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Qualitative and Quantitative Analyses of Drivers Attitudes towards General Usability of Smart Technology Specific to the Secondary Task of Texting While Operating a Vehicle

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Qualitative and Quantitative Analyses of Drivers Attitudes towards General Usability of Smart Technology Specific to the Secondary Task of Texting While Operating a Vehicle

by

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Bachelor of Science
Psychology
University of Central Florida
2009

A thesis submitted to the College of Aeronautics at
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In partial fulfillment of the requirements for the degree of
Master of Science
in
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We the undersigned committee hereby recommend

that the attached document be accepted as fulfilling in

part the requirements for the degree of

Master of Science of Human Factors in Aeronautics.

"Qualitative and Quantitative Analyses of Drivers Attitudes towards General Usability of Smart Technology Specific to the Secondary Task of Texting While Operating a Vehicle"

a thesis by Indira Maharaj

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Abstract

Title: Qualitative and Quantitative Analyses of Drivers Attitudes towards General Usability of Smart Technology Specific to the Secondary Task of Texting While Operating a Vehicle

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The purpose of this study was to assess the qualitative and quantitative analyses of driver's attitudes towards general usability of smart technology specific to the secondary task of texting while operating a vehicle for university students, aged 18-35, at the Florida Institute of Technology main campus in Melbourne, Florida. A mixed methods research design was utilized to gather data. The qualitative data were measured using content analysis, and the quantitative data were measured using descriptive and inferential analyses. The general consensus of both the quantitative and qualitative data showed that the majority of participants were satisfied with using smart technology to assist with the task of texting while operating a vehicle. While there were certain similarities between this current study and previous studies, there were also certain differences as well. This study focused specifically on the smart technology and its reception as opposed to the participant, or human user. The general trend of this study was that even though participants

agreed that modifications could be made, they still expressed a level of fondness with regards to using smart technology regardless of its flaws.

Table of Contents

List of Tables

Acknowledgement

This thesis would not have been possible without a few key members. Respectfully, I would like to thank the members of my thesis committee, Dr. John Deaton, Dr. Paul Buza, and Dr. Mark Harvey for their time, encouragement, and expertise throughout this project. Special thanks to the chair of my committee, Dr. John Deaton, for his exquisite attention to detail and for his demand for excellence.

Dedication

I would like to dedicate this fruit of my labor to the usual suspects: First and foremost, my amazingly talented thesis committee. For without their, patience, guidance and expertise, of course, none of this would be possible.

Second, my friends and family; with specific emphasis on my younger sister, Suni, who is by far, one of *the* coolest people that I know. You're a constant inspiration and motivational force for me. I hope to make you proud, know that I'll *always* be there for you, and I love you like the fat kid loves cake.

Third, I would like to dedicate this, for what felt at times like a Sisyphean task, to me. I hope this serves as a constant reminder than nothing outside of me is ever bigger than what is within me.

Finally, to Frank, my pet fish, who is no longer with us, you were always so much more than just a mere beta fish. To me, you were a true friend, a confidante, and a constant source of support. This is for you too, Frank!

Chapter 1: Introduction

A texting driver is 23 times more likely to get into a crash than a non-texting driver. The average text takes a driver's eyes off the road for nearly five seconds. When traveling at an average speed of 55mph that is enough time to cover the length of a football field. The aforementioned statements bring attention to the fact that texting while operating a vehicle is not what is so commonly believed to be multitasking, but rather, more accurately described as driving blind (http//www.adcouncil.org).

On average, about one million people text while operating a vehicle each day owing to social pressures and the ever-growing expectation to remain in constant contact, even when behind the wheel. Often enough, drivers either choose to simply disregard, or just do not realize, the very real and ever-present mortal threats that they are faced with when they take their eyes off the road and their hands off the wheel, to focus on the secondary task of texting while operating a vehicle. When practicing safe driving behavior, the driver's attention should always remain on the primary task of driving, and should never be divided between a secondary task (http//www.adcouncil.org).

Owing to the advent of smart technology in vehicles, drivers are now equipped with copious amounts of options that enable them to engage in secondary tasks while operating a vehicle, and in the process, continually breathe life into the myth of multi-tasking. This is no different for texting. Texting was initially introduced into our vehicular lifestyle through tactile cellular phones.

As technology unremittingly evolved, cellular phones advanced from its traditional tactile format to what it is now; the haptic smart phone. Smart technology is made available to the driver either through the enable software that is provided within vehicles today, or through cellular phones. Either option allows the driver more liberties to engage in an attempt to execute secondary tasks. Secondary tasks can be activities ranging from adjusting stereo and volume settings within the vehicular cabin, to making phone calls on the part of the driver all through an audible command.

Specific to this study, the main focus of a secondary task remained on texting while operating a vehicle. The marketing strategy behind the introduction of smart technology and advocacy for its usage is based on the claim that it allows the driver to safely multitask while never having to take hands-off-wheel or eyes-off-the-road. And for the most part, while this may be true in that it enables the driver to physically maintain the most optimum position for the primary task of driving, it still does not altogether eliminate the few random seconds in between that the driver may take their eyes off the road to visually oversee the task which was audibly commanded previously.

Additionally, while this may sought to solve the dilemma of physical posture, it introduces another problem in that it adds to the driver's mental workload. When mental workload (WL) increases, the driver's mental faculties are met with greater demand. This affects the driver's ability to be as aware of the environment in which they are occupying. This is known as decreased situation awareness (SA). When WL increases, SA decreases, and performance is negatively affected (Hendy, 1995). With this being said, this study explored the user's attitude towards general usability of smart technology specific to the secondary task of texting while operating a vehicle.

Statement of Problem

The inspiration for this study came from my personal experience of driving while simultaneously trying to successfully use smart technology to text various people. On many occasions, I have found that I had to pull off the roadways as my smart technology did not understand my command, or more often, misunderstood my command and started texting someone that I had no desire to contact.

This made me ponder the effectiveness of this modern luxury. There have been countless scenarios in the past where I have simply gotten frustrated and overwhelmed with attempting to send a text message via audible command, that I have more often than not regressed to either pulling off the roadways, or waiting until I was stopped at a traffic light before I proceeded to manually type and send my text.

Based on my experience, I found myself wondering how many other drivers share in my sentiments of this so-called smart technology that is supposed to assist in the ease of executing secondary tasks while operating a vehicle. The impetus behind this idea was to gain a better understanding of just how effective and efficient drivers really find smart technology to be in assisting them specifically with the secondary task of texting while operating a vehicle.

The subject of texting while operating a vehicle is a very popular one. So much so, that much research has been done on this topic, approaching it from varying angles. Hendy (1995) explored the psychological constructs that affect human performance. He found that rather than segregating the two constructs of workload (WL) and situation awareness (SA), they should be treated as different parts of the same collective. The importance of this study was that it proved that the mental process that goes into executing a task is not as clear-cut and well-defined as most would like. There are many facets that affect the thought process, which in turn affects what action or reaction that individual invokes.

Other studies sought to observe the physiological reactions and age associated with the division of the driver's attention between a primary and a secondary task (Mehler et.al., 2012; Monk et.al., 2004). Even different modal types were explored which observed preference of audio commands versus standard manual input, and tactile versus haptic (Ranney et.al., 2002; Scott et.al., 2008). Tijerina et.al., (1998; 1999; 2000) conducted multiple studies with various colleagues that observed if there is any correlation between how drivers perform on tests tracks and if this carries over into their everyday driving habits, to the actual attitude of drivers.

