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RESEARCH ARTICLE

Automated Vehicles and Transportation Justice

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Abstract Despite numerous ethical examinations of automated vehicles, philosophers have neglected to address how these technologies will affect vulnerable people. To account for this lacuna, researchers must analyze how driverless cars could hinder or help social justice. In addition to thinking through these aspects, scholars must also pay attention to the extensive moral dimensions of automated vehicles, including how they will affect the public, nonhumans, future generations, and culturally significant artifacts. If planners and engineers undertake this task, then they will have to prioritize their efforts to avoid additional harm. The author shows how employing an approach called a "complex moral assessment" can help professionals implement these technologies into existing mobility systems in a just and moral fashion.

Keywords Automated vehicles · Transportation justice · Moral prioritization · Complex moral assessment

1 Introduction

To fully understand the moral dimensions of automated vehicles (AVs), we must think about them in their (future) socio-political contexts from city streets to suburban cul-de-sacs. Examining their inherent qualities cannot tell us how or if AVs will actually have positive or negative effects on a city's inhabitants. Yet, when surveying the current AV literature, this focus accounts for much of the scholarship. For example, several of the initial moral inquiries into AVs used thought experiments to address how they would respond in the event of a crash, along with arguments addressing responsibility and decision-making algorithms. Recent research efforts advance these discussions, but they remain close to the original lines of questioning inherent qualities.

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While these works provide insights into the possible problems that AVs could bring, they tell us little about how they will influence qualify-of-life issues or how to deal with them in everyday settings for actual people in varying socio-political situations.[1] This topic is of paramount importance because transportation can disproportionately harm vulnerable people.[2] Neglecting to investigate the subject discounts its significance, implicitly saying that imaginary lives matter more than black, brown, and senior lives do. Correcting this oversight entails giving the topic attention and recognizing the imperatives that underpin it. For instance, issues such as helping poor people escape poverty, preventing the elderly from facing lonely deaths, and restoring integrity to fragmented and alienated communities are all critical aspects of the political dimensions of AVs.

I argue that these kinds of considerations should weigh heavily when it comes to how AVs are introduced into society, suggesting that moral prioritization is a problem that AV researchers, engineers, and planners must face. The point is not that there is something inherently wrong with these technologies, but we have moral obligations that carry different degrees of importance that determine who or what receives moral consideration, along with stipulations for how they receive it. In addition to vulnerable groups and the public, technologies also impact the nonhuman world and future generations, as well as historical and cultural artifacts. I argue that all of these entities deserve consideration, but they do not equally warrant it. To approach these kinds of multi-tiered issues, I employ a "complex moral assessment (CMA)," a guide for addressing situations that involve several kinds of moral considerations.

To understand how employing this measure contributes to the AV literature, I explore representative works that speak to the points above, identifying the void that this work fills. Next, I examine how these technologies could mitigate or exacerbate social and environmental harms. To address these concerns, I show how employing a CMA to deal with moral prioritization when implementing AVs into existing transport networks could alleviate hardships and promote a just society. In closing, I suggest some steps that municipalities could take to achieve such outcomes.

2 An Abridged Review of the Philosophical Literature on Automated Vehicles

Proponents of AVs hold that these technologies will reduce traffic fatalities and carbon emissions (Grunwald 2016). In turn, several US government agencies are adopting preemptive policies that support the development and implementation of AVs. For instance, Nevada was the first state in the USA to draft policies to encourage safety measures, and since then 12 other states have followed suit (National Conference of State Legislatures 2017). Nationally, the U.S. Department of Transportation's National

[1] Most of the examples in this paper are from the United States of America (US).

[2] The term "vulnerable" in this context includes people who exclusively depend on transportation services or who are suffering or who would suffer if such services were removed from society due to lacking a realistic alternative. This conception includes but is not limited to differently abled individuals, marginalized groups that have been historically and or systematically discriminated against, and senior citizens who lack no other means to travel. I expect that there are also outlier instances that do not perfectly fit within the description above. Such cases will require additional assessment.

