

# **The Effects of Cell Phone Distractions on Cognitive Flexibility**

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Lab 601 Group 12

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April 9, 2015

Key Words: cognitive flexibility, ECG, GSR, heart rate, Stroop test, color, mean arterial pressure (MAP), pulse pressure (PP)

## **Abstract**

The purpose of this experiment was to study the relationship between cognitive flexibility and cell phone anxiety measured by changes in the physiological responses of the human body often triggered by the sympathetic nervous system. 29 participants were randomly assigned to three groups and were monitored while performing a Stroop test, during which two of the test groups experienced distractions and the third group experienced no distraction. Heart rate, blood pressure, and galvanic skin response were recorded throughout the process. It was hypothesized that a measurable sympathetic response would occur in the group of participants who listened to a video soundclip of whispering while taking the Stroop test, and that a similar sympathetic response would occur in the group of participants who experienced vibrating cell phone notifications. The participants that did not experience any distractions were found to have lower final pulse pressures than either of the groups exposed to distractions during the test. Differences in heart rate throughout the duration of the experiment were found to be different between the group that experienced no distraction and the group that experienced cell phone vibrations, as well as between the group that experienced no distraction and the group that listened to a soundclip of whispering. Further experimentation is required to fully determine if there is a physiological relationship between anxiety due to cell phone distractions and cognitive flexibility. This study proposes a potential bridge between purely academic and physiological studies and can serve to direct further study of this increasingly prevalent issue of technology use in academic settings.

## **Introduction**

The ability of humans to multitask, or the capacity to divide attention between multiple tasks simultaneously, serves as a cornerstone of human cognition (Leber, et al. 2008). This type of processing, known as cognitive flexibility, affords humans the capacity to alternate, or switch between several tasks. Despite this adaption of the human mind to perform two functions simultaneously, studies have shown that multitasking decreases human information processing, as our brains are unable to attend to many tasks sufficiently (Junco 2012). Additionally, cognitive processing becomes divided when sequential functions are added, therefore limiting the storage of information in the brain (Naveh-Benjamin, et al. 2000). The advancement of technology over the past 30 years has also contributed to the increased amount of time students are choosing to spend multitasking between technology and education. Therefore, cognitive flexibility has come to play an increasingly more important role in everyday life with the rise of the technological era (Leber, et al. 2008). Prominent examples relative to students attending universities include the use of mobile devices during lecture, while studying, or even while socializing with peers. Students are able to process, encode, and store information completely only when focusing on one task alone with uninterrupted attention. The application of these results to college-specific situations predicts decreased retention of information learned during lectures when students divide their attention between cell phone use and lecture engagement.

With the rise of the digital era, distractions in the form of cell phone notifications, such as text messages, are playing an increasingly large role in the learning process of college students (Tindell and Bohlander, 2011). More attention has been directed toward the use of technological devices, and additionally since the sale of the first cell phone just over 30 years ago. This has an affect on people of all ages, with particular emphasis on college-aged individuals (Massimini and Peterson, 2009). At the university level, it was discovered that 95% of students travel to class

with their cell phones on a daily basis, and 92% of these students use their phones to send text messages during class (Tindell and Bohlander, 2011). Smartphones in particular have increased in popularity over the past 20 years leading to the ongoing challenge to define “normal” cell phone usage. College students were found to spend an average of nine hours daily on their cell phones divided between the use of various aspects of device functionality (Roberts, et al. 2014). The distinction of cell phone addiction becomes harder to define as cell phone usage continues to increase, and undoubtedly will continue to impact the learning atmosphere, and distractibility of students (2014).

College students are presented with the challenge of dividing their attention between cell phone use and their studies on a daily basis. In a 2011 study executed by Rosen et al., students were asked to respond to texts sent out at even intervals during a 30 minute lecture. The students were divided into three groups: low (1-7 texts), moderate (8-15 texts) and high (16 or more texts) messaging. The high messaging group exhibited decreased academic performance, scoring on average one letter grade worse than the low messaging group on a test given post-lecture. Decreased academic performance can also negatively impact the student in terms of increased anxiety. Anxiety has been shown to be associated with increased frequency of texting, which may both indirectly and directly impact academic performance (Lepp et al. 2014). The combination of these factors may lead to an overall lasting impact on the ability of students to learn more effectively, and may make it difficult to sustain from cell phone use for the duration of a class period.

Despite the abundance of published research characterizing cell phone usage and its effects on learning, studies characterizing the direct effects of cell phone use on cognitive function and sympathetic nervous system response are largely absent. The studies do not analyze

effects of cell phones at the physiological level of an individual, but are often based on surveys and/or learning outcomes. This study seeks to remedy this absence through the analysis of physiological consequences due to distractions associated with cell phone notifications in the form of vibrations, and aims to discover how receiving cell phone notifications physiologically impacts the response of the sympathetic nervous system and the ability of an individual to maintain their focus.

Student participants will be subject to perform a Stroop test while galvanic skin response, heart rate, and blood pressure are measured. The Stroop test is often used as a measure of the mental capacity of an individual, as well as the cognitive flexibility through the performance level on tasks that require cognitive processing. The classical Stroop test calls for the participant to indicate the color in which a word is written. When the word and the color are incongruent (e.g. the word red is written in blue ink) two concepts are simultaneously activated in the memory forcing the participant to differentiate between the meaning of the word and the color of the ink used (Flaudias and Llorca 2013). The purpose of using the Stroop test in this study is to induce a sympathetic stress response in participants while they are simultaneously utilizing their cognitive flexibility. We expect to see increased activation of the sympathetic nervous system in the participants who are experiencing cell phone distraction in the form of iMessage vibrations.

