British Journal of Arts and Social Sciences
ISSN: 2046-9578, Vol.11 No.I (2012)

http://www.bjournal.co.uk/BJASS.aspx

The Effect of Cell Phone Conversation and Texting on Reaction Time and Vehicle Accidents

Mariam Abbas
Bioengineering Department, University of Louisville: 2301 S 3rd St, Louisville, KY 40208
Psychology Department, Spalding University: 845 South Third Street, Louisville, KY 40203, E-mail: maa25@u.washington.edu
Tel: 502-299-4691

Abstract

This was a study involved in the field of human factors. The purpose of this research was determining and comparing between how engaging in a cell phone conversation, verses texting, affects reaction time and examining the effect that they could have on vehicle accidents. The hypothesis for this project is that both texting and conversation increase human reaction time and the possible risk of vehicle accidents and that texting increases human reaction time and may increase risk of vehicle accident more than a cell phone conversation.

The methodology of this experiment is that 16 total human subjects each completed ten trials total, five for the experimental condition and five for the control condition. In the control condition, the subjects hit a swinging target marker as fast as they could with their dominant hand, immediately after hearing a sound cue. For the experimental condition, each subject accomplished the same task, while speaking, or texting. A T-test, or significance test, was conducted for the averages of the raw data for the trials of each subject for both conditions. The results of the averages were 99.97% significance for texting and 99.99% for conversation. A Wilcoxon signed rank test was also conducted for the averages of the means of the raw data for the experimental and control conditions, and the results were 99.2% significant for the conversation and 99.95% for the texting.

Keywords: Human reaction time, T-test, Conversation, Texting, Vehicle Accidents, Evart

Introduction

Cell phones have been extraordinary inventions that have made communication easier and faster. They have become such an immense part of people's modern daily routine, with their abilities to speak and text, with many more features. With all of these features and abilities to store vital information to use anywhere, cell phones have also become a replacement to oral face-to-face communication. Although they are very helpful electrical devices, they are beginning to be a growing negativity to the society. More than a quarter of cell phone owners (28%) admit they sometimes do not drive as safely as they should while they use their mobile devices. Among cell phone users, men (32%) are more likely than women (25%) to admit they sometimes don't drive as safely as they should. 82% of all Americans and 86% of cell users report being irritated at least occasionally by loud and annoying cell users who conduct their calls in public places (Pew Internet & American Life Project). An issue that is beginning to grow is that many people are speaking and texting with their cell phones and driving at the same time. This is a growing issue, and it can have very dangerous consequences. When people talk and drive simultaneously, psychologically, their attention is divided, which means they concentrate less on the road (Ashcraft 2006). Even dialing a cell phone while driving is very dangerous because people have to take their eyes off of the road and focus on their cell phones. 40 different countries restrict or prohibit using cell phones while driving. So why doesn't America prohibit cell phone use while driving nationally as well? When cell phones are used at times when concentration is necessary, especially while driving, there is increasing chances of danger (some even deadly and life threatening).

Cellular devices are used often, especially in America. According to an article from the journal "Cell Phones and Driving", in June 2008, the Cellular Telecommunications & Internet Association reported that in America, over 260 million people use cell phones today verses just 4.3 million people in 1990. That is a very wide difference. Along with this fact, there has been an increase in the number of vehicle accidents in America (Pew Internet and Life Project). This is partly due to the lack of concentration that cell phones cause while driving.

According to USA Today, on Wednesday September, 17, 2008, the National Transportation Safety Board (NTSB) reported that a man named Robert Sanchez crashed a railroad train on September 13, 2008, into a freight train with many passengers aboard. Approximately 130 passengers got injured, and Mr. Sanchez died himself. This was the worst railroad accident in the past 15 years. The reason behind this crash was that Mr. Sanchez was text messaging while driving, and passed a red stop signal. This is another example of how distracting wireless communication can be.

The use of cellular devices was highest along the age of younger drivers, specifically teenagers, according to a survey of 1,200 drivers taken by Nationwide Mutual Insurance Company in January 2007, declaring that 73% speak on their cell phones while driving. This can indicate that younger drivers contain higher statistics of vehicle accidents. In fact, the risk of younger drivers having a fatal crash is three times greater than the risk of older drivers from age 65 to 69, and usually, human reaction time increases with age. A study conducted by Debra Ascone, Lindsey Tonja, and Cherian Varghese showed that the highest number of distracted driving occurs in the ages under 20, the teen age. Also, according to a survey taken in 2006 by the U.S. Department of Transportation and the National Highway Traffic Safety Administration, from people ages under 13 to over 85, the highest amount of motor vehicle deaths per 100,000 people was from age 16 to 20, with age 20 being the highest. Other researches have been conducted on cell phones and distracted driving, such as

Driver's brake reaction times by G. Johansson and K. Rumar (1971), *The effect of cellular phone use upon driver attention* by J. A. McKnight and S. A. McKnight (1993), *Association between Cellular-Telephone Calls and Motor Vehicle Collisions* by Donald A. Redelmeir and Robert J. Tibshirani (1997*), The distraction effects of phone use during a crucial driving maneuver* by A. P. Hancock, M. Lesch., L. Simmons (2002), national long-time studies such as Pew Research, and many more. Various studies have found that the decrease of vehicle control has contributions of four times the increase in risk associated with the use of a cell phone while driving as compared to not using a cell phone.

A diversion of the driver's attention and situational awareness from driving environment and potential hazards that may unexpectedly impact safety, during cell phone conversations, and basically the results that the use of cell phones lead to more risk of vehicle accidents. There are many studies that have tested the effects cell phone conversation and texting, but there are no yet published studies that have conducted research on and compared between conversation as well as texting with reaction time. That is the goal of this research. This study is combining findings of past research studies, into one study, by testing the effect of conversation and texting on human reaction time.

