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Longer View: The Fairness of Congestion Pricing

Michael Manville

Can congestion pricing be fair? On the surface, using tolls to fight traffic seems to perfectly illustrate the tension between efficiency and equity. Traffic congestion is an inefficiency. Roads get congested because they are underpriced — free to use even when demand is high. Underpriced goods suffer shortages (think fancy TVs on Black Friday), and congestion is basically a shortage of road. At busy times, drivers want more road space than space is available, and as a result they must wait. In waiting they lose time, get stressed, emit pollution, slow each other down, and increase the risk of crashes.

Maybe some readers are already objecting. How can anyone call roads free? What about gas taxes and registration fees? The distinction here is subtle. The government collects money to *provide* roads (through gas taxes and other fees), but rarely charges a price to access them, and certainly not a price based on demand. For most things we buy, the price we pay reflects not just the cost of providing the good, but also how much other people value it. That's why homes on the beach cost more than identical homes further inland. The price of driving, however, doesn't change as the road gets more valuable. The gas tax is the same if you drive at rush hour on a busy freeway or midnight on a rural byway.

The gas tax doesn't change with demand for the road because it isn't actually a charge for using the road. It's a charge for burning gas. You can pay lots of gas tax and barely use the road (buy an SUV and leave the engine running in your driveway) and you can pay no gas tax and use the road a lot (drive an electric car). Put simply, while we pay lots of fees *around road use*, we don't pay any fees to directly *use the road*. That small difference makes all the difference. It means that at busy times, the roads are underpriced — free to use when demand is high. That underpricing, in turn, creates the shortages we call congestion.

Underpricing's solution is accurate pricing. Congestion tolls work by charging more for roads in times and places of higher demand — more at 8 a.m. than 8 p.m., more on Monday than Sunday, more on urban freeways than in the urban fringe. When governments price roads properly, traffic flows freely.

The trouble is that prices ignore people's ability to pay. The poor would pay the same toll as the rich, so solving the efficiency problem could create an equity problem. Some low-income drivers, when confronted with a toll, could switch to transit. But good transit doesn't exist in many areas, and some low-income people (for instance, landscapers) rely on vehicles for work. Pricing could force these drivers to either pay tolls or forego travel. Scenarios like this have led opponents to decry priced roads as "Lexus Lanes" for the rich, and a tax on the poor.

How valid are these concerns? Fairness is important, and American public policy too often neglects it. Any congestion pricing program, moreover, must protect poor drivers. The poor contribute little to America's traffic congestion, and society shouldn't saddle them with the burden of alleviating it. But the fact that pricing *could* create equity problems doesn't mean it must. Nor does it mean that for the sake of equity all roads should be free. Few equity agendas in other areas of social policy, after all, demand that all goods be free. Almost no one, for example, suggests that all food be free because some people are poor. Society instead identifies poor people and helps them buy food. So why should all roads be free because some drivers are poor? Most drivers *aren't* poor, many poor people (including the poorest) don't drive, and most driving is done by the middle and upper classes. It is entirely possible to price our roads while maintaining a commitment to economic fairness.

Free roads are not a good way to help poor people. Virtually every fairness-based criticism of priced roads — they help the rich more than the poor, they prevent some people from traveling, they actively harm the poor — also applies to free roads. On free roads, the rich drive more than the poor. Unpriced roads get congested, and congestion prevents some people from traveling. Congestion also creates pollution, and the pollution actively harms poor people. It is appropriate to worry that pricing could be unfair, but we should not pretend our status quo is progressive or benign. Priced roads and free roads differ not because one causes harm and the other doesn't, but because one comes with a built-in solution to the harms it causes, while the other lets its harms go unnoticed and uncompensated.

The unfairness of free roads

Do free roads help the poor? Poor people have little money, so holding down prices can help them. But poverty is fundamentally a problem of low incomes, not high prices. The ideal anti-poverty program would therefore transfer money to low-income people and let them spend it as they see fit, not selectively lower the price of some goods and hope that poor people want them. Ideal programs aren't always feasible, of course, and efforts to give poor people money often encounter political resistance. Sometimes keeping prices low is the best we can do. But if lowering prices is the path we take, we should either lower prices *only* for the poor (as we do with food stamps) or — if we lower them for everyone — do so only for goods the poor use disproportionately (as we do with transit fares). Free roads, especially at peak hours, satisfy neither of these criteria.

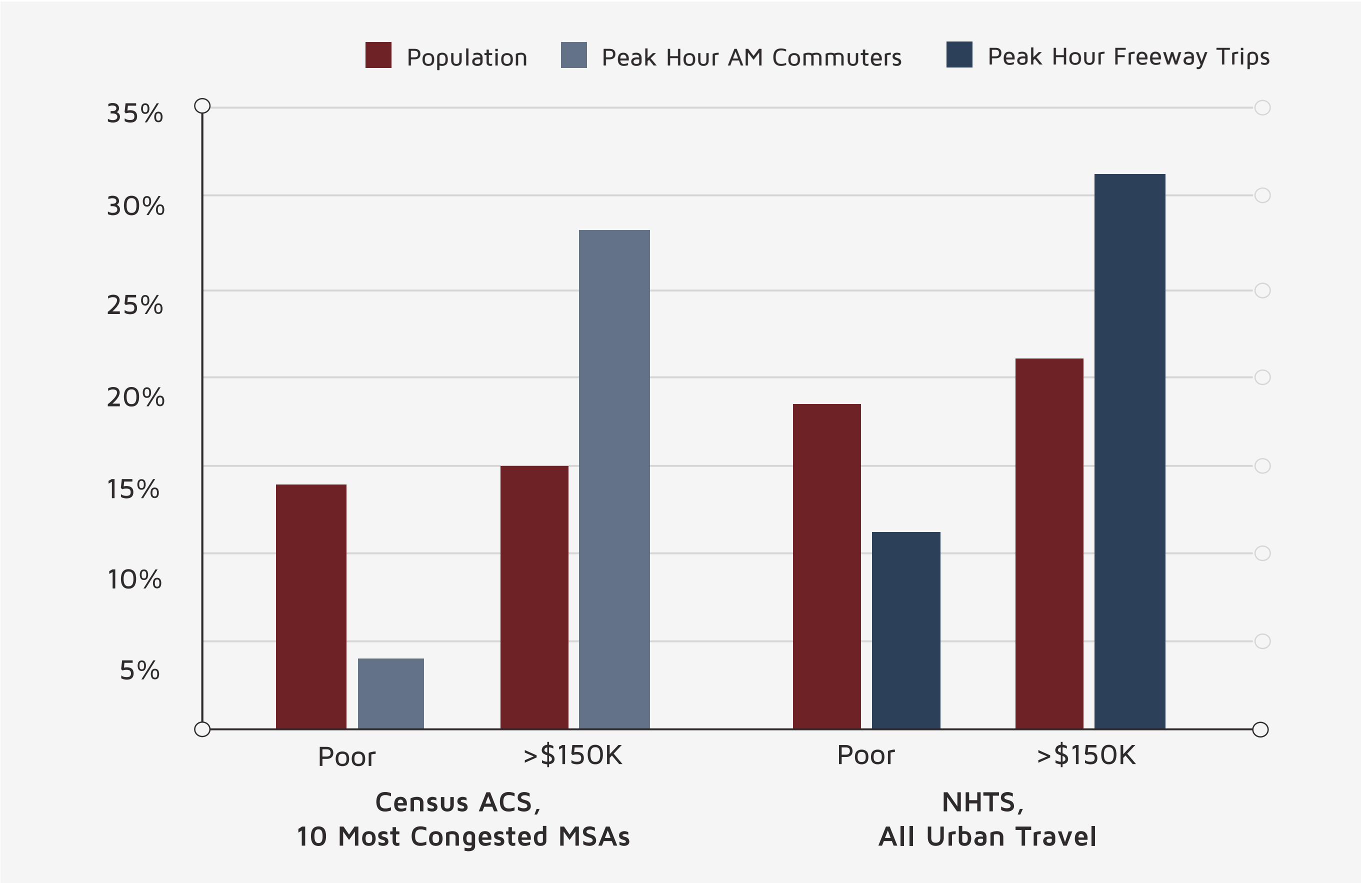
To see why, think of everything you must do before using a free road. You need to buy a car, fuel it, inspect it and insure it — already you've spent thousands of dollars. If that's beyond your means, free roads give you little benefit. If you *can* afford this investment, the free road helps you, but only in proportion to your ability to keep spending, since every time you use the road you are also burning gas, putting additional wear on your vehicle, and hastening the day it needs to be repaired or replaced.