## **Materials**

Prior to active participation, students filled out a google survey (Appendix B) and read through and signed a consent form modified from the University of Wisconsin-Madison Department of Physiology (Appendix A). The physiological measurements required several pieces of equipment, including an Omron 10 Plus Series Upper Arm Blood Pressure Monitor

with ComFit Cuff BP791IT (Kyoto, Japan) to measure blood pressure, Pulse Oximeter Model 9843 (Nonin Medical, Inc., Minneapolis, MN) to measure heart rate, and BSL Electrodermal Activity (EDA) Finger Electrode Xdcr SS3LA (BIOPAC Systems, Inc., Aero Camino Goleta, CA) in conjunction with BIOPAC Software (BIOPAC Systems Inc., Model MANBSL4, CA) on a Dell Inspiron 530 computer to measure galvanic skin response. The modified Stroop test was administered using Microsoft PowerPoint 2010 on a MacBook laptop computer.

## **Methods**

The study allowed for participation by students attending the University of Wisconsin-Madison. Participants were asked to fill out a google survey prior to participation regarding their name, age, gender, type of cell phone, cell phone use in academic settings, and most common cell phone notification mode (vibrate, silent, volume) (Appendix B). Students that did not have an iPhone were unable to participate due to limitations in terms of the type of cell phone used by the researchers. Prior to experimentation, all participants were given a consent form to read and sign, which served as permission to use any data collected in our published paper (Appendix A).

29 eligible student participants were randomly assigned to one of our three treatment options using Research Randomizer online software (Urbaniak, G. C., & Plous, S. 2013). Both the positive control (Group C, 10 participants) and the experimental group (Group B, 9 participants) experienced different distractions throughout the experiment, while the negative control (Group A, 10 participants) experienced no distraction. Each participant was individually led into a study room, and was instructed to remain seated at a desk with legs uncrossed to ensure accurate measurements. Additionally, the left arm with the pulse oximeter attached remained facing palm upward. Participants were asked to switch their phones on vibrate and

surrender their phone to the researchers for the duration of the experiment. One of the researcher's iPhones was exchanged with the subject's phone and placed in the top drawer of a metal desk in the experimentation room.

Before beginning the experiment participants from all three groups were told they would be taking a Stroop test, and were instructed to complete the entire test. Additionally, the pulse oximeter, blood pressure cuff, and galvanic skin response were connected to the subject, and initial baseline measurements were taken. Heart rate was recorded every 15 seconds for the duration of the experiment, and galvanic skin response continuously recorded data throughout the experiment. The positive control group listened to a YouTube video of whispering (TheWaterwhispers, 2012), which was played after the baseline portion of the Stroop test (Group C). The experimental group was subject to hear iMessage alerts, which were sent from one of the researcher's computer to the iPhone in the desk every 45 seconds beginning after the baseline measurements. The negative control did not experience any auditory distractions while they were taking the Stroop test. The mean and standard deviation was found for all physiological data collected. ANOVA and Tukey tests were used to further analyze data when appropriate.

The Stroop test used in this study was adapted by combining aspects of the original Stroop test as well as the Victoria version. The original version of the Stroop Test consisted of four parts (Stroop 1935). In the first part, the subjects had to read the names of colors written in black ink. In the second part, they read the names of colors written in colored ink, with no correlation between the name written and the color of the ink. In the third part, they had to say the name of the color of squares. Finally, in the fourth part, the same stimuli were presented as in the second part, but the subjects had to say the color of the ink with which the words had been written, disregarding the actual words.

The Victoria version (Regard 1984) of the Stroop test has three parts. In the first part, names of colors are presented written in black ink; in the second part, colored circles (red, blue, yellow, green); and, in the last part, written words (names of colors) printed in colored ink, without any correlation between the color of the ink and the written word. In the first step, the subject must read the words as quickly as possible. In the second and third steps, the subject must say the color of the circles and printed words, respectively. The Stroop test used in this experiment consists of two parts similar to that of the Victoria version of the test. In the first part, subjects will say the written word (names of colors) presented. In the second part, the subject will say the color of the presented series of X's or the written word, regardless of what the word says. The stimuli will be presented in a timed succession.

