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The effect of the essential oil of rosemary and lemon on memory ability in eighth graders

Ronda J. Irvin-Hamilton

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I am submitting herewith a dissertation written by Ronda J. Irvin-Hamilton entitled "The effect of the essential oil of rosemary and lemon on memory ability in eighth graders." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Education, with a major in Education.

Mary Jane Connelly, Major Professor

We have read this dissertation and recommend its acceptance:

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Accepted for the Council:

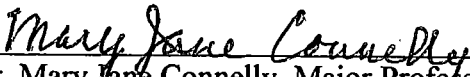
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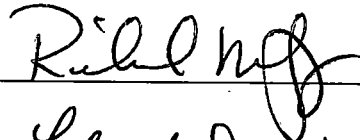
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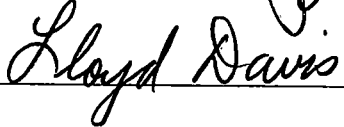
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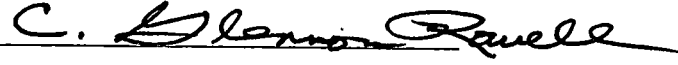


Dr. Mary Jane Connelly, Major Professor


We have read this dissertation
and recommend its acceptance:







Accepted for the Council:



Associate Vice Chancellor and
Dean of The Graduate School

The Effect of the Essential Oil of Rosemary and Lemon

On Memory Ability in Eighth Graders

A Dissertation

Presented for the

Doctor of Education

Degree

The University of Tennessee, Knoxville

Ronda J. Irvin Hamilton

May 2000

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DEDICATION

This thesis is dedicated to my parents

Mr. Donald Wayne Irvin

and

Mrs. Beulah Mae Irvin

You taught me by example. You worked hard and stressed good moral values as the key to living and success. Your belief in doing right and persevering to accomplish and finish tasks is what I attribute this final stage in my doctoral studies to represent.

Thank you, Mom and Dad, for being positive role models and loving parents.

ACKNOWLEDGEMENTS

I would like to thank the University of Tennessee system for offering this opportunity for me to advance my education with such an enriching program under the commitment of Dr. Mary Jane Connelly and the direction of Dr. Dan Quarles. Without this program's offerings, I could never have attained what I now have.

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The University of Tennessee, Chattanooga, Psychology Department has been invaluable to my research. Instructors were readily willing to assist me in the pilot studies by letting me come into the classroom and solicit student volunteers. The instructors also allowed me to actually perform portions of the experiment in their classrooms so I could familiarize myself with the process.

Ms. Delisa Dismukes, a colleague in Bradley County, Tennessee and fellow University of Tennessee, Knoxville, cohort member was very instrumental in helping me succeed. She ran one pilot study (omitting the fragrance) on her eighth grade students so I could determine the reliability of the word list. Her assistance helped me to be able to continue with the experimental phase of the study.

I thank my husband for listening to me rattle on about topics he could have cared less about. I appreciate his desire to see me succeed and accomplish my goals.

Without his encouragement, completion of this type of program could never have been a reality for me. I love him dearly and am thankful for such a supportive husband.

This study was only possible for me to readily complete, thanks to the eighth grade students, parents, faculty and administration of Dade County Schools in Trenton, Georgia. Their willingness to assist me through participation was the key to fulfilling the experimental portion of this investigation. Mr. Bill Bankson and Mrs. Patsy Cannon of Dade Middle School were invaluable for their technical assistance in setting up the encoding portion of the study. Mr. Kim Ambrose, Mr. Shane Cauthorne, Mrs. Susan Edwards, Mrs. Jana Powell, Mrs. Margaret Smart, and Mrs. Kim Traylor, were helpful in allowing me to use their classrooms, monitoring halls and getting the student rewards ready.

A special thanks goes to Amanda Burlingham, Patsy Cannon, and Kandi Jones-Freese for helping run the experiment in the classrooms. I appreciate their stimulating conversation, ideas and interest in research.

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ABSTRACT

The significance of the effect of the aromatic fragrances of rosemary and lemon on memory was investigated. One hundred and four eighth grade students participated in the study. Students were randomly assigned to encoding groups of 30 – 35 for exposure to an aromatic fragrance condition. A 30 – item word list was visually presented during exposure to the aromatic fragrance from water or the essential oil of rosemary or lemon. After a 1-½ hour delay, students were reassigned groups and asked to recall, directly and indirectly, the previously presented words while exposed to one of the three conditions. A test of direct recall asked the student to write as many previously presented words as possible. The indirect recall test consisted of 20 word fragments of words from the previous list and 20 additional filler words. Test order was randomly alternated. A 3 x 3 factorial analysis of variance was run to determine any level of significance. Findings indicated an interaction by order of test taken for direct recall. Students who took the direct recall test prior to the word fragment test did significantly better than those who took the word fragment test first. Also, those students exposed to lemon at encoding showed a higher average number of correct responses on the direct recall test. These findings suggest a positive link for children's memory ability to the aromatic fragrance of lemon. It may be plausible for lemon to facilitate young students in the learning and recall of information.

CHAPTER I

INTRODUCTION TO THE PROBLEM

In the state of Georgia alone, 30% of the adult population does not have a high school diploma. The statewide average number of high school dropouts between 1991 and 1995 was almost 7% (Georgia Department of Community Affairs, 1996). The new Millennium is almost here and America is still striving to catch up with Europeans in educational testing statistics (O'Neil, 1993; Rotberg, 1990). Continued efforts in cognitive psychology are attempting to find ways to create better learners (Gaskins & Elliott, 1991). Memory for material read is essential for students to illustrate competence. Many people have deficits in memory. The problem is in how to overcome this deficit. Finding a way to permeate this blockage for memory processing may help those who suffer from poor memory.

Something as primitive as one's olfactory processing may be the key to unlocking this barrier and providing a teaching method for memory enhancement. It has already been found that accurate labeling of odors improves performance on standard recognition tests (Rabin & Cain, 1984). McDougall & Velmans (1993) suggest that the interaction between prior knowledge and cue salience determines strategy use and results in memory performance. Unlike sounds and images, odors are not stored in memory as solitary entities, but are generally associated with other sensory perceptions such as tactile, auditory, visual, gustatory and thermal sensations (Royet,

1996). White and Treisman (1997) contend that short-term memory uses both verbal and olfactory stimuli. Howard Gardner (1987) encourages the openness to "...recognize and nurture all of the varied human intelligences..." to enable "...a better chance of dealing appropriately with the many problems that we face in the world" (Armstrong, 1994). Present findings on aromatherapy and aroma-psychology may offer a new dimension for empowering students with the ability to better store and retrieve knowledge.

Statement of the Problem

A student's inability to learn is inhibited by deficient memory processing. Young and old alike suffer from poor memory. The problem is that there are not enough economical, effective resources to combat this problem. A means of solving the dilemma needs to be found if we are truly to become a nation producing educated people able to compete in a global society. This investigator explored the usefulness of aroma-based strategies to increase memory on an educationally relevant task.

Research Question

The investigator attempted to explore memory and olfaction through the use of aromatherapy relative to learning. The essential oil of rosemary and its effect on memory was specifically studied. The essential oil of lemon and water only were used in control-group situations. The purpose for using

lemon was ancillary to that of water. Lemon had also been used in previous studies (Thiara & Ball, 1996; Smith, 1997).

The following question was addressed. Can teachers use the aromatic fragrance from the essential oil of rosemary to improve memory-learning performance?

Significance of the Study

In 1992, the United States Bureau of Labor and Statistics estimated that by the year 2000, 65 percent of all jobs will be for skilled laborers (United States Department of Education, 1992). In 1994 the Louisiana Department of Education speculated that a student without a high school diploma or GED would have a 92 percent chance of never rising above the poverty level due to underemployment. Kershner (1995) called for research in interventions and instructional strategies to help in reducing the number of low achievers. The need to produce qualified labor is more demanding, and these workers need to be life-long learners to be able to compete in a global economy (Young, 1995).

Students in the educational world who are low achievers are those who do not acquire the knowledge needed to become productive members of society (McCann & Austin, 1988). Memory can be improved for low and high achievers. Everyone is in need of ways to improve memory abilities (Carnine, 1991). Learning happens during all phases of life.

In order to begin improving the quality of memory and other work-related skills, early intervention strategies in the elementary classroom setting need to be implemented. Teaching to the individual child has been preached for years (Dunn, 1992). This sounds great in theory, but teachers have too little time and too few resources to teach and remediate each individual student (Davidson, 1990). A common approach to enhancing classroom learning has been in the use of materials that engage the sensory modalities of sight and sound. Teachers present material visually and verbally, attempting to reinforce concepts and promote learning. This continues even though research shows low-achieving students may not benefit from this approach (Klein, & Schwartz, 1979).

Badian, (1977) Klein and Schwartz, (1979) and Eden, Stein, Wood, and Wood, (1995) reviewed the literature of teaching by visual and auditory means from 1925 until 1994. These researchers came to the similar conclusion that low achievers may have deficits in visual or auditory functioning, creating disturbances in memory ability. Even though the deficit is either visual, auditory, or both, instructors continue to inundate the learner with information in this same way. As a result, many students are unable to learn and there is no answer to the problem of increasing memory ability.

Perhaps the problem can be approached by addressing different sensory modalities. Studies in olfaction have found the sense of smell to be incredibly sensitive. Current literature does not address the models and

theories of learning as being associated with sensory modalities such as touch, taste, or smell. (Baddeley, 1990; Morris & Gruneberg, 1994). Recent evidence suggests that olfactory information may improve memory (Hamilton, Bates & Metzger, 1996; Smith, 1998).

The concept of aromatherapy has been around for up to 6,000 years (Butcher, 1998). Aromatherapy uses natural aromas that have been used for centuries. Since ancient times people have used flowers, seeds, leaves, fruits, roots and barks in medicine. People eventually discovered plants that could affect the mind. Aromatherapists contend that certain aromas can improve performance and the capacity to remember. Some aromas can alter, relax and change moods.

The connection between aromatherapy and performance is only now being scientifically appreciated. Worwood (1996) reported that the Japanese have been using aroma as a management tool. Dr. Shizuo Torii in Japan showed that some aromas can have a stimulating effect while others produce a relaxing effect. The Shimizu Corporation, Japan's third largest construction company, has specialist engineers who implement aroma systems into new buildings. The aroma is used to improve efficiency and relax stress. One bank diffuses aroma into the customer and worker area of its facility. The fragrance company, Taskasago, has shown key-board punching errors to fall by 20% by infusing lavender into the work area, jasmine reduced the errors by 33%, and lemon reduced the errors by 54%.

Dr. Alan Hirsch of the Smell and Taste Research Foundation in Chicago, Illinois, has done extensive research in aromatherapy. Dr. Hirsch and his team have conducted 46 research studies looking at the effect of olfaction on learning (Worwood, 1996). They have discovered that calculus students increased their speed of learning by 230% when a mixed floral aroma was diffused into the room. They have also found that players in Las Vegas will spend 45% more cash when a certain aroma has "aromatized" gambling machines (Worwood, 1996).

Dr. Tom Orofino of the Wheeler H. Wheeler Center for Odor Research in Chattanooga, Tennessee, believes the sense of smell to be so instrumental in one's life as to be a part of the immune system. He contends "...that by smelling certain things there is actually a connection to the immune system that produces the necessary reactive antibodies to counter it." One disease, Alzheimers, is associated with one's decrease in memory ability (Avery, 1996). Much is being done to investigate a possible link between Alzheimers and a cure through aromatherapy techniques.

It appears from this brief introduction that aroma-based intervention may offer an approach to improving learning. Rosemary has been identified in both the popular (Allardice, 1994; Duke, 1997; Valnet, 1990; Worwood, 1996) and scientific (Smith, 1997; Thiara & Ball, 1996) literature as a fragrance with significant memory enhancing properties. The focus of this

study was to examine the usefulness of aroma-based strategies to improve memory on an educationally- relevant task.

No matter what term is used, an aroma-based strategy and the use of rosemary, an herb known for memory enhancement could be an avenue to use in increasing memory and learning.

Limitations

Certain limitations in the proposed study should be identified:

1. Subjects were only those in the eighth grade who returned a prepared permission form signed by a parent or legal guardian. (There is the one district only in Dade County, Georgia from which the sample is taken.)
2. Proposed subjects absent on the day of testing conditions were eliminated from the sample group.

Delimitations

The proposed study had certain delimitations to take into account:

1. Students who indicated allergic reactions to rosemary or lemon on the request form were excluded from the study.
2. The population from which the sample was selected was limited to eighth graders at Dade Middle School, Trenton, Georgia.

