Physiological Anxiety Responses with Cell Phone Separation and Subsequent Contact

Alexa DeBoth, Jackelyn Meyer, Natalie Trueman, Anjoli Zejdlik,

Physiology 435, Lab 601, Group 14

University of Wisconsin School of Medicine and Public Health

Department of Physiology

Key Words: Anxiety, Cell Phone, ECG, EDA, GSR, Respiration, Stress

Abstract

Past research has shown that people separated from their cell phones exhibit physiological responses related to anxiety. These responses include an increase in the release of stress hormones leading to an increase in heart rate, perspiration, and respiration rate. Because of the strong attachment young American adults have to their cell phones, the researchers hypothesized participants would show signs of anxiety when separated from their phones. To test this, twenty participants completed a word search once with their phone in their possession, and another when their phone was out of their reach. During the latter condition, an experimenter anonymously contacted the subject first by text and then by phone call. Heart rate, respiration rate, and galvanic skin response measurements were taken continuously throughout both conditions. The results obtained indicate that the only significant response supporting the researchers' hypothesis was the skin response data. The data obtained regarding heart rate and respiration rate was not sufficient to prove that there was a measurable physiological response to being separated from one's phone.

Introduction

In the United States, 98% of young adults ages 18 to 29 own cellular phones and use them for multiple purposes (Pew Research Center Internet Project Survey, 2014). Americans aged 18-24 send an average of 109.5 text messages per day, or about 3,200 texts each month, while also checking their cell phones 60 times a day (Pew Research Center, 2015). In addition to simply calling and texting, the use of social technology on cell phones has become a primary source of information access, social interaction, and personal safety for a majority of young adults (Aoki & Downes, 2003). As a result of a growing reliance on mobile phones, many people have formed an emotional attachment with their mobile device (Vincent, 2006, Clayton et al., 2015).

Furthermore, a cell phone user's relative emotional attachment level is correlated to increased levels of anxiety when the phone is absent (Vincent, 2006). Sixty-seven percent of cell phone users check their phone for messages, alerts, or calls even when they do not notice their phone ringing or vibrating (Pew Research Center, 2015). In recent studies, a participant's separation from their cell phone corresponded to physiological anxiety responses to varying degrees. These responses included an increase in the release of stress hormones, such as

adrenaline and cortisol, as well as the activation of the sympathetic nervous system (Clayton *et al.*, 2015). The measurable physiological effects of this response included an increase in heart rate, respiration rate, perspiration and blood pressure until the stressor was removed. Once participants were no longer separated from their cell phones, the elevated responses returned to a value within a normal range (Christenson, *et al*., 2012, Clayton *et al.*, 2015).

Even casual cell phone users may experience increased anxiety levels as a result of the perceived obligation to remain constantly connected with others (Lepp *et al.*, 2014). In a study done by Clayton, *et al.* (2015), 40 undergraduate students were separated from their cell phones and contacted while completing a cognitive task. The study found that cell phone separation lead to greater physiological anxiety, measured by increases in blood pressure levels and an increase in heart rate (Clayton *et al.*, 2015). In a two-week study of 21 college-aged students whose cell phone use was restricted, there was an increase in the overall state of anxiety for roughly one third of participants (Durocher, *et al.*, 2012). Additionally, a study done on 22 undergraduates at the University of Wisconsin-Madison found modest evidence for the onset of an acute anxiety response in participants upon separation from their cell phone (Christenson, *et al*., 2012).

These previous cell phone attachment studies show altered physiological responses upon the removal of participants' cell phones. The research done by Christenson *et al.* (2012) found no heart rate response due to cell phone separation, but blood pressure and galvanic skin response (GSR) rose slightly during the experimental test period. However, the researchers took discrete physiological measurements during test periods and did not attempt to reinforce participants' feelings of separation. Our study methods included continuous physiological measurements of heart rate, respiration rate, and galvanic skin response in both control and experimental conditions to expand on Christenson *et al.*'s previous research. Additionally, researchers in our

study contacted participants while their phones were not in their possession in order to reinforce the sense of separation from their cell phone. Participants were asked to complete one word search with their phone in their possession and another while separated from their phone during which time we contacted their cell phone twice. We hypothesized that participants' separation from their phone would be correlated with an increase in heart rate, respiration rate and GSR at the time that they were contacted by researchers. We also hypothesized that each participant would perform similarly on each word search and participants' performance on the word searches would be similar across control and experimental groups.

Materials

In this study we assessed physiological responses correlated to increased levels of anxiety using the Biopac Student Laboratory System complete with its necessary software. To collect this data, we measured heart rate, respiration rate, and galvanic skin response (GSR) according to the Biopac Manual. We used electrocardiogram (ECG) technology in the form of the BSL TP Electrode Lead Adapter *SS1LA* adapter to measure heart rate. The ECG required the use of electrodes and the application of Electrode Gel, 227g tube and *Gel 100* between the electrode and the skin. The BSL Respiratory Effort Xdcr *SS5LB* attachment measured participants' respiration rates. Finally, we utilized Biopac's BSL EDA Finger Electrode Xdcr *SS3LA* to measure GSR. This adapter required Isotonic Recording Electrode, Gel *101*.

Methods

Before testing the negative and experimental groups, we tested a group of students' heart rate, respiration rate, and skin response before and after a short period of physical activity. The resting rates of all three of these measurements proved to be lower than the values measured after the period of short physical activity. This served as our positive control to demonstrate that

changes in our three measured physiological conditions (heart rate, respiration rate, and skin response) were attainable.

Each of our twenty participants completed both the negative control condition and the experimental condition. A fair coin flip determined which condition participants completed first. Another flip of the coin decided which of the two word searches would be used first. Participants remained blind to the test conditions. Throughout the negative control and experimental condition, participants were attached to the Biopac respiration, GSR, and ECG monitors. During the negative control, the participant's phone remained in their possession and the experimenters did not draw attention to it as the participant completed one of the two randomized word searches for five minutes. At the beginning of the five-minute interval, all three of the Biopac monitors (ECG, respiration, and GSR) began recording and ran continuously for the entirety of the interval. After five minutes, measurements ceased and the participant was asked to stop working on the word search. A visual representation of our experiments is included in **Figure 1.** Throughout the five-minute interval, one researcher took notes on abnormalities in our data, noting when participants found a word, talked, or was otherwise distracted.

