

STRESS, pH & COPING:  
DOES EXPERIENCE MAKE A DIFFERENCE?

HONORS THESIS

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In Partial Fulfillment of  
the Requirements  
For Graduation in the University Honors Program  
& A Minor in Honors Studies

By  
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DOES EXPERIENCE MAKE A DIFFERENCE?

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## Stress, pH & Coping: Does Experience Make a Difference?

### *Honors Research Thesis*

#### ABSTRACT

The current study hypothesized a relationship between academic year, coping mechanisms, stress, short-term memory and salivary pH. Cortisol is a hormone release during stress that is often measured in studies despite its cost, but can salivary pH be used as a cheaper significant alternative predictor of stress and memory? It was expected that upper-classmen would: report using more effective coping strategies, have more optimal pH levels, be more accurate in assessing their ability to handle stress and have better short-term memory even in the face of a higher quantity and magnitude of outside life stressors.

Upperclassmen (28) and lowerclassmen (30) undergraduate students completed a life-stress scale, self-ratings of strategies used and effectiveness for handling stress. Short-term memory was assessed after a stressful rumination exercise using a reading passage and timed comprehension test. Participant pH levels were measured in the saliva twice to ensure accuracy.

Using a Pearson Correlation in a correlation matrix, several significances were found at the .05 and even .001 levels. Although the part of the hypothesis was not supported, there were significant findings with salivary pH and other relationships as well. Coping style and believed ability to handle stress were positively correlated ( $r=.549$ ,  $p<.001$ ) but year level and believed ability to handles stress are negatively correlated ( $r=-.258$  and  $p=.05$ ). Higher stress was correlated with lower memory retention with  $r=-.561$  and  $p<.001$ . *For pH:* It was found that there is a very positive correlation between pH and memory ( $r=-.909$ ,  $p<.001$ ) and a very negative relationship between pH and stress ( $r=-.492$ ,  $p<.001$ ). From the data collected in this study, we have concluded that salivary pH seems to predict memory retention just as well as stress levels do.

## INTRODUCTION

Cortisol is a hormone released into the bloodstream by the adrenal gland in response to stress. It raises blood pressure, suppresses the immune system and digestion, and gears the body up to handle a stressful situation. When released in a time of stress, it is meant to aid in “fight or flight” responses to possible dangerous situations, but in many cases this chemical is over secreted and remains active in the brain from the constant stresses of every day life. With this prolonged activity, the brain experiences negative effects, including a higher susceptibility to illness, high blood pressure, and a decreased ability to concentrate and encode information for long-term and short-term memory (Franklin, 2004). In the college world, the effects of this chemical abundance are clear. Students are trying to meet deadlines, prepare for multiple tests, support themselves, and deal with the pressures of social networks.

## THEORY

There have been several studies that have addressed the issue of stress in college students. In a study by Izawa (2007), researchers used the effective method of saliva sampling to test for cortisol in undergraduate college students who were writing their theses. They also had the students take a self-report questionnaire so that outside stress factors could be taken into account. They found that cortisol levels were much higher right before thesis submission. Also,

stress and how it is managed has an impact on the dropout rate of college students, as shown by Bray (1999). Bray did research on undergraduate students' different methods of coping with stress and looked at how it affected their social network and consequently their decision to continue with school. They found that with a lessened ability to manage stress, the chance of discontinuing their education increased. Another study looked at university freshmen and compared four individual coping techniques utilized by the participants with four different levels of health (Sasaki, 2007). The coping techniques were emotion expression, emotional support seeking, cognitive reinterpretation and problem solving. They found that using cognitive reinterpretation or problems solving to deal with stress yielded better overall health than when participants used the others.

