How Autonomous Vehicles Will Impact Social Perception of Vehicle Safety

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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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Introduction and Methods

Traffic fatalities are the leading cause of death among Americans between the ages of one and thirty-four (McMillin, 2010). This may come as a surprise, as driving is not generally perceived by the American public as a dangerous activity (Maynard, 2013). Each year, approximately 1.3 million people lose their lives in traffic accidents around the world (World Health Organization, 2021). In the United States alone, there are around forty thousand traffic fatalities a year (McMillin, 2010). Research has attributed ninety four percent of traffic accidents to driver/human error (Othman, 2021). This presents a substantial opportunity for autonomous vehicles (AVs) to drastically reduce traffic accidents and fatalities Therefore, the research question this paper aims to answer is: How will autonomous vehicles impact social perception of vehicle safety in the United States?

In this research paper, the autonomous vehicles discussed are hypothetical future vehicles that have been concretely proven to be more safe than human driven vehicles. As of 2022, this type of vehicle is under rapid development (Reese, 2020). Driver assistance systems in new vehicles have advanced features like automatic steering and lane changes (Pritchard, 2022). The Autopilot driver assist system from Tesla Motors even has cutting edge beta features that allows cars to appropriately stop at traffic signals and stop signs (Pritchard, 2022). It is uncertain when a complete autonomous vehicle that is superior to a human driver in all measurable metrics will be developed and approved. Some estimate it is possible by 2030 at the current rate of development and innovation, though predicting technological advancement is difficult and often unreliable (Reese, 2020). As stated earlier, this hypothetical AV would have the potential to reduce traffic accidents by ninety four percent, as all human error can be eliminated (Othman, 2021). Therefore, the deployment of this type of AV worldwide could save over one million lives a year, as well as prevent countless injuries and vehicle and property damage.

AVs have many other potential benefits. Regardless of if future autonomous vehicles are using gasoline powered internal combustion engines or battery powered electric motors, AVs will use less energy than human drivers (Rose-Harman, 2021). Human drivers tend to have more wasteful driving styles while AVs can be programmed to drive economically (Rose-Harman, 2021). Another environmental benefit of AVs is decreased production overall. The average car spends ninety five percent of its lifetime parked (Morris, 2016). Once all vehicles are autonomous, a vehicle that would have otherwise been parked can be used to transport other people, increasing total vehicle utilization. As a result of this increased utilization, the total amount of vehicles required to provide transportation will be reduced dramatically, and this could lead to many people choosing not to own a car and instead use AV taxi services. Additionally, since a significant amount of traffic congestion is caused by vehicle accidents or inefficient human driving behavior, AVs will likely decrease traffic congestion by reducing these issues (Reese, 2020). Lastly, AVs will return time back to drivers, decreasing stress (Steele, 2021**)**. The average American spends around one hour of their day in a car from commuting, grocery shopping, etc. (Steele, 2021). This time spent driving can often be stressful and require the driver's sustained concentration. By reducing congestion, AVs would decrease total transportation time and would ensure all time spent in vehicles is relaxing and stress free.

However, this potential can only be realized if AVs are mass adopted by the public, which will require this technology to be perceived and accepted as safe. Societal AV safety perception will largely depend on three main factors: perception of AV driving capability and knowledge, amount of control over the vehicle passengers perceive, and passenger comfort with

AV ethical decision making. Determining how these factors impact public AV safety perception will be crucial in designing future AVs for mass adoption.

To conduct research for this paper, I utilized several sources. I read news articles relating to autonomous vehicles to gauge how AVs are portrayed in the media. Specifically, I studied the connotations of the articles and especially the headlines. Additionally, I used research articles on the capability of future AVs and perception of control versus safety. Finally, I referenced public surveys on many AV related topics.

To analyze these different factors, I employed theories from science and technology studies. I used Actor Network Theory to analyze all actors in this problem and the associations between them. Specifically, the main actors are the United States government, the general public, and AV manufacturers.

