Psychological Ownership: A Study of Individuals and "Their" Autonomous Mobility

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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 Assignment

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Introduction

Occasionally, a technology will come along that will cause a paradigm shift: a fundamental change in approach or underlying assumptions. Autonomous Vehicles (AV) is one such technology. It could introduce a paradigm shift to the transportation industry as we know it. Imagine a utopian future where transportation is at its most efficient and safest: no traffic, no accidents, no congestion. A possibility introduced by autonomous vehicles that are orders of magnitude safer than human drivers, aware of every single other vehicle on the road coupled with a road system concentrated for these omniscience vehicles. Such a future may sound impressive, it is crucial to consider what goes into the creation of this future and the technology that brings it into reality.

Since AVs may prove to be a revolutionary technology, we need to answer the question of how they should be implemented into society. Building upon the future described previously, one where AVs share (or solely use) a significant share of the road systems in the world, the paper will aim to tackle some of the socio-technical functions AVs will replace and create in such a future.

As answering the question of how AVs will fit into all aspects of socio-technical intricacies of the future is a hard one. So, this paper aims to shed some light into how ownership could be implemented into AVs. Specifically, it will explore how the social-construct of ownership fits into the most prevalent vehicle ownership style of the current age: private ownership. Specifically, the paper will explore how a private autonomous vehicle use would affect one's notion of ownership.

Phenomenological relationships between people and vehicle: owning and self

A good point of reference for how ownership signifies the definition of one comes from Belk. Belk (1988) explores consumerism through ownership in his paper. His research delves into oneself and extension thereof: possessions. While the paper mainly explores how people treat their possessions and how these may provide insight onto various humanly behavior, one thing is certain: possessions play a large part in one's personal identity. A car tends to be the largest purchase one overtakes (after a house). Much like a house, they create a private environment for the users to stay in during their utilization of the vehicle. Although some people purchase vehicles solely for their purpose

of transportation, the different varieties of the same type of vehicle exist to compliment one's tastes, lifestyle, and social status is unnumerable. This signifies that people do not just purchase a vehicle for its specific purpose but to have it as *an extension of themselves*. Vehicles are not just any object but one that is a considerable part of socio-technical imaginaries as they hold both the functional value of transportation and symbolic value of status for the user. So, one's sense of ownership of their vehicle should not be too alien of a topic for anyone. For this reason, it is crucial to consider why ownership is an important aspect of defining AVs: even now, owning a car plays a large role in defining a society and oneself.

The view of vehicles as extensions of oneself does resonate with autonomous vehicles as well. In their paper, Lee et al. (2019) made statistical models to explore a user's perspective of Autonomous Vehicles and their usage. The models created included ownership as a variable for one's perspective of autonomous vehicles. The results from the models indicate that people's ownership makes them more likely to use an AV without increasing their perceived usefulness of the technology. This implies the importance of ownership within the framework of AV technology and its implementation as people would be more willing to adapt into such a technology if they felt ownership of it.

Lee et al. (2019) in their paper specify the concept of ownership they were considering: rather than calling it 'ownership' they named the factor 'psychological ownership.' This relates to users of an AV may be interested in the use of the technology without actually owning the technology and, rather, feeling an ownership of the AV. The paper aims to explore the construct of ownership in AVs through the lens of psychological ownership much like how Lee et al. tackled it within their paper.

Psychological Ownership refers to feelings that something is one's own and reflects a relationship between 'an individual and an object' in which the object is experienced as having a close connection with one's 'self.' (Pierce et al., 2003) It encompasses the thoughts and beliefs concerning the target of ownership as well as affective sensations of attachment to the object (Avery et al., 2009). Baxter et al. (2015) indicates that a vehicle conveys feelings of ownership to their users: providing them with the ability to control their process and environment; intimate knowledge of the vehicle; self-investment into the vehicle.

As stated previously, the paper aims to explore the notion of ownership within the framework of private autonomous vehicle usage. Baxter et al.'s framework provides a good basis to explore psychological ownership of private usage of autonomous vehicles. This paper will aim to augment the criteria of human-machine engagement under the criteria of three different means of ownership: physical ownership, access, and privacy.

