Sharing, Electrification and Automation
3 REVOLUTIONS

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Policy Brief

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Active Transportation in an Era of Sharing, Electrification and Automation

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In November 2016, the Institute of Transportation Studies at the University of California, Davis (ITS-Davis) convened leading academic, government, private industry, and public interest stakeholders to explore science-based policies that could steer the three transportation revolutions- shared mobility, electrification, and autonomous vehicles, toward the public interest.

This policy brief reflects the opinions of the authors and not UC Davis. This brief is one in a series that presents a range of policy concepts, recommendations and research needs discussed at the Three Revolutions Conference.

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Summary

Revolutionary change is happening within and around active travel modes. Sharing and electrification of bikes, scooters, and skateboards could complement auto electrification, automation, and sharing. Prioritizing safety, implementing sustainable planning, and reinventing our built environment with bikes and walking in mind will ensure that active travel modes benefit from and in turn support the three revolutions.

Introduction

Addressing the needs as well as the potential of active travel modes is critical for integrating the three revolutions into our communities in a way that enhances their safety and vibrancy. This brief introduces key findings and a set of policy recommendations to address how the three revolutions in ridesharing, vehicle electrification, and automation are impacting and reinventing active travel.

Walking and bicycling are low-cost, low-polluting, and healthy ways to travel. Communities that invest in so-called active travel modes rather than gas-powered

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vehicles enjoy cleaner air, stronger economic growth, better access, and opportunities for people who don't drive.

People often mix-and-match active travel with other modes, especially in cities. For instance, an office worker might bike to a rail station, ride the train into the city, then walk to her office. New sharing services, both bike sharing and car sharing, make such "mobility integration" even easier. Active travel modes are critical components of the expanding suite of mobility options.

Electrification and automation, the two other revolutions in transportation, offer both opportunities and threats for active travel. Today's automated vehicles (AVs) still have trouble recognizing pedestrians and bicyclists, but if future versions allow cars to travel more closely together, they will create more space for sidewalks and bike lanes. Similarly, the quietness of electric vehicles is a safety hazard for active travel but also a benefit.

Background

Active travel plays an integral role in American communities.

Walking - Walking accounts for 10.4% of all daily trips in the United States and 0.7% of person miles traveled, according to the 2009 National Household Travel Survey (NHTS).[1] But these statistics understate the importance of walking, which is a part of almost every trip made, if only from a front door to a parking spot. Walking is especially important in high-density urban areas and as a way of getting to and from transit.

Biking - Biking accounts for 1.0% of all daily trips in the United States and 0.7% of person miles traveled, based on the same survey, but its share is growing dramatically in cities that have invested in bicycling infrastructure, such as Portland, San Francisco, New York City and Washington, DC. The share of workers who say they usually commute by bicycle in the most populous U.S. cities increased from 0.7% in 2005 to 1.2% in 2013 (Alliance for Walking & Biking 2016).

Findings

The implications of the three revolutions for active modes are both positive and negative.

Sharing - The vehicle sharing revolution is largely complementary with active travel and is likely to increase use of these modes as travelers choose from an expanded portfolio of modes rather than relying on their own cars. Residents of U.S. cities can rarely meet all their needs on foot or by bicycle. Vehicle sharing, whether in the form of car-sharing or ride-sharing, helps to fill the travel needs that walking and bicycling cannot, but they are less likely to engender reliance on driving than car ownership (Martin et al. 2010). In addition, because vehicle sharing services have the potential to reduce overall vehicle travel in a community, they can help improve conditions for pedestrians and bicyclists. On the other hand, ride-sharing has the potential to replace some bicycling trips, leading to more driving overall and negatively affecting public health. Recent research shows that walking and bicycling increase for some ride-sharing users but decrease for others (Pike et al. in progress). Shared fleets of AVs would help to reduce the possibility that AVs lead to increases in driving, which would at least partially offset the benefits of AVs for active modes.

Electrification - The advent of hybrid electric and battery electric vehicles, which are much quieter than conventional internal combustion engine (ICE) vehicles, raised concerns about risks to pedestrians and bicyclists who would not hear these vehicles approaching (e.g. Wogalter, et al. 2001). Evidence suggests that the concerns are justified: in one study, the odds of being in a pedestrian crash are 22% greater for hybrid electric vehicles than ICE vehicles (Wu, et al. 2011). On the other hand, these quieter and cleaner vehicles contribute to a more pleasant environment for active travelers.

Automation - AVs represent an opportunity for improving safety for active travel. AVs and precursor technologies

1 http://nhts.ornl.gov/det/Extraction3.aspx

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such as connected vehicles help compensate for driver inattention and error, a common cause of vehicle-pedestrian and vehicle-bicycle crashes. The protection of road users outside of vehicles has been an important goal in the development of AV technologies, but these efforts must address a long list of questions about the interactions between vehicles and active travelers (Parkin, et al. 2016), and detection of bicyclists is especially challenging (Riggs and Boswell 2016). If AVs are programmed to be risk-averse, pedestrians may behave more boldly, crossing streets where and when they want; this could help to create more pedestrian-oriented environments, but it would also slow the flow of traffic (Millard-Ball 2016). Ensuring adherence to speed limits is another way AV technology could improve the active travel environment.

