

THE EFFECTS OF AROMATHERAPY SCENTS ON THE ABILITY TO RECALL
INFORMATION

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II. Abstract

THE EFFECTS OF VARIOUS SCENTS ON THE ABILITY TO RECALL INFORMATION

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The purpose of this experiment was to determine the effects of various scents on the ability to recall information. The hypothesis states that a person who is exposed to aromatherapy scents will be able to recall more information when exposed to the same scent as when the information was presented than a person who was not exposed to aromatherapy scents and asked to recall the information. Participants were asked to take a baseline test, which involved no intended scents, and then were asked to take a similar test while under the effects of one of the following aromatherapy scents: water (control), peppermint, lavender, rosemary, or ylang-ylang. Overall, thirty-two trials were run, with each of the sixteen participants taking a total of two memory tests. These tests led the administrators to believe that out of the four scents, lavender was the only one that showed the most increase in memory recall and out of the four scents, peppermint showed memory recall to decrease the most. The percent difference (which showed how much the memory recall increased or decreased from the baseline test to the test with the scent) was calculated for each scent group. The results were analyzed using a paired variable t-test and an unequal variance t-test. There was a statistically significant difference in memory recall between the lavender and peppermint groups and between the lavender and rosemary groups. The analyzed results revealed that compared to the control group (not exposed to a scent), the only group that recalled more information with a scent than without was the group exposed to lavender. When looking for a scent to study with, lavender should be chosen.

III. Introduction

There is a significant link between the senses and the increased ability to recall information. Sights, tastes, and scents have been known to bring back memories of one's past, such as the smell of freshly-baked cookies, bringing back memories of trips to Grandma's house as a child. In examples like the one above, the presence of the scent is known to trigger the olfactory system (Faust 2009). This process is known as Olfactory Cuing (Faust 2009). According to Faust, "...the odor is encoded along with the event details, and then the same odor serves as a cue in the retrieval of the memory."

When a fact is first presented to a person, the fact, such as each word in the lists presented in this experiment, is stored in the immediate memory section of our brain; however, this part of the brain has very limited space. Many times memories are recalled by scents because of association. "Memories are selective and are reconstructed; they are not exact replicas of experiences,"(Sargeant and Unkenstein 1998). Selective memory comes into play when someone only wants to recall the good, or exciting things that took place during an event; this is why it is often harder to recall more boring or less interesting things, such as where you left your car keys, without associating it with something memorable. By using the strategy of listing different words in the test, it is left up to each person to associate each word with their own memories, which in turn will make the word interesting. The brain remembers things because they are important or are interesting. When a participant is able to associate that word in the test with a certain memory in his or her past then it will be easier to remember than a word that the participant did not associate with a certain memory. In this case the brain will select the word connected to a memory when recalling the words. The authors of the book *Remembering Well*, Sargeant and Unkenstein, did a study on the connection of how the different odors are connected to how the mind remembers different things and what enhances the mind's ability to remember. "[the] most important conclusion of the study is that implicit memory for odors truly does exist" (Sargeant and Unkenstein 1998). Each odor has its own effect on the brain, which allow the connection between memory and that odor. The odor of rosemary has been found to provide a stimulatory effect on people (Levy et al. 2002), and the odor of lavender has been found to calm (Ilmberger et al. 2001). Because Lavender has a calming effect (Ilmberger et al. 2001), it is also linked to improving letter counting and mathematical tasks (Hewitt et al. 2008). The stimulating effect of

peppermint helps increase the attention span of a person (Hewitt et al. 2008). “The main thing in peppermint that helps the brain retain thoughts is Vitamin B, found in menthol. Vitamin B has been shown to improve concentration and performance in the brain nerves,” (Karges-Bone unknown date). Given the information noted above, the link between scents and memory recall may be significant depending on the scent.

The independent variables in this experiment include the various scents: peppermint, lavender, rosemary, and ylang-ylang. Each of the scents was chosen because of their remarkably different roles in aromatherapy and memory recall due to the effects on the brain. The dependant variable of this experiment is the amount of information recalled by each participant.

The purpose of this experiment was to determine the effect of peppermint, lavender, rosemary, and ylang-ylang scents on memory after the participant was asked to recall information while exposed to the same scent they were exposed to when the information was first presented.

The hypothesis of this experiment is that a person who is exposed to aromatherapy scents will recall more information than a person who was not exposed to aromatherapy scents. The null hypothesis is that aromatherapy scents will have no effect on a person’s memory.

IV. Materials

- 16 people (various ages between 14-16)
- Ylang-ylang oil, 0.5 Fluid Ounces (Nature's Alchemy Essential Oils, The Vitamin Shoppe)
- Rosemary oil, 0.5 Fluid Ounces (Nature's Alchemy Essential Oils, The Vitamin Shoppe)
- Peppermint oil, 1 Fluid Ounce (Now Foods, The Vitamin Shoppe)
- Lavender oil, 0.5 Fluid Ounces (Nature’s Alchemy Essential Oils, The Vitamin Shoppe)
- Diffuser (Creative Motion Ultrasonic Anion Diffuser, Walmart)
- Timer
- Laptop
- Small testing room located on the Heathwood Hall campus

V. Methods

Experimental Design Diagram

Title: The Effect of Aromatherapy Scents on The Ability to Recall Information

Hypothesis: The hypothesis of this experiment is that a person who is exposed to aromatherapy scents will recall more information than a person who was not exposed to aromatherapy scents.