So what is Reaction Time? It is similar to a human's reflex reaction. Reaction Time is the total amount of time that passes by, between something that quickens action, feeling, or thought called a sensory stimulus, and the response to that stimulus. Plus, it is also the measure of the total time needed for a chain of internal body events. These events follow in a certain order, and follow in four steps. First, the stimulus activates one or more sensory receptors, single structure or group of structures at the peripheral end of sensory or motor nerve fibers called end organs, of sensory neurons. Neurons, also called nerve cells, are specialized, impulse conducting cells that are the functional units of the nervous system. These neurons are specialized to be sensitive to stimulating agents, such as touch or heat. Second, the single receptor or group receptors send a signal to the central nervous system, also referred to as CNS. Third, the CNS processes the incoming signal and draws out a neural response that pertains to a nerve or the whole nervous system, and finally, the neural response travels to the appropriate muscles to generate the physical response. Reaction time is partly dependent on attention, which is a necessity for driving. A preferable unit of reaction time is a measurement in seconds.

Psychologists from the University of Utah published a study that showed drivers of motor vehicles who talk on a handheld or on a hands-free cell phone are just as impaired as drunk drivers. This project is testing a new, technological standard to a driver's distractions that is growing, as it becomes more and more convenient to today's modern society. Cell phone distraction is among the highest distractions with driving.

Some research conducted by other investigators include data showing that hands-free cell phones are just as distracting as handheld cell phones (Strayer, 2001). Other research shows that drivers who talk on their cell phones could be looking straight at the road but not really paying attention to it and aren't aware that they are impaired because their focus is on the cell phone conversation (Drews 2003). Another research project is one that was conducted in 2005, which reported that teenagers and young adults who talk on their cell phones have a reaction time as slow as the reaction time of elderly drivers. The growing technology of cell phones has made cell phones a leading cause in driving distractions.

Attention is defined as the ability or power to concentrate mentally. Humans not only need to keep their eyes on the road while driving but also need to give full attention and focus to the tasks of driving. People have to pay attention physically and mentally. If they are only watching, and not paying attention to the road, they could be just as impaired as a drunk driver.

Stopping distance, the total time translated into the distance that a vehicle and driver need to come to a halt is also important for safer driving. In relation, the slower the reaction time of a driver, the more time it will take for him or her to stop the vehicle.

Two reasons for performing this research are to one, design and conduct an experiment that connects to real world issues concerning the growth in technology, and two, compare that to other findings, data analysis and facts from other researchers. From gathering the information from this experiment and comparing it to what information others have, this project can observe and support the different effects of cell phones on driving. Also, this study will test how significant the data of the experiment will be, draw conclusions about the data analysis, and make comparisons.

This research is expected to provide a good test of human reaction time, determine if a cell phone could be enough distraction to make a driver more dangerous behind the wheel, and show the significance of the experiment. It will be conducted using a hands-on cell phone, in an experimental and control condition. This experiment is expected to prove the statistical significance or importance from its data analysis and strongly support the hypothesis.

The purpose of this project is to compare the effect of cell phone conversation and texting on reaction time and vehicle accidents, and examine the effect that they could have on human vehicle accidental injuries.

The hypothesis for this project is that cell phone texting and conversation both increase reaction time and the risk of a vehicle accident and that cell phone texting increases human reaction time and the risk of a vehicle accident more than a cell phone conversation.

Method

This project was conducted at the University of Louisville, Speed School of Engineering in a laboratory at the Belknap Research Building. The researcher had a supervisor that helped to manage the high level apparatus as far as the specific system calibration and computer program running, because the machinery required professional adult management, and the researcher was less than 18 years of age.

Before conducting any tests on human subjects, the researcher finished an online training program that gave information and tested the researcher's knowledge about the ethics, rules and regulations to follow when working with human subjects. After receiving a certificate of accomplishment for reading the information and passing the online tests, the researcher then obtained consent, assent, and human subject approval forms for the subjects to get them signed by the subjects and their parent(s)/guardian(s), for the subjects who were minors under the age of 18. There were no known risks associated with this study. The information, or data collected may not have benefited each subject directly; however, knowledge obtained in this study may be helpful to the society as a whole. No personal subject name or any other personal information was made public, and subject data was kept private by using locking cabinets to store written information and password protected computers and/or servers to store electronic information. The subjects taking part in this study was completely voluntary, and if a subject or subject guardian decided to stop participation in the study, the subject was not penalized or lost to any benefits.

The apparatus that was used for the experiment is called a motion tracking system. A motion tracking system consists of special cameras that surround a certain area of space. This area of space that the subjects completed the trials in is similar to a coordinate grid, except 3-dimentional. Eight cameras surrounded it. Just as an (x, y) coordinate grid contains individual squares each at a certain side length, the area of space was like a coordinate grid that contained and was measured by individual squares the size of 1 square mm. In contrast to a 2 dimensional coordinate grid, the measurements for this area were 3 dimensional, because the height also had to be measured, so the area was measured with (x, y, z) dimensions, with z being the vertical height in space. The positions for the origin of this area were (5, 10, 15), for the (x, y, z) dimensions, just as the origin for the (x, y) coordinates for a 2 dimensional coordinate grid are (0, 0).

The cameras that surround the area of space are called optoelectronic cameras. They can spot a unique type of reflective markers, which are put on each subject. Optoelectronic cameras contain lenses that sense, or detect optical active structures, and produce an image in an RGB system. An RGB system is a system that reflects and uses red, green and blue light electrons. In this case, the cameras sense the reflective markers and produce the image on a computer that is connected to a program called Evart. Evart contains masses of special features that allow someone to illustrate as many reflective markers as they need on the computer as coordinates or dots in space. It can even play back the time period at which a task was done in actual speed or in any other preferred speed, such as in 10 frames per second or 1000 frames per second. Frames are just like single, individual pictures that the cameras take, and then play back as a video representation. Evart is capable of translating a language that is not a text file into a text file language that can be used in other programs, particularly Microsoft Excel. This program also allows connection to the coordinates from the reflective markers that show on the program with lines to show the distances between them for a good visual representation of the subject performing the task.

