Social Side Effects of the Development of Autonomous Transportation

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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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Abstract

The development of autonomous vehicles raises many questions about how society will react to the addition of these vehicles to the roadways. Many people are eager for this next technological step but may not have thought about the unintended consequences of removing humans from the driver's seat. The goals of this paper are to analyze possible societal reactions to autonomous vehicles becoming a part of everyday life.

Technological determinism was used as the Science, Technology, and Society (STS) framework to conduct the analysis. The history of the automobile and its societal significance was examined to provide a baseline for predictions to be made. Current trends were used to extrapolate possible societal responses and consequences. The analysis shows that even though automobiles used to have a great social significance, particularly as a symbol of individuality, new generations put less personal value towards automobiles. Investigating the technical requirements for autonomous vehicles shows possible privacy and security concerns could make consumers more hesitant to accept autonomous vehicles.

Based on the results, multiple conclusions can be drawn about the future of autonomous vehicles and society. Since the personal importance of vehicles has been decreasing, it is likely that society will be shifting away from the current model surrounding vehicles towards a more detached system. Current developers and engineers have to be considerate of privacy of users to ensure a positive reaction from society. These results indicate that the overall societal reaction to autonomous vehicles will be positive.

Social Side Effects of the Development of Autonomous Transportation

Introduction

Since the development of machines has historically had large impacts on society, it is important to consider the social side effects arising from current technological developments. In order to properly analyze the possible social side effects caused by developing autonomous transportation, a Science, Technology, and Society (STS) framework must be applied. In this case, technological determinism, an STS framework, best fits since it states society and culture are shaped by the developing technology. The development of autonomous transportation carries a significance similar to the industrial revolution. Determining the possible social side effects resulting from the implementation of autonomous transportation, will require analyzing history and applying technological determinism. This paper will then thoroughly analyze current social values and behaviors in relation to transportation. Finally, through the lens of technological determinism, a reasonable conclusion can be drawn about how autonomous transportation will change society.

Technological Determinism

There are many different frameworks for identifying how technology and society interact together. Technological determinism is an STS framework stating, technology dictates society's response. It states as a new technology is developed and integrated into society, societal behaviors will change to better accommodate the growing technology. Technological determinism is analogous to pushing a square peg (new technological developments) through a round hole (societal behaviors), with the hole deforming until the peg fits clean and smoothly. Technological determinism maintains technology will remain and not be as swayed by society

but society will change around technological developments. Technological determinism can be applied to different fields of technology such as automobiles in the early 20th century and autonomous transportation. The concepts of technological determinism were developed in the mid-19th century after the industrial revolution and its principles can still be applied today even though technology has drastically changed.

The industrial revolution completely shifted the dynamics between humans and machines, so philosophers began to develop theories about how those dynamics function. Karl Marx, a German economist and philosopher, best known for his work, *The Communist Manifesto* (Marx, 1848), was the first to detail the phenomena. The theory was never formally defined by Marx but the concepts were present in his work, *Capital. A Critique of Political Economy* (Marx, 1867). Thorstein Veblen, an American economist later formalized and coined "technological determinism" (Communication, 2015). Technological determinism states a new or developing technology will lead to a change in societal behavior so society better accommodates the new technology. The main aspects of technological determinism are: an initial driving factor leading to the development of a technology, the developed technology is then implemented, and the implementation causes a change in societal behaviors.

In order to use technological determinism as a framework for analyzing how society will change after the implementation of autonomous transportation, it must be shown whether technological determinism is an acceptable fit. Determining connections between autonomous transportation and other technologies exhibiting traits corresponding to technological determinism will allow for an accurate assessment. The initial development of the automobile is a strong connection to autonomous transportation since the automobile allowed for traveling on a personal level never seen before. Originally designed for farmers, the Model T was affordable

enough for a working class family and after World War II, created the ability for leisure time and tourism (History.com Editors, 2018). This shows the automobile had a driving factor for development, was implemented, and societal behavior changed making the automobile more successful. Technological determinism shows how large developments in the transportation industry have changed in societal behavior.

Certain technologies have the ability to shape society and those technologies are similar since they provide new and drastically different solutions to problems. When this happens, it is called technological determinism because society is being shaped or determined by technological advances. Due to the prevalence of technological determinism in the automotive industry, it is logical to apply the framework to current developments of autonomous transportation.