IV:	Aromatherapy Oil			
Water (Control)	Peppermint	Lavender	Ylang-Ylang	Rosemary
3 participants	3 participants	4 participants	3 participants	3 participants
DV:	Amount of information recalled			
Constants:	Temperature of the testing room, length of time during which the scents are exposed in the room, length of time during which the participant is exposed to the aroma			

Sixteen Heathwood Hall Episcopal School Upper School students (Appendix A) ages fourteen to sixteen volunteered to take part in this study. Human consent forms were distributed to each participant and were signed by a parent/legal guardian. A conference room on the Heathwood Hall campus was used for testing.

Before the scent was diffused into the room, each of our participants was asked to do a memory test that involved the recollection of common nouns (Appendix B). This step has been subdivided into three parts: (a) Each participant was given a list of twenty words to memorize in two minutes; (b) The participants took a two-minute break to think about the list; (c) Each participant was given a scoring sheet and asked to recall as many words as possible in one minute. Scoring was as follows: one point for each word written down that was on the original list, two points for each word written down in the correct numerical slot found on the original

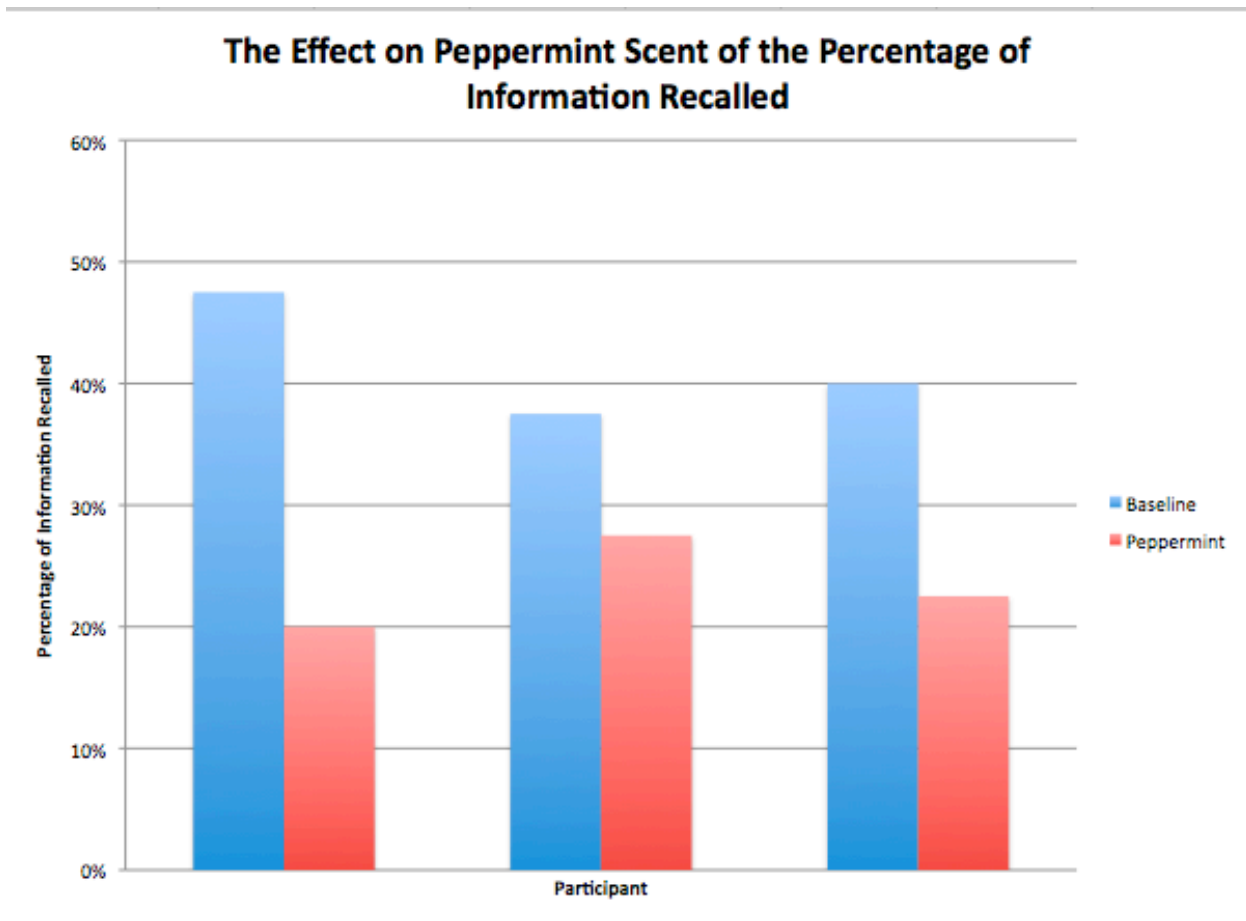
list. There were forty possible points, and scores were converted to a percentage by dividing the points gained by the total possible point then multiplying by 100.