Assumptions

The study was based on the following conditions:

1. Students were tested in an environment free of odors other than the odorants chosen for testing so as not to contaminate the test. No cleaning chemicals or air freshener scents were used in the room to avoid hindering olfactory ability.
2. The ITBS test used to obtain an average overall grade-level ability was assumed to be a valid instrument. ITBS test results are used to determine student reading ability, strengths and weaknesses in subject areas.

Definition of Terms

ITBS-Iowa Test of Basic Skills, Form K, 1997 edition.

AROMATHERAPY - "The clinical use of essential oils combined with physical therapy - usually in the form of massage or inhalations"(Worwood, 1996).

AROMA-PSYCHOLOGY - Aroma-psychology relates to the use of essential oils to positively affect the mind - such as memory enhancement, learning improvement, mood uplifting, and confidence boosting" (Worwood, 1996).

Aroma-psychology implies it to be a mechanism by which to utilize the mind.

Worwood (1996) argues that the term aroma-psychology is unsatisfactory because the mind and body are an integrated unit.

AROMA-BASED STRATEGIES - The dispersing of essential oils into an educational setting to increase ability levels of students.

DISSOCIATION - The observation that performance on separate tests of memory did not always result in the same outcome, i.e., explicit and implicit tests of memory show very different memory abilities. Mathematically this observation is supported by the absence of a correlation between the two measures.

ENCODING PHASE - The portion of the experiment where information is given and it is translated into mental or internal representatives and stored (Galotti, 1994). In this experiment the Encoding Phase occurs when the subjects are presented with the stimulus materials.

EXPLICIT MEMORY or DIRECT MEMORY – The use of conscious memory to perform a task (Graf & Schacter, 1985). The explicit test of memory used here was recall.

HITS – The correct response given on a test.

IMPLICIT MEMORY or INDIRECT MEMORY – The use of unconscious memory to perform a task (Graf & Schacter, 1985). The implicit test of memory used in this experiment was the word-fragment completion task.

RETRIEVAL PHASE - The portion of the experiment where the stored information is brought back to conscious awareness (Galotti, 1994). The retrieval phase in the present research occurred when the subjects were asked to report the information presented during the encoding phase.

Organization of the Study

Chapter I is an introduction to the proposed study and what the study addressed. The need for investigation into the study is argued in Chapter I. An introduction to the problem and significance of the study section provided support for the need to investigate the area presented. The study focused on the intervention of an aroma-based strategy as a method of increasing memory ability. The research question is stated to investigate whether there is a statistically significant increase in memory ability when one is exposed to an aroma-based strategy.

A review of the literature related to the study is given in Chapter II. The history of aromatherapy is examined, from the past up to the present. Although the use of fragrances dates back to early times, aromatherapy itself is a new concept to the 20th / 21st century. Explicit and implicit memory are discussed and an overview of the literature relative to memory and learning is presented. Background information on rosemary and lemon are also provided. Additionally, some current and traditional models of teaching implemented by teachers in the school setting are reviewed.

The methodology section of the research is presented in Chapter III. The population from which the sample will be drawn is delineated. The actual design of the procedures used for the experiment and the means of implementation is outlined. The statistical analysis derived from the study is presented at the end of the chapter.

The actual findings are outlined and analyzed in Chapter IV. Chapter V concludes with a summary from the researcher and suggestions of the implications derived from the findings. A list of references, appendixes and examples of all materials used in the study are included at the end of the dissertation.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

The purpose of this study was to investigate whether or not there was a difference in memory ability when an aroma-based strategy was introduced. This chapter provides background information to establish the relevance of the study. Aromatherapy, its past and present use, is reviewed from the popular and scientific literature view. The essential oils of rosemary and lemon are presented with current implications for use and effectiveness. Memory is discussed relative to direct memory and indirect memory. Present teaching techniques for facilitating memory are reviewed and discussed. Finally, the chapter is summarized and the relationship between the review of the literature and the potential contribution of the study is included.

The History of Aromatherapy

Robert Tisserand, a prominent researcher in the aromatherapy field theorized about the first uses of aromas. Tisserand (1977) suggests that our early ancestors, some tens of thousands of years ago, were accidentally exposed to aromatic smells by using the plants available at that time. Since rosemary and thyme are indigenous to Europe, Tisserand speculates that these were among the first plants to be burned, emitting their aroma into the air.

Depending on the plants used, early man would feel invigorated, or drowsy, or find the smoke pleasant to breathe.

Between 6,000 and 9,000 years ago, during the Neolithic Period in Europe, man could have used herbs to scent the fatty oils he put on his body and hair. Man could have then found the herbs to cause different effects on the body and mind when used as a massage (Tisserand, 1977).

Even though there are no formal records regarding aromatherapy, it is believed that thousands of years ago there were crude methods of distillation, extraction of essential oils, in countries such as Egypt, India and Persia. The original extractions were of exotic flower waters from rose and orange flowers. Whether or not the practice first originated in India or Egypt is unknown. There is, however, more evidence in history regarding the Egyptian lifestyle and aroma use (Price, 1995).

Vessels dating back between 3000 and 2000 B.C. appear to be ointment and scented oil pots. The Egyptians' advancements in perfumes and mummification during this time implies these ancient people probably were able to use aromatic odors (Tisserand, 1997). The art of perfumery was used in Egypt for religious purposes. Each god was associated with a particular fragrance. Priests formulated the aromatics for the Pharaohs. These aromatic fragrances were used as anointments for times of war, love and prayer. The Egyptians were able to successfully preserve animals and humans, using plants, aromatic resins and essential oils. The mummified bodies would last at

least 3,000 years (Price, 1995). King Tutankhamens's tomb had scent pots sealed within it over 3,000 years ago. Some of these pots contained unguents and the scent was still faintly detectable when discovered (Tisserand, 1995).

Papyri recordings dating back to 2800 B.C. cite the medicinal use of herbs. Hieroglyphic translations give recipes for eye inflammation and cosmetic face packs. All used herbs and oils in the recipes (Tisserand, 1977).

The first actual aromatherapists were priests around 2000 B.C. (Tisserand, 1977). One town in Egypt during this time period was actually designed to have large square spaces for herb burning. This process was to keep the air clean and germ free. Aromatics helped to make a place with poor sanitation and a hot climate more pleasant and healthier (Price, 1995). Only after aromatic use became more common did physicians implement usage of aromas (Tisserand, 1977).

King Thutmos, 1425 - 1408 B.C., is portrayed in an engraving offering incenses and oil to a god with the body of a lion. During this time and for about 1500 years, Egyptian use and knowledge about herbs heightened. Perfumes and medicines were contained in bottles, vases or pots made of hard substances like alabaster, glass or onyx. Occasionally these medicines or perfumes were kept in boxes made of ivory or a carved wood. Continual use sparked trading of aromatic gums and spices. One ritual of worship involved different incense burning three times a day. The evening mixture was said to cause one to be lulled to sleep and reduce anxieties. Because scientists of

today know Egyptians used cedarwood oil in mummification, this means that Egyptians used distillation to extract oils from plants about 2,000 years before Arabians were to have discovered this method (Tisserand, 1977).

Clay tablets 4,000 years old were found in Nippur, an ancient Sumerian town. These tablets describe prescriptions of flowers, herbs, plants and roots, including plants still in use today in the form of essential oils. Willow, in particular, was used to make aspirin. Extracted from the bark and leaves of the willow tree, the resin and juice have been used for thousands of years to treat rheumatism and other ailments (Worwood, 1996).

Written tablets tell of aromatic trade as far back as 4,000 years ago in Babylon and Egypt. Clay tablets dating from around 1800 B.C. were found which had an order for 'imported oil of cedar, myrrh and cypress'. This suggests that people knew how to extract oils and that aromatic trade did go on at that time (Tisserand, 1977).

The Bible speaks of the use of oils and aromatics. Exodus 30: 22-25 tells Moses how to make a holy water and a holy incense.

22: Moreover the Lord spake unto Moses, saying,

23: Take thou also unto thee principal spices, of pure myrrh five hundred shekels, and of sweet cinnamon half so much, even two hundred and fifty shekels and of sweet calamus two hundred and fifty shekels,

24: And of cassia five hundred shekels, after the shekel of the sanctuary, and of oil olive an hin: (6 quarts)

25: And thou shalt make it an oil of holy ointment, an ointment compound after the art of the apothecary: it shall be an holy anointing oil (King James Version of the Bible).

This was spoken to Moses during the time when the Jews left Egypt to go to the promised land, around 1240 B.C..

The use of this oil was reserved for holy people and holy purposes only (Tisserand, 1977). The fragrance counteracted the stench of the butchering, burning and cooking of animals in the tabernacle court (Dake Annotated Bible, 1996). Tisserand (1977) explains that we would not be able to duplicate this recipe today since there are differing opinions about the true botanical origin of myrrh and calmus. Exodus 30 : 33-38 explains this further:

33: Whosoever compoundeth any like it, or whosoever putteth any of it upon a stranger, shall even be cut off from his people

34: And the Lord said unto Moses, Take unto thee sweet spices, stacte, and onycha and galbanum; these sweet spices with pure frankincense; of each shall there be a like weight:

35: And thou shalt make it a perfume, a confection after the art of the apothecary, tempered together, pure and holy:

36: And thou shalt beat some of it very small, and put of it before the testimony in the tabernacle of the congregation, where I will meet with thee: it shall be unto you most holy.

37: And as for the perfume which thou shalt make, ye shall not make to yourselves according to the composition thereof; it shall be unto thee holy for the Lord.

38: Whosoever shall make like unto that, to smell thereto, shall even be cut off from his people (King James Version of the Bible).

Stace, which also was the balm of Gilead, was made from the resinous gum of trees on Mount Gilead. Onycha came from a shell fish species that resembled a crab. The leaves of a Syrian plant produced galbanum. These blended with pure frankincense created this secret formula, which has been lost. The sweet smelling incense produced by this mixture was not to be duplicated or replaced (McGee, 1991). The ointment was to be used freely in every generation, but not by anyone who was not a priest. Even anyone who compounded any ointment similar, to use privately or sell to others, was to be given the death sentence (Dake Annotated Bible, 1996).

The holy oil was used to hallow Aaron and his sons, conferring continuous priesthood from generation to generation. A holy incense of stacte, onycha and galbanum, with pure frankincense was combined to make a perfume (Dake Annotated Bible, 1996). The word 'perfume' originally meant in Latin, through smoke-incense. Dake (1996) explains that the commandments for the use of these spices and oils were not from herbs and plants indigenous to the area. This proves the Israelites traded with caravans from Egypt, Syria and Palestine, spreading the use of aromatics.

The onions were found to have a great effect against fighting infection. As early as the first century, AD, a Greek doctor, Dioscorides, found the onion to also be a great source as a diuretic. Many centuries later it was found that the juice from an onion acts as an antibiotic against staphylococcus and other microbes. It has proven to ease wasp stings and assist in diabetes control (Valnet, 1990).

During the fourth century Egyptians became masters of perfumery through floral extraction. Drawings on the temple wall of Edfu show perfume being extracted from the white madonna lily. Assyrian women are reported to use a stone to bruise the wood of cypress, cedar and frankincense, and poured water upon it until it became a certain consistency. This was poured on the body and face and it would have a 'most agreeable odour.' When it was washed off the following day, the skin would feel soft, having a beautiful condition.

Many perfumes of ancient times were also used as medicine. Marble tablets hold the recipes of many medicinal perfumes. The Greeks had a temple where healing essences were used. This was what we would today call aromatherapy (Tisserand, 1977). About 500 B.C. a medical school was established. This school became well known because of Hippocrates (460 B.C.-370 B.C.), who was later to be called the 'Father of Medicine.' At this school an aromatic fragrance called 'Megaleion' after its inventor, Megallus, was created. This medicine, extracted from plants, was capable of reducing

inflammation and healing wounds (Price, 1995). The Greek physician, Marestheus, recognized the stimulating or sedative properties of aromatic plants. He found rose and hyacinth as 'refreshing, invigorating to the tired mind' (Tisserand, 1977).

Cleopatra, the Queen of Egypt, is well known for her use of fragrances (Tisserand, 1977; Worwood, 1995). To announce herself to Mark Antony she soaked the sails of her royal ship with rose essence so the aroma would drift on the wind toward him (Schiller & Schiller, 1994). Cosmetics used by Cleopatra actually contained roses. The rose was thought to generate love, fertility, beauty and pleasure. Mark Antony did not stand a chance. Cleopatra carpeted her floors with red rose petals while entertaining him (Wilson, 1995) and later used jasmine to bring Antony around to her way of thinking (Masline & Closes, 1998).

After Antony's death, Egypt became a part of the Roman Empire. The Romans extensively used fragrances. Scents were used on hair, bodies, clothes, beds and even the military flag and walls of homes (Tisserand, 1977).

