Autonomous Vehicles: How Societal Opinions can Affect this Technology

A research paper submitted to the Department of Engineering and Society

Presented to the Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science, School of Engineering

Jack Yocom
Spring, 2021

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

Signature_____   _____ Date_____
            Jack Yocom

Approved_____ Date_____
            S. Travis Elliot, Department of Engineering and Society

Introduction

Since the time of Henry Ford and the Model T, cars have continued to become more advanced and smarter. Today, almost all vehicles on the road have at least some sort of autonomous capabilities. Whether this be cruise control, power steering, or anti-lock brakes, computers have been added to cars in order to make driving easier and safer. The natural next step from this point is fully autonomous vehicles (AVs), or cars that can drive themselves. Despite this seeming like the best course of action, studies run by universities around the country have shown that people are uneasy about this change to having no one behind the steering wheel. In this paper, I am going to try to learn about this uneasiness and find the best path forward for AVs.

In order to break down this phenomena, the STS framework of Social Construction of Technology (SCOT) will be used. This framework, developed by Wiebe Bjiker and Trevor Pinch, states that human action shapes technology, rather than technology shaping human action. Elements of the sociotechnical that will be explored are relevant social groups, interpretive flexibility, design flexibility, and closure.

To fully understand the issue at hand here, the definition of autonomy must be discussed. There are currently 6 levels of autonomy, aptly named 0-5. Level 0 is where the driver has complete control over the vehicle, and this level is not seen anymore due to the safety issues surrounding such a responsibility. Today, most modern cars are at level 2-3 of autonomy, which is where there are features that help the driver drive. These features include anti-lock brakes, cruise control, automatic transmission, and many others. There have recently been new breakthroughs and people are beginning to see the first level 4 autonomy cars, such as Teslas. Level 4 is defined as the driver not needing to intervene, but one can. Teslas today have

autopilot features used to drive on the highway without driver intervention. Lastly, Level 5 autonomous cars do not need a driver, and can make all decisions on the road by themselves (University of Michigan 2020). These cars have not hit the market yet, but with companies like Tesla, Apple, and Waymo racing to be the first to accomplish this feat, it is only a matter of time before they are sharing roads with us.

This issue is vast and affects almost everyone. To learn more about just how society will impact AV success, many studies from across the country will be examined. Along with this, I created my own survey in order to discover the opinions of as many people as possible. The survey is made up of a few sections. First, background information is collected and people are asked about their current opinions on if they would use autonomous vehicles or not. Then, a plethora of potential features for AVs are suggested and subjects must decide if each feature would make them more or less likely to use an AV. Lastly, questions about policy and ethical concerns are considered to see where subjects fall on these issues. It must be stated that this survey will be sent out to mostly people that I know and can contact, so the results may not be completely representative of the entire population. Most of the subjects will either be college students, members of my family, or others that they know and can spread the survey to. At the end of data collection, 228 people had taken my survey. 25.9% of those surveyed were younger than 25, 41% were 25-50, and 32.2% were over 50. A large majority (72%) live in the suburbs, with only 18% of respondents living in the city, and 10% in rural areas. Thus, if one wants to build off of this paper, one place to try and do this is finding a more representative sample of the entire American population.

Current Societal Opinion

Many studies have been conducted in order to gauge public feelings on these vehicles. Since the social group being examined here is so large, almost the entirety of the American population, studies will differ in their results, but many seem to concur. In one study from the Partners of Automated Vehicle Education, 48% of participants said they would never use an autonomous rideshare or taxi, and only 18% of people were excited for autonomous cars to be released (Hawkins 2020). Another study showed that the public is more worried (43%) about these vehicles than enthusiastic about them (39%). Also, it seemed like the participants favored restricting AV policies, including 53% in favor of a person having to be in the driver's seat and 47% in favor of autonomous vehicles-only lanes. On top of this, there is the moral dilemma of the trolley car problem, should the bystander flip the trolley track switch to kill one person, or let the trolley keep going and kill 5? Should the car save the passenger inside, or save more people that are outside of the car? A recent study showed that 47% of participants believe that more lives should be saved, but 50% of them believe that the passenger's life should be prioritized (Smith and Anderson 2017). The social group that is the American public will have many conflicting opinions on this new technology, but it is the car companies' job to design and market the cars in such a way that can break down the obstacles the public's distrust creates.