Background Research

Before the wide adoption of personal transportation, leisure time was limited to the home and local areas. However, as middle class families gained access to personal vehicles the ability to travel was created. Families started going on vacations and the tourism industry was created by having the ability to drive to places outside of walking distance. Localities took advantage of this by constructing attractions, like when Robert Moses designed and managed the opening of Jones Beach by adding road access for personal vehicles. In this case, the roadway designs by Moses were used to prevent commercial vehicles, like buses, from passing. It is believed this was done to prevent lower class families, mainly nonwhite families, from visiting the beach (Adno, 2017). Moses was able to do this because he knew poorer families would not be able to afford personal transportation and the bridges are too permanent to easily change. Moses took advantage of the social side effects coming from the personal transportation technology and designed bridges to reinforce culture divide forming in the transportation industry. This use of

technology to manipulate society, shows how careful engineers must be with designs because there could be negative impacts on society.

The initial research performed shows how society has historically relied on technology, and how reliance has shaped current behaviors. Transportation has had a direct impact on society since most people interact with the technology regularly. Many great societal changes have come from transportation, but there have also been some negative consequences associated with certain design aspects. These initial findings have lead to the following questions which will be the basis for analysis:

- How impactful has the automobile industry been historically?
- Does the current transportation model have deep cultural significance?
- Will the data collected by autonomous vehicles reduce the feeling of freedom currently associated with driving?
- Can the automotive industry change societal behavior?
- How will automated transportation change societal behaviors?

Research Methods

In order to better analyze the reaction society could have after autonomous transportation is implemented, research will have to be conducted to determine society's current view towards the transportation industry. A good starting point for research would be to determine how the transportation industry has been viewed historically by society and how society has been shaped by transportation. This can be done by looking for statistical correlations in history. Statistics on safety and laws regarding transportation could also provide insight on how society has reacted. News articles can provide collective assumptions about how society is reacting to current developments. Since blogs are written by average people it can provide raw feelings and

emotions, which can be useful if numerous blog posts come to the same conclusions. No one research method is sufficient to draw conclusions about how society will react to autonomous transportation. If trends appear to line up from different viewpoints, then it will be safe to trust that the correlations have minimal error and conclusions can be drawn after performing a proper analysis.

Analysis

How impactful has the automobile industry been historically?

The automobile industry did not always have control over society since personal automobiles were not widely accepted when first introduced in cities. Streets were originally for everyone, so when large moving machines started to use the streets and people began getting hurt, the public grew to dislike automobiles. As accidents occurred, there were no laws to support the driver regardless of the circumstances of the accident so judges would rule in favor of the pedestrian (Stromberg, 2015). Automobile manufacturers and dealers feared sales would plummet so they began to lobby for pedestrians to cross at designated intersections by using the term "jaywalking," which was an offensive term to those living in the city (Stromberg, 2015). After these initial missteps with automobiles were fixed, not with safer technology but with new social stigmas and laws, the general acceptance of automobiles began to increase and shape society.

Initially, personal automobiles were too expensive for the average family, but Ford implemented the moving assembly line to reduce the cost of the Model T and increase the production rate (History.com Editors, 2018). By reducing the cost, the appeal of personal automobiles grew and after World War II, owning an automobile soon became part of the American Dream. Ford's methodology of creating the same car for years at a time was not

without its downsides. Alfred Sloan of General Motors (GM) realized in order to increase sales, the desire for automobiles must also increase by making periodic changes to the current model. By releasing yearly models and providing cosmetic differences for customers to choose from, GM became the industry leader. This change in technology persuaded consumers to trade in their automobile for a new model more frequently and caused automobiles to become more widespread.

Now the average family can afford personal transportation in the form of their own automobile, so a new industry began to form. Tourism did not really have a place in American society until the transportation issue was solved since the time investment to travel was so large. As more automobile manufacturers fine tuned their production practices similar to Ford, an "unprecedented construction of transportation" occurred since there were more cars than roads (Gyr, 2010). The Interstate Highway System connected states and cities with roads for automobiles, allowing people to easily visit cities they had never been to before.

As people began traveling, using their personal automobiles, to different cities and states for leisure and relaxation, new communities were formed on the basis of getting out of the city by being able to travel to the workplace. Suburban communities were supposed to be more spread out than cities, with families having a detached home and a yard. The classic American Dream was centered in suburban communities with "a house on their own land, a car, a dog, and [two and one third] kids," but this was not possible if there was no way to live farther away from the workplace (ushistory.org, 2020). Many people flocked to the suburbs and thus new businesses were opened such as shopping centers and fast food restaurants.