Physical Ownership refers to the most common and natural interpretation of ownership of something: the physical access to it. It considers the how quickly one has access to the vehicle, if they can decide where to hold the vehicle, adjust the appearance, and in general, anything physical that the user can do to the vehicle. This is an important part of owning something as it defines the user's ability to physically alter and interact with the vehicle. Defining the color, looks, and how they may choose to use a vehicle compliments one's own lifestyle choices, providing a sense of ownership of the vehicle.

Access is targeting the ability to use all of one's vehicle and alter it to one's heart's content after paying for the vehicle. Currently, one can modify, use, and repair vehicles as they desire. This may not be the case with AVs soon, however, as the emergent activities among AVs resemble the digitalization of services and software such as the inability to use the software without access to company servers or the need for in-app or in-game purchases to have full access to a software or game's features. Just look at Tesla: It recently remotely disables a car's Autopilot feature after the vehicle was bought because the owner can't use features "they did not pay for" even though the mechanical parts and the software required are already baked into the car (Statt, 2020). If one does not have the ability to alter and use their vehicle to its fullest after paying for it, this may affect how much of the vehicle they can own.

Privacy is relatively self-explanatory: it refers to the access of one's own data and ability to determine how their data is utilized. This is, also, known as "Data Ownership." The sheer amount of data that can be generated and consumed in a fully autonomous vehicle due to its nature – from the speed and the GPS coordinates of the car to the user's temperature and entertainment settings – would imply that there will be some compromise in the privacy of one's data in the utilization of AVs. Cichy

et al. (2014) has run experiments regarding how people feel about ownership of their data. Their results indicate that the individual's privacy concerns tend to lower their willingness to share their 'personal' data with a third-party and that feelings of ownership towards one data, also, decreases one's willingness to share their data. This implies that AVs which prioritize one's privacy would have higher feelings of ownership associated with it. Back in 2016, Germany pushed out a black-box requirement for autonomous vehicles that aims to prove whether it is the user or the vehicle's error in case of an accident. They argue this would assist in working on the technology and its implementation (Staff, 2016); some may consider this a breach of their privacy as they may not wish to share every detail of how they utilize their vehicles. This black-box or other means of data collection and usage may feel as if one *lacks ownership* of one's vehicle, which would affect one's psychological ownership of an autonomous vehicle.

Dawkins et al. (2017) suggest that psychological ownership is a dynamic property which fluctuate over time. This implies that one's understanding of ownership of AVs could change, indicating that the exploration of various aspects of the ownership could help us understand how and why. Building upon Baxter et al.'s analysis of vehicle ownership, the exploration of private ownership of autonomous vehicles under these three clauses of ownership will provide us with an understanding of how psychological ownership could affect the utilization and implementation of AVs.

Private Ownership

Private ownership is having a rightful legal title to a vehicle where the user pays for the vehicle and that vehicle becomes theirs to use their own. It is currently the most common means of using and owning a vehicle in the world. The vehicle is under the full legal ownership of the user. To define this model further: Without the consent of the owner, no one else can use the vehicle, sell it, or rent it out. These vehicles can be used or new but, in all scenarios, must belong to a person privately. The person purchasing the vehicle new can determine its color and packs that belong in the car. They decide to service it on their own term – but this does not mean that they can get it serviced anywhere. The owner must pay for the service out of their own pocket (or through their insurance/warranty.) Gas/electricity costs are directly paid by the owners and they fill the vehicle up with energy as much as they personally require. They can ride the vehicle anywhere that is legally applicable.

Physical Ownership

Private ownership tends to resonate with the physical ownership of a vehicle. This is due to how closely related the current understanding of these concepts are. Private ownership – car ownership – tends to be considered fully physical where the user has access to the vehicle all around. Physical ownership tends to be the most powerful way private ownership exerts psychological ownership to the user.