It is thought that the stone used to close Jesus's tomb was actually a stone used to extract oil from jasmine. Speculation suggests that the flowers were placed in a trough with olive oil. The stone then pressed the essence out of the flower. Even today, the essence of jasmine must be extracted by pressing. Heat damages the essence quality (Tisserand, 1977).

It wasn't until the late tenth century that the actual art of distillation was perfected (Tisserand, 1977). The use of essential oils, as it is known today, probably was originated by Avicenna of Persia during this time (Schiller & Schiller, 1994). With his perfection of oil extraction more attention was focused on the use of essential oils. This increased interest brought more refinement of extraction and additional formulas for ointments and perfumes (Price, 1995). The Arabs progress in chemistry led to aromatic discovery. With this came the manufacturing of perfume (Tisserand, 1977). As soldiers and travelers went from country to country, medicines and plants traveled with them, spreading the knowledge associated with each. Mediterranean knowledge spread to Rome. Arabian perfumes and floral waters would have been brought back to homelands along with ideas about herbal medicine (Price, 1995). By the end of the twelfth century Europe was also manufacturing perfumes (Tisserand, 1977).

English writing from the 14th and 15th century refer to herbal oils and provide instructions on how to make them. The extraction of the fragrances was primarily done through infusion, heating the herb in oil.

During the disease ridden periods known as The Great Plague and Black Death of the 14th century, aromatics were used to try to eliminate the germs spread by these diseases (Tisserand, 1977). The disease killed 80 million people in Europe (Valnet, 1990). It is reported that those people who were in closest contact with aromatics were virtually immune to the plague

(Tisserand, 1977). Frankincense and pine were burned in the streets while scented candles burned indoors. People wore garlands of aromatic herbs, spices and resins around the neck to help fight the plague (Price, 1995).

Religious and philosophical influences attempted to stifle the use of aromatics. During the 16th and 17th centuries, European Puritans and Roman Catholics discouraged the personal use of fragrances. This use was associated with pagans and witches. Aromatic use was said to be vain and adornment of fragrances diverted ones spirituality (Wilson, 1995).

Perfume use was seen by some British lawmakers as giving women an unfair advantage over men. These fragrances were said to be forms of witchcraft allowing women to seduce and lure men into marriage. The scent from the perfumes were believed to cause men to lose full command of their senses. Such a law prohibiting the use of perfumes did not pass, allowing essential oils to continue to be the “most powerful antiseptics available until modern chemicals appeared” (Wilson, 1995).

Essential oils were being used in medicines by the 18th century. All aromatics are antiseptic and up until the 19th century, medical practitioners carried walking sticks that held a container for aromatics on the top of it. Medical practitioners would sniff these as an antiseptic so they would not catch contagious ailments when treating patients. During the 19th century essences were investigated scientifically. Rosemary and lemon were among the 22 official essences known during this time (Tisserand, 1977). In 1886,

John Pemberton used the essential oils of lemon, orange, nutmeg, cinnamon, coriander and neroli to create Coca-Cola. This was his famous 7X formula. The seventh ingredient was never revealed (Worwood, 1995).

By 1896 chemical science came up with a cheaper way of obtaining the "same" properties in the herbs and essential oils from plants used medicinally. These synthetic copies are sometimes toxic and do not have the same effect on human tissue as the natural properties. Side effects result from these synthetic substitutes, creating a need for additional patient treatment. Also, the natural herbs and essential oils do not require dosage increases as synthetic drugs so often do. Germs often become resistant to the synthetic forms (Worwood, 1995).

The term "aromatherapy" probably was first coined by Rene'- Maurice Gattefosse', a French chemist. Gattefosse' was badly burned on his hand after a laboratory explosion. The hand was immersed in neat lavender oil. As a result, his burned hand healed at an incredible rate and no infection or scar affected the hand (Valnet, 1990). During WWI (1914-1918), Gattefosse' and others used essential oils on the wounds of those injured in battle (Worwood, 1995). Gattefosse' refers to aromatherapy as 'a therapy employing aromatics in a sphere of research opening enormous vistas to those who have started exploring it' (Tisserand, 1977).

Gattefose's first book Aromatherapie was published in 1928. WWII however, somewhat quenched interest Gattefosse' had sparked with additional

scientific papers and books related to essential oils. Italian doctors, Gatti and Cajola, did some work on the medicinal and psychological effects of essential oils during the 1920s and 1930s. Jean Valnet, a French medical doctor, used essences to treat wounded soldiers during WWII (Tisserand, 1977).

The late 1950s found aromatherapy expanding into Britain. Marguerite Maury, an Austrian who was married to a French doctor and homeopath, worked with essential oils both medically and with its ability to maintain youth by penetrating the skin. As a result, aromatherapy was capitalized on by the beauty industry. Since beauty therapists are not allowed to treat medical conditions, 'the main application of aromatherapy in Britain was to relieve stress and skin conditions by massage only. Because of this and essential oil information being tied up in the perfume business, aromatic compounds were presented with essential oils with massage therapy (Worwood, 1995).

Valnet continued Gattefosse's research on aromatherapy about 15 years following the end of WWII. In the early 1960s Valnet published articles and a book on aromatherapy. As a result, Valnet is credited with the recognized respect of aromatherapy today (Tisserand, 1977).

Aromatherapy in Today's Society

Today essential oils are tested in laboratories. There are about 3,000 essential oils in the world. Of those, about 300 are presently used and traded. As a result of this current and ongoing research around the world, third-world

countries are finding a new source of revenue. The majority of these plants are grown in third world countries and are a new cash crop for selling to the growing aromatherapy market. Plants from different regions do not have the same properties. It is important for the extraction of the essential oil to come from the area native to the plant. A plant grown in Egypt will not produce the same oil as the same type of plant grown in China. Soil temperatures, moisture content, and overall climate contribute to the production of varying essential oils (Worwood, 1995).

Essential oils seem to be able to bring the human body into balance. The essential oils act to naturally cleanse the inward and outward body as well as balance the nervous system (Worwood, 1995). Research companies are coming to appreciate the potential use of aromas. The International Flavor and Fragrances (IFF) has received a patent on the use of nutmeg to reduce stress. A study found that inhaling an apple-spice blend with nutmeg oil lessened muscle tension and blood pressure (Avery, 1996).

Today, essential oils can be used virtually anywhere. They can be applied directly to the skin, diluted in water for application, neat or diffused into the air, in baths, compresses or cosmetics (Metcalf, 1989; Worwood, 1995; Masline & Close, 1998). An increased interest in alternative medicines is creating an influx of interest and research into aromatherapy (Metcalf, 1989). A concern about the environment and a desire to get closer to nature is also a reason for increased fascination in this area (Wilson, 1965). The 1990s

have seen an overabundance of interest into this art, which is quickly becoming a science (Masline & Close, 1998). Scent application is being used in commercial and residential buildings, the healthcare and hospitality industry, educational, and entertainment systems. Hundreds of aroma systems are employed in Europe, Japan and the United States. The National Institute of Health funds olfactory-related studies. The scientific results of these studies have attracted the academic world and smells are found to be associated with emotion and memory ("Conditioning indoor environments", 1998).

Britain and Europe have strict guidelines for attaching the title of aromatherapist. France requires that before one can be an aromatherapist, one must first be a qualified physician. This may be because of the antiseptic qualities of essential oil. Thyme in essential oil form acts as an antibiotic to clear up bacterial infections. It can be diluted with vegetable oil and rubbed on the chest. The United States and Canada are presently undergoing the process of establishing the profession of aromatherapist with strict credentials attached (Worwood, 1995). Aromatherapy is more popular in Europe. There, insurance will pay for herbal prescriptions ("Can Aromas Heal?", 1996).

Many in the British royal family use natural medicines. Princess Diana was reported by the press to have gone for aromatherapy treatments. The British also use aromatherapy in hospital maternity wards and intensive care units. London Lighthouse uses aromatherapy to help care for people with AIDS (Worwood, 1995). Worcester Hospital in Hereford, England,

performed a six-month trial using aromatherapy. The essential oil of lavender was emitted into the air of the hospital. Lavender has a calming effect. As a result, patients were reported to have slept better and more naturally and were less aggressive during the day. Furthermore, some patients were gradually taken off tranquilizers during this time period (Worwood, 1996).

The bath and shower industry in England markets soaps that have essential oils. Boots has a product that contains beads of avocado oil. These oil beads are suppose to reduce cellulite when rubbed into the skin. Johnson and Johnson have two therapeutic bath products to help decongestion, sore skin, and rashes. The bath liquid of Flying Saucers is suppose to limit or prevent pre-menstrual tension. Sara Lee has produced a bath and shower product with wheatgerm oil (Rudd, 1997). Germany has a best selling prescription drug - ginkgo biloba, an extract taken from an herbal plant. Ginkgo biloba is used to stimulate cerebral circulation in the elderly (Worwood, 1996).

The Japanese use aromatherapy as a management tool. In 1985 Dr. Shizu Torii demonstrated that some aromas can have a stimulating effect on the mind and other aromas can have a relaxing effect. Fifty aromatic diffusers are now used in commercial and municipal offices (Worwood, 1996). Banks and large companies in Japan diffuse essential oils into the air to help make customers feel comfortable and relaxed in shops and offices. Lemon is dispersed into the working area in the afternoon to invigorate employees and

stimulate keyboard operators to be more alert. Tokyo corporations diffuse lemon and peppermint through the air-conditioning systems to help promote worker concentration levels (Worwood, 1995). One bank diffuses lavender or rosemary into the customer area and lemon or eucalyptus into the workers' area to keep them alert at their computers (Worwood, 1996).

Commercial diffusers are recommended by Japanese architecture schools. In an attempt to create the perfect working environment, it is suggested that diffusers be placed in different areas of the workplace. This would facilitate the infusion of different aromas during the day (Worwood, 1995). The Shimizu Corporation, Japan's third largest construction company, installs the diffusion systems into new buildings (Lawless, 1994; Worwood, 1996). Another construction company, the Kajima Corporation, sells aroma diffuser systems. A computer system determines the blend of aroma to disperse by taking into account the time of day and the male-female ratio. For general purposes, a lavender and rose combination is emitted to create a calming, stress-relieving effect that also reduces blood pressure. Lemon and jasmine are used after lunch to refresh and revive employees. Toyota uses floral aromas to attract women into showrooms (Worwood, 1996). Japanese researchers at Shinsen, the third largest cosmetic company in the world, have found that women who are given facials with orange and tangerine have lowered their blood pressure (Worwood, 1995).

Some overseas airlines use essential oils to help passengers overcome jet lag and travel fatigue. Research is ongoing to create relaxing, comforting blends and special aromas to ward off air-sickness during air travel as well (Lawless, 1994).

Hotels and retail outlets distribute natural and synthetic aromas to help people relax. It is hoped this relaxing feeling will cause people to stay longer or feel like coming back (Reiter, 1998; Worwood, 1995). Office workers use essential oils to get and keep themselves going throughout the day. A drop of grapefruit essential oil on a washcloth in the shower can liven one up to start the day. Bergamot can give a quiet, cool confidence - helpful if one is going for a job interview. Basil assists in the efficient working of the brain. A blend of rosemary and lemon can create an alert, efficient and calm state of mind (Worwood, 1995). The Marriott Hotel in Miami has installed a fragrance generator. The fragrance 'Mango', is aimed toward Central and South American clients (Lawless, 1994). One car manufacturer in the United States is funding research to find an aroma to make their salesmen appear to be more "honest and trustworthy to customers" (Worwood, 1996).

Robert Baron of the Rensselaer Polytechnic Institute in New York has published studies that illustrate mood effects due to the introduction of a fragrance. He has invented the Optimatic 120. This unit fits on a desktop and plays a disc of a light floral scent for a relaxing mood. The disc may be changed to emit a citrus fragrance for alertness (Lawless, 1994; You, 1994).

Susan Shiffman, a psychologist at Duke University has found that chocolate desires can be quenched by spraying a chocolate scent to the back of the tongue. She has also found that peach scent can abate pain. The Sloan-Kettering Institute, a cancer research facility in New York City, has found that a vanilla-like fragrance reduces anxiety (Lawless, 1994).

Dr. Alan Hirsch of the Smell and Taste Research Foundation in Chicago has performed an experiment in a department store setting. Thirty-one people were asked whether they would purchase Nike shoes. Identical shoes were offered to the same people in two different rooms. One of the rooms was scented with a light floral aroma. As a result, 26 of the 31 people said they would buy the Nike shoes in the scented room. In that room shoes were even \$10.33 more costly!

Another Hirsch experiment was in a gambling casino in Las Vegas. An aromatic fragrance was put around selected slot machines. The amount of money spent in these slot machines increased by 45%. The area where no fragrance existed saw no increase in the amount of money put into the slot machines (Worwood, 1996).