Based on the extensive research, the deficiencies seemed to lie in the fact that the devices were thoroughly studied, and the human mental model and performance were studied, but there seems to be a gap that actually accounted for how the users of these devices interacted with it in the real-world environment. Furthermore, the majority of these studies utilized quantitative methods that highlighted statistical data, but the driver using the smart technology is not merely just another statistic. This driver is a person. A person who does not only interact with the mechanics of this device, but also the emotional constraints that comes along with it; the frustration that accompanies the misunderstood verbal command, the elation that comes with the satisfaction of the well accomplished task on the first attempt.

More importantly, what was questionable was the way users really felt about using these devices without their expectations and experiences being biased by the opinions of external entities, such as the manufacturers who planted the idea that these devices were intended to make secondary tasks more manageable and accessible. Given the above, it was this researcher's opinion that a mixed methods study would be conducted in order to augment the pre-existing quantitative findings on this topic.

At any given point in time, there are numerous advertisements that seek to dissuade drivers from texting while operating a vehicle; and it seems as if the majority of these campaigns are geared toward the university-aged population, honing in and magnifying the frivolous and callous behavior that seems to be synonymous with this age group. This study was significant as it sought to explore how the primary target group, university-aged individuals, really felt about using these devices in terms of how useful it was in the moment it was required. By gaining a better understanding of the needs of the target group, this would potentially assist in the future of the development process in making better human centered designs.

Purpose Statement

The purpose of this study was to assess the qualitative and quantitative analyses of the drivers attitudes towards general usability of smart technology specific to the secondary task of texting while operating a vehicle for University students at the Florida Institute of Technology main campus in Melbourne, Florida. For the duration of the study, the qualitative and quantitative analyses of the driver's attitudes towards general usability of smart technology specific to the secondary task of texting while operating a vehicle was generally defined as the driver's ease of device usability.

This leads into chapter 2, where I discussed and did a brief review of the current literature available on my thesis topic. I also highlighted the deficiencies of these pre-existing studies, and what my topic addressed to supplement this information.

Chapter 2: Literature Review

Society today has evolved exponentially with the advent of technology. Technology now allows us to accomplish many more tasks within a traditional 24 hour day whereby increasing our production levels ten-fold. The driving theory behind the introduction of technology into everyday lives is that it seeks to increase human performance by decreasing our overall workload (WL), as it increases situation awareness (SA), or at the very least, does not hinder it; or so it seems in theory.

Specific to this paper, I focused on smart technology that is now made available in vehicles of most standard makes and models, in relation to the task of texting while operating a vehicle. Smart technology is a generalized term used to classify all types of technology that can be used in cars that do not require the driver to take their hands off the wheel of the car, or take their eyes of the road.

The concept behind this type of technology is that it is supposed to increase driver performance, thus reducing the probability for road accidents or incidents, by ensuring that the driver remains focused on the primary task of driving while the smart technology handles secondary tasks. Again, although most smart technology is capable of adjusting car temperatures inside the cabin, adjusting the volume levels on the stereo system, changing radio stations, and answering mobile calls through the car's Bluetooth system via its speakers, to name a few, the main focus of the secondary task discussed in this paper remained on texting while operating a vehicle.

Using smart technology, drivers can now audibly command smart technology to do the task of texting simply by pushing one button that is usually, either located on the steering wheel of the car, or on the dash-console, and saying out loud the name of the person they want to text and the message that they want to send. Supposedly, through this feature, the driver is provided with the option of giving an audible command to execute a secondary task, all while still being capable of maintaining focus on the primary task at hand.

The problem with this idea is that while it aims to ensure that the driver maintains a specific physical posture such as "hands-on-the-wheel, eyes-on-the-road", it does not account for the cognitive model of the driver. The cognitive model of the driver defines the driver's level of attention that is attributed to road tasks at hand. This primarily determines that the driver's performance is mainly affected by the driver's level of SA, which in turn is directly affected by the level of WL being experienced within the specific task of driving.

Theoretically, smart technology aims to decrease the driver's WL as it can successfully perform a secondary task on the part of the driver, ensuring that the driver remains focused on the primary task of driving. With WL being decreased, SA is supposed to increase, as the driver can now be more aware of the environment in which they occupy as opposed to executing the secondary task. When SA and WL synchronize, performance is considered optimum.

Current Research

Keeping this in mind, Hendy (1995), exemplified this notion when he stated that rather than SA and WL being treated as two separate constructs, it should be classified more appropriately within the same category being that these two constructs directly relate and affect the other. By gaining a basic understanding of the relationship shared between these two constructs, one can clearly see how this can affect the driver's ability to successfully execute a secondary task when burdened with the primary task of maintaining proper road etiquette when behind the wheel. In this case, proper road etiquette would be considered the practice of safe driving behaviors, and in turn being conscientious to the many other drivers that share the roadways by practicing safe driving habits.

One heated debate that discusses safe driving habits relates to the main topic at hand which is none other than texting while operating a vehicle. Texting while operating a vehicle is a leading cause for countless road accidents and fatalities that occur across the country. There are now a myriad of government websites that are dedicated to providing statistics related accidents due to texting while operating a vehicle; all urging drivers, and especially younger drivers, to avoid texting while operating a vehicle.

Tijerina (2000) cited in a recent study, stated that the best proactive measure with regards to smart technologies and its effects on driver performance is to begin by eliminating the trends of improper driving behavior, while simultaneously improving the smart technology product as well. Tijerina's study was rather impressionable in the sense that instead of following the standard procedure of assessing the technological component, he sought instead to look at the human component that interacts with the technological component. He capitalized on the idea that the human component can be viewed as the variable within this equation, while the technological component can be viewed as the constant.

What can be inferred from this is that there is no uniformed approach to understanding how every mental model will process and understand how to successfully interact with every piece of technology that they interact with. Keeping this in mind, the design process becomes a little more challenging now as there is no generalized blue-print to be followed when producing smart technology. Tijerina remedied this dilemma by posing that designers change their approach altogether as the focus should now be redirected to the user, or in this case, the driver. By ensuring that the driver practices safe driving behaviors, this when combined with the use of technology can lead to a more successful relationship as the driver is now better aware of the primary task at hand, which remains safe driving.

While it appears as if Tijerina was on to something here, the deficiencies lie in the lack of suggestions to improve or groom better driver practices while operating a vehicle. Within the proposed study, it is the aspiration that a better understanding of current driver practices can be ascertained through gaining a better understanding of the average driver's mental model towards driving, as well as towards secondary tasks while operating a vehicle such as texting. Surveys can be used as a tool to gather such information.

A study previously conducted by Tijerina et.al., (1999) may have provided the answer for being able to train drivers with better driving behavior. In this study, participants were assigned with driving through a course while simultaneously interacting with the car radio, a cell phone, and a GPS device. Their performance was gauged on the course test, and then they were given a battery of perception and cognitive tests. The study showed that when the results of both and battery of the tests and the performance on the driving course was compared, the test battery reflected the performance on the driving course.