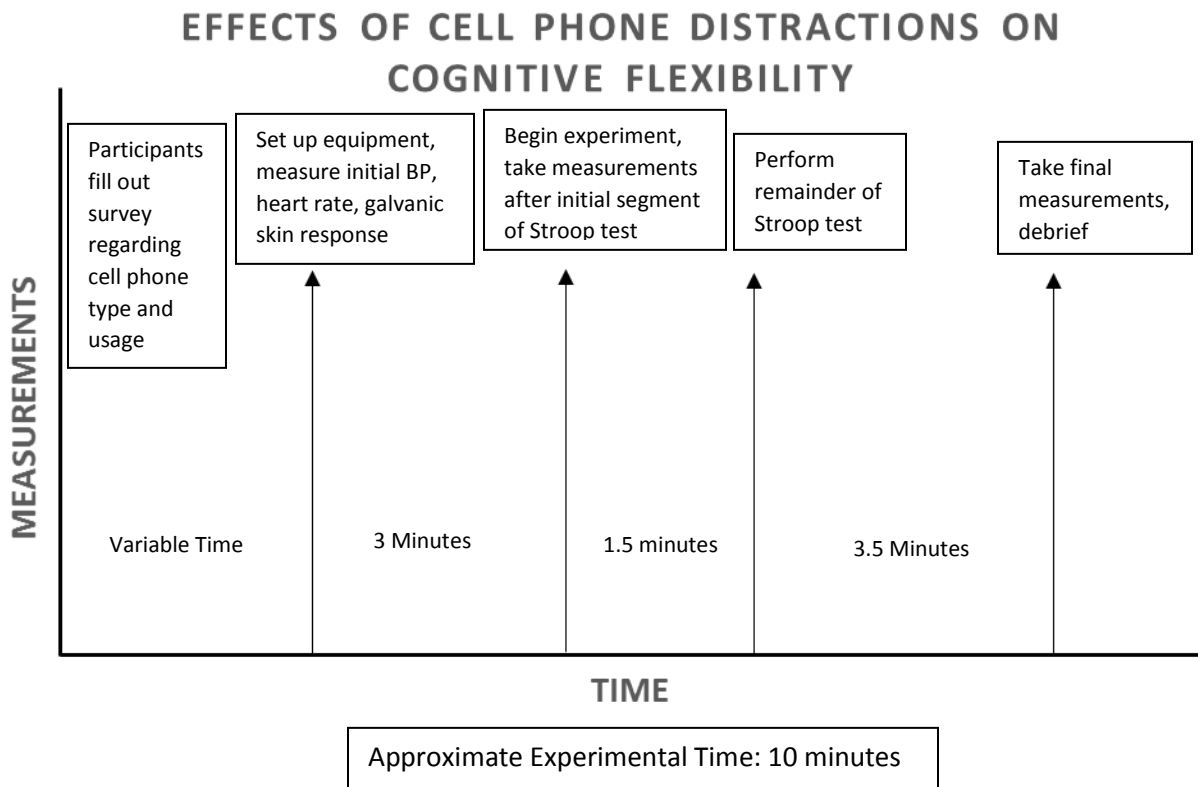


Figure 1. Representation of experimental timeline for each participant.



## Results

To analyze blood pressure measurements, systolic and diastolic pressures were used to find pulse pressure and mean arterial pressure (Figure 2, Figure 3). These values were chosen for analysis founded on the knowledge that analysis of systolic and diastolic pressure alone should not be performed, and that interpretation should focus on pulse pressure and mean arterial pressure (Levitzky and Raff 2011). Pulse pressure represents the force generated by the heart during each contraction, and can be calculated as the difference between the systolic and diastolic pressure readings. Group A participants averaged an initial pulse of pressure of  $31.0 \pm 4.6$  mmHg, a post-baseline pulse pressure of  $35.6 \pm 11.3$  mmHg and a final pulse pressure of  $30.5$  mmHg. Participants in group B had an initial pulse pressure of  $42.3 \pm 17.1$  mmHg, followed by  $34.3 \pm 8.9$  mmHg after the baseline and  $44.3 \pm 14.7$  mmHg at the end of the experiment. Analysis of group C participants revealed an average pulse pressure of  $36.5 \pm 10.0$  mmHg initially,  $37.2 \pm 10.6$  mmHg after the baseline and  $40.3 \pm 10.6$  mmHg after the administration of the Stroop test. Statistical analysis by the use of a Tukey significant difference test did not show any significant differences between the initial, post-baseline and final pulse pressures for any of the groups (Table 1). However, the analysis did show that the differences between the final pulse pressures were significantly different among the three treatment groups ( $p=0.032$ ).

Mean arterial pressure (MAP) represents the average arterial pressure during a cardiac cycle, and was estimated using the diastolic pressure +  $\frac{1}{3}$  pulse pressure (Levitzky and Raff 2011), and the values were assessed and statistically analyzed. Analysis revealed that group A

had an average initial pressure of  $87.3 \pm 4.7$  mmHg, a post-baseline pressure of  $88.6 \pm 8.5$  mmHg, and a final pressure of  $85.7 \pm 7.3$  mmHg. Assessment of group B revealed an average initial MAP of  $89.2 \pm 5.2$  mmHg, a post-baseline MAP of  $91.4 \pm 6.1$  mmHg, and a final MAP of  $89.6 \pm 5.3$  mmHg. Group C participants were found to have an average initial pressure of  $89.0 \pm 7.7$  mmHg, a post-baseline pressure of  $90.0 \pm 7.6$  mmHg, and a final pressure of  $87.7 \pm 8.1$  mmHg. Although none of our values were statistically significant by the use of a Tukey significant difference test (Table 2).

Galvanic skin response measurements recorded throughout the entire duration of the experiment were analyzed with regards to their average values, range of values during the duration of the experiment, and the difference between initial and final readings recorded by the equipment (Figure 4). Mean values included  $6.85 \pm 4.60$   $\mu$ S for group A,  $6.72 \pm 4.54$   $\mu$ S for group B and  $4.1 \pm 2.4$   $\mu$ S for group C. The mean of the range of values for group A was  $2.95 \pm 2.48$   $\mu$ S,  $1.84 \pm 1.86$   $\mu$ S for group B, and  $1.70 \pm 0.93$   $\mu$ S for group C. Group A analysis comparing the initial and final values averaged  $0.13 \pm 2.92$   $\mu$ S, while group B averaged  $0.69 \pm 1.24$   $\mu$ S and group C averaged  $0.65 \pm 0.78$   $\mu$ S. ANOVA analysis did not reveal any p values below 0.05, and therefore imply that there is a lack of statistical evidence to suggest the GSR means, GSR ranges, or GSR differences are significant (Table 3).