Alzheimer's disease affects between four and six million people in America. The number affected is expected to reach 14 million by the year 2020. Alzheimer's is a deterioration of the reasoning and memory areas of the brain (Mindell, 1997). The sense of smell is directly transmitted to the limbic system of the brain, which deals with memory, among other abilities.

Alzheimer's deals with a loss of remembering recent events, places or people (Worwood, 1996). Aromatherapy has been tried with Alzheimer's patients. Worwood (1996) thinks that "because of the powerful olfactory link with memory, aromas might be the last link between the real experienced world, and the mind which is now hidden within" Alzheimer's afflicted patients.

As of yet, there is no concrete scientific evidence to determine that aromatherapy is a cure for this debilitating disease. Dr. Jim Duke retired from the USDA in 1995. His continuing research leads him to believe that aromatics, specifically, rosemary, may help keep Alzheimer's disease from controlling a person's life. Dr. Duke does caution that there is "no proof (yet) that rosemary can prevent or even slow the progress of Alzheimer's disease". He does claim that rosemary contains "many compounds whose activities could prove useful in combating conditions like Alzheimer's disease" (Duke, 1997).

Deanna Wolf (1996), Texas Regional director for the National Association for Holistic Aromatherapy (NAHA), gives an account of aromatherapy use with an Alzheimer's patient. This was an elderly woman who lived with the Wolf family for seven months. Many essential oils were incorporated in the woman's surroundings. Her clothes were washed in oils; a lavender wreath was hung over her bed to facilitate sleep. Eucalyptus, pine and Douglas fir were used to ease breathing. A blend of rosemary, peppermint, basil and ginger were diffused for memory enhancement. Ginkgo

biloba and B-12 were added to her diet and as much as possible, fresh herbs were used in cooking.

After five months of this exposure, the woman was able to remember where her bedroom and clothing were. She also repeated herself less often. Her zeal for life and desire to be involved in helping others returned. An untimely fire forced the woman to be placed in a nursing home. Since going to the nursing home and not having the essential oil exposure, her memory has lapsed.

Dr. Alan Hirsch has conducted several studies dealing with odors and learning ability. He has used connect-the-dot time tests and mazes. To treat with the odor condition, subjects wore surgical masks that had been soaked in aromatic odors. He found that those adults, high school seniors and first through third graders, who wore the masks soaked in a mixed floral aroma completed the tasks with double the speed of those with no aroma condition (Poirot, 1997).

School teachers in California are using aromatic fragrances in the classrooms. Tami Schwartz of Camellia Avenue School in North Hollywood uses a lavender solution sprayed into the air. She claims it not only gets rid of germs, but helps her fourth and fifth graders concentrate better. Marilyn Nardidn-Smith at an Orange County public school uses several blends with her middle school handicapped children. She claims that orange blossoms in the morning help the students to feel relaxed and be alert. Rosemary after

lunch stimulates the students and a pine scent at the end of the day prepares them to go home (Reiter, 1998).

Rosemary

Rosemary is an evergreen perennial shrub type plant native to the western Mediterranean. The plant has needle-like leaves and blooms with pink, white, blue or violet flowers (Oliver, 1997). Respect for this herb dates back to the 14th century (Oliver, 1997, Jones, 1998).

Rosemary has been associated with memory for about as long. A 17th century herbalist, Gerard, gave an implication as to how rosemary was regarded in early medicine: "Rosemarie is given against all fluxes of blood; it is also good, especially the floures thereof, for all infirmities of the head and braine, proceeding of a cold and moist caufe; for they drain the brain, quicken the senses and memorie..." (Frontier Cooperative Herbs, 1998).

Mummies found with rosemary-scented wrappings were thought to imply rosemary's association with remembering the dead. Australians, today, wear sprigs of rosemary on Anzac Day to remember those who died in war. The ancient Greeks thought that wearing rosemary garlands would improve memory (Oliver, 1997). Ophelia, in Shakespeare's Hamlet says: "There's rosemary, that's for remembrance; pray love, remember..." (Oliver, 1997; Frontier Cooperative Herbs, 1998).

Rosemary was once used as a love charm. A person tapped with a rosemary twig with an open blossom is said to be destined to fall in love with the person who tapped them (Castleman, 1991). Wedding garlands of rosemary were worn by newly married couples so they would always remember their vows. A rosemary bush in a garden meant the woman was the head of the household. Men were often seen pulling up these bushes in order to show their manhood! (Oliver, 1997). The use of rosemary to improve memory ability was apparent in all facets of life.

Implicit and Explicit Memory

Examining both implicit memory, an unconscious use of memory to perform a task, and explicit memory, a conscious use of memory to perform a task, is important. Testing both areas will assist in discerning if one area of memory is enhanced over the other area through the aromatic fragrance introduction. This will also allow the research to show whether the introduction of the aromatic fragrance from the essential oil of rosemary increases memory ability. Explicit memory represents a conscious search while implicit memory does not. Explicit memory is a recall phase. The participant is asked to go back and actively look for previously presented items. Implicit memory involves responding with the first word that comes to mind. It happens without effort. Rosemary could affect one area and not the

other. Smith (1997) only found explicit memory to be affected. Thiara and Ball (1996) found the implicit task to show improvement.

Differentiation between implicit and explicit memory dates back to 1804 with Maine deBiran, a French philosopher. He concluded that after repetition, an act or idea could become automatic or unconscious. Other thoughts or actions can be conscious recollections. This was the first clear distinction between what is now termed multiple memory system differences in implicit and explicit memory (Schacter, 1987). "Implicit memory can occur without awareness or recollection of previous experience. Explicit memory is knowledge due to the internal recollection of a previous experience as a task or stimuli" (Park & Gabrieli, 1995).

Tests commonly used in implicit retrieval are lexical decision, word identification, word stem or word fragment. Word stem or word fragment tests allow completion with words previously exposed from a prior list (Schacter, 1987). Methods of testing for implicit or explicit memory retrieval are well documented. These tests must be comprised of two ingredients. Encoding or external cues must be the same for subjects. Only the testing instructions should vary. "Explicit instructions should ask participants to recollect the prior study episode; implicit instructions should not" (Seamon et al., 1995): Weldon (1993) explains the importance of specifically addressing memory through implicit and explicit tests. She contends that testing memory in both areas allows dissociation so variables that demonstrate one pattern of

effects will illustrate no effects or opposite effects on implicit tests, and vice versa. Weldon cites reputable researchers from 1987, 1988 and 1989 in making this claim. Weldon also clarifies that explicit memory is well documented and is the basis for most memory theories. Furthermore, implicit memory, governed by different standards, lends to dissociation, generating theoretical implications.

Implicit memory has been found to be consistent in relationship to age. Children and adults show little or no variations regarding implicit memory ability (Komatsu, 1996). Implicit memory was found to decline only about 4% (Graf, 1990). Russo and Parkin (1993) also found that there was not an age-related decrease associated with implicit memory. Explicit memory, on the other hand, increases with age and decreases in late adulthood (Komatus, 1996). Salthouse (1982) found that there is a decline in explicit memory associated with age. Graf (1990) found this to be as much as 50% or more.

It has been argued that implicit memory may in fact be an explicit memory retrieval process (McKoon & Ratcliff, 1995). Work with amnesic patients has shown implicit recall to be very good while explicit memory is not. Patients have been able to unconsciously recognize words on a stem test while the same words were not recognized from a yes/no recognition test. Amnesia is "an inability to remember explicitly recent events and new information" (Schacter, 1987). Amnesic patients have been found to be able to implicitly remember information for a week (McAndrews, 1987). Graf and

Mandler (1984) and Schacter and Graf (1986) speculated that explicit memory is not used on implicit tasks. If explicit memory were being used there would be direct correlations on implicit and explicit memory tasks, not the dissociation found in testing.

Roediger and Srinivas (1993) explain the effects of implicit memory tests associated with amnesics. These researchers cite studies that show no decrease in implicit memory ability for amnesics after studying a list of words. These studies also found explicit memory to be virtually non-existent for these patients (Warrington & Weiskrantz, 1970; Graf, Shimamura & Squire, 1985). Weldon (1993) also cites evidence to this fact. Patients who are unable to accurately do explicit memory tests have been found to do better, and as well as normal on implicit tests (Graf & Schacter, 1985).

This helps demonstrate that differences in implicit and explicit memory do exist. Graf and Schacter (1985) cite numerous research studies from 1968 – 1984 to support this. It is also believed that implicit memory is grounded on the retrieval of previously stored memory. Since more testing procedures have used familiar items at encoding, this theory seems viable. This leads to the conclusion that activation of these previously stored remembrances is automatic and independent of the operation for explicit remembering. The activation theory has been proven with amnesic patients. The study by Graf and Schacter (1985) yielded the conclusion that “implicit

and explicit memory for new associations are mediated by different underlying processes.”

CHAPTER III

METHODOLOGY AND PROCEDURES

Introduction

In this chapter, a descriptive overview of the methodology to be employed in this study will be given. The purpose of the study was to investigate whether there is an increase in memory ability when an aroma-based strategy is introduced. More specifically, the essential oil of rosemary was used to determine if its aromatic fragrance would improve memory in middle school students. The following is a discussion of the subjects to be tested, procedures to be implemented throughout the investigation, and a delineation of instrumentation to be used for statistical analysis.

Subjects

The population from which the sample for this study was selected is public school eighth graders in Dade County, Georgia, who attended Dade Middle School during the 1998 – 1999 school term. Dade County is a rural community 20 miles from the metropolitan city of Chattanooga, Tennessee and 130 miles from Atlanta, Georgia. Approximately 360 seventh and eighth graders are enrolled at the school. Permission to conduct the study at the school was granted from the building principal and school superintendent (Appendix A). Permission from the University of Tennessee, Knoxville

Human Subjects Compliance Section, Officer of Research was also obtained (Appendix B).

All of the population was asked to take home a parental consent form prior to experimentation. The participants were the students whose parents signed and returned the consent forms (Appendix C) prior to the experiment. The nature of the study and oils to be used were discussed in the parental consent form, but the anticipated outcomes were not.

To determine the appropriate sample size needed, a Cohen (1977) a priori power analysis was run. Using the means and standard deviations derived from a comparable study by Smith (1997) an effect size of .5 was calculated. The program G*Power uses Cohen's method to determine the subject sample size. Using an alpha of .05 and a medium effect size of .50 with 9 groups, Cohen's method calculated a needed total sample size of 108 for an actual power of .96.

Of the approximately 200 available students, 104 returned permission slips and participated in the complete study. The mean age of participants was 13.47. Fifty-eight percent of those tested were females and 42% were males. Of the total participants, 15% had at one time, or presently do, smoke. These students were randomly assigned to each of the nine conditions.

Materials

The essential odors of rosemary and lemon were presented at encoding and retrieval, while a no odor condition of water was also used. Lemon and water were used also as control group conditions. The use of the essential oil of lemon was to eliminate the possibility of the Hawthorne Effect. Lemon is not found to be a memory enhancer in scientific or popular literature. Each testing room had a diffuser to disseminate the odor or lack of odor. Six drops of essential oil (Worwood, 1997) were placed in the diffuser (Aura Cica) for the 30 minute encoding and retrieval procedure. It is vital that the essential oils be used, not synthetic oils (Smith, 1997). For this reason, the oils were purchased through an established company (Aura Cica).

A list of age appropriate words (Appendix D) were visually presented using an LCD projector and the computer program Power Point. These words were compiled from a list of words used in a study by Snodgrass and Vanderwart, (1980). Smith (1997) had also compiled her list from the Snodgrass and Vanderwart listing. Smith's research was a springboard for this study. The technique for word selection were the same Lehman (1997) practiced. Lehman (1997) chose words and asked teachers to specify if the selected words were age appropriate. Teachers corroborated that the selected words for this study should be known by most sixth graders.

A filler task asked the students to write about a childhood memory (Appendix E) during encoding. The encoding period would be equivalent to

the teaching phase of learning. The filler task was used to alleviate any attempts of memorization on the student's part. At retrieval, students were asked to complete two activities. One was to list as many of the previously shown words as possible (a test of explicit memory) and the other was to complete a word fragment test comprised of the previously presented words and additional filler words (a test of implicit memory).

Testing Procedure

A research team from the University of Tennessee at Chattanooga Psychology Department conducted the data collection. The research team consisted of three students who have had experience in odor testing. Students whose parents had agreed to allow them to participate were drawn from either physical education or exploratory class time for testing. This was done in order to interfere as little as possible with the core education process at Dade Middle School. Students were randomly assigned to encoding groups for exposure to an odorant condition. This was done by numbering each returned parental consent form allowing participation and using a table of random numbers. The students were tested in groups of 30-35 in three individual classrooms. These classrooms were available since grade level teachers had planning during student physical education/exploratory time. At this time, students were told the nature of the experiment and asked to complete the informed consent (Appendix F). Each student received a candy bar for

participating in the study. Students were told that rosemary, lemon and water were used in the groups, but were not told of the anticipated outcome from any of these conditions. This eliminated any chance of the Hawthorne effect.