The experimental procedure was identical to the negative control procedure. However in the experimental condition, before beginning their word search, participants were asked to turn their cell phone volume on high so the ring would be audible when researchers contacted their phone. The phone was then placed screen up on the table in front of them so that the participant could see the phone but it was out of their reach. They were then asked to complete the second randomized word search of equal difficulty for five minutes. Measurements of heart rate, respiration rate, and skin response began simultaneously recording again as the participant started the word search. The measurements were taken continuously for the five-minute

experimental condition. At 60 seconds an experimenter sent a text message to the participant from a foreign number and at 180 seconds the experimenter called the participant for a duration of ten seconds. Both methods of contact were audible to the participant. One experimenter took notes on the time when the phone was contacted, if texts were received by outside parties, and other disruptions. The researchers then disconnected participants from the monitors and asked participants to complete an exit survey regarding the participant's cell phone usage to gain further perspective into our recorded data.

The researchers collected data using Biopac software of heart rate, respiration rate, and GSR data. To collect heart rate we used BPM (beats per minute). We averaged the BPM of the five beats before the stimulus (text or call) and the five beats immediately following the stimulus of the experimental data. We then found and averaged the corresponding time intervals in the control data of the same participant and collected five beats before and after the time interval corresponding to that of the experimental run. To acquire the respiration rate data (also measured in BPM) for the experimental condition, five full cycles (breaths) were recorded before the time of the stimulus as well as five full cycles after the stimulus. The five cycles before and the five cycles after the same time point for the same participant were measured in the control condition and averaged. For the experimental GSR data we averaged three, two-second intervals (measured in micro Siemen) before and after the stimulus. In the control condition we used the same three time points and averaged the two-second intervals before and after the time of stimulus.

Researchers then compiled experimental and control data into a spreadsheet for statistical analysis. We began by making individual comparisons of Before Text v. After Text data and Before Call v. After Call data for heart rate, respiration rate and skin conductance in order to determine the mean difference in values surrounding the time of contact. We calculated the mean

difference by taking the average physiological value of a six second time interval after the time of contact (text or call) and then subtracting the average value of a six second time interval before the time of contact. Additionally, we determined the mean differences for Before Text v. After Text data versus Before Call v. After Call data in order to examine differences in responses for a Text versus a Call in heart rate, respiration rate, and skin conductance. We then performed a third analysis on data of self-reported high and low cell phone attachment and the mean differences found in the Before Text v. After Text data and Before Call v. After Call data. The goal was to determine a correlation coefficient between participants who reported higher phone attachment scores and this change in mean difference for the data. Lastly, we investigated participant performance on the randomized crosswords to determine if correlations on crossword performance or experimental error existed.

Results

Heart Rate

In the control group, the mean difference in heart rate for Before Text v. After Text was an increase of 2.67 BPM with a statistically insignificant p value of 0.0571. The mean difference in heart rate for Before Call v. After Call was an increase of 0.21 BPM with an insignificant p value of 0.4119. In the experimental group, the mean difference for heart rate measured in beats per minute (BPM) for the Before Text v. After Text was a decrease of 1.02 BPM with a statistically insignificant p value of 0.2022. The mean difference in heart rate for Before Call v. After Call was a decrease of 0.57 BPM with a statistically insignificant p value of 0.3595 (**Figure 2**). In a comparison of the mean differences for Before Text v. After Text to those mean differences for Before Call v. After Call we found statistically insignificant p values, 0.0833 and 0.3934, for the control and experimental groups respectively (**Table 2)**.

Respiration Rate

In the control group, the mean difference increase in respiration rate for Before Text v. After Text was an increase of 0.41 BPM, with a statistically insignificant p value of 0.3408. The mean difference in respiration rate for Before Call v. After Call was a decrease of 0.47 BPM, with a statistically insignificant p value of 0.2310. In the experimental group, the mean difference for respiration rate, measured in breaths per minute (BPM), was an increase of 2.52 BPM for Before Text v. After Text with a statistically insignificant p value of 0.0571. The mean difference in respiration rate for Before Call v. After Call was an increase of 0.21 BPM with a statistically insignificant p value of 0.4119 (**Figure 3**). The comparison of mean differences for Before Text v. After Text to those for Before Call v. After Call found statistically insignificant p values of 0.3807 and 0.0577 for the control and experimental groups respectively (**Table 2**).

Galvanic Skin Response

In the control group, the mean difference in skin conductance, measured in micro Siemens, for Before Text v. After Text was a decrease of 0.05 μS, with an insignificant p value of 0.1216. The mean difference in skin conductance for Before Call v. After Call was an increase of 0.05 μS, with a statistically insignificant p value of 0.1343. In the experimental group, the mean difference for skin conductance, measured in micro Siemens (μS), was an increase of 0.47 μS for Before Text v. After Text with a statistically significant p value of 0.000. The mean difference in skin conductance for Before Call v. After Call was an increase of 0.74 μS with a statistically significant p value of 0.0005 (**Figure 4**). These results in comparison to the mean differences found for heart rate and respiration rate can be viewed in **Table 1**.The comparison between mean differences of Before Text v. After Text and Before Call v. After Call found a statistically significant p value of 0.0500 for the control group but a statistically insignificant p

value of 0.0754 for the experimental group. A summary of the comparisons between the mean differences of Before Text v. After Text and Before Call v. After Call for heart rate, respiration rate and skin conductance is shown in **Table 2**.

Cell Phone Attachment

Researchers then explored correlations between self-reported phone attachment and differences in measurements of Before Text v. After Text and Before Call v. After Call in the experimental data. We investigated this data to determine if having a high cell phone attachment was correlated to a greater change in physiological mean differences in Before Text v. After Text and Before Call v. After Call. Self-reported phone attachment is exhibited in **Figure 5**. In the case of correlation, the closer to 1 or -1 the coefficient was, the stronger the relationship. A coefficient greater than 0.4 or less than -0.4 meant there was evidence a relationship existed. The correlation coefficient for heart rate was -0.228 for Before Text v. After Text and -0.135 for Before Call v. After Call. The correlation coefficient for skin conductance was 0.329 for Before Text v. After Text and 0.438 for Before Call v. After Call. The correlation coefficient for respiration rate was -0.009 for Before Text v. After Text and 0.149 for Before Call v After Call. The correlation coefficient of Before Call v. After Call for skin conductance was the only value that demonstrated evidence of a significant relationship between people with higher phone attachment scores and the mean difference. The correlation coefficient was 0.438 for Before Call v. After Call, the Before Text v. After Text again had an insignificant correlation coefficient of 0.329. These results are shown in **Figure 6**.

