The Effects of Rose Oil Aromatherapy on Test-Taking Anxiety



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Submitted to the Psychology Department, Allegheny College

in partial fulfillment of the requirements for the degree of

BACHELOR OF SCIENCE

April 1st, 2019

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Acknowledgements

This project was the most challenging academic task I've ever completed, and I am so proud of this accomplishment. I wouldn't have been able to complete it without my strong support system of friends, family, and professors. I am so grateful for all of you.

Professor Jackson, you are incredible. I can't thank you enough for all of the time you've spent guiding me not only through this project, but my two years at Allegheny. Most importantly, thank you for helping me overcome my anxieties and fears the whole way through this journey. You've allowed me to understand that my anxiety is conquerable, and I can do anything I set my mind to. Just know, anxiety has got nothing, and I repeat, nothing on us! Professor Conklin, thank you so much for your input on my project. You gave me such important ideas to incorporate into my methodology and research, and I am very grateful for your help.

Hope, you always know how to pick me up on my absolute worst days. Even when I slip in the mud, you never hesitate to help me clean it off. I can't wait to overeat Uncle Sam's with you after graduation. To the rest of my housemates at Flavortown, you may not know this, but you all kept my head held high during this process. On my hardest days, I'd always look forward to coming home to our crazy household shenanigans. Yes, this includes Jason, Kelsey, Veronica, and Nala too. You too Caitlin, I miss you.

Jourdan, thank you for motivating me every single day. You listened to all of my worries and struggles, and you constantly assured me that I was capable of overcoming them. I'm so thankful to have you by my side. Finally, to my family, thank you for always praying for me and pushing me to succeed. You always made sure I had everything I needed and more, and I don't know where I would be without you guys.

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Abstract

Aromatherapy using essential oils has been studied as a cost-effective, non-pharmacological, widely available intervention, and studies support the anxiolytic effects of lavender, peppermint, sweet orange, and rosemary (e.g., Dunnigan, 2013). However, there is a paucity of research on the anxiolytic effects of rose oil. Twenty-nine undergraduate students were recruited to participate in this mixed-model experiment which examined the effects of rose oil aromatherapy on test-taking anxiety. Test-taking anxiety was measured using the State Trait Anxiety Inventory (The STAI, 2018). Participants were randomly assigned to one of the three conditions: rose oil, lavender oil, or the control group, which received no aromatherapy. All participants were instructed to complete a math matrices task (Amir, Ariely, & Mazar, 2008) before reporting their state anxiety for a second time. Results showed limited support for the hypotheses that rose and lavender oil aromatherapy would decrease anxiety scores amongst the participants. However, it was found that the perceived pleasantness of the conditions could play a role in the potential calming effects of aromatherapy. More research is needed to fully explore the anxiolytic effects of aromatherapy and rose oil in test-taking conditions. Limitations and future directions are discussed.

Keywords: Test-taking anxiety, rose oil, lavender oil, aromatherapy

The Effect of Rose Oil Aromatherapy on Test-Taking Anxiety

Imagine that you are in the middle of taking an exam in one of your college classes. You are on the second page when you approach a question that you are completely unfamiliar with. You notice your heart begins to speed up, your palms start to sweat, you can no longer take a deep breath, and you suddenly cannot read for comprehension. In this situation, you have imagined what it is like for individuals with test-taking anxiety. Aromatherapy using essential oils has been studied as a cost-effective, non-pharmacological, widely available intervention, and studies support the anxiolytic effects of lavender, peppermint, sweet orange, and rosemary (Dunnigan, 2013; Goes, ,Antunes, , Alves, , & Teixeira-Silva, 2012; Kinzelman, McCaffrey, & Thomas, 2009). However, little is known about the anxiolytic effects of rose oil, a common ingredient of many cosmetics that has lately experienced a renaissance of sorts (Chang, 2012). The goal of the present study is to expand existing work by testing if rose oil has any effects on the symptoms of test-taking anxiety.

Test-taking anxiety

Test-taking anxiety (TTA) can be defined as a "state" distinguished by persistent symptoms of anxiety in testing conditions often sparked by a pressure to do well (Mocanu & Sterian, 2013). Students who experience TTA can encounter decreased performance on cognitive and intellectual tests; this can be a challenge for many students. Data show that about 30% of American school aged children and students have faced symptoms of test-taking anxiety to some degree (Mocanu & Sterian, 2013). TTA does not have its own Diagnostic and Statistical Manual (DSM) diagnosis, however, it can be categorized as a form of social phobia, which is included in the DSM-5 (Zuriff, 1997). Symptoms of TTA can include dry mouth, accelerated heart rate,

excess sweating, stomach aches, dizziness, and uncontrollable urination sensations in test-taking situations. These symptoms make it difficult for students to concentrate on their exams, which consequently can lead to poor exam results (Mocanu & Sterian, 2013). Test-taking anxiety can greatly impact a student's academic performance, however, there may be interventions to address this problem.

In the United States, the total economic cost for all mental disorders was $147.8 billion in 1990, and anxiety disorders made up almost one third of that amount at $46.6 billion (Rice & Miller, 1998). Since TTA has the potential to hinder academic potential, it is necessary to explore interventions to counter the issue in ways that supplement cognitive-behavioral therapy and are proactive, fast-acting, cost-effective, and safe. Given the cost and limited access to mental healthcare, it is essential to research interventions that will be accessible to all people regardless of income or health insurance.

Aromatherapy is one well-known, cost efficient intervention that has shown some promise in symptom relief for people suffering from anxiety disorders. It is the use of aromatic essences from plants to promote a healthy mind and body. These aromatic essences are commonly referred to as essential oils, and they are made up of several organic compounds that may have therapeutic benefits (Jones & Reis, 2017). Several essential oils are known for their calming and relaxing effects on the mind and body including but not limited to, lavender, rosemary, sweet orange, and peppermint.

Essential Oil Aromatherapy and Test-Taking Anxiety

Aromatherapy is the process of inhaling essential oils from aromatic plants; once the oil is inhaled, receptors in the nose become activated, and neural signals are sent to the limbic

system, specifically the amygdala. Studies have shown that essential oils may be psychologically and physiologically effective, but the research on the physiological mechanism of aromatherapy is very scarce (Lis-Balchin, 2006). It is possible that perceived pleasantness of essential oils could affect anxiety levels in participants, but it is also possible that there is a biological mechanism that is responsible for the effectiveness of the oils. For instance, the amygdala is a part of the brain that is responsible for emotional responses to stimuli, and it has been shown that some essential oils can trigger positive and negative emotions in this system. For example, one study found that pleasantly rated odorants, like vanillin and menthol, evoked happiness and surprise in the participants, while unpleasantly rated odorants, such as propionic acid, evoked feelings of disgust and anger (Alaoui-Ismaïli, Robin, Rada, Dittmar, & Vernet-Maury, 1997). Not only can positive and negative emotions be triggered, but anxiety symptoms can also be affected (Bowman, 2015). To illustrate, lavender is an essential oil that is known to be useful for relaxation purposes and anxiety control; the oil that is extracted, often from the *lavandula angustifolia* plant, has parasympathetic effects which can lead to decreased stress and anxiety levels (Lankford, 2017). The effects of lavender are similar to the responsibilities of the parasympathetic nervous system, which include the "rest and digest" functions of the body (McCorry, 2007), however, more research needs to be conducted on the mechanisms behind these similar effects.