This study can be useful being that it has provided researchers with a measure that is capable of producing results that can be predictive of driver performance. Armed with the capability to deduce predicted performance, researchers can not only gain a better understanding of the drivers cognitive model, but can also apply this to the development process of smart technology, keeping the human mental model paramount in the design process.

The deficiency with this study was that it focused a generalized format for perception and cognitive tests. With the proposed study, the goal is to gain a specific understanding of the driver's attitude towards using smart technology while operating a vehicle, and overall usability such as level of stress and attention experienced and required when doing a specific task such as texting using smart technology while operating a vehicle.

Alternatively, when considering the design process involved in smart technology production, another factor designers need to consider is the actual way that it can communicate with humans and how humans can communicate with it, or in other words, input devices. Tijerina et.al., (1998) found that the best method for input devices would be voice input. They conducted a study to assess the interaction of users between voice input and manual input using a GPS device. It was found that the voice input required less time with eyes off the road, glanced at the device less, and swerved out of their lanes more.

With regards to the current study at hand, the study by Tijerina et.al., (1998) supports the fact that drivers prefer to interact with smart technology via voice commands. However, it does point out that it still requires the same amount of input time. A deficiency with the aforementioned study is that it does not account for drivers attempting to correct misinformation perceived by the smart technology while operating a vehicle. The point of the intended study is that it hopes to remedy this deficiency by focusing on this point and gauging participants' response to this dilemma.

One of the main points of smart technology is providing the driver with the ability to perform secondary tasks, such as texting, through voice command without distracting the driver from driving. When considering the advantages of voice command smart technology, one of the main arguments that is advocating in this direction is the claim that voice commands allows the driver to sustain the main focus on the primary task at hand, which is driving and being attentive to road responsibilities such as being aware of other drivers, staying in the designated lane, going along with the flow of traffic, and so forth.

Ranney et.al., (2002), conducted a study that focused on the reduced driver performance as a result of performing secondary tasks while operating a vehicle. The secondary tasks were performed using voice-based and visual/manual interfaces. The results founded that voice command technology reduces the peripheral impairment that a driver can experience as the driver tries to maintain a visual on the secondary task. However, attentional impairment was still a problem.

Even though voice command solves the problem of assisting the driver in maintaining more eye contact on the roadways, it still demands a certain amount of mental occupancy. Increased mental occupancy can be hazardous to drivers safety as it essentially reduces SA of the road environment that the driver is currently occupying, while simultaneously increasing WL. When SA decreases and WL increases, the prospect of performance being negatively affected is now far greater.

Another interesting point raised by this study is the mere importance of the secondary task to the driver. The deficiencies of this study was that it only proved that the driver can be distracted using either device, but did not suggest solutions to driver distraction when using either. Furthermore, the importance of secondary task is arbitrary when considering that it is specific to each individual, rather than being general.

With specific regards to current study at hand, age may affect the importance of engaging in the secondary task. Based on the data that were collected, it is anticipated that there may be some form of similarities amongst what a university population may deem as important enough to attempt to partake of the task while operating a vehicle. It can be assumed that maintaining a priority of what is important may change as drivers get older. For example, a secondary task that may be considered as important for a teenage driver, such as replying to friend's text about a superficial matter immediately upon receiving the text, may not be considered as urgent for an older driver who may opt to respond to a text from a friend maybe at a stop-light, or if at all while operating a vehicle.

This leads into another interesting aspect related to usability as smart technology, and that is age. Mehler et.al., (2012) conducted a study to test if there was a difference amongst how older drivers handled road stressors versus how younger people handled it. Of course, a requirement for his study was that all participants be in good general driving health. This study focused on three age groups ranging from the 20's, 40's, and 60's.

The objective was to gauge if there are any difference in the physiological responses of the participants under different levels of cognitive demand while operating a vehicle. The physiological measures being tested were heart rate (HR) and skin conductance level (SCL), which gauges perspiration production through increased cognitive demands. The results of this study indicated that age did not play a role in determining whether there was an increase of HR of SCL. The physiological factors were more influenced by the cognitive demands placed on each driver.

What this study reiterates is that driver performance cannot be generalized based on age, as age cannot be used as a predictive tool to deduce whether of not the driver's performance will be impacted negatively or positively. An interesting point that results form this is the idea that some older drivers adapt to smart technology better than others, and this is based more personal preferences and lifestyle, such as whether the individual is more active with other forms of technologies in the everyday life such as using the internet and so forth; and this could be true for younger drivers as well.

Conversely, Monk et.al., (2004), questioned whether age had any effect of distraction recovery. This study focused on driver distraction specific to recovering from interruptions which come about when the driver switches between road tasks and in-car tasks, such as observing traffic flow and dialing on a cell phone. The participants included a younger age group versus and older age group. The results indicated that the older participants recovered less quickly than the younger participants when switching between tasks and an interruption occurred.

Another noteworthy part of this study is that it points out that the primary distraction is not always the road at hand, but whatever task that the driver is currently engaged in. What is thought-provoking about this is the common notion that people often cite which is that they have extremely good driving skills, and they are quite proficient in multi-tasking; such as when texting while operating a vehicle.

This highlights the idea behind novice versus expert (driver), as well as the roles of short-term memory (STM) and long-term memory (LTM). For example, drivers always claim that their years of experience on the road will compensate for their divided attention between primary and secondary task.

However, this may not always be accurate. For example, a road that is driven rather frequently with minimal traffic may be far easier to engage in a secondary task. Compare this to a road that is not familiar at all, or even a traffic-congested roadway; in these scenarios, engaging in a secondary task may be more demanding on the driver's cognition.

Drivers also claim to be better at executing secondary tasks that they have engaged in countless times in the past. This is then falsely attributed to driving skills and driving experience as opposed to what it could really be; and that is memory. A driver that engages in the same task habitually can eventually commit that task to LTM. When something is committed to LTM, it requires less immediate attention to successfully complete the task. However, when a driver is task with something that is not done as often, the driver then relies on STM to help process and execute the task.

Again, the deficiency of this study is the amount of variables unaccounted for; meaning that age and skill, or recovery, varies on individualistic experiences and less on chronological age. As stated previously, the current study at hand will seek to observe the general attitudes towards age and technology, but the drawback remains the limitation of a campus population in terms of age constraints.

Complementary to the intended study at hand, an alternate consideration to be addressed is the effectiveness of how this smart technology communicates with the driver. It is already understood the input devices these technologies are equipped with, such as voice activation etc., but what is to be further explored is the confirmation that the driver may receive from the device that assures the driver that the command was received. The standard audible command seems to be the most popular way for communication currently, but what about other hindrances that may intercept this confirmation communication such as road noises, the noise levels passengers in the vehicle, the volume of the stereo, or even if a call is currently underway. It may serve well to consider other various modes of reciprocated communication such as tactile, or a vibration to the steering wheel of the car.

Scott et.al., (2008), conducted a study to determine the most effective type of warning system for driver collision prevention; tactile, visual, or auditory. The results found that driver's who were warned through the tactile condition had a faster reaction time, thus giving them more time to prevent the collision. This study also concluded that more research was required in order to establish the best method of making tactile warning available to the driver.

Although this study was specific to the prevention of rear-end collisions, much can be learnt from what was gathered from the study. Based on this, it seems as if the best method to gain the attention of the driver the quickest would be through some form of physical contact, or some external environmental stimuli alerting the driver to the impending dangers ahead.