Another social group being affected here are car companies. The leader of Tesla, Elon Musk, has been repeatedly questioned about when autonomous cars will be on the road, how they work, and other ethical concerns (Woodyard 2020). Musk often sets extremely lofty goals for his companies, and said last year that fully autonomous cars would be ready by the end of 2020. This has not happened yet, but the cars' autopilot features have come a long way since the start of the company in 2003. Also, according to Musk, as more cars use the autopilot features, the feature itself will become smarter and better (Baldwin 2020). Despite the progress being

shown, many people are still concerned. In fact, in a BBC article, IHS Markit analyst Tim

Urquhart discussed how people are misusing the autopilot technology, such as falling asleep at

the wheel, which can cause huge problems and be very dangerous (BBC 2020). It is

understandable to have these concerns with the current configuration of autopilot in Teslas, but

as these cars become smarter, they should become better drivers than humans, which would have

many impacts across the world.

Opinions gleaned from the responses to the survey showed similar statistics to the

research discussed before. First, 32.2% of respondents claimed they would not use an

autonomous vehicle, while 24.2% said they would and 43.6% said they would maybe use one.

Next, when asked about their feelings towards AVs 41% of the subjects said they would be

nervous or scared, while only 33.5% said they would be excited. 48.2% of those surveyed stated

they would be nervous sharing a road with an AV. Lastly, having to do with the ethical issues

here, 83.3% of respondents stated that the most amount of people's lives should be prioritized

over the passengers. 38.8% said that the government should have final say here, while 28.8%

said car companies have the choice. There was also an "other" option here, and about 20% of

respondents said the consumer should make this choice. Finally, there was a split of 49.3% who

said car companies are liable in an accident, while about 40% said liability should be

investigated on a case-by-case basis. Many people are clearly wary about autonomous driving,

but the potential impacts of this technology can be so widespread and beneficial, so the

companies selling these vehicles must be able to sway people's opinions.

Influences of Autonomous Driving

While driving today is fairly safe, with so many people on the roads, there is bound to be

a significant number of human error incidents. For example, drowsy driving is believed to cause

16% of deadly accidents, according to a study run by AAA, and distracted driving caused an estimated 431,000 injuries and 3,179 deaths according to a study by www.distraction.gov (robsonforensic.com 2016). On top of that, according to a study by The Zebra, 20.1% of responders ages 25 to 44 knew someone killed in a drunk driving accident (Covington 2020). Thirdly, Americans sit in more traffic than any other country's citizens. 5 of the top 10 worst traffic cities are in America, which are Los Angeles, New York, San Francisco, Atlanta, and Miami. It is estimated that traffic congestion cost drivers $305 billion in 2017 (mobilitylab.org). Issues like these negatively affect both the society and the car companies that interact with these cars. These statistics could potentially be avoided with the implementation of AVs, so companies developing these AVs need to educate the public in order to show them just how impactful and beneficial this technology can be.

A capable autonomous vehicle will never be drowsy, distracted, or drunk. Also, autonomous vehicles could be linked to others so that they know about the environment around them, reducing accidents and traffic jams. It is projected that autonomous cars could reduce traffic deaths by 90% and as few as 5% of cars being autonomous on the road could reduce stop-and-go waves caused by human driving behavior. This has the potential to recover 80 billion hours lost due to driving and congestion, as well as reduce carbon emissions by a possible 40% (Goldin 2018). Even if there is traffic, the passenger can focus on other, more productive tasks rather than driving.

