

The Effect of Aromatherapy on Reduction of Physical Stress

Phys 435 Lab 602
Group 14

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Abstract:

Past research has shown that lavender is effective in reducing both physical and mental indicators of emotional stress but its effect on physical stress has yet to be determined. Physical and mental stress share many of the same physiological effects including increases in galvanic skin conductance, heart rate and blood pressure and it is likely lavender will lower these values following physical stress as it does following mental stress. To test this, participants were asked to bike until they reached 90% of their age-predicted heart rate max on two separate occasions - one with aroma and the other without. While not statistically significant, our study shows a trend for decreased recovery time in the aroma group for heart rate but not for blood pressure or GSR. Interestingly, this decrease was greater in the non-exercise group than a group that exercised at least 3 times a week.

Keywords:

Acute, aerobic, aromatherapy, blood pressure, essential oil, exercise, Galvanic Skin Response (GSR), heart rate, lavender, physical stress, psychological stress, recovery time, stress, sympathetic nervous system.

Introduction:

Aromatherapy is the art and science of using essential oils for the purpose of holistic healing (NAHA, 2015). This healing technique has been practiced for thousands of years and is becoming increasingly popular in the US and Europe today as an alternative treatment for alleviating stress. There are several different essential oils that can be used, each with different chemical properties that will elicit different physiological responses, some acting as stimulants and some as relaxants (NAHA,2015; Perry and Perry, 2006); however, lavender has been popularly used and studied for its suggested efficacy in reducing mental and psychological stress, thereby acting as a relaxant (Jo,2010; Toda, 2008; Motomura, 2001; Perry and Perry, 2006).

Lavender is known to be used as a “holistic relaxant... its sedative nature, on inhalation, has been shown both in animals and man” (Lis-Balchin and Hart, 1999). Specifically *Lavandula angustifolia* has relaxant, sedative, and anesthetic properties that result from two chemical compounds present in the extract, linalool and linalyl acetate (Ghelardini et al., 1999). The efficacy of these properties from lavender have been tested over many studies and several have shown that lavender is an effective relaxant. A study done by Sayorwan et al. showed “lavender oil caused significant decreases of blood pressure, heart rate, and skin temperature, which indicated a decrease in autonomic arousal” (Sayorwan et al., 2012). Other studies have shown that lavender aroma results in decreases in other physiological stress markers, including salivary cortisol levels and chromogranin A (Toda and Morimoto, 2008). Other studies have also evaluated participant’s raw scores of stress and significant reduction in reported stress after lavender exposure before or after surgery (Muzzarelli et al., 2006; Braden et al., 2009).

In general, stress can be defined as “any external perturbation to an organism’s optimal homeostasis” (Dow, 2014). Psychological stress results in, but is not limited to, the following set

of symptoms: increased salivary cortisol levels, increased blood pressure, increased heart rate and increased galvanic skin response (GSR) (Dickerson and Kemeny, 2004; Kirschbaum et al., 1995; Kirschbaum and Hellhammer, 1989; Vrijkotte et al., 2000, Takai et al., 2004). Not coincidentally, physical stress as a consequence of intensive exercise also induces similar symptoms as psychological stress does. Following intense exercise, a couple studies observed increases in salivary cortisol levels and sympathetic nervous system responses, including increases in heart rate, blood pressure and GSR (Renold, 1951; Vrijkotte et al., 2000).

There is evidence that inhalation of lavender extract contributes to the alleviation of physiological manifestations of psychological stress. Given the same physiological factors are affected during acute physical stress, this study aims to assess the effect of lavender essential oil, on physical stress. We will investigate whether inhalation of lavender essential oil will facilitate a subject's return to baseline vitals faster than in control conditions after an acute bout of vigorous aerobic exercise. As defined by the American College of Sports Medicine, if the level of exercise a person performs at requires 60-90% of their age-predicted heart rate max (APHR), that level of exercise is considered vigorous (ACSM, 2014).

We measured heart rate, blood pressure and GSR following an acute bout of vigorous physical exercise, as all of these tests are measures of sympathetic nervous response. GSR, specifically, has been used as an indirect measure of physiological stress (Storm, 2000). We predicted that aromatherapy would contribute to the relief of stress induced sympathetic nervous system responses, where GSR, heart rate and blood pressure will all return to normal levels faster rate in the group exposed to lavender essential oil as opposed to the control group that received no intervention. As mentioned above, mental and physical stressors elicit similar and paralleled physiological responses. Because of this, we investigated whether the same physiological

responses, namely a decrease in heart rate, blood pressure and GSR, due to exposure to lavender essential oil would be the same if someone underwent a physical stressor as opposed to a mental stressor.

Materials/Methods:

Subjects:

Twenty students enrolled at the University of Wisconsin-Madison participated in this study. There were seven male test subjects and thirteen female test subjects. All test subjects were capable of undergoing a short, yet intense cardio workout. Participants with heart conditions were excluded from participation. Participants who exhibited respiratory sensitivity to, or are allergic to various scents were also excluded.

Materials:

For the stressor, the subjects used a Gold's Gym 390R Cycle Trainer (model number GGEX67172.2, item number EE251H12397, Logan, UT) in order to raise their heart rate to 90% of their age-predicted maximum heart rate. The aromatherapy that was used was an air diffusion method. Sixty drops of 100% Pure Organic True French High Alps Lavender *Angustifolia* Essential Oil (Lot number 320WB1228213B, Minneapolis, MN) was mixed with 4.5 ounces of distilled water and that solution was sprayed, via spray bottle, into the air after the subjects had undergone physical stress. A Nonin Pulse Oximeter/Carbon Dioxide Detector (item number 118103096, model number 9843, Plymouth, MN) was used to measure heart rate before during and after exercise. An Omron 10 series + automatic Blood Pressure monitor (item number 2014100439Lg, model number BP791IT, Lake Forest, IL) was used to measure blood pressure

before and after exercise. A BIOPAC BSL EDA Finger Electrode Xdcr (item SS3LSA) along with BIOPAC Isotonic Recording Electrode Gel (item GEL101) was used to measure GSR before during and after exercise.

