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Communicating through Distraction: A Study of Deaf Drivers and Their Communication Style in a Driving Environment

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Communicating through Distraction: A Study of Deaf Drivers and Their Communication Style in a Driving Environment

By

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Abstract

This study will investigate the driving habits of deaf drivers and the manners in which they adapt to their driving experience. The lack of an auditory sense presents some unique challenges. While it is clear that driving is a predominantly visual task, auditory stimulation is still a part of the driving experience. This study seeks to determine how deaf drivers cope in a driving environment despite hearing loss. The results of the study will help to inform policy that can make the driving experience safer.

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Introduction

America has millions of drivers that take to the roads every day. However, driving is also one of the most dangerous and life-threatening activities we engage in almost on a daily basis. It is one of the leading causes of death, especially among younger individuals. Many crashes and deaths are a direct result of distracted driving (National Highway Traffic Safety Administration, 2009). Distracted driving encompasses secondary activities that engages the driver while operating a motor vehicle, such as calling on a mobile device (hand held or hands free), texting, eating, adjusting the car controls, etc. There has been extensive research showing the dangers of distracted driving, namely with the use of cell phones or some other form of communication (Cretacci, 2008; Farmer, Braitman, & Lund, 2010; Garcia-Larrea, Perchet, Caroline, Perrin, Fabien, & Amenedo, Elena, 2001; Hageman, 2010; Lamble, 1999; Strayer, Drews, & Crouch, 2006; Strayer & Drews, 2007; Zhang, 2011).

However, not all communication has to be verbal or texted. There are many drivers who are deaf and rely on their ability to visually see their passenger when they are engaged in American Sign Language (ASL) conversation. Research on the impact of ASL communication while driving is very limited. A few studies exist on this particular facet (Hersch, Ohene-Djan, & Naqvi, 2010; Keating & Mirus, 1998; Zodda, 2012). Consequently, it is an area that can benefit from diligent research to determine if something needs to be done to improve the overall safety of not just deaf drivers, but for all motorists as well.

In conjunction with studying communication habits, this paper will also examine cognitive load. Cognitive load is the ability of the brain to handle a variety of functions, allowing individuals to focus all their attention and cognitive resources on one task or a multitude of

tasks at the same time. The more processes the brain must perform will require a higher amount of cognitive capacity. As such, the brain will allocate cognitive resources to perform these tasks. (Lamble, Kauranen, Laakso, & Summala, (1999), Lavie; 1995, 2000, 2006, 2010).

Objective

This study acknowledges that there is a lack of comprehensive research conducted on deaf drivers. However, some good literature does exist (Hersch, Ohene-Djan, Naqvi, 2010; Keating, Mirus, 1998; Miyazaki & Ishida, 1987; Zodda, 2012). Communicating in ASL requires a visual frame of reference. The necessity of being able to see your passenger signing to you may suggest an added risk of being distracted while using ASL in the car. An exploratory study will be conducted focusing on deaf drivers and their adaptations to the communication environment while in a car.

Overall, this research will help to determine the manner in which deaf drivers communicate with their passengers and how they overcome the limitations a vehicle may impose. The research will examine how deaf drivers utilize the car and available technology to converse with their passengers while identifying how deaf drivers cope with distractions. The findings may help to spur further empirical research and perhaps pave the way for new policies in regards to driving.

Chapter One: Literature Review

A particular area of interest for research is assessing the capabilities of deaf or hard of hearing individuals while they drive. Few, if any studies have been done to examine how well deaf or hard of hearing individuals are able to safely operate a motor vehicle (Coppin & Peck, 1963, 1964; Hersch, Ohene-Djan,& Naqvi, 2010; Miyazaki & Ishida, 1987; Zodda, 2012). Unlike the research studies involving cellular phone use or drunk driving in which the results virtually unanimously agree that they are detrimental to driving abilities, there seems to be a mix of those that agree deaf drivers pose a significant safety risk and those that argue that deaf drivers are not a safety risk (Hersch et al., 2010; Lee, 2008; Zodda, 2012). Some people have suggested that deaf drivers are actually safer on the road than their hearing counterparts (Zodda, 2012). Unfortunately, the research backing these claims and assumptions is severely limited and hampered. The studies focused on reaction and response times to stimuli through simulator programs (Sladen, Tharpe, Ashmead, Grantham, & Chun, 2005) or through spatial attention processing experiments (Bosworth & Dobkins, 2002; Parasnis & Samar, 1985). Consequently, there is a gap in the research that needs to begin to be filled by examining communication habits in a driving environment.

Despite the lack of direct research on deaf and hard of hearing drivers in relation to distracted driving, there has been a plethora of research performed on a general population of individuals. These studies have analyzed cellular phone use, drunk driving, texting, calling and much more (Farmer, Braitman, & Lund, 2010; Garcia-Larrea, Perchet, Perrin, & Amenedo, 2001; Hageman, 2010; Honig, 2008; Leung, Croft, Jackson, Howard, & Mckenzie, 2012; Strayer, Drews, & Crouch, 2006; Strayer & Drews, 2007; Zhang, 2011). Because of the vast amount of

information already available, it is important to understand these findings to identify potential research designs that can be utilized strictly on the deaf population.

This study will attempt to identify the adaptations deaf drivers make to communicate with their passengers and to cope with auditory cues while driving. There will be a small focus on communication accommodation theory (CAT). This theory follows the stipulation that individuals and speakers will shift their communication style in a manner that is similar to others. This is accomplished through two different manners. The first being divergence and the other being convergence (Giles, J. Coupland, & N. Coupland, 1991; Giles & Ogay, 2007; *Defining Communication Theories*, n.d.)

Divergence & Convergence

Groups that have a strong sense of ethnic or racial pride will often highlight divergence which helps distinguish them from other groups. While deafness itself is not a race or ethnicity, there is certainly a Deaf culture. This culture can be easily identified in the manner in which the Deaf population communicate with each other. Their use of ASL divides and diverges this manner of communication from the orally speaking population. The terms “Deaf” and “deaf” differentiate the culture from the actual hearing loss. When “Deaf” is written with an uppercase “D,” it is referencing the Deaf culture. When “deaf” is written with a lowercase “d,” it is simply referencing the physical condition of not being able to hear.

Convergence is utilized when a group of individuals (oftentimes powerless) have a strong need and desire for social approval (*Defining Communication Theories*, n.d.) While the Deaf community certainly is not powerless, they still face a difficult time in garnering social support from the hearing population. Examples of lack of social support can be evidenced from

few, if any, closed captioned support or interpretive services. This can effectively shut out the Deaf community from events and interactions among a predominantly hearing crowd. The Deaf culture provides a support system, one in which communication in ASL is paramount. Communication features, such as the manipulation of hands comprise a core dimension of what is necessary to be identified with a particular group. Giles identifies this through gang members and the hand symbols they may utilize. This is just as applicable to deaf individuals that use ASL. While ASL users may not spell "Blood" with their fingers to associate themselves with a gang, the act of signing is a powerful statement shared by the Deaf community. (Giles et al., 1991; Giles & Ogay, 2007).

Distracted Driving

The literature is vast in regards to driving behavior, especially that of distracted driving. Distracted driving can be caused by a multitude of factors. Perhaps the most well-known distractions are those that include drunk driving, utilizing cellular devices as well as devices that allow the driver to play music, whether via radio, mp3 players, CD's, or a wide assortment of other music players (Farmer, Braitman, & Lund, 2010; Hageman, 2010; Hickman & Hanowski, 2012, Honig, 2008; Howard & Mckenzie, 2012; Leung, Croft, & Jackson, 2012; Strayer, Drews, & Crouch, 2006; Strayer & Drews, 2007; Zhang, 2011).

A number of studies point that cellular use while driving, whether hands-free or not, has an adverse impact on the ability for an individual to drive safely (Farmer, Braitman, & Lund, 2010; Hageman, 2010; Hickman & Hanowski, 2012, Honig, 2008; Howard & Mckenzie, 2012; Leung, Croft, & Jackson, 2012; Strayer, Drews, & Crouch, 2006; Strayer & Drews, 2007; Zhang, 2011). A study performed by Leung et al. (2012) sought to compare the effect of mobile phone

use and alcohol consumption and its effect on driving performance. Through the use of simulators, the study determined that as the blood alcohol content (BAC) levels increased, the ability of the subjects to drive was hampered. Delays in reaction time were observed in a number of variables including speed, braking reaction time, etc.

The effects of alcohol consumption were also compared with mobile phone usage by studying the same variables. Drivers either engaged in a scenario with no phone use, hands free conversation, an intellectually stimulating conversation and texting. The results dictated that mobile phone use decreased driving performance regardless of the manner in which it was carried out. Driving performance declined with phone use similarly to drunken driving (Leung et al., 2012).

Strayer et al. (2006) also conducted a similar study observing the effects of drinking and cellular use while driving. The results determined that cell phone use can impair the driving ability of an individual in a manner similar to drunk driving. The research did not take texting into account, which was not as commonly used then. Overall, the results show that talking on the phone is a distraction that impairs driving ability in individuals.

Another interesting study was performed that seems to have a somewhat conflicting set of results. Hickman and Hanowski (2012) conducted a three month long study of commercial motor vehicle drivers, that is, those with a specialized license. The data obtained from the study found that drivers engaged in tertiary tasks such as holding a phone conversation did not significantly increase the likelihood of the operator being involved in an accident or situation that would endanger themselves or other motorists. However, the researchers did identify a peculiarity; they found that the subtasks associated with phone use such as looking at the

screen, dialing, or texting were found to increase the likelihood of an accident (Hickman & Hanowski, 2012).

While the study seems to contradict those of Leung, Croft, Jackson, Howard and Mckenzie and Strayer, Drews and Crouch, it does take into account the potential dangers and perils texting and other tasks associated with a phone may have on distractedness and driving ability.

Another study performed by Farmer, Braitman and Lund (2010) showed that through past research, crash risk was four times higher when talking on a cell phone than not talking on a cell phone. When compared with data from cell phone usage rates and crash rates, it was determined that 22% of the crashes that occurred in 2008 were preventable had the driver not been distracted. This percentage accounts for about 1.3 million vehicle crashes stemming from using a phone to communicate (Farmer, Braitman, & Lund, 2010).

Inattention Blindness

An interesting phenomenon called inattention blindness was studied to determine the impact it had on driving. Strayer and Drews (2007) researched this phenomenon which they described as the inability of the driver to see objects that are clearly visible in their driving environment. Rather than studying how driving performance was affected, the researchers wanted to understand how the cognitive ability of the brain processed the information it received while driving. Subjects were tasked with identifying objects in their driving experience and trying to recall them. They were put through several distracting scenarios including in-vehicle conversations and phone conversations. The results showed that in-vehicle

conversations did not impair driving because it was less taxing on the cognitive functions of the brain, but cellular conversations led to a decrease in cognitive function (Strayer & Drews, 2007).

Strayer and Drews (2007) concluded that drivers could "synchronize the processing demands of driving with in-vehicle conversations rather than with cell phone conversations." (p. 128). They also identified single and dual task actions. As the name implies, single task actions refer to only one task being physically performed at one time while dual task occurs when two actions are performed simultaneously.

A dual task action would be driving and talking on the phone at the same time while a single task action would just entail the driving. Subjects who were engaged in dual tasks were twice as likely to not recognize roadway signs, especially when they were on the phone. This inability to recall what they saw leads to the "inattention blindness" which is ultimately a distracting aspect of the driving experience. Dual tasks require more cognitive resources of an individual. The more cognitive resources that are required, the more distracted a driver will be (Strayer & Drews, 2007).

A study published in the Journal of Psychopsychology and carried out by Luis Garcia-Larrea (2001) also sought to measure the reaction times of individuals trying to observe particular targets on a screen. Ten subjects were placed through multiple scenarios involving distractions or no distractions. Like the aforementioned studies, the results were very similar. Phone use delays a driver's responsiveness. Garcia-Larrea concluded this study stating that cellular phone conversations would decrease the "attention to sensory inputs, which has as a likely corollary a decrease in stimulus-induced arousal." (Garcia-Larrea, 2001, p. 20).