Nine groups were exposed to nine different conditions. The groups differed in the aroma received at encoding and then at retrieval. Students were divided into three initial groups for the encoding phase. The encoding conditions were either rosemary, lemon, or water. At retrieval the three groups were divided into thirds. This allowed for 1/3 of the students to receive the same aroma at retrieval as during encoding. Two-thirds of the students then received a different aroma at retrieval. Table 1 outlines the various phases of conditions.

Table 1

Encoding and Retrieval Stages of Conditions

		Retrieval Odorant		
		Rosemary (r)	Lemon (l)	Water (w)
Encoding Odorant	Rosemary (R)	Rr	Rl	Rw
	Lemon (L)	Lr	Ll	Lw
	Water (W)	Wr	Wl	Ww

The morning session was arranged as follows:

Groups 1, 2, 3 – Mrs. Hamilton's room (R).

Groups 4, 5, 6 – Mr. Ambrose's room (L).

Groups 7, 8, 9 – Mrs. Traylor's room (W).

The afternoon session was arranged as follows:

Groups 1, 4, 7 – Mrs. Hamilton's room (r).

Groups 2, 5, 8 – Mr. Ambrose's room (l).

Groups 3, 6, 9 – Mrs. Traylor's room (w).

Two testing periods were needed to complete the experiment. The first period was the encoding phase, or learning period, where words to be remembered were first introduced. The informed consent form was given to the students and explained. Students were shown a list of 30 age appropriate words at four – second intervals using a Power Point presentation over the school's televisions. This was the encoding phase of the experiment and took about 3 minutes for the list of words to be presented to the students. In order to prevent attempts for memorization of the listing of words, a filler task, asking students to write for 10 minutes about a childhood memory was given.

The second period of testing was the delayed retrieval stage. This stage was three and a half-hours later. This length of time allowed for a delay period and was the next available opportunity for students to be accessible. During this stage each exposure group was randomly divided into thirds and randomly assigned to an odorant condition for retrieval. Finally, students were asked to recall as many words as they could from the earlier list (Appendix G) and were asked to complete a word fragment exercise (Appendix H) containing words from the earlier list. The order of these tasks were counterbalanced

within each group so direct and indirect memory may be analyzed. Time was allowed for students to finish as much as they could remember.

The use of pure, non-synthetic essential oils and the water was dispersed with a diffuser. Pure oils are necessary because synthetic oils lose some of the properties found only from natural oil extraction (Masline and Close, 1998). A window was opened after each testing session to eliminate the presence of the odor in the room between testing sessions. Otherwise, students returning to these classrooms after the encoding phase might have contaminated the results if some were exposed to the lemon or rosemary during the period between encoding and retrieval.

Confidentiality of Data

Subject names were held in confidence. Each student was identified by a code number used only in this study, with no association of the individual's name. All data storage is by number and no link can be made between name and identification number following the initial compilation of the data. Data will be stored by the Experimenter for three years before it is destroyed.

Statistical Analysis

Means were calculated for the number of correct responses for each test. Scores were then analyzed using a 3 X 3 factorial analysis of variance. An ANOVA was run to determine statistical significance in the condition

groups. A post hoc Newman-Keuls test was run to analyze individual cells when F was found to be statistically significant.

Pilot Test I

A pilot test was run on 23 UTC senior psychology students. These students were not randomly selected. The testing procedure was an encoding and retrieval phase of no odor. The purpose was for the researcher to experience the testing and to see results the chosen test would yield.

The group as a whole was aurally presented with 30 words. After being presented with the word list, students were asked to write about a childhood memory. About five minutes was given for this task. This was given as an attempt to eliminate memorization of the words. Students were not instructed to use any of the words. The task was given simply to keep the students from practicing the list of words in their mind.

Following the activity, the students were given the explicit and implicit tests for memory at retrieval. The explicit test was a test of recall and asked students to list as many of the words presented earlier as possible.

The implicit test was a list of 40 word fragments. Twenty of these were randomly chosen from the encoding list. The other 20 were randomly chosen from the word list of Roediger, Weldon, Stadler, and Riegler (1992). Students were instructed not to turn back to the first page after going to the second page and were asked to do the tasks in the order given. The tests were stapled

together with alternating tests first. No time limit was given to finish. All finished the testing procedures within ten minutes.

The mean number of words recalled when recall was given first was 7.36. When recall was tested second, the mean was 5.75. The number of encoded words correctly completed in the word fragment test was 7 when the word fragment test was given first and 5.17 when the word fragment test was given second.

The pilot test simulated a Water-water condition (no fragrance present at encoding or retrieval). An ANOVA was then run on the two retrieval groups to determine if order of explicit or implicit testing made a difference. No significant difference was found between giving the recall or word fragment test first ($F = 1.755$, recall and $F = 1.749$, word fragment, $p > .05$).

A concern arose in whether the word list was too difficult. The previous test had been a no fragrance condition test. The average number of recalled words was small, (5 – 7). Another pilot test, this time using a Rosemary-rosemary condition was employed. For this procedure, 16 different students from a psychology class were tested. The same procedure was used at encoding and retrieval as for the Water-water phase earlier. The difference was in the introduction of the treatment of rosemary and a 1 ½-hour delay was implemented between encoding and retrieval. This was done to more closely resemble the actual testing situation to be employed in the study with children.

Findings did not show an increase in explicit or implicit memory in the rosemary condition. A mean number of words remembered on the explicit memory test was 5.125 and the mean number of words remembered on the indirect memory test was 4.812. There was no effect as to which test was given first at retrieval. No statistical significance was found for interaction when the control group of water was compared to the treatment of rosemary ($F = 1.816, p > .05$).

Conclusions from Pilot Test I

This researcher needed to revisit the test and find a different word list. This was not an attempt to find an easy way to prove a hypothesis. Instead, it was an attempt to find a more reliable word list to test. Even at the Water-water condition, students were only able to remember an average of about 23% of the words. This low percentage of retrieval brought concern about the word list, especially since the actual testing situation was to use eighth grade subjects.

Pilot Test II

Pilot Test II consisted of a different word list from Snodgrass and Vanderwart (1980). This was the same study from which Smith (1997) had compiled a word list for her aroma-based experiment. The Lehman (1997) technique for word selection was employed. Lehman had teachers examine

the chosen words and agree whether the words were age-appropriate or not. Teachers corroborated that this chosen word list was age-appropriate (Appendix I). For this pilot test, 22 eighth graders with different ability levels were aurally presented the word list. The encoding and retrieval phase was a no odor condition.

The group was presented with 30 aurally presented words during encoding. After being presented with the word list, students were asked to write about a childhood memory. About five minutes was given for this task. Students were not instructed to use any words from the list. This activity was given as an attempt to eliminate memorization of the words and had no other purpose in the study.

Following the activity, the students were given the explicit and implicit tests for memory at retrieval. The explicit test was a test of recall and asked students to list as many of the words presented earlier as possible.

The implicit test was a list of 40 word fragments (Appendix J). Twenty of these words were randomly chosen from the encoding list. The other 20 were randomly chosen from the second word list from Snodgrass and Vanderwart (1980). Students were instructed not to turn back to the first page after going to the second page and were asked to do the tasks in the order given. The tests were stapled together with alternating tests first. A five-minute time limit was placed on each test, but all students finished prior to the five minutes.

The mean number of words recalled when recall was given first was 8.91. When recall was tested second, the mean was 8.20. The number of encoded words correctly completed in the word fragment test was 10.8 when the word fragment test was given first and 8.5 when the word fragment test was given second.

An ANOVA was then run on the two retrieval groups to determine if order or explicit or implicit testing made a difference. No significant difference was found between giving the recall or word fragment test first.

Conclusions from Pilot Test II

The word list for encoding and retrieval should come from the second pilot test. The calibration of words was more applicable to eighth grade students. The first test showed the word list to be too difficult, as the college students' recall was low. Pilot Test II found the students to be able to remember an average of about 33% of the words. This was 10% more than Pilot Test I word list.

Collection and Analysis of Data

Subjects returning parental permission forms were randomly assigned to one of nine groups. The groups were as follows. The first fragrance was the encoding fragrance and the second fragrance was the fragrance at retrieval. Group 1: Rosemary/rosemary; Group 2: Rosemary/lemon; Group 3:

Rosemary/water; Group 4: Lemon/rosemary; Group 5: Lemon/lemon; Group 6: Lemon/water; Group 7: Water/rosemary; Group 8: Water/lemon; Group 9: Water/water.

To ensure that each group received the same instructions, a protocol was written and distributed to each of the three persons in charge of the rooms during encoding and retrieval. (Appendix K).

A correct response on the recall test was any word from the encoding list. Plural forms and phonetic spellings were regarded as correct answers, or hits. Hits on the word fragment test were those words from the encoding list. This also included plurals or phonetic spellings as correct responses.

The tests were scored and correlated with the demographic information provided by the student. A list of student names and group assignments were double-checked. By having the subject put his or her name on the test packet before beginning the retrieval phase, accurate groupings could be assured. It was found that one student had gone to the wrong assigned room for the retrieval phase. As a result, she was regrouped into the correct encoding / retrieval group.

The sample used for this study was comprised of 104 eighth graders. None of the subjects' scores were deleted from the analysis. Information regarding (1) age, (2) gender, (3) tobacco usage, (4) group number, (5) test order, (6) word fragment hits, (7) recall hits, (8) encoding group, and (9)

retrieval group were entered into the computer using the Statistical Package for Social Sciences (SPSS).

Three independent variables of encoding group, retrieval group, and test order were employed. The dependent variables of word fragment hits and recall hits were defining variables in the analysis of variance.

CHAPTER IV

RESULTS OF DATA

Introduction

Two dependent variables, word fragment test and recall test, results were compared for the factorial combination of fragrance received at encoding (3), by the fragrance received at retrieval (3), and the order of the dependent test (2). An additional analysis was performed using sex as a between subjects variable; sex had neither a main effect nor interaction and will not be discussed further. Fragrances at encoding and retrieval were rosemary, lemon or water. Order refers to the arrangement of the retrieval measures, with word fragment test before direct recall test (word fragment first) or direct recall test before word fragment test (direct recall first). The research question sought to determine if the aromatic fragrance of rosemary had a significant effect on memory ability in eighth graders. To determine the answer, the data were subjected to two statistical analyses tests using SPSS. First, an encoding by retrieval by order between subjects analysis of variance was performed for the word fragment test. The second analysis was on encoding by retrieval by order between subjects analysis of variance for the direct recall test. These analyses were used to determine if any fragrance had an effect on memory ability and if the order of test taken first had any effect on memory ability.

Direct Recall Test Results

The fragrance received at encoding influenced recall, $F(2, 86) = 5.148, p = .008$. There was also a significant interaction of encoding by order for recall $F(2, 86) = 3.276, p = .043$. The mean number of hits based on fragrance received at encoding, or learning, are presented in Table 2.

Those students who received the aromatic fragrance of the lemon at encoding show a higher average number of correct responses on the direct recall test. Table 3 describes the mean number of hits based on type of test received first at encoding.

Figure 1 visually illustrates the average correct responses for fragrance at encoding by order of test taken. The graph shows the mean number of hits for word fragment or direct recall test first, along with the fragrance received at encoding.

Table 4 presents the summary table for this analysis. Here, the ENCODE significance of .008 suggests that there is a difference in the mean number of words recalled. The significance value of .043 for ENCODE * ORDER (fragrance at learning and order of test taken first) signals that those who took the direct recall test first, after being exposed to lemon at encoding, did better than those who took the word fragment test first. A Newman-Keuls post hoc test confirmed the significance of exposure to lemon at encoding. Those students who received lemon at encoding, or learning, did statistically better on a test of direct recall first than those students who received rosemary or no fragrance. Table 5 enumerates these findings.

