

Sociotechnical Imaginaries and Autonomous Vehicles in Charlottesville

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

Robert Fusek

Spring 2020

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

Advisor

Sean M. Ferguson, Department of Engineering and Society

Introduction

On average, Charlottesville has higher rates of poverty and car ownership than the rest of the United States (Charlottesville). This may allude to the fact that the public transportation system is not adequately equipped to handle the population of Charlottesville. By updating public transportation in Charlottesville, the need to own a car could decrease which might save the residents of Charlottesville money. Recently, Perrone Robotics, in conjunction with Albemarle County and the University of Virginia, announced its goal of creating an autonomous shuttle service. TONY (TO Navigate You) is a zero emission self-driving vehicle. While a potentially safer and greener mode of public transportation seems exciting on paper, it raises many ethical questions.

For example, are people as willing to ride in an autonomous vehicle as they are in a standard vehicle? Are there demographics that are more opposed to using these vehicles than others? Are there physical impairments that would not allow someone to ride in one of these vehicles? These questions are of utmost importance when considering changing the existing public transportation system. Furthermore, regarding Perrone Robotics, is TONY meant to replace public vehicles or complement the current system? Does TONY have a different purpose entirely? Many of these questions do not have easy answers but attempting to answer them will hopefully help Charlottesville create a system that better serves its community. While the future of these vehicles seems bright, it is vital that these vehicles create an environment that does not exclude those already marginalized by our society.

This paper analyzes public transportation in Charlottesville and theorizes how and if autonomous public transportation will change the current transportation landscape by using sociotechnical imaginaries. Sociotechnical imaginaries “builds in part on the growing recognition that the capacity to imagine futures is a crucial constitutive element in social and political life” (Jasanoff & Kim, 2009). Further, the idea that a new technology could be an integral part of the future can be prescriptive in realizing those imaginaries. While proponents of autonomous vehicles excitedly await potential increases to efficiency and safety, many have ever-increasing doubts about the accuracy of these claims as well as increased reliance on automation. These doubts are as relevant to the discussion of autonomous vehicles as are the upsides. In this paper, I will first discuss the potential benefits of autonomous vehicles. Next, I will discuss the current statistics regarding adoption, or lack thereof, of autonomous vehicles. Finally, I will analyze the first steps of Perrone Robotics and their product TONY to see if there is space for this new technology in the city of Charlottesville.

Literature Review

While autonomous vehicles seem to be getting ever increasing media attention, only 41% of consumers say that they would currently ride in someone else’s self-driving car (Self-driving cars). Additionally, when asked, “Once there is a fully automated vehicle on the market how many years will it be before you are comfortable riding in one?”, 42% of respondents said they would never ride in a fully automated vehicle (J.D. Power, 2018). Although these vehicles boast improved safety and reduced emissions, less than half of the public is currently willing to adopt this new technology.

Although there are many ethical questions raised by autonomous vehicles, the potential safety benefits are undeniable. 94% of serious crashes are due to human error. 37,133 people died in motor vehicle-related crashes in the U.S. in 2017 (Automated Vehicles for Safety, 2019). There is insufficient data currently to prove that self-driving vehicles are significantly safer than human drivers; however, these cars have huge potential safety benefits as the technology improves. Additionally, a NHTSA study showed “motor vehicle crashes in 2010 cost \$242 billion in economic activity... and \$594 billion due to loss of life and decreased quality of life due to injuries” (Automated Vehicles for Safety, 2019). A fully autonomous commuter system has the potential to save 1,000s of lives and billions of dollars a year.

A potential implementation of public autonomous vehicles comes in the form of a shared autonomous taxi. It is estimated that shared autonomous vehicles (SAVs) consume 12% less energy, emit 5.6% less greenhouse gases, and produce considerably less non-greenhouse harmful gases compared to the average US light-duty vehicle (Fagnant, Kockelman, 2014). This grouped with increased safety and potential AI routing optimizations presents these SAVs as a promising new technology. It is estimated that each SAV could replace up to twelve personal vehicles.

In a survey of 5,700 individuals regarding public autonomous vehicles, 12.6% of respondents said that autonomous vehicles lack long-term substance, 45.6% said that autonomous vehicles will be a component of transportation with limited use, and 41.8% said that autonomous vehicles will be transformative to the transportation landscape. Additionally, regarding private smart service providers, these numbers changed to 2.7%, 32.4%, and 64.9%, respectively (Reigler, 2019). These numbers indicate that people believe that the government is less likely to implement autonomous vehicles into their services than private companies. This rational may stem from the governments perceived lack of resources, lack of competence, or lack of necessity; however, it is evident that people put less faith into the government than private companies in regards to implementing autonomous vehicles. Additionally, when asked “What do you think is the greatest potential advantage of fully automated vehicles?”, only 19% of respondents said increased auto safety while 40% said they see no advantage to automated vehicles (J.D. Power, 2018). It does not bode well for integration of autonomous vehicles into the public sector if 40% of the population are vehemently opposed as they see no advantage.