In public finance terms, free roads look less like a progressive transfer (the government moving resources from rich to the poor) and more like a matching grant (the government moving resources to people who can first produce resources themselves). Matching grants have their uses, but for obvious reasons they are terrible ways to assist the disadvantaged. Free roads "help" the poor, but only after the poor have made large investments, both upfront and ongoing, in the depreciating assets that are cars.

The argument here is not that poor people don't drive. The United States is built around automobiles, and even low-income people make most trips by car. But the poor drive much less than the affluent. They are particularly less likely to drive in peak directions at peak times, when tolls would be highest. This is so in part because the poor are less likely to be employed, and in part because when they are employed they are more likely to work at off-peak hours (for example, as janitors or waitstaff or retail clerks), and not commute in peak directions (e.g., driving from the city to suburban malls).

Figure 1 shows data from the 2011 U.S. Census (the left pair of bars) and the 2009 National Household Travel Survey (the right). Both tell the same story: in the morning peak, the poor are under-represented on the roads, while the rich are over-represented. The Census data show that in the United States' 10 most congested urban areas, poor households are 14 percent of the population, but only 4 percent of peak-hour drive commuters. Households earning more than $150,000 per year, meanwhile, account for 15 percent of the population but 28 percent of peak-hour drive commuters. Most drive trips aren't commutes, of course, and many commutes don't

Figure 1. Poverty and affluence in morning peak period travel



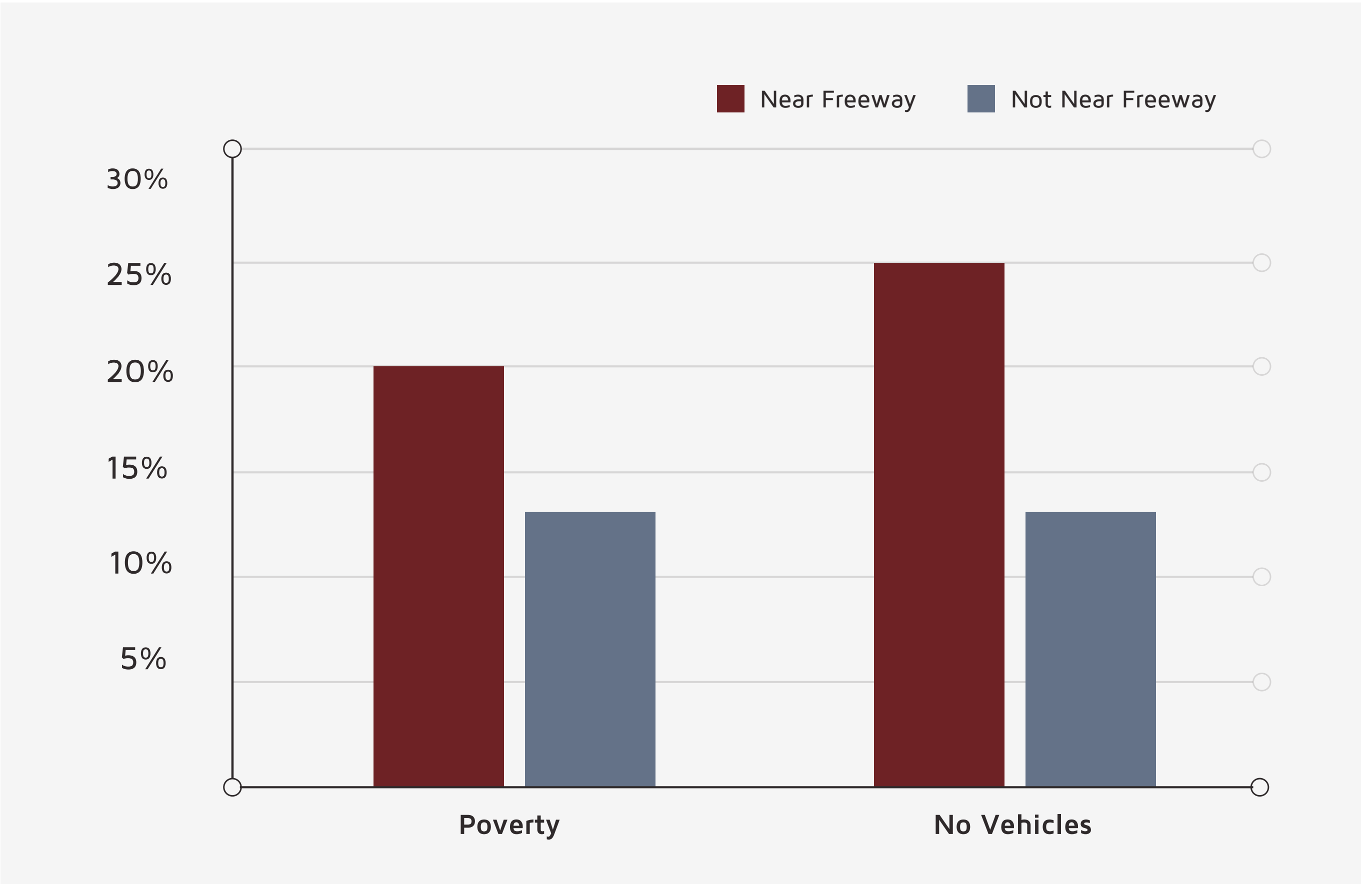
occur on crowded roads, but the NHTS data show that even if we account for these factors — by examining all morning peak driving on urban freeways areas — the story doesn't really change. The poor account for 19 percent of the urban population but only 11 percent of peak freeway driving trips, while households earning more than $150,000 a year are 21 percent of the population but make 31 percent of peak freeway driving trips.

These data suggest that free roads are indeed a subsidy, but not one for the poor. Free roads are instead a subsidy to the affluent that some poor people — those prosperous enough to have reliable cars — can enjoy. Keeping roads free delivers no benefit to many people in need (those too poor to drive), and many benefits to people whose needs have been more than met.

Do free roads harm the poor? They can. When roads are free they get congested. Congestion's most visible costs — lost time, wasted fuel, and crashes — fall largely on drivers, which means they fall largely on the affluent. But congestion also creates vehicle emissions, which are most harmful within a short distance of congested roads. Since low-income people are more likely to live near freeways and other congested facilities, they bear a disproportionate burden of the pollution's costs.

Figure 2 examines the 10 most congested urban areas in the United States, and compares the population living within 1,000 feet of a freeway to the population that does not. Twenty percent of the freeway-adjacent population is poor, compared to 13 percent of people who aren't freeway-adjacent. These averages, moreover, conceal much larger disparities in individual regions. In New York, the poverty rate in freeway-adjacent places is almost double that in places without freeways, and in Atlanta, Boston, and Seattle it is at least twice as large. In total, the freeway-adjacent parts of these regions are only 0.3

Figure 2. Poverty status and vehicle ownership by freeway adjacency, 10 most congested U.S. urban areas



percent of the land area, but hold over 2 percent of the population in poverty. Households close to the freeways, furthermore, are more than twice as likely to lack automobiles as households farther away. Thus people who live near unpriced freeways tend to enjoy fewer of the freeways' benefits (because they own fewer cars and drive less) while suffering more of the freeways' costs (because they must breathe the emissions of those who drive more).