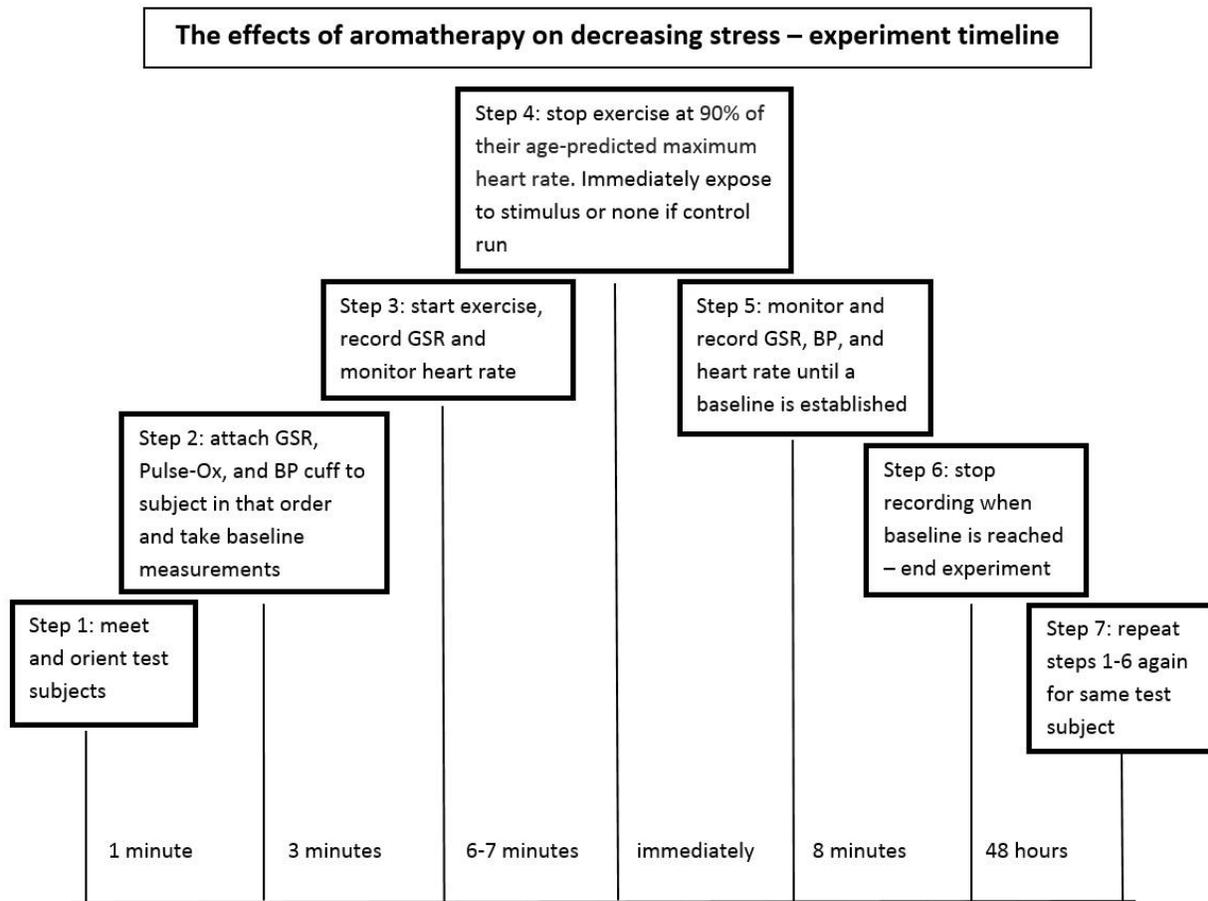
Design:

When the subject arrived, they were connected to the GSR, blood pressure cuff, and the Pulse-Ox for immediate recording to establish baseline measurements. The GSR was then recorded for the remainder of the experiment. Two minutes after the initial blood pressure measurement, a second blood pressure reading was taken. If the blood pressure readings were within 3 mmHg, the blood pressure was considered the same, and a baseline vital measurement was taken as the average of the two values, barring major differences in heart rate. If the blood pressure measurement was not within 3 mmHg, blood pressure was continuously measured until the newest measurement was within 3 mmHg of the preceding one and the last two measurements were averaged as a baseline bp.

Once baseline measurements had been established and recorded, test subjects began biking on the bike at a resistance level of 7 (out of 16). GSR and heart rate were both monitored for the duration of the stress test. Once the subject's heart rate reached 90% of their age-predicted maximum heart rate, exercise was ceased and a timer started. If the subject was receiving aromatherapy, the aroma was released immediately when the participant stopped biking. Blood pressure was simultaneously taken regardless of aromatherapy. When the participants received the lavender aroma, it was diffused into the air via spray bottle two feet in front of the subject every one and a half minutes in order to ensure quick and effective scent

diffusion. Each subject participated in both trials, with and without aroma, separated by at least 48 hours.

Blood pressure was taken every two minutes for the remainder of the experiment. When both blood pressure and heart rate had reached their baseline, time was recorded and the experiment stopped. If subjects did not reach their baseline measurement, but had consistent measurements for blood pressure and heart rate for one minute, a new baseline was established and the experiment ended.



Results:

There were twenty participants in our study (N=20), seven males and thirteen females (Refer to Figure 4). Seven participants did not exercise on a regular basis (exercised less than

three times a week) and the other thirteen did cardio, strength/condition training or both at least three times a week (Refer to Figure 3). The ages of our participants ranged from 20 to 25; 13 out of the 20 participants fell into the 21-22 age group (Refer to Figure 4). We ran a paired t-test comparing recovery time, the time from the end of exercise to a stable post-exercise heart rate. While our data was statistically insignificant with a p- value of 0.5108, it showed a slight trend toward decreased recovery time in the aroma group (experimental group) compared to the control group of 9.2 sec.

The Galvanic Skin Response test was used to determine the difference between the GSR (microSiemens) at the participant's max heart rate and at the new baseline. This was done for both conditions (with aroma and control) and then compared (refer to Figures 8 and 12). The aroma group had a difference in GSR 0.4745mS greater than that of the non-aroma group; however this was not statistically significant with a p-value of only 0.2282.

Blood pressure was also taken directly after exercise. The amount of time it took each participant to return down to baseline blood pressure was measured for both the control and experimental group. The systolic and diastolic baselines were compared separately (refer to Figures 6 and 7). After analysis of blood pressure readings, no discernible pattern was observed and no further analysis was performed. Finally, after taking each participant's heart rate from maximum to baseline post-exercise, we evaluated the difference in heart rate for both the control and experimental groups. The non-aroma group had a drop in heart rate 0.875 beats/min greater than the aroma group. These results however were also found to be statistically insignificant with a p-value of 0.7706.