Table 2

Encoding Fragrance on Recall

Encoding Fragrance	Mean Hits	Std. Error
Rosemary	7.227	.493
Lemon	9.185	.503
Water	7.167	.531

Table 3

Encoding by Order on Recall

Encoding Fragrance	Test Order	Mean	Std. Error
Rosemary	Word Fragment first	7.944	.779
	Direct Recall first	6.509	.605
Lemon	Word Fragment first	8.315	.636
	Direct Recall first	10.056	.779
Water	Word Fragment first	6.333	.754
	Direct Recall first	8.000	.749

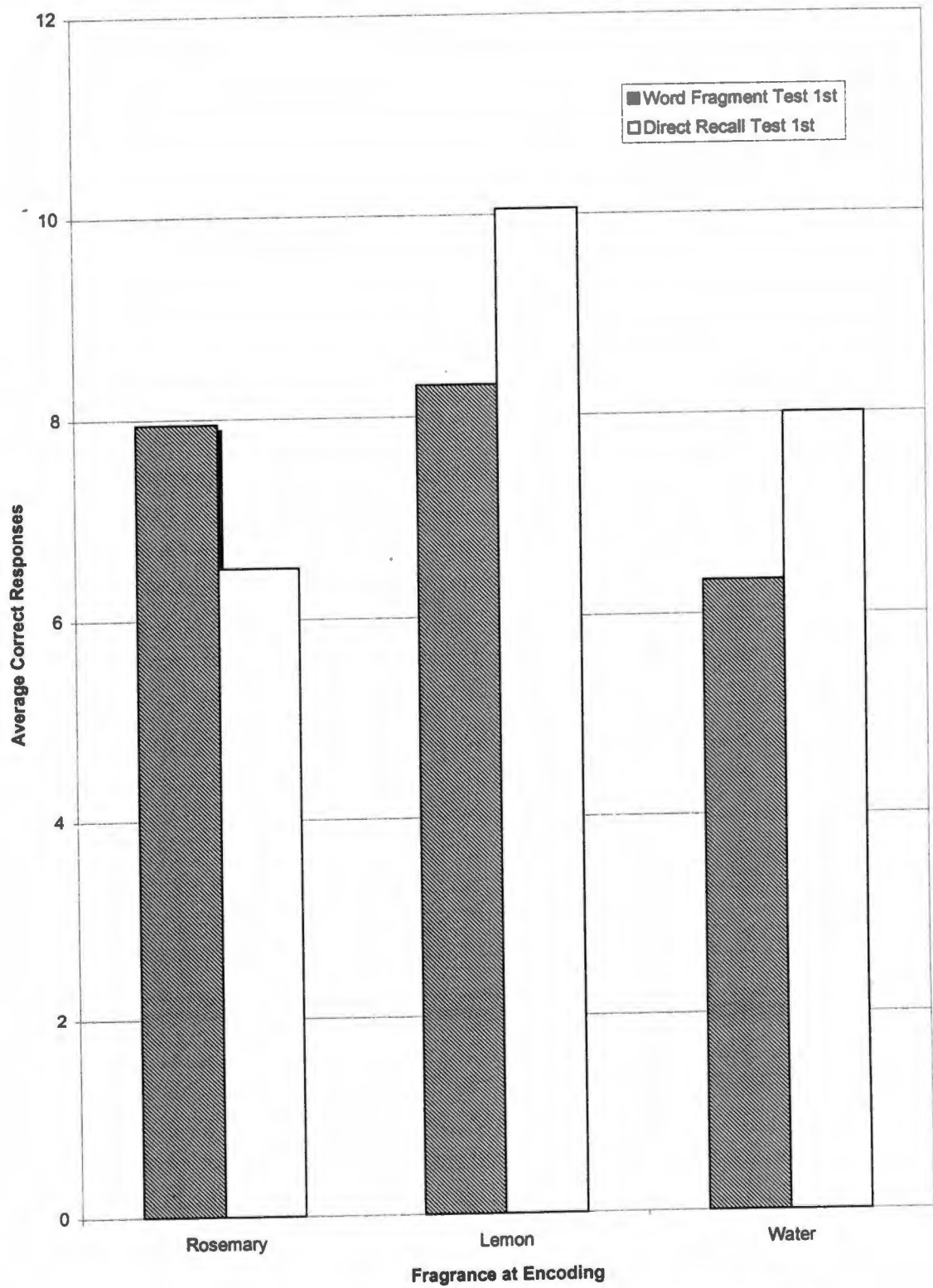


Figure 1. Encoding Fragrance and Average Correct Responses by Type of Test Taken First

Table 4

Summary Table of Encoding by Retrieval by Order Analysis of Variance for Recall

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	213.152	17	12.538	1.531	.103
Intercept	5848.36	1	5848.361	714.233	.000
ENCODE	84.306	2	42.153	5.148	.008
RETRIEVE	17.822	2	8.911	1.088	.341
ORDER	10.229	1	10.229	1.249	.267
ENCODE*RETRIEVE	21.383	4	5.346	.653	.626
ENCODE*ORDER	53.644	2	26.822	3.276	.043
RETRIEVE*ORDER	10.738	2	5.369	.656	.522
ENCODE*RETRIEVE*ORDER	8.392	4	2.098	.256	.905
Error	704.194	86	8.188		
Total	7226.000	104			
Corrected Total	917.346	103			

Table 5

Newman-Keuls for Encoding on Recall

Encoding	N	Subset 1	Subset 2
Fragrance			
Rosemary	37	7.0270	
Lemon	36		9.0278
Water	31	7.2581	
Sig.		.738	1.000

Word Fragment Test Results

The word fragment test was the dependent variable for an encoding, by retrieval, by order between-subjects analysis of variance. Hits for word fragment results were found to be significantly affected by the fragrance at retrieval, $F(2, 86) = 3.500$, $p = .035$. Test order was also significant $F(1, 86) = 9.315$, $p = .003$, but did not interact with any effects. Mean hits at retrieval for word fragment tests are shown in Table 6. Mean hits for order of test, with word fragment as the dependent variable, are illustrated in Table 7.

No significant main effect was found for fragrance at encoding on the word fragment test. Table 8 presents the full summary table for this analysis and although the table shows that there was an interaction for ORDER (order of test taken first), the interaction is not for taking the word fragment test first. There is no statistical significance reported for any of the interactions.

Table 6

Word Fragment Performance by Fragrance at Retrieval

Retrieval Fragrance	Mean Hits	Std Error
Rosemary	7.967	.479
Lemon	7.954	.503
Water	9.502	.468

Table 7

Test Order Effects for Word Fragment Performance

Test Order	Mean Hits	Std. Error
Word Fragment first	7.622	.398
Direct Recall first	9.327	.392

Table 8

Summary Table of Encode by Retrieval by Order Analysis of Variance for Word Fragment

Source	Type III Sum of Squares	df	Mean Squares	F	Sig.
Corrected Model	218.268	17	12.839	1.739	.051
Intercept	6798.876	1	6798.876	920.861	.000
ENCODE	11.866	2	5.933	.804	.451
RETRIEVE	51.676	2	25.838	3.500	.035
ORDER	68.776	1	68.776	9.315	.003
ENCODE*RETRIEVE	27.681	4	6.920	.937	.446
ENCODE*ORDER	13.511	2	6.755	.915	.404
RETRIEVE*ORDER	25.871	2	12.935	1.752	.180
ENCODE*RETRIEVE*ORDER	33.505	4	8.376	1.135	.346
Error	634.953	86	7.383		
Total	8521.000	104			
Corrected Total	853.221	103			

Overall Conclusions

The original research question asked if there would be a significant effect on memory for the aromatic fragrance from the essential oil of rosemary. This study found no significant effect of rosemary on memory ability in eighth graders. However, the aromatic fragrance from the essential oil of lemon did contribute to student memory ability on a test of direct recall. Those students exposed to lemon during the encoding phase, recalled more words from the word list than students who were exposed to rosemary or no fragrance.

The question of whether test order made a difference in correct responses was also addressed. This study found test order to be a significant factor in memory recall ability. The interaction during recall was significant between the groups. The significance was only when the group receiving lemon at encoding also took the direct recall test first.

CHAPTER V

FINDINGS, DISCUSSION, AND RECOMMENDATIONS

Findings

The original intention of this dissertation was to determine if an aromatic fragrance could improve memory ability of young learners. Rosemary, in particular, was the fragrance thought to be the aromatic fragrance to promote learning. Rosemary's connection to being the fragrance of remembrance dates back for centuries (Castleman, 1991; Oliver, 1997; Frontier Cooperative Herbs, 1998). This particular study, however, did not find rosemary to be the aromatic fragrance of memory. Instead, lemon was found to have an effect on memory ability. Lemon is thought to promote alertness (Worwood, 1995).

Eighth graders who were exposed to the aromatic fragrance of lemon at encoding were able to remember more on a direct recall and word fragment test than subjects exposed to rosemary or water. Those students who were exposed to lemon at encoding did significantly better than those exposed to rosemary or water on a test of direct recall. This is contradictory to the findings of Smith (1997) who found no significant interaction between odors in a similar testing situation with college students. The present findings are also contrary to those of Thiara and Ball (1996) who found a significant effect for rosemary for indirect memory on a word fragment test.

Discussion

Aromatic techniques are already being used in the European business world. American companies sell aromatic air fresheners. Already there are accounts of aromatic fragrances being used by many private individuals throughout the United States. Aromatherapy centers are springing up in large and small towns. The breakthrough to the educational realm is close. Is it possible that the inclusion of an aromatic fragrance into the classroom could help students in their ability to remember?

Lemon was found to increase eighth-graders ability to recall more on a three and a half-hour delayed test. Many things may have attributed to this. Perhaps the smartest subjects ended up in the lemon-encoding group. If so, this would taint the findings. To explore this possibility, student reading vocabulary scores were analyzed, from the previous year's ITBS testing. The average vocabulary score for the rosemary-encoding group was at the 60.5 percentile. The water-encoding group's average percentile was 55.0 and the average percentile for the lemon-encoding group was only 53.2. The lemon- encoding group had the lowest overall vocabulary percentile. The differences in percentile are small and do not warrant a justifiable difference in ability level.

How does this study relate to other research in the area of aromatherapy and memory? In two other studies, Smith (1997) and Thiara and Ball (1996), also examined the effectiveness of rosemary or lemon to heighten memory. In Smith's initial study, she found rosemary to have an effect on direct memory. The follow-up

study, however, did not find any significant relationship between rosemary, or lemon on a test of direct or indirect memory. Thiara and Ball found rosemary to have an effect on indirect memory. There are, however, some differences in comparing this study to the two previously mentioned studies.

Both Smith (in the follow – up study) and Thiara and Ball used college students in their studies and a 20-item word list. These participants were presented the list and tested in small group settings over a period of time. This study's participants were eighth-grade students who were presented with a 30-item word list. All participants were tested the same day and in a large group setting. The method of exposure to the aroma was not given by Thiara and Ball. It is assumed that an aromatic diffuser was used since these are popular in Europe. Smith had participants sniff the aroma from a vial stuffed with cotton that had three drops of oil on it. Smith prompted the participants to sniff from the vial during the encoding and retrieval phase. The present study used a professional model diffuser for disseminating the aroma throughout the classroom. One conclusion could be that an aromatic diffuser actually weakens the delivery of the fragrance from rosemary. In turn, the aromatic diffuser may heighten the fragrance from lemon. Rosemary may be more difficult to diffuse than lemon.

Presentation of the word list for Thiara and Ball was with an overhead projector. Words were manually presented at 5-second intervals. Smith also visually presented the word list at 5-second intervals using slides. Smith used a stopwatch to determine time. The present study used a Power Point slide show presentation to

visually present the words at encoding. The timing was set to automatically change the words shown at 4-second intervals. Manually changing the word presented from an overhead projector or slide as Smith and Thiara and Ball did, and keeping the time constant for each is questionable.

Both Smith and Thiara and Ball used a two-hour delay interval between encoding and retrieval. A three and a half-hour delay was used in this study since it was the next available opportunity for testing the participants.

Water was not used in this study as a control. However, neither Smith nor Thiara and Ball used a control group. Also, Thiara and Ball only tested for indirect memory. Table 9 shows the proportion of words completed in the indirect test. Thiara and Ball have a larger percentage of recall than do the Smith or present study. These data suggest that both this study and the Smith study had comparable outcomes.

This study, as well as Smith's study, does not support Thiara and Ball's findings that rosemary had an effect on indirect memory. However, unlike Smith, this study did find the essential oil of lemon to have an effect on direct and indirect memory. This finding could be the result of a different design with the implementation of a control group.