Given what we know about cortisol release and past research, there is still a question that arises and needs to be tested. Past studies have confirmed that cortisol testing is an effective way to detect stress, that stress frequently has a huge impact on college students, different coping strategies are better than others, and that cortisol and stress can be detrimental to health and success. What the previous studies don't look at is if time and experience have a significant effect on the development of coping techniques used to deal with stressful situations. They assume that coping strategies vary from person to person but overall remain constant for an individual over time. We believe, however, that academic year level shapes stress coping mechanisms and we will see a difference in the ability to handle stress between upper and lowerclassmen. Students further along in

college are more likely to have the ability to deal with stress better, but by assessing three levels (time in college, a physiological measure of stress, and coping techniques), we will be able to see if it is the certain strategies the students choose to use that help them deal with stress or if it's the length of time they use them. Based on Sasaki's findings on the efficiency of different coping strategies, we believe this study will show that upper-classmen use better coping strategies and will perform better on the memory test.

As mentioned earlier, previous studies have shown that cortisol testing is a significant indicator of stress. Unfortunately, cortisol testing is very costly and time consuming. We wanted to have a physiological measure but could not afford cortisol assays, so we consulted a biological psychologist to review other options. He informed us of salivary pH, which would be cheap and easy. After looking into pH balance, we saw that the body always tries to maintain an optimal range and is constantly fighting to do so. Factors that affect and cause an unbalanced pH can be sickness, or other body problems (pH Ion, 2008), which we thought could possible be stress induced. We decided to use this study to see if salivary pH can be used as an inexpensive alternative to cortisol testing for stress and a predictor of memory retention, although pH-stress-memory links are not supported by any previous literature. To have a possible physiological measure of stress, we recorded the pH of each student's saliva to see if there were correlations with the other variables in the study. We believed that a higher (more optimal) pH scale

score will be positively correlated with year in college and memory score, and will be negatively correlated with stress.

## MATERIALS & METHODS

In this study, undergraduate students at Texas State University were asked to complete two questionnaires. The first was a questionnaire that measured the individual participant's believed capabilities for handling stress. This sheet also asked the participant to select the coping strategy they most utilize, and recorded what year in college they were in. The second questionnaire that was administered was a life-stress scale, which measured stressors in the lives of the participants such as loans, relationship problems, and sickness. We altered a version of the Holmes & Rahe "Life Stress Inventory," (Holmes, 1967) to fit the college lifestyle (i.e. \$5,000 in loans rather than a \$5,000 mortgage).

To induce mild stress, a two-minute, common, college situation was provided for rumination. It was pre-recorded to reduce experimenter bias. Each participant heard identical readings with all the exact same vocal inflections, dramatic pauses, or anything else that may have evoked emotional stress. A generic passage was then given and the participants were tested afterwards to measure short-term memory retention. This passage has been used in previous studies and has been proved to be an efficient gauge of short-term memory retention (Hayes, 2007). Each participant was also tested to measure pH levels

using pH Ion Balance Stix (pH Ion, 2008) in the saliva twice: before the study began and at the end. We took two readings to ensure accuracy of the pH score and did not expect to see pH differences as a result of the short stressor the participants experienced during our study. The pH scale score was recorded as follows, with optimal pH holding the highest value:

1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10

(Very acidic → Very alkaline → Slightly acidic → Slightly alkaline → Optimal)

Participants were solicited from Psychology courses (only with instructor permission). We were looking for an equal number of both upper and lowerclassmen, with total participant population equaling 58 (34 females, 24 males). If the professor agreed, extra-credit was offered to Psychology students who participated. For those students who chose not to participate, a time-comparable alternative method for earning the extra credit was provided. Due to the sensitive and personal nature of some of the questions in this study, we took every measure possible to guarantee confidentiality. The consent form and actual surveys were kept separate from each other. None of the surveys asked for identifying information. The consent form, containing the participant's name, was taken from the room upon completion and the completed survey was placed randomly in a folder, so there was no possibility that anyone can associate the name of the student with the actual survey.

Designing the study this way allowed us to test the following effects: 1. If upper-classmen students use more effective coping strategies, 2. To determine if length of time in school alone leads to lower physiological stress levels, and 3. To see if there is something unique about the combination of strategies chosen and time in school that has an effect on stress and pH levels. We were looking for a relationship between pH, self-report of ability to deal with stress, actually ability to handle stress and length of time in college.