Also, the same computer that was connected to the cameras was also connected to a buzzer that sounded the cue for when the subjects should start to perform the task when it is pressed. The buzzer was programmed to give an initial sound and a final sound with three seconds apart from the two sounds. This experiment was timed to measure the speed of the subjects' movements or tasks in 100 frames per second.

A control and experimental group was used for this project, for the texting and conversation variables. For the experimental group, the subjects performed the task with a cell phone, but for the control group, the subjects performed the task without a cell phone. The order of the control and experimental conditions were switched, or alternated, between each subject, and a pilot study was conducted before actual experimentation. Sixteen total subjects were used for this experiment. Since past research has shown most vehicles accidents occur around the teen age that age number was focused on in this experiment. Most of the subjects were below twenty years of age. A couple of the subjects were a bit older, in order to include a more random sample, but they did not exceeded the age of thirty. All of the other subjects were teenagers. This was a within-subjects study, meaning the same subject was used for the experimental condition and control condition. Five trials for each condition were conducted (ten trials total, per subject). Sixteen total subjects were used or 160 trials. Eight subjects or 80 trials were used for the cell phone conversation half of the experiment and eight for the texting portion. The researcher made sure that all of the controlled variables stayed controlled, all of the experimental conditions were as consistent as possible, and that each subject would perform all ten trials within the same session, for both conditions.

Before beginning with any experimentation, first the motion tracking system was calibrated, which adjusts where the cameras are focused, so that each camera captures the subject at about the same angle. Then, a task was set up in the computer program, to put and save the trials in. Afterward, the calibration was loaded into the task project, or a file to save the trials in.

Before any real experimentation, a practice or pilot study was conducted with two subjects used, the researcher and the assistant themselves, whom did not have to be within a particular age. The pilot study was conducted in order to make sure the apparatus was working, to provide practice for the assistant, to provide chance for improvement on the conversation if needed, and to determine how many trials for each subject the researcher needed to get a consistent measure of reaction time. The same field of space was used in which the subjects remained in while doing the task, for the control and experimental condition. Subsequently, the steps were followed to conduct the actual experimentation.

First, for the experimental condition, a list of five open questions was prepared to be asked by the researcher's assistant for each subject. The questions were used as an engaging conversation and texting. After that, a string from the ceiling hanged a marker at arm length away from the subject, about 0.9 meters higher than the ground, and with a reference point of about 30° from the vertical axis of the space. The reference point was kept approximately the same throughout the whole experiment. This marker was used as the target marker that the subject would attempt to hit as fast as he/she can. Also, all of the subjects that would eventually have to go after the previous subject stayed in an separate environment in order to not be able to hear or see the subjects performing the task, so they could not obtain more experience or familiarity with the task than the other subjects.

The control and experimental trials for the cell phone conversation was completed before the texting trials. For the trials, seven Markers were placed on each subject's left shoulder blade (referred to as the offset), right shoulder, left shoulder, right elbow, right wrist, left elbow, and left wrist.

For the experimental condition, the subjects used their non-dominant hand to hold the cell phone, and their dominant hand to hit the target marker, keeping their dominant hand on their lap before the task. The subjects sat in front of the target marker at about arm length away. The researcher asked the subjects one open-ended question for each trial. The questions that were used were, what do you think will happen in the future in America? What do you think is the most important change you have passed in your life? Why/why not do you think school is necessary? How do you think you would survive if you were lost in the wilderness? And what are your long-term goals in life? The subjects would reply to the questions verbally through a cell phone, held next to their ear, or by texting with a full keyboard cell phone. For the conversation, the questions were verbally asked, but for the texting, the questions were texted from another cell phone. When the subjects began to answer the questions, the researcher swung the marker in front of the subject from side to side, from the same reference point, and then stepped back from the field that the cameras surround. While the target marker was swinging, the sound cue was released to signal the subjects to hit the marker as fast as they could.

The computer measured the time that it took the subject to move after the buzzer was pressed, and how long it took the subject to come in contact with the swinging marker from that time. The reaction time taken was the total time from when the subject moved until the subject's hand came in contact with the target marker.

For the control condition, the same procedures as the experimental condition were used except that the subjects initially placed both hands on their lap before hitting the marker, without the conversation or texting. After the researcher pressed the buzzer, the subjects tried to contact the swinging target marker as fast as they could with their dominant hand without a cell phone conversation, initially placing both hands on their lap.

After collecting the data, the researcher analyzed the results, by taking the averages of the data for each subject, for the experimental and control condition. Also, the plan was to draw a conclusion on whether the data from the experiment supported the hypothesis. This conclusion was drawn by conducting a paired, or two-tailed independent T-test, also called significance test, on the data for the control and experimental conditions to observe the significance level of the data.

Results

After gathering all of the data for the trials of the control and experimental conditions, the results of the data were loaded and printed in a Microsoft Excel file and charts and graphs were created. The raw data for the trials of each subject was averaged for the experimental and control condition of the texting and conversation. These were the numbers used for most of the analysis. The same measurements and units used for the experimental condition were used for the control condition to measure reaction time, which was in seconds, and the same scale, or number interval, was used for all of the charts and graphs.

Table 1.