Ultimately, an impairment of cognitive ability on the part of the driver leads to a detrimental loss in ability to operate a motor vehicle. The increase in the cognitive load leads to slower reaction times which may be crucial in potentially life threatening situations on the roadway such as avoiding an accident or ensuring enough braking distance to safely bring the vehicle to a stop (Garcia-Larrea, 2001).

The results are not only backed up statistically, but medically as well. Brain imagery shows exactly how a driver is distracted. Certain regions of the brain light up when stimulated, showing that there is an increase in the cognitive load processes when an individual is engaging in a secondary action to driving, such as texting or talking on the phone, regardless if it is hand held or hands free conversation (Garcia-Larrea, 2001). The study clearly showed that outside stimuli negatively affects the preparedness the driver would exhibit due to an increased mental load.

Similar to Garcia-Larrea (2001), Dave Lamble (1999) concluded that the use of mobile phones in a vehicle will have an adverse impact on reaction time, regardless of the manner in which the phone is used. Response times were delayed when the driver was engaged in other activities such as dialing on a numeric keypad. These actions required the brain to process more, and consequently led to delays up to a full half second longer. For comparison, a person driving at 50 miles per hour can cover a distance of approximately 37 feet in less than half a second. This distance is enough to go through an intersection or swerve into oncoming traffic (Lamble, 1999).

The Center for Disease Control (CDC) has compiled an impressive volume of statistics relating to motor vehicle accidents. In their topic of motor vehicle safety, there is a section on

their website labeled distracted driving. Within it, they detail that on any given day, more than 15 people will die in a motor vehicle accident and over 1,200 people will be injured as a direct result from distracted driving. The CDC defines distracted driving as, “driving while doing another activity that takes your attention away from driving; these activities can increase the chance of a motor vehicle crash” (Injury Prevention and Control: Motor Vehicle Safety, para 1). It goes on to elaborate that there are three different types of distraction:

1. Visual, in which the driver takes their eyes off the road
2. Manual, in which the driver takes their hands off the steering wheel, and
3. Cognitive, in which the driver takes their mind off their immediate task at hand: driving safely and defensively (para 2).

Distracted Driving (Cont.)

Distracted driving does not result just from cellular phone use, although that is certainly a very distracting habit. Texting, eating, making adjustments to electronics or controls in the vehicle such as GPS navigation systems, mp3 players, or simply fiddling with the radio or heat/AC settings. Applying make-up, noisy kids, audio books, all contribute to distraction, as well at talking with passengers. Signing, with passengers can also be viewed as a form of distraction for the driver. The data has some extremely shocking statistics in relation to distracted driving. In the year 2009 alone, over 5,400 people died in crashes that were reported to have a distracted driver and about 448,000 people were reported to be injured as a result. (Centers for Disease Control, 2013; National Highway Traffic Safety Administration, 2011). Of those that were killed or injured in these crashes, about 1,000 deaths and 24,000 injuries were reported to include cell phone use as the major distraction (National Highway Traffic Safety

Administration, 2011). When examining the span of time from 2005 to 2009, the data shows that the proportion of drivers that were reportedly distracted during a fatal crash rose from 7 to 11 percent (National Highway Traffic Safety Administration, 2011).

About 25% of drivers in the US reported that they "regularly or fairly often" talk on their cell phones while driving (Porter, 2010, para 3) and in Europe, those percentages ranged from 21% in the Netherlands to as low as 3% in the UK (Center for Disease Control, 2010). These same sources also identified that in the US, approximately 75% of drivers between the ages of 18-29 reported talking on their cell phone while driving at least once within the past 30 days. A study in Europe found the percentage was approximately 50% In Portugal and 30% in the Netherlands in which young adults reported talking on their cell phone at least once in the past 30 days while driving (Center for Disease Control, 2010).

A very recent study conducted by the Texas A&M Transportation Institute concluded that voice-to-text is just as dangerous as regular texting that requires the use of fingers. The researchers identified that those who used the voice-to-text actually spent more time completing a text than it would if they did it by hand. The research found that the time spent looking at the roadway was roughly the same regardless if the driver was using voice-to-text software or their fingers to text. Ultimately, regardless of the manner of texting, reaction times were twice as slow as when the drivers were not distracted through texting (Yager, 2013).

Needless to say, many states have recognized the seriousness and severity of mobile phone use while driving. As of January 2013 with information provided by the Insurance Institute for Highway Safety (2013), ten states have placed a ban on all drivers from talking on a hand-held mobile device. These states include California, Connecticut, Delaware, Maryland,

Nevada, New Jersey, New York, Oregon, Washington, and West Virginia as well as the District of Columbia. Furthermore, the use of cell phones by novice drivers (ages vary between states) are banned in 33 states as well as Washington D.C. Text messaging is also banned for all drivers in 39 states, as well as Washington D.C. To top it off, even some states that do not explicitly have a ban against cell phone will have some locality and jurisdictions within the state that enforce their own laws and ban the use of mobile devices (Insurance Institute for Highway Safety, 2013).

Deaf Drivers

Deaf drivers, like anyone else, can participate in functions like texting while driving; the extent of which they may do that is unknown as the research has been conducted on a general population that is presumably free of physical ailments. It is possible that deaf individuals have been participants in this research, however their roles were not identified. Their disability may afford them certain advantages that a hearing driver would not otherwise have, such as being more adept at communicating via text. Also, if a hearing driver has a passenger, they are able to verbally communicate without needing to make visual contact with their passenger (although they may very well do so).

Policies and federal laws establish that deaf drivers are able to obtain a drivers' license and operate a motor vehicle. In the early 1920's, several states banned deaf drivers from ever being able to own or operate a motor vehicle. However, the National Association for the Deaf rose up against this and the bans were repealed (Esurance, 2014). The Americans with Disabilities Act (ADA), guarantees every deaf person the same and equal rights to their ability to obtain a license, possess and operate a motor vehicle. Of course, the ADA does not guarantee a

license will be issued. A deaf individual must still meet all requirements imposed on any non-handicapped individual.

Certain states however, have imposed their own restrictions or requirements that deaf drivers may be required to follow. New York imposes a restriction that if you fail to meet the requirements of a DMV hearing test, they may elect to impose a restriction of "Hearing Aid or Full-View Mirror" which would be added onto your license (New York Department of Motor Vehicles, 2015). Not every state will impose restrictions unless the DMV can show without a doubt that the restrictions are necessary to ensure the safety of every other motorist or pedestrian. States will also offer identification cards that a deaf driver can give to an officer if they are pulled over. The card explains that the operator is deaf or hard of hearing and offers the officer some guidelines with how to communicate with the driver.

Limited research has been conducted with a focus on deaf drivers (Hersh, Ohene-Dian, & Naqvi, 2010; Keating & Mirus, 2012; Miyazaki & Ishida, 1987; Zodda, 2012). However, much more still needs to be done to address driver distraction in deaf drivers. But some of the research that exists shows surprising evidence that deaf drivers may not be as distracted as some might think. In fact, hearing loss can be considered an advantage in some lights. These advantages were identified by Songer et al. (1992) who identified that deaf commercial motor vehicle (CMV) drivers could smell burning rubber on steel before their hearing peers and stop the vehicle before there was a problem. Furthermore, deaf drivers were able to feel vibrations that could alert them to potential dangers, as well as utilize their field of vision more adeptly (Songer et al., 1992).

Before delving too much into the research, it is important to understand the differences in habits of communication. There is no question that deaf drivers bring their own unique culture with them while they drive. Because of their inability to hear, it is crucial for deaf drivers to try to compensate in other manners that have benefitted them outside of the driving experience. Driving is a predominantly visual task. As such, deafness is not considered to be a severe driving risk (Sivak, 1996). It has been asserted that driving is dominated by the visual sense by as high as 90% (Sivak, 1996).

Clearly, a lack of hearing does not impede their ability to be visually attuned to the road. However, there are some atypical moments in a driving experience that may require the ability to hear. A 1993 report from the Department of Transportation identified that there are several situations in which the ability to hear would be important. The study has identified that hearing exterior sounds from outside of the vehicle can be critical. These sounds can include a wide variety of warning sounds such as sirens from emergency response vehicles, horns from other motorists and so forth. Furthermore, the study identified that there may be times when the vehicle is making some odd noises that can indicate a mechanical failure that may otherwise be undetectable. However, at the same time, the study had acknowledged that these situations were relatively uncommon and not normally expected in the average driving experience. Furthermore, the Department of Transportation stated that these external noises may not always be addressed by drivers who possess average hearing. (Department of Transportation, 1993).

Research also indicates that despite the loss of hearing, deaf drivers may actually possess some unique advantages over hearing drivers. Multiple studies have shown that deaf

drivers will use their vision to a broader extent than their hearing brethren. This is achieved by being able to detect objects in their peripheral vision at a quicker rate than their peers (Bavelier, Dye, & Hauser, 2006; Chen, Zhang, & Zhou, 2006). In other words, deaf drivers have been able to detect targeted objects in a peripheral range of vision more quickly than those who possessed their hearing in a controlled setting. In an everyday driving experience, this visual benefit suggests that a deaf individual would be able to more quickly respond to a vehicle or pedestrian that they detect from the sides of their sight line.

Driving is clearly a process which requires the operator to delegate their attention to the tasks required from this activity. Attention itself is a cognitive process. Treisman (1964) developed an attenuation model in which she argued that attention is a cognitive process. She argues that attention is able to be delegated to a primary activity or behavior while still allowing the brain and its cognitive capacity to provide control for secondary activities or behaviors. In this example, attention "can be primarily directed towards one behavior (e.g., scanning the road ahead) while still providing cognitive control towards other secondary behaviors (e.g., shifting gears." (Treisman, 1964).

Treisman (1964) later conducted further research with Davies (1973) and found that while attention can be divided up between multiple tasks (primary and secondary behaviors), that the cognitive resources to do so were limited. Treisman and Davies (1973) found that the limits of an individual's attention would decrease when it was exposed to multiple channels of information at the same time at the same sensory modality (Treisman & Davies, 1973). Therefore, in a driving context, a deaf driver would operate a motor vehicle through a visual-spatial modality. If we recall ASL, we know that communication is a visual-spatial activity.

Consequently, using this model, Zodda could hypothesize that if a deaf driver were to communicate with a passenger through ASL, the limits of cognitive process through dividing attention to two common modalities would result in driving performance decreasing (Zodda 2012).

Zodda (2012) utilized this hypothesis to determine if there was a significant difference between the way deaf and hearing drivers reacted to the environment around them. His study led to some interesting results from the driving simulation scenarios that he put deaf drivers and hearing drivers through. Through the simulation, he determined that when driving through a course with no distractions provided, the deaf drivers committed a mean of 1.76 errors while the hearing drivers committed a mean of 1.27 errors. During this phase, there was not a significant difference in the number of driver errors. However, in the second phase of the testing in which the participants were engaged with a passenger while driving, the mean of the errors were 1.72 and 1.16 for deaf and hearing drivers respectively. This particular bit of data dictates that the hearing group did make significantly fewer errors than the deaf group, which further supported the hypothesis stemming from Treisman and Davies (1973).

While the study did show that there was a difference between the two groups, Zodda (2012) determined that the differences were really quite small and were unlikely to be noticeable outside of the laboratory setting. However, on further review of the data, it was determined that the deaf participants appeared to commit more speeding violations than hearing participants in the second phase of the study. Zodda (2012) stated that it appeared that the simulation's auditory speeding cues such as hearing the engine rev louder as speed increased, may have been a contributing factor because the deaf participants would not have

been able to hear that sound. However, when compensating for the speeding errors and removing them from the study, the results were compared again and showed that there was no significant difference in driver errors between the groups (Zodda, 2012). The rationale for purging these errors was based on the understanding that deaf drivers have other cues readily available to them in a real vehicle that they did not have during the simulated experience. These drivers are able to feel the engine accelerating and they are also able to utilize their vision by responding to visual cues as they travel through a 3-D environment. In the simulation, these experiences were absent, thus providing the hearing drivers with a noticeable advantage through strictly auditory means.