Highway Traffic Safety Administration released the Federal Automated Vehicles Policy in 2016, which included guidelines for designing, testing, and introducing AVs, along with policy recommendations for states and some ethical guidelines (US Department of Transportation 2016).[3]

While these considerations cover much ground, ethicists have advanced several other concerns, exhibiting the depth of such issues. Initial worries focused on AV's algorithms that will "make decisions" in the event that a crash is imminent. For example, early arguments in the AV literature appealed to the classic moral puzzle known as the trolley problem (Achenbach 2015; McFarland 2015; Lin 2016).[4] In this thought experiment, a runaway tram (trolley) rushes toward five people on the tracks (Foot 1967). You are next to a lever that can divert the trolley, but doing so would kill a person who is on another set of tracks. Do you kill one person or let five die? Applying the thinking behind this thought experiment to AVs, one sees the trouble that some programmers face: in the unlikely event that the car must "choose" between killing five people or killing the driver, what should happen and why should it be that way?

Moral philosophers have thoroughly explored this issue based on or inspired by this kind of hypothetical thinking, from theoretical underpinnings to real-world applications. For example, Gerdes and Thornton (2016) want to extend utilitarianism and deontology to AVs, maintaining that they should minimize harm while aiming to avoid hitting individuals. Gogoll and Müller (2017) raise questions about the possibility of AVs having mandatory or personal ethics settings. They argue that the latter would result in a prisoners' dilemma, suggesting that we give control of the issue to a third party. Robert Sparrow and Mark Howard (2017) make the case that when AVs become commonplace, it should be illegal for humans to operate motor vehicles because we would be driving like "drunk robots."

de Sio (2017) develops an approach based on the doctrine of necessity to address cases wherein drivers intentionally damage people and property to avoid calamity. Going beyond the academy, Mercedes-Benz (Taylor 2016) takes a stand on the issue, asserting that the likelihood of saving the driver is extremely high compared to people outside the vehicle; therefore, their car should always aim to save the driver. Even though many of the cases above garner substantial attention, Brooks (2017) argues that such scenarios count as extremely impractical outliers, making a strong case against researchers giving them substantial attention. This view holds that when AVs become an ordinary part of the cityscape, engineers will have resolved such issues, and AVs will be safer than human drivers. Lin (2017) counters Brooks, holding that engineering education requires that these kinds of instances receive attention to prevent catastrophes. Engineers must discuss fringe cases because they are the kind of instances that they aim to eliminate (ibid.).

[3] It is worth mentioning that the current administration favors industry, meaning that their guidelines for AVs do not make the same room for ethical considerations. For example, see: https://www.technologyreview.com/the-download/608859/new-driverless-car-guidelines-dont-provide-much-guidance/.

[4] It might be useful to think about this issue in the context of robot ethics. See: Wallach and Allen (2008). *Moral Machines: Teaching Robots Right from Wrong*. New York: Oxford University Press. Also there is a critical account of the trolley problem for AVs that deserves attention; see: Nyholm and Smids (2016). The Ethics of Accident-algorithms for Self-driving Cars: An Applied Trolley Problem?. *Ethical Theory and Moral Practice*, 19(5), 1275–1289.

While the arguments presented in this section largely address the nuances of responsibility from an ethics-of-design point of view, the next step should focus on integrating these technologies into society. Undertaking this measure means expanding the scope of moral inquiry to include AV's broader social impacts, focusing on the city. These steps should explore how these technologies will improve daily life for all city residents, the kind of city that they could help shape, and how to deal with problems that arise when they conflict with beneficial infrastructures, services, nonhuman others, and historical and cultural artifacts. These discussions require examining the full range of effects that driverless vehicles could bring, which surface in the following sections.