These costs aren't trivial. Vehicular air toxics are the largest cause of air-pollution-related cancer in the United States, and car-based pollutants also cause respiratory disease, cardiac disease, and preterm birth — which in most years is the leading cause of infant mortality in the country. Fortunately, most preterm babies survive, but the condition has been linked to lifelong disadvantage. Exposure to traffic congestion at an early age is thus both a consequence and cause of poverty, an example of the intergenerational transmission of disadvantage that economist Janet Currie calls "inequality at birth."

The fairness of priced roads

Priced roads pose an equity problem because they are regressive: their burden rises as income falls. A toll designed to maximize a road's performance (for example, maintain speeds of 55 mph) is levied without consideration of driver income. London's congestion charge, for example, is $15 per vehicle, regardless of who is in the vehicle. On efficiency grounds, this makes sense: cars don't consume less space, and cause less congestion, simply because the people driving them have less money. On equity grounds, however, it can be troubling; $15 is a bigger obstacle for a poor person than a rich one.

Does this regressivity make pricing unfair? From one perspective, no. Congestion prices are fair the same way water meters or carbon taxes are fair: If you're going to use a resource, you should pay for it, not push some of the costs — in time, pollution, or crash risks — onto others. Pricing is *not* fair, however, according to the "ability to pay" principle, which holds that those who have more should pay more. It is the ability-to-pay perspective that yields the "Lexus Lane" critique: fast travel for the lawyers, lost trips for the landscapers.

Again, though, how are free roads different? On free roads, those who have more don't pay more — everyone pays nothing. And while congestion charging might stop some people from driving, by making it too expensive in money, *congestion* also stops some people from driving, by making it too expensive in time. Tolls can deprive a landscaper of precious earnings, but so can traffic jams, if they prevent him from reaching an additional job before day's end. Is it worse to have paid roads where prices prevent some trips, or free roads where shortages do the same? To paraphrase the writer Frances Spufford: what's the difference between being able to afford something that isn't available, and not being able to afford something that is?

Maybe charging people in time is inherently fairer than charging people in money? Time, after all, is a great equalizer: the rich have more money, but everyone has only 24 hours per day. So when we trade in time, everyone starts with equal endowments. But equality and fairness are not the same thing, and neither is synonymous with well-being. People with the same amount of time might, in different circumstances, value that time very differently. When everyone with a car can access roads for free, that's equality. But is it fair if, as a result, someone on their way to give birth gets slowed down by someone on their way to buy potato chips?

Free roads advance equality, but do so by leveling down rather than up. They offer equality in misery: every driver, regardless of income, suffers from the poor performance of our roads. This is an odd form of equality to strive for. Most people would want equal access to *good service*, not just equal access for its own sake.

Pricing delivers good service. It ends the shortage of roads. If some people can't afford the price, that's a problem, but the price itself contains the solution. Pricing creates revenue, and governments can give some of that revenue to poor people. A great advantage of money is that spending it doesn't make it disappear; it just makes it available for others. A rich person's toll payment can thus become a poor person's toll support. We can use the congestion charge to deter the potato chip buyer, the revenue to help the landscaper, and the open road to help the pregnant woman. But we need prices to do it. We cannot pursue such redistribution if we pay for roads in time. Time isn't like money. Time, once spent, is gone forever.

In summary, we can charge prices to advance efficiency, and use the revenue to protect equity. If this logic sounds familiar, it should. It describes our existing approach to most vital infrastructure. Governments regularly charge regressive user fees for water, electricity, and heating fuel. These services are all at least as important as roads, and precisely because we charge for them, we don't see daily shortages of them. When utility bills burden low-income people, we don't respond by making all utilities free. Nor do we say that metering shouldn't occur until every household has an "alternative" to water or electricity. We just use some of the meter revenue to reduce the burden on the poor. And yet few people consider water, gas or electric meters unfair. Most of us understand that these meters don't exist to punish the poor. They exist to discourage wasteful use by the rest of us. The same can be true of road prices.

Conclusion: A false choice

Suppose we had a world where all freeways were priced, and where we used the revenue to ease pricing's burden on the poor. Now suppose someone wanted to change this state of affairs, and make all roads free. Would we consider this proposal fair? The poorest people, who don't drive, would gain nothing.

The poor who drive would save some money, but affluent drivers would save more. Congestion would increase, and so would pollution. The pollution would disproportionately burden low-income people. With priced roads, poor drivers were protected by payments from the toll revenue. With pricing gone, the revenue would disappear as well, and so would compensation for people who suffered congestion's costs.

This proposal, in short, would reduce both efficiency *and* equity. It would harm the vulnerable, reward the affluent, damage the environment, and make a functioning public service faulty and unreliable. Most people would view the idea with skepticism — the same way they might view a proposal to abolish water meters. Today, however, this situation is not a proposal but our status quo, and so it is a *departure* from this scenario, not its introduction, that arouses our suspicion. We have so normalized the current condition of our transportation system that we unthinkingly consider it fair and functional. It is neither. Our system is an embarrassment to efficiency and an affront to equity. The choice between fairness and efficiency, in this case, is a false one. Charging prices would increase efficiency. Dedicating some revenue to the poor would protect equity. Falling pollution might well advance equity. There is nothing intrinsically unfair about pricing roads, or intrinsically fair about leaving them free. And people who worry about harms to the poor when roads are priced, but not when roads are free, may be worried more about the prices than the poor.

This article is adapted from Manville, M., & Goldman, E. (2018). Would congestion pricing harm the poor? Do free roads help the poor? Journal of Planning Education and Research, 38(3), 329–344.

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Disruptive Transportation: The Adoption, Utilization, and Impacts of Ride Hailing in the United States

Regina R. Clewlow

Ride-hailing services such as Uber and Lyft are changing the way many people travel in major cities. Due to their rapid rise in popularity, relatively light levels of regulation, and lack of available data on how, when, and why people use these services, city and transportation planners and researchers know alarmingly little about how ride-hailing is changing travel choices or how to plan for them in the future.

Nearly 10 years after these services were introduced, we still have limited research and few answers to key questions, including: To what extent do ride-hailing services influence vehicle ownership? Where is ride-hailing complementary to or competitive with public transit?

Many public agencies responsible for transportation planning in the United States — typically metropolitan planning organizations and state transportation and environmental agencies — conduct travel surveys to gather data on vehicle ownership rates, trip-making patterns, and transportation mode choice. However, these custom surveys are costly and typically administered only every five to 10 years, which is not frequent enough given our rapidly changing transportation ecosystem. To address this gap in knowledge, our research has sought to better understand the relationships among ride-hailing services, demographics, and travel behavior.

To begin quantifying the adoption and travel behavior impacts of these services, we gathered data in major metropolitan areas of the United States through travel surveys designed by our team. Our survey asked questions about the adoption and utilization of shared mobility services, including carsharing, ride-hailing, bikeshare, and more recently, shared electric scooters. The results presented in our 2017 research report are based on data that were collected from fall 2015 through spring 2016 in seven metropolitan areas: Boston, Chicago, Los Angeles, New York, the San Francisco Bay Area, Seattle, and Washington, D.C. We employed sampling methods that regional planning agencies typically use to gather data from a statistically representative sample using rigorous methods so that we could draw defensible conclusions about the population at large.

Shared mobility: A diversifying landscape

Much of prior research on the behavioral impacts of shared mobility services focused on what we term "Carsharing 1.0,"early models of carsharing where vehicles were picked up and returned to the same location, typically through hourly rentals. The shared mobility landscape has rapidly evolved and new services have been introduced, including free-floating car-sharing, ride-hailing (e.g. Uber and Lyft), and pooled or shared services (Table 1). A key takeaway from our recent research is that not all shared services should be viewed through this lens and that the adoption rates and behavioral impacts of different types of shared mobility services vary substantially.