Finally, there are potentially immoral ethical dilemmas that must be coded into autonomous vehicles as safety precautions. N. Goodall at the University of Virginia Transportation Research Council states that automated vehicles “face a greater challenge. They must decide quickly, with incomplete information, in situations that programmers often will not have considered, using ethics that must be encoded all too literally in software” (Goodall, 2016). For example, if the options are run over a pedestrian or swerve into oncoming traffic, what does the autonomous vehicle do? This is an impossible question to answer, but it may also be immoral to code decisions like this. Further, in the case of tragic accidents, where should the blame be cast? It can be argued that coders, the companies, the insurance companies, and or the legislators should be held accountable. There are no easy answers to these questions which sheds light upon the difficulty of publicly implementing autonomous vehicles and, in general, controversial technologies.

Sociotechnical Imaginaries

The idea of sociotechnical imaginaries asserts that the ability to imagine the future is an integral facet of the ethos of a community. Imagination allows communities to foster discussion and set goals in order to create a future that better serves the population as a whole. Sociotechnical imaginaries find use because they can create rough visions of how a technology may be adopted in the near or distant future. This estimation has business and scientific implications because scientists and businessmen are, “constantly trying to understand the present by borrowing from a cautiously imagined emergent future, filled with volatility, and uncertainty” (Marcus, 1995). These potential futures can help reaffirm their ambitions and encourage further development.

Sociotechnical imaginaries help to understand a population’s current dreams, fears, and emotions on emergent technologies. However, an imaginary does not set a strict projection of the future with a rigid plan for implementation. Jasanoff and Kim state, “Sociotechnical imaginaries should not be seen as static or tightly bounded belief systems.” Rather, an imaginary allows for a general prediction how society might look if a particular technology is adopted or not by recognizing that “the capacity to imagine futures is a crucial constitutive element in social and political life” (Jasanoff & Kim, 2009). By using a sociotechnical imaginary, one can generalize the potential of immersing technologies to reach a future constructed within that potential.

Imaginaries in Charlottesville

The adoption of autonomous vehicles into the current transportation network nationwide has sparked considerable controversy. Many people tout that autonomous vehicles are safer and more efficient than gasoline vehicles; others say that autonomous vehicles are not statistically significantly safer than human drivers at the moment and cause specific deaths that could be prevented by human drivers. Elaine Herzberg was tragically killed while pushing a bicycle across a road after being hit by an Uber test vehicle operating in self-drive mode (Hawkins, 2019). While this is the only case in the United States of a pedestrian being killed by an autonomous vehicle, the outcome likely would have been avoided if the driver had been paying attention as seen by the dash cam. These cases are extremely tragic and raise the question if its moral to implement autonomous vehicles while they still can create accidents. Despite these concerns, autonomous vehicle manufacturers have popped up across the United States including in Charlottesville.

Perrone Robotics, located in Charlottesville, has set out to create a product similar to the previously mentioned SAV. Last year, Perrone Robotics announced a \$600,000 joint investment with Albemarle County and Jaunt, Inc to create an autonomous shuttle service for the county. Their goal is to create “zero-emission transit service (that) brings the promise of reduced parking needs and greater use of green technologies” as well as increased mobility for those unable to operate motor vehicles (Autonomous Shuttle Service Announced!, 2019). However, the aforementioned statistic begs the question of should the government be investing in technologies that only 41% of residents are currently willing to use? Not only do only 41% of people currently

feel comfortable enough to ride in an autonomous vehicle, but 42% of people currently feel that they will never ride in an autonomous vehicle. I believe that the goal of Perrone Robotics and other autonomous vehicle proponents is to change these statistics.

Based on the language used in their 2020 brochure, it seems like Perrone Robotics is attempting to create a bridge between the present with little automobile automation and a future where people happily adopt these vehicles. Perrone Robotics is certainly aware that a large percentage of people in the United States are not yet ready to ride in autonomous vehicles. Therefore, it would make sense for their brochure to have language that gently introduces the reader to autonomous vehicles, which it does. The title is “Your Driverless Journey Starts Today” which implies that the reader may have not adopted the technology, but it incites imagination about the possibility of this “Journey” (Perrone Robotics). The second page introduces Perrone Robotics as a team of experts with a proven track record and years of experience. Additionally, it describes the safety of the TONY. The foremost concern for many people regarding autonomous vehicles is safety, Therefore, it is paramount for the people writing the brochure to relax the reader by ensuring them that their product is safe. The brochure goes on to describe the possible uses of the TONY, so that the reader can step into the vision that Perrone Robotics has imagined for the future of Charlottesville. Finally, the brochure ends on the line “Find your own path to autonomy. Perrone Robotics knows the way.” This line encourages the reader to do step further into the autonomous “journey” while stated themselves as a trustworthy guide. Throughout the brochure, there is no heavy-handedness on the part of Perrone Robotics. Perrone Robotics identifies that this technology will not be adopted overnight. More than anything, this brochure is to peak the interest of those reading it while maintaining that Perrone Robotics is at the forefront of this technology and will speak to even those who have one ear open.