## RESULTS

Using SPSS to create a Pearson Correlation in a correlation matrix, we found several significant links between variables at the .05, .01, and even .001 levels. These levels are set during data analysis to filter data and find the significant correlations. The outcome can be read as the smaller the “p” is of two variables, the stronger their correlation.

There is a significant negative correlation between sex and coping styles ( $r = -.354, p < .01$ ). Males used the “better”, more cognitive styles while females utilized more emotion-based coping, which supports previous research on gender and coping (Bradley, 2008). A very significant positive correlation can be seen between coping styles and believed ability to handle stress ( $r = .549, p < .001$ ). Participants who use better coping styles see themselves as better at handling stress. As age and year level of participant increases, their believed ability to

handle stress decreases. Age has  $r=-.276$  and  $p<.04$ . Year level has  $r=-.258$  and  $p<.05$ . There is a significant negative correlation between stress and memory ( $r=-.561$ ,  $p<.001$ ), which also supports past research (Franklin, 2004). Participants who had higher levels of stress had poorer memory retention.

*Findings for pH, memory and stress:*

There is a very significant negative relationship between pH and stress ( $r=-.492$ ,  $p<.001$ ) and a very significant positive correlation between pH and memory ( $r=-.909$ ,  $p<.001$ ). If pH was more optimal, stress was lower and memory was higher. If it was further from the optimal range, stress was high and memory retention was low.

## DISCUSSION

Through SPSS data analysis, we found a strong negative correlation between pH and memory performance, and a positive correlation between pH and outside stressors. We did not, however, find correlations in the rest of our hypothesis. There were no differences in coping mechanisms used or memory retention between upperclassmen and lowerclassmen.

It is interesting to note that participants who used more efficient coping styles also rated themselves as better at handling stress. Lower classmen reported a better ability to handle stress, although there is no significant correlation between year level and coping style utilized, nor is there a significant relationship

between year level and amount of stress reported. This stress level outcome could have been different though by adding more outside stressors to our stress scale. The one we used was a generic one created for college students in general, but with adding possibilities tailored to individual upper or lowerclassmen (i.e. homesickness for lowerclassmen or job-searching for upperclassmen), we may have seen some differences in stress levels.

### *pH Discussion*

Although the previous data results did not support a part of our hypothesis, the pH/stress/memory correlation were much more significant than what was expected. From the data collected in this study, we have concluded that salivary pH seems to predict memory retention just as well as stress levels do.

## CONCLUSION

Since the pH-stress-memory relationships have not been seen in other studies, we believe this is a significant finding and should be looked at further. This provides some promising "early" data to suggest that pH might be a very cost efficient way of looking at the physiological effect of stress. Future studies could be implemented to cement possible links between salivary pH and cortisol, as well as salivary pH and stress. It is important to note that if our outcome pertaining to pH and memory/stress is studied more and further supported and even linked to

cortisol levels, salivary pH could become a very popular, reliable, and inexpensive alternative to cortisol assays.

**Price difference:**

1 cortisol assay = ~ **\$65** (Stratech, 2008)

1 pH detection strip = ~ **\$0.08** (pH Ion, 2008)

Ideally, students in years ahead could follow up this research. Since this study has been completed, grant funding would be larger and more readily available, which would enable future researchers to utilize cortisol assays along with salivary pH and also broaden the tested population. After increasing generalizability and solidifying the relationships found in this study, new data results could have great potential to significantly contribute to and better the field of psychology.

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**Supporting Materials**

- I. Consent Form
- II. Coping Style Survey with other questions
- III. Life Stress Scale – Used to rank outside stressors
- IV. Memory Passage with timed questions
- V. Participant Profile – Filled out for each participant

## I.

**Texas State University  
Consent Form**

IRB Approval Number: \_\_\_\_\_

You are being invited to participate in a research study investigating the relationships between college academic year level and stress. Stress is a good but also harmful aspect of college life and it is our belief that academic year level shapes stress coping skills. If you are able to develop these mechanisms to deal with stress, the more likely you are to perform well in school. By participating in this study, you will be helping us to gather important information about stress levels, stress coping mechanisms, and the differences in stress management between upper and lower classmen. This research study will take approximately 45 minutes to complete. Participation is entirely voluntary. The project is being conducted by Lindsay Bira ([lb1197@txstate.edu](mailto:lb1197@txstate.edu)) for partial fulfillment of the requirements in her PSY 4395 – Independent Study course under the supervision of Dr. Randall E. Osborne ([ro10@txstate.edu](mailto:ro10@txstate.edu) or 512-245-8236) of the psychology department.