Table 1. The evolution of shared mobility services

Carsharing 1.0 Station Based	• Zipcar • Hertz On Demand • City Car Share	Every model of carsharing where vehicles are picked up and returned to the same location; typically through an hourly rental
Carsharing 2.0 One-to-Many	• DriveNow • Car2Go • Scoot	Second generation of carsharing where vehicles can be picked up and dropped off in different locations (possibly by zone vs. designated parking spots); typically charged by minute
Carsharing 3.0 P2P	• RelayRides • Getaround	Peer-to-peer sharing where individuals can rent out their personal vehicles to others when not in use
Ride-Hailing	• Lyft • Uber	Platform where individuals can hail and pay for a ride from a professional or part-time driver through an app
Shared Ride-Hailing	• Lyft Shared • Uber Pool	Extension of ride-hailing where individuals can be matched in real-time to share rides with others going on a similar route
Microtransit	• Via • Chariot	App and technology-enabled shuttle services, typically in a van-size vehicle; some with dynamic routing, others with semi-fixed routes

Source: Clewlow, R. R. and G. S. Mishra (2017) Disruptive Transportation: The Adoption, Utilization, and Impacts of Ride-Hailing in the United States

Among these various forms of shared mobility, the rates of ride-hailing adoption have far outpaced the adoption rates of other shared mobility models. Carsharing 1.0 business models had attracted only 2 million members in North America and close to 5 million globally between the early 2000s and 2017. By contrast, ride-hailing services, such as Uber, Lyft, and Didi, are estimated to have grown to more than 250 million users globally during the 2010s alone. Our more recent research on "micromobility" services, such as shared bikes, electric bikes, and electric scooters, finds that the adoption rates of these services have grown at an even faster pace than for ride-hailing.

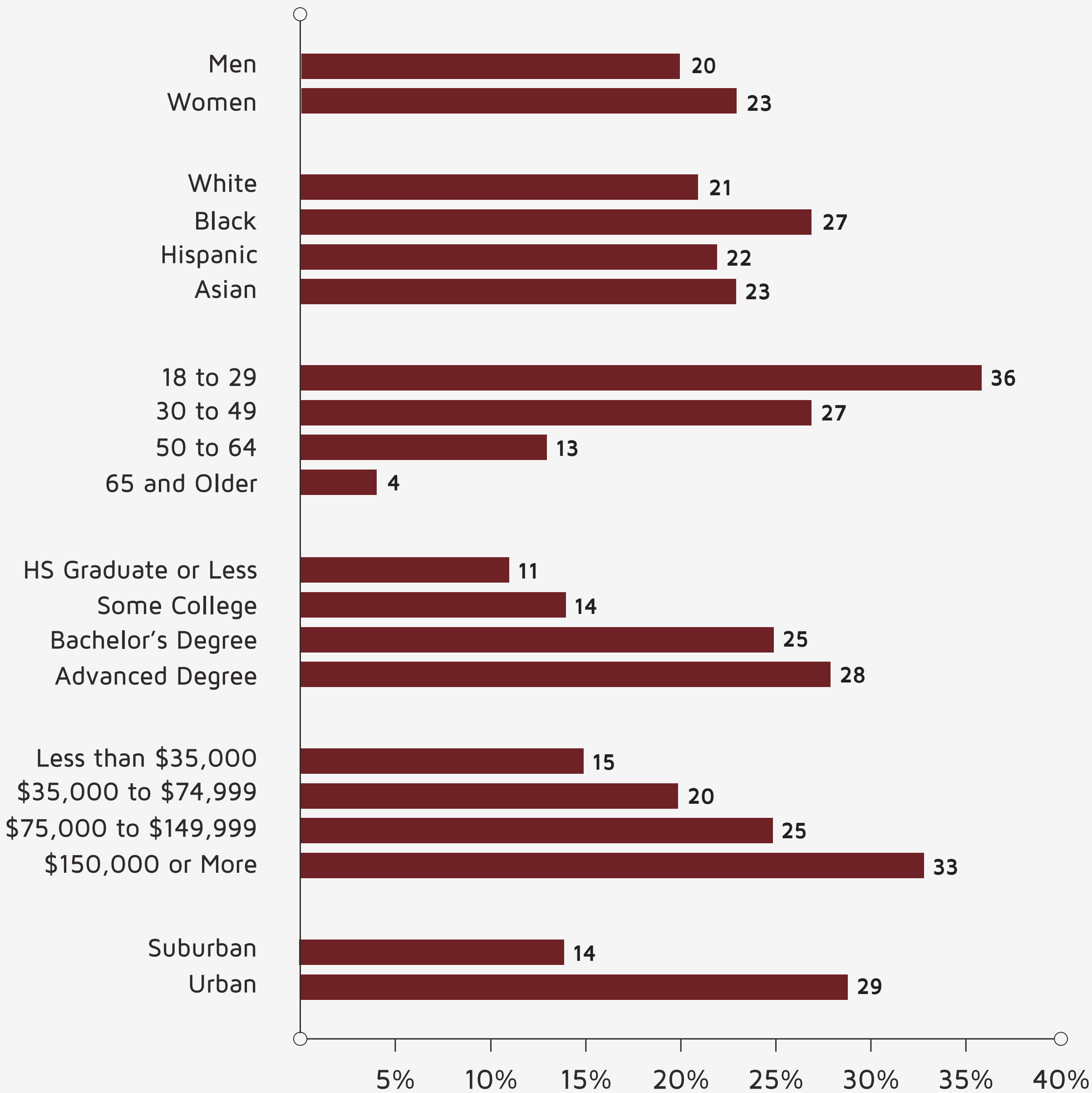
Adoption of ride-hailing

The adoption rates, or share of the population that has used Uber or Lyft, in our study were significantly higher than those reported in previous research. While earlier studies found adoption rates of 10 to 15 percent, our 2015–2016 data found that 21 percent of adults had personally used ride-hailing services (measured as having installed and used a ride-hailing app), and an additional 9 percent of adults had used ride-hailing with friends. Our different results are likely due to our focus on major metropolitan areas and suggest that ride-hailing service use is increasingly widespread, particularly compared with adoption rates of previous generation carsharing services, which are roughly an *order of magnitude* smaller.

Similar to the higher ride-hailing *adoption* rates, we also found higher rates of *utilization*, or frequency of use, among ride-hailing users in cities. Nearly a quarter (24 percent) of ride-hailing users reported use on a daily to weekly basis. Such a significant portion of people relying on these services daily or weekly suggests that ride-hail is shifting from a niche to a mainstream travel option in many cities.

Similar to the adoption trends for new technologies and prior carsharing services, we found that early ride-hailing adopters tended to be younger, more

Figure 1. Ride-hailing adoption by demographics and geography, 2015-2016



educated, and have higher incomes than the rest of the population (Figure 1). Notably, we find women and minorities were more likely to adopt ride-hailing. There was a fairly significant gap in adoption between the youngest and oldest segments of the population. More than one-third (36 percent) of those between 18 and 29 years of age had used ride-hailing services, while only 4 percent of those 65 and older had. Although ride-hailing is often cited as a possible transportation solution for aging Baby Boomers, our research suggests very few of them currently utilize services like Uber and Lyft.