Word Search Performance

Additionally, we examined word search performance data of experimental and control groups as well as differences in performance on the “Camping” word search and “50 States”

word search. This data is represented in **Table 3.** Participants in the control group found a mean of 12.3±4.4 words. Participants in the experimental group found a mean of 13.6±4.7 words. With a p value of .3337, there is no statistical evidence to suggest participants find a different number of words in the experimental or control settings (**Figure 7**). All participants completed two word searches consecutively. The mean number of words participants found in the first word search they were given was 13.5±4.9. The mean number of words found in the second word search was 12.4±4.1 with an insignificant p value of .4187 (**Figure 8).** We used two word searches in this study: a "Camping" word search and a "50 States" word search. All participants worked on both word searches, the order of which was randomized. The mean number of words found in the "Camping" word search as 11.2±3.9. The mean number of words found in the "50 States" word search was 14.7±4.5 with a significant p value of 0.0042 (**Figure 9**).

Discussion

The high rates of cell phone usage among young adults in the United States and the reported development of emotional attachment to these devices merits the study of physiological response when the device is inaccessible (Pew Research Center Internet Project Survey, 2014). A previous student research group studied cardiovascular and galvanic skin response to acute stress when a participant's cell phone was removed from their possession (Christenson *et al.,* 2012). This previous study only took four discrete measurements of physiological responses during an hour of cell phone separation. The experimental group demonstrated a change in blood pressure and galvanic skin response, but not heart rate when separated from their cell phone. It is possible that due to the few and discrete measurements, participants' physiological responses did not differ significantly at the times measurements were taken by researchers. Participants who were separated from their cell phones may have not exhibited a strong anxiety response due to

desensitization after being separated from their phone for a prolonged period of time. Therefore, this study examined physiological responses collected continuously over the course of the cell phone separation. Participants in the experimental group were contacted multiple times by the researchers to reinforce the sense of separation from their cell phone. Each research subject participated in both experimental and control settings in order to minimize environmental variables and physiological variances that occur normally throughout the day.

After finishing the analysis of our statistics, we discovered the results of our experimental condition contradicted much of our original hypothesis. Mean differences of heart rate for Before Text v. After Text and Before Call v. After Call were not significant. This data cannot support that separating a participant from their phone elicits a significant difference in heart rate in the time immediately surrounding the stimulus (text or call). As hypothesized, the heart rate in the control conditions did not have a significant mean difference in the corresponding times of contact in comparison to the experimental condition. The difference between the mean differences for Before Text v. After Text in comparison to Before Call v. After Call were also found to be statistically insignificant for heart rate in both the experimental and control conditions. This further concludes that no significant heart rate response occurred when the participants had limited access to their phone.

Additionally, the data surrounding respiration rate did not correspond with our initial hypothesis. The mean difference in the experimental respiration rate was not significant for Before Text v. After Text or for Before Call v. After Call. The lack of significance means no known correlation exists between a change in respiration rate and contact by the researchers throughout a period temporary cell phone separation. There was also no significance in the difference between the mean differences of Before Text v. After Text and Before Call v. After

Call. The respiration rate in the control conditions followed the same trend as our experimental condition and showed no statistical significance in the mean difference for both Before Text v. After Text and Before Call v. After Call. Furthermore, comparing the mean differences of respiration rate of Before Text v. After Text to Before Call v. After Call in the control condition yielded no significant results. All data gathered on participant's respiration rate supports the conclusion that respiration rate is independent of researcher contact of a participant's cell phone throughout the period of separation.

Skin conductance, GSR, was the single physiological response that aligned with our hypothesis. In the experimental condition, the statistically significant p values for mean difference of both Before Text v. After Text and Before Call v. After Call demonstrated there was statistical evidence to suggest average skin conduction increased after the participant received both the text and the call. In our control condition, there was no such statistical significance surrounding these mean differences, suggesting there is no change in skin conductance throughout the same time periods examined in the experimental condition in our control set-up. Since there is a significant difference in the experimental and not the control condition, we can conclude that the increase in skin conduction at the time points examined can be attributed to researchers contacting the participants while they are separated from their cell phones. When comparing the mean differences of Before Text v. After Text to Before Call v. After Call we found a significant value in the control group for skin conductance but not for the experimental group. Although the control group showed a significant difference in the mean differences between time of text and time of call, we cannot attribute these responses to our direct, conscious experimental set-up. Exterior variables may have contributed to this statistic. Participants may have had physiological skin conductance responses to the anxiety of being

watched by unfamiliar individuals, or completing a words search, variables unrelated to being contacted by the researchers.

Additionally, when examining participants who self-reported high attachment to their phone a significant positive correlation coefficient was found between these participants and the mean difference of skin conductance for Before Call v. After Call in the experimental condition. A positive coefficient means a positive relationship (when x increases so does y). However, no significant correlation coefficients were found for heart rate and respiration rate for both Before Text v. After Text and Before Call v. After Call and the value for Before Text v. After Text for skin conductance. We can infer from this data is that the participants who were most attached to their phones had greater increases in skin response when they were called. This could signify that participants who were most attached to their phone showed the greatest anxiety response, as measured by skin response, when receiving a call that they were unable to answer. These results in addition to the significant mean differences found in the Before Text v. After Text and Before Call v. After Call indicate an increased skin conductance, and therefore of elevated physiological anxiety responses, due to cell phone separation.

In addition to physiological data, we collected and analyzed participants' performances on word searches according to research setting, order of word searches, and type of word search. Refer to **Table 3** for specific values referred to in the following paragraph. Word search performance was statistically the same between control and experiment group. The order in which participants completed the word search did not affect their performance and was found to be statistically the same. Conversely, there was a statistically significant difference in mean words found between the "Camping" and "50 States" word searches. Participants found significantly more words in the "50 States" word search than in the "Camping" word search.