It is also interesting to note the differences in performance through the conversations the deaf and hearing groups had. The accuracy of the responses were of particular interest. There were a total of 85 and 13 errors for the deaf and hearing groups respectively, which was significantly different. This suggests several things. For one, it shows that the deaf drivers were trying to pay more attention to driving than were the hearing participants. Because the difference in errors was so high, in reviewing the communications of the deaf groups, Zodda determined that instead of dividing their attention between driving and signing, the deaf drivers would actually alternate their attention between driving and communicating with the passenger. This indicates that deaf drivers place a greater focus on driving than on attending to a conversation (Zodda, 2012).

Cognitive Load & Multiple Resource Theory

While a focus on communication is beneficial, it would be amiss to not include a section about cognitive load. Cognitive load and Cognitive Load Theory (CLT) details how the brain is limited in its processing power at any given point in time. The more activities or functions a person must do requires more work from the brain as it attempts to delegate cognitive capacity to different functions (Lavie, 2010; Paas, Tuovinen, Tabbers, & Van Gerven, 2003).

"Cognitive load can be defined as a multidimensional construct representing the load that performing a particular task imposes on the learner's cognitive system." (Paas, Tuovinen, Tabbers, & Van Gerven, 2003, p. 64). Mental effort is similar to cognitive load, but it is determined by the complexity of the tasks requiring a cognitive effort. A higher degree of mental effort would be necessary to perform complex theoretical physics questions than for simple math involving only addition or subtraction. However, the mental effort is also limited by the cognitive capacity of the brain to delegate its resources to performing this task (Paas & van Merrienboer, 1994).

Multiple resource theory, which is very similar subset to cognitive load theory in scope, further backs up these assertions. Wickens (1984, 2012) utilized multiple resource theory in asserting that,

> "Multiple resource theory suggests that two tasks that draw upon the same mode (e.g., information received through the eye only or through the eye and the ear), code (i.e., analogue/spatial vs. categorical/verbal processes), or stage of processing (e.g., perceptual, cognitive, the selection and execution of response) will interfere with each other more than two tasks that draw upon different resources (Lee, Y., Lee, J.D. & Ng Boyle, 2007, p. 722)."

Lee, Y., Lee, J.D. & Ng Boyle draw upon the research of Dewar & Olson (2002) and summarized that driving is a mentally and visually stimulating activity that significantly draws

upon cognitive resources. Performing additional actions would be detrimental in the ability to successfully maintain complete focus on driving. Lee, Y., Lee, J.D. & Ng Boyle summarizes their findings simply, “Driving makes intense demands on visual perception. As a result, operating devices that require glances away from the road results in structural interference, which can have obvious negative effects on driving performance.” (Lee, Y., Lee, J.D. & Ng Boyle, 2007, p. 721).

Cognition is reliant upon memory. The association it shares between short term memory and long term memory influences the cognitive capacity for which individuals require in many daily tasks. In short, cognition is a “working memory” (Sweller, Ayres, & Kalyuga, 2011). Sweller et al. do a great job at defining this as a whole,

> “Human cognition includes a working memory that is limited in capacity and duration if dealing with novel information but unlimited in capacity and duration if dealing with familiar information previously stored in a very large long term memory. Once appropriate information is stored in long term memory, the capacity and duration limits of working memory are transformed and indeed, humans are transformed. Tasks that previously were impossible or even inconceivable can become trivially simple.” (Sweller, Ayres, & Kalyuga, 2011, p. vii).

Cognition capability is also a result of a combination of biologically primary knowledge and biologically secondary knowledge. The former is identified as knowledge that is intrinsically learned. Such an example would be learning to speak a first language. A first language is a skill, that despite the immense information load requires the manipulation of the lips, tongue, breath and voice in a myriad of variations is learned and not taught. On the other hand, biologically secondary knowledge is taught. Such an example would be learning to write. Writing itself is not an intrinsic knowledge that humans instinctively know how to do. And

because writing is a relatively recent phenomenon, it can't be influenced by biological means (Sweller, Ayres, & Kalyuga, 2011).

Biologically primary knowledge and biologically secondary knowledge may seem irrelevant, but these forms of knowledge stem from different areas of the brain. Consequently, the knowledge that forms within them means that the cognitive functions are very different and heavily influenced by the type of memory association (short or long term memory). Simply put, cognitive load derives its capacity based on where the information is stored within the brain (Sweller, Ayres, & Kalyuga, 2011).

Overwhelming cognitive load by performing multiple activities or functions leads to a reduction in the ability of the individual to place 100% of their mental or physical effort in any one aspect at the same time. Therefore, an individual who is driving and talking to a passenger has to divvy up their cognitive capacity between these two tasks. As such, capacity and capability will have to give in some respects. This is clearly visible in the studies mentioned beforehand in which the drivers had become more distracted, suffered slower reaction times, and otherwise committed more driving errors while they are tasked with carrying out a conversation, texting, or some other secondary activity.

Higher amounts of stimuli, multiple modes or channels, the higher the complexity, the more execution needed and the association with loosely ingrained knowledge all lead to higher amounts of "load" that the brain must process. The divvying of brain power is taxing when confronted with a plethora of information. Cognitive load theory addresses the delegation of brain power.

Distractions also increase our load. As Lavie (2010) points out, other types of load are possible, such as visual load which can lead to loss of attention on a primary task and therefore, regulate our cognitive capacity to placing an emphasis on the distraction. This example is highlighted by suggesting that as you read the article, a pop up for an internet dating website, or a ray of sun streaming in from the windows may provide a source of distraction. This distraction is visible, or it can be heard, and once the brain detects it, we shift our cognitive focus on the distraction and it grabs our attention. Once the attention is grabbed, we are distracted from our primary task (Lavie, 1995; Lavie, 2000; Lavie, 2010).

Distractions can lead to load induced blindness. Macdonald and Lavie expand on this notion that load leads to a type of "blindness" in which we are unaware of the things that are immediately around us. While this relies on load theory, it certainly can attempt to explain some aspects of distracted driving. A driver texting her friend may experience a cognitive load that is too great to handle, and therefore, she experiences "blindness" on the road which increases the likelihood and risks for accidents (Cartwright-Finch & Lavie, 2007; Lavie, 2006; Macdonald & Lavie, 2008).

While the Zodda (2012) experiment brings to light an interesting aspect of deaf driving and determining if they are distracted or not, it fails to mention just how deaf drivers may communicate and what they do to compensate for it. It is crucial to understand how ASL is used in a normal everyday conversational setting and how it is adapted to fit the confines of a vehicle. Keating and Mirus (2012) do an excellent job of describing sign language and how it is used in a vehicle.

Examining the Use of ASL

"Language is a rule-governed communication system" (Clayton, Ceil, p. 2, 2001). When a communication system is based on rules that users know and follow, it is classified as a rule-governed system. These rules are necessary because without them, it would be nigh impossible to understand communication. Without rules, a single word, expression or signal could be used arbitrarily and therefore, have multiple differing meanings and connotations.

Consequently, in order for communication to be successful, there must be a widely recognized and established set of rules that govern the way a particular method of communication is utilized. The English language has a comprehensive set of rules (including exceptions to the rules) that dictate how a word is to be written or spoken to define a particular symbol for which it is expressing through the use of one or a combination of the 26 letters that make up the English alphabet. Morse Code is another rule-governed language. Communication via Morse Code relies on a systematic series of dots and dashes that can be understood through tonal sounds or light. Users of Morse are able to non-verbally convey information in a clear and succinct manner (Clayton & Ceil, 2001).

Like English, or the Morse Code, American Sign Language is a system that is rule-governed. There is a widely established ASL alphabet that dictates how users are to spell words via their hand motions. Through this, more complex words can be signed via "finger spelling" or establishing a particular hand(s) motion that conveys a precise word. The language is very nuanced and can have signs that have more than one meaning or have multiple signs for the same word, very much like how English may have synonyms (Clayton & Ceil, 2001).

Further research of ASL shows that through spatial and visual cues, subtle or overt expressions can be portrayed and understood. The speed at which one signs, combined with the use of their spatial area, the frequency of which a user drops or adds words can indicate a user "stressing" their words. Wilbur states that, "…signers systematically modulate prosodic characteristics of their production as a function of signing rate. This pattern suggests that signed prosody, like that of speech, is characterized by an integrated, multivariate system of units that can be regulated in production across different contexts" (p. 232, 1999).

Given the complexity of ASL, it should come as no surprise that it is an established and recognized language (Wilbur, 1999; Clayton, Ceil, 2001). ASL is able to take spoken word and convey it in a manner in which it can be understood visually. This understanding from the users harkens back to the rule-governed concepts that dictate how ASL is to be properly utilized. Languages such as Morse Code or the use of signal flags prove that speech or hearing is not a critical requirement for an established language. ASL can overcome the loss of hearing through expressionism to convey their information in a manner that is easily understood.

ASL has some benefits as an unspoken language than other verbal languages. For one, it is exceptionally useful in noisy environments. While a spoken conversation may be very difficult to understand in noisy areas such as a club blaring dance music, or a cafeteria, etc., the ability to sign allows individuals to bypass that barrier to understanding communication. Because it is not dependent on whether or not you hear something, deaf individuals are able to easily hold a conversation because ASL is a visual, not auditory language. Furthermore, studies have continuously shown that deaf individuals are able to utilize their peripheral field of vision and

understand the area around them better than hearing individuals (Keating & Mirus, 2010; Swisher, 1990).

American Sign Language is a language that requires a great deal of physical cues that incorporates not only the hands itself, but facial expressions, timing of their signing, as well as the space around them. ASL is a complex language that incorporates words and sentences that can be used by using one hand or both hands to convey something with meaning. Many different signs, or words, in the ASL language require only the use of one hand to portray its meaning. Other signs will require the use of two hands to effectively portray what is being said. Furthermore, some words in ASL do not have a designated sign so they are finger-spelled out. Finger-spelling is the process of spelling out a word using one hand by making gestures that correspond to the letters of the English alphabet. For a more complete understanding of the signs of the alphabet, refer to the chart located in the appendix under Exhibit A on page 70.

Certain words, such as “mother” are able to be identified by using only one hand and signing the word for “mother.” This sign is made by extending all the fingers of the dominant hand and the thumb is touching the chin of the speaker. The word “father” is the exact same sign, however the hand placement is located on the forehead. The spatial placement of the hands can indicate gender with masculine words occupying the top half of the spatial zone and feminine words occupying the bottom half. Reference Exhibit B, page 70, to see a visual representation of the words “mother” and “father” and how they occupy different spatial areas in relation to the signer. An example of a sign that requires two hands to convey is “appreciate.” In order for someone to convey this word, the signer must use both hands and place them over their chest with the dominant hand on top. The hands are placed in such a way

that they resemble the letter “B” in the alphabet. The hands are then circled around the chest in counter-clockwise circles utilizing about half the area of the chest throughout the motion as referenced in the appendix under Exhibit C, page 71. However, if instead of two hands, only one hand was used but the circular motion was the same, then the word that sign represents would be “please.” Reference the appendix, Exhibit D, page 71.

What was not mentioned yet was that while the signs are able to portray words, a lot of those signs are very dependent upon other visual characteristics, such as location of the hands in relation to the rest of the body. Furthermore, facial expressions are an extremely critical aspect of signed language (Maebatake et al., 2008; Keating & Mirus, 2012,). The face is able to portray a lot more emotion than the hands. Through the face, signers are able to make eye contact, make expressions with their eyebrows, and even formulate their mouths into particular shapes. Furthermore, signers will also utilize their whole body such as twisting and turning the body, eye-gazing and so forth (Engberg-Pedersen, 1993; Baker & Padden, 1978; Meier, 1990).

In the examples of the signs listed above, the facial expression would be very important for the word “appreciate.” It would be extremely confusing to someone if you signed, “I appreciate you,” while having a very stern or angry looking face. The facial cues and the signage of the words would create quite a bit of an oxymoron. Even if the face was neutral, the sign would come off as insincere. However, by signing this with a smile, eye-contact, directly facing the recipient with a relaxed welcoming facial expression, the recipient is able to understand that the person is expressing their appreciation for them. This is effectively very similar to the tone of voice a verbal person would utilize except that in the case of ASL, the tone is expressed

through a wide combination of facial expression, body postures, and the manner in which the speaker is conveying their thoughts.