Similarly, to slightly mitigate the attentional paucities brought about by communication deficits between driver and smart technology, in addition to providing an audible confirmation, smart technology should also be equipped with alternative means of communicating effectively such as tactile responses. Gathering information on the types of confirmation that the driver receives, and their preference, from the smart technology being used will also be included in the current study.

In summation, the majority of these studies focused on many variation of driver distraction through secondary tasks when in-vehicle. Amongst the variations discussed were multiple types of GPS devices, interacting with stereo systems, receiving and making calls on a mobile, using different types of mobile such as touch screens versus standard tactile, and even trying to complete tasks such as following directions to follow another vehicle currently on the road ahead of the driver. Based on the research and current literature available, there seemed to be a deficiency in understanding the usability of smart technology available in cars.

The current study that was conducted sought to gain a better understanding of the ease of driver usability of smart technology in cars. This proved to be a very valuable tool in gaining better insight into the cognitive models of drivers. As Tijerina et.al.,,., stated; a good place to start is with the human component and understanding human behavior. By doing so, drivers can be trained on better driving habits, and smart technology can be better designed with the drivers cognitive model in mind.

Thus far, I have introduced my topic of interest, reviewed and discussed the current literature available. From this literature, I have stated how my study was differentiated in what I sought to learn and add to the foregoing collective knowledge regarding my topic. This now leads into chapter 3, where I discuss my methodology. Under the methodology, I discussed the type of research design I utilized, the population of interest, the sampling procedure used to collect data, and lastly, the data analysis procedure.

Chapter 3: Methodology

Experimental Design

For the purpose of this study, I employed a mixed methods research design. By combining both these methods, not only did they reinforce each other, but it also strengthened the data collection in that one method uncovered important features that other method omitted. For example, the quantitative results provided the general attitude of participants towards the ease of device usability, while the qualitative results allowed the participants to provide input on device modifications.

Population and Characteristics

I chose to target the Florida Institute of Technology University population as my participant pool mainly based on the fact that the majority of drivers that text while operating a vehicle using smart technology falls within this age bracket (i.e.18-35 years). This study was opened to any participant that fell within the designated age range, gender, ethnicity, and college year. Obviously, the education level would have either been undergraduate completion, or in progress, and currently enrolled graduate students.

Sampling Method

The participants were recruited via a class announcement made by selected professors who taught at this institution. They offered class extra credit in exchange for their students' participation in this study. Additionally, the study was made available via SONA; an online resource available to students. SONA is a website that allows experimenters to post links to gain access to surveys once the study has been approved by the Institutional Review Board (IRB). Once on SONA, the link provided redirected students to a website known as Qualtrics where they gained access to begin the survey.

In order to qualify to partake in the study, participants had to be familiar, if not use on a daily basis, smart technology to assist them in texting while operating a vehicle. This was determined by requesting that the professor state this as the main and only criteria for participation. SONA displayed these criteria as well.

Measures

A brief survey of 26 questions that requires no more than 30 minutes to complete was made available to the participants on a free survey website known as "Qualtrics". The survey began with an informed consent document. Once the participant provided consent, they continued on to 12 quantitative questions on a 5-point Likert scale. Each question was designed on a scale ranging from "Strongly Disagree" at 1, to "Strongly Agree" at 5. Ten qualitative questions followed with a box below each question for participants to write their answers. The survey ended with 4 demographic questions that are mentioned below. The age demographic was left open-ended so that participants could enter their age, rather than select from a category grouping. For example, instead of selected a category grouping of 18-25 years, the participant simply entered their age in numbers.

The quantitative data was measured using an independent samples t-test. A descriptive analysis was performed where means and SDs was reported for all 12 questions. The responses gathered from the Likert scale survey was grouped into categories. Based on the multiple categories for the demographics, the analysis for these data consisted of an independent sample t-test, a linear regression analysis, and one-way ANOVAs. The number of respondents per each category determined which tests were used. That is, while the survey broke down demographics into multiple categories, the type of test used was determined by the category of demographic. For example, an independent samples t-test was used for gender. A one-way ANOVA was used for university level. A linear regression analysis was used for age, and a one-way ANOVA was used for ethnicity. Included below is table 1 that illustrates the demographic variables of interest.

The qualitative data was measured using a conventional content analysis where the comments gathered from the survey were grouped by themes to allow for binary coding. For example, one group had been those who had found the technology easy to use and was satisfied with its assistance, while a second group found it unhelpful and frustrating to use.

Table 1: *List of Demographic Variables of Interest*

Variables
Gender Male Female
Ethnicity White/Caucasian Hispanic/Latino Caribbean Islander Asian/Pacific Islander Native American Indian African American Other
Age 18 – 35
University Level Associates of Arts Bachelors Masters Doctorate

A power analysis was conducted for an ANOVA with 3 levels using G*Power (Faul et.al., 2009). The parameters of the power analysis are as follows: effect size = 0.25, power = .80, alpha level = .05. The power analysis, using the parameters above, indicated that the ideal number of participants should be no less than 100. Included below is a sample of the quantitative, qualitative and demographic questions that were on the survey:

Quantitative Questions: (5-Point Likert Scale: 1=Strongly Disagree, 5= Strongly Agree)

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I thought there was too much inconsistency in this smart technology.
5. I would imagine that most people would learn to use this smart technology very quickly.
6. I found the system very cumbersome to use.
7. I felt very confident using the system.
8. I needed to learn a lot of things before I could get going with this smart technology.
9. I think that using a hand's free system allows me to drive without distractions.
10. I feel that using smart technology makes it easier to text while operating a vehicle in comparison tactile technology.
11. I feel that I am more skilled at using smart technology to text while operating a vehicle than the average user.
12. I think that drivers who get into car accidents while using smart technology to text while operating a vehicle possess poor driving skills.

Qualitative Questions:

13. What is your general attitude towards using smart technology to assist in the secondary task of texting while operating a vehicle?
14. What do you think is the success of the execution of the secondary task of texting while operating a vehicle using the audible command function? (specific to device functionality)
15. How successful do you think you are at interacting with smart technology specific to the secondary task of texting while operating a vehicle? (specific to user functionality)
16. How often do you interact with smart technology?
17. How do you describe this experience?
18. How do you think that smart technology can be better modified to be more effective at the secondary task of texting while operating a vehicle?
19. How "user-friendly" do you find using smart technology to be?
20. How do you feel about sharing the roadways with other drivers who use smart technology to text while operating a vehicle?
21. Do you think that using smart technology makes it safer to text while operating a vehicle?
22. Do you think that a driver who got into a car accident while using smart technology to text while operating a vehicle has poor driving skills of just experienced difficulties using their smart technology?

*<u>Demographic Questions:</u>

*23. Please indicate your gender.

*24. Please indicate your age in number of years.

*25. Please indicate University level.

*26. Please indicate your ethnicity.

**Please note that options for all questions, excluding age, are included on the actual survey. This is illustrated in Table 1.*

Ethical Concerns

Once the participant has given consent to proceed with the study, concerns of mental stressors and increased mental workload may arise as participants try to mentally recall being in these situations. This may contribute to stress levels and cognitive concerns such as biased memories etc.