2.1 The Social Context of Automated Vehicles

While the arguments above examine the inherent moral dimensions of AVs and some implications for social and policy concerns, the next phase of study should investigate the effects that they will have on society. In this regard, much headway has been made in terms of how AVs will reshape social structures. For example, Fraedrich et al. (2015) advance our understanding of this topic, focusing on the sociotechnical dimensions through discussing how AVs could reshape the future of mobility. They explore different scenarios wherein AVs become part of mobility systems, identifying aspects that could help or hurt AV's future role in transportation networks (ibid.). For example, they point out that supporting infrastructure and policies will have to change to include AVs, and users will have to alter how they deal with new traffic patterns (ibid.).

Since this assessment, several other papers have emerged that concentrate on how AVs will change society (Maurer et al. 2016). These investigations address numerous topics, including but not limited to security, land use, traffic control, freight transport, and economic risks (ibid.). While listing every way that AVs could reshape society is unreasonable, examining areas that will affect vulnerable groups should be of interest to justice scholars. A goal of examining AVs in this manner is to discover principles that can eliminate or prevent harm, efforts that favor social justice. Undertaking this task requires moving away from relativistic notions that one would expect to find when examining mobility systems in different cultural settings. This does not entail that we must discover moral absolutes that pertain to transportation infrastructure, but working toward that goal will increase the certainty that supports such decisions. Although each city has unique elements that come into play when examining its mobility system with regards to social justice, there is enough common ground to have a conversation that is relevant to numerous urban centers.

For example, several grassroots organizations are fighting for transportation justice across the USA. These groups include OPAL and Bus Riders Unite in Portland, Oregon, Urban Habitat in the San Francisco bay area, On The Move in Boston, UPROSE in New York City, ACCE Riders for Justice in Oakland, and the Rainier Beach Transit Justice Project in Seattle.[5] While these groups fight against the unequal distribution of services and treatment of riders, several quality-of-life issues motivate

[5] OPAL, http://www.opalpdx.org; Bus Riders Unite, http://www.opalpdx.org/bus-riders-unite/; Urban Habitat, http://urbanhabitat.org; On the Move, http://bostononthemove.org; UPROSE, https://www.uprose.org; ACCE Riders for Justice, http://www.acceaction.org/oakland; Rainier Beach Transit Justice Project, http://www.rbcoalition.org/rainier-beach-transit-justice-youth-corp-completes-metro-mural-their-latest-project-to-better-our-community-transportation-wise/.

users to take action. For example, Bullard and Johnson (1997) shows that transportation affects every aspect of people's lives, from daily activities such as visiting the doctor and buying groceries to getting to work and spending time with friends and family. Due to the overwhelming sense of familiarity that accompanies these tasks, they do not immediately appear to be contemporary moral issues or concerns for justice, but further examinations show otherwise. For example, transit riders in Portland have seen bus services in poor neighborhoods decrease while services in affluent areas improve (OPAL 2012). In Brooklyn, UPROSE fought to restore bus service to the B37 line, a route that provided much needed transportation to elderly, young, disabled, and infirmed residents (Katinas 2014).

Additionally, studies show that inefficient (or lack of) transportation is the primary obstacle for people trying to escape poverty (Bouchard 2015). Understanding transport's far reaching effects means that we must view mobility services as they connect to issues such as housing, labor, and food security. Through using these lenses, we see how decisions that govern transportation are subject to moral scrutiny. Specifically, the issue is not just about the fair and equitable distribution of harms and benefits of transport infrastructure, but it is about how it hinders or enhances the quality of people's lives. When introducing AVs into population centers, acting morally and justly demands that one must investigate how they will positively or negatively affect existing social arrangements. I examine some of these elements below.

3 Automated Vehicles and Challenges to Justice

Perhaps the most pressing issue that has not received sufficient attention in the literature is how AVs will affect vulnerable groups. Through heavily focusing on theoretical problems, researchers inadvertently ignore the need to alleviate harms that current forms of transportation infrastructure can inflict. In turn, we lose an opportunity to discover how transportation-related barriers that hinder economic and social advancement remain in place, perpetuating oppression. Through investigating current transportation systems, we see the difficult conditions that dependent riders face.