The final physiological parameter measured and analyzed was heart rate (Figure 5). Although data was collected every fifteen seconds, four main time points were used for analysis: once for the baseline (Time point zero to 1:15 minutes), and three time points corresponding to the estimated time of texts sent and heard by the participants (2:30, 3:15 and 4:00 minutes). The mean for group A during the baseline was  $71.0 \pm 5.1$  beats/minute, while the mean for groups B and C were  $75.5 \pm 11.4$  beats/minute and  $73.1 \pm 10.2$  beats/minute, respectively. The mean

values at the approximate time in which the first text was sent was  $80.4 \pm 9.5$  beats/minute for group A,  $75.6 \pm 12.9$  beats/minute for group B, and  $77.1 \pm 12.8$  beats/minute for group C. At the time of the second text, group A participants had a mean heart rate of  $77.9 \pm 9.4$  beats/minute, group B participants had an average heart rate of  $78.0 \pm 14.5$  beats/minute, and group C participants had a mean heart rate of  $76.8 \pm 13.2$  beats/minute. At the final time point, the mean heart rate for participants in group A was  $77.4 \pm 9.4$  beats/minutes, the mean heart rate for group B was  $78.0 \pm 18.7$  beats/minute, and for group C was  $73.3 \pm 8.5$  beats/minute. Further statistical analysis in the form of a blocked ANOVA revealed a statistically significant difference among the treatment groups, and that the effect of the treatment is significant when observing the differences in heart rate, but not between the times that the texts were sent (Table 4). A follow-up Tukey multiple comparison test of means test suggests that the significant differences occur between treatment groups A and B and A and C ( $p=0.0018, 0.0022, 0.0399$  where  $p < 0.05$ ), and that these results are not due to random chance.

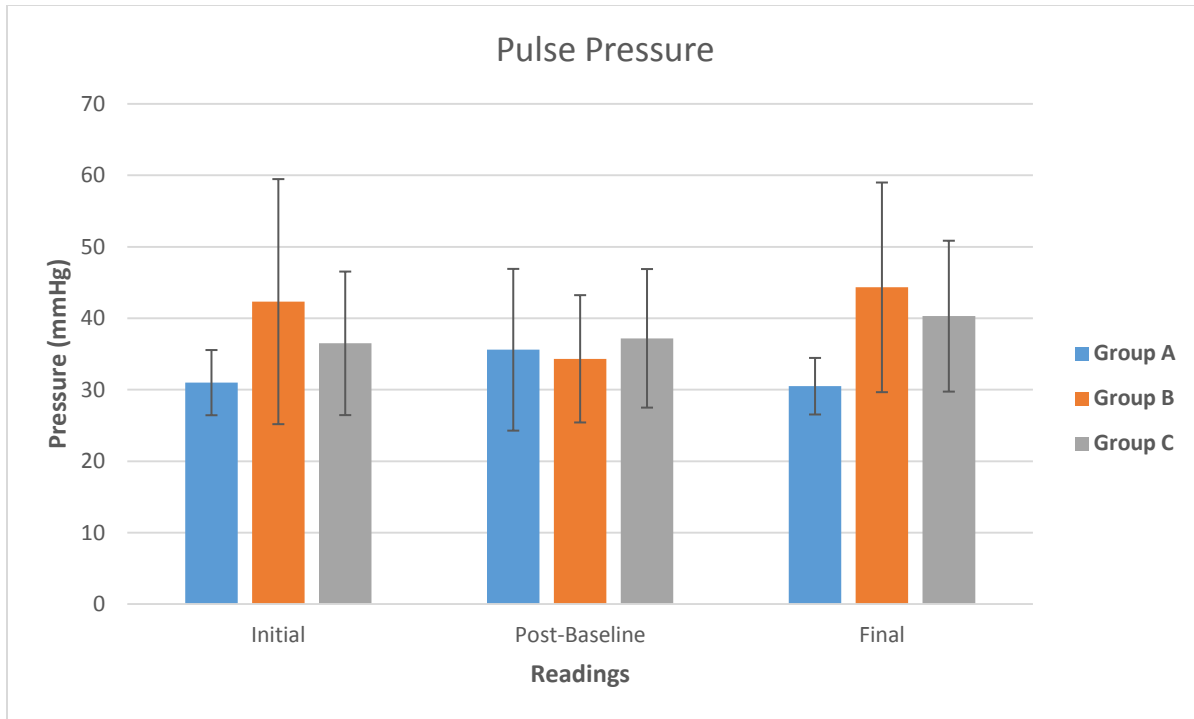


Figure 2. Pulse pressure values obtained from the difference between systolic and diastolic pressures taken at three times throughout the duration of the experiment for the three treatment groups.

Group Means	Initial	Post	Final	ANOVA p-values
A	31.0	35.6	30.5	0.290
B	42.3	34.3	44.3	0.336
C	36.5	37.2	40.3	0.701
ANOVA p-values	0.149	0.841	<b>0.032</b>	

Table 1. ANOVA P values comparing calculated values of pulse pressure among the three experimental groups at initial, post-baseline and final time points.