Autonomous vehicles also have the potential to create waves in areas other than driving. For instance, it takes 15% less space to park these cars, as humans do not have to get out after parking. A large portion of land in major metropolitan areas is devoted to parking, and this could free up the land or allow more cars to be parked, which would affect real estate prices. If

autonomous vehicles begin to spread, professional drivers will be put out of business. Mechanic shops may start to have to compete with technology companies for business on cars, as a lot of the parts will be technologically based. Insurance companies will have to change their car insurance contracts, and urban planning could change, since less congestion means proximity to your place of work will be less important (cbinsights.com 2018). Each of these aspects involve different social groups that will be affected by this technology differently, which brings about the phenomena of interpretive flexibility. Interpretive flexibility states that technology will have different interpretations and meanings to different groups. Professional drivers and mechanics will most likely view the technology negatively, despite its benefits, as it will inhibit the amount of money they can make and change how they live. These groups could use their unions in order to fight back and lobby against AVs, causing potential problems. Real estate brokers may see a potential opportunity, as prices could drop due to repurposing land, or prices could rise in suburban areas since people will be more willing to commute. These few examples exhibit how potentially widespread the effects of autonomous vehicles could be. These effects can be negative for some, but positive for others. Companies need to figure out ways to design and sell their cars so that they are appreciated by the most people and have the most impact.

Can we maximize consumer interest?

Design flexibility is another pillar of SCOT. This means that there are more than one way to configure a technology, and how it is designed should reflect public opinion. With the advent of AVs, the current limitations set on car design will be irrelevant. Without the need for a driver, the interior of an AV could look completely different from the interior of cars seen today. For example, seats could be rear facing or recline all the way down like a bed. These cars could lack a steering wheel, and even potentially be windowless. Designing AVs today is like a blank

canvas, since none have fully been developed before, but companies must gauge consumer interest in order to find the best design.

Upon examining the survey responses regarding design, there were some interesting results. First, 84% of respondents stated that an override system would make them more likely to ride in the car. This shows how wary people are of the technology. Next, 91.2% of those surveyed said they would be less likely to ride in the car if it lacked a steering wheel. 73.7% said they would like a user interface to show them the car's decision making. The ability to drive faster and an entertainment system both were evenly split between more likely, less likely, and indifferent. 93.4% of people said that the car being windowless would make them less likely to use it. Then, 44% of respondents said they would be more likely to use an AV if it had a voice. Lastly, those surveyed were mostly (48.2%) indifferent to AVs being rideshare vehicles only. Companies designing AVs can take information from this survey and similar surveys and begin choosing features based on what the public believes is best. This way, the technology will be accepted and used by society.

Beyond features of the car that will change societal opinion, there are many other ways that companies can try to sway consumer interest. Ad campaigns will have to be run in order to stress the safety and capabilities of these cars. Beyond just advertising, the cars will have to be demonstrated to the public. One potential way that this could be done, although it may sound silly, is to enter an autonomous vehicle into a NASCAR or Formula 1 race. While it would be unfair to the other drivers most likely, the company does not need to take home any prize money if their car does well. The real prize here is showing that computers can outperform any driver out there, as NASCAR and F1 drivers are the best in the world. Once people see what these cars

can do, it will only be a matter of time before they are accepted and impacting society at the highest level.

Potential Policy

Another issue to discuss is that of policy that could be designed for autonomous vehicles. It is most likely that the government creating policy for these vehicles will cause interpretive and design flexibility to collapse, bringing about closure. This happens when people no longer believe there are issues with the technology. If the government writes into law that humans are no longer allowed to drive, eventually the technology will have a similar effect and meaning to the entire public, reducing interpretative flexibility. If the government writes into law that companies can not create a car without a steering wheel, this limits the features that can be added to the vehicle, thus limiting design flexibility. On top of potential policy, ethical concerns having to do with the trolley problem are going to be big issues. Is it the government's job to declare who should be saved? Or potentially the car companies? Lastly, who is liable in the event of a crash? These questions and more need to be tackled by government officials in order for the public to back autonomous vehicles and for them to be as safe as possible.

When asked about AV policy, many respondents shared opinions. First, 86.8% said they would be against policy restricting people from driving once AVs have been proven to work. Next, 81% said they would be in favor of AV only lanes. Lastly, 56.4% of respondents said they would like if companies were restricted in how they design their vehicles. Clearly, respondents are nervous towards this new technology, so companies must find ways to break down this barrier.