AVs could also help to improve the environment for walking and bicycling in indirect ways. Because connected and automated vehicles will be able to travel safely at closer distances to each other, they will require less road space than the same number of conventional vehicles. If they reduce the total number of vehicles, the space savings are even greater. Cities can transfer this space to other users, for example, by widening sidewalks or installing protected bike lanes. This transfer of space would have the double benefit of encouraging active travel while capping the growth of vehicle travel. A reduction in the need for parking, or at least space devoted to parking, offers another opportunity to expand and improve active travel infrastructure and increase infill development. However, if automation leads to an increase in vehicle travel, as some researchers predict, and if this increase is not managed through pricing or other policies, then the opportunity to reallocate space may be limited.

There are revolutions happening within the active modes themselves.

Sharing - Sharing is already expanding the role of bicycling in the transportation system. More than 50 U.S. cities have installed bike sharing systems since 2010,[2] with yet more systems to come. These systems expand access to bicycles, especially when cities offer them to lower-income residents, and they may help to

2 http://nacto.org/program/bike-share-initiative/

Table 1. Implications for Active Modes of Three Revolutions in Vehicles

	Positives	Negatives
Electrification	Improves active travel environment owing to less noise and lower emissions.	Reduces safety when active travelers can't hear them coming.
Automation	Lowers crash risk BUT many technical issues remain to be worked out. Lowers crash severity IF used to limit speeds. Leaves more space for active modes IF driving doesn't increase.	Raises ethical dilemmas. Drop-offs could be safety issue for bicycles.
Sharing	Complements active modes for longer trips. Enables multimodal lifestyle and may reduce auto reliance and ownership. Improves active travel environment IF less driving overall.	Could compete with bicycling for some trips.

build a culture that encourages bicycling in general (Shaheen et al. 2010).

Electrification - Electric pedal-assist bicycles ("e-bikes" or "pedelec" bikes), widely used in China, are growing in popularity in the United States.[3] E-bikes go faster and require less exertion, thus expanding the viability of bicycling as a mode of transportation to more people (including older citizens), more trips (especially those to more distant destinations), and more places (such as hilly ones), though their high cost and weight may prove prohibitive for some users (Popovich et al. 2014). Electrification of bicycles as well as another active modes such as skateboards and scooters may expand the range of modes available but they also raise safety concerns when they mix with faster (driving) and slower (walking and conventional biking) modes. E-bikes can replace driving but also transit and other low-impact modes (Fishman et al. 2014).

Automated bike sharing – While self-driving bicycles are unlikely to catch on, some cities are considering "fourth generation" bike sharing systems (Shaheen et al. 2010) in which the check-out controls are built into bikes rather than docking stations. These systems would enable users to return bikes anywhere, making bike sharing more convenient for riders. Financial incentives can ensure an efficient distribution of the bikes across the city.

Policy Recommendations

To maximize the societal benefits of the three revolutions, policies should prioritize human mobility and community livability over vehicle mobility. Communities should be designed for people, not vehicles; AVs should serve the community, rather than the community serving AVs. The adoption of state-level policies could codify these priorities and require state, regional, and local agencies

3 http://www.navigantresearch.com/research/electric-bicycles ; https://blog.e-bikerig.com/2015/11/17/increasing-sales-of-electric-bikes-and-future-e-bike-trends-2014-2023/

Table 2. Three Revolutions in Bicycling

	Positives	Negatives
Electrification	Enables bicycling for more people (e.g. older) for more trips(e.g. longer, hillier, stuff/kids to carry, rural areas). Generates new mode options (e.g. electric skateboards).	May reduce physical activity. May not mix safely with other modes, e.g. pedestrians and e-bikes on shared-use paths. May compete with transit. High cost may be prohibitive for low-income households. Heavy weight reduces ease of storage, use with transit.
Automation BikeSharing	4th generation bike sharing reduces need for docking stations.	Bike costs are higher for service provider though capital costs are lower.
BikeSharing	Expands access to bicycles, e-bikes. Helps to build bicycle culture. Supports transit use.	Generally not feasible in low-density areas.

to reform auto-oriented planning processes to focus on human mobility and community livability. The following policies targeting the built environment, automated vehicles, and planning practices would help to ensure that active travel modes benefit from and in turn support the three revolutions.

Built Environment Policies

Strong "smart growth" policies help to mitigate the potential for AVs to increase suburban sprawl, where low population and employment densities work against both active travel modes and shared fleets of AVs. By reducing sprawl, such policies help to increase the viability of active travel modes by dampening the possibility that the three revolutions will increase vehicle travel; they also ensure that destinations are within walking and biking distance and otherwise improve the active travel environment. Such policies include those **shown in Table 3**.