In the USA, for example, groups that solely rely on transport systems struggle to find jobs, meet their needs, and they must allocate a significant sum of their income for travel. (Deka 2004; Fol and Gallez 2014). Due to these difficulties, they often sacrifice time that would be spent with family (OPAL 2012). Although the conditions affecting vulnerable groups differ across cities, for some metropolitan areas, mobility systems burden numerous residents. For instance, 70% of people in the USA can travel by some form of public transit, but 39 million residents do not have access to such services. (Tomer et al. 2011). Across all urban centers, recent feasibility assessments show that workers can only reach 30% of jobs within 90 min of travel time (ibid.). While these services are beneficial, it seems reasonable to challenge the idea that spending 3 h per day in transit is acceptable.

One could argue that lengthy commutes and travel times should motivate people to buy cars so that they would not have to endure the burden of inefficient public transit. This situation is a "transportation catch-22," meaning that poor people who cannot afford to purchase a vehicle must buy one to overcome the problem of not owning a vehicle (Epting 2016b). While this feat is attainable, residents must endure long trips

until they can overcome this hardship or until planners can ameliorate such matters. To improve these travel times, one would assume that municipalities would have to make services more efficient and effective through dedicating costly resources. Instead, there is a noticeable trend of cities opting to subsidize transportation network companies (TNC) to meet residents' mobility needs (Grabar 2016).[6] In several instances, cities rely on TNCs (e.g., Uber and Lyft) to help residents travel the "last mile" between bus/train stop and their residences, usually in suburbs or metropolitan fringes (ibid.). Presently, these companies employ human drivers, but their goal is automation (Bhattarai 2016).

While such measures provide a stopgap, municipalities should have reservations about relying too much on TNCs. The argument against subsidizing ride-sharing companies proposes that if cities focus their attention on subsidizing them, then their efforts would take away from improving public transit services (Grabar 2016). Champions of AVs neglect to consider the fact that driverless cars will still require upkeep of roads, along with any possible smart infrastructure that is necessary for safety and efficiency. Expenditures for existing public roads cost billions each year in the USA (US Department of Transportation 2017). One would expect that making them smart would significantly increase costs. Due to such high expenses, exploring new transportation options might not be feasible for cities. In turn, mobility networks receive a digital upgrade, but the system remains intact without introducing any additional alternatives.

Although this solution has short-term advantages, there is a problem: embracing measures that preserve a "transportation monoculture" will not alleviate the social justice problems mentioned above. In addition to future concerns, planners and engineers could lose motivation to research and develop alternative forms of transit that could alleviate hardships. Devoting public monies for TNCs does not establish a permanent, reliable, and predictable service. Unless regulated, TNCs could exacerbate matters. For instance, researchers such as Eugensson et al. (2013) offer a vision of the future wherein on-demand AVs cruise the city streets, delivering users to their destinations. Due to the communication networks shared by AVs, congestion problems will lessen or vanish (ibid.).

One problem with this view is that unless municipalities regulate AVs, there is no guarantee that they will not saturate the market, worsening congested roadways. Examining the current state of TNCs, this problem has already emerged in San Francisco (Rodriguez 2016). Presently, there are 45,000 TNC drivers on the city's streets, and officials are concerned that they are contributing to the city's enervating congestion (ibid.). Keeping this point in mind, arguments that champion ubiquitous AV ownership and service to combat congestion seem ill conceived, considering that traffic conditions could worsen.

Bagloee et al. (2016, 288) exhibit the unsure-yet-confident nature of predicting AV's abilities to improve traffic congestion: "Consequently, it is crystal clear that AV technology will soon have a positive effect on traffic congestion abatement unless it induces additional demand that in turn might add further burden to an already congested network. The overall impact of the AV on traffic congestion has yet to be investigated." Although this passage seems paradoxical, it suggests that effective

[6] The California Public Utilities Commission coined the term "Transportation Network Company." See http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M077/K112/77112285.PDF.

regulations could produce uncongested streets. If this is the case, then AVs could improve urban travel. However, they could also create additional traffic, a situation that could worsen the problem.