Previous research has found evidence that essential oil use can affect the symptoms of TTA; one study focused on the effects of lavender and rosemary essential oil aromatherapy on nursing students' TTA levels. This study was performed on nursing students because their exams are generally very stressful and demanding. Using a quasi-experimental design with pre and

post-test measures, the researchers studied a group of 40 participants over the course of three examination periods; therefore the group acted as its own control, and each member participated in the different experimental sessions. The researchers observed the participants in pre and post test conditions by measuring their blood pressures, pulse rates, and test-anxiety scale (TAS) scores before and after the examination sessions. The first examination was utilized as a control measure to discover the participants' baseline stress and anxiety levels. The participants completed the TAS and received blood pressure measurements before and after the examination without the use of aromatherapy. The second examination period was similar to the first, except the participants were instructed to use an inhaler containing lavender once before the exam and as needed during the exam. The third session was also similar to the first, but the participants were instructed to use an inhaler containing rosemary in the same manor. The inhalers contained an essential oil soaked cotton ball, and each cotton ball contained 3 drops of the essential oil being tested. After the trials, the researchers held meetings with each participant to discuss possible stress reducing and anxiolytic effects of their trials. The researchers analyzed these conversations to gain a better understanding of the results of aromatherapy. It is important to note that verbal conversations about anxiety may have produced demand effects, however the differences in TAS scores in pre and post test conditions showed a significant decline in self-reported anxiety for both aromatherapy conditions. When aromatherapy was not used, test anxiety levels stayed the same in the pre-test conditions and post-test conditions (Kinzelman, McCaffrey, & Thomas, 2009). This study showed that both of the aromatherapy conditions demonstrated significant decreases in anxiety amongst the participants, however, there were some limitations that could have affected the results. For example, demand effects may have

affected the results of the study because the participants were being asked to interpret and discuss how they felt after the trial. This could have prompted the participants to respond as if the inhaler treatments reduced anxiety because they may have thought that was the purpose. It is evident that both aroma conditions showed a decrease in anxiety scores, so this raises the possibility that the effects of the essential oil are psychological rather than biological. The quasi-experimental design used in this study could also be problematic because the researchers used the same group of participants for each examination session. As a result, there was no use of random assignment, which threatens the internal validity of the study because self-selection or third-variables, such as personality differences, could have influenced the results. Hence, the present study will utilize an experimental design to counter this issue.

Another study found that inhaling lavender from a soaked cloth decreased TTA in nursing students (Kavurmaci, Kucokoglu, & Tan, 2015). The students were randomly assigned to experimental and control groups with the use of odd and even numbers according to their class name list. The experimental and control groups were tested in two separate but identical rooms. Researchers placed non absorbent cloth with three drops of lavender oil on each testing table, about 15-20 centimeters away from the students' noses. The researchers allowed the cloth to sit in the testing classroom for 15 minutes to attain a smell homogeneity in the atmosphere before the experiment began. After the initial 15 minute period, the experimental group students were taken into the classroom, and after another 15 minute period of inhalation, they were given the State Trait Anxiety Inventory (STAI) to assess their state anxiety levels before the exam. After they completed the STAI, they were given their exams. The control group followed the same procedure, except no intervention was applied to their room. Results showed that the

participants' mean STAI scores were lower in the experimental condition than the mean scores in the control condition (Kavurmaci, Kucokoglu, & Tan, 2015). These results demonstrate that lavender aromatherapy can have beneficial effects on state anxiety levels before an exam, and they could potentially help nursing students deal with their stressful testing situations. College students generally experience similar stressful testing demands, therefore essential oil aromatherapy may benefit them as well. It is important to note that perceived pleasantness of the conditions was not assessed in this experiment, so this variable should be considered in replications of the study.

It has been found that several other essential oils have similar calming effects in stressful environments. Namely, sweet orange essential oil has been found to have anxiolytic effects on the human body. In one study, participants were instructed to complete a Stroop Color-Word Test, which was meant to elicit anxiety. The participants in each of the three experimental groups were exposed to 2.5, 5, or 10 drops of sweet orange essential oil during the test, while the control group received no intervention. The essential oil drops were placed on a surgical mask, and the inhalation period lasted 5 minutes per trial in the experimental group (Goes, Antunes, Alves, & Teixeira-Silva, 2012). Results showed that of the three doses, 2.5 and 10 drops showed anxiolytic activity, but 10 drops were most effective at reducing anxious symptoms during the task. Participants who received these doses had fewer anxiety symptoms in comparison to the control group who had increased anxiety symptoms; the STAI score findings were not significant, but researchers still made note of the anxiolytic effects of sweet orange aromatherapy (Goes, Antunes, Alves, & Teixeira-Silva, 2012). There were several limitations to this study that need to be taken into consideration; first of all, the sample size was relatively small. In addition,

the researchers only recruited male graduate students to participate in this study. These results are not representative of the populations within many education settings, therefore the current study will include a similar amount of men and women.

In addition, participants in one study performed better on a vigilance task when scents of peppermint oil were delivered periodically throughout the 40 minute task. The task required the participants to look at a computer screen at several lines with a dot centered in between them and to tell the researchers when they saw slight changes in the line placements. The participants wore surgical masks and received 30 second inhalations of the fragrance every five minutes. These researchers used a fragrance delivery system that required 5 pellets of peppermint for that specific trial. Results showed that the participants who received peppermint oil in their masks performed better on the vigilance task than the trial which tested muguet essential oil. Since the vigilance task was similar to a testing environment, these results suggest that peppermint oil could improve attentiveness during a testing situation (Warm, Dember, & Parasuraman, 1991).

Studies have been done observing the anxiolytic effects of lavender, rosemary, peppermint, and sweet orange oils in stressful testing environments, however there is little to be found on the effects of rose oil in a test-taking environment. Rose essential oil has been found to have anxiolytic effects on the body (Setzer, 2009), so it is essential to observe if the anxiolytic effects of rose oil would be present in a testing environment as well.

Rose Essential Oil Aromatherapy

There are several commercial variations of rose products including essential oils, rosewater, and dried flower products. Not only is the plant used in commercial products today, but rose has been considered an ancient remedy in several Eastern cultures. Specifically, Middle

Eastern cultures refer to rose, otherwise known as *Rosa Damascena*, as the flower of the Prophet Mohammed because it was used as an ancient treatment for several health problems such as abdominal pains, chest pains, and digestive issues (Mahboubi, 2016). According to more recent studies, rose oil consists of 2 important components that are proposed to be responsible for its calming effects; sytrinol and 2-phenyl ethyl alcohol. (Kheirkhah, Pour, Nisani, & Haghani, 2014). These chemicals are believed to be responsible for the anxiolytic effects seen with the use of rose oil aromatherapy. Alongside those 2 important components, rose oil also contains phenolic acid, flavonoids, kaempferol, geraniol, linalool, and citronellol, which all take pharmacological action in the central nervous system (Dolati, Rakhshandeh, & Shafei, 2011). One study found that rose oil was associated with a significant decrease in oxyhemoglobin concentration in the right prefrontal cortex and an increase in feelings of relaxation (Igarashi, Ikei, Song, & Miyazaki, 2014). More research is necessary to determine the specific brain pathways that are associated with the potential anxiolytic effects of rose essential oil.

The effects of rose oil aromatherapy on TTA have yet to be explored specifically. Past research suggests that rose oil could have anxiolytic effects on participants with TTA because it had similar effects in other stressful situations. Many studies have explored the effects of essential oils that are more commonly known to be associated with relaxation, such as lavender, on TTA. It has been found that lavender may inhibit sympathetic nerve activity through activation of H-3 receptors in the brain (Koulivand, Khaleghi, & Gorji, 2013). It is important to highlight the physiological and chemical similarities of lavender and rose. For example, the two essential oils both share a chemical called linalool, which was found to be responsible for a decrease in beta wave activity after inhalation in a group of participants aged 20 through 26

(Perry & Perry 2006). These potential CNS depressant effects of linalool may occur due to modulation of the components of the glutamatergic system or through the inhibition of ion channel activity or neurotransmitter release (Perry & Perry 2006). The synaptic alteration may affect the intercellular cyclic adenosine monophosphate also known as cAMP (Lis-Balchin & Hart, 1999). When cAMP activity decreases, sedative effects may be observed on the body. Not only this, but linalool has been previously found to be associated with muscle relaxant activity, otherwise known as spasmolysis. It is suggested that the spasmolytic effects of lavender may be associated with cAMP activity as well (Lis-Balchin & Hart, 1999). It is possible that the shared chemical, linalool, could be responsible for the relaxing effects associated with lavender and rose oil aromatherapy.