Alternatively, one could be concerned about whether a participant was previously or recently involved in an incident or accident that was caused due to texting while operating a vehicle, or whether perhaps they have lost someone due to this. This would definitely raise concerns as it would not only bias the data, but it can also rehash the emotional trauma and thus, cause the participant to become emotionally and mentally distressed.

Participants' behavior can also be affected post-study participation as participants are now confronted with the real threats that can arise from texting while operating a vehicle being that they have taken part in this study and are now much more aware of the situation from a personal perspective. For the most part, this study was done on a voluntary basis, and all information regarding requirements and expectations of participants were divulged before participants could commit to the study, during the recruiting phase.

Additionally, participants were made aware that they can rescind their voluntary commitment to this experiment at any point, before or during the experiment with no penalty or negative repercussion to them. Therefore, the risk was minimal as far as being recruited was concerned. Otherwise, the study seemed to be rather low-risk.

Significance of Study

At any given point in time, there are numerous advertisements that seek to dissuade drivers from texting while operating a vehicle; and it seems as if the majority of these campaigns are geared toward the university-aged population, honing in and magnifying the frivolous and callous behavior that seems to be synonymous with this age group.

This study was significant as it sought to explore how the primary target group, university-aged individuals, really felt about using these devices in terms of how useful it was in the moment it was required. By gaining a better understanding of the needs of the target group, this could potentially assist in the future of the development process in making better human centered designs.

This could mean that based on the information that was learned from this study, future designers would have a better idea of what functions within this feature works best and what functions should be altered, if not altogether eliminated from future designs. For example, after the text message has been sent, the driver often has to manually exit the software to get back to the main screen.

By learning from this study if this frustrated drivers, this is a design feature that can be remedied for future designs. In addition to the benefits that it can provide to the development process, it can also add to the pre-existing literature current on this topic, and thus adding to the overall knowledge base of this topic.

In this chapter, I discussed the type of research design I utilized, the population of interest, the sampling procedure used to collect data, and lastly, the data analysis procedure. In the next chapter, I will discuss the details of the results obtained from data collected via surveys administered to the participants. The results will be addressed in three sections: the quantitative data, the qualitative data, and the demographic data.

Chapter 4: Results

Data Tools

Data were gathered in the form of a survey that was made available to FIT students through the SONA and Qualtrics website. On both of these websites, the survey was placed on a timeframe that kept the study open to participants for one month.

The SONA website is a tool that experimenters use to display their studies as a means of recruiting participants. This website allows students to view, access, and participate in studies via surveys, or links to surveys, which have been posted. This website is exclusive to FIT's students and faculty. In order to have the link to my survey posted to this website, I requested approval from the university's Institutional Review Board (IRB), which was granted.

Once the link to the survey was posted on this website, it was open to any student who satisfied the age and university level criteria. The link on this website redirected students to the Qualtrics website, which is where my survey was available and the data were automatically stored. After it was successfully completed, the student was automatically given credit for their participation through the SONA website.

The Qualtrics website is a private research software company, and it enables users' access to a variety of online data collection and analysis options. The only criteria required to access the use of this website is student status. I created an account on this website linking it to my SONA account at FIT through my student email. At the end of one month, the data stored in Qualtrics were exported to Microsoft excel and SPSS, which will be discussed later in this chapter.

Data

A concurrent mixed methods design was used for the current study. The survey began with 12 quantitative questions, followed by 10 qualitative questions, and was concluded with a total of 4 demographic questions pertaining to gender, age, university level, and ethnicity. A sample of the survey can be found in the previous chapter under the Methods section. The data were exported from the Qualtrics data bank into Microsoft Excel and SPSS. Table 2 provided below illustrates the descriptive statistics of the demographic variables.

Table 2: Demographics, Frequencies, Percentages, Mean and SD (N=111).

Demographics	Number of Participants	Percentages	Mean	SD
Gender				
Male	36	32%		
Female	75	68%		
Age			28.18	4.38
18 - 23	17	15%		
24 - 29	52	47%		
30 - 35	42	38%		
University Level				
	23	20%		
Associates/Arts	75	68%		
Bachelors	12	11%		
Masters	1	1%		
Doctorate				
Ethnicity				
White/Caucasian	49	45%		
Hispanic/Latino	9	8%		
Caribbean Islander	16	14%		
Asian/Pacific Islander	11	10%		
Native American Indian	2	2%		
African American/Other	17	15%		
No Comment	7	6%		

Quantitative Data

There were a total of 12 quantitative questions, and a total of 111 participants (36 males and 75 females) between the ages of 18-35. These questions were presented on a 5-point Likert scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. The data were downloaded from the

Qualtrics website and imported into Microsoft Excel. Once in Excel, questions 2, 4, 6, 8, and 12 were reverse coded. Therefore, the points on the Likert scale would now reflect as: 5 = strongly disagree, 4 = disagree, 3= neutral, 2 = agree, and 1 = strongly agree. This was to ensure that upon data analysis, the results would reflect directional uniformity, and questions 2, 4, 6, 8, and12 would align with the direction of the results of questions 1, 3, 5, 7, 9, 10, and 11. Therefore, the higher the mean score, the greater was the agreement with the question.

After the data were reversed coded, it was uploaded into SPSS to conduct the data analysis. An overall t-test was performed which was not significance. Therefore, individual t-tests for all 12 questions were not done.

Table 3 below illustrates the data gathered for all 12 quantitative questions (hereinafter referred to as Q1–Q12), using the 5-point Likert scale relative to gender, and Table 4 provides the means (M) and standard deviations (SD) for all 111 participants for questions 1-12 (Q1-Q12). Means for each of the questions could range from 1 to 5.

For Q1 (M=4.02; SD=1.06), the data showed that 44 out of 111 participants strongly agreed with the statement "I think that I would like to use this smart technology frequently", 43 participants agreed, 12 were neutral, 8 disagreed, and 4 strongly disagreed.

For Q2 (M=2.01; SD=0.97), the data showed that 39 out of 111 participants equally strongly disagreed and disagreed with the statement "I found the smart technology unnecessarily complex", 23 participants were neutral, 7 agreed, and 3 strongly agreed.

For Q3 (M=3.92; SD=0.97), the data showed that 45 out of 111 participants agreed with the statement "I thought the smart technology was easy to use", 35 participants strongly agreed, 23 were neutral, 5 disagreed, and 3 strongly disagreed.

For Q4 (M=2.48; SD=1.06), the data showed that 36 out of 111 participants were neutral about the statement "I thought there was too much inconsistency in this smart technology", 35 participants disagreed, 22 strongly disagreed, 14 agreed, and 4 strongly agreed.

For Q5 (M=3.65; SD=0.89), the data showed that 49 out of 111 participants agree with the statement "I would imagine that most people would learn to use this smart technology very quickly", 30 participants were neutral, 19 strongly agreed, 13 disagreed, and 0 strongly disagreed.

For Q6, (M=2.30; SD=1.10), the data showed that 38 out of 111 participants were neutral about the statement "I found the smart technology very cumbersome to use", 35 participants strongly disagreed, 25 disagreed, 9 agreed, and 4 strongly agreed.

For Q7, (M=3.89; SD= 1.06), the data showed that 40 out of 111 participants agreed with the statement "I felt very confident using the smart technology", 37 participants strongly agreed, 20 were neutral, 9 disagreed, and 5 strongly disagreed.