Cities throughout the U.S. are adopting such policies driven by a variety of motivations, though such efforts may need adjustments to adequately respond to the three revolutions. The National Association of City Transportation Officials (NACTO), for example, has issued a policy statement on AVs calling for a rebalancing of the use of the public right-of-way "with less space for cars and more space for people walking, cycling, using transit and recreating" (NACTO 2016). Parking policies are an especially important target for reforms, so that cities can repurpose parking lots and structures if the need for parking declines over time.

Automated Vehicle Policies

The safety benefits of AVs for active travel modes depend on technology but also on restrictions on the use of AVs. The benefits are greater if shared use of AVs dominate over individual use, and if overall vehicle travel does not increase. Policies to ensure safety for active modes include those **shown in Table 4**.

The federal government has an important role to play in establishing AV policies that protect active modes. The U.S. Department of Transportation's Federal Automated

Table 3. Built Environment Policies

Policy	State	Region	City
Adopt strong growth management policies, such as urban growth boundaries, that limit suburban sprawl.		X	X
Adopt zoning and financial incentives that encourage in fill development and mixed-use development, particularly pedestrian-oriented retail.			X
Prioritize bicycle and pedestrian infrastructure in allocating transportation funding.		X	X
Adopt "fix-it-first" policies that prioritize spending on road maintenance over road expansion.	X	X	X
Adopt "complete streets" policies that prioritize active modes in reallocating road space.	X		X
Revise parking policies to reduce or eliminate requirements for developers to provide a minimum number of parking spaces and to impose fees for on-street and off-street public parking.			X

Table 4. Automated Vehicle Policies

Policy	Federal	State	City
Adopt requirements that bicycle and pedestrians are accounted for in the development of on-board AV systems as well as wayside connected vehicle systems.	X	X	
Establish protocols for clear communication between AVs and bicyclists and pedestrians.	X	X	
Adopt lower speed limits on facilities shared with active travel modes, coupled with technological restrictions on speeding for AVs that operators cannot override.	X	X	X
Adopt regulations and/or pricing that restrict AV circulation within residential areas, school areas, shopping areas, and other areas with high levels of pedestrian activity.		X	X
Prioritize multiple-occupant AVs over single-occupant AVs through pricing and road access policies.		X	X
Establish designated drop-off and pick-up zones for shared AVs to minimize conflicts between AVs and active modes.			X
Involve bicycle and pedestrian interest groups in the development of AV policies at all levels of government.	X	X	X

Vehicles Policy, adopted in 2016, establishes an initial framework for government action, but what actions the federal government will take and when remains to be seen. In 2011, Congress called for the establishment of noise standards for electric vehicles in the Pedestrian Safety Enhancement Act, but the National Highway Traffic Safety Administration (NHTSA) has pushed back their adoption until at least 2018. Action at the local level is also important. NACTO has issued a policy statement on automated vehicles that calls for prohibitions of partially automated vehicles on city streets and technologically-enforced speed limits for AVs of no more than 25 mph (NACTO 2016).

Planning Process and Practices

Reforming auto-oriented planning processes to focus on human mobility and community livability requires substantial changes in the planning process and traditional practices. The three revolutions create additional impetus for the following changes, already underway in many regions and encouraged to some degree by current federal policy are **shown in Table 5**.

Opportunities for Future Research

The essential research question is this: Do the recommended policies succeed in achieving the desired

Table 5. Planning Process and Practices

Policy	Federal	State	Region	City
Adopt a true multimodal approach to transportation planning that enhances the range of options available to travelers and enhances the ease with which they can mix-and-match among these options to better meet their own needs.		X	X	X
Revise travel demand forecasting models and other planning tools to reflect the expanding suite of mobility options and revise traditional assumptions about travel behavior.			X	
Adopt new performance metrics for the transportation system that are consistent with a focus on human mobility and community livability, for example, measures of health benefits and accessibility to jobs and services.	X	X	X	X
Improve data collection for active modes, including data on amount of active travel and safety outcomes.	X	X	X	X
Improve coordination of transportation planning across jurisdictions and levels of government, and ensure that pedestrian and bicycle interest groups are involved in planning processes.		X	X	X

outcomes? This question can only be answered over time through rigorous studies that evaluate the actual impacts of the adopted policies. These studies could be conducted in multiple cities through the building of research collaborations. In the meantime, researchers can help agencies prepare for the three revolutions and ensure a continued role for active travel by addressing these questions:

- How should we design streets to minimize conflicts between active modes and AVs? Where and how should we mix modes, and where and how should we separate them?
- What is the likely trajectory for parking demand for each possible trajectory of AVs? What parking policies can be adopted now to ensure sufficient flexibility to respond to changing demand in the future?
- How can AVs and shared-ride services be used to collect better data on walking and bicycling, including how many people are walking and bicycling where?

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