There are very few controlled studies on rose essential oil aromatherapy and its anxiolytic effects; however, the few studies that have been done show that rose oil may have possible anxiolytic effects on animals and humans. One study demonstrated that rose essential oil promotes anti conflict effects in mice, meaning that the oil had anxiolytic effects on them in stressful experimental settings. Researchers conducted experiments on mice where they were put cages with either food or water, and they were shocked after a certain amount of consumption. The mice that were injected with rose oil before the experiment had an increased response rate in comparison to the control group. This means that rose oil produced anti-conflict effects in the mice, which encouraged them to continue eating despite the shocks. This suggests that this oil may take pharmacological action against anxiety in humans as well (Umezu, 1999). In addition, another study found that rose essential oil helped rats deal with a high-anxiety situation that included an elevated plus maze (EPM), which is an elevated, open area used to measure anxious

behavior in mice (de Almeida, 2004). Researchers placed several rats in several separate EPMs; some mazes utilized different concentrations (1.0%, 2.5%, and 5.0%) of rose essential oil emulsions, while the control maze utilized only saline (de Almeida, 2004). Rats in the rose oil conditions spent more time exploring and visiting the most elevated sections of the maze in comparison to the control group. This shows that rose oil may have had anxiolytic effects on the rats because they were less fearful of the maze and more willing to explore it. Furthermore, one study found that an aqueous extract of *Rosa Damascena* had antidepressant effects in mice during a swimming test. A 15 milligram dose of the extract was injected into the mice, and 30 minutes after the injection their swimming performances were observed. The results showed that the experimental group had improved swimming times and decreased immobility times. Those results are significant because the symbol of depression in animals is immobility, and a small dose of rose oil decreased immobility, therefore decreased levels of depression in the mice. This research raises the possibility that rose essential oil could have anxiolytic and antidepressant effects on the human body. It should be noted that there is a significant difference between injection and inhalation of essential oils, however these studies show that there may be a physiologically effective mechanism of rose oil. Researchers believe it is possible that the anxiolytic effects of rose oil inhalation could be short-lived because humans adapt to smells quickly, possibly making injections more powerful (Umezu, 1999). Still, the logistics of receiving injections negate some of the characteristics that make essential oils so promising as cost-effective, fast-acting interventions that require no technical skills.

Several studies do suggest, however, that the inhalation of rose oil may be effective in humans. For instance, in a randomized clinical trial study on women in labor, anxiety symptoms

decreased in the participants after using a hot rose oil aromatherapy foot bath in comparison to the control group, which only received routine care during labor (Kheirkhah et al., 2014). There were two experimental groups incorporated in this study; the first experimental group received a warm foot bath with a 1% distilled rose oil solution for ten minutes, while the second experimental group received just the warm foot bath without the essential oil. The results showed that the rose oil foot bath aromatherapy was associated with the decrease in sympathetic stimulation in comparison to the control group and therefore contributed to the reduction of their anxiety symptoms during labor. Furthermore, a four week randomized controlled clinical trial on 46 hemodialysis patients found that the inhalation of rose water fragrance significantly decreased participants' state trait anxiety levels in comparison to the control group, which received no intervention. The participants were instructed to place three rosewater drops on a cotton handkerchief every night before bed and before each dialysis session; each inhalation session lasted 15-20 minutes (Barati, Nasiri, Akbari, & Sharifzadeh, 2016). Since rosewater significantly decreased their state trait anxiety scores, it is possible that rose oil aromatherapy could have similar effects. It is necessary to note that this study did not utilize a second experimental group, so it is difficult to tell if the effects were due to the actual scent of rose or if the general smell condition itself.

Not only has some research found that rose oil has anxiolytic effects, but it has been found that it may be associated with pain relief as well. One study tested the effects of rose oil aromatherapy by conducting a randomized clinical trial on 50 burn patient victims. After assessing their baseline pain levels, patients in the experimental group were asked to inhale five drops of damask rose essence distilled in water, while the control group received only drops of

water. Results showed that there was a significant difference in pain intensity levels before and after aromatherapy in the experimental group. In comparison to the control group, there was also a significant decrease in pain severity after aromatherapy (Bikmoradi, Harorani, Roshanaei, Moradkhani, & Falahinia, 2016). In addition, another study explored the effects of damask rose on the severity of postoperative pain following knee joint surgery. In this quasi experimental clinical trial, two hospitals participated in the experiment, and a coin toss was done to determine which hospital would be the experimental group and the control group; each hospital had a sample size of 40 people. Initial pain levels were evaluated with a pre-test, and intervention followed directly after. The aromatherapy intervention for the experimental group included 3-4 drops of Damask Rose Essence mixed with a small amount of saline in a plastic zipper bag. Patients inhaled this mixture for about two minutes, holding the zipper bag one to two centimeters away from their noses. The aromatherapy intervention for the control group contained only distilled water. Results showed that the rose oil aromatherapy had significant effects on pain reduction in the surgery patients, and it decreased the overall pain of the elderly as well (Bastani, Kia, & Haghani, 2016).

Another study found that rose oil aromatherapy helped to improve PMS symptoms in a group of women. This double-blind randomized clinical trial received five minutes of rose oil aromatherapy twice daily for five days during their luteal phases. Separate laboratory professionals prepared the essential oils for the trials, rather than the study investigators. The experimental group received 4% rose oil aromatherapy twice daily for five days over the course of the luteal phases of their menstrual cycles. The researchers asked the participants to administer their aromatherapy by placing ten drops of the essential oil onto an absorbent pad.

After this, they were instructed to hold the pad about 30 centimeters away from their noses and to inhale for five minutes. The control group followed the same procedure, but they were given 100% sweet almond oil, which is a lightly fragrant carrier oil. Results showed that the rose oil aromatherapy helped to alleviate the psychological, physical, social, and total symptoms associated with PMS. The control group did not experience these same improvements (Heydari, Abootalebi, Jamalimoghadam, Kasraeian, Emamghoreishi, & Akbarzaded, 2018). This suggests that rose oil aromatherapy has anxiolytic effects along with pain reducing effects. Researchers also found that rose oil aromatherapy was associated with pain relief in women with dysmenorrhea, or painful menstrual cramping. The experimental group received 2% rose oil aromatherapy through the use of electronic vaporizers along with an anti inflammatory treatment (NSAID). The vaporizer was placed one meter above the participants, and it was designed to spray the aroma every 10 minutes. The control group only received NSAID treatment alone. The pain measurements of the women in the experimental group were significantly lower than those in the control group. This study shows that rose oil may be effective at reducing pain in women with dysmenorrhea (Uysal, Doğru, Sapmaz, Tas, Çakmak, Ozsoy, & Esen, 2016).

Not only has rose oil shown some effects as an anxiolytic pain reducer, but it also has been shown to improve sleep quality. This was tested in a study on 60 hospitalized patients in a coronary care unit (CCU). The CCU patients who were placed in the experimental group received Rosa damascene aromatherapy for three nights. Researchers applied 3 drops of rose oil on a paper towel and attached the towel to the side of each patients' pillow for 8 hours per night. It is important to note that the control group was receiving routine sleep care, which included reducing environmental noise and light. The experimental group received the same routine sleep

care in addition to the rose oil aromatherapy. The researchers found that rose oil aromatherapy significantly reduced sleep disturbances, sleep latency, and also improved sleep quality and duration in comparison to the control group (Hajibagheri, Babaii, & Adib-Hajbaghery, 2014). Though promising, most of the studies conducted with human participants compared rose oil to fragrance-free controls. This leaves open the possibility that it is the fragrance, rather than anything specific to rose oil, that may account for some of the observed effects. Perhaps the mere presence of a reasonably pleasant smell helps participants re-evaluate their pain and symptoms of anxiety.

Appraisal

It is evident that there may be a biological association to the anxiolytic effects of rose oil aromatherapy, however, research shows that hedonic value could also have an impact on its results (Broughan, 2004). It is possible that an individual's perceived hedonic value of a scent could significantly affect the results of an aromatherapy session. If someone thinks that an essential oil has an unpleasant smell, it is likely that the intervention will not be very beneficial for them. On the other hand, if an individual thinks the scent of an essential oil is pleasant, they may observe more beneficial results. For instance, one experimental study found that exposure to hedonically pleasant odors was associated with improved vigilance task scores (Ruhl & Dember, 1999). Participants were asked to press the spacebar of a computer less than two seconds after seeing a stimulus appear on the screen in order to receive a correct detection. Before the experiment, researchers had the participants rate four different substances based on their perceptions of pleasantness. The scents that were rated most pleasant were clementine and vanilla bean, and the least pleasantly rated scent was butyric acid. Researchers used these three

substances for the experimental group trials, while the control group only received water vapor. Each participant completed a vigilance task in a room with one of the four conditions being released by a fragrance delivery system. According to the findings, both clementine and vanilla bean scents were associated with higher correct signal detection rates than the control group. The participants in the butyric acid condition performed worse on the vigilance task than the control group, meaning they falsely detected signals more often (Ruhl & Dember, 1999). This shows that negative hedonic value of a scent could affect how participants perform on a task. It is possible then, that aromatherapy may not be as effective if an individual dislikes the scent being used. In other words, the benefits of aromatherapy could depend on the perceived pleasantness of the scent.