After the first memory test, which served as a baseline, the participants left the room to allow one of the four scents: rosemary, ylang-ylang, peppermint, or lavender, to diffuse into the air for five minutes. In order to diffuse the scent into the room, the diffuser was filled with water and three drops of the oil were mixed with the water. The participants took a second memory test (Appendix B) while exposed to one of the four scents. This step has also been subdivided into three parts: (a) The participants studied a second list of twenty common nouns for two minutes while exposed to one of the designated scents; (b) Each participant took a two-minute break outside of the testing room to think about the list; (c) The participants were each given a scoring sheet and asked to recall as many words as possible in one minute. Scoring was as mentioned above. The steps above were repeated three more times (once for each scent group). A control group was tested as well. For this group, everything was completed as mentioned above, but the second test was completed without any exposure to a scent.

The percentage of information recalled was calculated for each participant in each group. The mean percentage of correct answers for each scent was also calculated. Additionally, the mean percent difference between the percentage of correct answers before and after aromatherapy exposure was calculated for each scent.

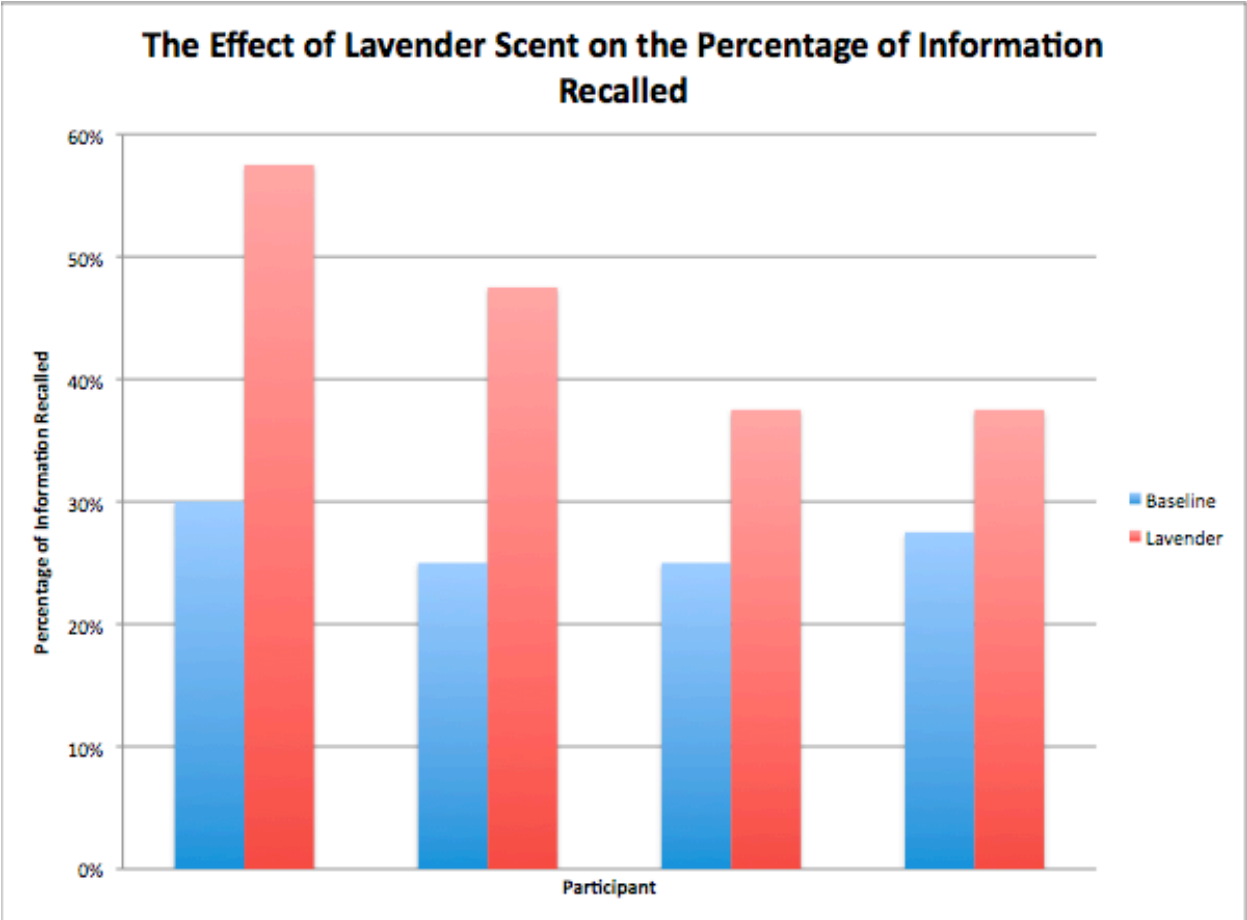
VI. Results

Figure 1: Peppermint Results



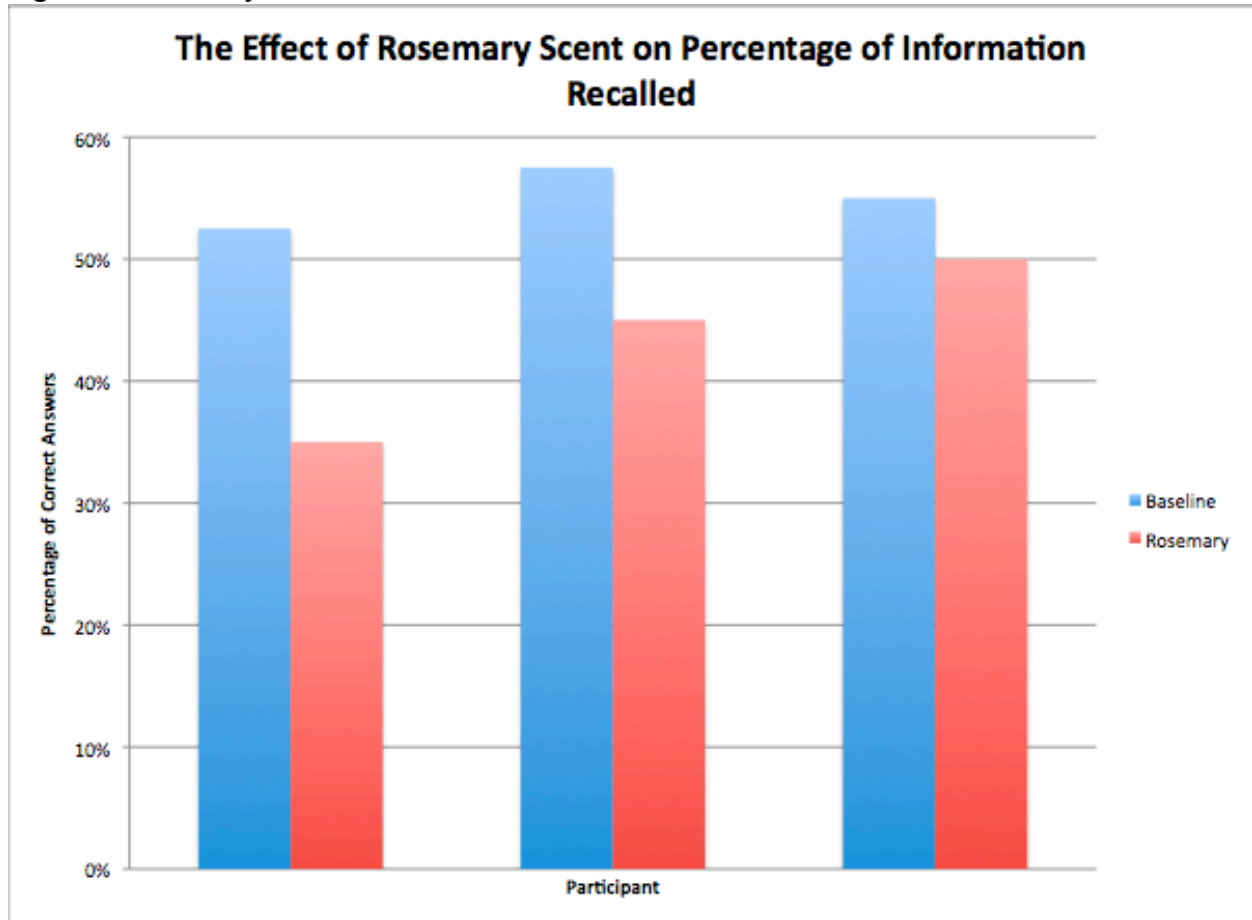
percentage of information recalled is summarized in Figure 1. The blue bars represent the percentage of correct answers given by each participant when not exposed to the peppermint scent, while the red bars represent the percentage of correct answers given by each participant while exposed to the peppermint scent. As the graph depicts, the baseline test results (blue) for these particular trials were clearly better than those of the peppermint (red) results. These results did not support the hypothesis that peppermint would increase a person's ability to recall information.

Figure 2: Lavender Results



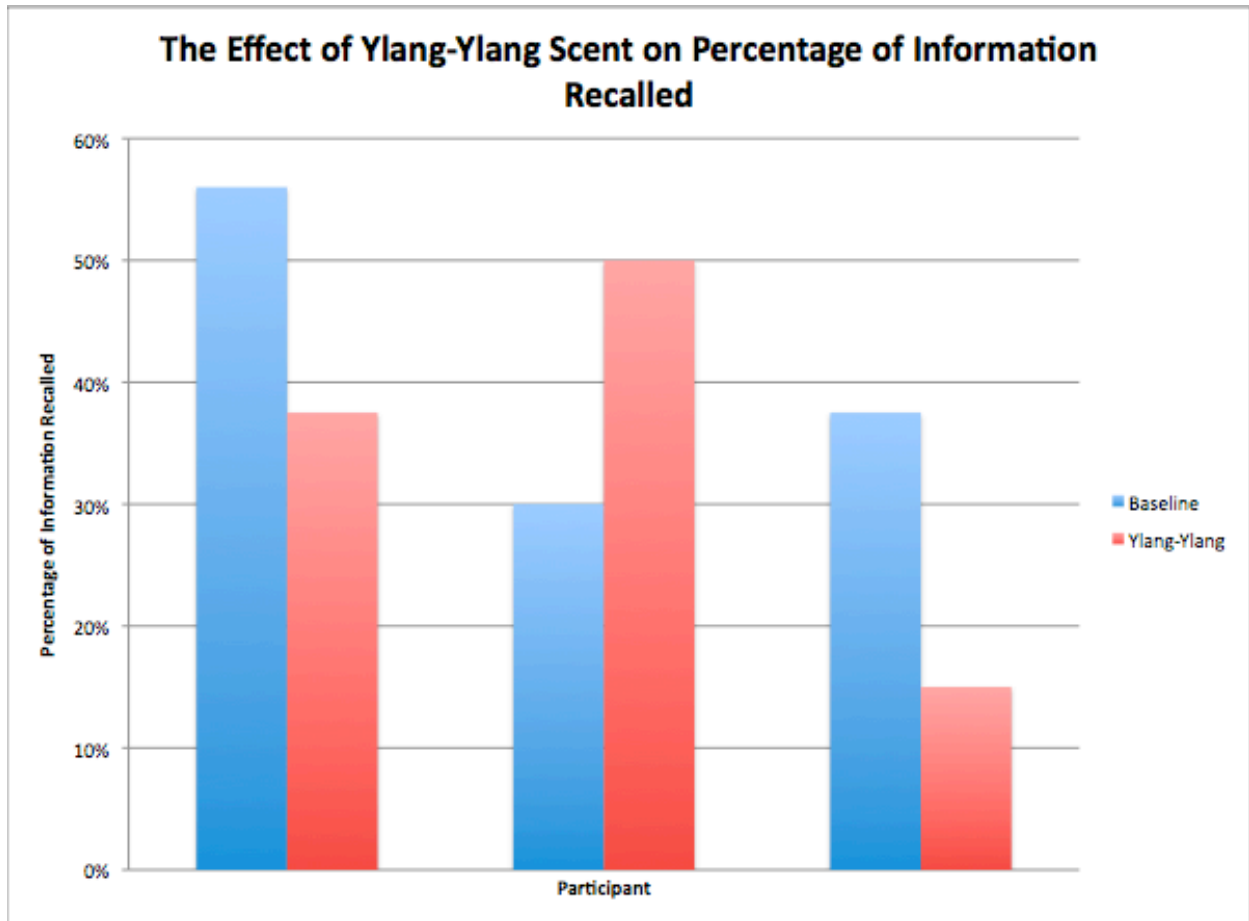
The effect of lavender scent on recollection is summarized in Figure 2. The blue bars represent the percentage of correct answers given by each participant when not exposed to the lavender scent, while the red bars represent the percentage of correct answers given by each participant while exposed to the lavender scent. As the graph depicts, the results from the trials with the presence of the lavender scent (red) were considerably better than the results for the baseline test (blue). These results did not support the hypothesis that lavender would increase a person's ability to recall information.