**We will be assessing stress levels using the following methods:**

- Questionnaires
- Cortisol detecting strips on saliva samples
- Memory quiz

This study is designed to compare upperclassmen and lowerclassmen memory performance to salivary cortisol levels and a rank of stress factors in the lives of the participants. These findings will allow us to determine whether years of college experience and/or repeated exposure to stress affect cortisol release and predict memory retention. In this study, stress will be measured using cortisol levels in saliva so participation will require a saliva swab. You will be given an initial cortisol reading and will then be asked to complete a brief Life Stress Questionnaire. This will be followed by a rumination exercise where you will be asked to think deeply about a provided stressful situation. You will then be given a passage to read and a short quiz, which is followed by another cortisol reading. There is one more questionnaire on your believed ability to handle stress that we will ask you to complete. The order of these tasks may be different from participant to participant.

Although some questions may involve sensitive information about your hardships, please be assured that we are NOT asking for any identifying information that could link you in any way to the data you provide. All informed consent forms will be kept completely separated from data response sheets. All data collected will also be kept in a locked file cabinet in a locked research room. Once all data has been entered into the computer and analyses completed, all original data sheets will be destroyed.

Keep in mind that your participation is completely voluntary. Should you choose not to participate or to withdraw your participation at any time, there will be no penalty whatsoever to you, academic or otherwise. You may ask the experimenter about an alternative method for earning the extra credit, which involves reading a research article about stress in college students and writing a brief summary.

If you have any questions about this study, contact the Principle Investigator, Dr. Randall E. Osborne ([RO10@txstate.edu](mailto:RO10@txstate.edu)), Dept. of Psychology, Texas State University-San Marcos, 512-245-8236. If you have any questions about the research or your rights in this or any other study, you can contact the Chair of the IRB, Dr. Lisa Lloyd (512-245-8358) or the Office of Sponsored Projects Administrator, Becky Northcut (512-245-2314). If you would like a summary of the results of this study emailed to you, please check the box below. A summary of the findings will also be posted on the bulletin board outside room

202 of the Psychology Building at the completion of the study. You will receive a copy of this consent form.

I would like a copy of the research summary emailed to me at the following email address:

\_\_\_\_\_

If this study raises any personal questions or concerns for you, you may want to contact Blanca Sanchez-Navarro, Supervising Counselor ([bs05@txstate.edu](mailto:bs05@txstate.edu)), the Student Health Center at 245-2167 and/or the Counseling Center at 512-245-2208.

By signing below, you are giving your consent to participate in this research study.

\_\_\_\_\_  
Participant's Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Printed Name

**II.****Your Stress Coping Style**

Listed below are four different strategies used to deal with stress. Please read the description to each and circle the ONE method you feel you use the most.

1.     **EMOTION EXPRESSION**  
When a stressful situation has occurred, you react and deal with it by letting your emotions out. You easily show anger, sadness, or other strong emotions in such times.
  
2.     **EMOTIONAL SUPPORT SEEKING**  
When a stressful situation has occurred, you react and deal with it by turning to others to get their feedback. You may be most likely to call a friend or family member to get their take on the situation.
  
3.     **COGNITIVE REINTERPRETATION**  
When a stressful situation has occurred, you react and deal with it by thinking about it in a different light. You turn the bad into good by reinterpreting the situation and are able to handle it that way.
  
4.     **PROBLEM SOLVING**  
When a stressful situation has occurred, you react and deal with it by finding a solution that will make things better. You work through the stressful problem and try to find a solution.

**On a scale of 1 to 10, from lowest to highest, what do you believe is your ability to cope with stress? Please circle a number:**

1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10

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**PLEASE CHECK ONE**

*I am a:*

- Freshman/Sophomore
- Junior/Senior

*In between the ages of:*

- 17-19
  - 20-22
  - 23-25
  - 25 or older
- 

Have you ingested anything besides water in the last 2 hours?