Expectancy Effects

The anxiolytic effects of aromatherapy could also be associated with expectancy effects of the intervention itself. In other words, some researchers believe that aromatherapy is an ineffective treatment but an effective placebo (Chamine & Oken, 2015). To illustrate, researchers found that verbally induced expectations are associated with the effectiveness of aromatherapy. The researchers studied the effects of aromatherapy on a stressful task performance followed by a cognitive task, while also assessing expectancy effects. Participants were randomly assigned to one of three aroma groups, which included an active experimental group, a detectable placebo, and a non detectable placebo. The active experimental group received lavender aromatherapy, the detectable placebo group received coconut oil aromatherapy, and the control group only received water. Additionally, the participants were divided into two prime subgroups; the priming subgroup were told that they were going to experience stress-relieving aromatherapy;

the “no-prime” group was told that they were about to experience an aroma that may or may not improve their stress levels. Researchers placed a 5x5 mm cloth between the lips and noses of the participants; the cloths contained three drops of the substance being tested. First, the researchers conducted several stress tests, including a physical stressor, emotional stressor, and mental stressor tests. Next, researchers tested the participants’ cognitive abilities with a go/no-go task, meaning they had to click a button when a certain letter appeared on a computer screen. They found that participants who received the positive priming message about aromatherapy had faster post-stress reaction times on the cognitive task than those participants who received no priming message. They did not find any specific aroma effects on stress or cognition (Chamine & Oken, 2015).

An additional study showed that the participants’ post-arousal relaxation patterns were influenced by participant expectancies rather than lavender oil aromatherapy (Howard & Hughes, 2008). Similar to the previous study, researchers tested three conditions: lavender, tea tree oil, and a non-aroma placebo; tea tree oil acted as the aroma placebo for lavender, and the non-aroma placebo group received no scent at all. All participants were then divided into either the facilitation priming group, inhibition priming group, or no prime group. Participants were instructed to complete a stressful task which required them to repeat several numbers in the reverse order that the researcher said them. Next, the participants in the lavender and placebo aroma conditions received a jar that contained a cotton ball with the relevant essential oil. The researcher instructed the participants to take two deep breaths from the jar and then set the jar down on the table for the rest of the trial. The participants in the facilitation priming group were told that the aromatherapy should have a calming effect. Participants in the inhibition priming

group were told that their aromatherapy condition could increase anxiety levels. Furthermore, the participants were instructed to sit in a relaxing environment for 10 minutes. Anxiety was measured with the STAI before and after each trial. Researchers found that there was no difference in relaxation patterns across the three aroma conditions, however they found that there was a difference between the priming groups. Results showed that the participants moderated their efforts to achieve relaxation according to their expectancies about the effectiveness of the aromatherapy (Howard & Hughes, 2008). In other words, participants in the inhibitory priming group tried harder to relax than the participants in the facilitation priming group. Participants in the no prime group had mid-range relaxation levels. This study shows that the results were significantly influenced by participant expectancies rather than the aromatherapy itself. This mechanism is especially relevant for scents that are often paired with expectations around relaxation and stress-relief, like lavender or chamomile teas, sprays, soaps, or other products. Although expectancy effects are possible around rose oil, it is much less advertised as a stress relieving scent than a nourishing, regenerative, and soothing ingredient in many cosmetic products (Sarkic & Stappen, 2018).

The Present Study

Aromatherapy has been researched for its possible anxiolytic effects in stressful situations, and some research even suggests that it can have an effect on test-taking anxiety (Kavurmaci et al., 2015; Kinzelman et al., 2009). Previous studies have explored the effects of several essential oils including sweet orange, rosemary, and lavender (Goes et al., 2012; Kinzelman et al., 2009), however little to no studies have analyzed the effects of rose oil aromatherapy itself, let alone on TTA. Most aromatherapy studies have been plagued by

methodological concerns that compromise internal validity and proclude conclusions about the mechanisms by which the essential oils work. Considering there is not a significant amount of research on rose oil aromatherapy there is relatively little expectancy for the effects of rose oil, therefore, this study aimed to avoid rose-specific expectancy effects. Not only this, but several other studies informed the participants that they were involved in an aromatherapy study, so this created potential for expectancy effects. In the current study, the participants were not informed that they were participating in an aromatherapy study in order to counteract general expectancy effects. This study focused on the hedonic qualities of aromatherapy, and highlighted the little existing research on physiological pathways of aromatherapy. If the effects of aromatherapy are hedonic, the anxiety scores in the rose and lavender conditions should not differ. If rose is physiologically ineffective in comparison to the active control, TTA should be lowest in the lavender condition.

In this study, it was hypothesized that rose and lavender essential oil aromatherapy would decrease the participants' test-taking anxiety symptoms. Because lavender has been shown to have anxiolytic properties, it served as an active control group. A second control group was exposed to water and was added as a comparison for both the lavender and rose oil conditions. Other researchers have utilized several different inhalation methods to explore the effects of essential oil aromatherapy, but this study utilized a nebulizer that delivered the essential oils in mist form. In past studies, researchers exposed their participants to their specific essential oil aromatherapies for as little as two minutes or as long as eight hours per trial. In the present study, each participant was exposed to their assigned condition for at least 5 minutes, but no longer than 10 minutes. By using an experimental approach, this study measured about 30 participants at a

small liberal arts institution in Western Pennsylvania; About 10 participants were randomly assigned to each of the three experimental conditions (rose oil vs lavender vs control).

Methods

Participants

This study recruited 29 students from a small liberal arts school in Western Pennsylvania (see table 2 for demographic information). The students were recruited through an online study system called the Sona Experiment Management System. In order to get a substantial amount of people to participate, the participants were given the incentive of receiving Sona credit for completing the study. Participants also had the chance to be entered into a raffle for a chance to win a $10 gift card to Market House.

Materials

TAS Questionnaire. The researcher utilized this questionnaire as a preliminary eligibility screening for the participants. The participants would only be eligible for the study if they received a score of 20 or higher for this test taking anxiety measure.

Allergy and Wellness Questionnaire This questionnaire contained several questions to assess the health of the participants to ensure they were eligible for the study. It included questions such as, “Do you have any known allergies to smells?”, and, “At the moment do you have any sinus conditions that are preventing you from breathing normally (colds, stuffy nose, allergies)?”. If the participants indicated that they had one of these sinus conditions, they were excluded from the study.

Essential Oils and Oil Diffuser. *Rosa damascena* oil, *Lavandula angustifolia* oil, and water were used for this study; to avoid cross contamination, the researcher utilised three separate

Nature's Truth oil diffusers. The nature's truth oil diffusers were plugged directly into the USB port of a hidden plug dock. For each experimental group, two drops of the essential oil were placed in 30 mL of water inside of the Nature's Truth essential oil diffuser. The control group's oil diffuser only contained 30 mL of water. The aromatherapy mist was minimal and discrete enough that the participants could not notice it. To avoid oil contamination in the testing room, there were randomly assigned testing days for each condition, allowing for residual smells to be aired and filtered out between testing days.

The "Test". The participants attempted to complete a series of 20 math matrices as their test; each matrix had 12 total boxes. The participants were tasked to find the set of two numbers out of the 12 which added up to ten (Mazar, Amir, & Ariely, 2017). This test was timed, and the participants were given five minutes to solve the matrices. In a previous study, participants could complete about 8 matrices in 5 minutes on average (Mazar, Amir, & Ariely, 2017). After the time ran out, the participants typed in the amount of matrices they solved into the final MediaLab assessment.

State Trait Anxiety Inventory. The participants were given a modified version of the State Trait Anxiety Inventory. This scale was used to measure participants' state anxiety levels in the moment. The modified questionnaire was given to the participants before and after the math matrices task. This inventory asked the participants to rate several statements on a 4 point Likert-based scale (1= *Not at All*, 4= *Very Much So*) about how they felt in the moment. Some of these statements included, "I feel jittery","I am tense", and "I feel calm" (The STAI, 2018). This measurement was used as a pre and post-test measure of anxiety. This scale, along with the math matrices can be found in the Appendix.