Figure 3: Rosemary Results



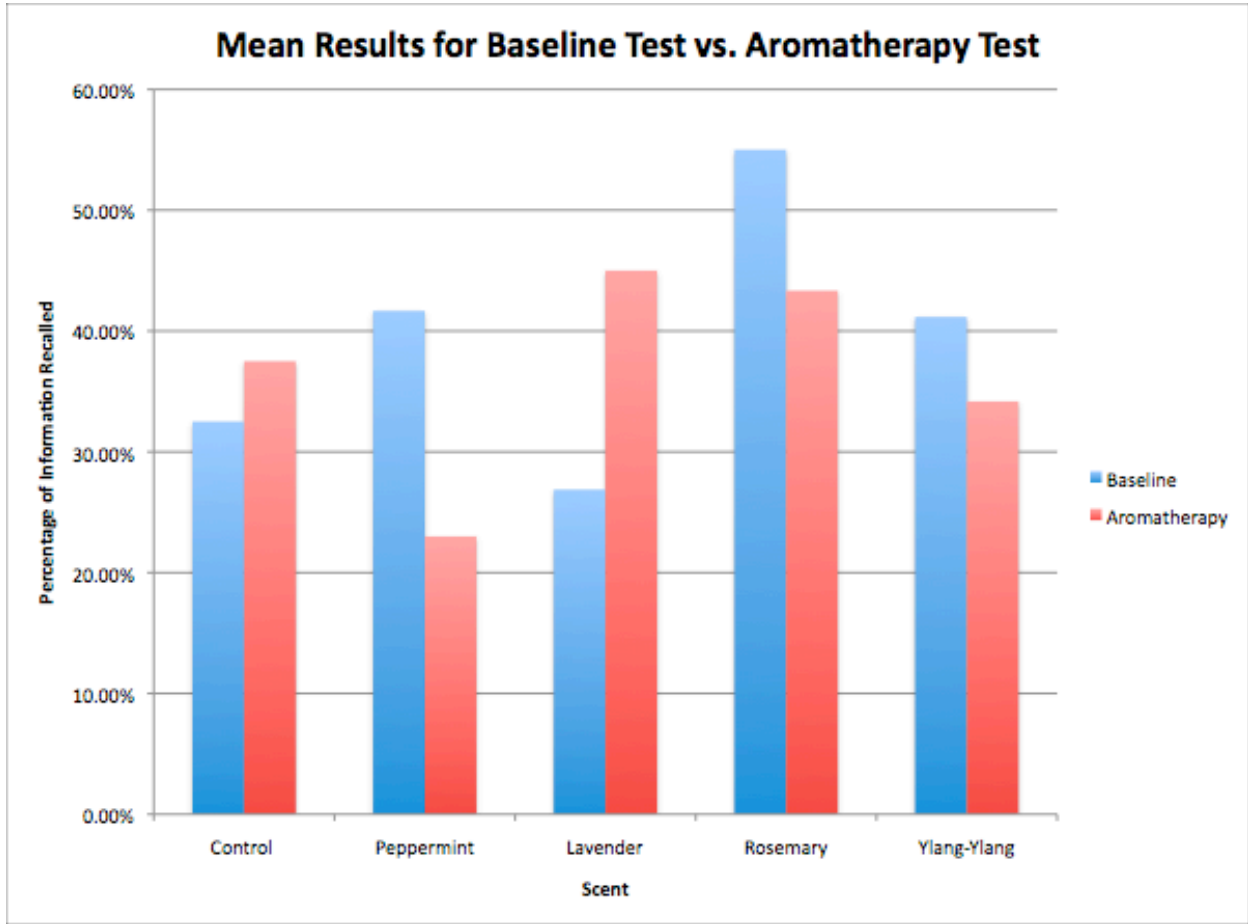
The effect of rosemary scent on recollection is summarized in Figure 3. The blue bars represent the percentage of correct answers given by each participant when not exposed to the rosemary scent, while the red bars represent the percentage of correct answers given by each participant while exposed to the rosemary scent. As the graph depicts, the baseline test results (blue) for these particular trials were clearly better than those of the rosemary (red) results. These results did not support the hypothesis that rosemary would increase a person's ability to recall information.

