Social and Cultural Hurdles in Design Implementation of Autonomous Vehicles

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Societal Factors Influencing the Design and Full-Scale Adoption of Autonomous Vehicles

Pedestrian safety in the US has increasingly become a major issue for federal, state, and local governments. The NHTSA reports that in 2018 alone, approximately 6283 pedestrians died in a traffic accident, an increase of ~3% from the previous year and the highest since 1990 (NHTSA, 2020). Considering almost everyone is a pedestrian at some point, this is an issue that resonates in the entirety of society. As more of the population moves into the suburbs (Parker et al, 2020), an increase in vehicle miles driven per day is sure to follow and so too will the number of pedestrian accidents and fatalities. As a result, pedestrian safety will only become more important to local communities. The aim of the technical part of this project is to design and implement pedestrian safety improvements in a local community. It will also aim to explore the various ways that the future of transportation and transportation infrastructure can improve pedestrian safety. As the technological infrastructure of transportation progresses, it has the ability to have a profoundly positive impact if it manages to address significant issues. The STS section will explore autonomous vehicles (AVs), a major component of the future of transportation, and the societal and industry wide issues they need to overcome in order to be fully implemented.

Social Hurdles for AVs

In our car centric society, owning and operating personal vehicles is seen as a sign of independence. From teenage years all through adulthood, cars are often the primary source of transportation for millions. This also means that we spend countless hours in these vehicles, commuting, sitting in traffic, and wasting valuable time and money. Autonomous Vehicles (AVs) have the potential to drastically change all this and return that time back to their users, but they face a myriad of hurdles to their wide adoption and acceptance in society. To best explore

these hurdles, the Social Construction of Technology (SCOT) framework will be used. This framework argues that a technology is deemed successful not because it is described as "the best" technologically but rather by how various groups in society interact with, define its capabilities, and take advantage of its benefits. In this case, understanding the lack of awareness that consumers have about AVs and in some cases the mistrust that others have. These hurdles are important to address because they can shape how the developers of these technologies, specifically vehicle manufacturers and their marketing teams, target consumer groups. Additionally, they can also shape policies created by governments to assure the safety of consumers using this technology, in turn convincing more consumers to use them knowing that their respective governments will provide legal remedies in case of dissatisfaction and harm.

Lack of awareness and education

The impact that autonomous vehicles could have on our lives, especially with regards to commute times, is projected to be significant. With the average American now commuting about 25 minutes every day (~45 round trip daily excluding extraneous travel), a significant amount of time is spent in our cars (Noguchi, 2017). Autonomous vehicles have the potential to help commuters reclaim that time for personal use or to get a head start on work. While the benefits of these vehicles are many, a large percentage of Americans do not understand how these vehicles work. Many are misled in believing that systems such as Tesla's Autopilot and GM's SuperCruise are considered self-driving vehicles when they are in fact just driver assistance systems. Fueling this lack of awareness are some of the main industry players who intentionally label their products as capable of self-driving when in fact, they are merely there to supplement the driving. An example of this is with Tesla's system that it labels as Autopilot (Autopilot, n.d). This naming convention is similar to that used in the aviation industry for aircraft systems that

provide the capability for an aircraft to fly and land by itself. However, those systems require constant monitoring by the crew in an aircraft's cockpit and require numerous hours of training to master as well as retraining to avoid complacency. This is not the case in Tesla's or most other manufacturers systems. They are marketed as being able to handle themselves in most driving situations, but they can only perform just as and if not slightly better than a human in particular scenarios such as highway cruising. Often, it is only in the very fine print that manufacturers warn that these systems are not capable of driving themselves in all situations and that drivers must constantly be vigilant about their surroundings. This false sense of security can lead consumers into believing that the systems implemented in their vehicles can allow them to delegate the driving to the vehicle and when they fail, can lead to unnecessary injury and loss of life. The consequences that arise from the lack of awareness of the capabilities of current systems will only serve to convince the public that these vehicles are unsafe and do more harm than good. If manufacturers wish to have their AVs compete successfully in the market, they must develop strategies and push for policies that mandate transparency on current capabilities to usher in the future.