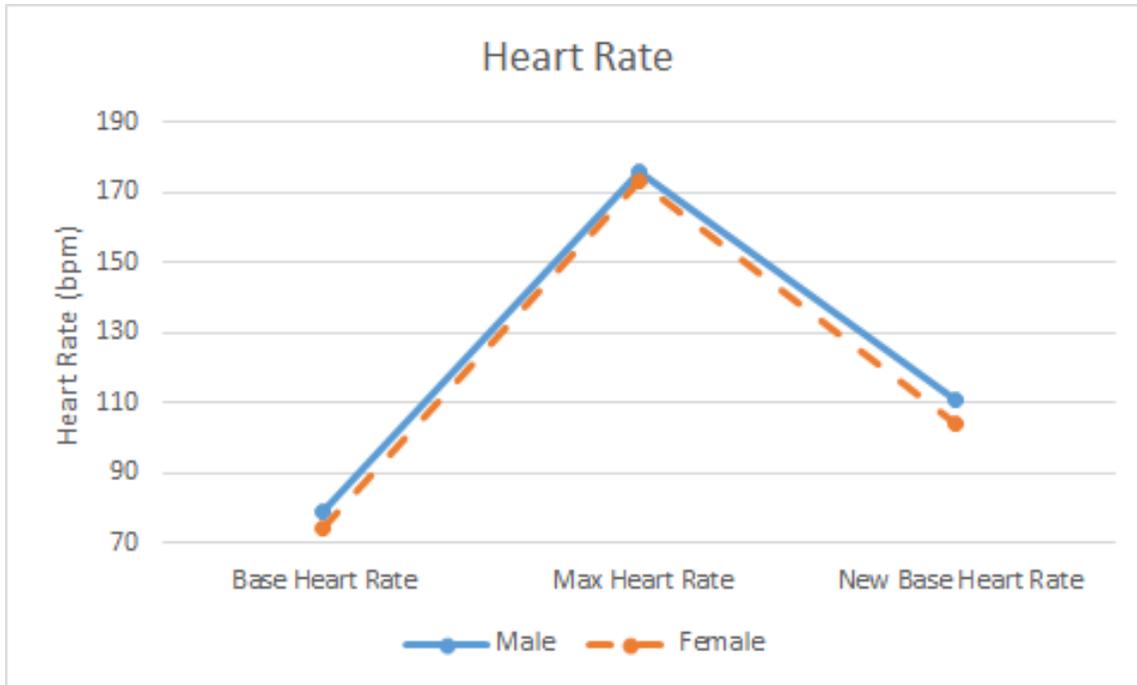


Figure 1: Shows that heart rate increases during exercise and decreases after exercise for both males and females.

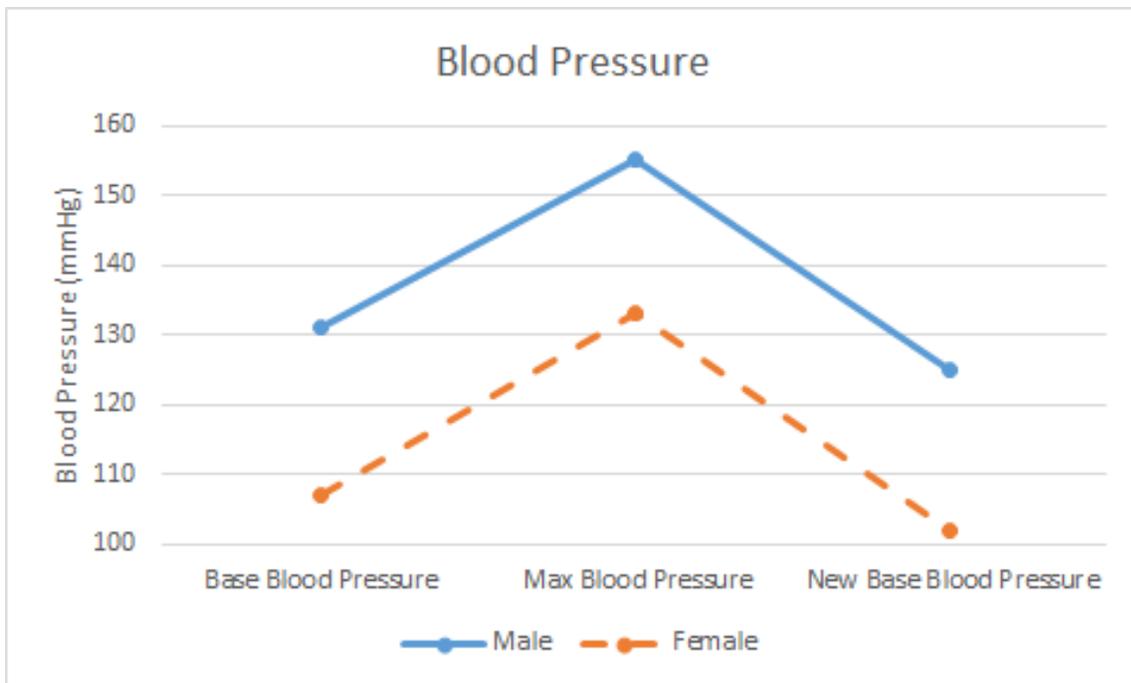


Figure 2: Shows how systolic blood pressure increases during exercise and decreases after exercise for both males and females.

