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Walt Whitman Press

A collection of  
student research  
and writing.

The Whitman  
Journal of Psychology



# The Whitman Journal of Psychology

January 2017

Dear Readers,

I am excited to present the January 2016 issue of The Whitman Journal of Psychology. This issue is made up of selected experiments and literature reviews written and submitted by high school students across the country, along with an article from one of our editors.

The articles featured in our publication showcase a variety of subjects in psychology. This edition of the journal was more heavily focused on experiments, ranging from training adolescents to read microexpressions to examining the effect of parenting style on grades. Many of the articles, although not all, were related to teen behavior.

People often wonder if they work better under pressure or in a more relaxed environment. An experiment conducted on the effect of time constraints on testing results found interesting correlations between time constraints and stress levels. The finding of this experiment proves relevant in today's discussion over standardized testing, such as the SAT and ACT.

A research paper analyzes the relationship between depression, a relatively common disorder, and episodic memory loss. The piece looks into the neurological relationship between the two.

Thank you to our faculty advisor, Ms. Del Savio, for encouraging us to research and write about the topics that we are passionate about, along with keeping staff members of the journal on top of things when they should be. Thanks in addition to my fellow staff members, who are enthusiastic about everything they do, and have become some of my closest friends. Working in such an engaging environment makes all the difference.

A final thanks to our readers and contributors to the journal, who make all of this possible. Enjoy the January 2017 edition of The Walt Whitman Journal of Psychology!

Sincerely,

Sophie Lieber  
Editor-In-Chief

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The Whitman Journal of Psychology is a forum in which student-conducted research in the field of psychology is recognized. The Journal contains research from many subject matters and is not limited to any specific field of study.

## Manuscript Preparation

Authors should prepare manuscripts according to guidelines established in the Publication Manual of the American Psychology Association (6th ed.). The Journal reserves the right to modify APA style when necessary. Manuscripts should be no longer than 15 pages and should include an abstract. Additionally, all manuscripts must include a list of references as well as parenthetical documentation in accordance with APA style. Professional and other scholarly sources should constitute the majority of references. It is suggested that manuscripts include the following sections: introduction, methods, results and discussion. Manuscripts are not limited to these sections. Detailed requirements can be found on our website.

All manuscripts submitted for consideration may be mask (blind) reviewed at the request of the author. Clear notification must be given on the title page of a manuscript in order for it to be mask reviewed. It is the author's responsibility to ensure that identification is omitted from the manuscript. All manuscripts submitted are subject to editing on both the basis of style and content. It is the author's responsibility to ensure clarity of expression.

We accept submissions year round; however, there is a deadline to be considered for the next publication which can be found on our website.

## Manuscript Submissions

Submissions should include a cover page with the following identifying information: author's name, school affiliation, advisor's name, address, phone number and e-mail address. Please e-mail a copy of your file(s) along with a cover letter with the requirements listed above to [whitmanpsychsubmissions@gmail.com](mailto:whitmanpsychsubmissions@gmail.com). You will get a confirmation e-mail once we have received your submission and are able to open the file(s).

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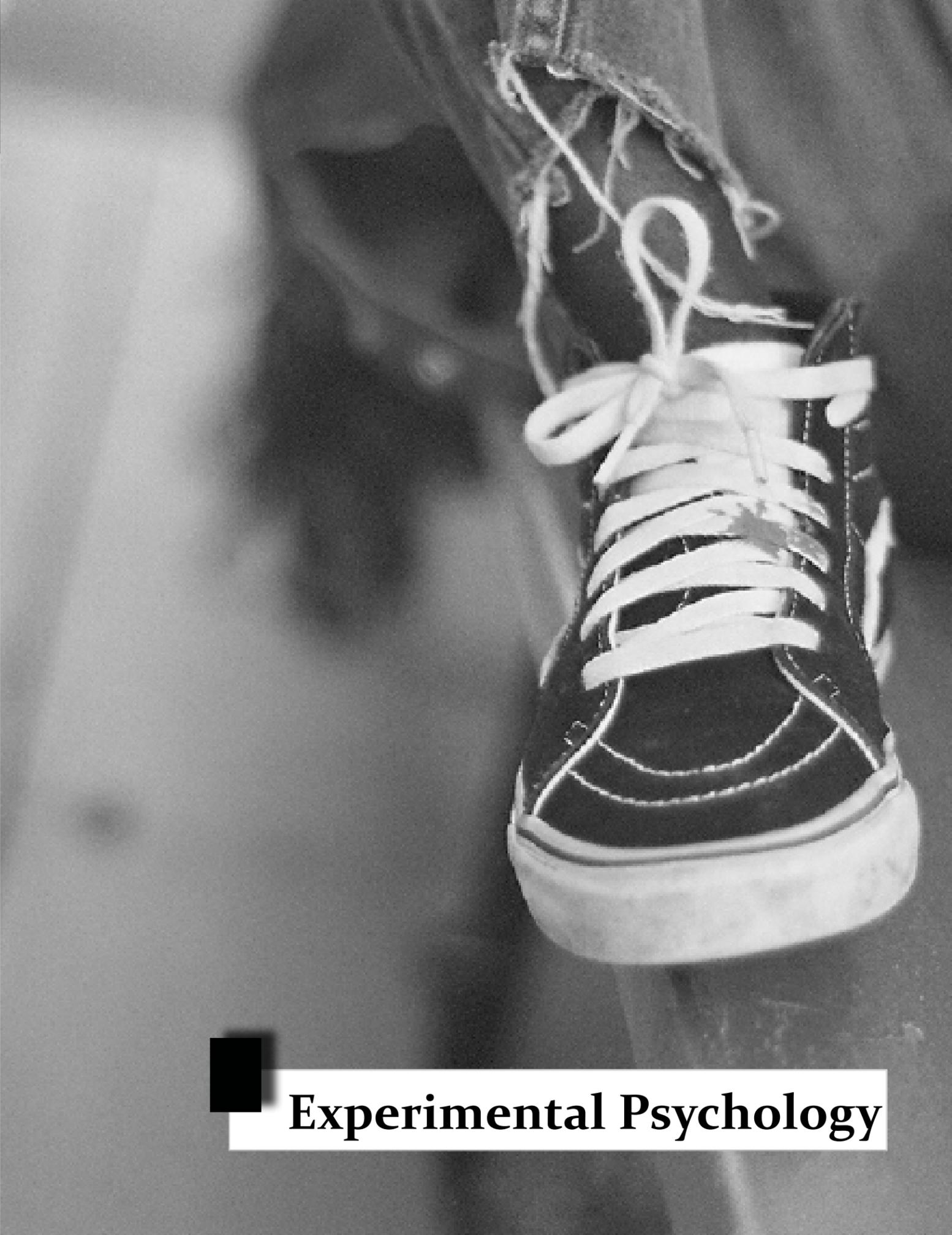
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# How to Detect the Undetectable: An Empirical Study on a New Micro Expressions Training for Adolescents

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## Abstract

This study focuses on the development of the recognition of emotions in adolescents through the use of a micro expression training. The results showed that the new micro expression training, developed for adolescents, significantly affected the adolescents' ability to detect micro expressions. The training did not affect the participants' overall emotional intelligence and social skills; however, it did affect a small branch of their emotional intelligence (EI): recognizing emotions. It was also discovered that girls had a better ability of detecting the micro expressions, before and after the training. This micro expression training contributed to improvement in adolescents' ability to recognize micro expressions, which is an essential component of EI.

## Introduction

There has always been a scientific fascination with exploring others' emotions; however, we cannot read other's minds, and will never truly know what they feel. Instead, we rely on our impressions and social perceptions to draw reasonably accurate conclusions about others. Not many people can recognize hidden emotions with extreme accuracy (Ekman, 1993), but with modern advances in psychology, people can be trained to improve emotion recognition. Training adolescents on recognition of emotional micro expressions may have important outcomes such as improvement of emotional intelligence, social skills, and communication.

Emotional intelligence (EI) is the capacity to reason about emotions and for emotions to enhance thinking (Mayer, 2013). An individual who has high EI has better social relations, can solve emotional problems more quickly and easily than others, is strong in verbal, social, and other intelligence categories, is less apt to engage in prob-

lematic behaviors, and tends to avoid self-destructive and negative behaviors such as smoking, drug abuse and violence (Mayer, 2013). Emotional intelligence consists of four branches: perceiving emotions, using emotions to facilitate thought, understanding emotions, and managing emotions (Mayers, 2013). EI is related to discerning and understanding emotional information that is commonly used in daily life. Understanding anxiety and fear through an observation of a person's facial cues show a sign of high EI. This non-verbal behavior conveys emotional information that we process in communicating with others.

## Universal Expressions

Charles Darwin first proposed the idea that both man and animals were able to recognize universal expressions in his book *The Expressions of the Emotions in Man and Animals* (1838). In the 1970s, the idea of universal facial expressions came up again with newer cross-cultural data (Ekman, 2013). Ekman and Izard focused on ex-

ploring universal expressions. They showed photos of Caucasian people with a variety of facial expressions to people from different cultures (as shown in Figure 1) and asked them to choose the correct emotion on the photo. The results showed that people from both Western and non-Western cultures were correctly able to label happiness, anger, fear, sadness, disgust, and surprise.

According to Darwin (1872), primary emotions conveyed by the face are universal, partly because emotional expressions had survival value for the developing human species. Darwin's inhibition hypothesis first brought up an idea similar to micro expressions where he suggested that "facial actions that cannot be controlled voluntarily may be produced involuntarily even if the individual is trying to control his or her expressions" (Matsumoto and Hwang, 2011). Micro expressions are emotional displays that are quick and usually occur when one is under the pressure to conceal or mask his or her emotions and last around 1/25 to 1/15 of a second. These "pressures" exist regularly in daily life such as a function of culture, status, politeness, context, etc.