Along with these concerns, there are other issues to address. For instance, Grunwald (2016) argues that AVs can provide the elderly with access to mobility, and therefore support social justice. While this is a good point, he gives the impression that AVs are the only option. This view neglects to consider that seniors not only have difficulties being mobile, but they also suffer from loneliness. This condition is becoming a public health crisis (Cornell and White 2009). Although it can affect any person, situations such as social disconnectedness and perceived isolation are serious health conditions that largely afflict seniors (ibid.). AVs take seniors away from their homes to run errands, but research shows that traveling by car increases social isolationism, and there is no reason to suspect that AVs will alter this effect (*ibid*).

An optimal solution would provide seniors with mobility in a manner that does not increase social isolationism. Improving public transit services could yield favorable outcomes, but municipalities must invest in research, design, and upgrades. It could be the case that subsidizing public transit with TNCs could be an optimal solution, but for the long-run, it seems wise to invest in exploring a city's options rather than assuming that subsidizing TNCs is the only option. These issues illustrate that using public monies for AVs should come with some reservations, but such hesitations should not hamper the excitement behind AV technology. While the points above address possible problems that could arise from implementing AVs into transportation networks, the point is not to rally against their future presence on city streets. On the contrary, there are several positives, and investigating how AVs can alleviate such harms make this notion apparent. In the next section, I will explore these benefits.

4 Automated Vehicles and Dimensions of Justice

Implementing AVs into existing mobility systems provide planners with an opportunity to relieve social and environmental hardships. For example, poor people who live next to highways and busy roads suffer from respiratory illness while commuters who travel on them do not (Lazarus 2001; Maantay 2007). This is the reality for minorities who live in the urban core of Atlanta and in the Bronx (Lazarus 2001; Maantay 2007). If future AVs are electric, then harmful auto emissions that contribute to unwanted health impacts will diminish.[7] Such outcomes would show that AVs are a solution to the dangerous emissions associated with traditional vehicles, effects that disproportionately harm poor residents.

In addition to these predictions, proponents of AVs argue that these technologies will have a positive effect on the environment. For example, Wadud et al. (2016) argue that while AVs cannot inherently reduce greenhouse gases, designers and policymakers can facilitate a shift that supports needed efforts. To be highly effective, this process would

[7] There is good reason to argue that the majority of AVs will be electric. For more information, see: Securing America's Future Energy (2017). SAFE Analysis Shows 80 Percent of Light-Duty Autonomous Vehicles Use Alternative Fuel Powertrains. http://secureenergy.org/press/safe-analysis-shows-80-percent-light-duty-autonomous-vehicles-use-alternative-fuel-powertrains/. Accessed 4 July 2017.

go beyond passenger vehicles to include automated trucks that transport consumer goods (ibid.). Although replacing traditional vehicles with AVs will be a piecemeal process, some estimates show that 90% of all commercial automobiles will be automated by 2055 (Greenblatt and Shaheen 2015). Other predictions maintain that nearly all new passenger cars will be fully automated by 2030 and that non-automated vehicles will mostly be prohibited by 2040 (Levinson et al. 2016). Considering all of the combined efforts of replacing passenger and commercial vehicles with energy efficient AV models, overall greenhouse gas emissions from transportation should eventually reduce by 90% (Greenblatt and Shaheen 2015). With these topics in mind, increased energy efficiency and the associated decrease in harmful emissions hold steady as the primary environmental benefits for AV technologies.

Although these reasons are good motivations for advancing AV technology, engineers and planners should take measures to ensure that they support social justice. To carry out this daunting task, I suggest the use of a complex moral assessment to introduce these technologies into built environments in a manner that supports such measures. In the next section, I examine how to use a complex moral assessment to guide this process.