In more modern history, companies such as Amazon have relied on automobiles to deliver their products to consumers. Typical methods for consumers to purchase goods are to

buy them at a brick and mortar store or to order them and have them delivered. Amazon is leveraging the advantages of automobiles to deliver packages faster and cheaper than ever before (Grabham, 2017). There is little reason for consumers to leave their homes to purchase goods since online retailers can offer better prices with more convenience. This has created a shift in public culture from going to shopping malls for a day outing to browsing for items on the internet.

The automobile industry has been the root of significant cultural change since its origins. Personal transportation opened up gateways to new communities with initially little to offer but capitalized off of this feature in combination with growing leisure time to create the tourism industry. Individuals were given the ability to drive to work instead of walking so families moved out of the city to form suburban communities thus completing the American Dream. Businesses began to capitalize on the automobile by offering delivery services for their products through mail order catalogs and eventually the internet which has attracted a majority of the population. Overall the automobile industry has been able to impact most people, since the affected areas were areas of massive cultural significance.

Does the current transportation model have deep cultural significance?

Cars have been integrated into our society for over a century and the reliance on cars has grown as we have approached present time. Car ownership has increased from the invention of the automobile due to lower costs, easier car loans, and a spreading population. People now live farther from the city in suburban communities and neighborhoods which require personal or public transportation to gain access to amenities in the city. Since most public transportation does not service all suburban areas, personal automobiles are the only solution. Many teens use automobiles when they get their driver's license to express the freedom they feel as they step

away from their parents and begin to form their own personality in young adulthood. However, other methods of transportation have risen in popularity during the last decade such as ride hailing companies (Uber and Lyft) and car sharing companies (Zipcar). These new methods have changed the way average people interact with personal vehicles by allowing people to pay for individual rides or rent vehicles for specific periods of time. Determining the current cultural significance of personal automobiles will help establish society's viewpoints towards a changing industry.

In the late 20th century getting a driver's license was the first coming of age moment for many Americans. Turning sixteen allowed teenagers have the freedom to drive to places without their parents. Teenagers were able to express themselves in ways they normally could not if their parents were transporting them around. Many teens took this opportunity to take up summer jobs and buy their own vehicles so they would not have to share one with their parents. However, the significance has declined over the past two decades due to the rising cost of owning and operating automobiles and the wide selection of other transportation methods. High costs of owning and operating automobiles is due to the higher resale prices of used vehicles, rising gas prices, and rising insurance prices (Roberson, 2013). Public transportation has greatly improved as pushes for more climate friendly options have increased. Cities and localities have also taken this push to make walking and biking more acceptable again by installing the proper infrastructure to maintain proper safety from vehicles. The freedom aspect of having a driver's license and being able to drive around independently has also decreased due to the invention and acceptance of smartphones and social media. Since social media has the freedom and expression teenagers desire in the palm of their hands and communication with friends just a couple of button pushes away, the need to drive somewhere to meet up has decreased. Some teenagers

who have taken steps to obtaining a driver's license and drive their own vehicle have not done so for enjoyment but for necessity (Roberson, 2013). The desire and cultural significance of getting a driver's license and owning a personal vehicle has appeared to decrease due to the rise of other methods of transportation, social technologies, and a general disdain for driving.

Buying your own personal vehicle used to be a part of growing up, along with getting your driver's license, but as fewer people have decided to go test to get their driver's license even fewer have decided to purchase their own vehicle. The cultural meaning attached to owning and customizing a vehicle has shifted to smartphones and social media. The way people shop for vehicles has also changed, before it was an expression of yourself but now the feeling has changed to be "just about utility" by looking for cars with the most intrinsic value (Fisher, 2015). This disconnect between young adults and cars can also be traced back to the technology itself as cars are becoming more utilitarian and automated. The increased reliability of cars has reduced the need to perform maintenance work and thus many people do not feel a connection with their vehicle (Fisher, 2015). As the connection between owners and vehicles has faded, the desire for the most cost effective vehicle with the most intrinsic value has increased. Many young adults fear they do not have the financial stability to invest in a vehicle they feel only has a utilitarian purpose. As ride hailing companies, Uber and Lyft, have gained traction amongst young adults the need for owning a personal vehicle has decreased and a ride can be summoned from a smartphone. Culture has begun to shift away from owning personal vehicles, towards getting a ride when necessary since personal ownership has become more expensive.