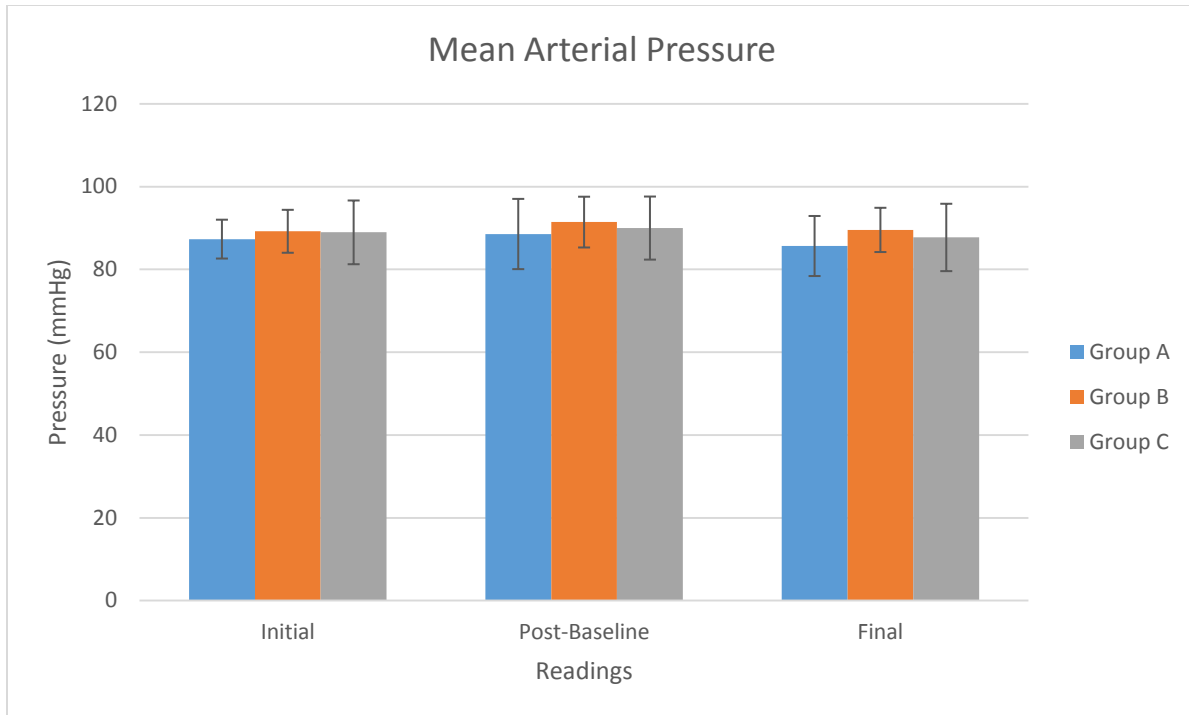


Figure 3. Mean arterial pressure values estimated as the sum of diastolic pressure plus one third of the pulse pressure measured at three times throughout the duration of the experiment for the three treatment groups.

Group means	Initial	Post	Final	ANOVA p-values
A	87.3	88.6	85.7	0.681
B	89.2	91.4	89.6	0.694
C	89.0	90.0	87.7	0.829
ANOVA p-values	0.779	0.735	0.532	

Table 2. ANOVA P values comparing calculated values of mean arterial pressure among the three experimental groups at initial, post-baseline and final time points.