With a privately owned vehicle, the user has full control over the car's physical features as they are buying or configuring it. This includes the color, shape, or type of the car being purchased. While there may limits to how configurable a car might be, there will likely be enough options for a user to pick from to customize their own, private vehicle to their liking. By adding a personalization aspect to the vehicle, people can create an object that would reflect their personality and likes. According to Kirk et al. (2016) the ability to configure and customize an object causes the users to place a higher value upon that object as well as an increased word-of-mouth compliments (Kirk et al. 2015a) This implies the increase of the psychological ownership associated with the object in question. The ability to customize the looks of the vehicle proves useful in this aspect by increasing a user's feeling of ownership of the vehicle. On top of the physical customization of the vehicle, the user

can store personal items inside and decorate – not modify – the vehicle over time. This creates an environment inside of the AV which allows a more personal and familiar environment for the user. The sense of 'homeliness' created by the ability to customize a privately owned vehicle creates a strong connect between the object and the person, increasing the psychological ownership factor of this type of usage.

A privately owned vehicle provides full temporal control to the user as well. Since the user can use the vehicle and handle it the way they wish, the user can utilize it spontaneously and whenever they want. This temporal convenience provides a sense of comfort and security for the user. Baxter et al. (2016), indicates that temporal control of an object plays a role in determining the psychological ownership one feels towards that object. Private ownership is exemplary in this category as one can determine when they wish to use their vehicle. This will be explored further under Access.

Furthermore, privately owning a vehicle bolsters the proximity to the vehicle as well as increases the total time spent in that specific vehicle. Spatial proximity to an object increases the appeal of a target to the user (Newcomb, 1956; Shin et al., 2019). If a person privately owns a vehicle, they can store it wherever they wish as they have a very high physical ownership of the vehicle. This means that the vehicle will be near them and this proximity will increase the psychological ownership factor of the vehicle. On top of private ownership means that the user will utilize a specific vehicle quite often, increasing the time spent within the vehicle. Relating to the high customization aspect, the more time a user spends in a vehicle and the more memories they have associated with an object. Once one has a lot of memories with an object, the object will gain sentimental value to the user, increasing the feelings of ownership associated with the object.

Monetary aspects could affect ownership. Cars hold monetary value rather poorly, though, they still provide a sense of monetary security as the user can sell the vehicle if they require the money. On top of this, the user can decide the level of insurance coverage they wish to pay for as well as how much they wish to utilize their vehicles. After the user buys the AV, they're the one paying for gas/electricity which means they can optimize their usage as they wish. While the true monetary costs of privately owning an AV is currently not known, experts suggest that private ownership incurs larger

costs, higher emissions, and lower efficiency in transportation (Motavalli 2020). The acknowledgement of higher emissions, higher costs, and lower efficiency may turn seem like an unwanted technology among the masses, though, it has been seen that users tend to pay a higher value if an object is more personal (Kirk et al. 2016).

Access

Most would assume that private ownership would allow the user to do all sort of changes to their vehicle without the consent of manufacturer – after all, the vehicle belongs, legally, under their name. However, for AVs, this may not be the case. Current AV manufacturers hold the right to activate and deactivate features from vehicles without having physical access to these vehicles (Oremus, 2017). Tesla has turned off self-driving abilities of one of its customers and 'unlocked' more of each car's batteries for the owners of those cars to utilize during a hurricane. This may become more commonplace as AVs get more technically advanced – especially with the software integration into the vehicle. This hampers the control and customization one has over their vehicle especially considering how one would assume, under private ownership, that they would be able to access every part of their vehicle, as necessary. Relating back to the physical ownership, this does imply that manufacturers may be able to stop a vehicle from functioning fully, causing feelings of helplessness within the users of the AVs, even though they privately own the vehicle.