While it is amazing how the deaf community has adapted to communicate, it has to overcome certain barriers that would not otherwise exist in a hearing individual's world. Motor vehicles are perhaps one of the most widely used forms of transportation. It is used by millions of drivers on a daily basis for travel between home, work, visiting relatives, or embarking on vacations. However, driving is a cognitively demanding task that requires individuals, regardless of hearing loss or not, to be able to focus on the road and be prepared to respond to the traffic conditions as they come up.

Zodda (2012) did touch up on the differences in how a hearing driver and a deaf driver will react when engaged with a passenger through a conversation. However, he does not get into depth how those that use ASL compensate for communication. A car is not the friendliest location for a deaf driver to be able to communicate with their passengers. There are many barriers that are prevalent inside a vehicle that reduces the ability of deaf individuals to communicate as they normally would. With the loss of their auditory senses, they are unable to engage in conversation and keep their eyes on the road at the same time. While in a vehicle, there is not as much room to move your hands than if you were in an open environment. There is a significant lack of eye contact as the primary focus is maintaining a visual emphasis on the road. Certain signs that require both hands have to be adapted into just one hand so that the driver is still able to control the vehicle by keeping at least one hand on the steering wheel. There is also the challenge of for the driver to be able to see the facial expressions of his passenger, especially for those that may be in the back seat. Consequently, deaf drivers have

adapted to communicate in a manner that makes it easier for the driver to still be involved in a discussion, while maintaining safe control of the vehicle while driving (Keating & Mirus, 2004).

Chapter Two: Methodology

This study will explore the communication and driving habits of deaf drivers and hearing drivers via two small focus studies of at least 8-12 licensed drivers per focus group. The object of the focus groups is to explore the methods of communication while driving. One focus group will be comprised of severe to profoundly deaf individuals. These individuals will all be licensed drivers and all will use ASL as their primary means of communication. The second focus group will consist of hearing individuals. These individuals will communicate with English as their first language. However, they will also be adept at communicating in ASL as well. The desire to have ASL adept hearing individuals is to provide a basis of comparison through a hearing perspective and the ability to relate to a non-hearing perspective.

Focus groups generally are composed of 10-12 individuals, however, smaller "mini focus groups" are frequently utilized composing of 5-7 members (Retrieved from http://www.credoreference.com/entry/esthospitality/focus_groups). Others say a focus group should contain approximately 8-12 individuals for a suitable number of subjects (Krueger, 1994; Sim, 1998; Stewart & Shamdasani, 1990). Selecting 8-12 individuals provides a nice balance without over-complicating things.

Focus groups are in essence a "group interview." This "interview" is focused on a particular subject (the focus) and is facilitated by a moderator. In this particular instance, the researcher will be the moderator and throughout the duration of the focus group, gather qualitative data. Obtaining the data is done through close examination of the interaction that occurs between the individuals in the group (Sim & Snell, 1996).

A focus group offers several advantages for this particular exploratory study. It allows the researcher to tap into the views of multiple people at one time. A standard interview is a one on one affair that can be tedious when the viewpoints of numerous individuals are needed (Krueger, 1994). In addition, it provides a level of "protection" to the subjects. This means that the subjects may feel "safer" because they will not have to feel obligated to respond to every question which a one on one interview might (Vaughn et al., 1996).

In addition, focus groups provide for a higher degree of spontaneity as suggested by Butler (1996). This allows for members to listen to what other individuals have to say and they can build off from that person's experiences or viewpoints and use them to influence their own. It becomes a highly collaborative experience. This all helps lead to a better degree of understanding of the focus topic (Morgan, 1996).

At the same time, it is important for the moderator to allow a natural flow of communication between focus group members and him or herself. A natural flow of information will provide the greatest qualitative data. However, a focus group can run the risk of getting off topic. It is the responsibility of the moderator to facilitate the flow of communication in the direction necessary so that the proper data can be obtained. The moderator must balance the role of guiding the conversation and ensuring that they do not disrupt this flow. Despite the best efforts of the moderator to guide the discussion, it still ironically disrupts the interaction which is the ultimate purpose of the group (Ager & MacDonald, 1995).

It is also possible for one on one interviews to yield more information. Furthermore, a focus group relies on a smaller group of people for obtaining data. As a result, it may not

contain the most representative data like a survey would be able to do (Morgan, 1996). Despite these shortcomings, this explorative study would greatly benefit from this manner for numerous reasons. The focus of the research is relatively new and could stand to have more exploratory studies. Since the researcher is not too concerned with quantity, surveys are not necessary. However, a focus group provides enough subjects to conduct a strong qualitative study.

Methods

An effective focus group will require a few basic grounds of understanding, especially where terminology is concerned. Terminology is especially crucial in this focus group. Deafness, is, in all respects, a form of hearing loss. However, there are various degrees of hearing loss ranging from those that are deaf, to the most mild form of hearing loss in which the ears are still functional but unable to pick up certain pitches or tones. There are six commonly identified degrees of hearing loss. From least to most severe, it follows as: normal, mild, moderate, moderate-severe, severe, and finally, profound. For the purpose of this study, deaf individuals will be identified as those who possess severe to profound hearing loss and are unaided with any form of corrected hearing. Devices such as Cochlear Implants, Bajas, hearing aids, etc., will not be used in the study by the focus group members.

It is with the understanding that individuals with severe and profound hearing loss can have corrected hearing. However, in hopes of keeping the research “pure” for this intent, these individuals will not be considered for testing. This is of course a weakness in the overall research design for failing to include these individuals, as well as researching other hard of

hearing individuals. However, it is with optimism that researchers with more time and funding can dedicate a substantial amount of research to this particular group.

The convenient location to the National Technical Institute for the Deaf provides the researcher with a great selection of individuals that are eligible to be members in the focus group. These individuals will satisfy the requirements of being profoundly deaf and utilize ASL as their primary language. Participants will be obtained through the snowball method. The snowball method, also known as chain sampling, actively involves the subjects to find other participants for the study. The researcher reached out to a contact and instructed her to find willing participants for the study. This contact sought out friends and colleagues that may be interested and told them to pass along the information. Any person that was willing to be involved in the study is able to get in touch with the researcher directly through an email the researcher provided. The same tactic will be employed to find subjects for the hearing focus group. This method enables the researcher to find the requisite number of participants without having to expend much effort.

For those willing volunteers, they will be given a consent form before their participation which outlines that their participation is completely voluntary and they may elect to stop participating at any time. The form also explained that their statements would remain confidential and in no way whatsoever would their disclosures be directly attributable to them. The consent form can be referenced in the Appendix of this paper.

Christopher Fenn will serve as the interpreter for the focus group. He is an individual that wears a Cochlear Implant and is able to hear. His primary language is English, but Fenn is

also fluent in ASL. He will help translate ASL to English so that the researcher may better understand what the subjects are saying.

The discussion in the focus groups will lead to a deeper understanding of how deaf drivers communicate with their passengers as well as the role passengers may play in the driving environment. In addition, we will be able to glean how hearing drivers utilize ASL to deaf passengers. The focus group will help to determine how drivers will respond to outside auditory stimuli. Do they compensate by scanning the road more often or by utilizing certain objects, such as a wide rear-view mirror. The focus groups will provide an opportunity to see if these drivers use any resources to make their driving experience easier and if they are aware of certain laws or limitations in place for deaf or hard of hearing motorists.

The focus groups are expected to last approximately 60-90 minutes. This time range should provide plenty of opportunity to gather a great wealth of qualitative data without sapping out too much time and energy of the subjects. However, if more time is needed to conduct the focus group, which will not be an issue as the goal is to obtain as much relevant information as possible.

The particular focus of this study will find its' basis in identifying how deaf drivers will adapt to communicate in an environment that is confined and more restricting to ASL. Before being able to progress further, the Institutional Review Board (IRB) has to review the scope of this research. The process consists of filling out the forms provided that requires information on the type of research being performed, the funding, the research problem being addressed, who the participants will be and the manner in which the subjects will be obtained and so forth. In addition, the IRB forms requests the methods in which data will be collected, stored and

safeguarded. It also asks the researcher to provide the benefits to the research while also taking care to list any risks that may be associated with it. Given that the security and well-being of the subjects are of paramount importance to the IRB, the researcher is responsible for providing honest feedback on how the research will be conducted. The IRB will review the proposal and most likely make recommendations for the researcher to take into account for their research. The concerns and recommendations of the IRB must be addressed before the researcher is given the green light to commence their research.

Hypotheses 1 and 2

Deaf drivers lack the benefit of having auditory sensory abilities. Consequently, they are limited to primarily relying upon their vision for driving. Hard of hearing drivers can also lack that benefit too with various degrees of severity due to hearing loss that can be mild, moderate, moderate-sever, severe, or profound and as mentioned before, will not be a part of this study but should be considered for future studies. As discussed in the literature review, there are mixed findings determining just how safe deaf drivers really are and whether or not they can compensate by being more visually attuned to road conditions. The focus groups hope to address the following research questions:

1. In the absence of auditory cues, how do deaf drivers communicate to other passengers in a motor vehicle? In other words, how do they adapt to the driving experience outside of their normal modes of communication?

H_1: Deaf drivers will adapt their native ASL language in a manner that is simplified and allows them to maintain their focus on the road.

2. Do deaf drivers adapt to technology, i.e.: iPods, iPads, tablets, phones, and other electronic devices in a manner that differs from hearing drivers?

H_2: Deaf drivers will adapt to technology in a different manner than hearing drivers, such as utilizing a video call service for communication as opposed to vocally communicating over a phone or hands-free device.

In order to address these questions, the researcher will be focusing on a great deal of detail in personal driving habits and communication methods of individuals. To accomplish this, questions will be asked that address the following:

- Demographic Questions: age, race, gender, etc.
- Communication methods during a normal manner of conversation and communication methods during in-vehicle communication. What do the drivers and passengers do to make communication easier?
- How hearing drivers use ASL with deaf passengers and how they communicate with hearing passengers
- How hearing passengers communicate via ASL to deaf drivers
- Primary means of communication
- Any restrictions on the driver's license
- Use of technology while driving
- Perceptions of their driving habits compared with their peers
- Any noticeable distractions or perceived distractions
- Driving experiences

This is but a small sampling of what will be addressed, but provides a good sense of exactly what the researcher is trying to accomplish.

Measuring the Independent Variable of Communication

The independent variable in question is the auditory status of the individual. In this particular case, hearing loss to the extent that the individual is completely deaf will serve as the independent variable in the research.

Control Variable

The control variable will be the interviews conducted with hearing drivers. Given that an overwhelming majority of motorists on the road possess no significant physical disability as is the case with deafness, they would be an excellent basis from which to compare.

Measuring the Dependent Variable of Communication and Adaptation

This experiment is going to utilize communication as a means of providing a distraction. There are two distinct variables in communication: oral communication and ASL communication.

Oral speech is the natural language a large majority of Americans use to communicate with others. Given that there are many languages that are prevalent in America, it should still be duly noted that English is the primary language. As such, we are controlling for language by asserting that the oral participants are all English speaking and use English as their first language.

Sign language is yet another form of speech. However, it is predominantly used by people in the Deaf culture (includes deaf and hard of hearing) while there are those who are hearing that can also communicate using sign language. It is also important to take note that

there are multiple forms of sign language, not only for different languages, but for dialect as well. The most common sign language used in the United States is American Sign Language (ASL). However, English Sign Language (ESL) is another form of sign language but not nearly as common as ASL is. Consequently, it is also important to control for the type of sign language I will be analyzing. Only those deaf individuals who use ASL as their primary means of communication will be considered.

Like the studies carried out by Leung et al (2012), Strayer and Drews (2006), Strayer and Drews (2007), Garcia-Larrea (2007), and Lamble (1999), they all sought to identify the ability of the operator to respond when presented with a distraction whether in the form of a hand-held or hands-free call, or even texting. Although deaf drivers are unable to yield the benefits of hands free calls, they may very well adapt in a different manner that could be unique for this particular demographic.