Demographic Questionnaire The researcher collected each participant's demographic information during the final portion of the study. This information included participant age, gender, and class year.

Post-test questionnaire. This questionnaire assessed several things including participant suspicions, perceptions of smell, and hypothesis predictions.

Procedure

This study took place in a testing room on the second floor of Carnegie Hall at Allegheny College. Before each trial began, each participant was randomly assigned to one of three conditions: lavender oil, rose oil, or water. Before each participant entered the testing building, the researcher prepared the materials by assembling the Nature's Truth essential oil diffuser and opening the MediaLab program (Empirisoft, 2012), an offline data-collection software that allows for the computerized presentation of stimuli and questionnaires. At this time, the researcher filled the diffuser with 30 mL of water and either added the two drops of essential oils or only water depending on the condition. The diffuser was plugged in the testing room, but it was not yet turned on. When the participant arrived, the researcher led the participant to a pre-test room, with no diffuser, to mention that the purpose of the study was to explore the effects of scent, mood, and productivity. Here, the researcher explained to the participant that they would be partaking in a random task as a part of the study, and they were asked to sign an informed consent form, which confirmed their full understanding of the study. In addition, they were also given an allergy and wellness questionnaire. If they indicated they had any allergies to the essential oils in this study or if they had any sinus conditions, they were immediately debriefed. If they continued on with the study, they were given a modified version of the STAI

questionnaire as a pretest measure of their initial state-anxiety levels. This measure intended to provide a general idea of their anxiety levels before they were exposed to their condition.

While the participants were completing the pre-test measure, the researcher went to the testing room to turn on the diffuser to a low setting. After they completed the pre-test STAI questionnaire, they were escorted to the testing room and given their set of 20 math matrices to solve; at this time the researcher left the room, closed the door, and set the timer. The participants were allowed 5 minutes to complete this task, and the timer was set to ensure they didn't go over the time limit. Once the 5 minute timer rang, the researcher entered the room and collected their matrices. Next, the participants were asked to complete demographic information, the post test STAI, and the post test questionnaire. Each participant completed the post test questionnaire which asked them questions about their perceptions of the testing room atmosphere. For instance this form asked questions like, "Did you smell anything during the test?", and "If you smelled something, was it pleasant or unpleasant?". Lastly, once the participants finished this portion of the study, they were debriefed by the researcher and given a debriefing form.

Design and Analyses

This study used a 2 (time) x 3 (aroma) mixed model experimental design. Each participant's anxiety scores were compared at time one and time two across all three conditions. A 2x3 mixed model analysis of variance (ANOVA) was used through SPSS software. The mixed model ANOVA was used to test if there was a significant difference in anxiety scores at time one and time two amongst the rose oil, lavender oil, and control conditions. It was hypothesized that there would be an interaction between time and aroma, meaning that the experimental conditions

would decrease the participants' state anxiety scores over time. It was predicted that there would be no main effect of time and no main effect of aroma.

Results

Manipulation Check

A smell questionnaire assessment was used to test if the manipulation was successful. Participants were asked if they smelled anything, and they were asked to report the substance they smelled if they answered "yes". All 21 participants who were in a smell condition, reported that they smelled a substance. Across the two experimental conditions there were some common answers. Seven people stated that they smelled something floral, three people said they smelled a clean fragrance, and two others reported smelling an herbal scent. The eight participants who were in the control reported that they did not smell anything. The participants were also asked if they perceived the smells as pleasant on a 1-11 scale (1=not at all; 11=extremely). Results showed that there were differences between the three conditions in perceived pleasantness of aroma $F(2,26) = 3.51$, $p=.045$, $\eta 2=.21$. Tukey post hoc tests indicated that rose ($M=9.67$, $SD= 1.00$) was significantly more pleasant than the control ($M= 7.55$, $SD= 1.97$), $p=.04$. The lavender condition ($M= 8.78$, $SD= 2.17$) did not differ from the control or the rose condition, $p>.05$.

Effect of aromatherapy on anxiety

Anxiety scores were assessed with the State Trait Anxiety Inventory (STAI). Of the ten items on the scale, five were reverse coded so that higher scores indicated higher anxiety scores. The STAI was found to be reliable at time one ($\alpha=.88$) and at time two ($\alpha=.93$), and average anxiety scores were calculated for each participant at time one and time two. To test if aromatherapy affected anxiety scores, a 2 (time) x3 (condition) mixed model ANOVA was run.

Results show that there was no significant difference between participants in the rose group (M=1.77, SD =.49), the lavender group (M=1.94, SD=.47) and the control group (M=1.96, SD =.47) when evaluating anxiety levels $F(2,26) = .52$, p=.60, $\eta 2$=.04. There was, however, a main effect of time, $F(1,26) = 6.40$, p =.02, $\eta 2$=.20, indicating that anxiety was higher at time two (M=2.19, SD=.13) than at time one (M=1.90, SD=.01). Contrary to predictions, results also showed that there was no interaction between aroma and time, $F(2,26)$=.19, p=.83, $\eta 2$=.02.

Correlation between pleasantness and anxiety

A Pearson's product-moment correlation analysis was run to test if there was an association between perceived pleasantness of smell and anxiety levels. Results showed that there was a significant correlation between perceived pleasantness of smell and anxiety scores amongst the participants. Specifically, pleasantness was not associated with anxiety scores at time one, but it was associated at time two, indicating that pleasantness of smell was negatively associated with anxiety (r= -.40, n= 29, p=.03). It is important to note that the participants were not exposed to a smell condition at time one. However, at time two when participants were exposed to the smell, as the perceived pleasantness of smell increased, the mean anxiety scores at time two decreased. For means and standard deviations see table 1.

Discussion

Test-taking anxiety has been known to affect a notable amount of American students, and the symptoms associated with it can be consequential for student performance on exams (Mocanu & Sterian, 2013). The purpose of this study was to examine the effects of rose essential oil aromatherapy on the effects of TTA. Previous research has shown that aromatherapy, especially oils such as lavender, can be associated with relaxing and calming effects on the

human body in test taking situations (Goes et. al, 2012; Kavurmaci et al., 2015; Kinzelman, et. al 2009). There are very few research studies that have observed the effects of rose oil aromatherapy in testing situations, but several studies have shown that rose oil may have calming effects as well (Central, 2015; Kheirkhah et al., 2014; Umezu, 1999). However, existing studies have often been limited by methodological concerns including quasi-experimental designs and potential demand effects. These concerns were addressed in the current study by implementing an experimental design which did not allow for demand effects. The participants were randomly assigned to their conditions, and they were unaware of the manipulation for the duration of the trial. The goal of this study was to expand on the minimal literature of the potential calming effects of rose oil in a test-taking situation. Therefore, the hypothesis of the study was that rose oil aromatherapy would decrease test-taking anxiety levels in the participants in comparison to the control group. To address the limitation of many existing studies that only compared a scent to an unscented control substance, the present study included an active control in the form of lavender, an oil that has widely been tested for its potential anxiety-reducing properties. It was hypothesized that the active control lavender condition would show a decrease in anxiety levels similar to rose in comparison to the control group.

Test-taking anxiety was measured using the State Trait Anxiety Inventory both before and after being instructed to complete a math matrices task (Spielberger, 1968). Contrary to the predicted hypotheses, it was found that the mean anxiety scores increased across all conditions at time two in comparison to time one. It was expected that anxiety would not increase in the rose and lavender conditions compared to the control, but results showed that there was no interaction between scent and time. However, when perceived pleasantness and anxiety scores were

correlated, it was found that there was a significant negative correlation between the two variables, meaning as the perceived pleasantness of the condition increased, anxiety scores decreased, suggesting that those who experienced the smell as more pleasant also reported lower anxiety scores.

Why Did Anxiety Increase?