Another fall back of access that is becoming more prevalent in today's vehicle ownership is the ability to repair and service one's vehicle. It is easy to come across AV owners that are complaining about how hard it is to service or repair their cars by themselves and even through the manufacturer. Teslas, as a large example, are indicated to have hard to reach customer service after a vehicle is bought (Why Is It so Hard to Contact Tesla after You Buy a Car?, n.d.), repairs taking too long because a lack of 'approved' repair centers and parts available (SFGATE, 2019) as Tesla prefers to do adjustments in house, and very limited self-repair options as well as nearly no third-party repair shops after warranty. The company provides virtually no repair options once the warranty is out, which places owners in a helpless state as they cannot use third-parties or Tesla for repair if their vehicle is damaged. Tesla pays a lot of money to strengthen the security of its software so that the

features implemented in its vehicles stay locked unless the company unlocks them itself (Lambert, 2020). This implies that it will be taking all steps necessary to keep a user from accessing the software and all the features of the car even if the user wishes to adjust, as an example, certain algorithms or the OS inside of the vehicle. Taking away the ability to service, repair, and modify an AV easily is against the notion of 'freedom' usually associated with cars. Paundra et al. (2017) indicates the inability of vehicles could 'frustrate existing feelings of efficacy, self-identity, and sense of belonging with the private car, and may lead to a reevaluation of alternatives,' implying that the users would have less psychological ownership towards AVs.

Independent ownership does possess access qualities that strengthen the feelings of ownership one would have towards the AV, however. An argument could be made that when one goes through the hoops of fixing, modifying, or customizing their AV, due to the amount of time they spend with the vehicle, they will be more likely to feel ownership of the vehicle. Though, the line where the frustration and work increases or decreases the ownership associated with a vehicle would differ from individual to individual.

Another aspect that could strengthen feelings of ownership in a car due to access is the comfort the vehicle could provide through access to various entertainment and work alternatives provided within. If a privately owned vehicle would allow the user to use whichever services they wish for work or entertainment, this freedom could insinuate a sense of comfort, which bolster feelings of ownership one could feel towards an autonomous vehicle (Jussila et al., 2015).

Privacy

One would assume that the data collected in a privately owned vehicle would be mostly private. However, the current climate regarding data suggests otherwise. If AVs will become like phones, tablets, computers, and many other tech devices that are privately owned and used in our day to day lives, then personal data collection is likely to be baked into these vehicles. The expectation that a vehicle one owns would choose to protect their privacy is likely to be more detrimental than not if private data collected is shared with many others.

Currently, privately owned autonomous vehicles collect a lot data. As an example, Tesla collect information from one's speed, braking habits to internal and external video feeds of each one of their vehicles. This data, then, may be used to suggest maintenance, roadside assistance, as well as provided to business partners for additional services (Muller, 2019). While users have options to opt out of some of the data collection, they are not able to do so fully. On top of this, a research done by McKinsey suggests that big data from vehicles could be a $750 billion dollar industry by 2030 (DeBord, 2016), suggests that data collection and selling on even independently owned vehicles will be common.

Anecdotally, conversations with potential young buyers of vehicles indicate opinions regarding data collection in privately owned vehicles from users is conflicting. Even the users do not have a clear definition of what would be ok and believe the government regulations should be followed. However, it was suggested that any amount of data collection from a privately owned AV others than to improve the AV's capabilities and would make the user feel less secure – especially if the data is being sold or used for marketing purposes – hence, lower the user's psychological ownership of the vehicle.

Discussion

The research reveals that the clause of "private ownership" is not set in stone. While it seems like a familiar and easy definition, there are many ways the clause can have differing styles of ownership within it. As an example, the personalization, use, and store an autonomous vehicle under physical ownership seems like areas that would not be altered much. After all, one legally owns the vehicle, and they *would be expected* to have rights to adjusting it. Yet, much like in access, manufacturers could argue that the software of the vehicle would perform best if the vehicle were left intact and would follow the manufacturer's indicated specifications. Considering that, even now, vehicles can remotely lose access to features if the manufacturer does not condone the actions of the owner, the expected usability and personalization of a privately owned autonomous vehicle could change.

To make the correct decision on what should be changed and implemented, there is an essential factor to consider: the software. Software will seem to be an integral part of future AVs since the vehicle will be driven by a software rather than a human being. The real question is who owns the software once a vehicle is purchased – is it still the manufacturer or is it the user? This would define how physical ownership and access could differ in implementations. Additionally, the ability of the user to customize the software or utilize a different software than the one manufacturer provides with the vehicle should be considered. There could be safety concerns raised upon how customizable software should be due to how it may make a vehicle malfunction, but assuming that there are regulations in place that force vehicle software to be over a given 'safety limit' should the user be able to customize the software however they wish. If the user owns the physical vehicle, shouldn't they be able to change the software that comes with it for one that is still safe but resonates more with them, which could increase psychological ownership.