Results and Analysis

Perception of AV Capability

Societal perception of AV safety will be significantly affected by public perception of AV driving capability (Hutson, 2017). Even AVs that are only ten percent better than the average human driver would save hundreds of thousands lives in the United States alone over thirty years if widely adopted (Shariff, 2021). Earlier adoption of AVs would also provide manufacturers access to large scale driving data sooner, allowing for faster safety improvement. However, it is unlikely that someone will switch to an AV if they believe they are a superior driver. People tend to overestimate their own abilities and view themselves as an above average driver believing they drive “vastly safer” than the average driver (Shariff, 2021). This is why while an AV that is ten percent better than the average driver could save many lives, it would have difficulty convincing consumers that it is safer than driving themselves. AVs would need to be vastly superior in safety to the safest drivers to be able to convince the average consumer of its safety.

Even once this extremely safe AV is created and a large catalog of research has concluded that it is significantly safer than human drivers by all metrics, this data will likely not be enough evidence for a large percentage of the population (Shariff, 2021). Consumer distrust of AVs is substantial. In a AAA survey, “78% of respondents said they were afraid to ride in an AV” and in another survey “41% didn't want to share the road with driverless cars” (Hutson, 2017). Regardless of how safe AVs become, AV impact will be lessened greatly if this distrust prevents their mass adoption by the public. This distrust in AVs could be due to algorithm aversion, a psychological phenomenon where people trust human agents over an equally capable or superior machine/algorithm (Dietvorst, 2015). People are also less tolerant of errors made by algorithms (Dietvorst, 2015).

In order to reduce algorithm aversion and distrust in AVs, there are a few actions that can be taken. One method is to humanize the AV. Manufacturers have experimented with giving AVs a voice. Experiments from AV manufacturers found that when AVs announce their behavior, such as announcing that the vehicle is slowing down due to a pedestrian, passengers trusted the vehicle significantly more (Hutson, 2017). Another addition to AVs that could reduce distrust is to give passengers a visualization of what the vehicle sees. For example, if AV is approaching a red light, it would be reassuring to passengers to be able to see on a screen that the AV knows of the car ahead and is slowing down.

AV Passenger Perceived Control

For any activity, the amount of control a person feels greatly influences their perceived safety of the activity (Horswill, M. S., & Mckenna, 2006). Generally, the more control someone feels they have, the safer they perceive themselves to be (Horswill, M. S., & Mckenna, 2006). It is important to note the difference between the amount of control someone actually has and the amount of control they perceive themselves to have. Driving is a great example of this difference as there is usually a large discrepancy between a driver's perceived control and their true control over the vehicle (Shariff, 2021). As stated earlier, many drivers greatly overestimate their own capabilities and have strong trust in their own skill (Shariff, 2021). These same drivers are also usually inexperienced with controlling their car in dangerous situations such as hydroplaning, understeering, or oversteering (Shariff, 2021). This is likely why, despite the fact that driving is the most dangerous daily activity performed by the majority of the population, it is generally viewed as safe (Maynard, 2013).

An analysis of perceived safety in commercial flying is an interesting case study relating to how perceived control affects perceived safety. Taking a commercial flight is remarkably less dangerous than driving (Wilson, 2021). Dr. Barnett, a professor at the Massachusetts Institute of Technology, calculated flying to be nineteen times safer than driving (Wilson, 2021). However, this information is not common knowledge, as many people view flying as significantly more dangerous than it actually is (Wilson, 2021). Much of this discrepancy between perceived and actual safety can be attributed to the complete lack of control a commercial airline passenger feels while on a flight, as well as the spectacular nature of airline crashes and their coverage in the media. Airplane passengers have no control over the plane itself, and also have little access to information about what is happening in the cockpit and outside the aircraft. Due to this structure, passengers are at the mercy of the airplane pilots, and must trust them with their lives in the event of an incident. As outlined earlier, people trust their own ability over others, especially when the other person is a stranger such as an airline pilot.