Haggard and Isaacs (1966) were the first scientists who discovered micro expressions; however, they called them "micro-momentary" expressions. They detected them while scanning motion picture films of psychotherapy hours, searching for indications of non-verbal communications between the patient and therapist. They explained that these expressions occurred because the patient did not know what he or she was feeling. A few years later, Ekman and Friesen (1969) proved that micro expressions can be perceived in real time. They also provided the real reason as to why micro expressions occur; people try to conceal their emotions from others or they try to conceal their emotions from themselves through repression.

## Microexpressions Training

A study executed by David Matsumoto focused on the recognition of micro expressions through the use of the Micro-expression Recog-

nition Training Tool (MiX) (Matsumoto, 2011). This training tool is not the same as Paul Ekman's Micro-expression Training Tool (Mett). There were 81 participants in Matsumoto's study, all from Seoul, South Korea (the mean age was 30 years). The results came out as hypothesized: the training group increased in their MiX scores from pre-test (mean=.47) to post-test (mean=.65). The control group showed no change: pre-test (mean=.49) directly to post-test (mean=.50), without the MiX (Matsumoto, 2011). Matsumoto also measured the group's social skills before and after the training. As expected, the training group had significantly higher scores (mean=2.88) than the other group (mean=2.38) (Matsumoto, 2011). Thus, micro expression trainings have been found to be effective.

The current micro expressions training programs have been applied to adults only. Their effectiveness and impact on social skills have never been tested on children and pre-teens before. This shows a major flaw in research because, according to Montepare et al. (1999), older adults have a harder time distinguishing emotions. In a two-part study of decoding of emotion through nonverbal behaviors, it was found that older adults made more overall errors in identifying emotions depicted in videotaped displays of actors portraying emotional situations (Montepare et al., 1999). The results of this study also showed that older adults made more errors identifying emotional displays that are negative in content. Although young people are more accurate in emotion recognition, research on nonverbal behaviors and EI of young people are very limited, despite their advantages during social interactions. If people were taught at a younger age to read micro expressions, it might create a more lasting and positive impact on them throughout their lives.

## Deception and Microexpressions

When a person lies, he or she will try to inhibit facial expressions in the attempt to deceive others. According to Darwin (1872), the facial nu-

cleus transmits impulses to specific facial muscles and receives impulses from different parts of the brain. In other words, the brain signals the facial muscles that when the person is lying, he or she must also suppress their facial expressions. When a muscle is activated involuntarily, the person cannot prevent it from contracting, therefore, it is extremely difficult for a person to give away no hints while lying. Certain emotions, such as sadness, disgust, anger, and fear, are difficult to constrain, therefore, they betray how a person feels even when he or she attempts to conceal that information. Paul Ekman (2011) shows, by observing videotapes of people lying, that these emotions somehow reflect across the face no matter what the person tries. These brief flashes of sadness, disgust, anger, and fear are micro expressions. However, micro expressions do not always have to occur when someone is lying, which means that just because there is no micro expression, it doesn't always mean that the person is truthful. Paul Ekman supported his theory in a line of study. For instance, he asked participants to lie about different movies they have watched. His results showed that a quarter of the liars showed micro expressions. Deception and micro expressions are an extremely controversial topic because there is no true way of identifying whether a person is lying or not, there are only hypothetical clues.

### Hypotheses

Based on prior research and theories of EI, the following hypotheses will be tested:

1. The micro expression training will increase the emotion recognition ability of adolescents.
2. The micro expression training will improve emotional intelligence of adolescents.
3. The micro expression training will improve the social skills of adolescents.

## Methods

### Pilot Study

**Participants:** The pilot study was conducted to ensure that the training was comprehensible, and the micro expressions were presented at a reasonable speed. 16 people (11 students, ages between 12-14 and 3 adults) were gathered to test. Although the training is for adolescents, the adults' perception of the training was also important.

**Procedure:** First the participants of the pilot study were given the practice, and were warned about the speed of the micro expressions and asked to pay attention to the entire face. They were then given the shortened version of the training and asked to complete the micro expressions' pretest. After they completed the pretest, they were asked whether they had any questions or comments.

### Main Study

**Participants:** The main study included 132 adolescents (84 in the treatment group, and 48 in the control group) composed of 7th and 8th grade students in a junior high school in Orange County, California. The average age was 12.7 years. 49.4% of the participants were Asian, 16.1% were Caucasian, 6.1% were Hispanic, and 1.1% were African-American.

**Procedure:** First, I obtained permission from a teacher who has classes with 7th and 8th grade students on the same day so that there was no significant variation in the amount of students per class, and that all students receive the training on the same day. Therefore, the group size and the timing of the training were controlled. Second, for the treatment and control group I maintained the same time period between the pretest (EI & SS questionnaire and micro expressions) and posttest (EI & SS questionnaire and micro expressions). Two days before the micro expressions pretest and training was given, I handed out the emotional intelligence

(EI) and social skills (SS) questionnaire. The day of the training, I first showed them the practice for the pretest and then handed out the answer sheet. After the pretest was given, I collected the answer sheets and began the training. Throughout the training, interaction was encouraged through the use of the mirrors. Each class was executed in the same way except for the third class where a video of the entire procedure was taken. Four days after the pretest was given, the same practice was shown along with some examples from the training before the posttest. After these practices, the posttest was presented on the screen. Finally, three weeks after the questionnaire was given, the same questionnaire was given as a posttest for emotional intelligence and social skills. The same procedure was executed for the control group; however, there was no pretest and posttest for the emotional intelligence and social skills questionnaire.

### The Development of the Microexpression Training

The examination of the past research and current emotion recognition and micro expression training programs indicated that there is no such training designed for children or adolescents. This study required a micro expression training for adolescents, therefore, I decided to develop a new one based off of the Mett 3.0.

### Preparation of the Photos and Videos for the Training

First step was to find at least eight actors (4 boys and 4 girls, ages 13-14). These actors were initially trained on how to exhibit the 7 universal emotions (happy, contempt, sad, anger, surprise, disgust, fear). A quiet place was found to take picture and videos. The background used was as neutral as possible, for it did not pose as a distraction during the training. Once the actors have learned and successfully expressed these emotions, I took pictures of each actor expressing each emotion. Then I took videos of

the actors. In the videos, the actor started in a neutral pose, slowly expressed the emotion, and returned back to the neutral pose. The video were later slowed down by 25% so that all the motions of the face could be recognized during the training. This procedure was taken from Ekman's training.

### Development of Training

The training first starts with a brief overview of emotional intelligence, micro expressions, universal emotions, and ten to fifteen facial muscles along with a diagram. The purpose is to introduce the basic concepts to the participants. To teach the basic emotions and their expressions, these steps were followed:

a. The first slide has a brief description of the emotion followed by one or two facial muscles involved in exhibiting the emotion and finally the motion cues of the emotion. On the first slide there is a picture expressing the emotion with arrows pointing to the key facial muscles. This picture does not have to be one of the actors.

b. The second slide is the slow motion video of an actor.

c. The third slide consists of a final image of the emotion expressed by an actor.

d. On the third slide, there is an instruction asking participants to look into a mirror and try to express the emotions themselves. The trainer corrects the participants who have difficulty making the expression until they successfully express each emotion. Self-expression is an important feature of the training, based on Ekman's and Matsumoto's trainings.

e. These steps are repeated for each emotion.

After all the emotions have been presented there should be a slide that focuses on the importance of the training and how it might affect emotional intelligence and social skills. The final slide consists of how micro expressions can be used in detecting a lie. There is a picture showing the difference between a real smile and fake smile from a study conducted by Duchenne.

During this slide, the trainer speaks briefly about how a small glimpse of a micro expression can aid in detecting a lie. After the slides were put together, it is reviewed multiple times to ensure completion and accuracy.

### Development of the Microexpressions' Pretest Measure

First, I selected two photos reflecting each emotion (thus 14 photos for 7 emotions). Each photo was carefully selected by matching it with Ekman's online images for emotions. These 14 photos were presented in a random order. A number from 1-14 was assigned to each photo. These numbers corresponded to the numbers on the answer sheet.

The micro expressions were presented for 60 milliseconds sandwiched in between two one-second presentations of the same actor's neutral face. This is following Ekman's and Matsumoto's instructions in their training. Before the pretest was presented, based on Ekman's training, a short practice was introduced to get the participants familiar with what they will be tested. The practice had only 3 micro expressions that were not used in the pretest. After each micro expression, the answer showed up on the screen.

### Development of the Microexpressions' Posttest Measure

The 5 step procedure used to develop micro expressions' pretest measure was also followed to develop the posttest measure. The photos used in pretest and posttest were different.

### Development of the Emotional Intelligence and Social Skills Questionnaire

The questionnaire consisted of 45 statements in which the participant had to rate themselves (1=strongly disagree and 5= strongly agree). The first 30 statements were about emotional intelligence and the last 15 measured so-

cial skills. The statements were taken off of two different sites: (JobTips- Social Assessment) and (Hunsaker).

### Design

This study uses a nonequivalent control group pretest-posttest design which is a type of a quasi-experimental design. This design has a treatment (training) and a control (no training) group so that it can be shown whether the training has an effect (i.e., the treatment group should show improvement in comparison to the control group). Additionally, it included a pretest which allowed me to observe the change in scores from the pretest to the posttest. However it lacks equivalence because the participants were not randomly assigned because the training was conducted in large groups (15-20 at a time).