**YES**                      *or*                      **NO**

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If YES, what was it?

**A MEAL**                      **A SNACK**                      **A DRINK**

**III.**

**Scale of Outside Life Events**

*Based on the Holmes-Rahe Life Stress Inventory*

Read each of the events listed below and check the line next to any event that has occurred in your life in the last two years. There are no right or wrong answers. The aim is just to identify which of these possible outside stressors you have experienced lately.

<input type="checkbox"/>	Death of immediate family member - - - - -	100
<input type="checkbox"/>	Relationship breakup - - - - -	73
<input type="checkbox"/>	On & off relationship - - - - -	65
<input type="checkbox"/>	Jail term - - - - -	63
<input type="checkbox"/>	Death of other family member - - - - -	63
<input type="checkbox"/>	Personal injury or illness - - - - -	53
<input type="checkbox"/>	Beginning a new relationship - - - - -	50
<input type="checkbox"/>	Fired at work - - - - -	47
<input type="checkbox"/>	Change in health of a family member - - - - -	44
<input type="checkbox"/>	Pregnancy/pregnancy scare - - - - -	40
<input type="checkbox"/>	Gain of a new family member - - - - -	39
<input type="checkbox"/>	Change in financial state - - - - -	38
<input type="checkbox"/>	Death of a close friend - - - - -	37
<input type="checkbox"/>	Changing jobs - - - - -	36
<input type="checkbox"/>	Working over 20 hours/week - - - - -	35
<input type="checkbox"/>	Taking over 15 hours of school - - - - -	35
<input type="checkbox"/>	More arguments with boy/girlfriend - - - - -	35
<input type="checkbox"/>	Roommate issues - - - - -	35
<input type="checkbox"/>	Loans over \$15,000 - - - - -	31
<input type="checkbox"/>	Foreclosure of a loan - - - - -	30
<input type="checkbox"/>	Change in responsibilities at school/work - - - - -	29
<input type="checkbox"/>	Trouble with family - - - - -	29
<input type="checkbox"/>	Outstanding personal achievement - - - - -	28
<input type="checkbox"/>	Begin or end school - - - - -	26
<input type="checkbox"/>	Change in living conditions (moving, etc.) - - - - -	25
<input type="checkbox"/>	Revision in personal habits - - - - -	24
<input type="checkbox"/>	Trouble with boss/professor - - - - -	23
<input type="checkbox"/>	Change in work hours or conditions - - - - -	20
<input type="checkbox"/>	Change in residence - - - - -	20
<input type="checkbox"/>	Change in schools - - - - -	20
<input type="checkbox"/>	Change in recreation - - - - -	19
<input type="checkbox"/>	Change in social activities - - - - -	18
<input type="checkbox"/>	Loans over \$5,000 - - - - -	17
<input type="checkbox"/>	Change in sleeping habits - - - - -	16
<input type="checkbox"/>	Change in eating habits - - - - -	15
<input type="checkbox"/>	Vacation or recent travel - - - - -	13
<input type="checkbox"/>	Minor violations of the law - - - - -	13
	TOTAL: _____(We will calculate)	

#### IV.

##### Memory Passage

Please read the following passage. After reading, you will be given a timed memory test, which will include 11 questions. We will let you know how long you have to answer.

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**Intrinsic motivation** is based on internal factors such as self-determination, curiosity, challenge, and effort. **Extrinsic motivation** involves external incentives such as rewards and punishments. The humanistic and cognitive approaches stress the importance of intrinsic motivation in achievement. Some adolescents study hard because they are internally motivated to achieve high standards in the work (intrinsic motivation). Other adolescents study hard because they want to make good grades or avoid parental disapproval (extrinsic motivation).

**Self-Determination and Personal Choice.** One view of intrinsic motivation emphasizes self-determination (Deci & Ryan, 2001). In this view, adolescents want to believe that they are doing something because of their own will, not because of external success or rewards.