For Q8, (M=2.12; SD=1.20), the data showed that 43 out of 111 participants strongly disagreed with the statement "I needed to learn a lot of things before I could get going with this smart technology", 36 participants disagreed, 15 were neutral, 10 agreed, and 7 strongly agreed.

For Q9, (M=3.63; SD=1.26), the data showed that 35 out of 111 participants strongly agreed with the statement "I think that using a hand's free system allows me to drive without distractions", 34 participants agreed, 19 were neutral, 14 disagreed, and 9 strongly disagreed.

For Q10, (M=3.41; SD=1.38), the data showed that 31 out of 111 participants strongly agreed with the statement "I feel that using smart technology makes it easier to text while operating a vehicle in comparison to tactile technology", 28 participants agreed, 25 were neutral, 17 strongly disagreed, and 10 disagreed.

For Q11, (M=2.95; SD=1.29), the data showed that 40 out of 111 participants were neutral about the statement "I feel that I am more skilled at using smart technology to text while operating a vehicle than the average user", 18 participants agree, 18 strongly agreed, 21 strongly disagreed, and 14 disagreed.

For Q12, (M= 2.76; SD=1.36), the data showed that 37 out of 111 participants were neutral about the statement "I think that drivers who get into car accidents while using smart technology to text while operating a vehicle possess poor driving skills", 28 participants strongly disagreed, 17 disagreed, 17 strongly agreed, and 12 agreed.

A general consensus of the quantitative data showed that the majority of participants were satisfied with using smart tech to assist with the task of texting while operating a vehicle as shown in Table 3.

Table 3: Quantitative Questions, Number of Participants on Scale of Agreement, and Gender (N=111).

Question	1= Strongly Disagree	2= Disagree	3= Neutral	4= Agree	5= Strongly Agree
Q1. I think that I would like to use this smart technology frequently.	4	8	12	43	44
# of Male	1	2	3	14	16
# of Female	3	6	9	29	28
Q2. I found the smart technology unnecessarily complex.	39	39	23	7	3
# of Male	9	11	10	4	2
# of Female	30	28	13	3	1

Q3. I thought the smart technology was easy to use.	3	5	23	45	35
# of Male	0	1	8	10	20
# of Female	3	4	15	35	15
Q4. I thought there was too much inconsistency in this smart technology.	22	35	36	14	4
# of Male	15	7	10	7	3
# of Female	7	28	26	7	1
Q5. I would imagine that most people would learn to use this smart technology very quickly.	0	13	30	49	19
# of Male	0	3	7	14	10
# of Female	0	10	23	35	9
Q6. I found the smart technology very cumbersome to use.	35	25	38	9	4
# of Male	9	6	11	5	2
# of Female	26	19	27	4	2
Q7. I felt very confident using the smart technology.	5	9	20	40	37
# of Male	0	3	7	10	15
# of Female	5	6	13	30	22
Q8. I needed to learn a lot of things before I could get going with this smart technology.	43	36	15	10	7
# of Male	10	11	4	6	3
# of Female	33	25	11	4	4
Q9. I think that using a hand's free system allows me to drive without distractions.	9	14	19	34	35
# of Male	2	6	2	9	15
# of Female	7	8	17	25	20
Q10. I feel that using smart technology makes it easier to text while operating a vehicle in comparison to tactile technology.	17	10	25	28	31
# of Male	5	3	4	8	14
# of Female	12	7	21	20	17

Q11. I feel that I am more skilled at using smart technology to text while operating a vehicle than the average user.	21	14	40	18	18
# of Male	14	2	10	5	10
# of Female	7	12	30	13	8
Q12. I think that drivers who get into car accidents while using smart technology to text while operating a vehicle possess poor driving skills.	28	17	37	12	17
# of Male	8	13	11	3	9
# of Female	20	4	26	9	8

Table 4: Mean and Standard Deviation of Quantitative Questions 1-12 (N=111)

Quantitative Question	*Mean*	*Standard Deviation*
Q1	*4.02*	*1.06*
Q2	*2.01*	*0.97*
Q3	*3.92*	*0.97*
Q4	*2.48*	*1.06*
Q5	*3.65*	*0.89*
Q6	*2.30*	*1.10*
Q7	*3.89*	*1.06*
Q8	*2.12*	*1.20*
Q9	*3.63*	*1.26*
Q10	*3.41*	*1.38*
Q11	*2.95*	*1.29*
Q12	*2.76*	*1.36*

Demographic Data

Gender

An independent-samples t-test comparing the overall scores of the 12 questions for males and females was conducted to examine the ease of smart technology device usability specific to the secondary task to texting while operating a vehicle. Means could range from 12 to 60. Means and SDs were calculated on the sum of the scores for all questions on the survey. There was no significant difference in scores for males (M = 44.11, SD = 6.25) and females (M = 43.54, SD = 7.24; t (109) = .401, p = .689). Given the insignificance of this finding, it was determined that conducting individual t-tests on individual survey items was not appropriate.

University Level

A one-way ANOVA was conducted to compare the scores for ease of smart technology device usability specific to the secondary task to texting while operating a vehicle for university level; Associates of Arts (AA), Bachelors (BA), Masters (MA), and Ph.D. There was no significant difference in scores for university level; AA (M = 37.44, SD = 5.13), BA (M = 35.56, SD = 469), MA (M = 36.00, SD = .0) and Ph.D (M = 36.91, SD = 5.11; F (3, 104) = .39, p = .754. Given the insignificant finding, no post hoc tests were conducted on these data.

Age

Since age was a continuous variable, a linear regression analysis was conducted to determine if age could be an accurate predictor of usability ratings. The results show that age was not a good predictor of device usability as defined by total score on the usability survey F (1, 104) = .573, p = .451, R^2 = -.004.

Ethnicity

A one-way ANOVA was conducted to compare the scores for ease of smart technology device usability specific to the secondary task to texting while operating a vehicle for ethnicity; Caucasian/White, Hispanic, Caribbean Islander, Asian, Native American, African American/Other, and No Comment. There was no significant difference in scores for ethnicity; Caucasian/White (*M* = 37.13, *SD* = 4.61), Hispanic (*M* = 34.44, *SD* = 5.48), Caribbean Islander (*M* = 38.75, *SD* = 4.97), Asian (*M* = 35.91, *SD* = 4.57), Native American (*M* = 35.50, *SD* = 6.36), African American (*M* = 37.41, *SD* = 6.08), and No Comment (*M* = 39.00, *SD* = 6.21; F (6, 101) = .983, p = .441. Given the insignificant ANOVA, no post hoc tests were conducted.

Qualitative Data

There were a total of 10 qualitative questions (see Table 5), and a total of 111 participants. A conventional content analysis was used to analyze the qualitative data. Using Microsoft Excel, it was then categorized and coded numerically, and was represented by frequency of responses and percentage. Each of the qualitative questions targeted specific concepts, so each question was categorized and coded in accordance to the nature of each individual question. Table 5 depicts the qualitative data by question, category, coding, frequency and percentage.

The manner in which the table is constructed below does not reflect the manner in which the participants viewed the survey. Participants were not allotted options such as category codes. They were simply posed with the question and answered in a short-answer type format. Based on these answers, three classifications emerged from the overall theme of the qualitative data as it was being analyzed. When the data were imported into Microsoft Excel, it was first categorized according to individual themes that emerged from each question.