### Results

The results in this study were analyzed through the statistical software package for social sciences (SPSS). A paired t-test was used to compare the means of the treatment and control groups. A t-test is used to see if two means are reliably different. There are three types of t-tests and in this study a paired t-test was used. This type of t-test basically measures the mean of one group twice. The formula for the paired t-test is shown below. The top of the formula reads as "the sum of the differences." The bottom of the formula reads as "n times the sum of the differences squared minus the sum of the squared differences, all over n-1 (degrees of freedom); all under a square root."

If a t-value is large enough to produce a probability value (p-value) that is less than 0.05 then it proves that the differences between the means are beyond chance.

The results showed that the mean of the treatment group increased from the pretest (M = 5.61) to posttest (M = 9.83),  $t(83) = -14.52$ ,  $p = 0.00$  (See Figure 2). Therefore, it was concluded

that the micro expression training improved the emotion recognition ability of the participants. However, when the control group was analyzed, there was no significant difference between the means of pretest and posttest (M = 5.81 and 6.06 respectively),  $t(47) = -0.71$ ,  $p = 0.48$ . Thus the slight difference between pretest and posttest means was simply due to chance. Overall, the micro expression training proved to be a vital factor in increasing the emotion recognition ability of adolescents.

After the main study was evaluated, the gender differences were also looked upon (Figure 4). The treatment and control groups were combined when analyzing the gender differences. The pretest means were compared between the boys and girls (M=5.29 and M= 6.27 respectively), the girls had a higher pretest score than the boys, ( $t(129) = 2.70$ ,  $p = 0.008$ ). Then the posttest means were evaluated between the boys and girls (M= 8.10 and M= 8.98 respectively), the girls had a higher mean than the boys, however, it was only marginally significant ( $t(128) = 1.80$ ,  $p = 0.08$ ). When the treatment and control group were looked at separately, the girls' from the treatment group had a difference in mean from pretest to posttest: 6.12 to 10.42 while the boys' increased from 5.32 to 9.40. Thus, it was concluded that girls had a better understanding of the emotion recognition of micro expressions than boys.

This study consisted of one manipulated variable (training vs. no training) along with several responding variables (emotion recognition of micro expressions, emotional intelligence, and social skills). The emotional intelligence (EI) and social skills (SS) of the adolescents were analyzed through the use of a self-evaluating questionnaire. There were 30 questions for emotional

intelligence, and 15 for social skills. The scores for these questions were averaged to calculate a composite EI and a composite SS score for each participant. The reliability alpha was 0.81 for pretest EI and 0.85 for posttest EI. The reliability alpha was 0.76 for pretest SS, and 0.77 for posttest SS. These composite scores were used in the following analyses.

The results showed that EI did not significantly increase from pretest to posttest (M = 3.46 and M = 3.50 respectively),  $t(82) = -0.97$ ,  $p = 0.33$ . It was also shown that the social skills did not increase from pretest to posttest (M= 3.56 and M= 3.54 respectively),  $t(78) = 0.51$ ,  $p = 0.61$ .

Although the overall emotional intelligence and social skills of the adolescents did not increase, there were two specific questions that dealt with the understanding of others' emotions: item 18 and item 25 from the questionnaire (Figure 5). Item 18 was worded as written, "By looking at their facial expressions, I recognize the emotions people are experiencing." The mean for this item increased from pretest to posttest (M= 3.45 and M= 3.73 respectively),  $t(79) = -2.12$ ,  $p = 0.04$ . Item 25 was worded as written, "I am aware of the non-verbal messages other people send," and the mean increased from pretest to posttest (M= 3.25 and M= 3.64 respectively),  $t(78) = -2.55$ ,  $p = 0.01$ . It was concluded that the micro expression training did effect a branch of the adolescents' emotional intelligence: the recognition of emotions.

There were several other responding variables that were also evaluated; however, these did not have significant differences and impacts on the overall study. The first was ethnicity. There were four different ethnic groups: Asian, African-American, Caucasian, and Hispanic. The differences in the means of these groups were not

$$t = \frac{\sum d}{\sqrt{\frac{n(\sum d^2) - (\sum d)^2}{n-1}}}$$

significant. This proves the idea of universal emotions as proposed by Paul Ekman. Second, age was looked upon and, again, there was no significant differences between 11, 12, 13, and 14 year olds. Finally, there was a comparison between the gender of the participants and the gender of the actors in the micro expression pretest and posttest. Again, there was no correlation between the genders.

### Conclusion

The present study focuses on the change of the emotion recognition of adolescents through the use of a micro expression training. It was found that the micro expression training did significantly affect the adolescents' ability to detect micro expressions. The training did not drastically affect the participants' emotional intelligence and social skills, however, it did affect a small branch of their emotional intelligence: recognizing emotions. It was also discovered that girls had a better ability of detecting the micro expressions before and after the training. There are several explanations as to why the results have turned out this way.

This current study has several other strengths: The training was carefully designed based on Paul Ekman's Mett 3.0, and reviewed and approved by two social psychologists. The training was done within 2 days to control for timing effect. The training was conducted in a class where the students could pay attention. While researching this topic, it was found that EI was more important than IQ for success in social life, therefore any contribution to the improvement of EI of adolescents was an important step. It is especially important to point that this is the first study that achieved an improvement in adolescents' ability to recognize micro expressions which is an essential component of EI.

It was found that the girls had better abilities at detecting micro expressions. It is natural for the girls to excel in this area because of their place in society and because of gender stereotypes. Girls are raised to be more nurturing and sensitive, therefore they are more likely to be empa-

thetic, and emotionally closer to others in society. As shown in neuroimaging research, women are found to be better at taking other's perspectives, and feeling their pain and experiencing compassion for others than men (Martin Schulte-Rüther). Also, the girls had a higher pretest mean score with a significant p-value, however, in the posttest the girls' higher mean score was marginally significant which shows that the training affected the boys more.

Because the training affected the emotion recognition of micro expressions of the adolescents, it was thought that it would affect their emotional intelligence and social skills as well; however, this hypothesis was not supported. It has been concluded that the emotional intelligence and social skills of the adolescents did not increase because of the short amount of time (3 weeks) that the results were taken in. It would have been a more ideal situation if the participants had several months. Many social skills trainings are therapy sessions that last for months, so it was a little bit of a long shot to try and improve the social skills of the adolescents. However, the training impacted a critical branch of EI, the ability to recognize emotions, as the scores of the related items on the self-assessment questionnaire increased after the training.

As seen in the data tables, there was a slight, insignificant increase from the pretest to posttest in the control condition. This can easily be explained through the testing effect which states that testing a person's memory will strengthen it, even if there is no feedback. The control group participants were also slightly more prepared for the posttest because they already had went through the process. Although there was an increase, it was too slight to have a significant effect on the study.

Additionally, there was a loss of data from the pretest to the posttest, therefore the sample sizes were not exactly equal. This is a common issue in pretest-posttest studies. Another limitation is that there was no assessment of EI and social skills in the control group due to lack of time in completing data collection. However, in the end, there was

no difference in these measures so no valuable information was lost. Finally, although the pictures were taken from students who were trained, it would have been even better to analyze them using the FACS system.

### Future Research

The results of this experiment are only the beginning of researching the detection of micro expressions of adolescents. Firstly, a more professional training (photos reviewed using the FACS) can be used with a more diverse group of adolescents, thus increasing the reliability of the experiment. Detection of subtle expressions can be added so that detecting lies becomes an ability that the adolescents can learn. Other than the detection of facial expressions, the adolescents can be tested on the effects of these trainings on their social lives. Although this experiment did not have positive results with the participants' emotional intelligence and social skills, other experiments that have more time and more participants may be able to get more reliable data. Different types of participants could also be used in the future. Ekman has tested his Mett 3.0 on patients with schizophrenia and found that it improved their micro expression recognition. If this same idea was used with adolescent patients and my micro expression training, it could lead to a whole new study.

Figure 1. The 7 Universal Expressions of Emotion



Figure 2. Mean of the Facial Recognition Scores of the Treatment and Control Groups