Initially, we chose these word searches because they were both rated at the same difficulty level, but our data analysis suggests otherwise. However, we randomized the word searches independently of experimental and control settings so word search difficulty should not affect the physiological responses of either group.

After completion of this experiment, we identified aspects of our experiment that could be improved to strengthen the results of the study. First, we could have made the control condition identical to the experimental condition by contacting the control group while they had possession of their cell phone. These interruptions would make the comparison between the two groups more powerful. Second, we would have liked to separate individuals from their phones for a longer period of time. It is possible that removing cell phones from a participant for a more time would elicit stronger sense of separation and therefore a greater change in physiological response. Perhaps heart rate and respiration rate take a longer time to increase.

Although our physiological data did not fully support our hypothesis, there are still some connections that need to be made about participant response to cell phone removal and subsequent contact. Most notable is that participant's skin conductance behaved as predicted. Participant's skin conductance increased in response to contact, both by text and by call. Skin conductance is a measurement of how much the body is perspiring; therefore an increase in this value means an increase in perspiration, one of the indications of an anxiety response. However, other indicators of an anxiety response, such as an increased heart rate and respiration rate were not statistically supported throughout our experiment. Therefore, the evidence collected from our experiment generally supports the conclusion that removing a participant's cell phone and contacting them does not immediately induce an anxiety response.

References

[1]Aoki, K., & Downes, E. J., An analysis of young peoples use of and attitudes toward cell phones. Telematics and Informatics. 20, 349-364. 2013. Accessed April 7, 2015.

[2]Christenson E., Ferrara L., Kim J., & Solverson M. Cell phone restriction correlates with increased systolic blood pressure and GSR but not heart rate. Journal of Advanced Student Science. 2012.

[3]Clayton, R. B., Leshner, G. and Almond, A. The Extended iSelf: The Impact of iPhone Separation on Cognition, Emotion, and Physiology. Journal of Computer-Mediated Communication. 2015, doi: 10.1111/jcc4.12109

[4]Durocher JJ, Lufkin KM, King ME, Carter JR. Social technology restriction alters state anxiety but not autonomic activity in humans. Am J Physiol Regul Integr Comp Physiol. 2011 Dec; 301(6):R1773-8. Epub 2011 Sep 28. Accessed February 3, 2015.

[5]Freebie Word Searches. Stacy Fisher. 2015. Accessed Feburary, 2015 http://freebies.about.com/od/free-printable-word-searches/tp/hard-word-searches.ht

[6]Lepp A., Barkley JE, Karpinski AC. The relationship between cell phone use, academic performance, anxiety and Satisfaction with Life in college students. Computer in Human Behavior. 2014; 31: 343-350. Available from: ScienceDirect. Accessed February 3, 2015.

[7]Pew Research Center Internet Project Survey. Mobile Technology Fact Sheet. January, 2014. Accessed April 7, 2014.

[8}]Pew Research Center. Mobile Technology Fact Sheet. 2015. Accessed February 3, 2015.

[9]Vincent J. Emotional Attachment and Mobile Phones. Knowledge, Technology & Policy [serial online]. Spring 2006;19(1):39-44. Available from: Academic Search Premier, Ipswich, MA. Accessed February 3, 2015.

Acknowledgements

We would also like to thank the University of Wisconsin-Madison Department of Physiology for the use of their laboratory space and their equipment in conducting our research. We would also like to thank Kristin Byrne for performing the statistical analysis for our project. Lastly we would like to thank Dr. Andrew Lokuta, the student mentors and teaching assistants for all of their invaluable help with this project.

Tables

Mean Difference After Condition - Before Condition				
	Control		Experimental	
	Time of Text	Time of Call	Time of Text	Time of Call
Heart Rate (Beats per Minute)	2.67	0.21	-1.02	-0.57
Skin Conductance (Micro Siemens)	-0.05	0.05	0.47	0.74
Respiration (Breaths per Minute)	0.41	-0.47	2.52	0.21

Table 1. The mean difference between average values after time of contact (call or text) minus average values before time of contact. A negative value implies that the value before the time of contact was higher than the value after the time of contact. The highlighted values represent the two mean differences that had statistically significant p values.

Differences Between the Time of the Text and Time of the Call		
	Control	Experimental
Heart Rate (Beats per Minute)	Not Significant	Not Significant
Skin Conductance (Micro Siemens)	Significant	Not Significant
Respiration (Breaths per Minute)	Not Significant	Not Significant

Table 2. A visual representation of whether there is a difference between the mean differences for Before Text v. After Text and Before Call v. After Call. The single significant value is highlighted.

Word Search Performance in Control and Experimental Groups						
Group Means	Control	Experimental	1st word search	2nd word search	Camping	50 States
Mean	12.3	13.6	13.5	12.4	11.2	14.7
Standard Devia	4.4	4.7	4.9	4.1	3.9	4.5
p-value	0.3337		0.4187		0.0042	

Table 3. Word search performance results across control and experimental groups. The mean represents the mean number of words found in each scenario. The single significant value is highlighted. This demonstrates that participants performed better overall on the 50 States word search than the Camping word search.