Once AVs cause drivers to transition into passengers, it is likely that the perceived control these passengers feel they have over the vehicle will sharply decline as driver input is no longer necessary. This will make AVs feel similar to airplanes where passengers are at the mercy of the vehicle and its technology. While AVs will have superior control over themselves compared to human drivers making them remarkably safer, this decline in perceived control over the vehicle would likely lead to a decline in perceived safety of AVs overall.

There are a few actions AV manufactures can take to increase perceived control inside their vehicles. Driver inputs such as the steering wheel, accelerator pedal, brake pedal, and horn are the main tools that drivers are used to using to control their vehicle. It is important that these inputs remain in AVs until far in the future, and drivers should have the ability to use them to control the AV at a moment's notice. Knowing that they have the ability to control the AV if needed may help consumers feel more in control in their AVs. New forms of passenger input can also be added as technology improves. For example, voice recognition technology can be implemented in AVs to allow passengers to verbally tell their AV where to take them. Motion recognition technology could also be added to allow passengers to use phrases like: “Drop me off over there” and point where they would like the AV to stop.

Another way to increase perceived control is to allow consumers to customize the behavior of their AVs. Passengers would likely feel more in control of the vehicle if they had some control over vehicle speed, following distance, and how soon the passenger is alerted to unusual activity. Current driver assist systems like Autopilot from Tesla Motors have already implemented some of these customizations (Pritchard, 2022).

AV Ethical Decision Making

Another issue relating to the perceived safety of autonomous vehicles is how the vehicle should react in the event where an accident is imminent and unavoidable. Imagine a situation where an AV is transporting one passenger when a concrete highway barrier suddenly appears in front of the vehicle. There is not enough time for the vehicle to come to a stop and if it collides with the barrier the single passenger in the vehicle will perish. There is a sidewalk next to the road that the AV could swerve onto and avoid hitting the barrier. However, there are four pedestrians standing on the sidewalk that would be struck by the vehicle. If struck by the vehicle, all four pedestrians would die. The AV has to decide, keep traveling straight and let the single passenger die or swerve, saving the passenger but causing the four pedestrians on the sidewalk to die.

This may seem like an easy decision to make at first. Several studies have used surveys asking what AVs should do in situations similar to that described above (Gent, 2017). The majority of respondents choose to save as many lives as possible, or in this situation do not swerve the vehicle and sacrifice the passenger to save the lives of the four people on the sidewalk (Gent, 2017). This is an example of making ethical decisions based on Utilitarian Ethics, an ethical framework that centers around making decisions that produce the most net good. In this situation that translates to saving as many lives as possible. Additionally, the responses of the respondents were also affected by the age and gender of the hypothetical passengers and pedestrians (Gent, 2017). However, many of the same respondents from these studies stated they would not want their own personal vehicles to be ethically programmed using utilitarian ethics (Gent, 2017). These respondents wanted their personal vehicles to always protect themselves no matter the situation. This is an example of making ethical decisions based on ethical egoism, a framework that centers around making decisions that optimize self-interest above all else. The respondents also opposed creating regulations that require all AVs to use utilitarian ethical decision making (Gent, 2017).

While it is important to consider ethics when designing AVs, it is also important to minimize the amount of ethical decision making performed by AVs. AV ethical decision making should be a last resort failsafe that is only performed when all other safety considerations fail. Neither engineers nor software should regularly ‘play god’. Therefore, other safety mechanisms need to be designed to reduce the need for AV ethical decision making. A promising solution thought of by Tesla Motors CEO Elon Musk is to bore holes underneath congested areas and build roads underground (Fortney, 2022). This solution would not only eliminate AV interactions with pedestrians, it would also reduce congestion (Fortney, 2022).