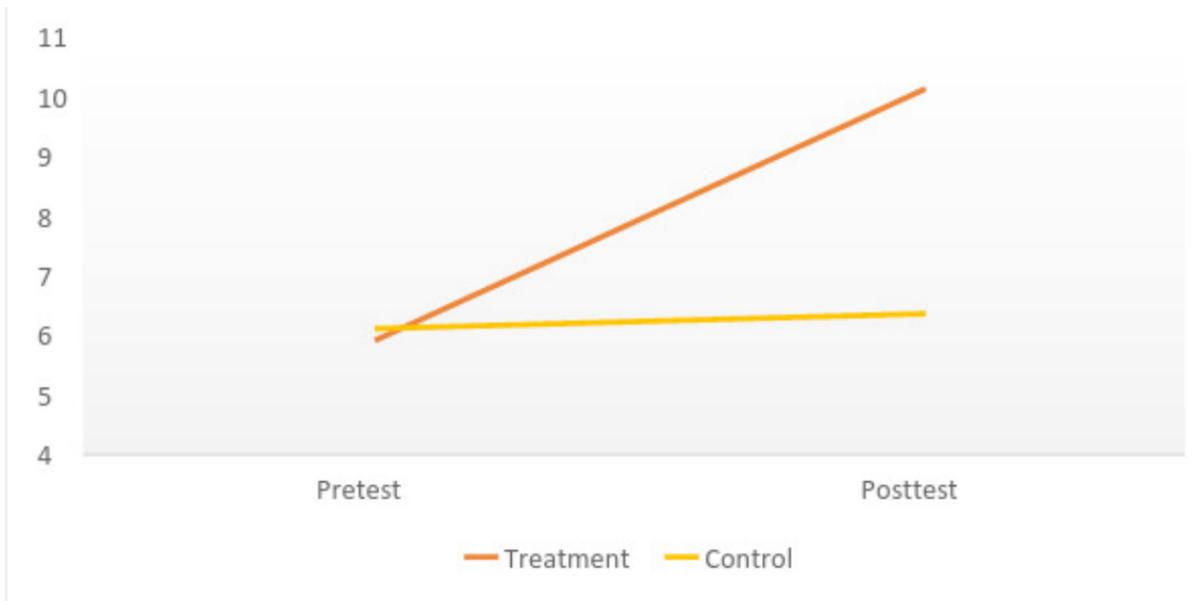


Figure 3. Mean of the Facial Recognition Scores by Gender

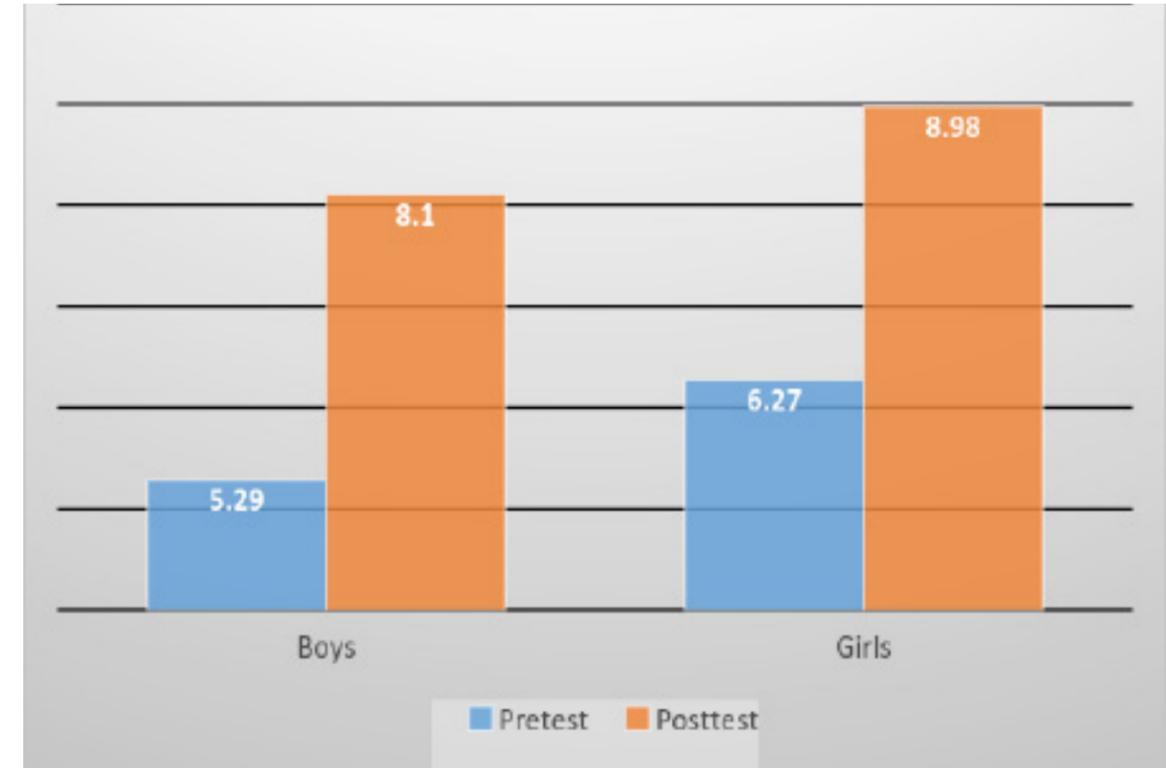


Figure 4. Mean for Items 18 and 25 from the Emotional intelligence Questionnaire



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# The Effect of the Color of Beverages on Taste

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## Abstract

The perception of one sense is often distorted or altered by another. Sight and taste are related in this manner. In this experiment, participants tasted several different samples of flavored and dyed waters and recorded what flavor they believed it was. In some test sets, flavoring and coloring of the beverages corresponded, so that red would be paired with strawberry, for example. In other sets, the colors did not correspond to the flavor, so that yellow and strawberry were paired. Some samples had no flavoring, but were dyed. When participants tasted samples in which the color was paired with an unexpected flavor, they often mislabeled it. However, when it was correctly paired or had no flavor, participants could often identify this.

## Introduction

Humans have five main senses, many of which interact to create their perception of the world. The aroma of food often impacts a person's desire to have such food. However, the effects of vision on taste are far less discussed and appreciated. The visual appeal of food may impact its taste. Many flavors are associated with certain colors of beverages or food. For example, cherry flavored drinks are always red, while lime flavored drinks are always green. People can be slightly confused when they see a beverage of a certain color and it does not taste as they would expect. There is no reason that they should assume it has a certain flavor other than a past experience that has conditioned them.

Many studies have explored the connection between taste and other senses. One such study, conducted by Kimberly S. Yan and Robin Dando (2015), compared the effects of sound stimulation to the perceived taste of food. Interestingly, they found that participants had perceived a lower intensity of sweetness, but a greater sensitivity to

umami. The level of sound stimulation did not affect any other aspects of taste. "When we eat, in fact taste, smell, and touch combine to form flavor. This process can be so complete that most people fail to recognize that smell contributes to flavor" (Stevenson 2014). The effect of the smell on flavor is perceived as continuous and as taking place only in the mouth, though the scent can also be perceived by the nose in pulses. The aroma of food and drinks are not completely separate from the flavor and have a very large impact on it. It is for this reason that food does not taste the same when people have a cold and are unable to smell. Taste is also linked not only to sensual perception, but to how other people's behaviors are perceived. In Israel for example, spiciness is associated with intelligence and sweetness with inauthenticity. When given a spicy snack, people are more likely to subconsciously perceive others as intellectually competent and authentic within an experiment (Gilead, Gal, Polak, & Cholow, 2015). This study shows the impact that taste can have on a person's interpretation of the world.

While it has been shown that smell and sound affect the intensity and flavor of food and that the taste of something can affect perception of other stimuli, there are still many things not demonstrated by the previously mentioned studies. Taste is also connected to vision, but this has not been explored by the studies mentioned. However, the purpose of this present study is to demonstrate the connection between the color of a beverage and a person's perception of the flavor it contains. Each color has certain flavors assigned to it by society, and when the colors and flavors are incorrectly paired, people will struggle to identify the correct flavor.

### Method

**Participants:** The participants were chosen from a convenience sample. They were members of Peace Lutheran Church in Waterford, Michigan or children from Our Lady of the Lakes School, also in Waterford, who volunteered to participate. After service at Peace Lutheran Church, volunteers to participate in an experiment were requested. Ten members volunteered, varying in age and gender. At the school, a sign-up sheet was placed in the hallway of the after school program center with the consent of the director. Nineteen students were then able to volunteer to participate in an experiment. Every participant gave their informed consent as they voluntarily agreed to be a part of a study. They were offered no reward for their participation. The majority of the sample was both caucasian and middle class, though age and gender varied. The sample was intended to represent the population of America in their perception of flavor based on the synthetic coloring added to flavored beverages.

**Design and Procedure:** In this study, researchers gave participants twelve small cups of dyed water and asked them to sample and to record which flavors they tasted. The independent variables were the color and actual flavor of the water. The dependent variable was the flavor

perceived by the participants. For the purposes of this study, the operational definition was whether the participants correctly identified the flavor or not.

In preparation for the study, twelve 8 fl.oz bottle of water were colored and flavored using Meijer Assorted Food Coloring and Egg Dye and McCormick Flavor Extracts. The bottles were then labeled in marker with the numbers 1-12. Each bottle had two teaspoons of water removed in order to allow room for sugar, which dilutes the flavor and masks the taste of the food dye. Two tablespoons of sugar was then added to each bottle. Each bottle was shaken so the sugar was dissolved. An additional teaspoon of water was removed to make room for the flavoring and dye. The bottles were then dyed and flavored in several different combinations, which can be found in Appendix A. One quarter teaspoon of flavoring was used for each bottle that was flavored. The amount of dye used varied based on color.

When the test was conducted, participants were seated at five tables and dispersed evenly. Each was provided with an answer document (Appendix B), and two crackers, each broken in half. All directions were read from a prepared script (Appendix C). Before any beverages samples were provided, the people were asked to circle their age range and gender. Then, they were told to eat one half of a cracker to cleanse any lingering tastes they may be experiencing.