As previously mentioned, participant State Trait Anxiety Inventory scores increased at time two across all conditions, which means all participants reported being more anxious after experiencing their aromatherapy conditions. There are several possible explanations as to why mean anxiety scores increased. First of all, it is possible that the study design was flawed and caused anxiety scores to increase as a result. The participants took the initial STAI without having seen the math matrices task, and the second STAI assessment was collected after the participants were introduced to their stressful task. Not only did the idea of math matrices affect their anxiety at time two, but the time limit most likely contributed to their anxiety levels as well. It is possible that their anxiety increased as a result of heightened alertness and time pressure after being put in the stressful situation. It is not clear in the literature if time pressure increases test taking anxiety levels specifically, but it has been found that time pressure can negatively affect performance on mathematical tasks (Kellogg, Hopko, & Ashcraft, 1999). One study discovered that participants performed worse on a timed task regardless of their levels of math anxiety. Both high math anxiety and low math anxiety participants performed worse on their arithmetic task in comparison to the untimed group. Perhaps the time pressure could have heightened anxiety levels in the present study because the pressure element could have negatively affected the participants' performances on the math matrices task. In future studies, it

may be important to familiarize the participants with the stressful timed task before collecting their baseline STAI scores to gain a better understanding of the actual effects of the manipulation.

Why No Aromatherapy Effect?

Given that other aromatherapy studies have found significant results, it is necessary to explore the reasonings behind the lack of its effectiveness in the current study. To begin with, the participants may not have been exposed to the conditions for a sufficient amount of time. This study utilized a five minute inhalation period while the participants worked on their math matrices. Several other aromatherapy studies took place over longer periods of time and had longer inhalation sessions. For instance, in a 4 week randomized controlled clinical trial on hemodialysis patients, researchers asked the participants to inhale 3 drops of rosewater on a handkerchief every night before bed for 15-20 minutes (Barati et al., 2016). The participants in the rosewater condition had significantly lower State Trait Anxiety scores than the control. It is possible that the inhalation period of 15-20 minutes would have been more effective than the five minute inhalation period used in this study. Not to mention, the current study only utilized one inhalation period, whereas the hemodialysis study utilized nightly aromatherapy sessions for four weeks (Barati et al., 2016). Therefore, it was a longer study overall, and it may be necessary to conduct longer aromatherapy sessions to find significant effects.

Furthermore, when researchers conducted a study on the the effects of a hot rose oil aromatherapy foot bath on the anxiety scores of women in labor, they found that an inhalation period of 10 minutes was effective enough to significantly lower anxiety scores during labor. This shows again that an inhalation period higher than five minutes could have been more

effective in the present study. In addition, another study found that participants performed better on a vigilance task after receiving thirty seconds of peppermint aromatherapy every five minutes for a period of 40 minutes in comparison to the control group. The participants wore surgical masks and the aromatherapy was delivered through the masks periodically during their task. This suggests that repeated exposures to aromatherapy could be more effective than one exposure alone. To add, another randomized controlled study on 95 students, found that students who completed their 60 minute exam in a room with 10 lavender incense, had significantly lower anxiety scores than the control group, which received no intervention. On average, the control group scored five points higher on their anxiety measure than the experimental group (Kutlu K., Yılmaz E., & Çeçen D., 2008). Once again, this shows that a longer exposure period to the aromatherapy may be associated with its effectiveness. It is important to note, however, that the participants were aware of their aromatherapy condition in several of these studies. This could have contributed to the effectiveness of the manipulation because the participants may have been expecting certain results to occur. The present study successfully avoided this issue by concealing the aromatherapy conditions from the participants.

Pleasantness and Anxiety

A significant negative correlation became evident after perceived pleasantness of smell was correlated with participant anxiety scores at time two. This means that as each participant's perceived pleasantness of smell increased, the mean anxiety scores at time two decreased. This shows that perceived pleasantness of a smell may be associated with the effectiveness of aromatherapy, although causal claims cannot be made without further experimental study comparing pleasant to unpleasant smells. However, previous research has found that exposure to

hedonically pleasing odors can affect participant performance, cognition, and mood. For instance, one study showed that perceived pleasantness of an odor was associated with enhanced vigilance performance (Ruhl & Dember, 1999). When the participants were exposed to hedonically pleasing scents, such as clementine and vanilla bean, during a signal detection task, the experimental groups had increased signal detection responses in comparison to the control group.

In addition, researchers found that EEG readings on physiological responding to lavender and jasmine depended on the individual's perceived pleasantness of the smell. When the participants perceived pleasantness of the scent increased, researchers observed an increase in alpha activity on the participants' EEG's, which indicates signs of relaxation (Yagyu, 1994). It is possible that the participant's preference for the scent could affect their brain activity, which can potentially trigger feelings of relaxation or anxiety. Furthermore, in another study, researchers found that individual perceptions of scent can affect participant motor times. Researchers exposed the participants to one of five scent conditions which included, peppermint, ylang ylang, jasmine, eucalyptus, cineole, or water (Ilmberger et al., 2001). They were then instructed to complete a motor skills task, and researchers concluded that the participants had improved motor times on the task when they perceived the scent condition as pleasant. When the participants perceived the scent as unpleasant, they performed more poorly on the motor task and got distracted more easily (Ilmberger et al., 2001). Little research has been done on the role of perceived pleasantness of odors in regards to the effectiveness of aromatherapy, however past research indicates that perceived pleasantness of an odor is an important factor when it comes to cognitive tasks, motor tasks, and mood evaluations. It is possible that there was a significant

negative association between pleasantness and anxiety in the present study because perceived pleasantness could be associated with relaxation and improved cognitive abilities.

Future Outlook

Future research on aromatherapy should take several factors into consideration including, inhalation time, pharmacological action of essential oils, expectancy effects, and assessing pleasantness as a potential factor in the effectiveness of the intervention. Researchers should consider assessing the differences in inhalation time in relation to the effectiveness of aromatherapy. It is possible that varying exposure times could produce different results. For instance, in the current study five minutes may not have been a long enough exposure time to the aroma conditions, however increasing the period of inhalation could have produced different results. In addition, more research needs to be conducted on the pharmacological action of essential oils in the brain. There is very little research that clearly explains the neurological pathways that are responsible for the calming effects of aromatherapy. Researchers should try to focus on the idea of neurological pathways of specific essential oils to better solidify the explanations of the intervention. Furthermore, certain methodologies can prompt participant expectancy effects, so it is important to consider this in future replications of the study. Researchers should avoid openly administering odors to the participants because this may cause them to expect certain results from the trial, rather they should try to make the manipulation as discreet as possible to avoid those expectancy effects. Lastly, future research should focus more on the factor of pleasantness in regards to the effectiveness of aromatherapy. Perceived pleasantness of smells has been measured in several studies on the effects on cognitive and

motor performance, but little research has been conducted specifically on the effects of perceived pleasantness on the effectiveness of aromatherapy.

Limitations

There are several limitations that should be addressed in this study. First, the study had a small sample size of 29 participants from a liberal arts institution comprised of about 2,000 students. Second, the manipulation was not successful in decreasing anxiety scores like previously predicted, and the methodological design could have affected the results; it is possible that the repeated measures design affected the anxiety scores and that the way the test-taking task was presented set up an uneven comparison between anxiety scores at time one and time two. Participants were instructed to complete the second STAI questionnaire directly after the math matrices, and it is possible that this caused a conflict with the anxiety scores. It may have been beneficial to collect one STAI response at the end of each trial to simply analyze the mean anxiety scores at one time across all conditions, rather than evaluating the before and after effects of aromatherapy. Still, even at time two, anxiety scores did not differ across the three groups, which shows that the methodology could have been flawed. While there was limited support for both hypotheses, it is necessary that this study be replicated using a larger sample size, and an experimental manipulation that effectively measures anxiety levels across conditions. It is important that this study be replicated with a larger sample size, and be chosen from a larger population in general.

Conclusion

Test-taking anxiety is a significant worry for many students today, and it is important to find cost-effective interventions to help them perform better on their exams. More research is

needed to illuminate the effects of rose oil aromatherapy on test taking anxiety, but it is important to build on the current research to gain a better understanding of the mechanisms behind the intervention. If more research can be conducted on the effects of aromatherapy, the findings could help it to become a more recognized and legitimate intervention for anxiety issues, especially in test-taking settings. Future research should focus on neurological and pharmacological actions of essential oils to conclude better evidence of the effectiveness of aromatherapy as a widely-available, affordable intervention that can be used just about anywhere.

