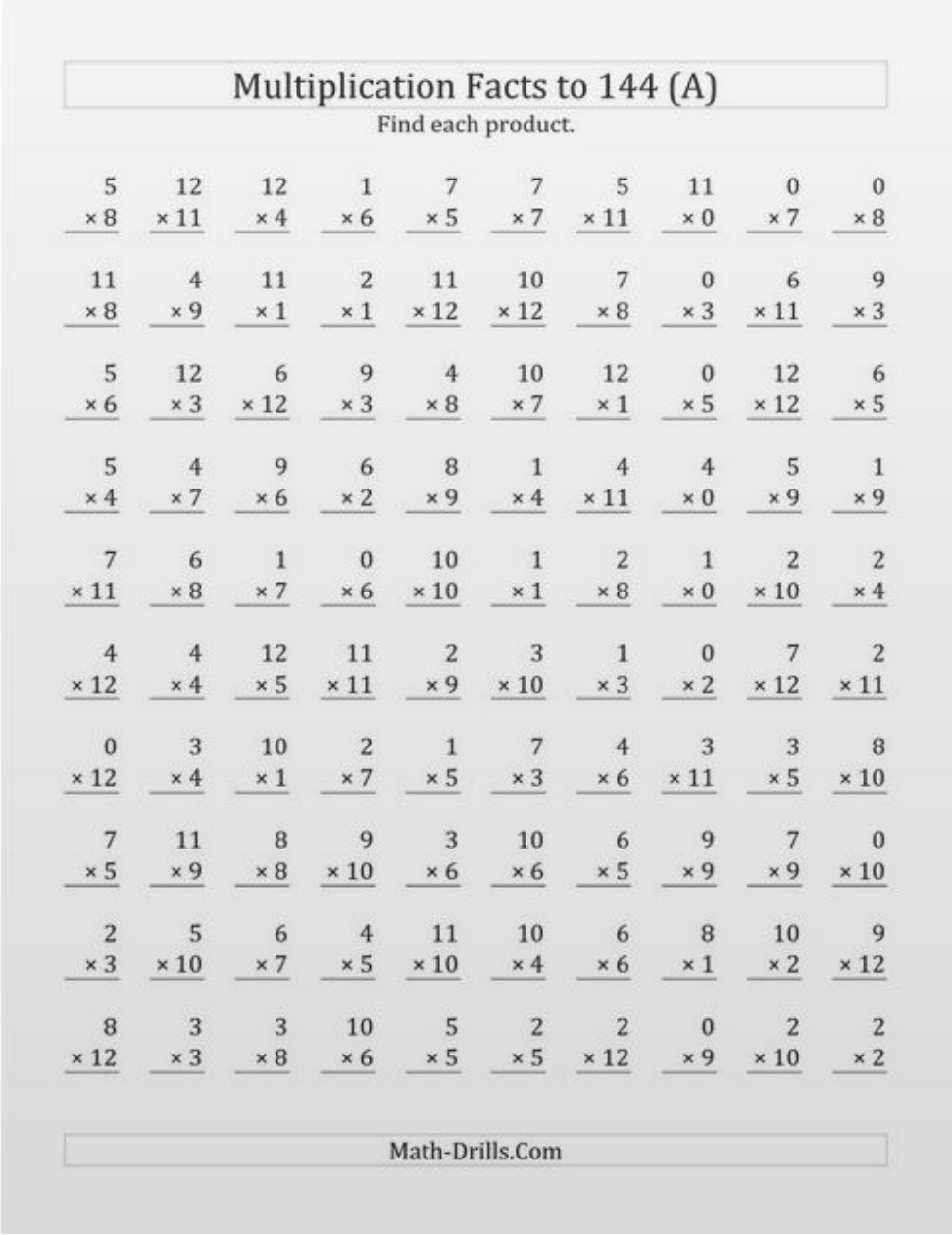


Figure 5: Graph representing the change in average respiratory rate resulting from the presence of meditation, measured in beats/min. Change in this instance refers to the difference in baseline values and values taken during the first minute of the timed test. P value of .521214 indicates no statistical significance at $p < 0.05$. Error bars reported in relation to standard error.



Multiplication Facts to 144 (A)

Find each product.

5 × 8	12 × 11	12 × 4	1 × 6	7 × 5	7 × 7	5 × 11	11 × 0	0 × 7	0 × 8
11 × 8	4 × 9	11 × 1	2 × 1	11 × 12	10 × 12	7 × 8	0 × 3	6 × 11	9 × 3
5 × 6	12 × 3	6 × 12	9 × 3	4 × 8	10 × 7	12 × 1	0 × 5	12 × 12	6 × 5
5 × 4	4 × 7	9 × 6	6 × 2	8 × 9	1 × 4	4 × 11	4 × 0	5 × 9	1 × 9
7 × 11	6 × 8	1 × 7	0 × 6	10 × 10	1 × 1	2 × 8	1 × 0	2 × 10	2 × 4
4 × 12	4 × 4	12 × 5	11 × 11	2 × 9	3 × 10	1 × 3	0 × 2	7 × 12	2 × 11
0 × 12	3 × 4	10 × 1	2 × 7	1 × 5	7 × 3	4 × 6	3 × 11	3 × 5	8 × 10
7 × 5	11 × 9	8 × 8	9 × 10	3 × 6	10 × 6	6 × 5	9 × 9	7 × 9	0 × 10
2 × 3	5 × 10	6 × 7	4 × 5	11 × 10	10 × 4	6 × 6	8 × 1	10 × 2	9 × 12
8 × 12	3 × 3	3 × 8	10 × 6	5 × 5	2 × 5	2 × 12	0 × 9	2 × 10	2 × 2

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Figure 6: Example of the multiplication facts sheet utilized for each participant. Received from https://www.math-drills.com/multiplication/multiplication_facts_to_144_zeros_001.php.