Figures

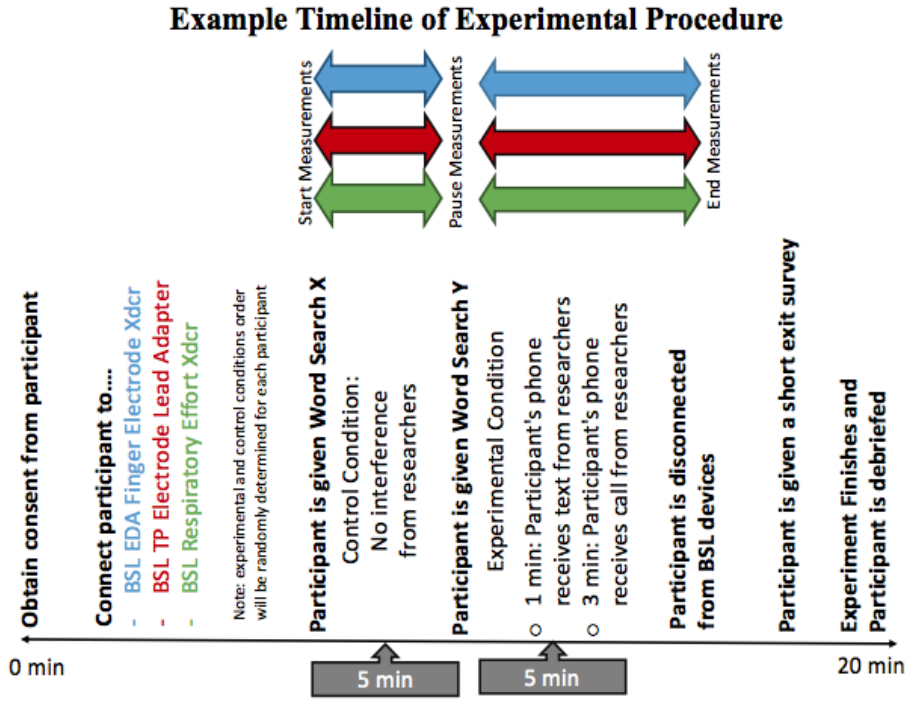


Figure 1. Example Timeline of Experimental Procedure.

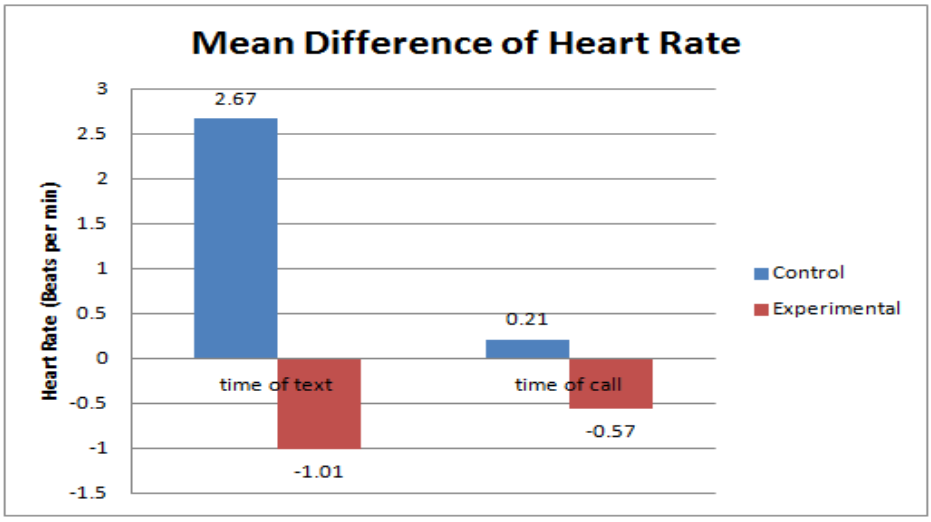


Figure 2: This is a bar graph representation of the data found in **Table 1**. The mean difference in heart rate for Before Text v. After Text and Before Call v. After Call for both the control and experimental groups were computed and displayed above. The calculated p values for these four mean differences were all found to be insignificant.

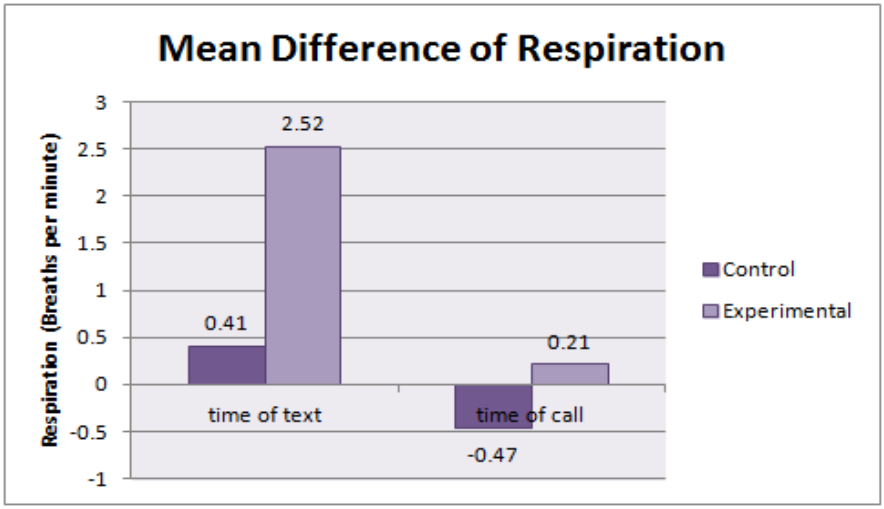


Figure 3: This is a bar graph representation of the data found in **Table 1**. The mean difference in respiration rate for Before Text v. After Text and Before Call v. After Call for both the control and experimental groups were computed and displayed above. The calculated p values for these four mean differences were all found to be insignificant.

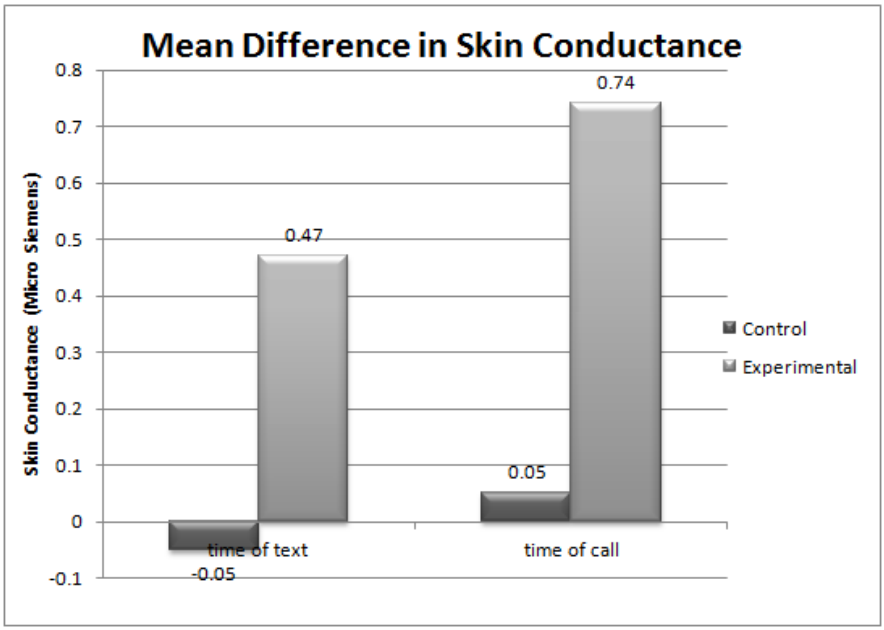


Figure 4: This is a bar graph representation of the data found in **Table 1**. The mean difference in skin conductance, or galvanic skin response, for Before Text v. After Text and Before Call v. After Call for both the control and experimental groups were computated and displayed above. The calculated p values for both text and call in the experimental group were found to be significant while the control group had a significant p value for only the Before Call v. After Call mean difference.