Next, the first set of three samples was distributed. The participants were told to taste each and to write down what flavor they believed it was. After they completed this step, they were directed to eat another half cracker. Then, the cups 4, 5, and 6, were distributed. The participants were again instructed to taste each sample and write down the flavor they thought it contained. Again, they were told to eat half a cracker. The third set, which contained samples 7, 8, and 9, was passed out and the participants tasted them in the same manner. The participants ate the last half cracker and tasted the fourth set, containing samples 10, 11, and 12. The answer sheets

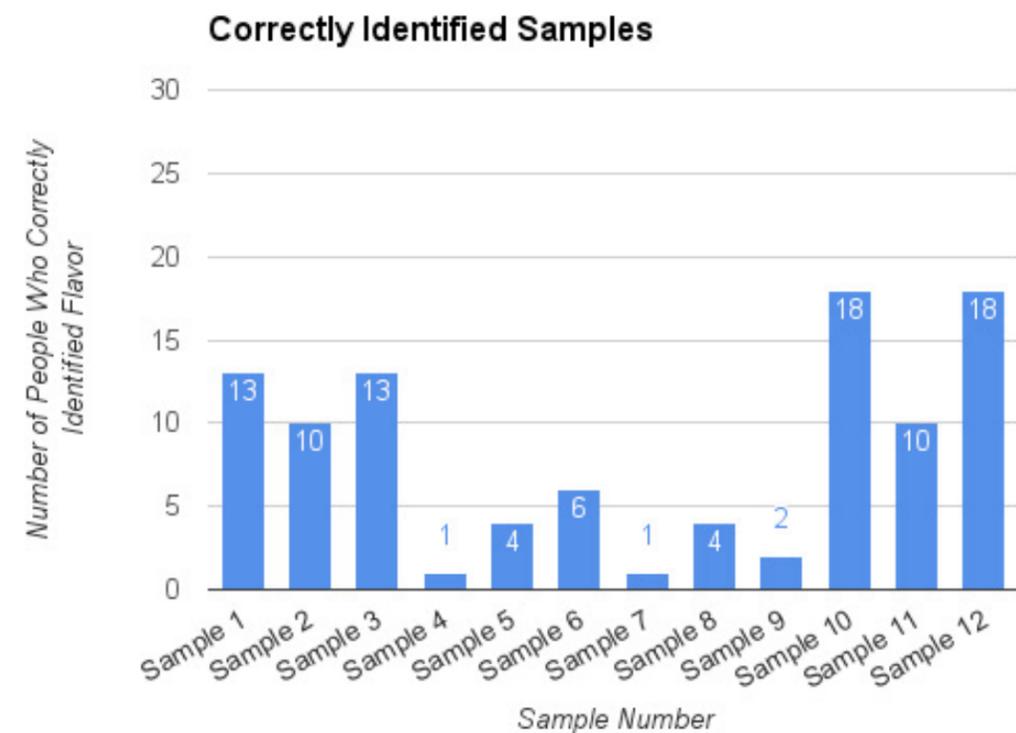
were then collected and the participants were each given a written and oral debriefing (Appendix D).

### Results

People were able to identify the flavor more often when there was either no flavor, or if the flavor was correctly matched to the color it was associated with. In Figure 1, it is shown that the highest amount of people who correctly identified the flavor occurred in the fourth sample set, where the colors matched the flavor. While many people failed to correctly identify sample 11, they often did identify another flavor associated with red, such as cherry or fruit punch, instead of strawberry. The

graph also demonstrates that when the colors were not correctly matched, it was near impossible for people to correctly identify the flavor. When the water was dyed blue, many people believed that the drink was blueberry or blue raspberry flavored, regardless of the actual flavoring used. On average, people were able to identify 3.44 of the twelve samples, and there was a median and mode of 3, as can be seen in Figure 2, which shows the measures of central tendencies for each set as well as the overall total. In Set 2 and Set 3, people, on average, could not even identify one of the samples. In both Set 1 and Set 4, on average, people identified just over 1 sample each.

### Data Collected



## Discussion

People had a very difficult time identifying the flavor of a beverage when it was not matched with its associated color, but were often able to identify when a beverage had no flavor. When a person drank a beverage they expected it to taste like the drink it was colored to match, but if there was a flavor and it was not the same, they altered their perception so that the situation made more sense. This is similar to the study done by Stevenson (2014), in which people's tastes were affected by the smell of the food they ate. The flavor of the food was composed of both smell and taste, much as this present experiment demonstrated, flavor involves multiple senses, including vision and gustation. The study conducted by Kimberly S. Yan and Robin Dando (2015) demonstrated that sound affected intensity of taste perceived, but it did not affect the actual flavor. While both made connections between senses evident, the current study showed not a change in intensity, but in the actual sensation that people perceived. Unlike the research done in Israel, this study did demonstrate a connection between perception and taste, but it did not show how flavor affected opinions of people, instead it showed how the colors of drinks affected how participants believed a beverage would taste. So many of our senses intertwine to create our perception of the world, even if it is wrong.

In this study, there were some confounding variables not taken into account. There was little to no diversity with regards to ethnicity. Different ethnicities may have different sensitivities to different tastes. Also, the study contained

an uneven distribution of ages and gender, making it difficult to generalize the results across an entire population. Another variable is that all of the participants were from one small community, and other areas within the country may associate colors with different flavors. Furthermore, if a participant had eaten something previous to the study that had a very strong taste lingering, even after eating the cracker, it may have affected their ability to correctly identify the flavor used.

If research is continued in this area, future work should include similar tests, but with varying intensities of flavor and color. This information could impact the production of flavored beverages, as it could be used to minimize the amount of flavoring and dye, while maximizing the consumer's perception of flavor. Further testing could reveal a varying level in the ability to taste differences based on age or gender. In order to do this, a more balanced sample would be required. This may be helpful to know how to cater to certain groups.

By having a participants in a study of people taste colored and flavored water, it is evident that the taste people perceive a beverage as having is greatly influenced by the color of the drink. When participants tasted drinks with no flavoring, they were often able to identify this, but once flavors were added, people often had a very difficult time identifying it correctly when the colors were switched. It is because of these results that one can assume that people unknowingly alter their perception of flavor when they see a certain color. While conducted on a small sample, the results made it evident that the color has a dramatic effect on perceived flavor.

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## Appendix A

| Cup    | Color  | Flavor     |
|--------|--------|------------|
| Cup 1  | Yellow | None       |
| Cup 2  | Red    | None       |
| Cup 3  | Orange | None       |
| Cup 4  | Yellow | Strawberry |
| Cup 5  | Red    | Orange     |
| Cup 6  | Orange | Lemon      |
| Cup 7  | Blue   | Orange     |
| Cup 8  | Blue   | Lemon      |
| Cup 9  | Blue   | Strawberry |
| Cup 10 | Yellow | Lemon      |
| Cup 11 | Red    | Strawberry |
| Cup 12 | Orange | Orange     |

## Appendix B

Age: 0-5 6-10 11-15 16-20 21-30 31-40 41-50 51-60 61-70 71-80

Gender: Male Female

Set 1:

Cup 1: \_\_\_\_\_

Cup 2: \_\_\_\_\_

Cup 3: \_\_\_\_\_

Set 2:

Cup 4: \_\_\_\_\_

Cup 5: \_\_\_\_\_

Cup 6: \_\_\_\_\_

Set 3:

Cup 7: \_\_\_\_\_

Cup 8: \_\_\_\_\_

Cup 9: \_\_\_\_\_

Set 4:

Cup 10: \_\_\_\_\_

Cup 11: \_\_\_\_\_

Cup 12: \_\_\_\_\_

## Appendix C

Script

Before you begin tasting, please complete the first two questions about age and gender on the top of the answer sheet. After you do this, please eat the piece of cracker provided.

Now, please taste samples 1, 2, and 3 and record the flavor of each in the space provided. Please choose a flavor, and try not to leave the line blank. If you believe the beverage has no flavor, please state that. Do not discuss your answers aloud with others. I want your personal opinion. Are there any questions?

After you have finished tasting the first three samples, another cracker will be provided for you. Please eat it before we begin the second set. Once you have finished, please taste samples 4, 5, and 6, recording the flavors in the designated blanks on the answer sheet.

After you have finished tasting the second three samples, another cracker will be provided for you. Please eat it before we begin the third set. Once you have finished, please taste samples 7, 8, and 9, recording the flavors in the designated blanks on the answer sheet.

After you have finished tasting the third set of three samples, another cracker will be provided for you. Please eat it before we begin the fourth set. Once you have finished, please taste samples 10, 11, and 12, recording the flavors in the designated blanks on the answer sheet.

Thank you for your participation in this study. Please leave the answer sheets on the table. I have a description of the study and other information for you before you leave.

## Appendix D

Color and Taste Study Debriefing

The overall goal of this study is to discover if the color of a beverage changes how a person perceives it to taste, specifically if people would be able to identify the correct flavor if they were given a drink that contained a flavor that did not correspond to the color it is usually associated with.

The first three cups had no flavor and were only colored. The second set of cups contained flavoring which did not correspond to its color. The yellow water had strawberry, the red had orange flavoring, and the orange water had lemon. The third set, which was all blue, contained one with each of the previous flavors. The last set contained water that was flavored to match the dye, so that yellow was lemon flavored, orange was orange, and red was strawberry.

Thank you for your participation in this study.

Results will be posted in the location where the study was conducted by May 30. If you would like a copy of the results please email [marissa.gallmeyer@gmail.com](mailto:marissa.gallmeyer@gmail.com).

# Watching the Clock

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## Abstract

High school students both nationally and internationally are tested constantly. While testing in mathematics, history, foreign language, and English classes, there are often strict time constraints imposed on students. These constraints are also imposed during many standardized tests, such as the SAT and ACT, that are used in the college admissions process. When students are under excessive pressure while test-taking, they often report increased stress levels. These increased stress levels can negatively impact many aspects of one's health and overall wellness. This study examines the effect of time constraints on testing anxiety. The results suggest that time constraints on students do increase stress levels. Further research regarding time constraints during testing is needed because it provides vital information regarding the practicality of setting time limits during high school quizzes, tests, and examinations.

## Introduction

The need to reconsider the use of time limits in testing has increased in recent years. The Anxiety and Depression Association of America claims that testing anxiety is real and that the main causes are "fear of failure," "lack of preparation," and "poor test history" (Test Anxiety). It also outlines different physical, emotional, and behavioral symptoms that can arise from anxiety, including headaches, nausea, and feelings of helplessness. When time constraints are added to an already pressured test setting, this added pressure can induce even higher anxiety levels. A study outlined in *The Journal of Experimental Education* found that students taking a statistics examination performed better under an untimed condition than a timed condition (Onwuegbuzie & Seaman, 1995). It also found that the benefits of the untimed examination were higher for highly anxious students. A study in the *Educational Psychology Journal* outlines different in-

terpretations that account for lackluster performance of highly anxious students. One of these interpretations claims that testing anxiety interferes with the retrieval of prior learning when a student is taking a test (Tobias, 1985). Whether or not time constraints affect test scores, the effects of time constraints could be detrimental to students' health and overall wellness.