Technological Determinism

A counter argument that could be made here is that the technology of autonomous vehicles is too powerful for society's opinions to affect it, and it will succeed no matter what. This argument is through the STS framework of technological determinism. This theory states that technology is the driving force in social, economic, and political change, and not social factors. While this seems to make sense in this case, the argument still falls short. Developing an autonomous vehicle is extremely resource dependent. Building a car is expensive by itself, but adding the necessary sensors and computational power for an autonomous vehicle will increase the cost by a large percentage. If a majority of people are not willing to try out autonomous vehicles, the millions of dollars invested in them in public and private corporations will go to waste. They will not be able to recoup their investment and the companies will fail. Without these companies, the vehicles will be forgotten and Americans will stay injuring over 400,000 people per year in car accidents.

A Path Forward

As can be seen with technologies of the past, public opinion is very important in determining whether or not a company will succeed. Developers of autonomous vehicles must consider this if they want their technology to maximize its potential benefits. A multifaceted approach must be taken by the companies in order to ensure success. First, the features of the vehicle must align with what people want in an AV. Designing based on my survey, the car should have windows, have a steering wheel, be possible to override, have a user interface and have a voice. Second, the cars must be displayed and demonstrated to a large public audience. Advertisements or competing with professional drivers are two ways that companies can evade society's mistrust of autonomous vehicles. Lastly, pro-autonomous vehicle policy must be

lobbied for in order to keep public opinion on the right side. If these three factors can be optimized, autonomous vehicles should have an extremely beneficial impact on society.

The Social Construction of Technology is a framework that emphasizes the social forces involved in the growth and spread of new technology. In the case of autonomous vehicles, these social forces are as important as ever. Without public opinion behind them, autonomous vehicle companies will most likely fail, and the huge amount of research put into them will be for nothing. As long as these companies can focus on the correct issues, societal opinion can be swayed. In the long run, the world will be better off with the advent of autonomous vehicles, so it is in everyone's best interest that these companies succeed in their undertaking.

Works Cited

Autonomous Vehicles Factsheet. Autonomous Vehicles Factsheet | Center for Sustainable

Systems. (n.d.).

http://css.umich.edu/factsheets/autonomous-vehicles-factsheet#:~:text=Potential%20benefi

ts%20include%20improvements%20in,associated%20with%20transportation%3B%20and

%20increased.

Baldwin, R. (2020, November 10). *Elon Musk Foresees Self-Driving Being Released to

Public by End of 2020*. Car and Driver.

https://www.caranddriver.com/news/a34431401/elon-musk-full-self-driving-release-late-20

20/.

BBC. (2020, July 9). *Elon Musk says full self-driving Tesla tech 'very close'*. BBC News.

https://www.bbc.com/news/technology-53349313.

CB Insights. (2020, February 24). 33 Industries Other Than Auto That Driverless Cars

Could Turn Upside Down. Retrieved October 19, 2020, from

https://www.cbinsights.com/research/13-industries-disrupted-driverless-cars/

Covington, T. (2020, August 18). Drunk Driving Statistics + Facts (including a 2020

survey): The Zebra. Retrieved October 19, 2020, from

https://www.thezebra.com/research/drunk-driving-statistics/

Goldin, P. (2018, February 20). 10 Advantages of Autonomous Vehicles. Retrieved

October 19, 2020, from https://www.itsdigest.com/10-advantages-autonomous-vehicles

Person. (2020, February 17). Human Error – Expert Article Examining the Role of Human Factors. Retrieved October 19, 2020, from https://www.robsonforensic.com/articles/human-error-expert-witness-human-factors/

Smith, A., & Anderson, M. (2020, August 6). *Americans and Automation in Everyday Life*. Pew Research Center: Internet, Science & Tech. https://www.pewresearch.org/internet/2017/10/04/automation-in-everyday-life/.

U.S. is the world leader in traffic jams – USA Today. Mobility Lab. (2018, February 6). https://mobilitylab.org/2018/02/06/u-s-is-the-world-leader-in-traffic-jams/.

Woodyard, C. (2020, September 23). *Elon Musk says Tesla's full self-driving Autopilot is coming soon and it's 'clearly going to work'*. USA Today. https://www.usatoday.com/story/money/cars/2020/09/22/tesla-elon-musk-full-self-driving-autopilot-software/3498264001/.