Weaknesses

Given that this research design is very limited in time and budget, this researcher is forced to make several concessions. First, the focus study will have a small number of people which are of course, not going to be completely representative for the entire deaf community. Furthermore, since the focus group will be obtained through snowball sampling, this also poses a problem for representation of a particular group(s). Consequently, the findings, while qualitative, do not possess a sufficient quantity of subjects to be generalizable.

Although it would definitely be interesting to examine how hard of hearing drivers compensate for communication, it provides too wide of an array of hearing loss to cover. However, this would certainly be something to consider and conduct more research in. There

are individuals with hearing loss who use some auditory aids. However, this does not necessarily mean that these individuals are all speaking. Despite being able to hear, some may prefer to not communicate in a verbal language and would rather communicate via ASL. However, there are others, myself included, who only knows how to communicate in English and is unable to communicate via ASL. Limiting the study to just deaf drivers forgoes the wide range of individuals who are in between complete hearing loss and those who possess average hearing. While focusing on deaf groups is not exactly a weakness, it certainly is a limitation that must be called to light.

Another glaring weakness, although perhaps on a superficial level is that this experimental design is being conducted by a novice researcher. This researcher does not have the qualifications and credentials of many more prominent researchers and this can understandably lead to the impression that the results and findings of this research are questionable or not worthy, simply on the basis of a lack of experience and credentials that many well respected researchers possess.

Also, the results will not be generalizable. Much more research will have to be conducted in many different locations with more participants, the inclusion of ESL and other "dialects" and so forth. It will be interesting to see if future studies show that perhaps these results can be generalizable if the findings are persistently consistent.

Finally, this researcher is conjoining the efforts of this thesis with another project. As a result, balancing the requirements of this thesis and research design as well as the requirements of the project require careful planning, timing and cooperation between

members of the thesis committee as well as the project members and the requirements of the judges involved in the projects.

Timeline

February 2015	Submit Proposal
March 2015	Conduct Interviews.
April 2015	Incorporate Interviews into Thesis
July/Aug 2015	Complete and Submit Thesis
Sept/Oct 2015	Present and Defend Thesis

Chapter Three: Results

The focus groups were able to yield a fascinating array of information. It was very apparent that while there are many similarities to communication styles between the two groups, there are certainly significant differences in habits and opinions. This section will detail the revelations from each focus group and analyze what makes them similar or different from each other. The results have two major sections which will be divided by the results from each focus group. One thing to note is that this section will incorporate several direct quotes from the participants. In particular, the deaf focus group will entail translations that may not be word for word, but is rather a more accurate English equivalent translation. Fidelity to intended meaning, however, is maintained in the quotes, where verbatim translation is altered. The original intent is still there and the translation simply addresses discrepancies between the two languages.

Deaf Focus Group

The 9 members in this group are RIT or NTID enrolled students which composes a mix of seven men and two women. Those that participated possessed a valid driver's license and met the requirement of having profound hearing loss. The ages, as verified by their license, were between 19 and 27. Each individual frequently drove their vehicles four or more days per week. The most cited reason for driving was to get to and from class, followed by doing errands such as shopping for groceries or running mail. Most estimated they would drive less than 20-25 minutes per day on the weekdays to get to and from school or work. Most of the time, they drive by themselves. However, on weekends, they were more likely to have other passengers in the car or be a passenger themselves as they get together with friends and family. The number

of passengers they drove with would fluctuate daily, weekly, or due to class demands. Everyone had started driving while they were still in high school.

Electronic Communication

Despite not being able to hear, deaf individuals are still able to communicate while they drive. During discussions, it was revealed that the participants would not only communicate with their passengers, but also communicate via electronic devices such as phones, iPods, tablets and laptops. Granted, verbal communication is not a viable means to communicate with someone if you are deaf. However, technology has made it possible for a deaf driver to still interact with others even if they are not physically present. The easiest way to do this is via texting. Texting is an instantaneous method for relating information from one party to another through the use of cell phones. The need for verbal communication is no longer essential.

Each individual in the group said they texted while driving and they did it often. It has become almost second nature to them. While everyone was aware of the laws surrounding texting/talking on the phone while driving, they all claimed they could still drive unaffected, even if they were texting at the same time. A few have brought up “safe” ways of texting while driving. To “safely” text and drive, the phone should be held in one hand while the other hand is one the steering wheel. The phone should be level with the top of the steering wheel or dashboard. By doing so, the phone remains in the field of vision with the road at all times. This posture can also be performed holding the phone with both hands while using the palms of the hands to grip onto the steering wheel. To quote, “Holding the phone like this (signer pretends they are driving with phone on steering wheel) allows me to still focus on the road. The phone placement is closer to the road’s field of view and is just as easy to read as my dashboard.

Holding it like this, (signer placed a single hand below dashboard level holding phone in one hand) forces me to move my head down and away from the road."

While texting is instantaneous, the sender and recipient still need to wait for the other person to respond. This can take a while, especially when the recipient is busy and unable to immediately send a response. When a more thorough discussion and conversation is warranted, all the subjects have utilized a real time video software program such as Skype or Apple's FaceTime. These application allow all users to communicate with each other. Instead of relying just on sound like a telephone, the applications allow for the users to be able to see each other in real time through a video camera mounted on a phone, tablet or laptop. Sound and video is synched immediately.

The deaf subjects lauded how Skype and FaceTime made communication much easier. They said that this method allowed them to be hands free and more effectively communicate using both hands. The individuals described being able to mount their phones or tablets to the windshield or dashboard in a manner similar to someone mounting a GPS device. "I can mount my phone on the windshield and Skype with my friends or family. It is better because I can see them right in front of me in real time and they can see me clearly as well. It allows me to be more expressive and accurate." One participant, who didn't have a phone or tablet mount simply placed their device on a crevice in the dashboard or instrument panel. Doing so eliminates the need to hold the phone or tablet, thus freeing up both hands. According to him, "My phone actually fits perfectly in the dashboard next to my speed gauges. I was going to buy a mount until I tried this and it works really well."

When a deaf individual has a conversation, it is easier to convey what they want to say if they have full range of motion for both of their hands. Using these applications while driving fosters an environment in which the participants are able to become more immersed in the conversation. More can be said in a shorter amount of time. The freedom of being able to use both hands opens up a more expressive discussion thanks to an increase in the spatial area around them. Because of this, the deaf subjects were more inclined to initiate or receive a call via Skype or FaceTime if they felt like having a full conversation. This method was preferable, especially if the drive was going to be for any extended length of time. Otherwise, the subjects felt texting was more appropriate for shorter drives under 15-30 minutes. Following is a list of comments that captures how the drivers felt about Skype or Facetime:

"This is easier than texting. Signing is more natural than typing. It's also faster."

"I can be more detailed on a video call than I can with texting. Sometimes, my texts get misconstrued and that is not a good thing. With Skype or Facetime or Tango, I can get my point across more easily because I can see and respond to their expressions and they can understand my expressions."

"Because we can't speak verbally, this allows us to talk to other people more quickly like a hearing person can talk on the phone."

Communicating with Passengers

Now that we have gotten a grasp how some deaf drivers communicate with others when they are driving alone, it is important to also explore communication methods with passengers in the vehicle. As with many other motor vehicle operators, deaf drivers enjoy having good company with them. Being able to hold a conversation with family and friends

allows the discussion to continue while making a trip more enjoyable. As evidenced previously, lack of hearing has not hindered these participants from finding a means or method to communicate when they are driving by themselves. It should come as no surprise that they have found ways to adapt while holding a conversation with a passenger or multiple passengers.

The subjects were pretty consistent with how they explained how they still communicate with their passengers as a driver. The following information will discuss how the subjects sign to their passengers and how they listen to their passengers with one section dedicated to being the communicator and another section dedicated to being the listener.

While driving, the subjects stated they go back and forth between using one or both hands depending on the condition of the road and their driving environment. Road conditions, weather, familiarity with the location are three common factors that influence how the deaf drivers would interact with their passengers. The combination of these variables helps to dictate whether or not a certain signing style is more appropriate.

The majority of the subjects said highway driving was the easiest road to be on when holding a conversation. Due to the straight nature of the roads and the gentle curves, the subjects said they could better focus on their passengers because highway driving is predictable. They can see several miles straight down the road and spatially know where they will be. It's harder to do that in a city or suburban area where the roads curve much more frequently. Furthermore, there are more fluctuating speed limit signs, traffic lights and general driving laws to follow in city and suburban areas than there is on a highway. One participant

stated, “If I know where I am on a highway, I can see where I will be. There is no issue talking on a highway. It’s a little harder in city driving but we find ways to still overcome that.”

There is less traffic in highway driving and they are able to keep a greater distance between cars. Less concentration is needed and they’re more able to communicate using both hands instead of just one. When driving on straight highway roads, a few have said that the minor corrections made to the steering wheel to keep the vehicle on path can be controlled using their knees but that they don’t do it very often. On the flip side, city or suburban driving requires a bit more concentration to the road on the part of the driver. Because of this, the drivers state that their eyes spend more time on the road.

In areas with many traffic lights, the drivers would sometimes wait till they hit a red light to engage in the conversation. Jefferson Road in Rochester, NY was cited as an example of a busy road with many traffic lights and intersections.

“Jefferson Road can be unpredictable sometimes and the traffic is bad. The traffic lights stay red forever so that is when I talk to my friends the most.”

“Rush hour on Jefferson is always backed up. We’re moving so slow or stuck at a light for so long or waiting for a person to make a turn. It’s annoying, but makes talking to the passengers easier, especially the ones in the back because I can turn around at a red light.”

The group said sometimes it was just easier to wait for a red light to talk with their passengers because they would get a solid minute or two to be fully involved in the discussion. They’ve done this often enough where they can time the lights and know how long they can talk and take their eye off the traffic light before it turns green again.

The weather also impacts how the focus group says they communicate with passengers. Naturally, sunny weather in idea conditions makes communicating easier. However, in cases of inclement weather like dense fog, heavy snow, torrential downpours and icy road conditions makes communicating more difficult. In fact, each member said that if the roads were in terrible shape and the weather was uncooperative, they were much less likely to even engage in any type of discussion. One female even told a story about how she was driving after a Rochester snowstorm with some of her friends. She reduced her speed to drive more safely. When she was saying something to her passengers, she had one hand off the wheel as she was signing and during that moment, the vehicle started to lose control. Fortunately, she was able to regain traction and control of the vehicle and pulled over to catch her bearings. In her words,

> "I'm from a warm area so I've never really experienced snow except for flurries. Well, last year, I was driving through snow with a couple friends with me. I've always heard to slow down so I did. It was dark and the snow was starting to stick. Of course, I was still naïve about how bad the roads could get. As soon as I took one hand off the wheel to say something to my friend in the back, I must've jerked the steering wheel enough to start spinning the car. I spun to the shoulder but was able to get under control again. I was freaked out and now if the weather is bad, I tend to not talk as much."

It was a scary moment for her and since that point, she rarely signs in poor driving conditions unless she is answering basic yes or no questions. A couple other drivers said they had similar experiences and will refrain from signing to their passengers if the weather or roads are less than optimal.

Listening to Passengers

When it is their turn to listen, the subjects shared how they could still pay attention to the conversation. One thing was immediately clear; it is the responsibility of the passenger(s), especially the individual in the front passenger seat to facilitate communication between all

those that are in the vehicle with the driver. The group acknowledges that whoever is driving has the main responsibility of operating the motor vehicle in a manner that is safe. Because the driver has to focus primarily on the road, they are not able to see everything passengers are signing especially those that are sitting in the rear seats.