Table 9

Comparison of Indirect Memory Tests Between Smith, Thiara and Ball and Hamilton:
Percentages of Words Recalled

Fragrance	Smith	Thiara & Ball	Hamilton
Rosemary/Rosemary	.36	.64	.40
Rosemary/Lemon	.32	.47	.41
Lemon/Rosemary	.37	.52	.35
Lemon/Lemon	.38	.55	.41

Recommendations

The infusion of the essential oil of lemon into classrooms is a viable option. Educators are often desperate to do anything that will enhance their students' learning powers. According to Komatsu (1996) and Russo and Parkin (1993) implicit memory does not diminish with age. Replicating this study with college students seems to be a worthwhile undertaking. The addition of a control group and if subjects could be tested in a large group setting as opposed to individually or in small groups, might find lemon to have the same results as with eighth graders. No one study can be held as conclusive evidence. The present study seeks to add to the common body of aromatic knowledge. The study raises the potential for the use of aromatics in an educational setting. More research in this field is needed. A one-time finding does not necessarily draw a definitive result. This researcher would like to see follow-up studies done in this area with other eighth graders and younger children as well. The availability of groups of students often hinders research of this kind. More educators need to be involved in attempting to replicate these findings. Educators at K-12 levels

have the available subjects. More scientific research in this area among educators is essential if the answer is to be revealed.

Demands for higher test scores might tempt educators to try the infusion of lemon into the classroom if it meant a one or two percentile increase. Many times student apathy and lethargic actions keep them from learning. Maybe lemon is the unconscious method teachers could use to stimulate the brain and assist in helping students pay more attention.

Math teachers might infuse the essential oil of lemon into the classroom during drills for addition and multiplication. Children have to be able to add and multiply to do subtraction and division. Lemon might stimulate the learning process enough to make it easier for children to learn these facts.

Vocabulary and spelling study could be made simple through the infusion of lemon into the learning environment. Students might be able to remember how to spell words easier. Definitions to vocabulary terms might be easily retrieved after the introduction of the word and its meaning with the essential oil of lemon.

School systems need to embrace and encourage experimental studies within their systems. University-approved studies should be welcomed by administrators. Proper attention to examining possible alternatives for learning are hindered by the unavailability of subjects. Researchers resort to using college students who participate for extra credit in a course. The experimental settings are often void of realistic classroom situations. School systems need to become a part of the experimental world researchers are trying to improve.

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APPENDICES

Appendix A

SCHOOL CONSENT FORM

DADE MIDDLE SCHOOL
250 Pace Drive
Trenton, Georgia 30752

Dr. Gayle Gallaher

Ms. Kelley Brim

Principal
Counselor

Guidance

Telephone (706) 657-6491
Fax (706) 657-3055

June 8, 1998

Ronda Hamilton has explained to me the study she will be conducting with Dade Middle School students. I give my full support and consent to allow her to pursue this endeavor with those students who agree to participate in conjunction with signed parent consent and the informed consent of the individual student.

Mr. Charles Johnston, Superintendent, Dade County Schools

Dr. Gayle Gallaher, Principal, Dade Middle School

Appendix B

HUMAN SUBJECTS APPROVAL, FORM B

IRB # _____

Date Received in OR _____

THE UNIVERSITY OF TENNESSEE, KNOXVILLE
Application for Review of Research Involving Human Subjects

I. IDENTIFICATION OF PROJECT

A. Principal Investigator

(PD) Ronda Hamilton
UTK at UTC Graduate Student: Teaching and Learning
P. O. Box 1484
Soddy Daisy, TN 37384
work: (706) 657-6491
e-mail: creek@voyageronline.com

Faculty Advisor

*Dr. Mary Jane Connelly
UTK EdSMRT
309 Claxton Addition Building
Knoxville, TN
work: (423) 974-6147
e-mail: mconnell@utk.edu

B. Project Classification

Dissertation

C. Title of Project

The Effect of an Aroma-based Strategy on Memory

D. Starting Date

Upon IRB Approval

E. Estimated Completion Date

May 30, 1999

F. External Funding

N/A

II. PROJECT OBJECTIVES

The proposed study will attempt to investigate memory and olfaction through the use of aromatherapy relative to learning. The aroma-based strategy will address the following question: Can teachers use an aromatic fragrance to increase memory learning performance?

III. DESCRIPTION AND SOURCE OF RESEARCH PARTICIPANTS

The population from which the sample for this study will be selected is public school seventh and eighth graders in Dade County, Georgia who attend Dade Middle School. Dade County is a rural community 20 minutes from the metropolitan city of Chattanooga, Tennessee and 130 miles from Atlanta, Georgia. Approximately 360 seventh and eighth graders are enrolled at the school. Permission has been granted by the school system for the research to take place (Appendix A).

All of the participants will receive and must complete a parental consent form prior to experimentation (Appendix B). The sample will be comprised of the student whose parents sign and return the consent forms by the assigned date (three days after receiving the form). These students will be randomly assigned to each of the nine conditions. Participants will then be given the informed consent form and explained the nature of the study (Appendix C).

Middle grades students were chosen because of their accessibility to the project director. The relationship of researcher and participants is teacher/student. An incentive to participate will be a candy bar. This is a small token of appreciation for the student giving up his or her time to participate.

IV. METHODS AND PROCEDURES

A research team from the University of Tennessee at Chattanooga Psychology Department will conduct the testing procedure. Students whose parents have agreed to allow them participation will be drawn from either physical education or exploratory class time for testing. This is done in order to interfere as little as possible with the core education process at Dade Middle School. The students will be tested in groups of 30 in three individual classrooms. These classrooms will be available since grade level teachers have planning during student physical education/exploratory time. At this time students will be told the nature of the experiment and asked to complete the informed consent form. Demographic information regarding age and gender will also be collected at this time.

Signed and returned parental consent letters will be given a number as each is turned in. The researcher will randomly assign students to groups using a table of random numbers.

The essential oils of rosemary and lemon, and a no odor condition of water will be presented in a factorial combination at encoding and retrieval. Each room will have a diffuser to disseminate the odor. Six drops of essential oil will be placed in the diffuser for the 30 minute encoding and retrieval procedure. These products will come from the manufacture, Aura Cica.

Procedures for the study are outlined as follows:

1. Obtain parental consent and randomly assign students to one of three groups at encoding: Rosemary, Lemon, or Water.
2. Participant will be read and explained the informed consent with demographic information prior to the actual testing.
3. Present a list of words to students. This will be presented visually using Power Point. (Appendix D)
4. Provide a filler task to prevent student memorization of words presented. (Appendix E)
5. There will be a three and a half-hour delay.
6. One-third of each exposure group will be randomly assigned to an odorant condition for retrieval. This will result in nine groups: Rosemary-Rosemary, Rosemary-Lemon, Rosemary-Water, Lemon-Lemon, Lemon-Rosemary, Lemon-Water, Water-Water, Water-Rosemary, Water-Lemon. The Water-Water group will act as a control group.
7. Subjects will be asked to recall as many words as they can from the earlier list by writing them on a sheet of paper, and they will be asked to complete a word fragment exercise containing words from the earlier list. These tasks will be counterbalanced within groups. (Appendix F, G)

A t-test and Anova will be run to analyze data and determine if the introduction of an aroma-based strategy may improve memory ability.

V. SPECIFIC RISKS AND PROTECTION MEASURES

There are no foreseeable risks involved in the application of this study. All subjects' names and data will be kept strictly confidential.

VI. BENEFITS

The risks involved in this study are minimal. If this study shows there is a statistically significant increase in memory based on the introduction of an aroma, the need for further investigation into this area will be supported.

VII. METHODS OF OBTAINING "INFORMED CONSENT" FROM PARTICIPANTS

1. Permission to do the study in the school will be obtained from the building principal and the superintendent of schools. (Attached)
2. A parental consent letter will be given to each child in the 7th and 8th grade. Only those who bring back the parental consent form, signed by a parent or guardian, authorizing consent for student participation will be eligible to participate in the study.
3. Students who have returned a parental consent letter will be read the informed consent form the day of testing and will then be asked to sign the form before participation may begin.
4. The language used in the consent forms is understandable to the parents and participants.
5. Consent forms will be kept locked in the Dade Middle School vault for three years past the completion of the study.

VIII. QUALIFICATION OF THE INVESTIGATORS TO CONDUCT RESEARCH

The project director is a teacher in this school and has been for ten years. Students participating have seen the project director at the school during their middle school career. She has previously successfully conducted research on odor memory in the school system.

The personnel administering the actual encoding and retrieval phase of the testing conditions will be undergraduate and graduate students from the Psychology Department at UTC. These students have participated in aroma-based testing before. These investigators will visit the school and classrooms a few days prior to testing to help establish a rapport between themselves and the students.

IX. FACILITIES AND EQUIPMENT TO BE USED IN THE RESEARCH

The facilities to be used during the testing conditions will be 8th grade classrooms for 8th graders and 7th grade classrooms for 7th graders. These rooms will be familiar to the students and provide adequate seating for the conditions. These rooms are available since students go off team to participate in either physical education/health or other exploratory courses. During the testing session, only those students assigned by the researcher will be present in the room. Other students will be off team, participating in regularly scheduled activities. There will be a window in each room so the room may be quickly and easily aired at the end of each session.

Equipment used will include rosemary and lemon essential oils, water and a diffuser (from Aura Cica). An LCD projector will be used in each room to display the word list using the computer program Power Point.

X. RESPONSIBILITY OF THE PRINCIPAL/CO-PRINCIPAL INVESTIGATOR(S)

By compliance with the policies established by the Institutional Review Board of The University of Tennessee, Knoxville, the principal investigator(s) subscribe to the principles stated in "The Belmont Report" and standards of professional ethics in all research, development, and related activities involving human subjects under the auspices of The University of Tennessee, Knoxville. The principal investigator(s) further agree that:

- a. Approval will be obtained from the Institutional Review Board prior to instituting any change in this research project.
- b. Development of any unexpected risks will be immediately reported to the Compliances Section.
- c. An annual review and progress report (Form R) will be completed and submitted when requested by the Institutional Review Board.
- d. Signed informed consent documents will be kept for the duration of the project and for at least three years thereafter at a location approved by the Institutional Review Board.

XI. SIGNATURES

Principal Investigator

Signature _____ Date _____

Student Advisor (if any)

Signature _____ Date _____

DEPARTMENT REVIEW AND APPROVAL

The application described above has been reviewed by the IRB departmental review committee and has been approved. The DRC further recommends that this application be reviewed as:

Expedited Review – Category(ies): _____

OR

Full IRB Review

Chair, DRC

Signature _____ Date _____

Department Head

Signature _____ **Date** _____

Protocol sent to Compliance Section for final approval on (Date)

**Approved: Compliance Section
Office of Research
404 Andy Holt Tower**

Signature _____ **Date** _____

Appendix C

PARENTAL CONSENT LETTER

Dear Parent or Guardian,

I am Mrs. Ronda Hamilton, Team 8-II Team Leader, reading and social studies teacher. Currently I am working on finishing my doctoral degree in education from The University of Tennessee at Knoxville. I would like to include your child in my dissertation study. The study will examine the usefulness of aroma-based strategies to improve memory on an educationally relevant task.

All testing will take two sessions, during physical education and exploratory time on one day. Students not participating will attend regular physical education and exploratory classes, 2nd and 7th periods. These classes last about 50 minutes. The testing session will take much of the entire period both in the 2nd and 7th periods.

A research team from the UT-C Psychology Department, headed by Dr. Richard Metzger, will test the students at Dade Middle School during physical education and exploratory classes. Dr. Metzger is the head of the Psychology Department at UT-C and will select the UT-C students who will conduct the data collection. The research team will sign a confidentiality statement regarding the data collected. Students will be taken out of physical education/exploratory classrooms for one day only, on January 7, 1999.

Each student will be asked to work on a reading exercise while smelling the scent of either rosemary, an herb thought to increase memory ability, lemon, thought to promote alertness, or water. Student memory ability will be tested. The procedures used in this study have been approved by the IRB at UT-Knoxville. No child's name will appear anywhere in the study. No child's grade will be affected by participation or non-participation in the study. There will be no risk to your child associated with this study. Data collected from this study will benefit and add to the knowledge associated with learning.

Please return the bottom portion so I may document your formal consent for your child to participate if your child chooses to participate. No child has to participate. Also, your child may withdraw from the project at any time. Feel free to contact me at Dade Middle School if you have any questions. Thank you in advance for helping me to further my studies.

Ronda Hamilton
work phone #: 657-6491

I, _____, do give my consent for _____
(Parent/Guardian Name) (Child's Name)
to participate in the study Mrs. Hamilton is attempting with the research team from UTC
on aroma-based strategies and memory.

Parent/Guardian Signature

Date

Please list any allergies your child may have: _____

Appendix D

WORD LIST FOR ENCODING PHASE

(Pilot Test I)

	<u>WORD</u>	<u>FREQUENCY</u>
1.	CHURCH	H
2.	GLASS	H
3.	PEACOCK	L
4.	TELEVISION	H
5.	WINDOW	H
6.	CLOUD	L
7.	HELICOPTER	L
8.	TABLE	H
9.	WHEEL	H
10.	CLOWN	L
11.	MOTORCYCLE	L
12.	TRAIN	H
13.	CAMEL	L
14.	HEART	H
15.	TELEPHONE	H
16.	CANDLE	L
17.	KNIFE	H
18.	WATERMELON	L
19.	GIRAFFE	L
20.	WATCH	H
21.	HORSE	H
22.	BARREL	L
23.	SUITCASE	L
24.	WAGON	H
25.	SHIRT	L
26.	BALLOON	L
27.	DRESS	H
28.	CHAIN	H
29.	RABBIT	L
30.	FLUTE	L

Appendix E

FILLER TASK

Please write a story about your best childhood memory.