Data of Experimental Condition for Conversation	Data of Control Condition for Conversation
1.534	1.042
1.596	1.122
1.765	1.162
1.552	1.124
1.932	1.240
1.640	1.078
1.304	0.736
0.902	0.794
T-test significance for this data 99.99% **Wilcoxon test significance for this data** 99.2%	

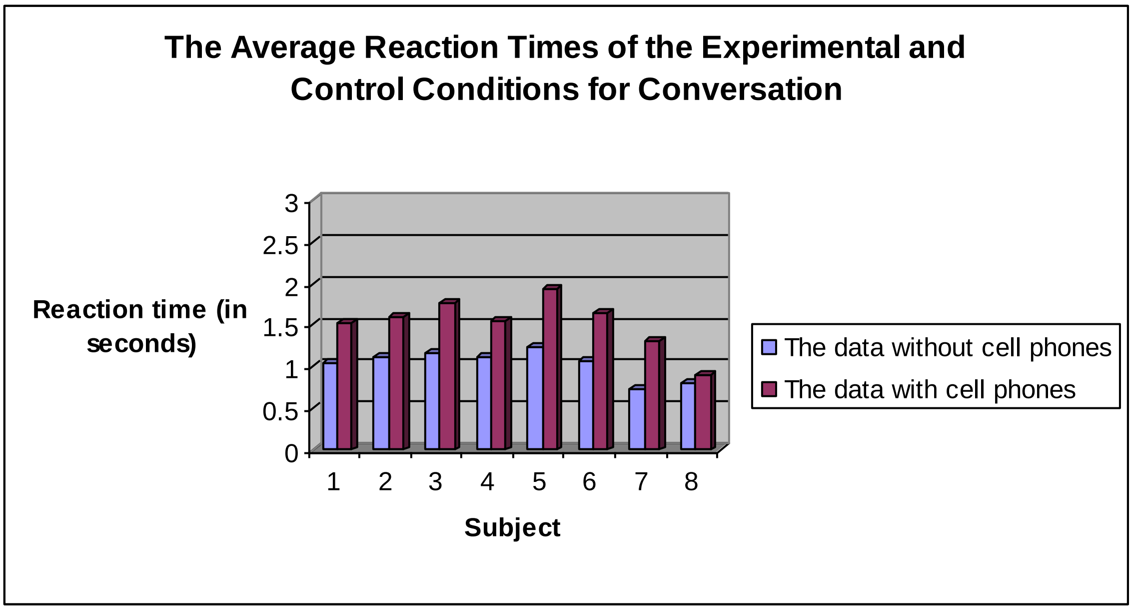
Table 2.

Data of Experimental Condition for Texting	Control Condition for Texting
1.43	1.194
1.38	0.764
1.25	0.886
1.332	1.082
1.23	0.784
1.42	1.336
0.918	0.644
2.568	0.848
T-test significance for this data 99.97% **Wilcoxon test significance for this data** 99.95%	

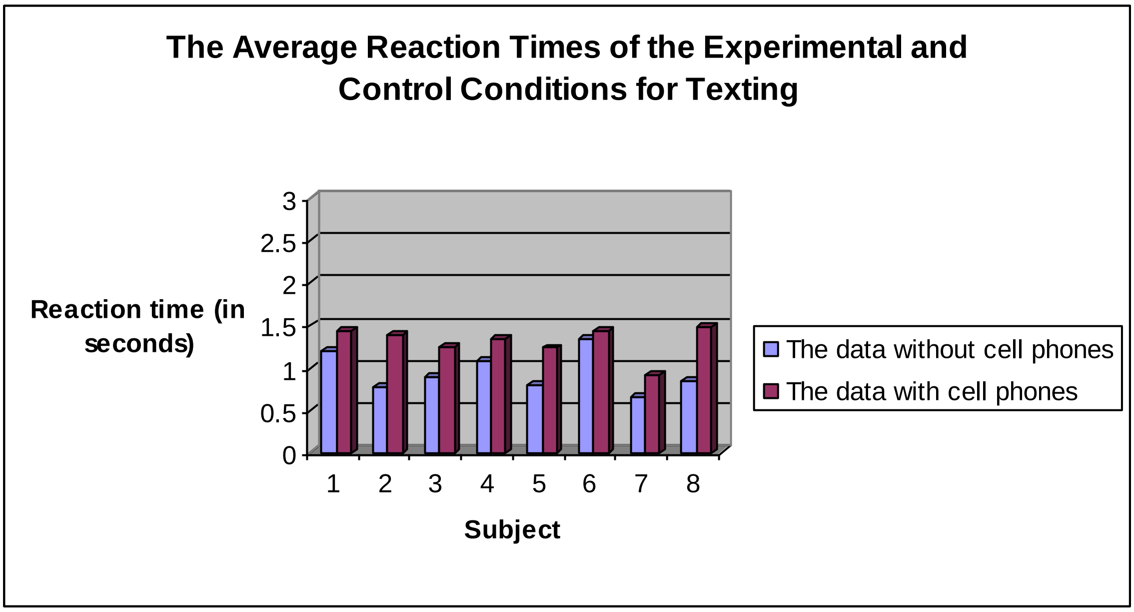
Table 3.

Difference of Conversation Data	Difference of Texting Data
0.492	0.236
0.474	0.616
0.603	0.364
0.428	0.250
0.692	0.446
0.562	0.316
0.568	0.274
0.108	0.620
Average of Difference	**Average of Difference**
0.491	0.390