Since people are more hesitant to buy cars and more accepting of getting someone else to take them around for short trips, a new solution had to be created so people could take long trips or vacations. Car sharing programs were created to fill this gap by providing consumers quick

and easy access to a selection of vehicles to be rented for short term usage. These differ from car rental services since cars are available for rental at any hour of the day not just when the business is open since most of the services are conducted through an app or website. Car sharing helps distribute the cost between users and fewer cars need to be purchased to achieve the demand and as a result carbon emissions should be reduced (Richard, 2020). One of the most popular car sharing companies, Zipcar, has grown to have over ten thousand vehicles in its two decade lifespan to support people all across the globe and demand in America has risen to almost one million consumers (Raymond & Dahl, 2017). The biggest advantage of car sharing is the distributed cost of purchasing the vehicle, therefore consumers can have access to more advanced vehicles, such as the newest and most autonomous technology. Ride sharing groups could evolve to allow users to summon autonomous vehicles to their location, have passengers board and program in their desired destination, autonomously navigate to the desired location, and drop off the passenger (Shaver, 2019). The advantages of car sharing companies and the disadvantage of autonomous vehicles being expensive seem to provide good reason to combine the two ideas together for the deployment of fleets of autonomous vehicles. One of the biggest disadvantages of car sharing companies has been revealed during the COVID-19 pandemic in 2020 due to the increased cleaning cost. Zipcar allows multiple users to book the same car for the same day so "the cleaning operations and other costs could increase" due to the safety management during the pandemic (Ramey, 2020). Having to clean the car after a consumer uses them adds to logistical complexity slowing down the efficiency and in itself incurring costs thus reducing the profitability of the system. The benefits of car sharing services seem to outweigh the disadvantages since younger generations are more inclined to share vehicles to save personal costs.

Even though getting a driver's license used to be a large part of growing up for many teenagers, society appears to have shifted away from being car obsessed with fewer teenagers applying for their driver's license. The decline of teenager drivers is connected to rising costs for owning and operating a vehicle. This decline can also be attributed to increasing pushes for climate change which encourages public transportation when possible and personal driving only when necessary. The rising cost of vehicles has also caused the total ownership of vehicles to decline in favor of sharing with family members. This can be seen in the desire of consumers to purchase vehicles based on utility compared to buying based on extrinsic value, so finding a single all around vehicle is appealing. Car sharing has recently risen in popularity due to the convenience it provides consumers in cities or areas with limited parking and the ease of reservations. The high costs of vehicles gives car sharing an advantage over buying a vehicle for personal use by saving consumers money. Since autonomous vehicles are predicted to be significantly more expensive than the average car, a majority of consumers may only get access to these new and modern vehicles by joining a car sharing program. Overall, society is less attached to cars now than in the late 20th century when cars were the main mode of transportation and expression.

Will the data collected by autonomous vehicles reduce the feeling of freedom currently associated with driving?

Currently one of the major advantages of owning a personal vehicle is the freedom it gives individuals by allowing them to travel wherever they want, whenever they want. Since the projected models for the implementation of autonomous vehicles would involve car sharing programs, people may not feel as free since they have to wait for a vehicle to pick them up and they can not personalize the vehicle. The fleet of vehicles will most likely collect significant

amounts of data about the passengers such as pickup and destination location to assist with optimizing logistical issues. Ideally the data collected would not contain personally identifiable information, but current technology companies specifically collect this type of data in order to increase profits by selling the data. New laws are being passed in many countries and states to protect consumers from businesses by regulating the way personal data is obtained and used. The distrust of technology companies was created due to this misuse of data and may sway future decisions about adopting more sophisticated and automated technology.