There isn't a single way to use an autonomous vehicle either – there could be other usage scenarios that users may have access to. The exact opposite of private ownership would be a ride-hailing model similar to what Uber and Lyft provide currently. This model is argued to be more efficient, cost-effective, and sustainable than the private ownership model (Motavalli, 2020), where

ownership is not expected but could be built for higher utilization of the service. Each user would request the ride from a designated vehicle for a designated location. The user only pays for the expense for the ride rather than paying for the servicing and fuel costs for the autonomous vehicle.

In this usage case, the strongest aspects of physical ownership would be lacking as the user does not physically have access to the same vehicle all the time as the vehicle changes on what is available at the time. The vehicles could provide some amount of customization by providing different classes of vehicles and would likely have high amounts of temporal control as the user can summon a vehicle whenever. Main fall-off occurs with the lack of proximity and memories associated with a single vehicle: the user won't associate personally with the vehicle they're receiving which would make them feel low amounts of ownership towards the ride-hailing AV.

Access is an area where ride-hailing vehicles could shine, keeping in mind that users will be aware of the limitations of vehicle modifications. Users are not the decision makers in how the vehicles will be serviced and maintained as the companies will cover these costs. While this could decrease psychological ownership as the user will spend less time trying to keep the vehicle in a shape they would enjoy, there is an argument to be made for brand royalty. Brand ownership has been associated with psychological ownership of brand's products (Chiang et al., 2013), which implies that when companies maintain vehicles well, users would have an increased brand ownership and in return have higher psychological ownership of the AVs. Furthermore, users would likely not be bothered by various lack of features unlike in private ownership as the user does not 'legally' own the vehicle, which could reduce negative feelings associated with AVs.

Privacy in the ride-hailing use case is less pronounced. Currently, Uber collects all sorts of data about its users and aims to control urban transportation data, which could be considered predatory. Anecdotally, potential young users of AV ride-hailing services indicated they would expect less data from the vehicle would belong but were not able to define the extent of this lack of ownership. Needless data collection and usage was looked down upon even in the ride-hailing model which could negatively affect one's ownership towards an AV and the ride-hailing company.

The differences between private ownership and ride-sharing use scenarios could be summarized as follows:

	Physical Ownership	Access	Privacy
Private Ownership	+ Personalization + Temporal Control + Proximity and Time ~ Monetary	~ Repairs and Service ~ Modifications + Personalized entertainment	~ Data Privacy ~ Data Ownership
Ridesharing	~ Personalization + Temporal Control - Proximity and Time + Monetary	+ Repairs and Service ? Modification + Personalized entertainment	~ Data Privacy ~ Data Ownership

Conclusion

The results of the study indicate that private ownership of AVs could still possess high amounts of psychological ownership associated with it due to physical ownership factors. In contrast, access and privacy are concerning for one's psychological ownership of AVs as these are ownership fields where the implementation of software and technology could take power away from users/owners. While some loss of power could be acceptable, a good medium must be found through further studies where the AV is competent without making users lack ownership of it. This is imperative as ownership seems to play an important role in one's willingness to use AVs, though it is not the only factor that is important in a user's decision to utilize the technology (Lee et al., 2019).

Private ownership is not the only usage scenario for AVs. Ride-hailing was briefly discussed as a more cost effective and efficient alternative to private ownership, though, with a lack-luster psychological ownership factor. Usage scenarios between these two models should be explored such as vehicle subscription models like Porsche Drive and Care by Volvo where users are able to 'rent' any kind of AV they wish and keep it within proximity as long as they pay the monthly fee with the ability to customize the type and looks of the vehicle as they wish. Exploration of such a usage method could determine an intermediate solution which combines the efficiency and effectiveness of ridesharing with the psychological aspects of private ownership.

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