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Table 1 Correlations

Variable	M	SD	alpha	1	2	3
1. Staxi 1	1.90	.47	.88	-		
2. Staxi 2	2.20	.66	.93	.47**	-	
3. Pleasant	8.59	1.96	-	-.27	-.40*	-

Note *p<.05, **p <.01 , ***p<.001

Table 2

Demographics

	Overall M(SD) (n=29)	Rose M(SD) (n=9)	LavenderM(SD) (n=9)	Control M(SD) (n=11)
Gender				
N (%) Female	25(86.2%)	9(100%)	7(77.8%)	9(81.8%)
N (%) Male	3(10.3%)	0(0%)	2(22.2%)	1(9.1%)
N (%) Other	1(3.4%)	0(0%)	0(0%)	1(9.1%)
Ethnicity				
N (%) White	26(89.7%)	7(77.8%)	8(88.9%)	11(100%)
N (%) AA	1(3.4%)	1(11.1%)	0(0%)	0(0%)
N (%) Hisp.	1(3.4%)	1 (11.1%)	0(0%)	0(0%)
N (%) Am. Ind	2(6.9%)	0 (0%)	1(11.1%)	1(9.1%)
N (%) Other	0(0%)	0(0%)	0(0%)	0(0%)
Age M(SD)				
	19.66(1.29)	19.89(1.69)	19.89(1.17)	19.27(1.01)
STAXI 1M(SD)	1.90(.47)	1.77(.49)	1.94(.47)	1.96(.48)
STAXI 2M(SD)	2.20(.66)	2.08(.65)	2.14(.67)	2.34(.71)

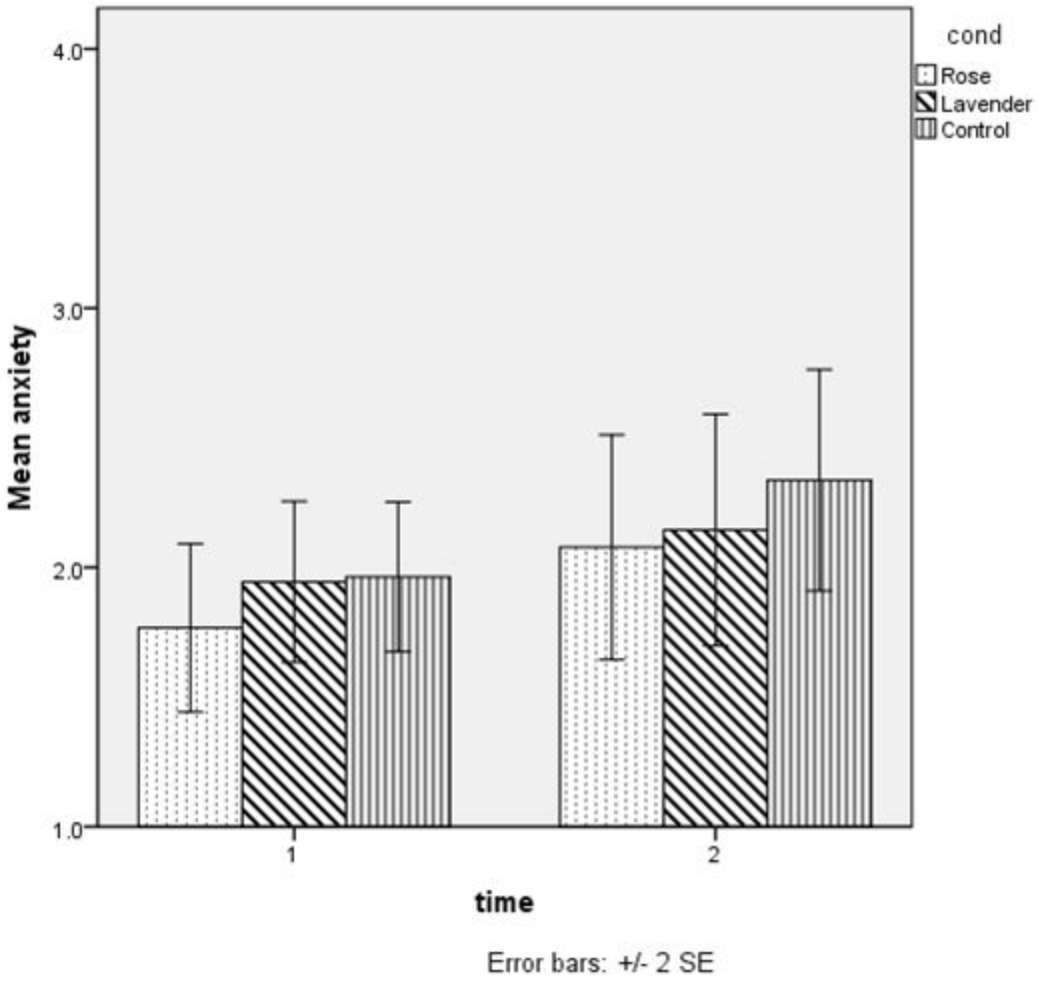


Figure 1. The mean anxiety scores at time one and time two across all conditions.

Appendix A

Test Anxiety Questionnaire

Nist, P. and Diehl, M. (1990). PHCC test anxiety questionnaire. Retrieved Nov 1, 2018

fromhttp://web.ccsu.edu/fye/teachingresources/pdfs/test%20anxiety%20questionnaire.pdf

Nist and Diehl (1990) developed a short questionnaire for determining if a student experiences a mild or severe case of test anxiety. To complete this evaluation, read through each statement and reflect upon past testing experiences. You may wish to consider all testing experiences or focus on a particular subject (history, science, math, etc.) one at a time. Indicate how often each statement describes you by choosing a number from one to five as outlined below.

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

1. **_____ I have visible signs of nervousness such as sweaty palms, shaky hands, etc. right before a test.**
2. **_____I have"butterflies"in my stomach.**
3. **_____I feel nauseated before a test.**
4. **_____I read through the test and feel that I do not know any of the answers.**
5. **_____ I panic before and during a test.**
6. **_____ My mind goes blank during a test.**
7. **_____I remember the information that I blanked on once I get out of the testing situation.**
8. **_____I have trouble sleeping the night before a test.**
9. **_____ I make mistakes on easy questions or put answers in the wrong places.**
10. **_____ I have trouble choosing answers.**

_____ = Total Scores will range from 10 – 50.

Appendix B

Introductory demographic questionnaire:

Age:

Gender:

What is your race/ethnicity (Circle one):

White African American Hispanic Asian American Indian Pacific Islander Other

Appendix C

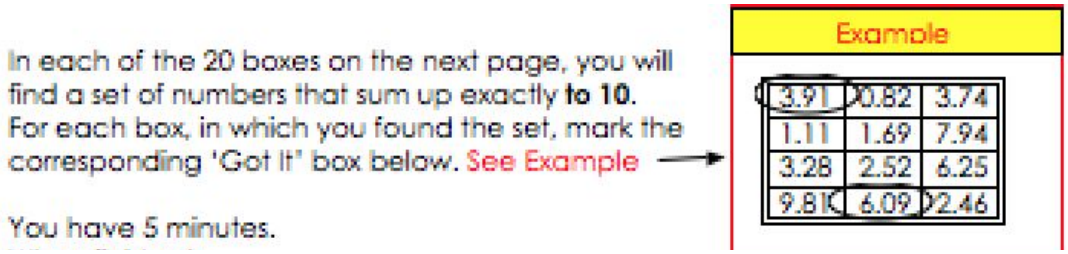
Allergy & Wellness Questionnaire

1) Do you have any known allergies to smells? Yes No
2) If you answered yes, what are you allergic to? _____.
3) At the moment do you have any sinus conditions that are preventing you from breathing normally (colds, stuffy nose, allergies)? Yes No

Appendix D

Math Matrices

Mazar, N., Amir, O., & Ariely, D. (2008). The Dishonesty of Honest People: A Theory of Self-Concept Maintenance. *Journal of Marketing Research,45*(6), 633-644. doi:10.1509/jmkr.45.6.633