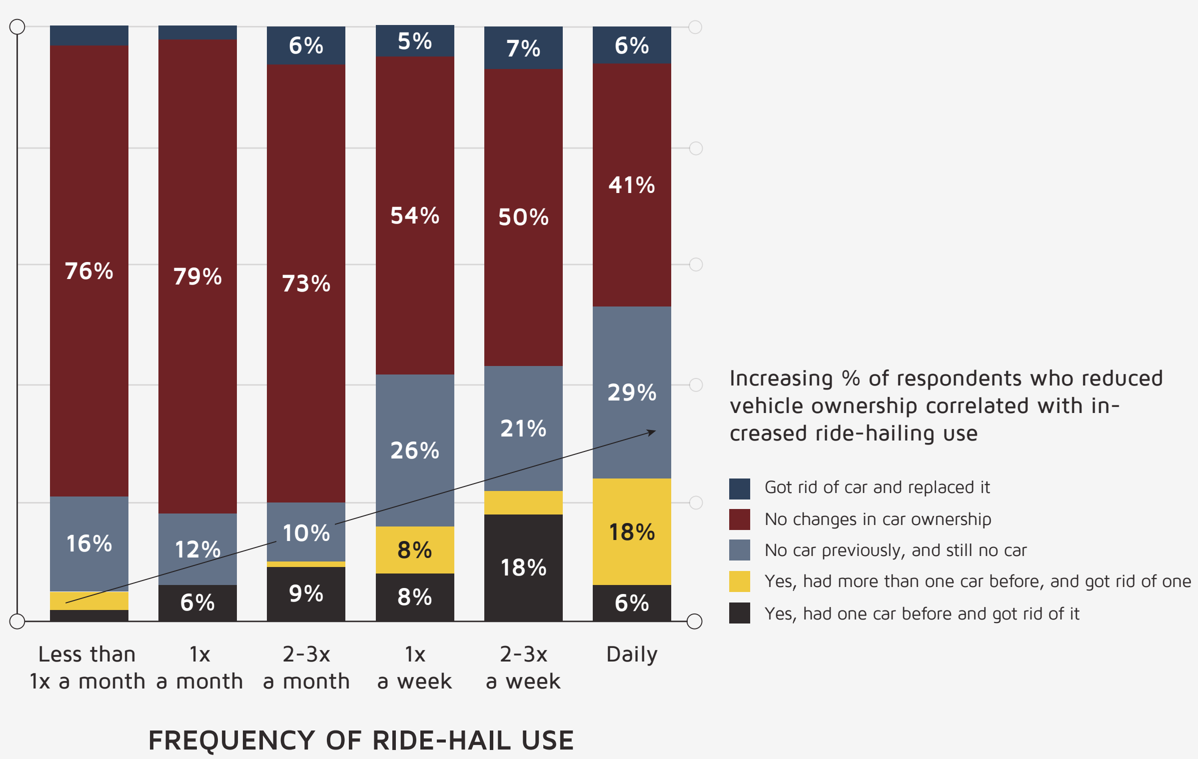
Wealthier, more educated people use Uber and Lyft at much higher rates than those who are less affluent. The adoption rate among the college educated (26 percent) was double that of those without a college degree (13 percent). Those with advanced degrees also had slightly higher adoption rates than those with only a bachelor's degree. Similarly, respondents with annual household incomes of $150,000 or more had an adoption rate of 33 percent, compared with only 15 percent among those earning $35,000 or less.

While many observers herald these exciting new mobility options, their continuing growth presents significant challenges for the public sector. As officials and managers at cities and public transit agencies consider whether and how to integrate these services into publicly subsidized transportation networks, these gaps in adoption between the wealthy and the poor need to be addressed.

Vehicle ownership and driving

Two important questions facing transportation policymakers are whether the adoption of ride-hailing

Figure 2. Vehicle shedding by ride-hailing utilization rate



services might reduce vehicle ownership and total vehicle miles traveled. Contrary to prior research on the topic, we found that ride-hailing users on average do not own significantly fewer vehicles than their non-ride-hailing counterparts. We find, as others have, that the key drivers of vehicle ownership are household income, household structure, and urban density, the latter of which is strongly correlated with limited parking. Once these factors have been statistically controlled, we observe little difference in vehicle ownership between those who use ride-hailing and those who do not.

When asked whether using Uber or Lyft had prompted them to decrease their ownership of motor vehicles, the vast majority of ride-hailing respondents (91 percent) reported making no vehicle ownership changes, while 16 percent indicated they had no vehicle to begin with. However, nearly one in 10 respondents (9 percent) said they had downsized by one or more household vehicles, which suggests that Uber and Lyft may indeed motivate long-range changes to vehicle ownership and use decisions.

From an environmental perspective, a significant shift away from personal vehicle ownership is primarily of value inasmuch as it reduces vehicle-related emissions. While vehicle travel is correlated with emissions, the effect of ride-hailing on total vehicle travel is the subject of ongoing debate.

We found a strong correlation between reduced vehicle ownership and increased ride-hailing use (Figure 2). This suggests that such travelers are substituting trips in which they would have driven themselves with trips that are now driven by an Uber or Lyft driver.

As we ponder the future introduction of shared, automated vehicles, trip-making and travel mode choice (i.e., walk, bike, transit, carpool, drive, ride-hail, etc.) will be central to determining whether their introduction will result in more miles traveled, more congestion, and more energy use, or whether they will be deployed to provide mobility benefits with fewer negative social, economic, and environmental impacts.

Impacts of ride-hailing on public transit

The extent to which ride-hailing complements or substitutes for public transit use will play a key role in whether Uber, Lyft, and potential automated vehicle services increase or decrease total vehicle travel. We addressed this question by assuming that not all public transit services are created equal. Some transit services are more frequent, reliable, and operate in environments where they are an especially convenient choice, while other services operating in less "transit-friendly" areas can be slow and inconvenient. In short, the question of whether ride-hailing competes with or complements public transit services depends on the context.

We asked survey respondents whether they use different public transit services, including buses, subways, and streetcars, more or less after they began using Uber and Lyft. The majority of respondents reported no change in their transit use. However, among the few who did report changing transit use, 6 percent said that they used bus services less and 3 percent said they used light rail (i.e., streetcars) less. By contrast, 3 percent of respondents reported increasing their use of commuter rail, which typically carries commuters longer distances from suburbs to central business districts. In short, we find that the substitutive versus complementary nature of ride-hailing services varies by the location, type, and quality of the transit service in question.

Recent research on New York City finds that travel has shifted away from public transit towards ride-hailing. So while many suggest that ride-hailing can be complementary to public transit by making it easier to get to and from transit stops and stations, there is mounting evidence that ride-hailing is pulling more people away from public transit than towards it.

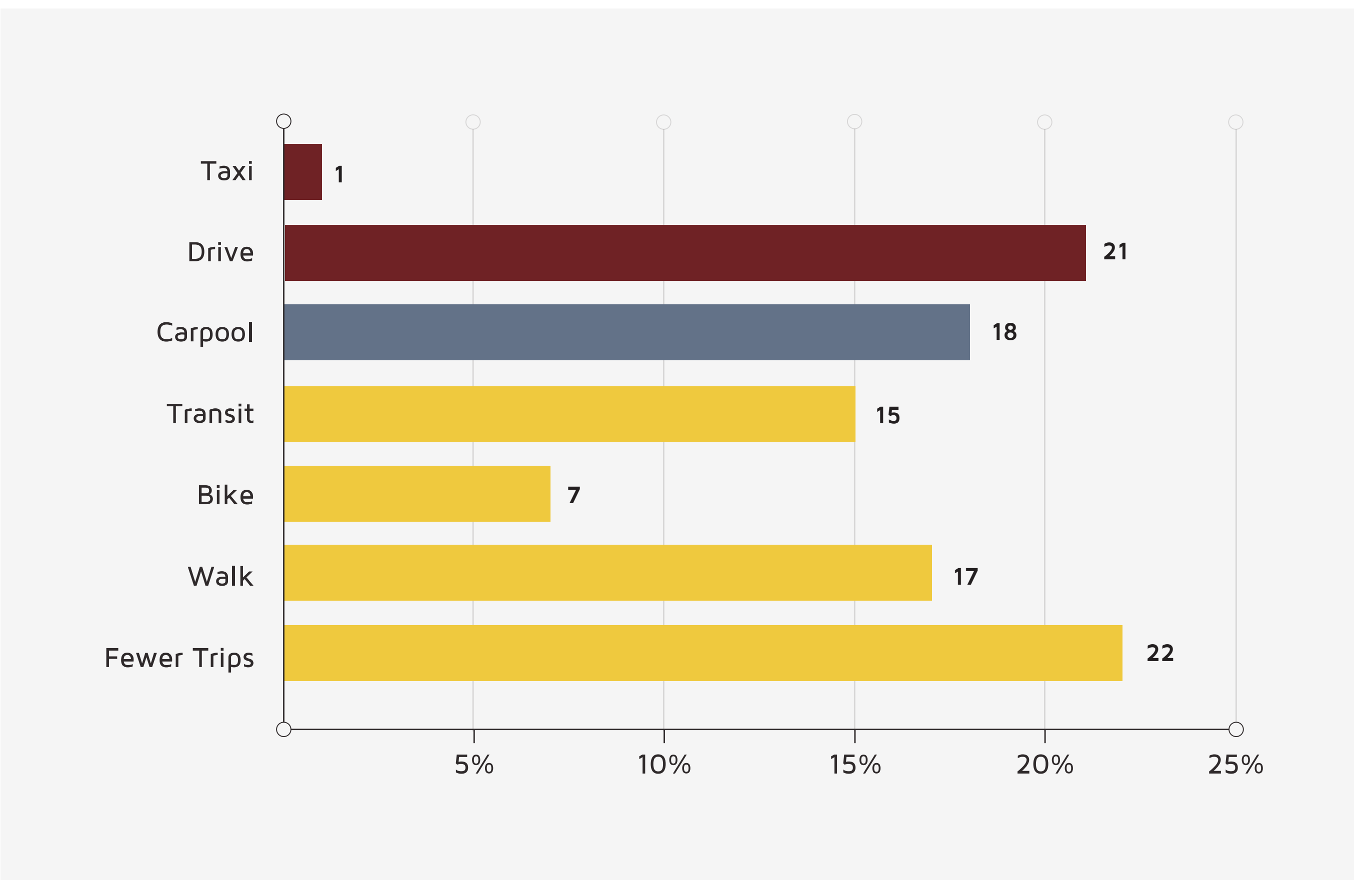
How might the introduction and increased use of automated vehicles affect public transit use and driving? Simulations that consider whether shared automated vehicles will replace public transit services have found that total vehicle travel increases moderately-to-substantially if shared-ride automated vehicles substitute for transit use: a 6-percent increase if buses are replaced, and an 89-percent increase if high-capacity transit, like urban rail, is replaced. These simulations assume existing levels of travel demand, but most transportation economists assume that the per capita demand for travel will increase with widespread adoption of fully automated vehicles. Why more vehicle travel? Some people previously unable to drive because of age or disability could now do so, others might find riding rather than driving less onerous, and so on.