The advancement of computer technology has made it possible for a lot of personal information and data to be recorded and stored by large corporations. Currently this data is collected on smartphones or personal computers through apps and websites offering services to consumers in exchange for data collection. The data collected is typically related to personal interests and search history but can be as personal as a name, date of birth, or location. Typically users have to grant companies the ability to access personal information, usually through an adhesion contract such as terms and conditions or end user license agreements. Adhesion contracts are legally binding agreements in which one party, party A, holds the majority of the bargaining power over the other party, party B, as such B must either accept the conditions set by A or walk away with nothing (Law, 2019). Since many people want to use the products produced or maintained by large technology companies, these companies have the ability to set the conditions in their own favor by requesting user data. The legality of these contracts has been challenged throughout the years, but generally the courts use the "doctrine of reasonable expectations" to determine if the contract asks too much of the weaker party (Kagan, 2021). Terms and conditions requesting personal data such as name and search history are generally considered reasonable for consumers to expect from technology companies and are thus

enforceable. Computers have been added to vehicles as a way to control mechatronic systems such as new semi-autonomous functions and entertainment systems but these advancements also give companies the ability to collect personal data from automobiles. It is reasonable to assume, as vehicles feature more advanced technology, the demand for personal data will increase (Wessler et al., 2019). A common piece of information likely to be collected is Global Positioning System (GPS) data providing the exact location of the vehicle at any given time. The collection of location data creates "privacy risks … [raising] both … personal … and societal concerns" due to personal transportation gaining the ability to reveal personal information about where someone travels (Navetta et al., 2019). Even if the personal information collected by the vehicle is not abused by the manufacturer, the police or government might try to obtain and use the data as evidence without possession of a warrant. In Mobley v State of Georgia, a Georgia Appeals Court upheld the Trial Court's decision to dismiss Mobley's motion to exclude black box data obtained without a warrant (Wessler et al., 2019). The Georgia Supreme Court reviewed the case and determined a warrant is required to download personal data from a vehicle making it "the first state supreme court to recognize the danger of warrantless access to … data collected by modern cars" (ACLU, 2019). The lack of case law shows there is room for personal data to be misused or rights to be limited until more cases are presented to higher courts. Since the amount of data vehicles are collecting is increasing, it will take new court cases and precedent to determine exactly how accessible private data is to companies and police.

It did not take long after the acceptance of the automobile for the rights granted by the Fourth Amendment to be applied to vehicles in a similar manner as houses. The rights given are significantly looser due to issues such as the plain view doctrine being more applicable and

vehicles not always being on private property. However case law still set forth rights protecting people from unreasonable search and seizure without a warrant. One question is determining whether or not an autonomous vehicle falls within the automobile exception set forth by *Pennsylvania v Labron* which allows for search and seizure without a warrant if there is probable cause (Hedges & Gottehrer, 2019). This ruling was made in response to traditional automobiles but since autonomous vehicles will incorporate more technology with more personal data and the driver is not actually driving, technological based cases might be more applicable. *Riley v California* ruled a "warrant is necessary to search a cell phone" even after seizure, so it is reasonable for the same rights to apply to the computer systems in autonomous vehicles (Grizzard, 2019). Even though these rights would logically transfer over, it is not written in the Constitution or law therefore, new cases would need to be tried to develop case law. Another case to help protect the rights of people regarding data stored on autonomous vehicles is *Carpenter v United States* since it states "a warrant is required in order … to access … location data directly from a cell phone company" despite the third party doctrine stating "there is no reasonable expectation of privacy" when information is given to a third party (Grizzard, 2019). This protects personal location data from being obtained by the government without a warrant and will likely carry over to protecting Global Positioning System (GPS) data recorded by autonomous vehicles regardless of if the vehicle is owned by a car sharing company or by an individual. The case law, statutory law, and Constitution do not properly account for autonomous vehicles so interpretations will need to be made to properly protect the freedoms granted to individuals. However, given how case law lags behind societal and technological developments there will be a short period of time where the application of the Fourth Amendment is questionable.

Recently, governments across the world have begun passing laws and regulations to protect the digital privacy of their citizens. These laws and regulations are in direct response to the growing collections of data about consumers held by technology companies. As the truth about companies collecting data became known to the general public, fears grew about how the data was being used and whether it could lead to misuse. In 2016, the European Union (EU) adopted the General Data Protection Regulation (GDPR) which requires businesses to protect EU citizens' "personal data and privacy" with strict regulations and requirements (Nadeau, 2020). Even though GDPR was passed by the EU, this affects companies on a global scale since it affects all companies "[processing] personal data of European residents" regardless of presence in the EU (Nadeau, 2020). This means American technology companies have to meet the same standards and regulations as European technology companies, given how the world has become globalized. Similar laws have been passed in the United States, such as the California Consumer Privacy Act (CCPA) which has similar requirements to GDPR showing there is a social push for proper handling of data. The passing of laws and regulations across the world demonstrates that society is wary of personal data being misused by companies. Governments have stepped up to combat the growing misuse of personal data by increasing the regulatory punishments and increasing the standards companies to follow.