Figure 4: Ylang-Ylang Results



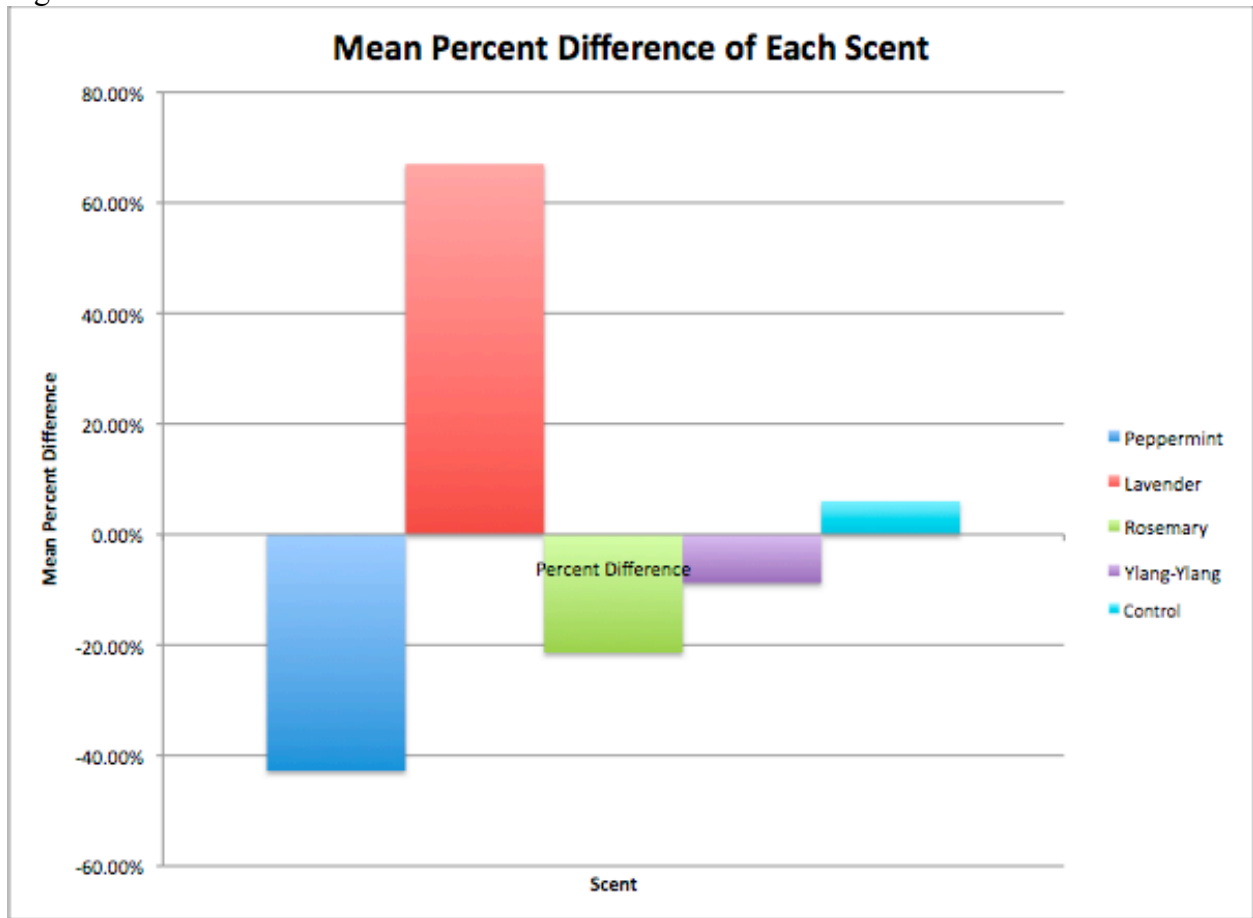
The effect of ylang-ylang scent on recollection is summarized in Figure 4. The blue bars represent the percentage of correct answers given by each participant when not exposed to the ylang-ylang scent, while the red bars represent the percentage of correct answers given by each participant while exposed to the ylang-ylang scent. There were mixed results for the trials of participants exposed to the ylang-ylang scent and the baseline test trials: two participants decreased performance, and one increased. These results do not support the hypothesis that ylang-ylang would increase a person's ability to recall information.