It is my belief that Perrone Robotics is attempting to share their vision that autonomous vehicles will create a future for transportation with less congestion, accidents, and emissions. If autonomous vehicles are shown to be significantly safer than human operated cars and electric cars are shown to be significantly better for the environment than gasoline cars, then it does not seem like a stretch to see more people fully adopt the idea of riding in a self-driving car and less people definitively say that they will never ride in an autonomous vehicle. If these differences can be shown definitively, the amount of people who imagine a future riding in autonomous vehicles will increase. This will lead to a public push for further automation which will inevitably lead to change.

On the other hand, some imagine a future with decreased personal autonomy. Autonomous vehicles to some represent a shift away from personal freedoms to a lifestyle further dominated by automation, a trend that has been observed since the industrial revolution. It is not unfathomable to imagine a future where it is made illegal to operate a motor vehicle. This would be highly concerning for any who do not trust their lives in the hands of a computer over their own.

It is unclear to the extent that the city of Charlottesville has partnered with Perrone Robotics. However, by expressing this partnership, it may indicate that Charlottesville has an

interest in what autonomous vehicles mean for the future of Charlottesville. The city of Charlottesville is at least willing to contribute some amount of funding in order to see if autonomous public vehicles is an avenue that they want to pursue. The city of Charlottesville is open to the idea of an autonomous public transportation system; however, it is yet to be seen if the public shares the same sentiment.

Conclusion

Currently, autonomous vehicles are a polarizing emerging technology. Many believe that autonomous vehicles will have less of an environmental impact than gasoline vehicles; however, this is not universally accepted by the public. Additionally, many people believe autonomous vehicles are safer than their non-autonomous counterparts, but again this is not universally accepted. Furthermore, some argue that even if autonomous vehicles are safer than non-autonomous vehicles on average, a death caused by AI driver is a death that could have been prevented by a human driver. Some people imagine a future of punctual public transit boasting zero emissions and perfect driver safety while others imagine a future of complete dependency upon technology without fail-safes should the system crash. The people at Perrone Robotics imagine a future more similar to the former and have begun to experiment with their autonomous vehicle TONY with help from the city of Charlottesville. If Perrone Robotics do manage to develop a safe and efficient autonomous vehicle for public use, then it is still unclear if a high percentage of the residents of Charlottesville would be willing to ride in it. It will take repeated exposure and reassurance of the vehicle's safety and efficiency for the people of Charlottesville to accept this new technology.

VI. Bibliography

1. Automated Vehicles and Insurance Pulse Survey. (2018, October 9). *J.D. Power*. Retrieved from https://www.namic.org/pdf/18memberadvisory/181008_Automated_Vehicles_JD_Power_NAMIC_Questionnaire.pdf
2. Automated Vehicles for Safety. (2019, August 12). Retrieved from <https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety>.
3. Autonomous Shuttle Service Announced! (2019, October 23). Retrieved from <https://www.perronerobotics.com/autonomous-shuttle-service-announced/>.
4. Charlottesville, VA. (n.d.). Retrieved from <https://datausa.io/profile/geo/charlottesville-va/>
5. Fagnant, D.J., & Kockelman, K.M. (2014). The Travel and Environmental Implications of Shared Autonomous Vehicles, Using Agent-Based Model Scenarios.
6. Hawkins, A. J. (2019, November 20). The world's first robot car death was the result of human error - and it can happen again. Retrieved from <https://www.theverge.com/2019/11/20/20973971/uber-self-driving-car-crash-investigation-human-error-results>
7. Jasanoff, S., & Kim, S. (2009). Containing the Atom: Sociotechnical Imaginaries and Nuclear Power in the United States and South Korea. *Minerva: A Review of Science, Learning & Policy*, 47(2), 119 - 146.
8. Marcus, G.E. (Ed)(1995) *Techno-scientific Imaginaries, Conversations, Profiles and Memoirs*. University of Chicago Press, Chicago and London.
9. N. J. Goodall, "Can you program ethics into a self-driving car?," in *IEEE Spectrum*, vol. 53, no. 6, pp. 28-58, June 2016.
10. Riegler, C. (2019). The Moral Decision-Making Capacity of Self-Driving Cars: Socially Responsible Technological Development, Algorithm-Driven Sensing Devices, and Autonomous Vehicle Ethics. *Contemporary Readings In Law & Social Justice*, 11(1), 15 - 20.
11. Perrone Robotics. (n.d.). Retrieved from <https://www.perronerobotics.com/>
12. Self-driving cars – facts and figures. (n.d.). Retrieved from <https://www.driverlessguru.com/self-driving-cars-facts-and-figures>.