Ride-hailing and mode substitution

In our survey, we asked ride-hailing users which transportation modes they would have used for the trips they currently make using Uber and Lyft (Figure 3). The majority of respondents said that they would have traveled by walking, biking, or public transit, or would not have made the trip at all, while nearly four in 10 (39 percent) reported that they would have traveled by car (either by driving alone, carpooling, or taking a taxi). Using data unadjusted by frequency of ride-hailing use, about half (49 percent) of ride-hailing trips were likely to have been made by walking, biking, or public transit, or not been made at all.

This new evidence of mode substitution suggests that ride-hailing is likely increasing vehicle travel in major cities, though to date by relatively small amounts. The 61 percent of Uber and Lyft trips that would have been made by walking, biking, or transit, or not been made at all are adding vehicles to the road. In addition, ride-hailing raises the concern of deadheading miles, or miles traveled without passengers, which have previously been estimated at 20 to 50 percent of ride-hailing miles. With deadheading miles included, the vehicle travel associated with a ride-hailing trip is potentially higher than if taken in a personal vehicle.

Figure 3. Likely travel mode used if Uber/Lyft were not available for last trip



While these data provide initial insights into the travel behavior changes associated with ride-hailing, they only represent a snapshot of representative data from a sample of large cities in late 2015 to early 2016. Continued research in this area is needed to help cities and transportation planners make critical policy decisions such when and where to invest in public transit infrastructure, and whether and when to price or subsidize private mobility services in order to manage travel demand.

Conclusions and policy recommendations

Given the rapid growth of private mobility services, it is critical to collect data on their potential impacts on travel behavior, including vehicle ownership, vehicle miles traveled, and travel mode. Further research is needed to understand how ride-hailing will influence future traffic volumes and associated emissions so that cities can effectively manage roads, vehicles, and travel. Absent these data, cities and transit agencies are in the dark when making important decisions that influence how citizens move in their regions. Accordingly, I recommend the following to ensure that the continued growth of private mobility services leads to better urban transportation.

Pricing and/or priority to improve the flow of high-occupancy vehicles

In the near term, policymakers need to address the additional vehicle miles that ride-hailing services contribute to cities. Given limited road infrastructure and expanding urban populations, high-occupancy vehicles need to have priority rights-of-way. Both congestion pricing (of all vehicles, including the majority, which are still personally driven) and bus priority lanes (to allow buses to bypass traffic, making transit faster and more attractive) can serve as effective measures to ensure that scarce roadway space is used effectively.

Improving data access for cities and transportation planners

There is an increasing data gap between privatized mobility operators and those in the public sphere who make critical transportation planning and policy decisions. As private mobility providers continue to rapidly expand, they gather massive amounts of data about how people move in cities – data that, for the most part, are unavailable to transportation planners or policymakers. Limited data in the public sector perpetuate less-informed decision-making, which in turn can result in transportation systems that may not meet the public's needs.

There are two potential solutions for bridging the data gap. First, the public sector can and should mandate data-sharing for new mobility operators like Uber and Lyft that travel on public streets and roads. The New York Taxi and Limousine Commission adopted regulations requiring ride-hail companies to share detailed data on rides in New York City. Provided they are sufficiently anonymized, and that cities have put in place clear policies and infrastructure to responsibly safeguard it, this type of data is essential for informed transportation decision-making. Regulators and planners can reasonably require the data because mobility operators rely on publicly funded infrastructure.

Second, the public sector can invest in more frequent data-collection efforts. While research that harnesses data from ride-hailing providers themselves may shed light on the utilization, demographics, and miles traveled of these services, the more complex decisions that individuals and households make about where to live, work, and how to get around require continued data-collection efforts through representative samples of the population. Given the pace of innovation in the transportation sector, the current pace of occasional data collection and travel analysis efforts are insufficient.

Ride-hailing services have disrupted traditional transportation providers, including public transit operators. The expansion of ride-hailing has highlighted a number of opportunities for cities to harness new technologies, data, and business models that can serve a greater portion of the population more effectively. While the introduction of private mobility services has brought about welcome innovation in the transportation sector and higher levels of mobility for many travelers, better collaboration between the public sector and these private service providers are required to ensure that these services can be effectively woven into the fabric of cities in ways that are sustainable, equitable, and safe.

This article is adapted from Clewlow, R. R., & Mishra, G. S. (2017). Disruptive transportation: The adoption, utilization, and impacts of ride-hailing in the United States. (Rep. No. UCD-ITS-RR-17-07). Davis, CA: UC Davis Institute of Transportation Studies.

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Commute Time as Quality Time

Susan Handy

Americans spend a lot of time commuting to and from work: about 50 minutes per day, on average, according to the 2017 National Household Travel Survey. This adds up to about 200 hours per year for full-time workers, assuming the usual two weeks of vacation, major holidays, and a few sick days along the way.

To put things into perspective, this is more than enough time to stream all 12 seasons of *The Big Bang Theory* or, if you prefer, all 11 seasons of *M*A*S*H*, including the two-hour series finale. Twice.

The quality of that time matters: Spending 200 hours per year in a stressful, unenjoyable commute can be a significant drain on one's general happiness and well-being, as a new and growing body of research from the United States and around the world has shown. Finding ways to improve commute quality – and indeed the quality of all travel – is thus an important goal of transportation planning, and better understanding the factors contributing to one's commute quality is a necessary starting point.