Figure 5: Mean Results for Baseline Test vs. Aromatherapy Test for Each Scent



The mean results of the baseline test vs. the aromatherapy test of the different scent groups tested are summarized in Figure 5. The blue bars represent the means of the baseline (first) test for that group, while the red bars represent the means of the second (scent) test. Two of the five groups listed above had better scores on the aromatherapy test than the baseline: the control and lavender groups. Three of the five groups listed above had worse scores on the aromatherapy test than the baseline: the peppermint, rosemary, and ylang-ylang groups. These results partially support the hypothesis since the lavender group performed better on the aromatherapy test than the baseline test.

Figure 6: Mean Percent Difference of Each Scent



The mean percent difference of each tested scent is summarized in Figure 6. As shown above, the lavender and control groups are the only groups with positive percent differences, with lavender increasing 67% and the control increasing 6%, while the ylang-ylang, rosemary, and peppermint groups all had negative percent differences, with peppermint decreasing the most at -42%, followed by rosemary at -21%, and ylang-ylang at -8%. These results partially support the hypothesis because the lavender group had a positive mean percent difference.

B. Tables:

1. Results

Subject	Control (% Corr.)		Peppermint (% Corr.)		Lavender (% Corr.)	
	Baseline Results	Scent Results	Baseline Results	Scent Results	Baseline Results	Scent Results
1.00	37.50	58.00	47.50	20.00	30.00	57.50
2.00	42.50	45.00	37.50	27.50	25.00	47.50
3.00	17.50	10.00	40.00	22.50	25.00	37.50
4.00	N/A	N/A	N/A	N/A	27.50	37.50
Mean	32.50	37.67	41.67	23.33	26.88	45.00
ST. DEV.	13.23	24.83	5.20	3.82	2.39	9.57
Mode	N/A	N/A	N/A	N/A	25.00	37.50
Range	25.00	48.00	10.00	7.50	5.00	20.00

Subject	Rosemary (% Corr.)		Ylang-Ylang (% Corr.)	
	Baseline Results	Scent Results	Baseline Results	Scent Results
1.00	52.50	35.00	56.00	37.50
2.00	57.50	45.00	30.00	50.00
3.00	55.00	50.00	37.50	15.00
4.00	N/A	N/A	N/A	N/A
Mean	55.00	43.33	41.17	34.17
ST. DEV.	2.50	7.64	13.38	17.74
Mode	N/A	N/A	N/A	N/A
Range	5.00	15.00	26.00	35.00

2. Descriptive Statistical Analysis

Subject	Percent Change					
	Control	Peppermint	Lavender	Rosemary	Ylang-Ylang	
1.00	55.00	-57.89	91.67	-33.33	-33.04	
2.00	5.88	-26.67	90.00	-21.74	66.67	
3.00	-42.85	-43.75	50.00	-9.09	-60.00	
4.00	N/A	N/A	36.36	N/A	N/A	
Mean	6.01	-42.77	67.01	-21.39	-8.79	
ST. DEV.	48.93	15.63	28.08	12.12	66.73	
Mode	N/A	N/A	N/A	N/A	N/A	
Range	97.85	31.22	55.31	24.24	126.67	

The findings from this experiment are summarized in Tables 1 and 2. The peppermint group recalled averages of 42% of the information during the baseline test and 26.3% in the aromatherapy test, an average percent difference of -43.77%. The lavender group recalled averages of 55.25% of the information during the baseline test and 45% in the aromatherapy test,

an average percent difference of 67.01%. The rosemary group recalled averages of 55% of the information during the baseline test and 43.3% in the aromatherapy test, a percent difference of -21.39%. The ylang-ylang group recalled averages of 41% of the information during the baseline test and 43.8% in the aromatherapy test, an average percent difference of -8.79%. The control group recalled averages of 32.5% of the information in the first test and 37.50% on the second test, a percent difference of 6%. The percent difference of the peppermint group compared to the percent difference of the baseline group is 114.05%. The percent difference of the lavender group compared the percent difference of the control group is 91.03%. The percent difference of the rosemary group compared the percent difference of the baseline group is 128.1%. The percent difference of the ylang-ylang group compared to the percent difference of the control group is 168.37%.

VII. Conclusion:

The purpose of this experiment was to determine the effects of peppermint, lavender, rosemary, and ylang-ylang scents on memory after the participant is asked to recall information while exposed to the same scent they were exposed to when the information was first presented. The results suggest that the only scent that increased the amount of information recalled compared to the control group was lavender, which was unexpected because of its relaxing effect. The scent that caused the most dramatic decrease in information recalled was peppermint, which also was unexpected due to its stimulating effect. The data supported our hypothesis that an aromatherapy scent, lavender, did increase memory recall, but did not support the hypothesis that not all aromatherapy scents increase memory recall. In similar studies, researchers also found that lavender produced the largest amount of increased memory when compared to a baseline that has no lavender. When reviewing the results of the peppermint group, the results were surprising, because peppermint was supposed to stimulate the brain. One of the participants in the peppermint group stated, “ While taking the test, I was distracted by the scent.”