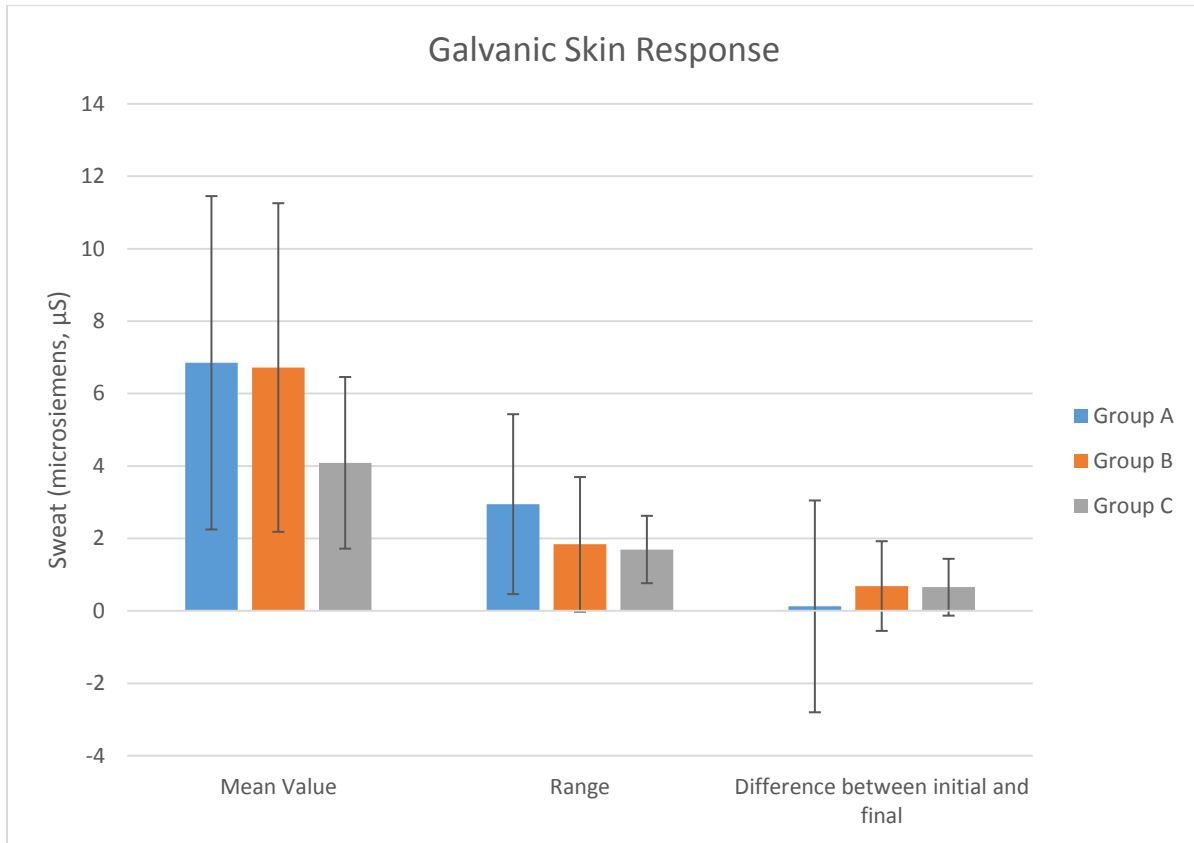


Figure 4. Galvanic skin response values measured as a mean value, range over the course of experimentation and difference between initial and final values.

Group Averages	Mean value	Range	Difference between Initial and Final
ANOVA p-value	0.300	0.371	0.803

Table 3. ANOVA P values comparing the three experimental groups' mean values, ranges and differences between initial and final readings measuring galvanic skin response.

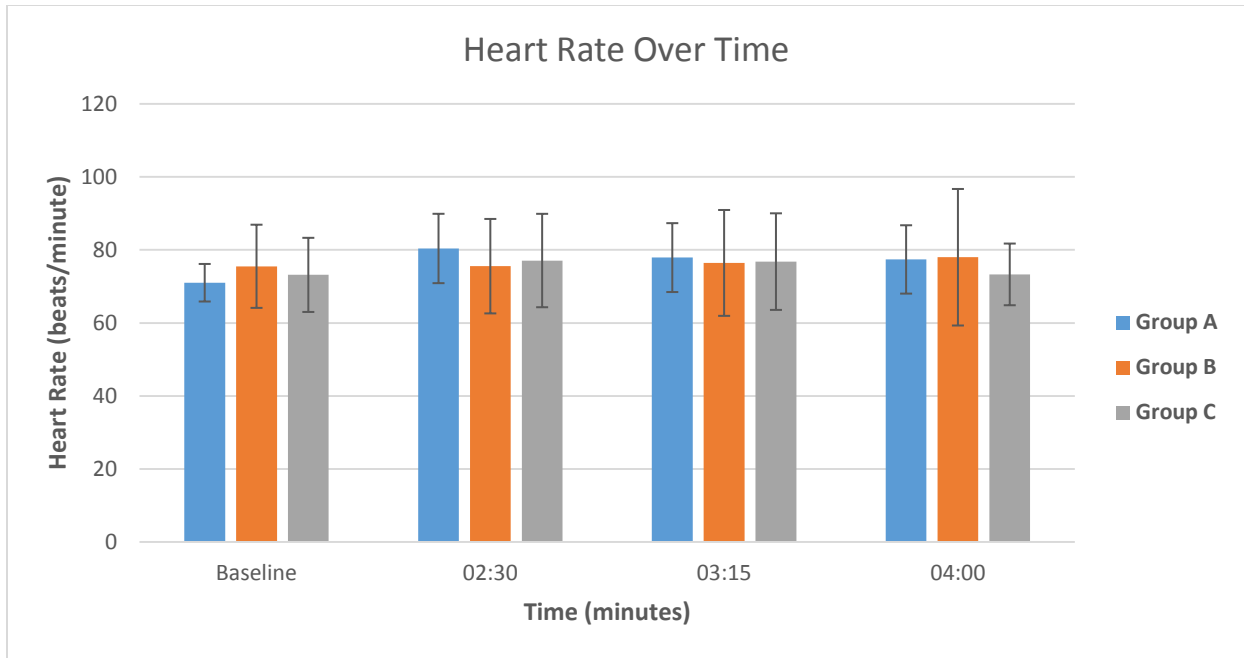


Figure 5. Heart rate gathered as a baseline, and at the approximate time period in which each text message was sent. The baseline results were averaged over the course of the first 1:15 minutes of the experiment.

ANOVA Values	Initial p- value	Post-Baseline p-value	Final p- value
Group A	<b>0.0018</b>	<b>0.0022</b>	<b>0.0399</b>
Group B	0.9085	0.7698	0.9858
Group C	0.0633	0.2594	0.9532

Table 4. P values gathered from blocked ANOVA testing for comparing the treatment groups at the first, second and third text times.