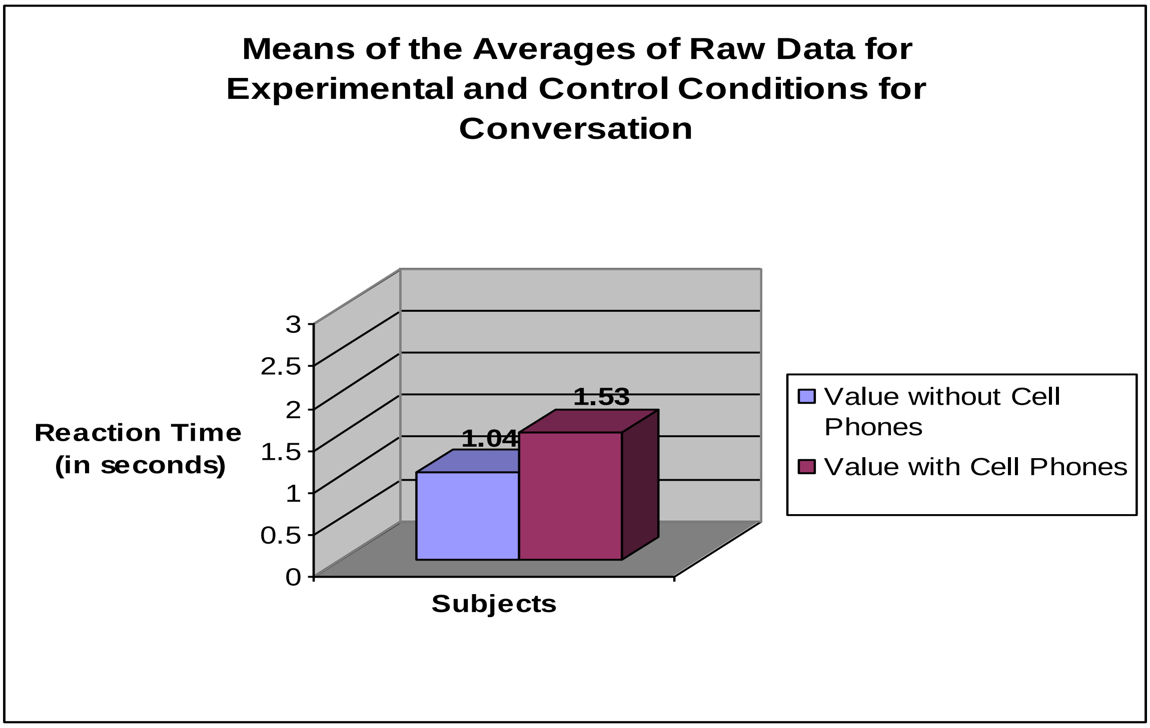
Graph 1.



Graph 2.



Graph 3.



Graph 4.

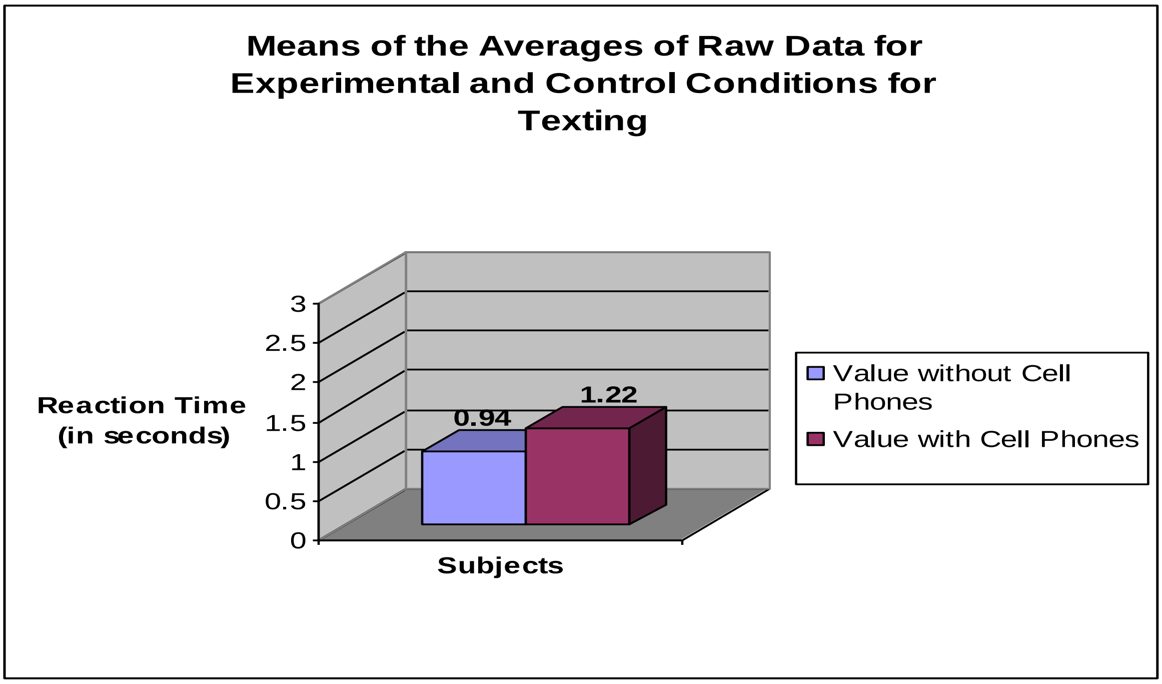


Table 4.

Teens and Distracted Driving

Have you ever experienced or done any of the following?