The front passenger has numerous duties to everyone else in the car to facilitate the conversation between everyone. They are the liaison between the driver, those in the rear seats, and themselves. They are tasked with double duty, not only signing for themselves, but also for the driver and the passengers in the rear. This finding is of particular note because it lends further credence to a number of things. For one, it solidifies the research of Keating and Mirus (2004) showing that deaf drivers adapt their communication to the driving environment they are in. Utilizing the assistance of the front passenger is yet another adaptation of a deaf driver which allows them to be still involved in discussions without sacrificing driving safety. In addition, this finding also supports the research of Maebatake, Suzuki, Nishida, Horiuchi, and Kuroiwa (2008), Baker and Padden (1978), Meier (1990), and Engberg-Pederson (1993).

For the times when the rearview mirror is not able to easily convey what the passengers in the rear seats are saying, the individual in the front passenger seat must be able to re-sign the conversation to the driver. In essence, he or she simply repeats what the people in the back said in a way in which it is easier for the driver to see and understand. To do this, they will place their hands and body as close to the driver's field of vision as possible without blocking their view.

To accomplish this, depending on the size of the vehicle, the front passenger can either place themselves in a position where they can see both the driver and the rear passengers and

relay the information that way. If the car is too small, they will alternate between facing the rear passengers and facing the driver. Regardless of the methodology, the passenger is essentially repeating what the people in the rear seats say. Sometimes, if the people in the rear were not able to understand everything the driver said, the passenger will re-sign everything the driver said for the passengers in the back.

Having the front passenger serve as the intermediary allows the driver to pay more focus to the road. The group came to a general consensus that having a passenger to take that role makes being involved in the conversation much easier and more enjoyable. They'll volunteer to be the front passenger if they aren't driving because of how important it is to them and being able to "foster an inclusive atmosphere." However, there are times when even that may not be enough and that will be addressed in the following paragraphs.

Conversations, regardless of the hearing capabilities of those involved can very deep and require a significant amount of concentration. While a car is not an optimal place to partake in these types of conversations, it does sometimes come up, although quite rarely. A few subjects in the deaf focus group have stated that if a conversation turns out to be highly emotional, argumentative or in some way or form becomes the primary concern for the deaf driver, they will try to find a safe place to pull over and resume the discussion. It is important for everyone to be involved in the conversation, including the driver. This further lends credence to the importance of having an all-inclusive atmosphere for the drivers.

These types of instances could potentially distract the driver enough so that they are not focusing on their primary task of driving. If they feel like they're too involved, pulling over allows the driver to focus 100% of their attention on the discussion at hand. As a result, they

are a full participant and are able to convey the deep thoughts they have to others around them. One subject said that because ASL is a very visual language, it would be hard for them as a driver to see the facial expressions and exaggerated signs of his or her passengers. It also makes it more difficult for the driver to thoroughly convey their streamlined thoughts and ideas if they are limited to using just one hand and not being able to use the full range of spatial motion they are normally accustomed to.

Deaf Driver Communicating with Hearing Passenger(s)

A few subjects have had the experience of driving with a hearing passenger either through relatives that are hearing or having hearing friends. Much of the same concepts apply in terms of communication styles. However, the general consensus was that it is more difficult to carry a conversation with a hearing passenger. Hearing individuals have a bit of a different ASL "accent" that makes understanding them a bit more challenging. This difference isn't insurmountable and is relatively minor that a conversation is able to proceed as normal. On rare occasions, the hearing passenger may be asked to repeat what they signed or fingerspell if their intentions weren't completely clear. Someone said, "I have a couple hearing friends from back home. They are still easy to understand but like with most other hearing people, they have a more distinct signing style."

Deaf Passenger with a Hearing Driver

Conversely, being a passenger with a hearing driver that knows ASL is a different story altogether. It would seem that, from their perspectives, hearing drivers who are ASL fluent are not as keen to sign while driving. For those that do, the subjects have said that their sign tends to be more choppy, especially if it's a person that doesn't use ASL on a daily basis.

There was a volunteer who was born to hearing parents. If he was a passenger in the vehicle with his mom or dad, they would still converse with him. However, they prefer to focus more on driving and not being as effective of a communicator. The man said his mom refused to sign while driving for a long time. Eventually, she started to try to sign to her son and was able to pick up on it and get better. However, he notes that the conversations are generally not that comprehensive. His statements were that, “My dad would sign, but my mom would not. It terrified her for the longest time. When she started she would say one word and then grab back on the steering wheel, say another word and grab back on the steering wheel. It felt like it took her ten minutes to say one sentence. Eventually, she got better but she still prefers to not sign and drive.”

Other subjects have reported similar experiences with their hearing relatives or friends. At first, most were apprehensive about signing while driving. However, as time progressed, they became more comfortable with it. Still, there is a noticeable difference between them signing in a vehicle and outside a vehicle. While not detrimental to the overall conversation, as a passenger, they may have to “dumb down” certain ways of conveying the information they want to impart.

Opinion: Who is a Better Driver, Deaf or Hearing?

The deaf focus group shared a unanimous agreement that deaf drivers are more adept than hearing drivers. They backed it up with statements arguing that driving is a very visual activity and hearing is not required for it. They also built up on the notion that if you lose one of your senses, your others kick in more to compensate for it. As such, they applied that their

hearing loss makes them see better, which allows them to be more observant drivers which in turn makes them safer and more responsible on the road.

When asked if hearing loss would make it more difficult for them to detect emergency vehicles, they acknowledged it was a valid question but hearing the vehicle was irrelevant because they would be able to see the vehicle ahead of them, through peripheral vision and by frequent use of the rearview and side mirrors. Simply, if they can't hear it, they can see it and make their driving decisions based on what they see.

To further prove this point, one of the subjects presented the following argument. You could take a hearing person and put them in a vehicle that was completely soundproof so that they couldn't hear anything on the outside. You could also give that same person noise cancelling headphones or ear plugs so they wouldn't hear anything. But despite not being able to hear, they can safely start up a car, drive from point A to point B following all traffic lights and signs, make turns and lane changes, park between the lines in a parking spot and exit the vehicle without any difficulty. Next, the subject argued that you could put a hearing or a deaf person in a car with the windows all blacked out and blindfolds on. You wouldn't be able to see anything through the blindfold or windows. If they were to attempt the same drive from point A to point B, it would be impossible. You'd drive off the road, not see the traffic lights or stop signs or worse, crash into other vehicles and cause serious accidents, damage, injuries and death. Ergo, hearing is not necessary for driving but your sight is. Further, because the group believes their sight, depth perception and peripheral vision is better than average, it makes them better drivers because they can see more.

A few people brought up the perspective that they aren't distracted by sound like hearing drivers are. There is no noise for them to be bothered by. They can't get distracted by singing along to a song on the radio. They aren't bothered by the sound of road construction and can't get distracted by those loud noises. Regardless of noise levels, deaf drivers and passengers can continue a conversation without having to adjust their speech patterns due to fluctuating road noise. They argue that hearing people are bombarded with so many different noises that they are trying to identify. These noises require the hearing drivers to process what they are hearing and that takes away from their ability to drive effectively.

Hearing Focus Group

This focus group was comprised of RIT students only. Unlike the deaf focus group which consisted of a mix of RIT and NTID students, this group could only get participants from RIT because NTID is exclusively for deaf or hard of hearing students. The 10 members of this group (7 men and 3 women) were all hearing and possessed a valid driver's license as well, all of which were obtained while the participants were in high school. In addition, they had to meet the requirements of being able to converse fluently in ASL or ESL. Their ages ranged from 19 to 22. Like those in the other group, the most cited reason for driving was to get to and from school or work as well as running errands. Participants drove their cars between 3-7 days a week with most saying that they drive five days a week. Participants estimated that they drove between 20-30 minutes per day. The subjects usually drove alone but would frequently have friends in the car with them after school or work and on the weekends. In those respects, there is not much of a differentiation between the members of this focus group and the members of the deaf focus group. However, half the group was considered CODA, meaning Child of Deaf

Adult and the other half wasn't. This lifestyles and perspectives of a CODA and non-CODA are markedly different and this dynamic will be explored later.

Electronic Communication

Each participant stated that they used electronic equipment to communicate with people while driving. In each instance, they used a mobile phone. Unlike those in the other group, no one said that they used tablets or laptops as a means of communicating with people.

The most frequent use of the phone was to send or receive brief text messages. This group had greater leeway to send texts. Eight members of the group said that when they text, they just talk to the phone through the voice recognition software. This software allows them to avoid having to type out what they want to say. Speech to text is very fast and very accurate. One subject said that his speech to text worked so well that he could say a paragraphs worth of words in a text message in "one-tenth" of the time it takes for him to type everything out normally. One of the female subjects stated,

"I'm one of the few people who actually type out everything in a text. I just hate when things are shortened and words are intentionally misspelled. So for me, like some other people here, it's easier to just talk to my phone in full sentences and have it translate it for me into text and send it."

The ability to simply speak to the phone to have it text for you is very helpful. The users claimed that not only was talking easier, it freed up from having to focus on typing out the words. In short, they felt it was a safer alternative than to actually type everything out because they didn't have to take their eyes off the roads to see what they were typing out. However, each person said they would occasionally type out their text messages if it was a short text. For

example, respondents said that they had no issue with typing out “np” (no problem), “thx” (thanks), “omw” (on my way), “lol” (laughing out loud), “yes/no” or other shorthanded phrases.

There was a slight drawback to using speech to text. While the programs for it are quick and accurate, it is not always 100% accurate. Sometimes excessive road noise or interference from the radio would make it difficult for the voice recognition programs to make a thorough accurate translation. It has led to some word confusion that would change the meaning of the text. However, in most cases, even these minor slip-ups still resulted in a very legible text message that is still well understood by the recipient. In very rare cases, respondents have reported that the programs have sometimes sent the most bizarre and sometimes obscene texts that had no bearing on what they were trying to say. These moments are usually remedied by rephrasing the text or simply by taking a moment to type it out when they can.

Driving conditions appear to be the determining factor for how the subjects determined when they would text and how they would text (speech to text or traditional typing). As would be expected, the more optimal the driving conditions, the more likely they would be to send a text if they felt the need or want to. The rationales provided were strikingly similar to those provided in the deaf focus group. Driving in good weather conditions and little traffic were more conducive opportunities to send out a text whereas poor driving conditions such as inclement weather, lots of traffic or construction were scenarios that are less “text-friendly” and therefore, not as likely to send a text.

“Ideal” moments to text included when at a stop sign or stop light. Other “ideal” moments are when they are driving on straight roads with little to no traffic such as highways. During these stops, respondents would be more likely to type out their texts.

"Stop signs or stop lights are ideal for texting. I can shoot off a quick text before the light changes green."

"If there is no one behind me on at a stop sign, I can text without having to worry about a changing stop light and having to move again. It gives me more time to myself without having to focus on the road around me as much."

There is less stress in those types of driving atmospheres which makes typing out a text message an easier thing to do. Furthermore, they would check other apps on the phone such as Facebook, or sports apps for their favorite teams. Behaviorally, the deaf and hearing focus groups were very similar in describing how they used their phones while they were stopped in their vehicle.

However, during times in which driving conditions are more trying, the respondents said they'd prefer the hands-free speech to text function of their phones. This allows them to keep their hands on the wheel and focus their eyes on the road. They felt it was less distracting and an adequate substitution for the traditional texting methods. For example, one participant said that she frequently drove through the city. The constant stop and go traffic is unpredictable and makes typing her text messages more challenging. It is easier for her to simply speak to the phone while paying attention to the changing traffic patterns.

When presented with the question with whether or not they were familiar with the texting and driving laws, each person admitted that they knew it was technically illegal but it seemed irrelevant if they texted while stopped or quickly so as not to have their eyes off the road for too long. Interestingly though, those subjects who used their speech to text didn't feel that if they spoke for their text messages that it would be illegal because they could do it

hands-free. “Texting might be illegal, but speech to text isn’t. They can’t arrest me for talking to my phone.” This sentiment was well received by the other members of the group.

Each participant in this focus group also said they make phone calls while driving. Like with texting, there are multiple options at their disposal to have a phone call. The participants revealed several ways to talk on the phone: hand-held, hands-free via the vehicles internal wireless Bluetooth system, hands-free via plug in headphones, or simply putting the cell phone on speaker. The ability to choose between multiple options allows the drivers to pick a method that they prefer as well as a method that works better for them in a given driving environment.