Owning and operating a personal vehicle grants individuals extreme amounts of freedom by allowing them to drive wherever and whenever they want. This freedom can easily be minimized by greedy companies or invasive governments through the misuse of data collected by advanced vehicles. Technology companies have been gathering data from consumers with the assistance of computers and adhesion contracts, which allows direct access to most types of personal data. As more advanced computers are integrated into autonomous vehicles even more

data will be able to be collected since there is a new source from which the data is provided. Governments have also tried to use the data collected by technology in pursuit of the law, however the Constitution has left grey areas about vehicles and computers. These grey areas have been interpreted by judges but there is still more case law needed to ensure proper search and seizure personal data from vehicles. New laws pertaining to protecting personal data have been passed, requiring companies to make a reasonable effort to protect their consumers' personal data. The misuse of personal data from both private companies and the government have created a sense of fear and anxiety in society. This fear and anxiety is being remedied by new court cases and regulations. Without these new regulations, society could be wary to adopt a new technology collecting even more personal data about their lives.

Can the automotive industry change societal behavior?

Throughout the history of the automobile, technology has been able to be successful with slight modifications to remain modern. However the main source of change to make the automobile successful was cultural. There appears to have been spontaneous changes in behavior over the past century. These changes in behavior can be accounted for by the invention and development of widespread personal transportation by using technological determinism as a framework for analysis. It has been shown through history, as technology provides another easier way for tasks to be completed, then societal behavior will change to readily adopt technology.

The influence of the automotive industry has decreased in the 21st century as some of the defining factors have lost their glamour and appeal. The desire for driver's licenses has been reduced as younger generations have moved back into the city and are more conscious about the high costs of owning a personal vehicle. Cultural significance of owning personal vehicles has

diminished as people search for vehicles based on utility and cost compared to older generations searching for personality. The decreased influence has not removed the automotive industry's ability to change societal behavior but the new technology must still satisfy the desires of the public. If new vehicles can satisfy the needs and wants of society, the new technological advancements will be accepted. Assuming the market research performed by the automotive industry was conducted sufficiently then it is likely new features added into vehicles to change human behavior.

How will automated transportation change societal behaviors?

Cultural changes are most likely to occur after the adoption of automated transportation due to the large impact vehicles, computers, and automation have had on societal behaviors. Individually each of these technologies has drastically changed certain facets of life thus these technologies combined all together in one will create greater changes. It may appear these individual technologies are driving behavioral changes, not the combination as an autonomous vehicle. This belief indicates there is no synergy between the technologies in the development of autonomous vehicles, which explains why the overall effect would not be greater than the individual effects combined. However in order to properly develop autonomous vehicles there must be technical synergy between all of the different components. The technical synergy allows the mechanical system to interact smoothly with the automation processes run on computers. This synergy is required for the technical success of autonomous vehicles thus the combined system will have a greater effect than each of the individual components combined.

Since it has been seen how impactful vehicles, computers, and automation have been on societal behaviors the combination should have a significantly greater effect. There are currently many large social and legal pushes to curb the influence these technologies have over society.

These pushes demonstrate society is aware of the effect technology possesses. They also demonstrate behavioral change as society tries to gain back its independence from invasive technologies. Overall it appears society is trying to maintain and develop a new standard of behavior by reducing the power technology has over cultural behavior.

Results

The development of the automobile has created major behavioral changes in society, centered around giving people more freedom. These technologies allowed people to spread out while still staying connected with the community. The automobile led to the creation of suburbs creating a massive shift in the dreams of average people with the formation of the American Dream revolving around living in suburbia (ushistory.org, 2020). Soon people began owning vehicles as a part of their personality instead of just utility by finding vehicles suiting them and performing maintenance and modifications themselves. As the 20th century came to an end the nationwide desire for a personal vehicle began to decline as seen in the drop of driver's licenses and vehicle purchases as individual priorities shifted becoming more fiscally conservative (Roberson, 2013). Now with the development of autonomous vehicles, society is most likely to exhibit behavioral changes again as the way people interact with their vehicles changes.