## Discussion

Study participants performed well on the Stroop test with the overwhelming number of participants performing with 100% accuracy, and therefore this data was not analyzed. Reaction time could not be accurately recorded due to the use of PowerPoint, coupled with the inability to locate an affordable online Stroop test that would allow for the collection of significant data

points. Other computerized versions of the Stroop test, such as the Cengage Learning CogLab's Stroop test, include a reaction time from when the stimulus is presented to when the participant responds, and/or a response by pressing the corresponding key on the keyboard for their answer, rather than saying the color aloud. In the future, these two factors may provide more insight in our study, as we would expect those who were in the B and C groups to have a longer response time as well as more inaccuracy when compared compared to group A.

The environment of the testing room likely played a large role in the data collection process. The testing room itself was surrounded by other testing rooms and also provided limited cell phone service, which are two factors that may have significantly affected our data collection. The testing room was located near other rooms where experiments were being conducted. Several times throughout the experiment, there were unintentional disruptions such as other groups conversing, people knocking, and individuals entering the room during a test. The room was also located in a place where the experimenters had limited cell phone reception. This resulted in times in which there was a delay in sending text messages, or even times in which the messages were not able to be sent at all, which prevented accurate testing of the participants. Future experimentation should seek to incorporate a location in which cell phone service is readily available, and that is quiet enough to allow for differentiation between the control and distraction groups.

### *Blood Pressure*

Based on our results, there was no statistically significant difference between the initial, post-baseline, and final blood pressure readings. From Figures 2 and 3, it can be inferred that systolic and diastolic blood pressure remained relatively constant after the initial reading. Blood pressure rises and falls throughout the day, and is affected by what you eat, how much you sleep,



how much you are moving and the level of stress you feel. We expected that the distractions experienced by groups B and C would partially raise the third blood pressure reading, as compared to group A. This was not evident in our data when comparing individual systolic and diastolic pressures. There could be two reasons for this: either the participants were concentrating on the Stroop test and not bothered by the distractions or that the study was too short in duration to see a significant change in blood pressure.

After reviewing the blood pressure data, we found that it would be more meaningful to analyze the pulse pressure, the pressure difference between the systolic and diastolic readings. When compared between the experimental and control groups, there was not much of a difference in pulse pressure before and after the baseline Stroop test. However, compared to group A the final pulse pressure of groups B and C were significantly higher. For a healthy person, the pulse pressure is around 40 mmHg. Group A was lower, group C was similar to that number, and group B was slightly higher than that average number. While the data is not statistically significant, an improved experimental design may be able to verify these observed results.

### *Galvanic Skin Response*

From Figure 5, the finger sweat accumulated between the initial and final reading was very low across all groups. In conjunction with heart rate and blood pressure, the participants did not indicate that they felt any anxiety from the distractions presented to groups B and C. Therefore, they did not accumulate any significant amount of sweat after the initial reading. The time frame between the initial reading and the end of the Stroop test averaged only about 5 minutes per test, and this may be an inadequate time frame to observe any appreciable difference in the GSR to distractions.

### *Heart Rate*

In Figure 6, the heart rate was recorded at the baseline and the estimated times at which the first, second, and third text messages received by group B. The ANOVA analysis showed that there was a statistically significant difference in heart rate between the initial baseline reading compared to the fourth reading (third text message received) over time, but not in-between the time the texts were sent (Table 3). Among all groups, the average heart rate increased 30 seconds after the baseline, after the actual Stroop test began. By the end of the test, their average heart rate had nearly returned to the baseline reading. This data suggests that the participants felt some anxiety from the change in colored X's to congruent and incongruent color words. After they accustomed to the Stroop test, they no longer felt anxiety and their heart rates returned to normal. Additionally, although the heart rate showed statistically significant differences in the heart rate over time, it did not indicate that the participants' heart rates increased because they were distracted by the cell phone vibrations or whispering. Therefore, for the purposes of this study the heart rate data was also statistically insignificant.

Overall, the differences in the data collected for blood pressure and GSR were statistically insignificant. The ANOVA analysis for heart rate showed some statistical significance for a change in heart rate over time among the groups, however, it did not show a difference after the texts were sent successively in the experimental group. We hypothesized that cell phone distractions in the form of vibrations would cause a sympathetic response to occur in participants our experimental group similar to that of our positive control group who received the whispering distraction. The data analysis for blood pressure, GSR, and heart rate, did not reinforce our hypothesis, showing no statistical significant differences between the experimental and control groups.

For future experiments, there are numerous adjustments that could be taken into consideration to improve accuracy and assist in determining if a relationship exists between cell phone vibrations and an increased sympathetic response. First, the environment should be in an area free of disruptions and have sufficient cell phone reception to ensure that outside interruptions could not influence testing. Secondly, a computerized Stroop test could be used to record reaction time and accuracy of key responses. Reaction time and accuracy could provide some insight on anxiety caused by cell phone distractions. We would expect that the experimental group with the cell phone distractions and the positive control group would be distracted causing a longer reaction time and more inaccurate responses. Thirdly, the survey given to the participants before the experiment could be analyzed and connected to our physiological data (Appendix B). This survey could provide useful information by comparing the three participant groups and their response for the number of times they check their cell phones while studying, or during lecture. We would predict that students who check their phones at a higher frequency would experience more anxiety when exposed to a cell phone vibration. Also, the survey could provide useful information by comparing the mode of notification (silent, vibrate, loud) participants keep their cell phones on with the response that was experienced to a cell phone vibration. It would be expected that the participants who keep their cell phones on vibrate would experience a greater sympathetic response than the participants who keep their phones on other modes.