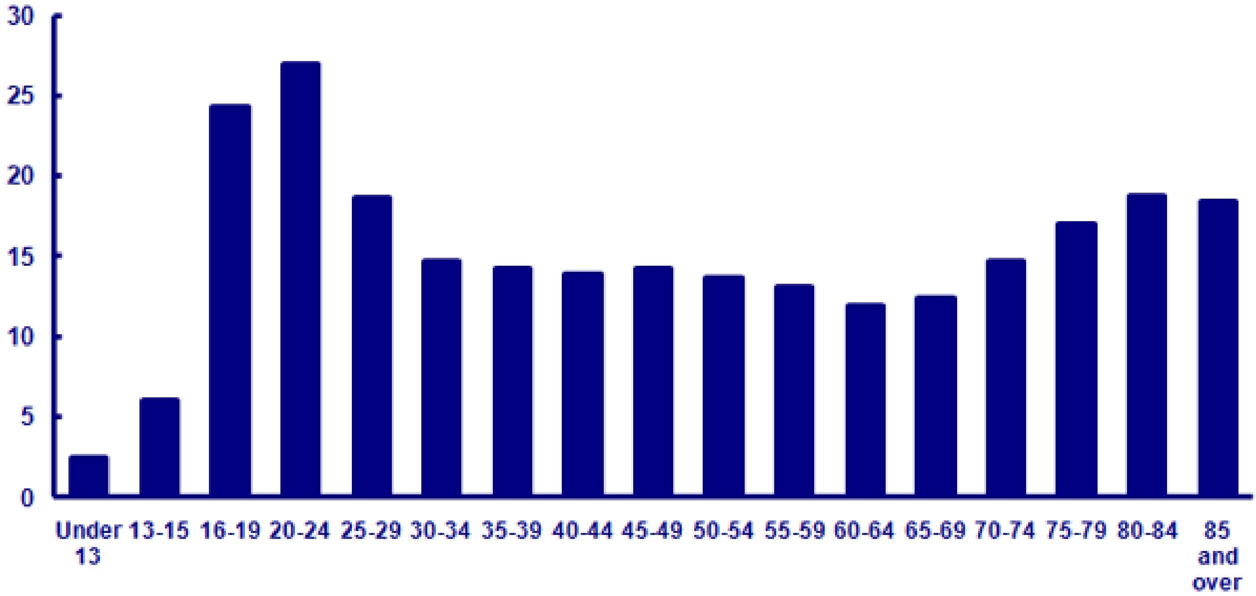
	All Teens 12-17	Older teens 16-17	Cell users ages 16-17	Texters ages 16-17
Been in a car when the driver was texting	48	64	70	73
Been in a car when the driver used a cell phone in a way that put themselves or others in danger	40	48	51	52
Talked on a cell phone while driving	n/a	43	52	54
Texted while driving	n/a	26	32	34

Pew Internet & American Life Project, Teens and Mobile Phones Survey conducted from June 26 - September 24, 2009. N=800 teens ages 12-17 and the margin of error is ±4% for all teens. For older teens ages 16-17, N=283. For cell users ages 16-17, N=242. For texters ages 16-17, N=222. Margins of error for these subgroups range between ±6% and 7%.

Pew Internet

Graph 5.

MOTOR VEHICLE DEATHS
PER 100,000 PERSONS BY AGE, 2006



(Source: U.S. Department of Transportation, National Highway Traffic Safety Administration.)

Discussion

Table 1 and Table 2 show the data values of the reaction times for all of the subjects for the two conditions of the texting and conversation, as well as the significance tests. Table 3 shows the differences of the data for the texting and conversation, and the average of the difference. According to Table 3, the difference of the texting was greater than the difference of the texting. But according to Table 1 and Table 2, the values experimental conditions for the texting and conversation were greater than the control. This means that conversation and texting increased reaction time with the subjects. So, this supported part of the hypothesis, that both conditions increase reaction time. The part of the hypothesis that says texting increases reaction time more than conversation was not supported, because the results showed the opposite. One possible reason for this is that the subjects in the texting trials were better able to hear the sound cue than in the conversation trials since there were no other sounds that could have distracted the subjects with the texting. This was a possible factor that was not considered in the experiment; because the subjects' main purpose was react to a sound, not a sight. But since there would be no way to put the subjects under exact outside simulation to test for reaction time, the sound cue was a good method of testing the differences in reaction times. Plus, all constants and methodology had to be kept the same in order to be able to compare between the variables of texting and conversation. So what worked for one condition might not have been appropriate for the other. Usually, under real-life driving conditions, the subjects would have to visually react to a stimulus when speaking while looking at the road, but they would have to react to a sound when looking away from the road while texting; and usually, vehicle accidents can occur when another driver, such as a drunk driver, is about to collide with the texting driver, but if the texting driver does not see the other vehicle coming, he/she could possibly not be able to react in time. But the main part of the project was to make comparisons, not to prove that one condition had to have more effect than the other does, although that was part of the plan. And in this case, the values of the experimental trials were greater than the values of the control trials, which supported that part of the hypothesis. So the data supported the majority of the intended hypothesis.

Graph 1 and Graph 2 show the average reaction times for each individual subject. Overall, the subjects showed an increase of reaction time in the experimental condition, but the reaction times of the texting were less than the reaction times of the conversation. This could be for the same reason of the sound cue in the different conditions.

Graph 3 and Graph 4 show the means of the averages of the raw data for the experimental and control conditions for conversation and texting, respectively. The results of these graphs showed similar data overall in comparison to Table 1, Table 2, and Table 3, Graph 1, and Graph 2. They both showed an increase of reaction time in the experimental condition, but the values of the texting was less than the value of the conversation. And again, this could be attributed to the subjects having the advantage of hearing the sound cue alone, with no other sounds.

Table 4 shows a survey taken by Pew Internet and American Life Project. It shows that older teens were the largest groups of people to have been driving with a texting or using cell phone, to have talked while on a cell phone, and to have texted while driving.

Graph 5, from the U.S. Department of Transportation National Highway Traffic Safety Administration, shows the number of motor vehicle deaths of 100, 000 people in 2006, and it shows that the highest rates were between ages 20 and 24. So most of the data did not show that texting-increased reaction time more than conversation. It showed the opposite, and the reason could have been the methodology. Although, data did support that conversation as well as texting increases reaction time; and all of the data showed high significance from the T-tests.