5 Complex Moral Assessments of Automated Vehicles

Considering the impacts that AVs could have on cities as mentioned in the previous sections, we see how their scope of influence goes beyond trolley-inspired situations. Implementing AVs in today's cities could affect vulnerable people, and they will also affect the public, nonhumans, future generations, and historically and culturally significant artifacts. Each of these groups deserves consideration for different reasons, but they do not equally require it. I argue that we must act so that the groups in the above queue receive consideration in the order that they are presented. Yet, there are exceptions wherein we must give consideration to other groups in the short-term because doing so respects the order in the long run. This is the problem of moral prioritization as it pertains to bringing AVs into cities. Working towards a just solution to this problem means that we must weigh considerations so that we do not give too much attention to one group so that other groups are disproportionately affected.

In various forms, this problem reappears throughout the history of philosophy. For instance, Sartre (1948) gave the example of the man who had to choose between staying with his mother or fighting in World War II. While he had an obligation towards her, he had a greater obligation to his country. In turn, he chose to go to battle because his obligation to his country (which in a broad sense included his mother) overrode his immediate duty to his mother (Callicott 1999). Shrader-Frechette (1996) develops a similar approach to address issues between human and nonhuman interests, coining the term "hierarchical holism" to provide an elementary account of moral prioritization, and Callicott (1999) endorses a similar measure. When it comes to cities, these environments have numerous historical and cultural artifacts that count as a new category that requires consideration.

Elsewhere, I introduced the concept of a complex moral assessment (CMA) to address moral problems in urban affairs. (Epting 2016a, b; 2017). Essentially, a CMA says that if we fail to properly act so that we give the groups in the above queue the

respect that comes with such actions, then we are inappropriately acting (Epting 2017). For instance, if we were to implement AVs into transportation systems only to help an endangered species, then any outcome that would harm vulnerable people or the public would be a moral upset, unless one could explain how shaping a transport system on "nonhuman species x" is in the long-term interest of vulnerable people or the public while outweighing short-term disadvantages.[8]

While the queue above generally counts as a standing order for dealing with affairs that have several groups that require consideration, it is not absolute. CMAs can be designed for particular purposes, and developing one for addressing concerns that arise when making room for driverless vehicles perfectly illustrates this point. This approach is beneficial because it lets us identify how incorporating AVs into population centers will help or harm different groups. Bearing in mind that cities differ, a CMA geared toward an issue in one city might not work well for the same issue in another municipality. Consider, for example, the kinds of problems that one might expect to find if they were to add separate traffic lanes for AVs in an ancient city. If historic buildings were to be demolished to include these new infrastructures, then we would have to make careful assessments of these situations to determine the morally optimal solution, and a customized CMA would have to be developed. When dealing with a concept city similar to Masdar City wherein there are no historic buildings, it would require a drastically different CMA, one that would exclude this group in the queue (Lau 2012).

The reason why vulnerable populations deserve first place in the queue is because in most instances they are already facing challenges within the existing transportation system, as seen in the previous section. While these populations deserve consideration based on topics such as historical injustice, systematic discrimination, and essential needs, their status as "vulnerable" means that they are subject to suffering through the effects of transportation infrastructure wherein other populations, the (non-vulnerable) public, are not.

Making accommodations for AVs that would benefit the public while vulnerable people continue to struggle with transport needs implies that it is better for people who already have a good means to mobility to gain an improved option than it is to relieve vulnerable people's mobility burdens. In turn, you have a case wherein the minority suffers while the majority benefits. We need not look any further than basic objections to utilitarianism to show why this is problematic (Driver 2014). Hence, keeping vulnerable groups at the front of the queue is a morally defensible position. In turn, when implementing AVs and the supportive infrastructure that they will require into cities, steps should be taken to ensure that their mobility needs are met. To put it briefly, if we have the ability to vastly improve mobility through AVs, then we can figure out (1) how not to let this improvement harm vulnerable people and (2) develop a solution that includes them.