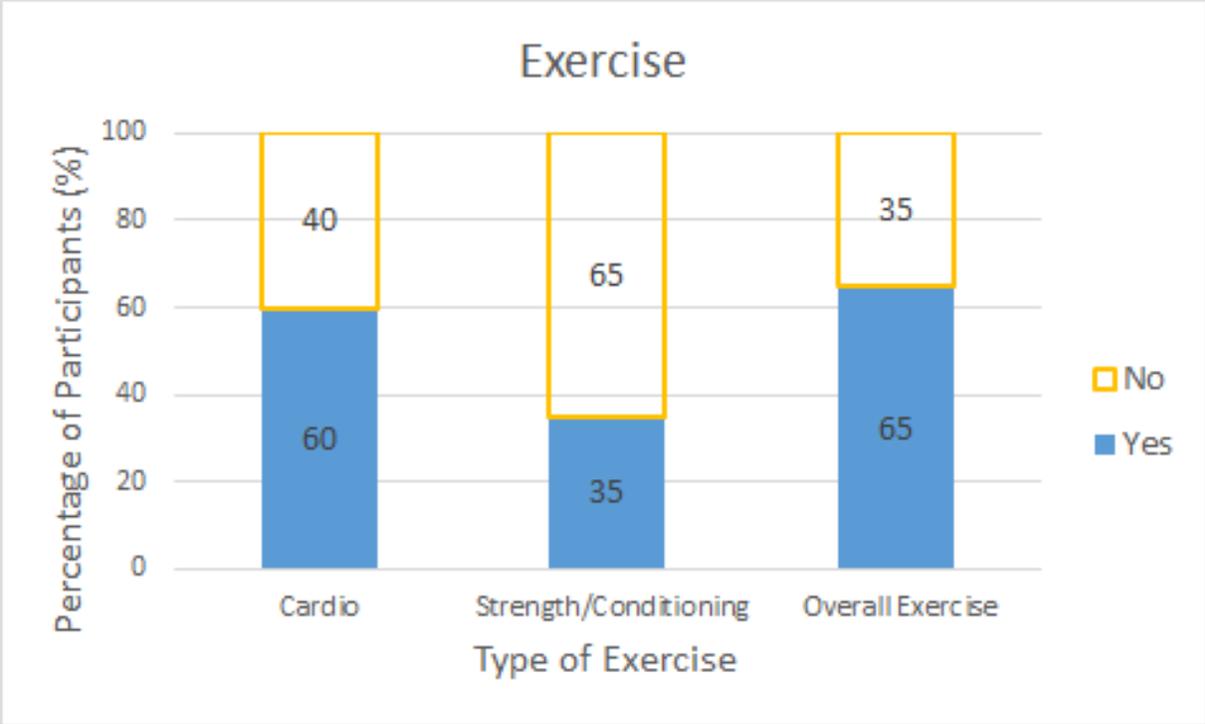


Figure 3: This figure shows the exercise habits in a percentage of participants who participated in this study. N=20

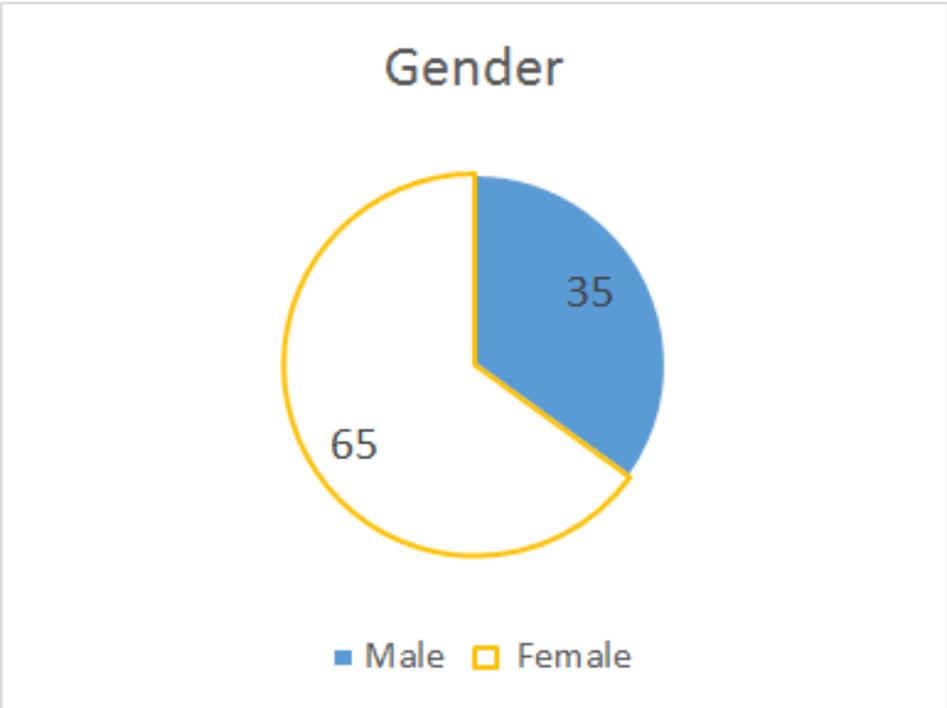


Figure 3: Indicates the percentage of males and females that participated in this study. N=20

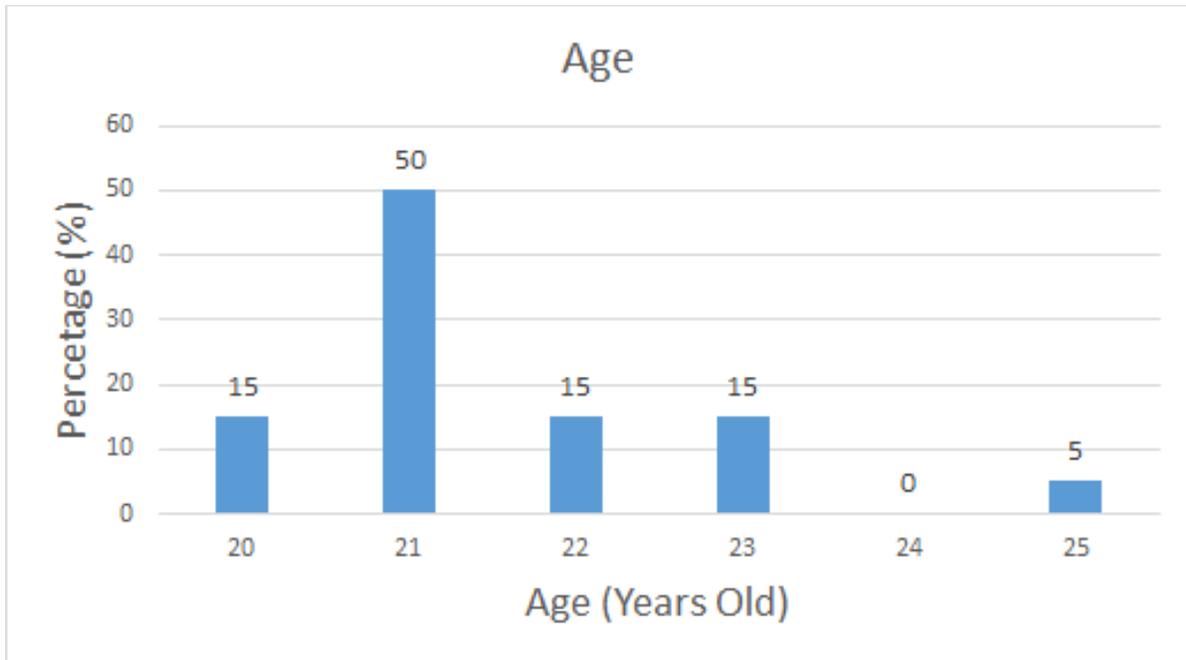


Figure 4: Indicates the percentage of each age of the participants in this study. N=20