It is important to mention that regardless of the type of Stroop test utilized, the duration of the test should be extended. More time could provide some implications for physiological responses that take time to occur. In a 2014 study by Cheever et. al, participants were split into a control group where users were allowed to keep their cell phones on silent and placed out of

sight and an experimental group where their cell phones were taken away from them. The State/Trait Anxiety Inventory was administered three times, twenty minutes apart from each time. Their study implicated that heavy cell phone users and moderate cell phone users whose phones were taken away felt more anxiety as each successive test was measured, due to their dependency of their cell phones. This suggests that five minutes was not a sufficient amount of time for frequent cell phone users to feel anxiety, and that this time should be extended to see if it invokes a sympathetic response in participants.

We could also take a different route and use a different form of cognitive testing, such as a format where participants read a passage and answer questions regarding that passage. The Stroop test may have been too simple of a test, considering the 29 participants had almost 100% accuracy overall. In a study by End et al., experimenters had participants take notes during a video presentation and later take a multiple choice test. They had two groups, the control where there were no cell phone rings and an experimental group that received cell phone rings. They found that the group that received cell phone rings performed significantly worse than the control group, with an average of 69% accuracy compared to 95% for the control group. This further reinforces our notion that a different form of testing should be utilized to assess cell phone distractions on cognitive flexibility.

A final consideration would be the type of physiological parameters chosen to measure sympathetic responses. Future experimentation could employ an electroencephalogram (EEG) as one of our physiological parameters. The EEG was discontinued from use in this study due to an inability to obtain adequate data using the Biopac equipment. An EEG displays electrical activity in response to a stimulus and could show changes in brain waves when presented with distractions. Additionally, activation of a sympathetic response could have been measured by

using the Respiratory Cycle I Biopac System. According to the Biopac Systems lab manual, “the Respiratory Cycle I is used to measure chest expansion and contraction and modifications in the rate and depth of the breathing cycle due to cerebral influence and chemoreceptor influence on the medullary control centers” (Kremer, P-1). We would predict that with an increased sympathetic response due to cell phone anxiety, the subjects would experience an increased respiration rate, while the depth of their breathing cycle would decrease. Overall, this experiment presents a layout in which future experiments can abstract and modify to obtain better data in hopes of proving the given hypothesis.

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## **Appendix A**

### **UNIVERSITY OF WISCONSIN-MADISON**

#### **Research Participant Information and Consent Form**

**Title of the Study:** Physiological Response to Stroop Test

**Principal Investigators:** Lina Nguyen, Clayton Rowe, Stephanie Rosicki, Haley Schoenberger

#### **DESCRIPTION OF THE RESEARCH**

You are invited to participate in a research study about cognitive flexibility.

You have been asked to participate because you are a student enrolled at UW-Madison.

The purpose of the research is to test the physiological responses to a Stroop test by measuring several physiological parameters, including heart rate, blood pressure and galvanic skin response.

This study will invite the participation of all students enrolled at UW-Madison.

This research will take place within Physiology 435 laboratory sections.

#### **WHAT WILL MY PARTICIPATION INVOLVE?**

If you decide to participate in this research you will be asked to perform a Stroop test.

Your participation will last approximately 15 minutes.

After the semester is completed, our results will be published in an online journal where you will have the option to view our results.

No credit will be assigned for your complete and voluntary participation. If you do not wish to participate, simply return this blank consent form.

#### **ARE THERE ANY RISKS TO ME?**

There are no known risks associated with your participation.

#### **ARE THERE ANY BENEFITS TO ME?**

There are no known benefits associated with your participation.

#### **HOW WILL MY CONFIDENTIALITY BE PROTECTED?**

While there may be printed reports as a result of this study, your name will not be used. Only group characteristics will be reported – that is results with no identifying information about individuals will be used in any reported or publicly presented work.

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**WHOM SHOULD I CONTACT IF I HAVE QUESTIONS?**

Haley Schoenberger, hschoenberge@wisc.edu

If you are not satisfied with response of research team, have more questions, or want to talk with someone about your rights as a research participant, you should contact Dr. Andrew Lokuta, 608-263-7488, ajlokuta@wisc.edu.

Your participation is completely voluntary. If you decide not to participate or to withdraw from the study it will have no effect on your grade in this class.

Your signature indicates that you have read this consent form, had an opportunity to ask any questions about your participation in this research and voluntarily consent to participate.

Name of Participant (please print): \_\_\_\_\_

---

Signature

---

Date



## Appendix B

### Physiology 435 Pre-Study Participation Survey

\* Required

Name (First and Last) \*

What is your gender? \*

What is your age? \*

What is your lab day and time? \*

- Tuesdays 8:50AM-11:50AM
- Tuesdays 1:20PM-4:20PM
- Wednesdays 1:20PM-4:20PM
- Not applicable

What is your group number? \*

If not enrolled in Physiology 435, write N/A.

What kind of phone do you have? \*

Note: Only iPhone users are eligible to participate in this study.

- iPhone
- Other Android
- Non smartphone

On average, how often do you check your phone during a class period? \*

- Once
- 2-3 times
- 4 or more times
- Not at all.

On average, how often do you check your phone while studying? \*

- Once
- 2-3 times
- 4 or more times
- Not at all

How long have you owned your current phone? \*

- Less than three months
- Less than six months
- Less than one year
- More than one year

What mode is your phone usually on? \*

- Vibrate
- Silent
- Volume