How drivers end up perceiving AVs with whatever level of education they have is a key tenet of the SCOT framework. As stated earlier, drivers have the most to gain with the full implementation of AVs and could see benefits in productivity and even personal leisure. This stresses the need for clear distinctions about what current systems can do to avoid having drivers lower their guards when driving. When manufacturers create these vehicles and label them in such a way to illicit public interest, they are making a claim to the driver that the vehicle is capable of handling itself. This then leads to these very drivers finding that the vehicle cannot be trusted with their safety and a reduction in sales of vehicles that claim those capabilities. It then

has the effect of reducing the amount of research funding that is put into developing AVs because of lack of consumer interest even when the benefits of these systems are numerous. For companies like Tesla which relies on collecting driving patterns and behaviors from their drivers as well as imagery for machine learning systems, this would also mean a complete stall in their progress towards developing even more advanced and higher-level autonomous vehicles. It would also mean that their current vehicles, which often come equipped with the necessary hardware that could allow the vehicle to move up in AV levels, would be saddled with that hardware which would increase maintenance costs for the current owners, increase depreciation rates and reduce re-sale value. These consumers would then be further turned away from the company, reducing its profits and potentially putting it out of business.

Policymakers, another relevant social group based on the SCOT framework, could also play a major role in how citizens are educated on the capabilities of these AV systems. The biggest power these policy makers have is to force companies to clearly state what the systems can do by introducing federal and state regulations that require that information be made easily available in clear terms. This would go a long way to give consumers a sense of just how low in the levels of autonomy their current vehicles are, forcing them to continue to be vigilant while driving with those systems engaged. However, there is a fine balance these regulations must handle. On one end, they could be designed to reduce consumer confusion with clear definitions of each level of autonomy, but on the other hand they could stifle investment in current systems as consumers become more frustrated with how little progress is being made for the expensive pieces of hardware that they are forced to carry around on their vehicles.

Mistrust

A recent survey by the Brookings Institute found that while a majority of Americans understood the benefits of autonomous vehicles, only about 20% would ride in one (West, 2019). This disconnect between the perception of the safety of autonomous vehicles and the reality of riding in one is a topic that has increasingly become a priority for researchers in the field. An Intel study from 2017 found that for many passengers, being familiar with how the AV worked reduced their unease with interacting with it regardless of whether they were passengers or pedestrians (Intel, 2018). In his article, Matthew Hutson explores how the intel study sought to increase consumer familiarity and the subsequent research it pioneered on new scientific inquiries into human factors innovation. Hutson first describes how the study was conducted, using a diverse group of 10 volunteers. These volunteers were given a brief overview of the vehicle and its capabilities after summoning it in the same way that ride hailing companies such as Lyft and Uber currently work. They then set off on a short drive on a closed course designed to mimic city streets. During and after the drive, almost of these volunteers had expressed a more positive view of the system, with many applauding the ability for the system to communicate not just to the engineers but the passengers as well (Hutson, 2018). Many even argued that the system was giving too much information at times, stating that they had become comfortable enough with knowing the internal decision-making process that they would prefer the vehicle keep some of that information to itself (Hutson, 2018). Although this was a small sample size, it does illustrate that by being able to understand how the systems work, consumers are more likely to trust it. This allows them to try and find ways to make their lives easier which will further increase buy in from skeptical consumers.

Using the SCOT framework, we can investigate even further on how allowing passengers to see and understand what the vehicle is doing can be beneficial to the development and implementation of AVs. When developers design these systems, they provide "dev" tools that give them a deeper look into what the vehicle is doing, can see, and plans to do. This information is often hidden from the end users because it is uninterpretable to anyone without the necessary background information to understand it. However, there are various aspects that can be shown to anyone with a basic comprehension of computers. Multiple video games and other simulators now give users access to the developers' version of their software, allowing them to make modifications to enhance their gameplay or debug issues with the games themselves without allowing them to break the game's core. This same process can be used to show passengers in a vehicle what said vehicle is doing.