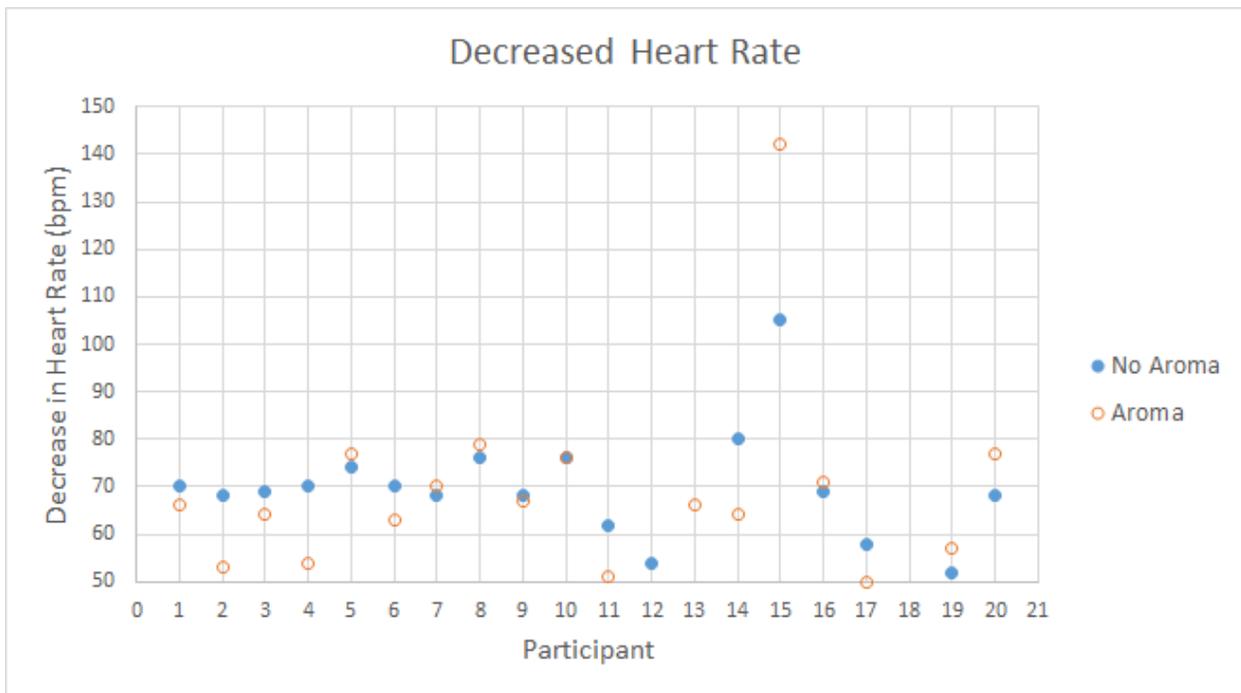


Figure 5: The graph shows how much the participant's heart rate decreased, both with and without aroma, over the time it took them to get back to baseline measurements after being exerted with physical exercise.

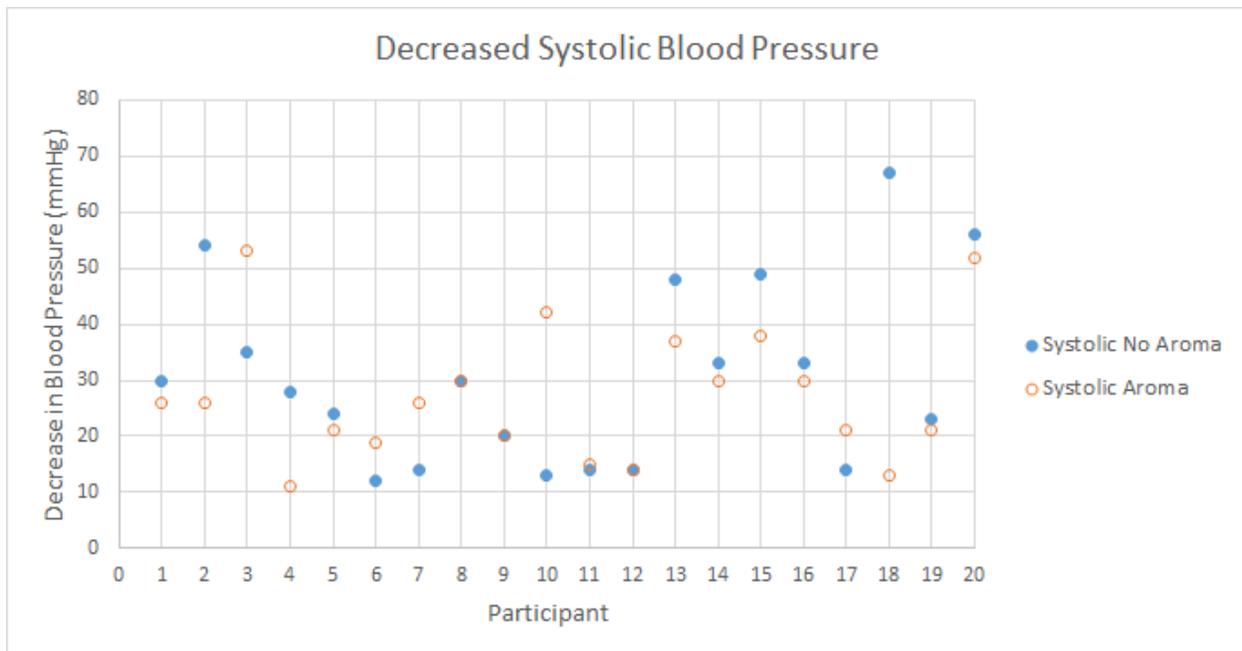


Figure 6: Indicates how much the systolic blood pressure decreased during the participant’s time back to basal measurements for both with and without aroma. The difference was calculated by taking the measurement the moment they reached their target heart rate and then subtracting that from when the participant had established a new baseline.