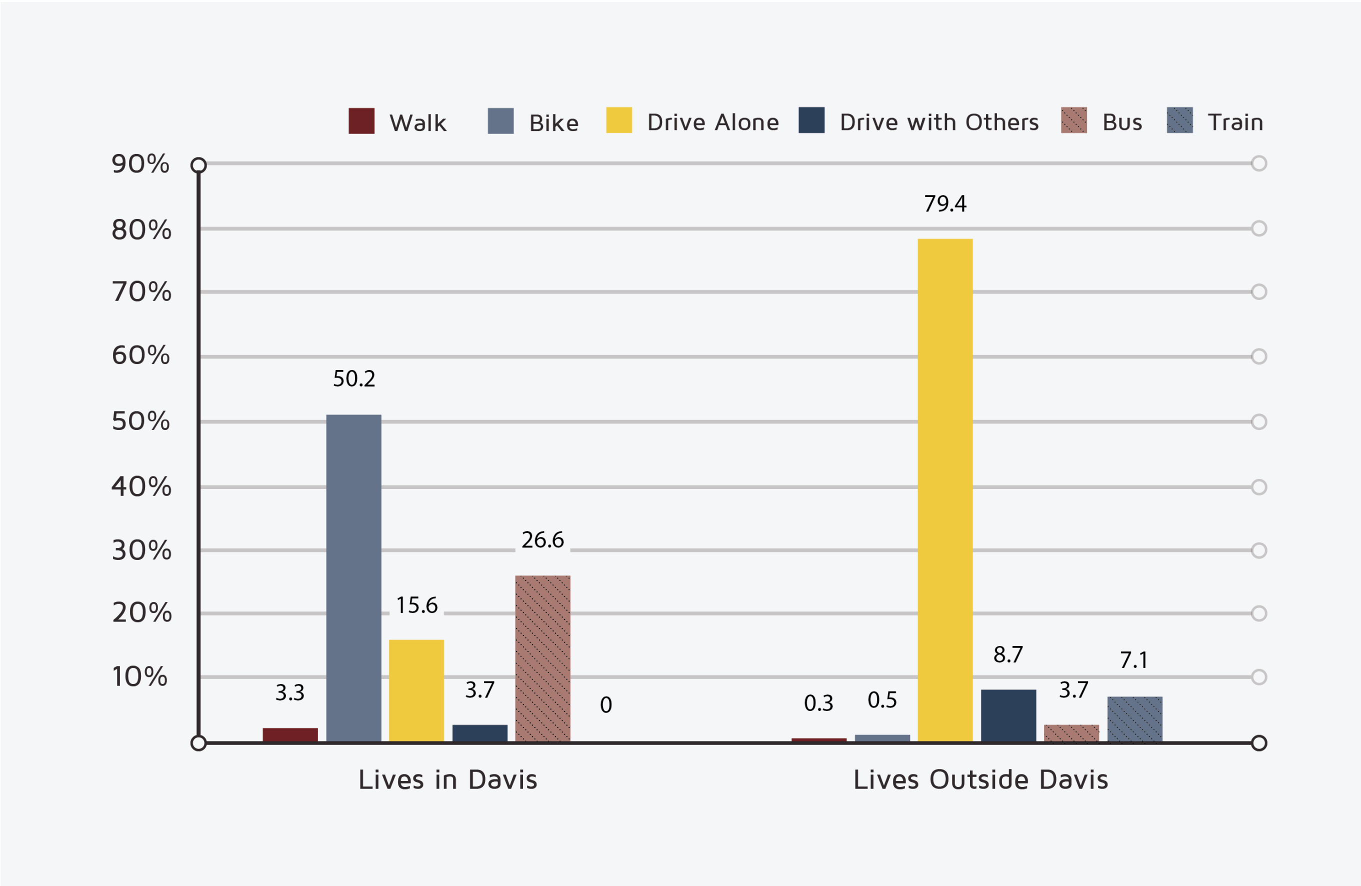
To this end, we explored factors associated with perceived commute quality and commute satisfaction using data from the annual UC Davis Campus Travel Survey. UC Davis is an ideal case for a study of commute quality, in that many of those traveling to and from campus have more than one viable way to get there. Bicycling is common in Davis, which is well known for its extensive bicycle infrastructure, and over 20 percent of commuters usually bike to work. Frequent local transit service and nearby commuter rail service make public transit an attractive option as well. The competitiveness of alternatives to driving for UC Davis commuters makes it possible for us to delve into factors other than travel time that might contribute to commute quality.

Our analysis focuses on the commute to campus for both students and employees. In measuring commute quality, we focused on three dimensions of the commute experience: how "stressed out" the trip to campus made commuters feel, whether they saw travel time as wasted time, and the degree to which they liked their usual commute mode. We also used a composite measure of commute satisfaction based on respondents' levels of agreement with six statements, such as "my commute trips are the best that I can imagine." Our dimensions of commute quality proved to be a strong predictor of commute satisfaction, so we focused our analysis on the factors influencing quality. Our findings point to an array of strategies for improving commute quality and satisfaction.

General patterns of commute quality and satisfaction

We looked at differences in commute quality and satisfaction by travel mode (e.g. walking, biking, public transit, driving), gender, campus role (i.e., student, faculty, staff), and residential location. In our UC Davis sample, these factors are somewhat intertwined, particularly mode and residential location. For those living within the city of Davis, driving, walking, bicycling, and taking the bus are all feasible, depending on how far one lives from campus. For those living outside of Davis (who, because of agricultural land preservation policies, tend to live 10 or more miles from campus), the primary modes are either driving alone, carpooling, or taking a regional bus or train — though a small number of hardy commuters living outside Davis do commute by bicycle on occasion.

Figure 1. Mode share by residential location



Travel mode shares reflect the different options available for both in-town and out-of-town commuters (Figure 1). In addition, campus role and gender are both tied to residential location and, thus, mode. Most students live in Davis, as do most faculty members (who are disproportionately men), but most staff members (who are disproportionately women) live outside of Davis.

These patterns are important to consider given significant differences in commute quality by mode. Bicyclists have the highest quality commutes: For most, the commute is not stressful, they do not feel that their travel time is wasted, and they like their mode. Although the sample of walkers in this study is small, they too report low stress and disagree that travel time is wasted. The train offers the highest quality commute (next to biking) for those living outside of Davis: Train riders do not think their travel time is wasted, plus they tend to like their mode. Bus riders and car drivers fare worst: They are more stressed, feel their travel time is wasted, and like their mode less than users of other modes. Commute satisfaction follows a similar pattern: Bikers and walkers are the most satisfied, with train riders next and drivers (alone or in carpools) and bus riders far behind. Reflecting the human tendency to adjust one's preferences to one's situation, no matter how suboptimal, users of all modes are satisfied on average.

Who has the worst commutes?

Three key stories emerge when we look at the relative commute quality of different campus groups.