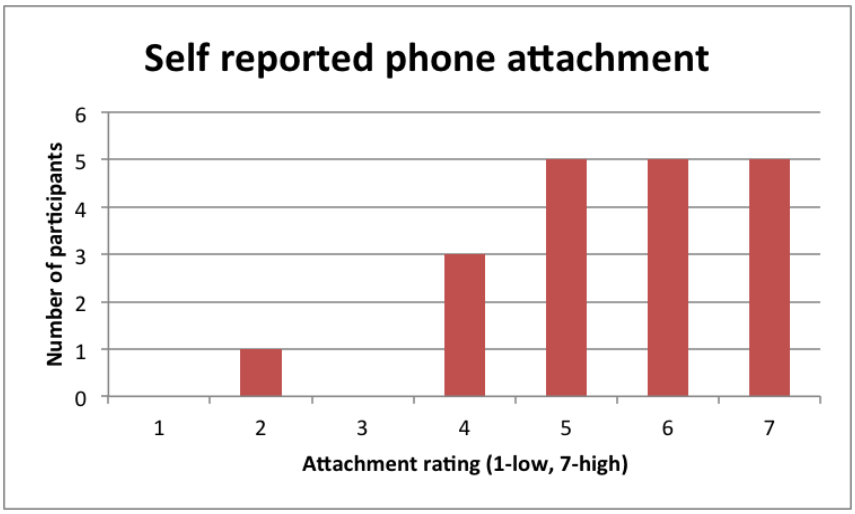


Figure 5. Self reported phone attachment as rated by each of the participants on their exit survey. Values close to 1 represented little to no attachment to their phone (hardly ever have their phone on them and often your friends and family have trouble contacting you). Values close to 7 represented a very high level of attachment to their phone (check their phone often even when they're not expecting someone to contact, their phone is the last thing they look at before they go to bed and the first thing they look at in the morning).

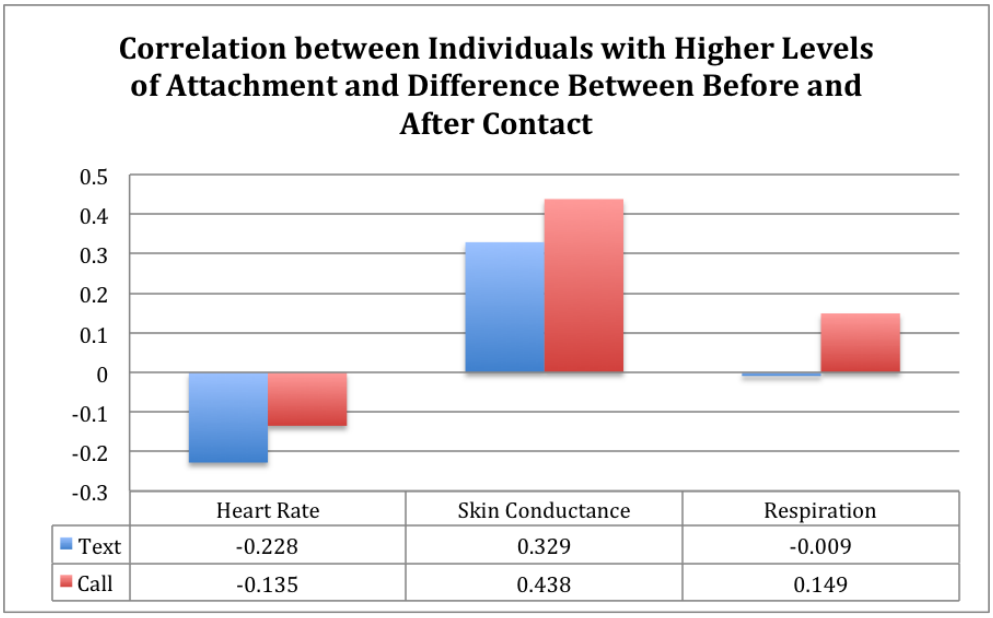


Figure 6. Correlation between participants, in the experimental group, who reported higher phone attachment scores and change in mean difference for Before Text v. After Text and Before Call v. After Call. The closer to 1 or -1 the coefficient is, the stronger the relationship. When the coefficient is near zero there is virtually no relationship. A positive coefficient means there is a positive relationship. A negative coefficient means there is a negative relationship. The only correlation coefficient above 0.4 or below -0.4 is the one for skin conductance and Before Call v. After Call. This means that participants who were more attached to their phone had a larger increase in skin response than those who reported a lower attachment to their phone after the researchers called their phones.