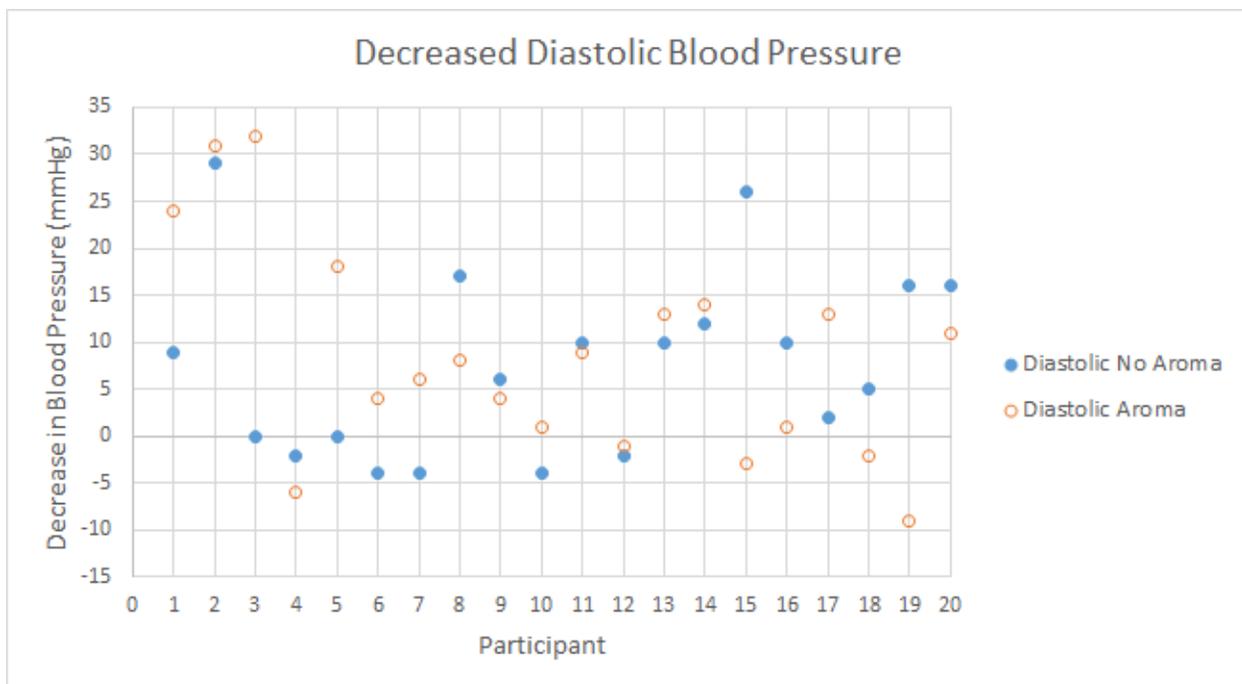


Figure 7: Indicates how much the diastolic blood pressure decreased during the participant’s time back to basal measurements for both with and without aroma. The difference was

calculated by taking the measurement the moment they reached their target heart rate and then subtracting that from when the participant had established a new baseline.

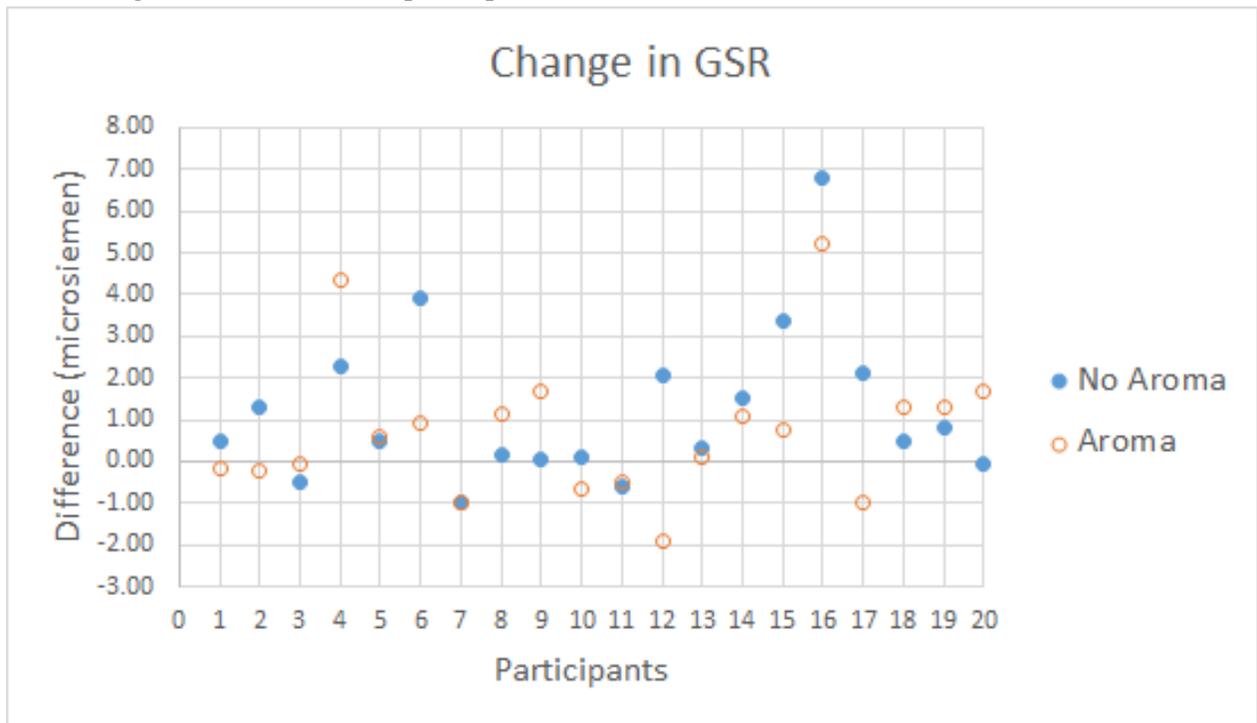
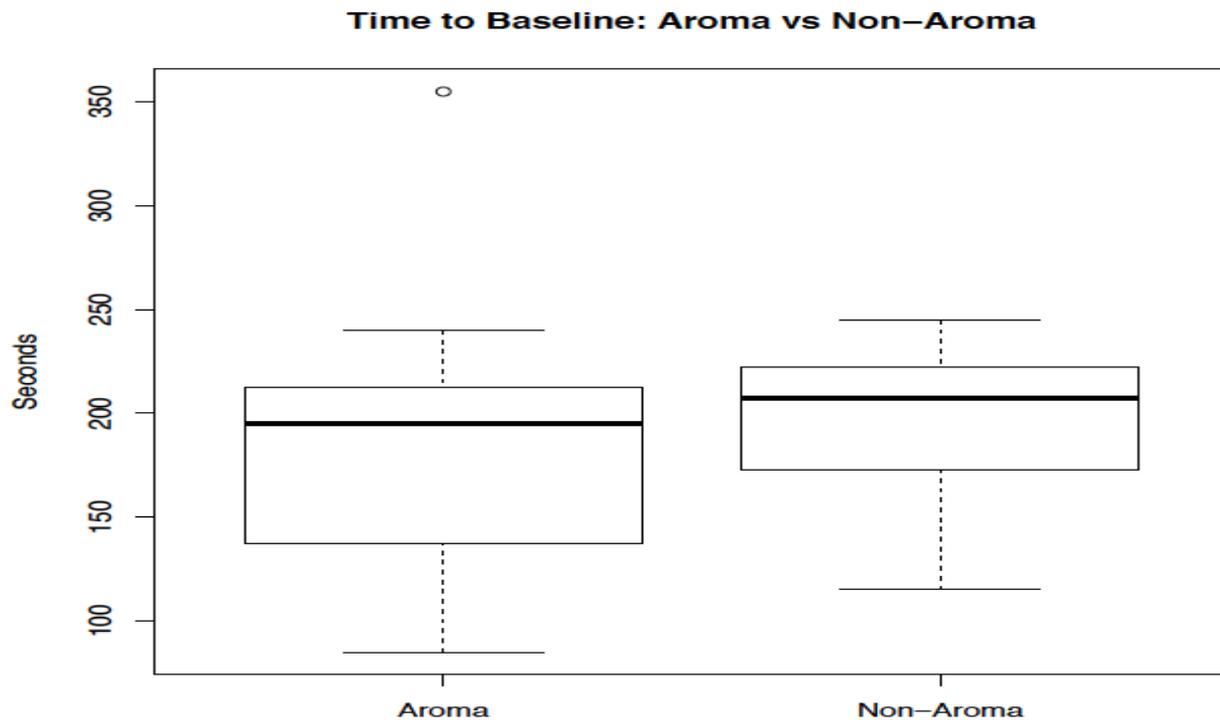
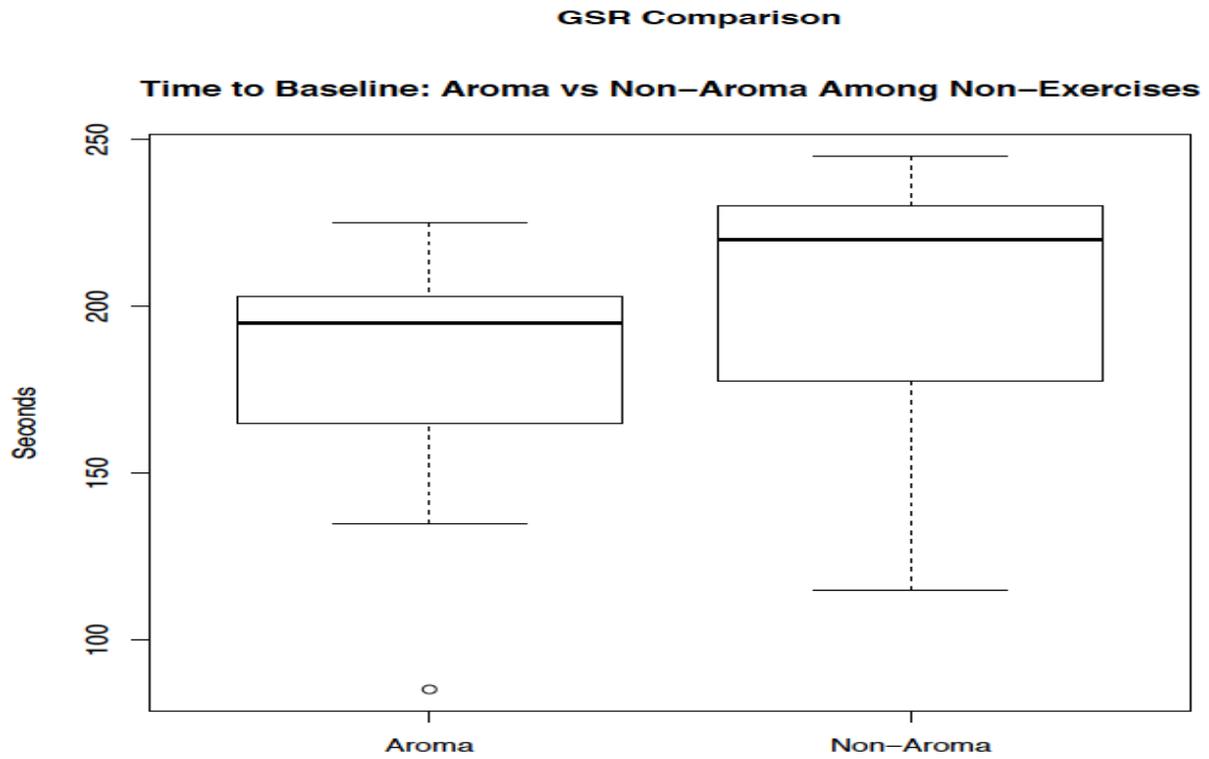