The limitations of this experiment include: some participants could have discussed the test during the two minutes allotted outside the testing room before they recalled the facts, the room may not have aired out enough overnight to the point where it was ok to test another scent, and that the tests may not have been comparable in terms of difficulty. We have come to believe that the second test may have been less difficult than the first, possibly explaining the many surprising results in percent change from test 1 to test 2. Another limitation that we had was that only one room was used for testing in this experiment, so only one scent group could be tested each day to make sure the scents did not mix. For a future study, the percent of recall for each scent could be tested with two separate groups by gender. The number of participants could have also been larger and the experiment could have been repeated. Having different gender groups would make it possible to see if each scent would have an increase or decrease the amount of information recalled in female vs. male groups. Another thought is that the test subjects could give their view on why they performed the way they did. Having the participants give their view on their performance could give the administrators more understanding as to why a scent did not improve the memory recall of the person. Different modes of testing, such as having students study for a particular subject test without and with scents could be used. This would allow the administrators to see what scents were better used in studying for each subject. More tests could also be added to this experiment by giving the participants a test 5, 10, and 15 minutes after the first test with the scent was administered, to see if a scent increased how long facts could be recalled after presented. Also for a future study, we recommend taking into consideration the difficulty of the tests. This would also improve the accuracy of this experiment.

VIII. Acknowledgements:

Many people deserve our thanks for the completion of this experiment. First and foremost, we wish to thank Mrs. Lisa Norman for her assistance during this period. Her patience and support has been tremendous, and we couldn't have done it without her. We also wish to thank our families for everything from driving us to meet with each other to keeping us focused and encouraged. Last, but not least, we would like to thank our participants for giving up their time to assist us in this project.

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X. Appendix:

Appendix A: Human Consent Form

This form was given to all participants in this project and signed by the participant, the parent/legal guardian of the participant, the investigators, and the supervisor of this experiment.

Human Consent Form

Title: The Effect of Aromatherapy on Memory in Terms of Factors Recalled
Conducted By: Pinkney Beal and Olivia Harden, Heathwood Hall Honors Biology Students, under the supervision of Mrs. Lisa Norman
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Heathwood Hall Episcopal School, 3000 South Beltline Blvd. Columbia, SC 29201 Phone: (803) 765- 2309 Fax: (803) 748-4755

You are being asked to participate in a research study. This form will provide you with information about the study. The person in charge of this research will also describe this study to you and answer all of your questions, concerns, or comments. Please read the information below and make us aware if you have any hesitations before proceeding with this study. Your participation is entirely voluntary. You can refuse to participate without penalty or loss of benefits to which you are otherwise entitled. You can stop your participation at any time, and your refusal will not impact current or future relationships with participation sites. To do so simply tell the researcher you wish to stop participating. The researcher will provide you with a copy of this consent form for your records if requested.

The purpose of this study is to determine the effect of aromatherapy on memory in terms of factors recalled.

If you agree to be in this study, we will ask you to do the following things:

- Take a memory test while not under the effect of an aromatic diffuser
- Take the same type of memory test while under the effect of either peppermint, lavender, ylang-ylang, or rosemary scents

Total estimated time to participate in this study for is about twenty minutes.

Risk of being in this study:

- This procedure involves no known risks. If you wish to discuss the information above or have any questions about potential risks, you may contact the researcher listed above or contact the supervisor. You may remove yourself from this experiment at any time and for any reason. Please do not participate in this experiment if you are allergic to lavender, rosemary, peppermint or ylang-ylang.

The benefit of this study is learning about aromatherapy techniques to help with recollection and focus.

Compensation: There will be no compensation for participating in this study; however, all materials will be provided for you.

Confidentiality and Privacy Protection:

The data resulting from your participation may be made available to other researchers in the future for research purposes not detailed within this consent form. In these cases, the data will contain no identifying information that could associate you with it or with your participation in any study.

The records of this study will be stored securely and kept confidential. Authorized persons from Heathwood Hall Episcopal School, members of the National and South Carolina Junior Academy of Science, and the sponsor of the project, Mrs. Lisa Norman, have the legal right to review your research records and will protect the confidentiality of those records to the extent permitted by the law. All publications will exclude any information that will make it possible to identify you as a subject. Throughout the study, the researcher will notify you of new information that may become available and that might affect your decision to remain in the study.

Contacts and Questions:

If you have any questions about the study please ask now. If you have any questions later, want additional information, or wish to withdraw your participation call the researcher conducting the study. Their names, phone numbers, and email addresses are at the top of the first page. If you have questions about your right as a research participant, complaints, concerns, or questions about the research, please contact Mrs. Lisa Norman, head of the project, at normanl@heathwood.org.

Please feel free to keep the above section for your records

Statement of Consent:

I have read the above information and have sufficient information to make a decision about participating in this study.

Signature of Participant: _____ Date: _____

Signature of Parent/ Guardian: _____ Date: _____

Signature of Project Supervisor: _____ Date: _____

Signature of Investigator: _____ Date: _____

Appendix B: Test 1 and Test 2

Test 1 was the test given to each participant with none of the four scents diffused in the room. Test 2 was the test given to each participant with one of the four scents: ylang-ylang, lavender, peppermint, or rosemary, diffused into the room except for the participants in the control group.

Test 1:

1. Tree
2. Feet
3. Stool
4. Car
5. Glove
6. Sign
7. Dice
8. Piano
9. Cat
10. Pen
11. Track
12. Egg
13. Witch
14. Heart
15. Purse
16. Birthday
17. Movie
18. Vote
19. College
20. Cigarette

Test 2:

1. Pear
2. Ladies
3. Mice
4. Base
5. Shoes
6. Sticks
7. Day
8. Spider
9. Planets
10. Dime
11. Soccer
12. Month
13. Elevator
14. Silicon
15. Tennis
16. Wedding
17. War
18. Ticket
19. Fish
20. Casino