When the passengers can see what the vehicle is doing, it could help them envision an actual driver in the car making conscious decisions about how to navigate. The SCOT framework explains how this interaction between passengers and the vehicle could push them into the mainstream. As the passengers become more familiar with the systems that give them insight into the workings of the vehicles, they can also become more comfortable with the vehicles themselves. Manufacturers would then be incentived to develop vehicles with this capability built in and with improved safety records, AVs could revolutionize how people travel. Under SCOT, one could not claim that this system is the best solution for easing passenger fears but because of how our lives revolve constantly around technology and screens it allows passengers to transition easily to interacting with it. There is also the potential additional benefit of helping these passengers become even better drivers because as they watch these computers make decisions, they could replicate them as well and improve safety for all other road users.

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Another contributing factor to the mistrust off AVs by consumers is the patchwork system of regulations governing their operation. Currently, only 28 states have any type of regulations or guidelines on the use of autonomous vehicles, whether during testing or operation (Teigen et al, 2017). At the federal level, there has been no legislation crafted to guide states in regulating the industry. Rather, agencies created to oversee transportation and associated safety regulation have been responsible for crafting non-binding guidelines that states have been free to use or disregard. An example is the National Highway Transportation Safety Agency's (NHTSA) new policy crafted last September that lays the foundation for how state and federal governments should oversee AVs. The NHTSA argues that because these systems are not advanced enough, state governments should be more lenient with their regulation until a later date when it updates its policy. However, this means that in the meantime, these companies have little to no oversight and so when things go, consumers have an even more negative perception of the technology.

This lack of oversight was recently cited in an investigation by the National Transportation Safety Board (NTSB), the agency more popular for investigating incidents involving aircraft but who is also responsible for any major crashes in the United States. In its investigation of multiple crashes involving Teslas being controlled by the companies Full Self Driving (FSD), the NTSB called for stronger guidelines from the NHTSA and Congress. They found that many of these systems lull users into a false sense of confidence which leads to misuse and in some cases injury (Kolodny, 2021). To remedy this, the agency argues the that the

NHTSA should implement more stringent rules on how companies can advertise their systems and specify and mandate the data that they must report to the federal government. By doing this, the NTSB claims that progress can accelerate because companies will know what they need to report and how they can better structure their test procedures (Kolodny, 2021).

Additionally, many of the companies that develop the technology have argued that the federal government needs to create official rules on testing and operation. During a hearing by the Energy and Commerce Subcommittee on Digital Commerce and Consumer Protection in February 2019, advocates, and members of the industry pressed congress to act because the patchwork system was inhibiting their ability to conduct proper tests. They stated that having multiple states with multiple rules on AV operation added unneeded complexity to their testing procedures because the type of data they can collect on roads in one state may not be collected in another, limiting how much useful data can be gathered (Teigen et al, 2020). By creating a federal standard with input from industry leaders, the United States government can help promote progress in the field while reducing consumer anxiety about lackluster safety requirements. This will ensure that in the same we trust our current cars to function due to government oversight, we as consumers can also have that same level of trust on the autonomous vehicles.

Conclusion

To design a system that improves pedestrian safety for our local community, my team must not only look at the infrastructure in its present form, but also consider the implementation of new technologies and the impacts they could have on the citizens of the surrounding area and

society at large. With the technical project, my team hopes to improve the lives and safety of the community of Bensely and reduce pedestrian fatalities significantly. The information we gather from this aspect of the capstone will be beneficial in giving us insight into how societies interact with their vehicle-pedestrian infrastructure and help me further explore other obstacles that could impede the development and full-scale implementation of autonomous vehicles as well as possible solutions to some of the current hinderances. The STS paper will then explore what and how AV's can overcome the current obstacles that it will face as it tries to reach wider audiences. It will explore the lack of awareness that leads to driver complacency and civilian injuries/deaths as well as mistrust in AV technology that could hinder its success and ability to benefit all of society.

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