Since human behavior has changed in response to minor and major technological advancements in the past, it is safe to assume another major technological advancement such as autonomous vehicles will also create significant behavioral changes. Given the new role vehicles will serve in everyday life along with different usage requirements, behavioral changes will be centered around how people view vehicles and transportation. These changes will be compounded due to the invasive nature of computers autonomous vehicles will possess. Considering the massive ongoing debates about how much power society will allow technology

to possess over their lives shows that society is aware of these technological influences. This awareness is creating behavioral changes in response to emerging and invasive technology. The freedom and independence defining American culture and behavior is at risk of changing due to the new technological systems required for autonomous vehicles.

The changes society will most likely experience will be centered around interactions with vehicles and transportation. One trend likely to continue is the decreasing ownership of personal vehicles as well as the lack of connection between owners and vehicles. The lack of ownership will bring way for fleet vehicles to operate, when people rent for the day or trip. Since many vehicles will be rented there may be some discomfort with the amount of personal data collected in order to improve logistics of a fleet operation. This discomfort can be eased as new privacy laws and regulations are passed, ensuring the protection of consumer data. Even with these new privacy laws, people can be subjected to unwanted search and seizure. This is seen in a science fiction television show, *Westworld,* when an autonomous vehicle alerts its location to the police and pulls over when it thinks a crime has been committed (Crouse et al., 2020). This could become a reality unless proper case law is established to ensure all searches and seizures are done with a proper warrant. However, this requires people's rights to have been violated and taking the issue up to a higher court. Without proper separation of personal data, many people will likely feel as if they are under the magnifying glass while traveling. Traveling was initially supposed to be to give people freedom but it has shifted to become another chore for some people. If the freedom to express one's self is reduced while travelling, then many more begin to feel like travel is a chore. Overall, the changes society will experience are unpredictable, but reasonable assumptions can be extrapolated from the current trends. These trends indicate a growing disconnect between society and vehicles due to fiscal and privacy issues.

These behavioral changes do not differ significantly from the current trend society appears to be on, but some of the changes may cross the line for some people. The reduced freedom and independence coming from autonomous fleet vehicles may increase distrust in companies and the government. This increased distrust is detrimental to society because communities operate on the basis of trust. If people feel they are being taken advantage of due to the invasion of privacy created by autonomous vehicles then distrust could spread to other technologies. Without proper precautions ensuring the protection of personal rights and personal data, society's distrust could grow too large and disrupt future technological advancements. Distrust can be minimized through proper laws and regulations based on the wants and needs of society to restore the lost trust. If companies and the government can maintain the trust of the people, these behavioral changes caused by autonomous vehicles will not be detrimental to society.

Autonomous vehicles are likely to create significant changes in societal behavior due to the technical systems in place. These systems will reduce the ownership of vehicles thus furthering the disconnect between driver and vehicle. The increased computer presence creates an invasion of privacy and could dampen the freedoms and rights of consumers. These changes will not be taken lightly and will most likely further the distrust between the general public and advancing technology. In order to prevent this distrust, engineers, businessmen, and lawmakers must work together to ensure the proper measures are taken to protect the privacy of individuals. As long as trust is maintained, these changes in travel related behavior will be isolated and not pose a detrimental threat to societal operations.

Conclusion

The development of new technologies could lead to unwanted societal changes if proper precautions are not taken to match the technology to current ideologies. Autonomous vehicles are going to provide increased safety and access to personal transportation but the costs are increased cost and decreased privacy. These effects could create massive behavioral changes towards personal transportation in society. The optimal framework for analysis is technological determinism which states, new technical developments will shape and change society and behavior. Technological determinism fits the development of autonomous vehicles well since vehicles have historically fit the model of shaping society. In order to determine possible social side effects of autonomous vehicles, it must first be proved whether autonomous vehicles can change society and then the possible changes will be identified.

Through historical analysis, vehicles were determined to have a large impact on society by providing an easy and private means of transportation. This impact changed where people lived and the goals many people strived to achieve. After determining the influence of vehicles on society, it was determined, autonomous vehicles would have a larger impact due to the inclusion of computers in the design process. This inclusion reduces the privacy of the consumer, so a feeling of distrust could form as companies and the government collect and use more personal data. A loss of trust of this magnitude would be detrimental to society since the average people would feel taken advantage of by the groups in power. Trust can be restored through proper laws and regulations, protecting the freedom and privacy of society. The development of autonomous vehicles will bring a lot of good to society by providing safe and reliable transportation for many people. However without proper care, personal data can be misused and decrease the freedom of average citizens. These factors should be considered

during the process of developing autonomous vehicles to make sure the people are protected from those in power.

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