Figure 8: This figure shows the change in the galvanic skin conductance of our participants during the cool down time both with and without aroma. The difference was calculated by taking the measurement the moment they reached their target heart rate and then subtracting that



from when the participant had established a new baseline.

Figure 9: Bar graph comparing the time it took for participants to reach a new baseline heart



rate after biking, both with and without aroma. Mean: 9.2, p value = 0.5108

Figure 10: Bar graph comparing the time it took non-exercisers to reach a new baseline heart rate after biking, both with and without aroma. Mean: 22 sec, p value = 0.4117

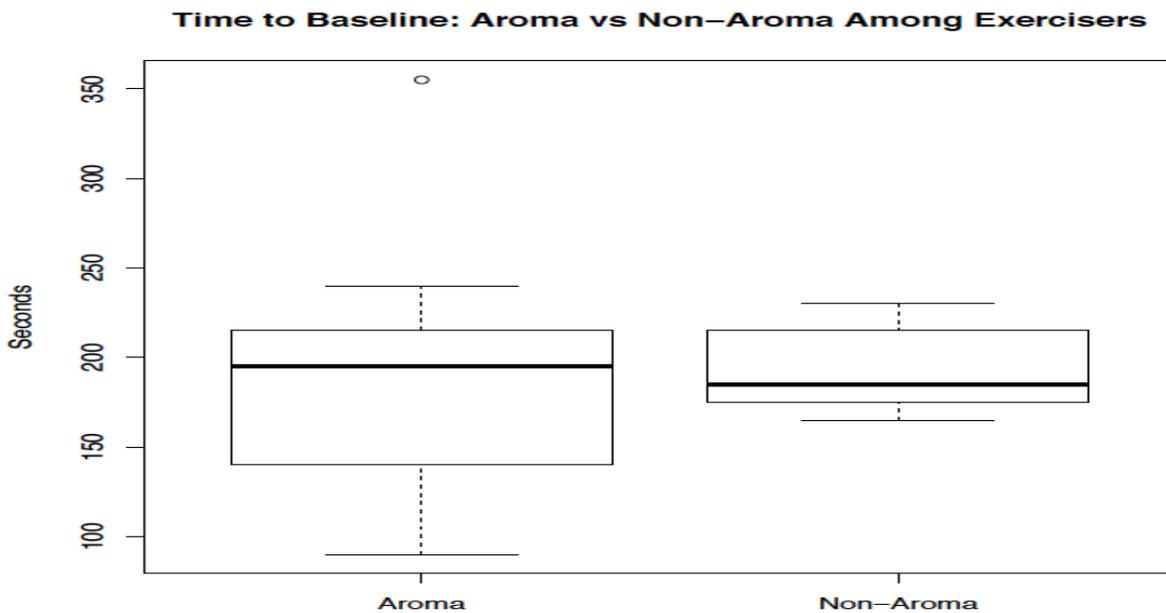


Figure 11: Bar graph comparing the time it took participants who exercised at least 3 times a week to reach a new baseline heart rate after biking, both with and without aroma. Mean: 2.308, p value = 0.8927