Researchers have found that giving adolescents some choice and providing opportunities for personal responsibility increases their internal motivation and intrinsic interest in school tasks (Stipek, 2002). For example, one study found that high school science students who were encouraged to organize their own experiments demonstrated more care and interest in laboratory work than their counterparts who were given detailed instructions and directions (Rainey, 1965). In another study that included many African American students from low socioeconomic status backgrounds, teachers were encouraged to give them more responsibility for their school program (deCharms, 1984). This consisted of opportunities to set their own goals, plan how to reach the goals, and monitor their progress toward the goals. Students were given some choice in the activities they wanted to engage in and when they would do them. They were also encouraged to take personal responsibility for their behavior, including reaching the goals they had set. Compared with a control group, students in the intrinsic motivation/self-determination group had higher achievement gains and were more likely to graduate from high school.

**QUESTIONS:** (Answers in bold)

1. Renée has a humanistic perspective. She is likely to emphasize the importance of \_\_\_\_\_ in achievement.  
A) flow  
B) social approval  
C) self-determination  
**D) intrinsic motivation**  
E) extrinsic motivation
  
2. Keenan studies hard in business because he knows if he graduates with honors, he'll be assured of getting a job with a top accounting firm. Keenan's behavior best exemplifies  
A) flow.  
B) intrinsic motivation.  
C) mastery orientation.  
D) self-determination.  
**E) extrinsic motivation.**
  
3. The desire to accomplish something in order to avoid punishment or disapproval is  
A) intrinsic motivation.  
B) performance orientation.  
C) self-efficacy.  
**D) extrinsic motivation.**  
E) an external attribution.
  
4. Brendan studies hard to get good grades. He knows that his parents will be disappointed in him if he doesn't make the honor roll every term. Brendan's motivation for working hard in school is  
A) intrinsic motivation.  
**B) extrinsic motivation.**  
C) social motivation.  
D) cognitive motivation.  
E) self-motivation.
  
5. Which of the following is an example of intrinsic motivation?  
**A) writing a well-written thesis for the challenge**  
B) writing a well-written thesis for an A  
C) writing a well-written thesis to keep from having to make revisions  
D) writing a well-written thesis to be accepted into the honors program  
E) writing a well-written thesis to make one's parents proud

6. Chelsea is a full-time EMT who volunteers an additional 10 hours each week in the emergency room in order to learn how to read EKGs more effectively. She wants to learn as much as possible in order to be a competent EMT. Chelsea's behavior illustrates
- A) intrinsic motivation.
  - B) extrinsic motivation.
  - C) social motivation.
  - D) cognitive motivation.
  - E) vocational motivation.
7. Which of the following is an example of extrinsic motivation?
- A) playing softball in order to get better
  - B) playing softball because it's fun
  - C) playing softball to reach personal goals
  - D) playing softball to try something new
  - E) playing softball so that other kids will like you
8. Jolene is extremely curious about computers, so she spends a lot of time exploring all the different aspects of her software programs. When it comes to learning about computers, Jolene has
- A) extrinsic motivation.
  - B) a performance orientation.
  - C) flow.
  - D) internal attributions.
  - E) intrinsic motivation.
9. Ms. Moore, a middle school teacher, wants to give students more choice and more opportunities for personal responsibility in her class. According to research, what is this likely to increase in the students?
- A) intrinsic motivation
  - B) extrinsic motivation
  - C) external attributions
  - D) performance orientation
  - E) helpless orientation
10. Research has found that giving adolescents more personal choice and responsibility in school leads to
- A) a performance orientation.
  - B) higher achievement.
  - C) a helpless orientation.
  - D) external attributions for success.

- E) lower self-efficacy.
11. Eric's technical education class has to design and build a model house for their project. The teacher gave them basic guidelines but the final product is up to each group of students. According to research, giving students choices about their work
- A) decreases motivation.
  - B) increases anxiety about expectations.
  - C) increases intrinsic interest.
  - D) increases extrinsic motivation.
  - E) has very little effect on their work.

V.