## Method

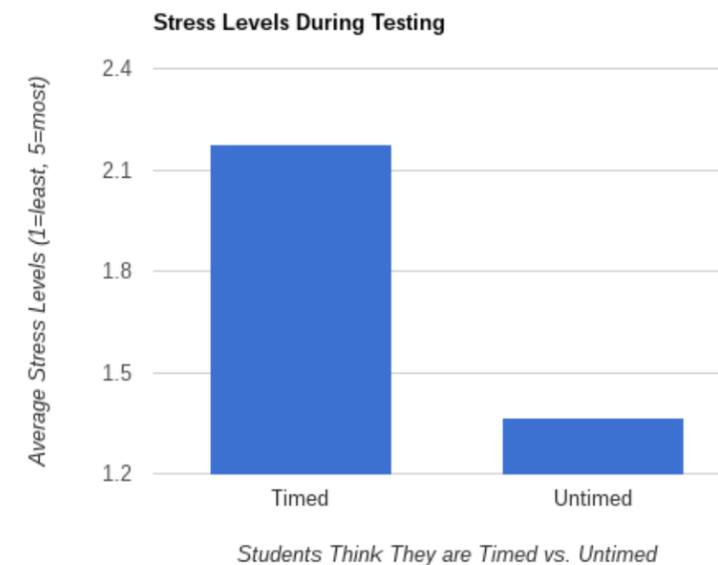
**Participants:** This study used a convenience sample with characteristics of a cluster sample. The population consisted of 104 students in four of Ms. Del Savio's AP Psychology classes at Walt Whitman High School in Bethesda, Maryland. The participants were 11th and 12th graders of various ages and genders, generally heterogenous. All test subjects were tested in the same location, and the data was all gathered on October 24, 2016. The four classes were told to complete a reading comprehension quiz, and

two were told that they had as much time as they needed to complete it. The other two were told they had 3.5 minutes to complete the quiz. The four classes were randomly assigned to be either timed or untimed. This method was used to examine the relationship between time constraints and testing anxiety.

**Design and Procedure:** To complete this study, when AP Psychology students entered the classroom for their period, reading comprehension quizzes made for 5th, 6th, 7th, 8th, and 9th graders by [ereadingworksheets.com](http://ereadingworksheets.com) and edited by the experimenter, were laying face down on each desk. The comprehension quiz was not expected to be difficult for most students. The reading comprehension quiz is provided in Appendix A. The quiz was estimated to take 3.5 minutes to complete. The teacher was instructed to tell the two untimed classes: "Please read the passage and then answer the questions on the second page about the passage. You have as much time as you need to complete the passage and questions. Please sit quietly when you are finished." The teacher told the two

timed classes: "Please read the passage and then answer the questions on the second page about the passage. You have 3.5 minutes to complete this assignment. There is a timer on the board. I will collect the assignment after 3.5 minutes have passed." Then, the teacher put a 3.5-minute timer on the board. For both groups, after 3.5 minutes, the students were instructed to put their pencils down and turn their papers over. So, the actual amount of time given to complete the quiz should not have affected the results; only the perceived amount of time the students believed they had for the test should have affected the results. Then, after shown a slide denoting different numbers to represent different levels of stress, students wrote down their stress levels out of five on the back of their papers. 1 represented the least amount of stress, and 5 represented the most amount of stress. Then, the assignments were collected even if students were not finished. The slide denoting the different stress levels is provided in Appendix B. The instructions read by the teacher are provided in Appendix C.

## Data Collected



## Discussion

After results were collected, the mean stress values for the timed classes and untimed classes were determined. The timed classes had an average stress level of 2.1745 while the untimed classes had an average stress level of 1.3635. So, there was a .811 difference in the average stress levels. The average scores for timed classes also differed slightly from the untimed classes but not enough to be statistically significant. There were, however, some confounding variables present in the experiment. All students participating in the study were enrolled in the AP Psychology course at Whitman High School, so these students could have characteristics that those students not enrolled in AP Psychology do not have. For example, they could be more relaxed in testing situations than a student who does not take any AP courses. Their knowledge of psychological phenomena gained in the course could also impact the study. Some

## References

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students could have also had more trouble with the reading comprehension questions than expected. However, confounding variables are not believed to have significantly impacted the results of the study.

## Conclusion

High school students around the world are consistently given time constraints during testing. Whether or not these time constraints affect their scores, they often cause increased stress levels. This anxiety has negative effects on many aspects of teenagers' lifestyles. It can cause headaches, nausea, and feelings of helplessness and depression. Educators and administrators around the United States need to consider the consequences of time constraints during quizzes, exams, and standardized tests in order to protect the wellness of high schoolers around the nation.

## Appendix A

Directions: Please read the following passage and answer the questions provided on a separate page.

Jacob the Great Jacob hated finishing things almost as much as he loved starting them. As a result, he had gotten into a million hobbies and activities, but he never stuck with any of them long enough to get any good. He begged his mother for months for a guitar so that he could play Black Eyed Peas songs to Angie, a girl he liked, but after he finally got one for Christmas, he found out that guitars don't play themselves. He took a few lessons, but strumming the strings hurt his fingers and he didn't like holding the pick, so now the five-hundred dollar guitar lives under his bed. After reading an ad in the back of one of his comic books, Jacob decided that he wanted a WonderSweeper 5000 metal detector, so that he could find buried pirate treasure. So he mowed lawns all summer and didn't spend his money on ice-cream like his younger brother, Alex. He saved it all in a shoe box in his closet. Then he shoveled driveways all winter, and he didn't spend his money on candy and chips like his classmates. By the time spring came he had saved \$200, and he purchased the Wonder-Sweeper 5000 metal detector. He beeped it around the park for a while, but he soon found out that no pirates had ever set sail in his neighborhood, and if they had they didn't leave any treasure. Even though he found a key ring, forty-seven cents, and all the bottle caps he could throw, he buried the metal detector in his closet. Given Jacob's history with hobbies, it was no surprise that Jacob's father was reluctant to buy him a magician's kit for his birthday. "Geez, Jacob... You sure you wouldn't rather I got you more guitar lessons?" He suggested. Jacob was insistent. "Dad, you've got to get me the magician's kit. This time I'll stick with it for real. I promise! Come on, Dad," Jacob begged. Jacob's father sighed and then replied, "Oh, I don't know, Jacob. Things are awfully tight right now." But Jacob's father was reminded of his own youth long ago, when he quit football and started karate practice before hardly getting his equipment dirty. So when Jacob's birthday came around, Jacob was both surprised and pleased to find the magician's kit that he had desired so badly with a big bright bow on it. Jacob opened up the box and unwrapped the many parts in the kit. As he did so, he imagined sawing his pet cat in half and putting it back together to the amazement of his friends and family. He took the many fake coins, trick cards, and rope pieces of varying length on the kitchen table and imagined pulling rabbits out of his hat and turning them into pigeons with a mysterious puff of smoke. As Jacob continued pulling plastic thumbs, foam balls, and giant playing cards out of the magic kit, a commercial on the TV caught his attention. "Hey kids! Have you ever wanted to go to space? Experience what it's like to be an astronaut? Do you want to explore the universe? Well, now you can." As the commercial continued playing, Jacob walked away from the magic kit on the kitchen table and stared at the TV screen longingly. "For only \$195 you can go to space camp and live life like an astronaut for a whole weekend. Enroll now for a once in a lifetime experience." Jacob's cry rang throughout the house as he yelled, "MOM!" He now knew what his true purpose in life was.

Questions:

1. What is the main idea of the story?
  - a. Playing guitar is an extremely rewarding hobby.
  - b. It's easy to quickly lose interest in hobbies when you are young and naive
  - c. Astronauts have the coolest job
  - d. A lot of people quit guitar because the strings hurt their fingers

2. What does Jacob continue to do throughout the story?

- a. Quit the hobbies he has started
- b. Play guitar
- c. Ask his mom questions
- d. Learn new magic tricks

3. What is one reason Jacob quits guitar?

- a. Strumming hurts his fingers
- b. He thinks lessons are boring
- c. He doesn't like the sound
- d. Because he is inconsistent and is bad at playing

4. How does Jacob become interested in becoming an astronaut?

- a. His friend wants to become an astronaut too
- b. His dad is an astronaut
- c. He reads about space in a book
- d. He sees a TV commercial

5. What does Jacob get for his birthday?

- a. A pirate eyepatch
- b. A magician's kit
- c. A rabbit
- d. Two pigeons

## Appendix B

Please assess the stress level you experienced while completing this assignment PRIOR to time being called.

- 1 - NO STRESS
- 2 - LITTLE STRESS
- 3 - MODERATE STRESS
- 4 - MODERATELY HIGH STRESS
- 5 - INTENSE STRESS

## Appendix C

Class 1 and 3-- NO time constraints

Instructions:

1. Pass out each page of the assignment face down (blank side up)

2. When each student has a copy, tell the class to "Please read the passage and then answer the questions on the second page about the passage. You have as much time as you need to complete the passage and questions. Please sit quietly when you are finished."

3. After 3.5 minutes, tell students to put their pencil down and turn their paper over.

4. Display the slide provided to TEACHER to assess stress levels of student. Instruct students to place a number 1-5 on the back of their paper.

5. Collect the assignment even if the students are not done.

Class 2 and 4-- 5 minute time constraint

Instructions:

1. Pass out each page of the assignment face down (blank side up). Put a 3.5 minute timer on the board.

2. When each student has a copy, tell the class to "Please read the passage and then answer the questions on the second page about the passage. You have 3.5 minutes to complete this assignment. There is a timer on the board. I will collect the assignment after 3.5 minutes have passed." Then, start the timer.