Communicating with Hearing Passengers

When speaking verbally to others, it is not necessary for the speaker or listener to have any visual contact at all. Spoken language is still easily understood in the absence of a visual line of sight. This is evident especially when a hearing individual holds a conversation with someone else over the phone. This ability is able to easily transfer over to a driving environment.

Each participant said that when they were talking with their passengers, it was never necessary for them to maintain eye contact or to constantly see who was speaking. They could drive and keep their eyes on the road at all times while still being able to converse with everyone in the vehicle. As a driver, their main focus was to scan the road for changing road conditions and any sign of danger that would require them to react accordingly.

While they may not need to see their passengers to carry a conversation, that doesn’t mean that the participants won’t glance over at their passengers while conversing with them. As a driver, they will make glances over to the passenger side or utilize the rearview mirrors if they have passengers in the back so they can make eye contact with them. These glances are

fleeting and last “1-2 seconds at the most” according to the subjects. While brief, these quick glances serve as a way for them to be more involved in the conversation and to show their interest in what is being discussed.

When inquired if they change their communication style while driving, the consensus was that they didn’t need to. However, a few participants reported that sometimes they will speak louder or that their passengers would speak louder to compensate for additional road noise such as when they roll the windows down or open up their sunroof. One subject drove a convertible and agreed that he and his passenger would speak louder as they were driving if the roof was lowered. Given that caveat, everyone else agreed that other than rolling down the windows or the roof, they couldn’t recall changing their communication style.

Conversing with Deaf Passengers

The feedback was split here. The participants had five members (three men and two women) that are “CODA.” This acronym stands for Child of Deaf Adult. Their unique upbringing has given them a different perspective than the other members of the group who simply knew ASL because they wanted to learn it. Half of this group knew ASL by necessity whereas the other half knew ASL because it was their major or because it was something they wanted to learn. This particular section will be split into two parts; the CODA perspective and the non-CODA perspective.

The CODA participants said that the way they communicated in ASL with a deaf passenger was heavily dependent on road conditions such as weather, city or highway driving and other variables in common with the deaf focus group. They would sign as normally as they

could to deaf passengers in very much the same way that the drivers in the deaf focus group would do to their passengers. The differentiation is nominal.

The CODA participants feel that while their signing style is similar to their deaf parent(s), that they are more likely to keep at least one hand on the wheel at all times. They have reported noticing and reacting to sounds they hear while driving (i.e. horns beeping, sirens, etc.) and their deaf passenger doesn't realize what is going on. The CODAs feel "cautiously comfortable" with being able to sign and react to the road appropriately. They view their upbringing has bred enough familiarity with ASL that they can still use it while driving. At the same time, the CODAs feel that because they are able to hear, they are able to react and respond to the myriad of dangers in the road more quickly. One male said, "Both my parents are deaf. I grew up learning sign so I basically sign the same way my parents do. So, of course, I sign and drive at the same time with them. However, I am still aware of what I hear and respond to that. Overall, I'm cautiously comfortable doing it. I'll still sign, but I won't go so far out of my way for it."

If the CODA is a passenger in a vehicle with a deaf driver, they also help serve as the "ears." Each CODA has reported a time when a deaf family member, relative or friend was driving and they helped to alert them to the presence of emergency vehicles. Oftentimes, they would hear the sirens before either they or the driver would see where it was coming from.

The non-CODA group had a very different perspective on using ASL to communicate with their passengers. While as a whole they weren't against it, it was something that they were apprehensive about. The non-CODA members said that while they would still use ASL if they had a deaf passenger, they definitely didn't feel that they could be as involved in the

conversation. The general gist was that they were more focused on driving that being able to sign at the same time was much harder to do. One person mentioned that she didn't "feel as in control of the vehicle" if she was signing at the same time. Other responses included that they felt "unsafe" or "incapable" of being able to sign while driving. The gist of their statements were:

"I've tried signing before and I don't feel as in control of the vehicle."

"I'm not good at it. I've tried and I'm just incapable. Everything I sign comes out blocky. I'll do it if I'm stopped at a light or something."

When asked why they felt that way the non-CODA members said that it wasn't always a very common occurrence to have a deaf passenger. Because of this, their exposure to being in that scenario is very limited. This unfamiliarity leads to them feeling that it is more difficult to be able to have a conversation with deaf passengers. For the times when they did sign, they felt that their ability to express their ideas was more limited. Their movements are blockier and not as fluid. In a sense, they sign at a lower level in a manner in which they feel doesn't detract from their ability to drive.

If there is a passenger who can sign and speak, they are more likely to rely on the hearing passenger to convey any part of the conversation that they might miss while driving. In this sense, the hearing passenger plays a similar role as a CODA would for a deaf driver. In this instance, instead of a deaf driver with hearing passengers, you have a hearing driver with deaf passengers. In both cases, we see that the passengers play an important role in facilitating communication for the driver and other passengers.

However, these participants said that if they were at a stop sign or stop light, they had no problem jumping in the conversation and signing normally. While at a complete stop, the need to follow changing road conditions, traffic and constant observation is minimized allowing the subjects to be more immersed into the conversation. In addition, these subjects felt that the more experience they had with driving with deaf passengers, the more comfortable they would get over time with their ability to carry a conversation at a level similar to a CODA or deaf individuals.

Opinion: Who is a Better Driver, Deaf or Hearing?

Perhaps unsurprisingly, this focus group as a whole felt that hearing drivers were better drivers. However, this opinion wasn't unanimous. There were a few dissenters from those that were a CODA. One CODA with a deaf father and a hearing mother said that his father was by far a better driver than his mother and felt that his dad drove on par or better than hearing drivers as a whole. This sentiment was echoed by another CODA whose parents are both deaf and he also said that the driving abilities of his parents are better than those of his hearing friends.

These two CODAs said that they felt their deaf parent was a better driver because they were more cautious and less likely to take risks while driving. They felt the ability for their parents to be observant makes them more aware of the constant changing road conditions. This in turn led them to believing that deaf drivers have the potential to be safer on the road than their hearing peers. In addition, they said that hearing wasn't completely necessary because deaf drivers would be able to feel loud noises. Another CODA said his father is able to tell when he needs to replace his tires simply from being able to feel it as he is driving. This

unique ability to sense minute vibrational changes in the vehicle can give deaf drivers a heads up when it is time to replace tires, get the engine checked out or other maintenance needs.

As for the remaining individuals, they felt hearing drivers were safer. The ability to hear odd engine noises, sirens, honking of horns, etc. provides more information for a hearing driver to react to, thereby making hearing people able to react more quickly and process the road conditions more efficiently. They also believed that deaf drivers would be slower to react to emergency vehicles simply because they couldn't hear it and prepare to respond accordingly. While they wouldn't discount deaf drivers as not being safe, they did feel that as a whole, it might take them slightly longer to respond to certain scenarios. If we recall the instance in which the CODA was a passenger for his father, he was able to hear and alert his dad to the emergency vehicle before his father was able to see it in the mirrors or in his direct line of sight.

They also argued that deaf people love to communicate and the nature of signing is very visual. They argued that when deaf people communicate in a car, they feel their eyes are off the road more than a hearing person. Depending on the scenario, they feel that could be a potentially dangerous situation.

Chapter Four: Discussion

This research has yielded a myriad of opinions and information on communication habits and styles through two separate focus groups: one which consisted of only deaf subjects and the other consisting of only hearing subjects who have a thorough knowledge of ASL. The findings show that regardless of auditory status, drivers or passengers will adapt their communication methods when subjected to various driving environments.

While it wasn't surprising that members of both focus groups would text or check apps on their phone, it was rather surprising to see deaf subjects saying that they've used laptops, phones and tablets to utilize video services like Skype or ZVRS while driving. While this information was not fully expected, it supports the hypothesis that deaf individuals will utilize technology to facilitate communication. Furthermore, when interacting with other deaf passengers, we see that passengers play a pivotal role in ensuring the deaf driver is able to fully comprehend all aspects of the conversation. The findings also showed that hearing drivers and passengers will adapt their communication methods like deaf drivers, albeit, in different manners.

The information gleaned from the research is valid to the extent it corresponds with the experiences and interpretations of focus group members. This information stems from the personal experiences of the subjects and their experiences with other individuals. The focus group was able to put similar peers together and recount their habits and methods with each other and provide a broad general scope of communication manners in relation to how they drive. The promise of confidentiality allowed the subjects to be frank and discuss things that are potentially illegal (i.e. texting while driving).

The research relied heavily on the direction the focus group decided to go. Consequently, there was an instance or two in which the researcher was unable to compare the information between the two groups. The approach was very hands-off and only required minimal guidance and questioning from the researcher. While this information is relevant and included in the results, there is no direct comparison between the focus groups.

Overall, distracted driving is, unquestionably, a serious safety concern, so much so, that the CDC has declared it to be a serious public health hazard. This research has further exposed that distracted driving is still a concern. Furthermore, it has exposed distractions that may otherwise not have been considered common, such as video calling while driving.

Despite numerous laws that already exist on the books for distracted driving to include texting/calling on phones, we still recognize that laws aimed at reducing the influence of such mobile technology on a driver do not necessarily eliminate these occurrences from happening. Technology has become so advanced so rapidly that our phones or tablets are able to do many different tasks, and do them simultaneously. A cell phone is no longer limited as just a calling piece. It now also serves as a computer, camera, GPS, media storage, and even a personal banking system.

Unsurprisingly, with the advancement of technology in personal electronic media, we've seen those same technological advancements make their way into vehicles. No longer are cars a simple utilitarian method of transportation. Cars are being created in factories with complex electronics to include central computer systems. These central computers have phones or tablets wirelessly link up to them. In short, the entire vehicle can allow personal electronic

media to sync up to it, effectively transforming a car from a tool of transportation to an entire entertainment system on wheels.

Vehicles are becoming smarter after every new model that makes its way to the floor. Car manufacturers have already developed autonomous vehicles that don't require driver input. While for the most part, these vehicles are still developmental. However, there has already been much success. From lane detection systems to driverless parallel parking to brakes wired with lasers or cameras for crash avoidance, these features are already being widely used. With continued success of autonomous vehicles, it wouldn't be altogether surprising to witness fully autonomous vehicles become the norm within the next few decades.

The future for technology and vehicles is very bright. If vehicles come to the point of being fully autonomous, laws barring the use of cell phones or tablets while driving would become outdated. In such a technologically connected world, we could one day text, Skype, call, etc. as much as we want while driving without being distracted by the task of actually operating the vehicle. This day could be happening much sooner than we think but should not take our eyes of the current dangers posed by distractions, especially those presented by novel uses of new, developing technologies in the hands of drivers.

Future Research Considerations

When looking at past research, these results further enhance the notion that distracted driving can take shape in many forms. Whether this is through the use of electronic media or conversational styles, the actions of the members of both focus groups show that some communicative methods are potentially more distracting than others. This is further evidenced in the opinions section in which the participants were able to lobby their views.

When it came to opinions on whether hearing or deaf drivers were better, the results were drawn on party lines. Members of the deaf focus group were adamant about possessing superior driving abilities and the hearing group had a near unanimous decision in thinking that hearing people drove better. The rationalizations proposed by each group makes sense. However, these opinions are heavily focused on their past perceptions and feelings. While the thought processes behind these opinions are helpful in formulating a general perspective, they are not sufficient to quantitatively make a scientific conclusion through testing in a controlled environment.

This research would benefit from a research design in which hearing and deaf subjects can be tested against each other in a controlled environment that would determine their reaction times and ability to discern potential road hazards. This type of research has been frequently performed in analysis of the distractions of cell phone use either via texting or calling on the phone. It would be beneficial because the results could be quantitated and directly compared and contrasted with each other.

Future research would do well to broaden the subject pool. The limited number of participants in each focus group are a far cry from a generalizable and representative population. This, factored in with quantitative research that emulates Strayer and Drews (2007) would provide a more complete picture on the impact communication has on driving ability.