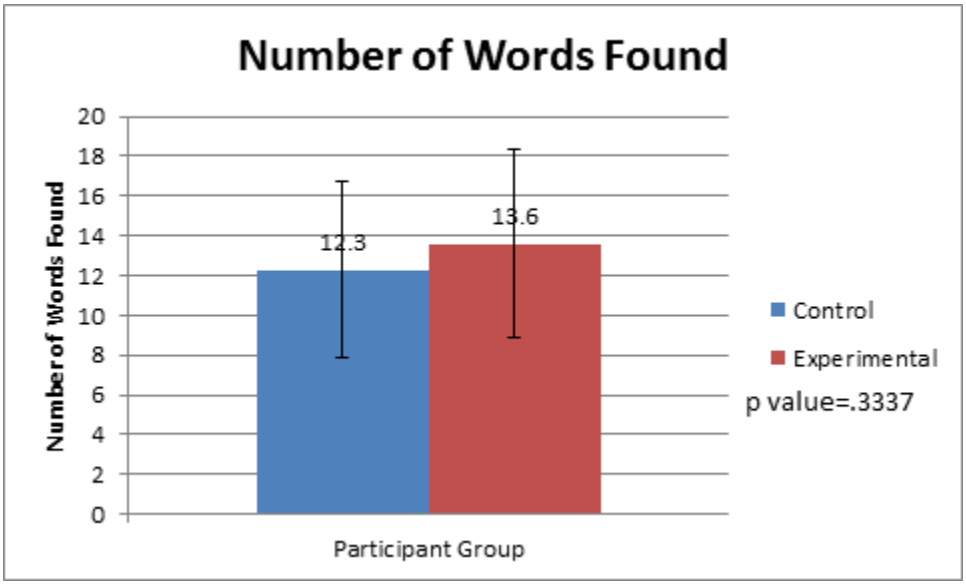


Figure 7. Number of words found by participants in experimental versus control settings. The control group found an average of 12.3 words and the experimental group found an average of 13.6 words. The mean number of words found is not statistically significant between experimental and control.

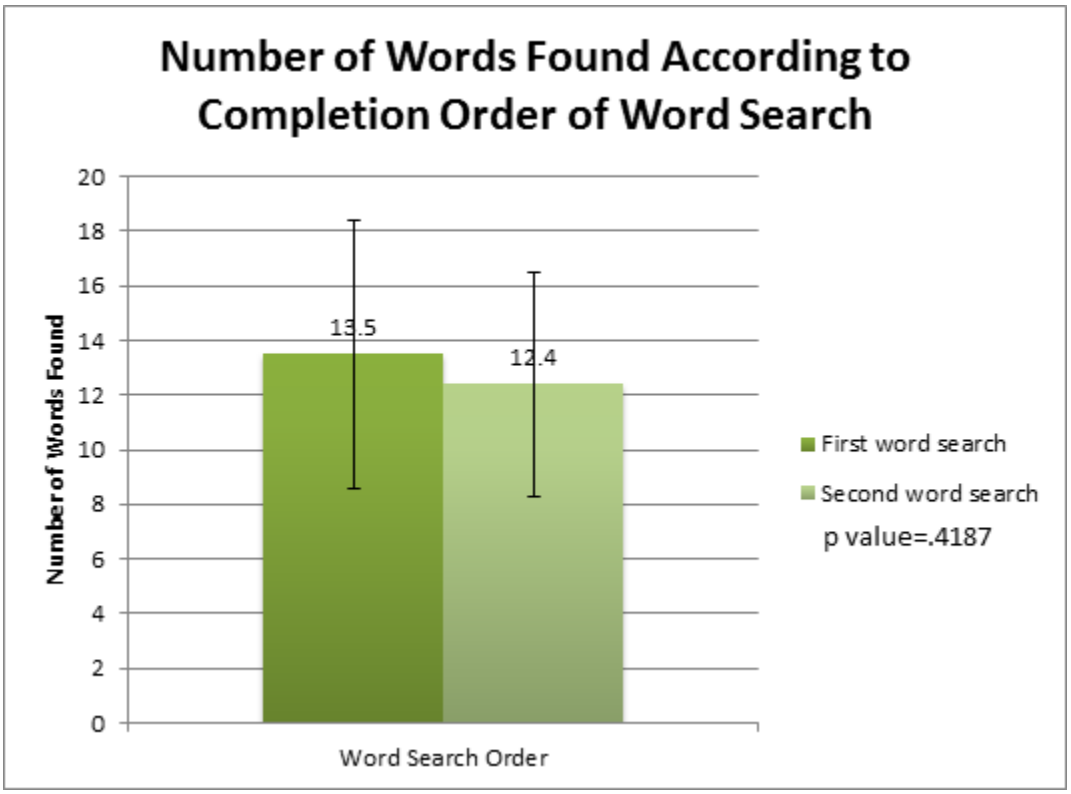


Figure 8. Each participant completed two word searches. This is a graphical representation of the mean number of word participants found in the first and second word search. The p value surrounding this data was found to be statistically insignificant.

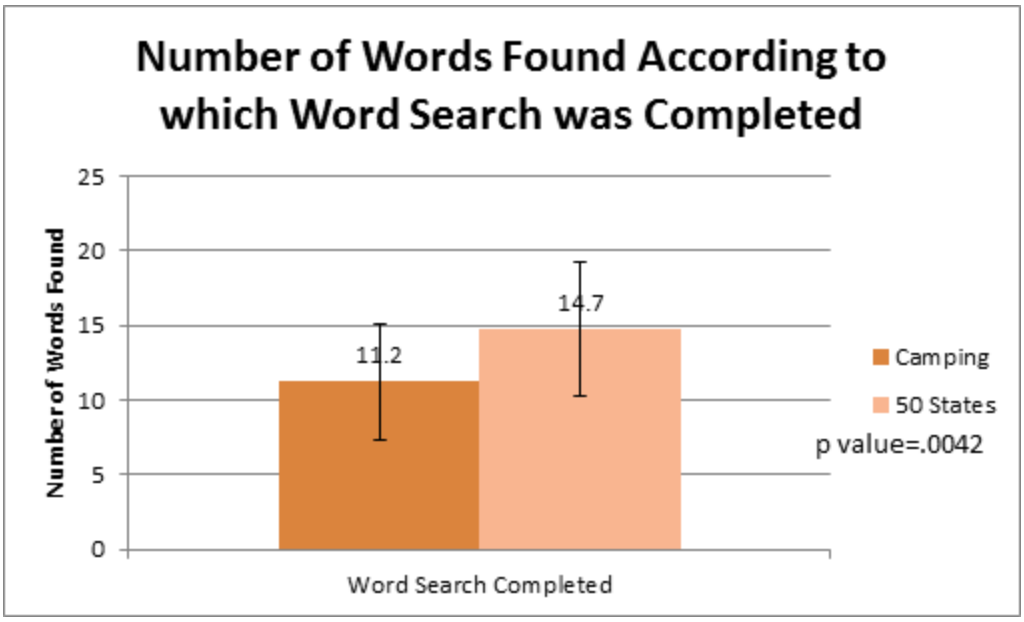
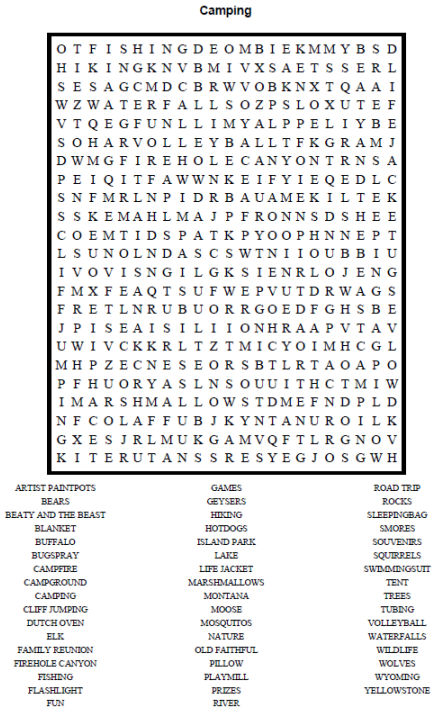