The coding range, 0 – 3, was assigned as a means to organize and calculate the data after it were categorized. The response frequency was calculated using the coding range, as a means to reflect the qualitative results in a numerical format. For example, for Q1, 69 out of 111 participants were coded as satisfied (=0), 10 out of 111 participants were coded as need improvement (=1), and 32 out of 111 participants were coded as dissatisfied (=2). The percentages were calculated using simple math. For example, for Q1, 69 out of 111 participants were coded as satisfied (=0). To get the percentage for 69 participants, 69 was multiplied by 100 then divided by 111. This provided the percentage of 62%. Thus, 62% of participants were coded as satisfied (=0) for Q1.

For Q1, 69 (62%) participants out of a total of 111 claimed that they were satisfied with using smart technology to assist in the secondary task of texting while operating a vehicle, while 10 (9%) participants claimed that the smart technology that they were using needed improvement, and 32 (29%) participants claimed that they were dissatisfied with using smart technology to assist in the secondary task of texting while operating a vehicle.

For Q2, 72 (64%) participants out of a total of 111 claimed to be successful at the secondary task of texting while operating a vehicle using the audible command function, while 39 (36%) participants claimed to be unsuccessful at the secondary task of texting while operating a vehicle using the audible command function.

For Q3, 76 (68%) participants out of a total of 111 thought they were successful at interacting with smart technology specific to the secondary task of texting while operating a vehicle, while 35 (32%) participants thought they were unsuccessful at interacting with smart technology specific to the secondary task of texting while operating a vehicle.

For Q4, 92 (83%) participants out of a total of 111 claimed that they often interact with smart technology, while 17 (15%) participants claimed that their interaction with smart technology was not often, and 2 (2%) participants claimed that they do not interact with smart technology at all.

For Q5, 75 (67%) participants out of a total of 111 claimed that they had a positive experience with smart technology, while 29 (27%) participants claimed that their experience with smart technology was neutral, and 7 (6%) participants claimed that they had a negative experience with smart technology.

For Q6, 84 (76%) participants out of a total of 111 made suggestions for modifications for smart technology specific to task of texting while operating a vehicle, while 27 (24%) participants made no suggestions for modifications for smart technology specific to task of texting while operating a vehicle.

For Q7, 84 (76%) participants out of a total of 111 found that using smart technology was very user-friendly, while 18 (16%) participants felt neutral, and 9 (8%) participants found that using smart technology was not very user-friendly.

For Q8, 65 (59%) participants out of a total of 111 felt negative about sharing the roadways with other drivers who use smart technology to text while operating a vehicle, while 41 (37%) participants felt positive about sharing the roadways with other drivers who use smart technology to text while operating a vehicle, and 5 (4%) participants felt neutral about this.

For Q9, 60 (54%) participants out of a total of 111 agreed that using smart technology makes it safer to text while operating a vehicle, while 43 (39%)

disagreed that using smart technology makes it safer to text while operating a vehicle, and 8 (7%) participants felt neutral.

For Q10, 44 (40%) participants out of a total of 111 claimed that a driver who got into a car accident while using smart technology to text while operating a vehicle had both poor driving skills and also experienced difficulties using their smart technology, while 31 (28%) participants claimed that neither, or other factors, were to be considered, 20 (18%) participants claimed that the driver experienced technical difficulties, and 16 (14%) participants claimed that the driver possessed poor driving skills.

Specific to using smart technology to assist with the secondary task of texting while operating a vehicle, what can be summarized from the qualitative data is that out of the 111 participants, 62% claimed to be satisfied with using smart technology to assist in the secondary task of texting while operating a vehicle (Q1). Sixty-four percent thought that using the audible command function to text while operating a vehicle was successful (Q2). Sixty-eight percent claimed to be successful at interacting with smart technology specific to the secondary task of texting while operating a vehicle (Q3).

Eighty-three percent claimed to frequently interact with smart technology regularly (Q4). Sixty-seven percent described their experience with using smart technology as positive (Q5). Seventy-six percent made suggestions for smart technology modifications (Q6). Seventy-six percent found smart technology user-friendly (Q7). Fifty-nine percent felt negative about sharing the roadways with drivers who use smart technology to text while operating a vehicle (Q8). Fifty-four percent agreed that smart technology makes texting while operating a vehicle safer (Q9). Forty percent of participants thought that a driver who got in an accident either experienced technical difficulties while using their smart technology or had poor driving skills (Q10).

In summation, while the general consensus seemed to reflect the opinion that smart technology is well received, a few questions revealed interesting opinions in comparison to the others. While the majority in Q1 through Q5, Q7 and Q9 agreed that they were satisfied, successful and overall positive about using smart technology, Q6 and Q8 reflected that participants still agreed that certain modifications could be made to smart technology to make it more effective, and drivers still were not comfortable sharing the roadways with other drivers who use smart technology to text while operating a vehicle.

Table 5: Qualitative Questions, Categories, Coding, Response Frequencies and Percentages (N=111).

* Question	Category	Coding	Relative Frequency and Percentages
1. What is your general attitude towards using smart technology to assist in the secondary task of texting while operating a vehicle? *(Q1)*	Level of Satisfaction	0=Satisfied 1= Need Improvement 2= Dissatisfied	69 (62%) 10 (9%) 32 (29%)
2. What do you think is the success of the execution of the secondary task of texting while operating a vehicle using the audible command function? *(Q2)*	Success Rate	0= Successful 1= Unsuccessful	72 (64%) 39 (36%)
3. How successful do you think you are at interacting with smart technology specific to the secondary task of texting while operating a vehicle? *(Q3)*	Success Rate	0= Successful 1= Unsuccessful	76 (68%) 35 (32%)
4. How often do you interact with smart technology? *(Q4)*	Frequency	0= Not at All 1= Not Often 2= Often	2 (2%) 17 (15%) 92 (83%)
5. How do you describe this experience? *(Q5)*	Attitude	0= Positive 1= Neutral 2= Negative	75 (67%) 29 (27%) 7 (6%)

6. How do you think that smart technology can be better modified to be more effective at the secondary task of texting while operating a vehicle? **(Q6)*	Input	0= Modification Suggestion 1= No suggestion	84 (76%) 27 (24%)
7. How "user-friendly" do you find using smart technology to be? **(Q7)*	Friendliness	0= User-Friendly 1= Neutral 2= Not User-Friendly	84 (76%) 18 (16%) 9 (8%)
8. How do you feel about sharing the roadways with other drivers who use smart technology to text while operating a vehicle? **(Q8)*	Attitude	0= Positive 1= Neutral 2= Negative	41 (37%) 5 (4 %) 65 (59%)
9. Do you think that using smart technology makes it safer to text while operating a vehicle? **(Q9)*	Input	0= Yes 1= Neutral 2= No	60 (54%) 8 (7%) 43 (39%)

10. Do you think that a driver who got into a car accident while using smart technology to text while operating a vehicle has poor driving skills or just experienced difficulties using their smart technology? *(Q10)*	Input	0= Poor Driving Skills 1= Experience Technical Difficulty 2= Neither/Other Factors 3= Both	16 (14%) 20 (18%) 31 (28%) 44 (40%)

- *For the duration of this paper, the qualitative data will be referred to as Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10*

In this chapter, the results of the quantitative, qualitative and demographic data collected were analyzed and noted. An overall review of the quantitative and qualitative data reveals similar results: the majority of the participants agreed that they were satisfied with using smart technology to assist with the task of texting while operating a vehicle. Additionally, the qualitative data disclosed that even though participants had an overall positive reception of the smart technology, they still made suggestions for modifications and inferred that they felt uncomfortable sharing the roadways with drivers who used smart technology to text while operating a vehicle. The demographic data were not significant in that they did not divulge any dominant demographic with specific reference to this study.