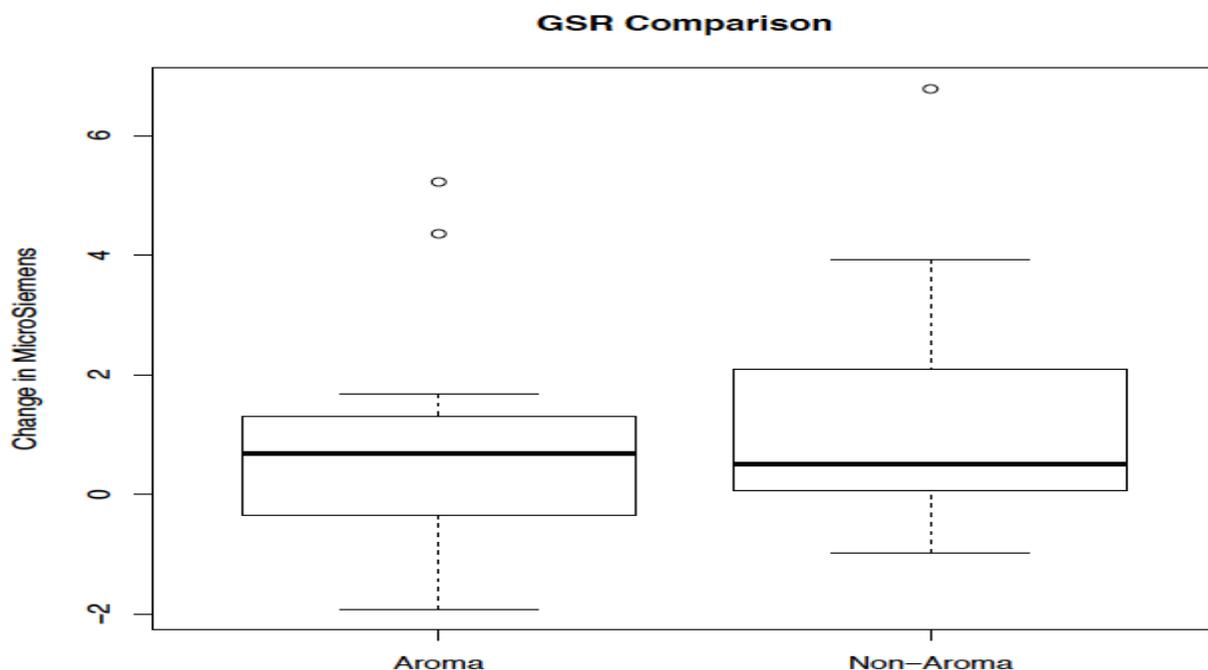


Figure 12: Bar graph depicting the difference between the average GSR for 1 sec before participant reached max heart rate and stopped biking and the average GSR for 1 sec when the participant had reached their new baseline heart rate. Aroma and non-aroma trials are compared. Mean: 0.4745, p value = 0.2282

Discussion:

Our hypothesis that lavender would decrease physical markers of stress following acute exercise was disproved by our study. While we found a trend toward decreased recovery time in the experimental group compared to the control, our findings were not statistically significant and we were therefore unable to conclude the meaning of increases or decreases as causative or correlated with respect to lavender aroma exposure. The average change in GSR was greater for the group exposed to lavender compared to the control group, suggesting a greater drop in the stress level when aromatherapy was administered, but this as well was not statistically. Finally,

the blood pressure readings showed a consistent trend downwards upon recovery in the control group however the data yielded no detectable trend towards a faster recovery with the treatment group with aroma.

Overall, there are several factors that could have contributed to the results yielded in our experiment. One factor could have been our limited sample size, where significance of our experiment might have been shown given a larger sample size. However, we are unable to say for certain that a larger sample size would have demonstrated significance. This study also took into consideration other potentially confounding factors that included sex and exercise frequency. However, because our data was found to be insignificant, we were unable to make inferences to the effect that these factors may or may not have contributed to the efficacy of aroma on test subjects. We would like to point out, however, that exercise frequency did appear to have an effect on response to aromatherapy. When participants were separated by exercise frequency, the non-exercise group had a much faster recovery time with aroma compared to their control trial.

Finally, we would like to address some important limiting factors that were encountered throughout the testing process. The first with respect to our limited sample size. Due to time constraints, only twenty people were tested twice. Another difficulty we encountered was the stabilization of the Pulse-Ox finger monitor on the participant's fingers. Because our study required the subjects to participate in intense exercise, their movement during exercise often led to the displacement of the Pulse-Ox finger monitor leading to a difficulty with reading and gauging the participant's target heart rate. Finally, it was impossible for us to distinguish between mental and physical stress in our task. From comments of participants, the biking test was at least moderately mentally stressful as well as physical, and we cannot attribute our results

to solely physical stress. This might explain the difference between non-exercise and exercise groups. Participants with experience exercising may have been less nervous or anxious biking in front of a group and less mentally stressed about reaching the target heart rate. Aromatherapy, therefore could be exerting a moderate effect by reducing their mental stress rather than physical stress.

After we tested our intended pool of participants, there were some alterations to the study design that could be made and considered in the future. One change could have been how we controlled our groups. During testing, we had a control group exercise intensely with no exposure to anything except the air of the testing room. A way to improve this could have been to use water in a spray bottle and spray that in a similar fashion to our experimental group so that the only factor that differs between the control group and the experimental group is the lavender aroma and not the whole aerosol mechanism. An additional factor that could have been considered was to randomize our trials. Subjects in this study first underwent the control then the experimental trials and order of the trials could have had an effect on their response.

A final factor that could have been considered was to use the same number of male-identified participants to female-identified participants. This is important just for the idea that their physiologies are different and if they contribute equally, we can more accurately infer that any potential discrepancies in results are not a result of the disproportion of sexes.

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Acknowledgements:

The authors of this paper would like to thank Dr. Andrew Lokuta and the Department of Physiology at UW-Madison for allowing us to use the facilities and equipment to perform our tests and the peer learning assistants and teaching assistants of Physiology 435 for their assistance through the process of testing and writing this paper. Additionally, we'd like to thank Nick Zeller for his assistance in statistical data analysis. Finally, we'd like to thank our participants for their help, without whom, this paper would not have been written.