Turning to the next group in the queue, a case should be made showing how to introduce AVs in a manner that benefits the public. Bearing in mind that these technologies are expected to decrease traffic-related incidents and improve travel time, then advocating for them does not require a lengthy explanation. However, we must address the tension between considerations for the group and considerations for the

[8] For an in-depth examination about moral responsibility in such cases, see Epting 2016a

individual. For instance, some cities will have to deal with labor concerns, meaning that while AVs benefit society in the aforementioned ways, they will also displace workers (McFarland 2017). There is also the notion of social identity that is enmeshed within driving culture, an element worth exploring (Edensor 2004; Sangster 2017). While this list of potential issues is non-exhaustive, it shows the kind of concerns that AV researchers need to anticipate when addressing the broader impacts that these technologies will have on society. Due to the unique composition of each city, developing a good CMA will require a site-specific approach that can cater to each municipality.

In addition to considerations for the public, environmental impact assessments (EIA) can help determine how AVs might affect individual nonhuman species and ecosystems (US EPA 2017). Making this case means examining the grounds for such a claim, wherein research from environmental philosophy serves us well. Consider, for example, that environmental ethicists hold that there are two primary ways to ground arguments for the consideration of the nonhuman world (Callicott 1999; Hargrove 1992). On one hand, there are reasons that rest on instrumental value, meaning that humankind ought to care for nonhuman life because we use it (Hargrove 1992). On the other hand, there are also arguments that go beyond this view, intrinsic value arguments, and these positions hold that the nonhuman world deserves moral consideration for its own sake, aside from any question regarding instrumental value (ibid.). Along with nonhuman life, this view can also apply to nonhuman, nonliving entities such as caves (ibid.).

Here is a brief sketch to elucidate this point. Library scientists have made a case wherein historically significant documents should not be destroyed, despite having preserved their instrumental value through making reproductions (Westney 2007). Consider, for example, that there are numerous copies of the US Constitution. Its instrumental value is preserved. If we were only concerned with this kind of value, then people would not have any good reason to want to hold on to the original, at least that is the line of reasoning. In turn, this sort of view applies to the nonhuman world when defending its right to exist. The problem with appealing to this element rests with its limits. That is to say, how can we establish criteria for sacrificing nature in order to respect the queue while keeping the intrinsic value of the nonhuman world firmly in view?

This inquiry suggests that when addressing concerns for the nonhuman world while planning for AVs and their infrastructure, employing an EIA would help determine how to introduce them in a manner that pays attention to the intrinsic value of the nonhuman world. Again, due to the particular ecological circumstances of each city, a case-by-case assessment is required. Considering that future humans will require nature for its *instrumental* value, (aside from intrinsic value), they must come after nature in this queue.

Lastly, in the same manner wherein intrinsic value can apply to caves and historical documents, it also applies to historical and culturally significant artifacts, especially considering that new AV infrastructure could impact them. Recent research in the preservation of historical artifacts shows that such topics are ripe with numerous ethical entanglements (James 2015; Matthes 2016). For example, if cities were to build separate roadways for AVs, then such a use of land could require that historic buildings need to be demolished. Aside from this context, however, the problem with this view is that everything that is an artifact could have this kind of value, suggesting that a case could be made against any sort of technological upgrades to the city (Epting 2017).

The worry is that the people who would be planning for AVs might not be able to identify with the historical or cultural significance of such artifacts. Environmental justice scholars such as Figueroa (2006) argue that failing to include marginalized people's voices in the policy decisions that affect them is unjust. It does not take much effort to extend this line of reasoning to other people who have cultural or historic claims on artifacts. One remedy is for municipalities to set up meaningful participatory processes that would support public justice (Barber 1984). While such approaches fall outside of planning norms, recent advances in research on restorative justice hold promise, and such an approach can also philosophically ground a CMA.