3. After 3 minutes, tell students to put their pencil down and turn their paper over.

4. Display the slide provided to TEACHER to assess stress levels of student. Instruct students to place a number 1-5 on the back of their paper.

5. Collect the assignment even if the students are not done.

# The Effect of Parenting Styles on Academic Achievement

Julie Mullins  
Lakeland High School

## Abstract

Researchers asked participants to take part in a survey regarding their parents and their cumulative GPA. Results were separated into three categories based on parenting styles: authoritative, permissive, and authoritarian, and were averaged out. It was concluded that students with authoritative parents have greater academic achievement than students with permissive and authoritarian parents. Students with authoritative parents performed with an average of a .9 higher cumulative GPA than students with permissive parents, and .27 higher than students with authoritarian parents. Similar results were found to be true in 1987 when researchers at the Sanford Center conducted a similar experiment. This information allows parents to be educated on the most effective parenting style in order to have the opportunity to care for their children in a way that benefit them the most.

## Introduction

Parenting style refers to the approach by which parents raise their children. These styles vary in the sense that the parents can either be strict, laid-back, or a combination of the two; known as authoritarian, permissive and authoritative parenting, respectively. Originally identified by Diana Baumrind in 1966, parenting styles have played an importance in the development of children and differences in parenting styles continue to demonstrate that the way a parent raises a child can affect what a child is like when they're grown.

There have not been recent studies conducted on how parenting styles affect a student's performance. The most recent well-known study on how parenting styles influence and affect academic performance was conducted in 1987, by experimenters at the Sanford Center in Bemidji, Minnesota. Results concluded then that students with authoritative parents tend to have higher grades than those with permissive and authoritarian parents.

These studies display separate, relevant information about how an array of different elements contribute to academic performance among teenagers; however, these studies do not investigate the modern consequences or betterment of parenting styles on academic performance. This study is designed to determine if those with authoritative parents will do better in school compared to those with authoritarian or permissive parents.

## Method

**Participants:** Researchers used a convenience sample from followers on Twitter and Facebook friends. Participants had the option to either contribute or to continue scrolling past the link. A total of 55 students from the convenience sample answered both questions with answers that were relevant to the study. No rewards were given as a result of taking the survey.

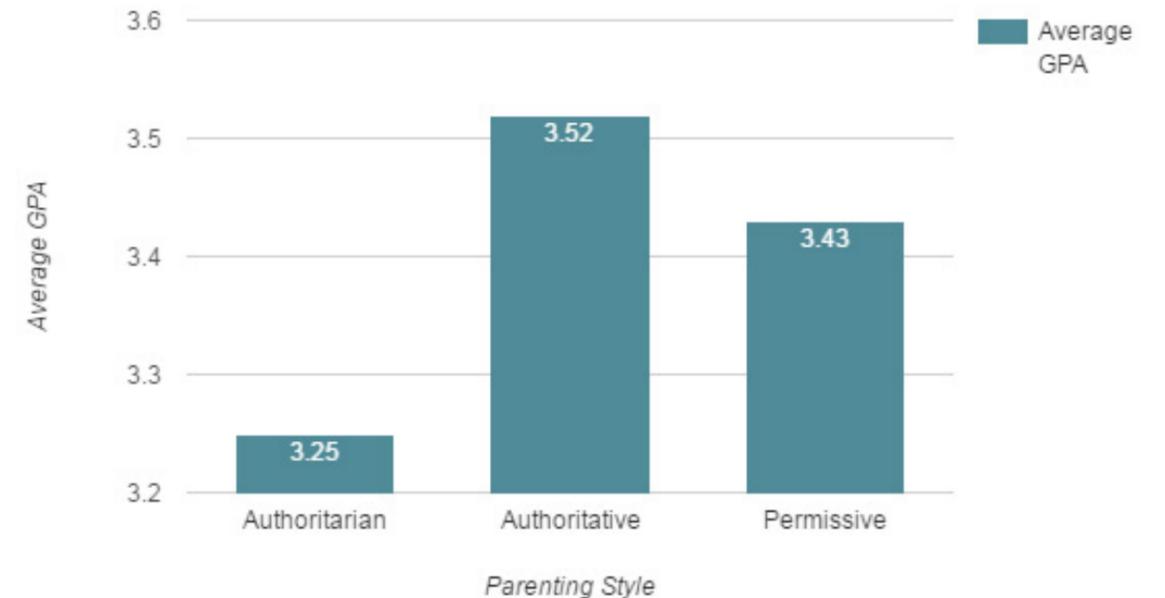
**Design and Procedure:** Researchers created a survey on SurveyMonkey.com regarding parent-

ing styles and academic performance. Academic performance was measured using GPA, while parenting styles were measured using a premade survey created by propofs.com (Appendix A). The link to the survey was posted by the researcher on both Twitter and Facebook, where participants could decide whether or not to partake in it. After 48

hours, the researcher closed the survey and split the information into three separate categories: GPA of those with authoritarian parents, authoritative parents, and permissive parents. The average GPA was calculated amongst each category and recorded onto a bar graph.

## Data Collected

Average GPA vs. Parenting Style (Figure A)



## Results

Figure A distinctly shows that on average, students with authoritative parents have a GPA that is .9 higher than students with permissive parents and .27 higher than students with authoritarian parents. Outliers skew the results for students with authoritarian and permissive parents since due to the relatively small amount of participants with parents that fit under each parenting style. For example, one participant that obtained 4.2 with permissive parents increased the average GPA from 3.12 to 3.25.

## Discussion

The researcher's hypothesis states that on average, students with authoritative parents will do better in school is accurate. At minimum, students performed .9 better on the GPA scale if they had authoritative parents. This is very similar to the results from the 1987 study on parenting styles and academic performance/achievement. However, the 1987 study was unable to provide numerical results.

Whether or not the students that took part in the survey answered each question truthfully dramatically changes the results. If a student selected a parenting style that did not represent their parent, their GPA would have been included into the

average for the wrong parenting style. The same goes for those who potentially could have answered the survey with a GPA different than their own. The way the questions were worded could have also confused some of the participants. In the recreation of the study, researchers should add more questions to ensure the participants are being judged fairly and accurately on their academic achievement level. An example of this includes asking for the number of AP or honors classes a student partakes in. Students that were in these classes had the option to either answer the survey with their weighted or unweighted GPA.

In the future, a the experiment could be conducted with a larger sample. The results were skewed mainly in the permissive and authoritarian parenting styles due to a lack of students with parents falling under that particular category. The results will be much more accurate if the research-

ers obtain a sample size that contains more equally distributed participants. This will ensure that positive and negative outliers won't have as great of an impact on the results.

The purpose of this study was to determine if students with authoritative parents have greater academic achievement in comparison to those with parents with other parenting styles. On average, students with authoritative parents have had greater academic achievement since 1987. Students with authoritarian parents perform significantly worse in relation to students with permissive and authoritative parents, according to their cumulative GPA. However, results can be easily skewed so the researcher should replicate the study with a larger sample size and a greater diversity of questions.

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# Examination of Deterioration of Episodic Memory in Major Depressive Disorder

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### Abstract

Many factors are associated with the link between episodic memory deterioration and Major Depressive Disorder (MDD). Major depressive disorder, or depression, affects 16 million people within the United States, and nearly 350 million people worldwide, producing symptoms which can impact how one thinks, feels, or carries out daily tasks (Nutt, 2008; WHO, 2016). Therefore, scientific research which deepens the collective understanding of contributors to depression is vital to helping millions worldwide. It has been definitively established that a direct association between an individual's episodic memory and the hippocampus, a small organ within the limbic system, exists (Tulving, 1998). Episodic memory, or the brain's ability to recreate a specific event, is often coupled with contextual emotions (Maratos, 2001). The limbic system, responsible for emotional regulation, is therefore associated with one's memory. However, it is an impairment of episodic memory, specifically overgeneral memory (OGM), or the inability to recall precise memories from one's autobiographical memory (AM), which is often evident in individuals with MDD (Williams, 2007). Meta-analyses, MaQueen et al., (2009) and Videbech & Ravnkilde (2004) show a reduced volume of the hippocampus in depressed individuals, firmly demonstrating that the hippocampus is linked to MDD (Videbech, 2004). Finally, Lemogne et al., (2005), and Bäckman, & Forsell (1994) found direct links between MDD and the deterioration of episodic memory. It can therefore be concluded that depression may cause a deterioration of the episodic memory.

### Discussion

Major depressive disorder (MDD) or depression is a common but serious mood disorder, affecting 16 million people in the United States and internationally, 350 million people (WHO, 2016). According to Nutt (2008) and Andréasson (2007), depression produces severe symptoms that may affect the way one thinks, feels, and carries out daily activities such as sleeping, eating, or working. The cause of depression is unknown but current research suggests that a combination of genetic, biological, environmental, and psychological factors are likely contributors (Beck, 2009). Definitive links between depres-

sion and episodic memory loss exist (Lemogne, et al., 2006). Procedural (implicit) and declarative (explicit) memory are the two forms of long-term memory; procedural memory is the unconscious memory of skills e.g., knowing how to ride a bicycle, and declarative memory is the memory of events and facts, or memories which can be retrieved consciously, e.g. recalling your wedding day (Brem, 2013). Declarative memory is comprised of both semantic memory and episodic memory (Riedel, 2015). Semantic memory allows one to recall basic facts learned during one's lifetime e.g., knowing the names of countries. Episodic memory complements knowledge recall with explicit memories of experiences and

events in a sequential order. Episodic memory provides an ability to recreate a specific event from a time in one's life. During recollection, episodic memory generally includes contextual emotions one experienced contemporaneously as opposed to merely explicit facts of the event.