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Appendix

Consent Form:

You are being invited to participate in a focus group. The focus group will be part of an exploratory study to gain a better knowledge of how communication occurs in a driving environment. The data obtained in this study will be very valuable and could possibly influence the course of policy upon further research.

There are some requirements that must be met:

For the first focus group, you must possess profound hearing loss and communicate primarily through American Sign Language. For the purpose of this focus group, "profound" hearing loss is defined as hearing loss that exceeds 80 decibels. In addition, you must also possess a valid driver's license. If you satisfy these requirements, your participation would be greatly appreciated.

For the second focus group, you must possess hearing with no noticeable form of hearing loss. Furthermore, you must also be able to understand ASL and hold a simple conversation in ASL. In addition, you must also possess a valid driver's license. If you satisfy these requirements, your participation would be greatly appreciated.

The study will take place in the form of a focus group, of which there will be 8-12 members (possibly up to 20). A discussion will last for approximately 45-90 minutes in which data will be gathered. The type of data sought includes personal experiences driving as a driver and/or passenger. Information regarding driving habits will be sought such as use of technology while driving or how you interact with others in a vehicle. Your honest experiences and perceptions are highly valued.

You would be among similar peers. Some topics in the discussion may be sensitive in nature. You will also be videotaped for the duration of the study. This will not be made public and will be safeguarded through secure encryption. The purpose of the video is to allow the researcher to review the focus group and gather as much data from it as possible. Given that the study is a focus group, if a question pops up that you are uncomfortable to answer, you can choose to not address it. Your statements and your name will remain confidential.

Participation in this is completely voluntary. You may leave the study at any time you want.
Food and drink will be provided to all participants (Salvatore's Pizza and soda).
Should you choose to participate, I thank you in advance for your time and effort.

For further questions, you may contact me at:
Cell (Talk/Text): 203-617-7140
Email: pth1482@g.rit.edu

Advisor:
Dr. Judy Porter

585-475-5367
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For more information on your rights as a research subject, you may contact HSRO at:
Heather Foti
585-475-7673
hmfsrs@rit.edu

Focus Group Questions:

Lead questions:
Generally speaking, how often do you drive?
How long is an average car drive for you? How many miles do you generally drive in a given day or week? Where do you drive to? School/work/home/family/friends, etc.
Do you drive with passengers? How many? How often?
The questions above are very simple and short questions that are designed to get the members of the focus group to get involved and answer some very basic questions. They are icebreakers and will serve to help me develop a positive rapport. Each participant should be able to answer these questions with great ease and not feel defensive. Once the participants get talking, they should be more comfortable for the following questions which will provide me with the core information I am looking for.

Defining questions:

Are you familiar with distracted driving?
How would you all define distracted driving? Is the radio distracting? What about the weather? Passengers? Familiarity or unfamiliarity with roads? Calling/Texting? Drunk driving?

The questions above are designed to provide a definition to what is distracted driving. Now, it is entirely feasible and expected that each person will have a different definition of what constitutes distracted driving. These questions are structured in a way so that the participants will be able to collaborate with one another and develop an overall common theme/definition for what they define as distracted driving. As a researcher, I would hypothesize that the participants will share several common sentiments for what they believe is distracted driving. This information is relevant because it will provide me with a benchmark for establishing what is distracted driving. These questions are positioned after the “icebreakers” because it is important to have a working definition before getting into the questions that ask for the nitty-gritty.

Reflection questions:

Now that we have defined distracted driving, have you engaged in anything that has caused you to become distracted while driving? If so, what are some examples of distracted driving that you have done?

How frequently does that occur?
What percentage of the time would you say that you drive while distracted?
Do you feel that distracted driving can significantly impair your ability to safely operate a motor vehicle?

The above questions are meant to determine whether or not the subjects engage in varying forms of distracted driving. Since these questions are self reflective and may cause subjects to admit something they feel they shouldn't be doing, this section of the focus study will have to be done tactfully. At this point, I'm not looking for specifics, but instead a general understanding of what types of distracted driving the subjects are privy to. This internal look at themselves will serve to further solidify the definition of distracted driving and lead way to analyzing one particular focus of distracted driving: conversational habits with passengers.

Thesis specific questions:

How do you communicate with your passengers?

- Eye contact? Look in a mirror? Stay focused on road and only listen (this applies to hearing individuals)? Turn body towards individuals? Wait till at a red light. Etc. How intense are your conversations?

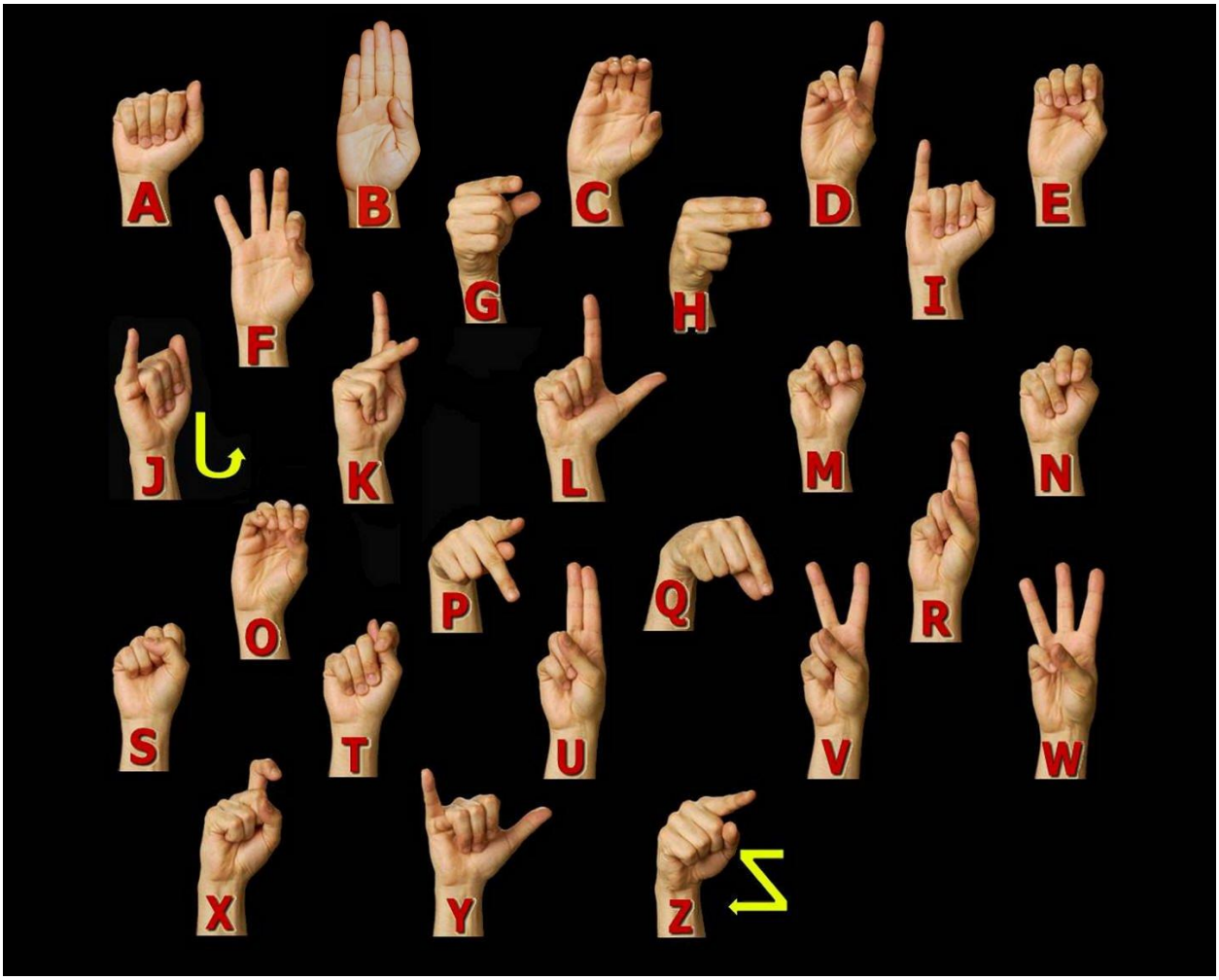
Do you use ASL to communicate with your passengers while you are driving?
In what manner do you use ASL when driving? For example, will you make eye contact or turn your body towards your passengers?
What barriers, if any, do you have to overcome while driving?
Is signing while driving distracting? Why or why not? Is it difficult and what challenges are associated with it?
Are there any methods you utilize to negate what could potentially be distracting? What strategies are effective and what isn't effective?

The questions above address what is the core of the thesis and what I want to identify. At this point of the focus group, the participants should be able to provide a comprehensive amount of information. The questions are neutral for the most part, although deaf individuals may feel conflicted when asked if using ASL while driving is a distraction. I don't anticipate this to be problematic as I feel the subjects would be open to explaining how they can communicate and what attempts are made to "negate" the distractions associated with communicating with their passengers.

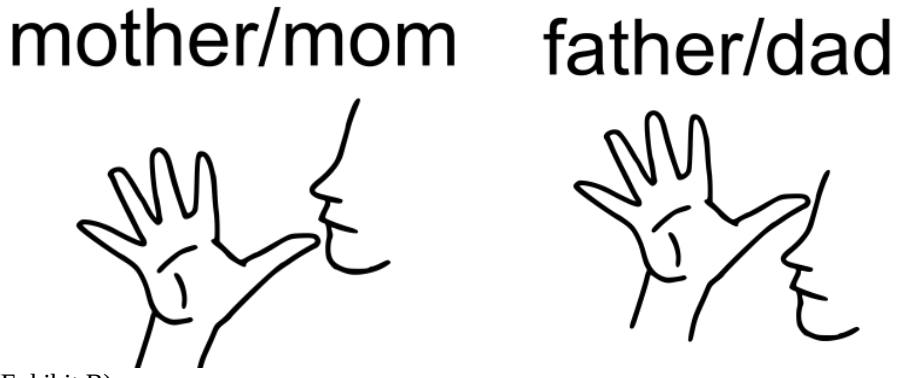
Opinion based questions:

How do you perceive the driving habits of hearing individuals? How do you perceive the driving habits of deaf individuals?
If you're a passenger, is there anything you do to minimize the driver from being distracted? For example, do you adjust the radio/GPS for the driver, make yourself more visible, speak louder, etc?

These question are a follow-up for the main questions that came before it. I'll be able to get the opinions of drivers on how they feel about the driving capabilities and habits of their fellow peers and those opposite them in this study. Also, since these participants drive, they have their own driving styles and manners in which they communicate with their passengers. However, it would be interesting to see what they do as a passenger when it comes to communicating with other passengers, especially the driver. The new perspective eases pressure off of their driving habits and allows them to focus on what they do when they don't have the responsibility of driving.

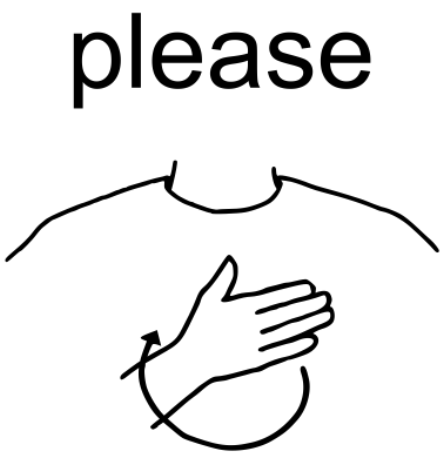


(Exhibit A)
This image depicts the entirety of the American Sign Language (ASL) alphabet. These hand shapes are used with the dominant hand when a signer is spelling a word out, oftentimes to spell a name, place or a word with no commonly established sign, to a recipient.



(Exhibit B)
This image depicts the words “mother” and “father” as well as the spatial difference in the location of the hands. While the hands have the same “sign,” it is the location that the hands are placed that change the meaning with masculine words typically dominating the upper spatial zone and feminine words dominating the lower spatial zone.

(Exhibit C)
The sign for “appreciate.” The hands form a “B” shape, are placed on the chest and circle in opposite directions to each other.



(Exhibit D)
The sign for “please.” The dominant hand forms a “B” shape, is placed on the chest and is moved in a circular direction.