Actor Network Theory Analysis

The main actors associated with this research question are the U.S. government, the general public, and AV manufacturers.

The U.S. government’s perspective will be a combination of the interests of several governmental organizations. The National Highway Traffic Safety Administration, Federal Highway Administration, and Department of Transportation all likely have similar perspectives on how autonomous vehicles will be integrated into society. Therefore, all of these actors can be black boxed as simply the U.S. government. The government values all lives equally (or at least should aim to) and one of the main goals of the above governmental organizations is to reduce transportation-related deaths as much as possible (Traffic Safety Facts - Transportation, 2005). Therefore, in terms of AV ethical decision making, the U.S. government will likely want AVs to save as many lives as possible, meaning it would want a utilitarian ethics approach. The government will also want to maintain as much perceived control in AVs as possible. Additionally, in the U.S. the automobile is a symbol for personal freedom, something that the public values very highly (D'Costa, 2013). This will make it in the government's best interest to ensure AVs have features that amplify perceived control in vehicles. Providing that AV manufacturers can prove AVs are safer than the average driver, the government would want AVs to be widely adopted quickly in order to reduce traffic related deaths. This may put the government in conflict with drivers/passengers, who may believe their driving ability is superior.

All of the many vehicle companies that build AVs will likely have similar interests and can therefore be black boxed as AV manufacturers. AV manufacturers will want their vehicles to be as capable as possible as it is a great selling point and avoids negative publicity due to accidents or safety concerns. For AV ethical decision making, AV manufacturers would be put in a difficult situation. AV manufacturers would not want negative publicity about their vehicle choosing to sacrifice its passengers, nor would they want negative publicity about their vehicle sacrificing many lives in order to save a single driver. This would likely lead manufacturers to seek guidance from the government for regulations on AV ethical decision making.

The public is an obligatory passage point in the network as AV mass adoption is reliant on it and the network would fail without its support. The dilemma of using utilitarian ethics or ethical egoism will likely have a great influence on the public's perceived safety of AVs. Both frameworks have several advantages and disadvantages with respect to AV safety perception. AV ethical decision making based on utilitarian ethics would likely lead to higher AV safety perception from people outside of cars such as pedestrians and cyclists, as vehicles would be valuing their lives as well. This form of decision making would also ensure that no additional lives are lost that are preventable. Utilitarianism, however, faces the issues shown in the survey.

Many car users would not want their car to choose to forgo preventing an accident in order to save others. This form of ethical decision making would significantly reduce AV perceived safety of vehicle passengers, and could discourage AV adoption. Ethical egoism would be perceived as safe from vehicle passengers and encourage AV adoption, though safety perception of pedestrians and cyclists would be decreased significantly. Overall, AV ethical decision making using utilitarian ethics is the superior option, assuming it is possible to achieve mass AV adoption with the framework.

Discussion

Overall, there are a few key considerations that AV manufacturers and the government need to consider when designing fully autonomous vehicles for mass adoption. One of the main considerations is capability. AVs should be safer than human drivers before being available for the public to buy. However, it should be considered that large scale driving data will improve AV safety and therefore the sooner AVs are being used, the sooner their safety will improve. Another important consideration is control. It is very important that the AV is more similar in perceived control to the existing automobile than it is to the commercial aircraft. To accomplish this, the steering wheel, pedals, and horn should not be removed from AVs and new forms of passenger input should be implemented, along with the ability to customize AV behavior. Additionally, every effort should be made to require all AVs to use utilitarian ethics when making ethical decisions. This could be accomplished through government regulation or through an agreement between AV manufacturers. It is also important to ensure that strong efforts are made to separate AVs from encounters with pedestrians. While AVs should be ethically programmed, the amount of ethical decisions made by AVs should be minimized to only in the event of systematic failure of all other safety mechanisms. Overall, autonomous vehicles have a long future ahead of them, but with the right actions they will be perceived as safe by the public, become widely adopted, and save millions of lives.

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