Participant Profile # \_\_\_\_\_

Male \_\_\_\_\_ / Female \_\_\_\_\_

Coping Style: \_\_\_\_\_

Handle Stress Ability: \_\_\_\_\_

Academic Year Level: \_\_\_\_\_

Age Group Number: \_\_\_\_\_

Ingested Food/Drink: \_\_\_\_\_

Type: \_\_\_\_\_

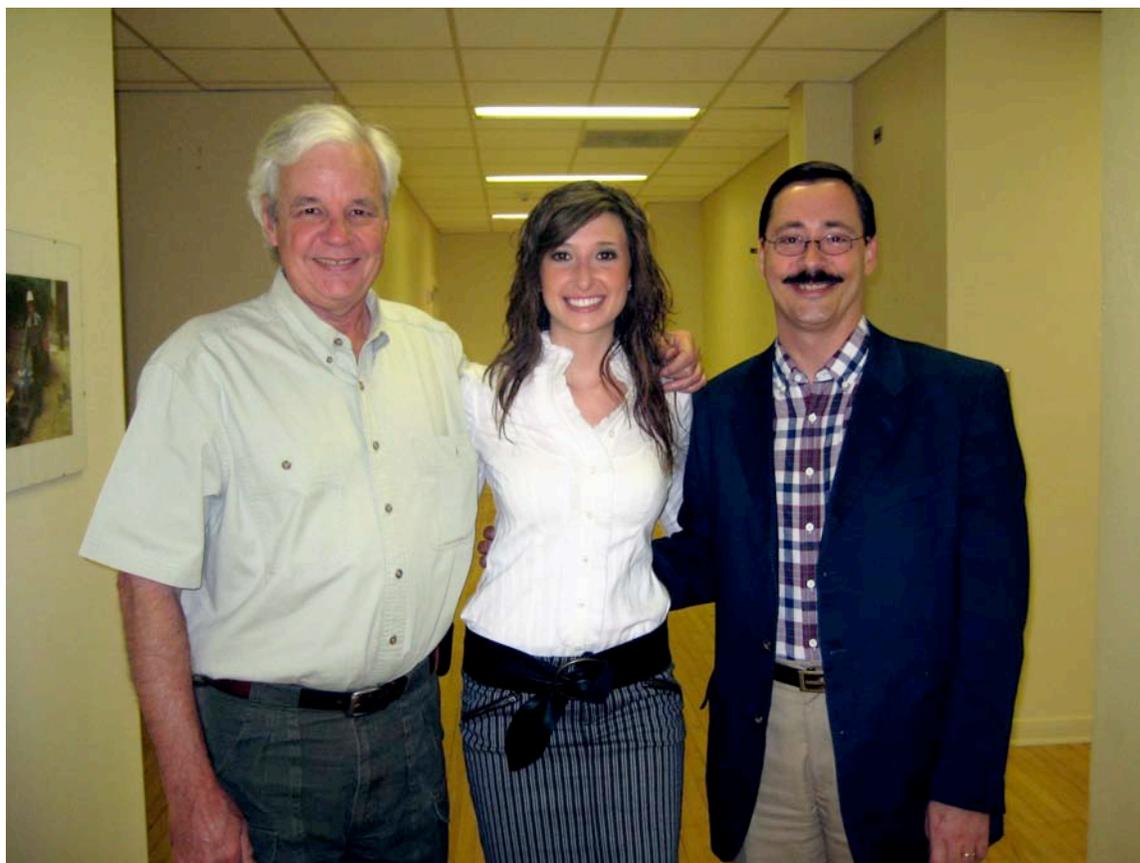
Life Stress Scale Score: \_\_\_\_\_

Memory Passage Score: \_\_\_\_\_ / \_\_\_\_\_ or \_\_\_\_\_

pH Levels → INITIAL: \_\_\_\_\_ FINAL: \_\_\_\_\_



I'd like to especially thank Dr. Randall Osborne and Mr. David Carpenter, my two amazing mentors throughout this study and my undergraduate journey. I have received so much constant support and guidance from them both.



Mr. Carpenter, Lindsay Bira & Dr. Osborne

Honors Thesis Forum Presentation

April 25<sup>th</sup>, 2008