Appendix F**INFORMED CONSENT FORM****THE EFFECT OF AN AROMA-BASED STRATEGY ON MEMORY**

You are invited to participate in a research study. The purpose of this study is to investigate whether memory can be influenced by the introduction of an aroma.

INFORMATION

You will be asked to participate in groups of thirty - thirty-five students during 2nd and 7th period. These periods are physical education and exploratory class meeting times. During the first session each student will be explained the nature of the study. Then, the informed consent form will be presented and students will be asked to sign it if they decide to continue with the study. Each group of participants will see a list of words in the first session, then be asked to recall these words during the second phase of testing in the afternoon. The testing will take most of the available time during both your physical education/exploratory time in one day. Those students not participating will be in regularly scheduled physical education and exploratory classes. Your parents are aware that you are participating and have given their permission. Participants are asked not to discuss the testing procedure with others until all testing is finished in the afternoon.

RISKS

There are no foreseeable risks from participating in this study.

BENEFITS

If this study shows there is a statistically significant increase in memory based on the introduction of an aroma, students will have an additional tool to assist in the learning process.

CONFIDENTIALITY

The information in the study records will be kept confidential. Data will be stored securely and will be made available only to persons conducting the study unless you specifically give permission in writing to do otherwise. No reference will be made in oral or written reports which could link you to the study.

COMPENSATION

For participating in this study you will receive a candy bar. If you are diabetic, another treat will be made available for you.

_____ **Participant's Initials**

CONTACT

If you have questions at any time about the study or the procedures, (or you experience adverse effects as a result of participating in this study,) you may contact the researcher, Mrs. Ronda Hamilton, at Dade Middle School, and (706) 657-6491. If you have questions about your rights as a participant, contact the Compliance Section of the Office of Research at (423) 974-3466.

PARTICIPATION

Your participation in this study is voluntary; you may decline to participate without penalty. If you decide to participate, you may withdraw from the study at any time without penalty and without loss of benefits to which you are otherwise entitled. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed.

CONSENT

I have read the above information and agree to participate in this study. I have received a copy of this form.

Participant's name (print) _____

Participant's signature _____

Date _____

The following demographic information is needed for statistical purposes. Please fill in the appropriate information or check the appropriate response.

1. Age ()
2. Male () Female ()
3. Do you smoke? Yes () No ()

Appendix G

EXPLICIT MEMORY TEST – direct recall

(Pilot Test I & II)

Please write as many of the words you can remember from the presentation given earlier.

Appendix H

IMPLICIT MEMORY TEST – word fragment

(Pilot Test I)

This will be used to determine how students like you can complete words.

- | | | |
|--------------|--------------|--------------|
| 1. ble_si_g | 2. _a_ou_ | 3. m_i__n |
| 2. p_s__io_ | 5. v__is_ | 6. _u_ct_on |
| 7. c__n_n | 8. s_el_e_ | 9. _is_hi__ |
| 10. _ala_c_ | 11. t_ai_o_ | 12. h_m__ |
| 13. m__l_on | 14. _e_i_f | 15. s__mb_r |
| 16. p_ct__ | 17. at_i_u__ | 18. f__nd |
| 19. _e_fu_e | 20. b_c__i_ | 21. __fic__ |
| 22. s__lo_ | 23. __a__nd | 24. h__to__ |
| 25. _hi_ne_ | 26. _c_as__n | 27. c__t_re |
| 28. _u_lis_ | 29. g_it_e_ | 30. a__ga__r |
| 31. s_rr__n_ | 32. __as_r_ | 33. l_n_u__e |
| 34. p_i_on__ | 35. ad_an_g_ | 36. _is_a_e |
| 37. __g_st | 38. __gin_ | 39. __nd__ry |
| 40. b__ar | | |

Appendix I

WORD LIST FOR ENCODING PHASE

(Pilot Test II)

Word List for Encoding Phase
(alphabetical listing with frequency)

<u>Word</u>	<u>Frequency</u>
1. absence	H
2. admiral	L
3. alligator	L
4. ancient	H
5. balance	H
6. beggar	L
7. belief	H
8. butcher	L
9. culture	H
10. diamond	L
11. digest	L
12. engine	H
13. failure	H
14. feather	L
15. function	H
16. glitter	L
17. helmet	L
18. husband	H
19. industry	H
20. maiden	L
21. memory	H
22. million	H
23. molecule	L
24. officer	H
25. perfume	L
26. position	H
27. sailor	L
28. shelter	H
29. sprinkle	L
30. surround	L

Appendix J

IMPLICIT MEMORY TEST – word fragment

(Pilot Test II)

WORD FRAGMENT TEST LIST

Please fill in the missing letters to create the first word that comes to mind.

- | | | | | | |
|-----|--------------|-----|------------|-----|-------------|
| 1. | A__LE | 15. | S_I_C__E | 28. | H__R |
| 2. | L_P__ | 16. | M__N | 29. | B_L_O_N |
| 3. | B_O__ | 17. | F_OW__ | 30. | __NI__ |
| 4. | G__P_S | 18. | TA_L__ | 31. | CL__K |
| 5. | H_R_E | 19. | C__D_E | 32. | B_O__ |
| 6. | T_A_N | 20. | B__L | 33. | BE__L__ |
| 7. | FL_T__ | 21. | H_ND | 34. | T_L_P_O_E |
| 8. | C_R | 22. | J_C_E T | 35. | M__O_C_Y__E |
| 9. | S_I_T | 23. | TE__V_SI_N | 36. | D__R |
| 10. | T_P | 24. | P__C_CK | 37. | C_L_R__ |
| 11. | EA_L__ | 25. | T_U__ | 38. | W_E_L |
| 12. | G_A__ | 26. | CH__N | 39. | C_OW__ |
| 13. | W__CH | 27. | GI_A_F__ | 40. | L_M__ |
| 14. | H__I_O__TE__ | | | | |

Appendix K

PROCEDURES FOR EXECUTING THE EXPERIMENTAL STUDY

Protocol for first session:

1. Students will be informed to go to the restroom and report to the library for classroom assignment.
2. Students will be assigned a group number and asked to report to the appropriate classroom.
3. If students speak about the aroma, acknowledge that they have spoken, "yes, I smell it"....
4. Say aloud the words in bold print.

In the classroom – first session

1. UTC students will introduce themselves: **Hello, my name is _____. I am a student at UTC majoring in _____. I am here today to assist Mrs. Hamilton in carrying out the experimental phase of her dissertation. A dissertation is a huge research paper. I want to thank each of you for agreeing to help her in her work. You will receive your candy at the end of the afternoon session, during 7th period.**

I also want to remind you to not talk while I am talking.

Also, no one is allowed to leave the room during this session so we do not disturb other sessions.

2. **Before we go any further, I want to go over the INFORMED CONSENT FORM with you. We need to do this before we do anything else. Yes, I know your parents signed a permission slip saying you could participate, but now you need to sign that you also agree to do this. The experiment will not harm you in any way and is an attempt to see if an aroma, or smell, can improve your memory ability.**
3. (PASS OUT INFORMED CONSENT FORM – count the number needed for each row and have the students take one and pass the rest back.)
4. **Ask: Does everyone have a form? Is there anyone who needs a pencil?** (Pass out pencils to any that may need them).
5. **Read the INFORMED CONSENT FORM TO THE STUDENTS.** Students are to initial side one.
6. **On side two of the INFORMED CONSENT FORM, be sure to remind students that honesty is a factor in answering the smoking question. It is not a**

question to be used again you, but let them know it is important for the research. Smokers do not have as good of a sense of smell as non-smokers.

7. Collect the forms by having students pass them up to the front row.

EXPERIMENTAL PHASE – FIRST SESSION

1. **We are now ready to start the experiment. We will soon see some words come up on the television screen. Please, do not write these words down, but read them quietly to yourself.**
2. **The screen will read: Ready, Set, Begin and then a list of words will appear for you to read to yourself.**
3. At this point, signal at the door that you are ready for the presentation over the television. If you do not see the words appear on the screen, signal at the door and someone will come to assist you.
4. Presentation of word list.
5. After the presentation, turn off the television.
6. Tell students, **Now you are going to write a story about your best childhood memory.** (Pass out papers titled: Please write a story about your best childhood memory.) **If you cannot think of a memory, make one up.** Allow about 5 minutes for students to do this activity.
7. At the end of 5 minutes, say **Please stop. If you are not finished, that is okay. Go ahead and pass your papers forward, please.** Collect papers. **Also, if I gave you a pencil, please return it to me at this time.**
8. **For the remainder of the period we are going to watch a video on the television. I do ask that you do not discuss the testing session with anyone until after the afternoon session is over. Discussion of the testing session could alter the final outcome and we want to avoid doing that.**
9. Turn the television on and enjoy watching the video!

Protocol for second session – afternoon

1. Students will be informed to go to the restroom and report to the library for classroom assignment.
2. Students will be assigned a group number and asked to report to the appropriate classroom.
3. If students speak about the aroma, acknowledge that they have spoken, “yes, I smell it”...

In the classroom – second session (approximately 3 hours later)

TESTING PHASE – SECOND SESSION

1. UTC students will introduce themselves: **Hello, my name is _____ . I am a student at UTC majoring in _____ . Thank you for following up with this second session. You will receive your candy after the session. This session should only last about 15 minutes. No one will be allowed to leave during the session. Is there anyone who needs a pencil? (Pause and hand out any pencils if necessary.)**
2. **I am going to pass out a test packet. There are two sheets stapled together. I am going to place these upside down on your desk. When you have your test packet, I would like for you to put your name on the page. This will help categorize your answers. Your name will not be used in the results. Is there anyone who did not get a test packet? (Pause and look around the room. Give anyone who has been left out a packet.) Is there anyone who needs some help? (Pause and look around the room.)**
Visually scan to ensure each student puts his or her name on the paper (first and last name.) Once everyone has accomplished this, continue.
3. **Before we begin, I do want to caution you against cheating. Not everyone has the same first and second page. Please do not look at your neighbor’s paper. I can not help you during the testing phase. Do not turn your paper over until I tell you to do so. Also, do not go to page two until I tell everyone to. You will have about 5 minutes to do the first page of your packet. Remember to read your directions! Are there any questions? (Pause and answer any questions.)**
4. **Once again, do not turn to the second page until I ask you to. You may turn your paper over and begin. Quietly circulate around the room, walking up and down the aisles. If students look up at you, smile, nod courteously, and continue on.**
5. **After 5 minutes, say Stop. You will have another 5 minutes to complete the next part of the test. Once you turn to the second page you may not go back to the first page. Now, turn to the second page, read the directions, and you may begin. Again, circulate around the room.**

6. After 5 minutes say **Stop. Turn your test packet back to the first page. Please pass your test forward so they may be collected. Collect papers. If I gave you a pencil, please return it to me at this time.**
7. **Thank you for helping in the experimental phase of Mrs. Hamilton's research. It is now time for the candy!**
8. Pass out the candy to the students. Motion at the door that you are finished so we may all dismiss at the same time. Someone will tell you when to dismiss the class.

Thank you for helping! Ronda Hamilton

VITA

Ronda (Irvin) Hamilton is originally from Southern Illinois. She graduated from McLeansboro High School in 1979. In 1983, Ronda graduated from Southern Illinois University in Carbondale, Illinois with a Bachelor of Science degree in Physical Education and an additional concentration in English. A move to Tennessee allowed for the pursuit of higher degrees. Ronda received her Masters of Education in Educational Administration from the University of Tennessee at Chattanooga in Educational Administration and Supervision in 1991. An Educational Specialist degree in Leadership Studies was acquired in 1995 from the University of Tennessee at Knoxville. The Doctor of Education in Education, with a concentration in Leadership for Teaching and Learning was obtained with graduation in May, 2000 from the University of Tennessee at Knoxville.

Ronda Hamilton teaches eighth graders in Dade County, Georgia and has 17 years teaching experience. Additional duties include acting as team leader, sponsoring an annual Washington, D.C. trip for eighth graders, their parents and other interested community members, and being the National Junior Honor Society sponsor for eighth graders. Professional Affiliations also include the Association for Supervision and Curriculum Development, The Delta Kappa Gamma Society International, National Association of Secondary School Principals and Professional Association of Georgia Educators.