TEST SHEET

1.69	1.82	2.91
4.67	4.81	3.05
5.82	5.06	4.28
6.36	5.19	4.57

Got it ☐

7.17	4.89	7.76
5.66	1.86	5.11
9.83	5.95	4.25
7.01	6.28	3.82

Got it ☐

0.49	0.74	1.17
3.72	2	1.22
3.75	5.22	5.67
8.83	8.23	7.7

Got it ☐

0.47	4.58	2.57
3.15	3.82	4.38
4.94	5.42	5.98
2.95	4.86	7.54

Got it ☐

2.92	4.98	4.34
0.39	0.72	5.53
9.61	3.57	3.36
6.8	0.53	8.58

Got it ☐

0.81	1.31	2.09
4.55	3.75	3.19
5.62	9.41	6.81
7.02	8.48	8.51

Got it ☐

0.17	2.46	2.44
6.02	5.6	2.63
6.05	6.21	6.6
8.22	8.19	7.54

Got it ☐

4.74	4.78	0.83
1.61	5.97	4.09
5.96	3.29	9.09
0.89	9.17	2.71

Got it ☐

6.21	2.47	9.57
1.68	9.52	4.52
8.7	7.69	1.47
6.4	4.44	8.32

Got it ☐

3.08	9.42	5.87
3.94	5.41	3.42
4.02	5.06	4.12
4.13	4.65	2.86

Got it ☐

0.15	0.95	1.31
4.98	2.9	2.88
6.66	6.73	7.67
9.75	9.85	8.17

Got it ☐

0.63	0.65	1.02
2.64	2.34	2.12
2.89	5.98	8.89
9.49	9.37	9.33

Got it ☐

2.22	4.5	7.13
9.33	9.77	5.96
7.04	4.04	5.22
2.28	1.72	8.16

Got it ☐

0.74	4.55	3.19
8.51	7.91	8.68
5.62	0.81	2
3.75	3.72	2.09

Got it ☐

5.97	9.62	9.41
3.6	7.4	7.01
5.49	0.59	2.62
7.51	5.71	0.49

Got it ☐

4.73	2.12	8.99
0.63	8.89	9.33
1.02	2.34	4.98
1.11	0.65	2.9

Got it ☐

0.12	0.71	0.74
4.27	3.07	2.27
5.09	5.73	5.82
9.27	7.03	6.79

Got it ☐

0.74	1.93	2.76
7.24	5.03	3.14
7.71	6.38	3.8
8.28	9.18	9.48

Got it ☐

0.14	0.67	2.22
5.96	5.58	5.22
7.04	7.59	9.33
9.77	9.5	8.52

Got it ☐

2.16	4.51	1.66
8.29	8.05	9.03
4.73	7.84	9.86
5.21	3.94	2.46

Got it ☐

Appendix E

State Trait Anxiety Inventory- Pretest & Posttest Measure

A State-Trait Anxiety Inventory STAI Form Y-1

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then write the number in the blank at the end of the statement that indicates how you feel right now, that is, at this moment. There is no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best

S. No.		**Not at all**	**Some What**	**Moderately so**	**Very much so**
1.	I feel calm	1	2	3	4
2.	I am tense	1	2	3	4
3.	I feel anxious	1	2	3	4
4.	I feel comfortable	1	2	3	4
5.	I feel self confident	1	2	3	4
6.	I feel nervous	1	2	3	4
7.	I am jittery	1	2	3	4
8.	I am relaxed	1	2	3	4
9.	I am worried	1	2	3	4
10.	I feel pleasant	1	2	3	4

Appendix F

Smell Assessment Questionnaire

1) Did you smell anything during this study? Y N Not Sure

2) How pleasant was the smell in the room?

Extremely unpleasant Extremely Pleasant

-5 -4 -3 -2 -1 0 1 2 3 4 5

3) If you smelled something what did it smell like?

The scent I detected was: _____.

4) Was the test-taking environment pleasant?

Not pleasant Pleasant

-5 -4 -3 -2 -1 0 1 2 3 4 5

5) How noisy was the room?

Not at all noisy Extremely Noisy

-5 -4 -3 -2 -1 0 1 2 3 4 5

6) Was the room well lit?

Not well lit Very well lit

-5 -4 -3 -2 -1 0 1 2 3 4 5

Appendix G

Research Participation Consent Form

The Effect of Test-Taking on General Mood

Allegheny College

Department of Psychology

Purpose of Research: The purpose of this study is to examine the relationships between test-taking, scent, mood, and productivity.

Procedure: I understand that I will be asked to complete a math matrices task in order to measure my current mood and rate of productivity.

Risks to the Individual: I understand that there will be no more risk other than what is normally experienced in everyday life.

Compensation: I understand that I may receive extra credit at the discretion of my instructor, and that I can choose to be entered into a raffle to win a $10 gift card to Market House.

Confidentiality: I understand that my name will never be associated with the data I provide and will be completely confidential. I understand that the researcher is interested in patterns in the data as a whole as opposed to individual scores. Any reports made based on the data will focus solely on these general patterns.

Furthermore, I understand that all data will be stored under lock and key in the Psychology Department at Allegheny College. I understand that my consent form will be stored in a locked cabinet separately from my data. When the data I provide today are no longer needed, they will be destroyed.

Voluntary Nature of Participation: I understand that I do NOT have to participate in this experiment. Furthermore, upon beginning the experiment, I may choose to withdraw my participation at any time without penalty. I understand that I may skip any individual questions that I do not wish to answer, and I may choose not to participate in any part of the study without being questioned.

Contact Information: If I have any questions about this research project, I can contact Anastasia Anthony at anthonya@allegheny.edu the research advisor, Dr. Lydia Eckstein at ljackson2@allegheny.edu or at (814) 332 5955. If I have questions or concerns about the treatment of research participants, I can contact Dr. Rich Bowden, Chair of the Allegheny Institutional Review Board (IRB) at rbowden@allegheny.edu

I understand that my signature below indicates that I am at least 18 years of age at the time of my participation in this study, and that I have a received a copy of this informed consent form. I have carefully read and understood the information on this form and all of my questions thus far have been answered. I hereby agree to participate in the study.

Participant's Signature _____ **date** _____

Participant's Name (print) _____ **date** _____

Researcher's Signature (Anastasia Anthony) _____**date** _____

Appendix H

Research Participation Debriefing Form

The Effect of Rose Oil Aromatherapy on Test-Taking Anxiety

Allegheny College

Department of Psychology

Purpose of Research: The purpose of this study was to measure the effects of rose essential oil on the symptoms of test-taking anxiety (TTA). Previous research has suggested that certain essential oils, such as lavender, have effects on test-taking anxiety symptoms. Thus far, there has been no substantial research on the effects of rose essential oil on TTA; however it was predicted that the rose oil condition would decrease test-taking anxiety scores. If you wish to look further into this research topic, several studies have been provided below.

Compensation: Participants will receive SONA credit for their participation. Participants may also enter their name into a raffle for a $10 gift card to Market House.

Confidentiality: The data you provided for this research project will be confidential and your name will never be associated with your results. Furthermore, when your data is no longer needed, it will be shredded.

To Learn More: For further information about this topic, please consult the following sources:

Kavurmacı, M., Küçükoğlu, S., & Tan, M. (2015). Effectiveness of aromatherapy in reducing test anxiety among nursing students. *Indian Journal of Traditional Knowledge*, 1(1),52-56.

Barati, F., Nasiri, A., Akbari, N., & Sharifzadeh, G. (2016). The effect of aromatherapy on anxiety in patients. *Nephro-Urology Monthly*, *8*(5), e38347. http://doi.org/10.5812/numonthly.38347

de Almeida, R. N., Motta, S. C., de Brito Faturi, C., Catallani, B., & Leite, J. R. (2004).

Anxiolytic-like effects of rose oil inhalation on the elevated plus-maze test in rats.

Pharmacology, Biochemistry and Behavior, 77(2), 361-364.

Contact Information: If you have any questions about this research project, please consult the information below:

Experimenter: Anastasia Anthony **E-mail:** anthonya@allegheny.edu

Faculty Advisor: Dr. Lydia Eckstein E-mail: leckstein@allegheny.edu
IRB Committee Chair: Dr. Rich Bowden E-mail: rbowden@allegheny.edu
Counseling Center (Reis Hall Room 304) - (814) 332-4368

If you would like a copy of the results of this research study, please fill out and tear off the bottom portion of this debriefing statement and return it to the researcher.

I would like to receive a summary of the results of this study.

Yes O No O

If yes, what is your Box #? _____