Figure 9. Number of words found by participants according to which word search was completed. Participants were given two word searches to complete: "50 States" and "Camping." Participants found an average of 11.2 in the "Camping" word search and 14.7 in the "50 States" word search. With a p value of .0042, the number of words found in the "50 States" word search and the number of words found in the "Camping" word search was determined to be statistically significant between word searches.



Camping

O T F I S H I N G D E O M B I E K M M Y B S D
H I K I N G K N V B M I V X S A E T S S E R L
S E S A G C M D C B R W V O B K N X T Q A A I
W Z W A T E R F A L L S O Z P S L O X U T E F
V T Q E G F U N L L I M Y A L P P E L I Y B E
S O H A R V O L L E Y B A L L T F K G R A M J
D W M G F I R E H O L E C A N Y O N T R N S A
P E I Q I T F A W W N K E I F Y I E Q E D L C
S N F M R L N P I D R B A U A M E K I L T E K
S S K E M A H L M A J P F R O N N S D S H E E
C O E M T I D S P A T K P Y O O P H N N E P T
L S U N O L N D A S C S W T N I I O U B B I U
I V O V I S N G I L G K S I E N R L O J E N G
F M X F E A Q T S U F W E P V U T D R W A G S
F R E T L N R U B U O R R G O E D F G H S B E
J P I S E A I S I L I I O N H R A A P V T A V
U W I V C K K R L T Z T M I C Y O I M H C G L
M H P Z E C N E S E O R S B T L R T A O A P O
P F H U O R Y A S L N S O U U I T H C T M I W
I M A R S H M A L L O W S T D M E F N D P L D
N F C O L A F F U B J K Y N T A N U R O I L K
G X E S J R L M U K G A M V Q F T L R G N O V
K I T E R U T A N S S R E S Y E G J O S G W H

ARTIST PAINTPOTS
BEARS
BEATY AND THE BEAST
BLANKET
BUFFALO
BUGSPRAY
CAMPFIRE
CAMPGROUND
CAMPING
CLIFF JUMPING
DUTCH OVEN
ELK
FAMILY REUNION
FIREHOLE CANYON
FISHING
FLASHLIGHT
FUN
GAMES
GEYSERS
HIKING
HOTDOGS
ISLAND PARK
LAKE
LIFE JACKET
MARSHMALLOWS
MONTANA
MOOSE
MOSQUITOS
NATURE
OLD FAITHFUL
PILLOW
PLAYMILL
PRIZES
RIVER
ROAD TRIP
ROCKS
SLEEPINGBAG
SMORES
SOUVENIRS
SQUIRRELS
SWIMMINGSUIT
TENT
TREES
TUBING
VOLLEYBALL
WATERFALLS
WILDLIFE
WOLVES
WYOMING
YELLOWSTONE

All 50 States

N E W M E X I C O O S A K S A R B E N H E F Y
A S U C Y W E S T V I R G I N I A M L F T Q I
S E O H A D I M J C P E N N S Y L V A N I A B
H S A S N A K I L I O M A I N E W Y O M I N G
V H I K R N Y S P H V N O O D A R O L O C T D
H M T R S I E S M X Y O N S H J G Y A A R E H
I I W O O L S I O P K I O E R F V I I B L V V
N N O Y U O R S N F R H R Y C V L G H A K J L
D N V W T R E S T E V O T A E T R O W C Y Z A
I E U E H A J I A M W N H T N O I A R K I T G
A S T N D C W P N O E H C E E A R C C I O M A
N O J Q A H E P A V A I A G E E I U U K D C J
A T H Y K T N I A E L N R M O S T S A T A A A
P A E D O U S D W L O S O K P N S D I L Y M O
I W X I T O A I I A X D L Z E S H E I U A N R
A R S L A S S N K Q K A I K I T H F N B O X E
W H U J D C O O M M H S N D R R O I A N J L G
O S D O O I U J F O K B A O I R A L R K E O O
I S V N S V E R M O N T N L N R A Q T E C T N
T Z S U R S H A W A I I E I A A R K A N S A S
V I W A S H I N G T O N A L X D N A L Y R A M
N W N T L B N M N R R H O D E I S L A N D E C
H A T U S T T E S U H C A S S A M X S A X E T

ALABAMA
ALASKA
ARIZONA
ARKANSAS
CALIFORNIA
COLORADO
CONNECTICUT
DELAWARE
FLORIDA
GEORGIA
HAWAII
IDAHO
ILLINOIS
INDIANA
IOWA
KANSAS
KENTUCKY
LOUISIANA
MAINE
MARYLAND
MASSACHUSETTS
MICHIGAN
MINNESOTA
MISSISSIPPI
MISSOURI
MONTANA
NEBRASKA
NEVADA
NEW HAMPSHIRE
NEW JERSEY
NEW MEXICO
NEW YORK
NORTH CAROLINA
NORTH DAKOTA
OHIO
OKLAHOMA
OREGON
PENNSYLVANIA
RHODE ISLAND
SOUTH CAROLINA
SOUTH DAKOTA
TENNESSEE
TEXAS
UTAH
VERMONT
VIRGINIA
WASHINGTON
WEST VIRGINIA
WISCONSIN
WYOMING

Appendix

Appendix A: The crosswords the participants completed in randomized order