So, the purpose of this project was determining whether or not engaging in a conversation and texting adversely affects reaction time, and examining the effect that it has on human accidental injuries such as car accidents. The actual testing in this project was between cell phone use and reaction time. The part about vehicle accidents is an inference based on the findings that many other studies that have been found, in which distractions increase the risk of collision. The goal of this experiment was to test the distractions, and in this case, the relationship between reaction time and cell phone use. The four test results that were conducted all supported the data of the experiment. For the T-tests performed on the averages of the raw data for the reaction times, the results were 99.99% significant for the conversation, and 99.97% for the texting. Also, a non-parametric Wilcoxon signed rank test, a test that does not require data to be normally distributed, was conducted on the data. It was conducted on the averages of the raw data as well. The results were 99.2% for the conversation and 99.95% for the texting. The data was supported as far as the results of the T-test, because the T-Test results were close to 100% significance. A reason for why the results were so significant are that a lot of constants were kept as constant as possible, such as using the same starting position to swing the target marker. The reaction times were greater in the experimental conditions than in the control conditions for the texting and the conversation. This supports that both variables increase a human's reaction time. But texting reaction time was less than conversation in the experimental condition, because the subjects in the texting had the advantage of no added noise before the sound cue. According to some the findings of many studies, who have found that reaction time increases the risk of collision, it could be said that since conversation and texting increased reaction time, they could be one of the major cause of vehicle accidents.

This project experimented with hands-on cell phones. The research conducted by David Strayer with assistants in 2001, showed that hands-free cell phones are just as distracting as handheld cell phones.

In this project, some of the subjects failed, or did not attempt to hit the target marker, under the main condition that they did not hear the sound of the buzzer during the experimental condition, because they were too engaged in the cell phone conversation. Similarly, a driver on the road could fail to turn the wheel of the vehicle before crashing into another object or car, causing a vehicle accident. Research completed by Frank Drews and colleagues' shows that drivers who talk on their cell phones could be looking straight at the road but not really paying attention to it, and they aren't aware that they are impaired because of the divided attention from the cell phone conversation.

Future study could include doing trials with hands-free cell phones, conducting the project with the subjects' feet as another variable, using a larger representative sample, performing future experimentation on more various driving ages such as the elderly instead of the young and middle ages, or possibly changing the methodology to suite both conversation and texting (such as using a different cue than a sound cue, to give the same advantage to subjects for all conditions).

Overall, most of the data and the significance tests of the experiment supported the hypothesis. And hopefully this research can be considered with other studies, as well as aid in enforcing government laws in every state concerning conversation as well as texting.

References

Ashcraft, Mark H. *Cognition*. Fourth ed. Upper Saddle River: Pearson Education, 2006. Print.

"Cell phones and Driving." Insurance Information Institute. June 2003. 17 Jul 2008.

Corkern, Jim. "Moister and Your Cellphone." Articlesbase Free Online Articles Directory 2005-2008

"Gender and age differences in psychomotor vigilance performance under differential sleep pressure conditions." Medscape 1994-2008

Hoffman, Howard. "Null Hypothesis." Statistics Explained, Internet Glossary Of Statistical Terms.

Kent, Peter. "Cell Phone and Automobile Accidents on the Rise." Articlesbase Free Online Articles Directory 2005-2008 18 Jul 2008.

Madden, Mary. "Teens and Distracted Driving -." *Pew Research Center*. 16 Nov. 2009. Web. 12 Jan. 2010.

Quinn, Levi. "Avoiding Car Accidents." Articlesbase Free Online Articles Directory 2005-2008.

"Significance in Statistics & Surveys." The Survey System. 2007-2008.

Stewart, Douglas. "The Growing Problem of Cell Phone Addiction." Articlesbase Free Online Articles Directory 2005-2008.

"Teens who text and talk while driving | Pew Internet & American Life Project." Pew Research Center's Internet & American Life Project. Web. 11 Jan. 2010.

"U News Center The University of Utah." Drivers on Cell phones are just as bad as Drunks.

Links to Pictures and Videos

Video of Evart Simulation of a Human Subject Performing the Task of hitting the target:

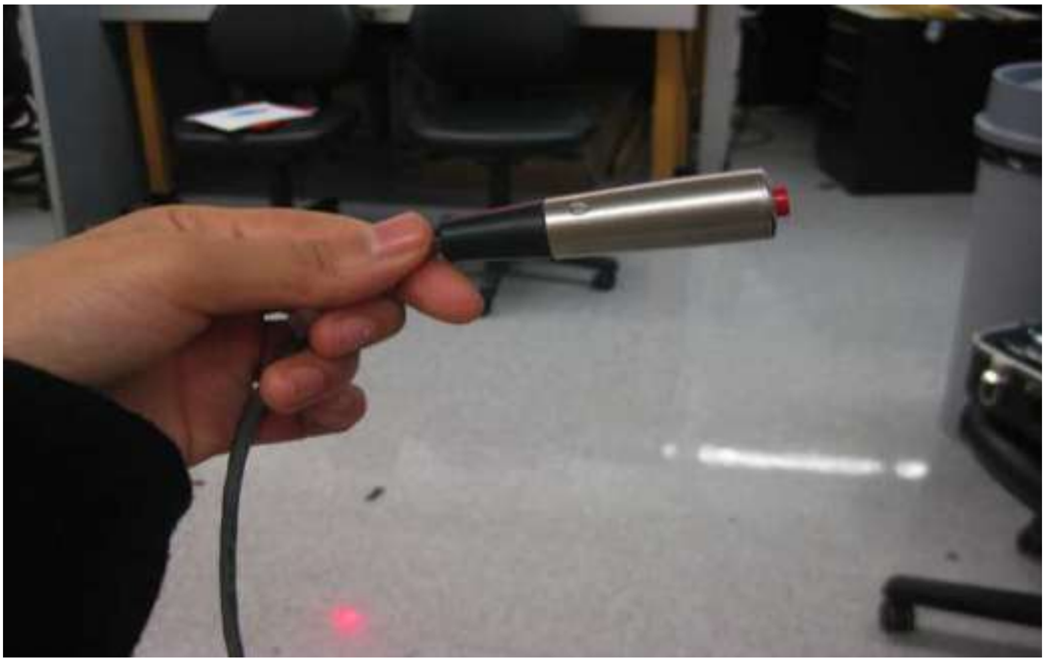
http://ees.elsevier.com/jerg/download.aspx?id=57487&guid=05e7bf2a-26e6-4479-ab25-81690b21a31d&scheme=1