Overgeneral memory (OGM) refers to the inability to recall particular memories from one's autobiographical memory. While attempting to retrieve a memory of a specific event, general memories are recalled instead. General memories are the recollection of repeated events, or events lasting long periods of time (Watkins, 2001). Research shows an association between OGM and certain mental illnesses, including posttraumatic stress disorder (PTSD) and MDD. Although research has been conducted to determine a relationship between OGM and anxiety disorders and personality disorders, none has been found. Yet, OGM has been found to be associated with PTSD and depression. OGM is thought to be exclusive to emotional disorders (Williams, 2007). In Lemogne et al., (2006) 21 depressed participants and 21 control subjects without a history of depression were recruited for the study. The depressed participants had no history of bipolar disorder, psychotic disorder, PTSD, substance use disorder, borderline and schizotypal personality disorder, or any other illness linked with memory loss. At the time of the study, the depressed participants received antidepressants and/or antipsychotics and were presented with a task used to evaluate episodic memory. In the task, participants were requested to recall and describe one positive event and one negative event. To determine if OGM was evident in the participants, the interviewer asked the participants to recall a specific memory that had a duration of less than 1 day and to recall as many details as possible, including facts, emotional recollections, as well as the event relative to time and space. The participants were then asked to provide additional responses if the subjects perceived the recalled memory as subjective or objective. They were also asked

to provide details that could discriminate between two alike events. Researchers (Lemogne et al., 2006) found that each depressed subject scored lower on the task than his non-depressed counterpart. As the task was used to assess episodic memory, the study suggests that depression negatively affects episodic memory.

Not only does research suggest that depressed individuals have more OGM, but that their memories may also be more negative in nature. Williams and Scott (1988), produced similar results when studying this same topic. In their study, 20 depressed participants and 20 controls were prompted to recall positive and negative events. The participants were asked to be specific in their description of the memories. The outcome of this study showed that depressed participants took more time to respond to positive prompts than to negative prompts. The depressed participants were also less specific when describing their memories, particularly when retrieving positive memories. In Bradley, Mogg, and Williams (1995), explicit and implicit memory biases were evaluated in 19 depressed participants, 17 anxious participants, and 18 control participants. A memory bias is a cognitive preference that may improve or weaken recollection. The bias may affect the time it takes to recall, or modify the substance of a memory. The participants were given tasks designed to assess the presence of mood-congruent biases in any of the groups. Mood congruence memory is a process that discernibly retrieves memories that are consistent with one's mood. When certain moods were stimulated, the depressed participants recalled more depressive words than the other groups in the study. The results indicate that depression is associated with mood-congruent biases in memory processes. These negative memory biases can cause further depression (Teasdale, 1983).

Research continues with the goal of determining additional likely causes of depression, including causes of OGM. Theories on potential causes of OGM concentrate on the role of memory retrieval. Subsequently, these theories have

materialized into a model known as Capture and Rumination, Functional Avoidance, and Impairment in Executive Capacity (CaR-FA-X) (Sumner, 2012). The first aspect of this model, Capture and Rumination, pertains to the notion that people with a negative self-image, during memory retrieval, access general memories that they conflate with negative perceptions of themselves. This behavior prevents people from progressing to more specific areas of the memory (Williams, 2007). The second aspect addresses Functional Avoidance which suggests that people who have depressive or PTSD symptoms, utilize a coping mechanism in which these individuals avoid specific memories that may elicit emotional distress. However, over time with repeated use, this mechanism becomes ingrained in the retrieval of memories. Because of this, one may not be able to easily access specific memories. The third aspect is based upon Impairment in Executive Capacity. This theory posits that autobiographical memory retrieval requires certain cognitive resources such as, working memory capacity and executive control. People with emotional disorders such as PTSD or depression are shown to have diminished cognitive resources (Hammar, 2009).

Likewise, it is commonly known that elderly people often have diminished cognitive abilities (Johnston, Wakeling, Graham, and Stokes, 1987). Bäckman and Forsell (1994) showed additional cognitive deficiencies in elderly people with depression. In their study, Bäckman and Forsell (1994), analyzed 17 depressed people, with a mean age of 83.29 years and 51 non-depressed people with a mean age of 83.29 years. The participants were tested on an array of episodic recall and recognition assignments. The study found that depressed elderly adults had greater deficits in recall in comparison to the controls. The study also suggested that elderly people with depression are associated with having a decreased capacity to utilize cognitive resources to improve episodic memory. The results showed that the process of encoding and retrieval are diminished in elderly people with depression. The CaR-FA-X

model shows that diminished capabilities of retrieval are strongly associated with OGM (Sumner, 2012). Liu, Li, Xiao, Yang, and Jiang (2012), in a meta-analysis, studied the results of 22 studies of people with depressive disorders in relation to AM. The study showed that participants with depressive disorders communicated more overgeneralized memories than the controls. The depressed participants also exhibited lengthier recollection times. The study suggests that the participants with depressive disorders had AM deficiency due to the overgeneralization of the memories, as well as longer response times.

OGM, an impairment of episodic memory, is associated with contextual emotion and can be better understood through examination of selected organs in limbic system. The well-established link between episodic memory and the hippocampus further reveals a reduction in the physiological volume of the hippocampus in people suffering from depression (Bremner et al., 2000; Tulving, 1998). Sheline, et al., (1999) suggests that recurrent episodes of depression may lead to hippocampal volume reduction. Tulving and Markowitsch (1998) maintain that it is widely recognized that the hippocampus is a crucial component in declarative memory. Their study suggests that the hippocampus is not necessary for the functioning of semantic memory but is critical in the processes of episodic memory. Bremner et al., (2000) states that episodes of depression are associated with heightened levels of glucocorticoids, which have been associated with damage to hippocampal neurons. The study further found that damage to the hippocampus may also result in episodic memory deficits in depressed people. In the study, 16 depressed participants were treated with an antidepressant. No participant received medication other than an antidepressant. Additionally, no subject had any history of PTSD. The study found that participants with MDD had a statistically significant 19% smaller left hippocampal volume than the controls, without a reduction in whole brain volume.

Similar to the research of Bremner, et al., (2000), a meta-analysis by Videbech and Ravnkilde (2004) examined studies totaling 351 participants with MDD or bipolar disorder and 279 control participants. In comparison to controls, depressed participants showed an 8% reduction of volume on the left side of the hippocampus and a 10% reduction of volume on the right side. The study found that hippocampal volume is diminished in participants with MDD, but not in participants with bipolar disorder. MaQueen, McKinnon, Yucel, and Nazarov (2009), in a meta-analytical study, used data for 32 magnetic resonance imaging studies of hippocampal volume in participants with MDD. The study found that among participants who have had MDD for longer than two years, or experienced more than one depressive episode, a disparity in the volume of the hippocampus exists between test and control subjects. The depressed participants had smaller hippocampal volumes than those of the controls. However, in participants with less than two episodes of MDD, no difference in hippocampal volume exists. It is apparent that the study suggests a reduction of the hippocampus occurs in people with recurrent depression or depression lasting longer than two years.

Additionally, Sheline, Gado, and Kraemer (2003) studied the effect of antidepressants on hippocampal volume in participants with MDD. 38 depressed participants were tested, some received antidepressants and some did not. The results showed there was no significant decrease in hippocampus volume in depressed participants receiving antidepressants. However, participants who had not received antidepressants experienced a reduction in volume of the hippocampus. Sheline, Gado, and Kraemer (2003) and Lemogne et al., (2006) both used antidepressants as a variable. Lemogne et al., (2006) found a reduction of the hippocampus in depressed participants taking anti-depressants. However, Sheline, Gado, and Kraemer (2003) found that depressed participants taking anti-depressants did not experience a reduction of the hippocampus.

Sheline, Sanghavi, Mintun, and Gado (1999) used magnetic resonance imaging (MRI) to quantify hippocampal volumes in people with a history of depression as compared to controls. 24 participants with a history of depression, and 24 controls completed MRI scanning. Participants with a history of depression had lesser hippocampal volumes than the controls. Moreover, the depressed participants scored lower in a verbal memory test. This verbal test measured neuropsychological hippocampal function.

To mediate decreased neurological functions in people with MDD, interventions such as mindfulness-based cognitive therapy (MBCT) and memory specificity training (MEST) have been used, and furthermore, have been shown to decrease OGM and symptoms of MDD (Williams, 2000). MEST instructs people to be more attentive to their environments. This results in the person being more attentive to their thoughts and their thought processes. When the depressed person is more attentive to his or her surroundings, the memories of that time period become encoded with greater detail. Multiple studies, including (Neshat-Doost et al. (2013), and Raes, Williams, and Hermans (2009), showed that MEST could decrease OGM in depressed individuals.

It is promising to note that OGM has been shown to be reduced after specific interventions in depressed individuals Neshat et al., (2012). These results could reduce the likelihood that individuals with depression or PTSD would experience OGM. Research shows that modifying this memory style could inhibit OGM as well as certain symptoms of depression from recurring (Raes, Williams, and Hermans (2009).

### Conclusion

Behavioral studies, including Lemogne et al., (2006), and Bäckman and Forsell (1994), found direct links between MDD and the deterioration of the episodic memory. It has been firmly established that the hippocampus controls episodic memory (Tulving, 1998). Physiologi-

cal meta-analytical studies, such as MaQueen et al., (2009) and Videbech & Ravnkilde (2004), showed a reduced volume of the hippocampus in depressed people. Because of these findings, it can be concluded that depression may cause a deterioration of the episodic memory.

Research accomplished by Raes, Williams,

and Hermans (2009) is significant in its findings of a successful intervention processes addressing OGM. Additional research should be explored to analyze the effects of anti-depressants and episodic memory.

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