This now leads into the final chapter; the discussion. Within the discussion chapter, I will state the major findings of the study and explain the meaning of and why the findings are important, relate the findings to similar studies, consider alternate explanations of the findings, acknowledge the study's limitations, and make suggestions for further research.

Chapter 5: Discussion

Major Findings

The findings suggest that the driver's attitude towards the general usability of smart technology specific to the secondary task of texting while operating a vehicle is an overall positive attitude. While suggestions were made for device modifications, and concerns were expressed about sharing the roadways with drivers who use smart technology to text while operating a vehicle, the overall consensus is that smart technology is very effective and efficient in assisting drivers with the secondary task of texting while operating a vehicle.

Meaning and Importance of Findings

A mixed methods research design was utilized as a tool to gather data for this study. The quantitative questions was designed on a Likert scale, giving the participants the opportunity to gauge their opinions about a range of questions designed to gather the overall attitude about ease of device usability specific to the secondary task to texting while operating a vehicle. The data from the quantitative survey supported that participants are satisfied with using smart technology. The qualitative questions were designed to be more open-ended, thus providing the participant with the opportunity to elaborate on their opinions.

Within this section of the survey, although participants reflected the same positive attitude towards smart technology gathered from the quantitative data, they also followed up with some interesting comments. Even though participants were generally satisfied with smart technology, they still made suggestions for modifications. Modifications ranged from structural design, i.e., device should have larger screens, and the screen was too sensitive to touch, to aesthetics such as verbal commands for font options and emoticons.

The most common suggestion though, was that of cadence. Most participants expressed that verbal commands for smart technology devices are sensitive to varying accents, which made it difficult, frustrating, and time consuming to use smart technology to assist with the secondary task of texting while operating a vehicle.

The demographic data were expected to depict trends between the specified demographics and the general attitude towards smart technology, but no such trends emerged from the data. This could be due to the population that was used, which happened to be an age group that would be more naturally inclined to incorporate and utilize smart technology daily, and therefore, there would be no trends to note specific to attitudes towards the use of smart technology being that all participants claimed to be skilled at using technology.

These findings are important for numerous reasons. First, it represents a relationship that is evolving between the human user and the technology. Second, by defining and further understanding this relationship, this could assist in future design and developmental research and implementation. Third, considering the fast-paced technologically advanced society that we live in, technology is up and trending, quickly making a place for itself in our everyday lives; thus, technological designers need to keep the human user in mind when designing technological devices.

Findings in Relation to Similar Studies

Previous studies, such as those discussed in chapter 2, focused on many variations of driver distraction through secondary tasks while in-vehicle such as multiple types of GPS devices, interacting with stereo systems, receiving and making calls on a mobile phone, and using different types of mobile phones such as touch screens versus standard tactile. These studies sought more of a relational cause-and-effect approach by having participants engage in certain activities while operating a vehicle to specifically observe the level of distraction experienced by the participant. This current study sought less of a cause-and-effect relationship, and more subjective user opinion by simply attempting to discover the participants' attitude towards the use of smart technology specific to the task of texting while operating a vehicle.

Previous studies appear to support the results of the current study in that technological assistance can have an adverse effect on the user by increasing user distraction, while decreasing performance and situational awareness. However, both current and previous studies also support that smart technology can be helpful and increase user performance when *used correctly*.

While certain similarities have emerged between this current study and previous studies, there are also certain differences as well. This study focused specifically on the smart technology and its reception as opposed to the participant, or human user. The general trend of this study is that even though participants agreed that modifications could be made, they still expressed a level of fondness with regards to using smart technology regardless of its flaws.

Alternate Explanations for Findings

The overall consensus claims that smart technology is useful, effective and efficient specific to the secondary task of texting while operating a vehicle. There could be several possible reasons for this unanimous opinion. First, owing to the age limitation, i.e., 18-35 years, of the sample population, this is a population that should be very well acquainted with technological advancement and may be more adept to interacting with technology. As a result, they may find technology not only easy to understand, but they may be able to adjust more quickly to implementing it in their everyday lives.

Limitations

During the course of this study, several limitations presented itself. First, considering that the study was conducted on campus during the summer term, this could have potentially affected the number of participants, as there are fewer students on campus during the summer term. Second, the data could have been compromised as students were offered class credit for participation, as opposed to quality of data they provided. This rendered some useless data as some students did not take the survey seriously being that they knew that they would get credit regardless. Third, it is unknown whether demographics could have affected the results of the data had there been a larger target population. Specifically, this study focused on an age group that happened to be more tech-savvy. Had a less tech-savvy age group been used, it is plausible that the demographic data would have generated different noteworthy trends.

Future Research

This study specifically focused on the ease of device usability specific to the secondary task of texting while operating a vehicle. Future studies can be expanded to cover beyond the singular task of texting while operating a vehicle. One subject that can be explored is ease of device usability in relation to other tasks engaged in while operating a vehicle such as using GPS, and giving audible commands to call contacts. Cadence may play a role in the effectiveness of device usability.

Another area to expand on would be to observe self-proclaimed expert multi-taskers' who believe that they are far better at multi-tasking and using smart technology while operating a vehicle in comparison to their like-minded peer. Age may also be another variable to pay specific attention to in future research. This study focused on the age group that was more inclined to be tech-savvy. A study that focuses on the experiences of the older generation who is less tech-savvy may yield a different attitude towards the use of smart technology.

Additionally, education may be a variable to observe in future research. This study could explore if there are any differences in the attitude towards the use of smart technology between a college educated population and a high school educated population. Lastly, research could be done on smart technology in car systems versus smart technology in mobile phone systems to see is users have a preference for which systems they find more user-friendly.

Conclusion

In conclusion, what can be said is that the usability of smart technology specific to the assistance of secondary tasks while operating a vehicle is a topic that has been heavily studied and will continue to be studied as technology becomes more and more ingrained in our everyday lives. With the advent of technology, this paves the way for more opportunities for multi-tasking in an ever-demanding world where there never seems to be enough hours in the day to complete an unending lists of mandates. However, it is known that technology can negatively impact a user's workload and overall situation awareness, which in turn negatively affects performance.

What needs to be at the forefront of this movement is that these devices are being designed for the human user; and there are always limitations to the abilities of the human user. Technology, when used correctly, can alleviate some of the daily stressors, but the key remains in designing for the human user while refraining from technological over-reliance. Technology is not a substitute for the human user, but should rather, when used as intended, be an extension of the human user.

Lastly, by the human user being cognizant of the assistance of technology to aid in secondary tasks, this should serve as a gentle reminder that the primary task should always take precedence. By doing so, it is hopeful that human error, or driver distraction, should be amended. Specific to the task of texting while operating a vehicle, drivers need to always make the initial task of driving their main priority regardless of assistance from smart technology.

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