Another Evart Simulation:

http://ees.elsevier.com/jerg/download.aspx?id=57488&guid=2e9a89b4-bbab-4ad3-88e3-10fbd1c416f4&scheme=1

Buzzer:

http://ees.elsevier.com/jerg/download.aspx?id=57491&guid=83b5d2f2-28bf-4419-b0f3-3937d892bfdf&scheme=1

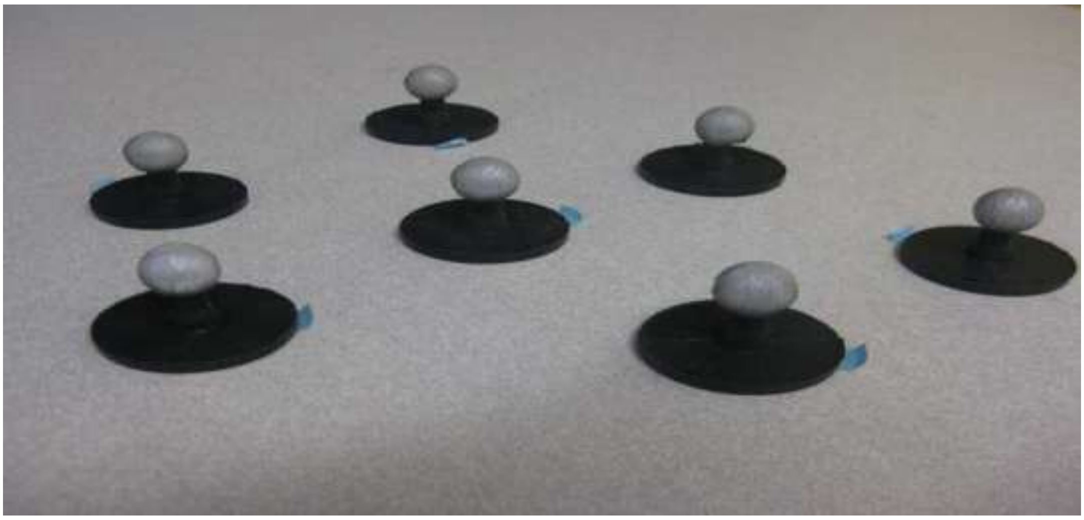


Optoelectronic Camera:

http://ees.elsevier.com/jerg/download.aspx?id=57493&guid=ec67d998-ef54-414e-9b80-d6cdbbfc378a&scheme=1

Markers:

http://ees.elsevier.com/jerg/download.aspx?id=57494&guid=5fa74f50-2e12-4655-b722-38c32e771095&scheme=1



Actual Subjects:

http://ees.elsevier.com/jerg/download.aspx?id=57495&guid=d2937f5d-9062-4bdf-81ae-9cf74dfc6de6&scheme=1

http://ees.elsevier.com/jerg/download.aspx?id=57496&guid=3248190f-6bdb-47d0-bdb1-c133686f574c&scheme=1

Laboratory Room:

http://ees.elsevier.com/jerg/download.aspx?id=57497&guid=72101b66-2b00-4e1b-a0e6-03e846df797a&scheme=1

Authors:

Mariam Abbas:

Currently an undergraduate student studying at the University of Washington for an exchange program, with University of Kentucky as being the home institution. Majoring in Chemistry and Biology on the pre-med track. In addition, planning on applying to medical schools on the summer of 2013.

Institutional Affiliation: University of Washington, University of Kentucky, University of Louisville, Bellarmine University

Country: United States

Email: maa25@u.washington.edu

Peter M. Quesada:

Dr. Peter M. Quesada is a Professor of Mechanical Engineering at the University of Louisville. He received his B.S. Degree in mechanical engineering from the University of Texas, and his M.S. and Ph.D. degrees in Bioengineering from the University of California, and his research activities lie in the general area of biomechanics. Specific interests include kinematics and kinetics of human motion, plantar foot surface loading, and biomechanical instrumentation. Dr. Quesada has published and presented papers on such topics as post-surgical kinematic and kinetic assessment of anterior cruciate ligament reconstruction, finite element analysis of a below-knee prosthesis, and evaluation of silicone gel filled orthotic shoe insoles. Dr. Quesada's background includes research affiliations during his graduate studies with the Rehabilitation Research and Development Services of Veterans Affairs Medical Center in San Francisco and the Department of Orthopaedics at the U.S. Naval Hospital in Oakland. After completing graduate studies, he worked one year as a Senior Research Associate Engineer in the Ohio State University Gait Analysis Laboratory and the last three years as an assistant professor in the Division of Orthopaedics in the Biomedical Engineering Center.

Institutional Affiliation: University of Louisville, University of California, University of Texas

Country: United States

Email: pmquesada@louisville.edu

David Morgan:

David Morgan earned his degree in experimental psychology from Auburn University in 1988, with an emphasis in human operant behavior. He is currently a full professor at the School of Professional Psychology and a faculty member in the Applied Behavior Analysis program. His primary area of expertise is behavior analysis, with an emphasis in human operant behavior. He maintains interests in behavior theory, single-subject research design, and the impact of human behavior on the natural environment. His recent textbooks include Essentials of Learning and Cognition (Waveland Press, 2007), and Singe-Case Research Methods for the Behavioral and Health Sciences (Sage, 2009) coauthored with Robin K. Morgan of Indiana University Southeast.

Institutional Affiliation: Spalding University

Country: United States

Email: dmorgan@spalding.edu