This suggestion deserves further exploration because CMAs align well with restorative justice's pluralistic framework. Sadly, the philosophical literature largely neglects the theoretical underpinnings of this approach (Walker 2006). However, researchers in criminal justice have laid the foundation in a manner wherein we can use its structure as a guide to address problems that share similarities such as offenders, victims, and society, but it is not fitting to think about them within a context of criminality. Consider, for instance, that scholars engaged in research on restorative justice define it as a process wherein stakeholders who have been affected by an injustice can discuss how the unjust act affects them, along with having the ability to weigh in on the decisions that concern setting things right, and it includes provisions for the future. (Braithwaite 2004).

Restorative justice is not concerned with how to achieve justice solely based on the idea that people should receive what they deserve, but it examines power-based relationships to fulfill each parties' needs (Johnstone 2013). Through using such an approach, addressing problems in transportation justice include issues such as the distribution of harms such as pollution, along with benefits such as convenience, efficiency, and safety. Dealing with these concerns also involve the ability of people who have been harmed to have a voice to determine the conditions for setting things right, along with issues that could impact their lives in the future.[9][10] Keeping in mind that the primary group that receives consideration in a CMA are vulnerable populations, employing an approach that is consistent with the principles of restorative justice can provide a way forward for cases that are dissimilar. In the final section, I explore some of the ways that municipalities can explore to usher in the implementation of AVs in a manner that makes use of these insights.

6 Situating Automated Vehicles in Mobility Systems: The Way Forward

Despite the moral challenges that remain embedded within approaches to incorporating AVs into existing mobility systems, engineers and planners must deal with the "real world." Walker (2009), for instance, notes that transit planners are not advocates of certain modes of transport. Instead, they focus on the task of moving people. Yet, the

[9] For a detailed account of restorative justice, see: Gavrielides, T. and Artinopoulou, V. (2013). *Reconstructing Restorative Justice Philosophy*. Burington, VT: Ashgate.

[10] To get an idea of the breadth of topics that fall under transportation justice, see: Martens (2016). Transport justice: *Designing fair transportation systems*. Routledge. Also, see: Attoh (2012). The transportation disadvantaged and the right to the city in Syracuse, New York. *The Geographical Bulletin*, *53*(1), 1. Also, see: Epting (2016b)

character of their profession entails that they are tacitly advocating for people, and this practice could entail supporting transport modes that favor moral prioritization, efforts that could improve the quality of people's lives. Bearing this point in mind, their work makes a moral statement, even if they are not cognizant of it.

If we examine recent advancements in transport thinking that could help eliminate the hardships explored in this essay, multimodal systems can play an important role (King 2014; Fields et al. 2013). By definition, such diverse networks go against transportation monocultures. Through including several mobility options such as mass transit, bicycle lanes, and pedestrian walkways, multimodal systems provide users with options that can alleviate harms associated with limited means of mobility. Multimodal systems have an inherent orientation that can facilitate an adaptation when required. This feature suggests that including an additional means of mobility such as AVs should not fundamentally disrupt its operations. Instead, the modes of transportation would have to merely adjust, and planners can use an additional means to complement other kinds of transport. If planners keep this idea at the forefront of initiatives, then they can adjust mobility systems when dealing with problems of moral prioritization.

Considering that mobility systems will continuously change, these conditions require planners and engineers to hold an outlook wherein they must constantly employ different measures to complete varying tasks. Perhaps the biggest challenge, however, is to include elements of social justice such as participation into the purview of "best practices" for urban mobility because such ideas challenge established practices.[11] Yet, working toward justice demands such measures. For example, Mitcham (1997, 272) argues that engineers must expand their mindset to include additional aspects to account for the conditions found in reality, "duty plus *respicere*." This notion applies to those professionals who will bring AVs into mobility systems that have different social, political, and environmental characteristics. Yet, being mindful that cities continuously change, their work is never done.

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[11] For a recent discussion on best practices for transport, see: McLeod et al. (2017). Urban Public Transport: Planning Principles and Emerging Practice. *Journal of Planning Literature*, 32(3) 223–239.

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