Living outside of Davis

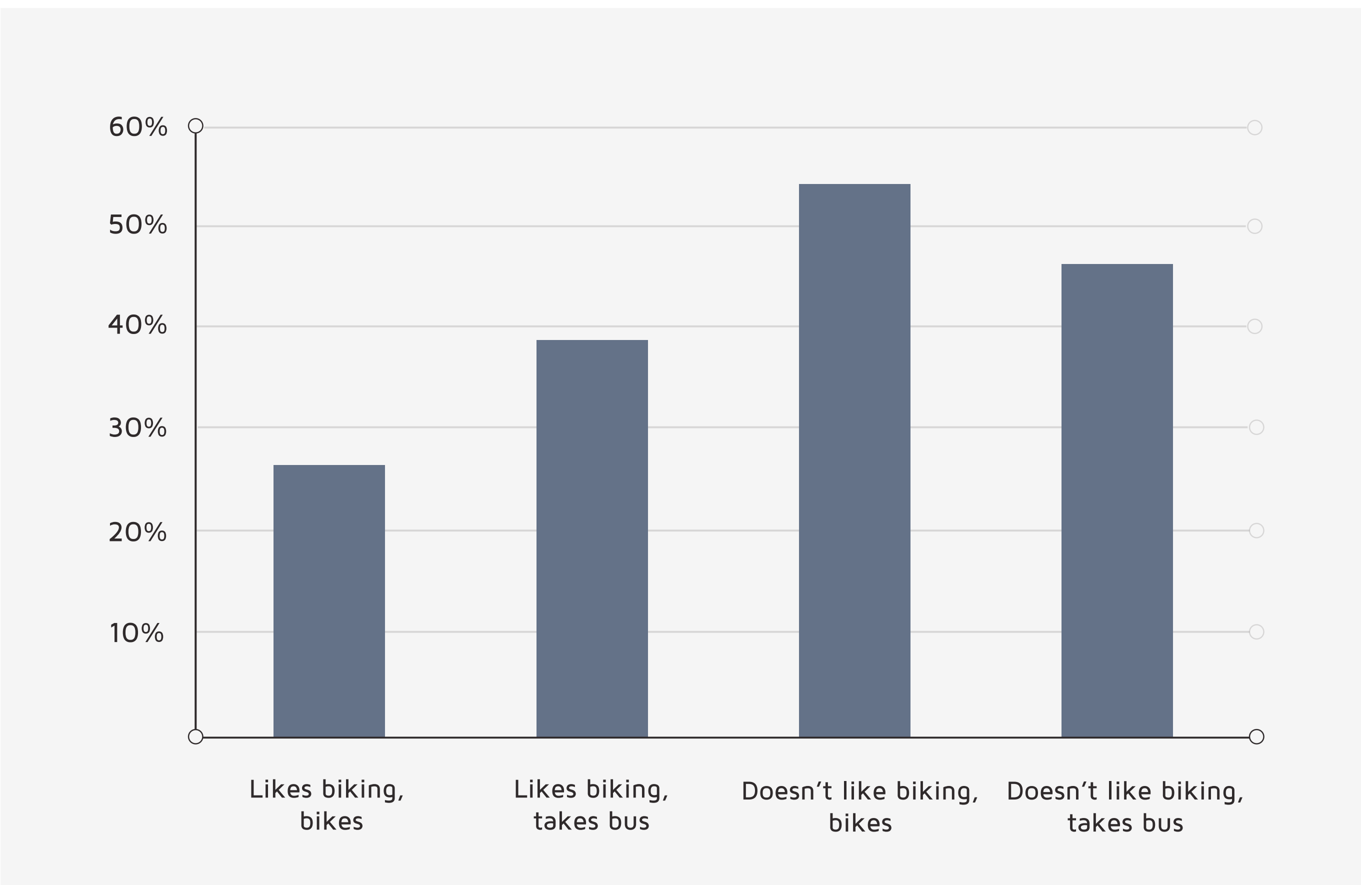
Residential location has a substantial impact on commute quality and satisfaction. Over 40 percent of those living outside of Davis report feeling stressed by their commutes. They are more likely to report that their travel time is wasted time, and they are less likely than those living in Davis to like their commute mode. While Davis residents are largely satisfied with their commutes, those living outside of the city are neutral on average. These differences are clearly tied to longer commute distances as well as differences in mode share: Owing to distances too great for biking or walking, coupled with limited transit service, nearly 80 percent of commuters living outside of Davis drive alone to campus, and as noted above, driving fares poorly on all measures of commute quality.

The story is much rosier for those who commute to Davis by train, however. Almost two-thirds of these commuters *disagree* that their travel time is wasted time, and they feel far less stressed than those who drive. Nearly nine in 10 respondents say they like their commute mode, nearly as high a rate as for bicycling. Their satisfaction levels are also high, though train commuters still report a lower commute quality compared to bicyclists and walkers living in Davis. Why more commuters do not take the train, given its higher quality, can be explained by its limited service area (a narrow corridor between Sacramento and San Jose) and its relatively high cost (though the university subsidizes the fares). The fact that many commuters living outside of Davis do not realistically have the option to ride the train adds to their commute dissatisfaction: Commuters with only one viable mode available to them are less likely to agree that they like their modes than those who have multiple options.

Undergraduates

Of all those surveyed, undergraduates report the worst commutes overall, a result related to their high share of bus commuting. Among the undergraduates living in Davis, which is most of them, nearly equal shares ride a bike or bus to campus (40 and 44 percent,

Figure 2. Percent of undergraduates agreeing that "traveling to campus stresses me out," by mode



respectively). In fact, undergraduates make up the vast majority of bus commuters, largely because they can board the university-run buses for free with their student IDs. However, four in 10 bus riders report their travel to campus stresses them out, the highest amount across all commute modes.

Why then do so many undergraduates ride the bus rather than bike, the mode that rates highest on our measures of commute quality? A dislike of bicycling may provide much of the explanation. Eighty-six percent of undergraduates who bicycle agree that they like biking, whereas just 47 percent of those riding the bus report liking biking, and 31 percent of bus riders *dislike* biking. In other words, those who take the bus might do so because biking would be even more stressful.

A closer look at the relationship between mode, mode enjoyment, and commute stress for undergraduates adds additional nuance. The students who bike and who like biking are by far the least likely to report stressful commutes of all students, while students who like biking but take the bus report stressful commutes at a much higher rate. (Why the latter students are not biking is an interesting question; anecdotally such students often cite stolen or broken bicycles as the reason.) Students who don't like biking report the most stress of all, whether they take the bus or bike (Figure 2). Is there a fundamental difference between students who like biking and those who don't with respect to their general stress levels? This is a possibility we will be exploring in future research.

Women

The situation for women is complicated. When we estimate a statistical model for commute satisfaction — controlling for location, campus role, and mode — women appear to be more satisfied with their commutes than men, all else equal. That is, when a woman and a man have essentially the same commute, the woman tends to report slightly higher satisfaction.

But all else is not equal.

Women report lower quality commutes on all three dimensions: more stress, more sense that travel time is wasted, and less liking of their modes. They are also more likely to live outside of Davis, where they have fewer commute options, and to be staff members with lower salaries on average than faculty members. Among those who live in Davis, women are less likely to bike than men, perhaps owing to greater responsibilities for childcare and other household duties.

In the interest of full disclosure, I am compelled to report that faculty members clearly have it best, with the highest levels of satisfaction and the lowest perceptions of stress and wasted time. With higher average salaries than staff, they are more likely to live in Davis, where the highest quality commute options of walking and bicycling are possible, and they may find it easier to afford the train if they live outside of Davis. But faculty are far more satisfied with their commutes even after accounting for differences in commute quality, perhaps owing to more control over their daily schedules or even to greater satisfaction in other domains as might result from greater income, job security, and intellectual fulfillment.

Improving commute quality

Like many employers, UC Davis has established the well-being of its students and employees as an important goal, for which commute quality clearly plays an important role. If an employer like UC Davis wants to increase commute quality so as to increase well-being, what can it do? Given the strong connection between mode and commute quality, two paths are possible: improve each mode to reduce stress and increase enjoyment, or enable and encourage commuters to switch to higher quality modes.

Transportation planning efforts in the region have long aimed toward the former, and our results suggest the need for improvements to bus service. But the fact that the modes yielding the highest quality commutes are also more environmentally sustainable than driving alone offers an additional reason to pursue the second aim: a mode shift. Indeed, UC Davis is now developing a comprehensive transportation demand management plan with the goal of reducing its drive-alone mode share. Shifting commuters to higher quality modes would clearly lead to higher overall satisfaction. For UC Davis, this means getting more Davis residents bicycling to campus and getting more of those who live outside of Davis commuting by train. The university already offers incentives to use these modes through its Go Club, which provides discounted train tickets, among other incentives. Of course, it is important to consider mode self-selection: Commuters generally use the modes they do for good reasons, including the satisfaction that they derive from that mode. So successfully enticing commuters into other modes might not increase their satisfaction. For example, undergraduates now taking the bus might find bicycling far more stressful and less enjoyable; employees driving alone might be less able to make productive use of time on the train than those currently taking it.

Given the likelihood many commuters already travel by the mode that suits them best, even if they aren't particularly happy with it, employers like UC Davis might do well to focus on two types of strategies. First, they might identify "mismatched" employees – employees who are not using the mode that would be the most satisfying for them. Some commuters may actually want to switch modes but need just a small nudge or a bit of assistance to do so. Second, the university might target underlying mode perceptions and preferences through social marketing techniques. In other words, they could help their students and employees see how other modes can be less stressful and more enjoyable.

Enjoying the commute mode is especially important to efforts to get people to switch. If commuters do not like something, they are less likely to choose it and will report less satisfaction when they do. We thus delved further into this question for driving and biking with an additional set of questions in the survey, focusing on the role of beliefs about these modes. Not surprisingly, bicycling scored far higher

Figure 3. Beliefs about biking and driving

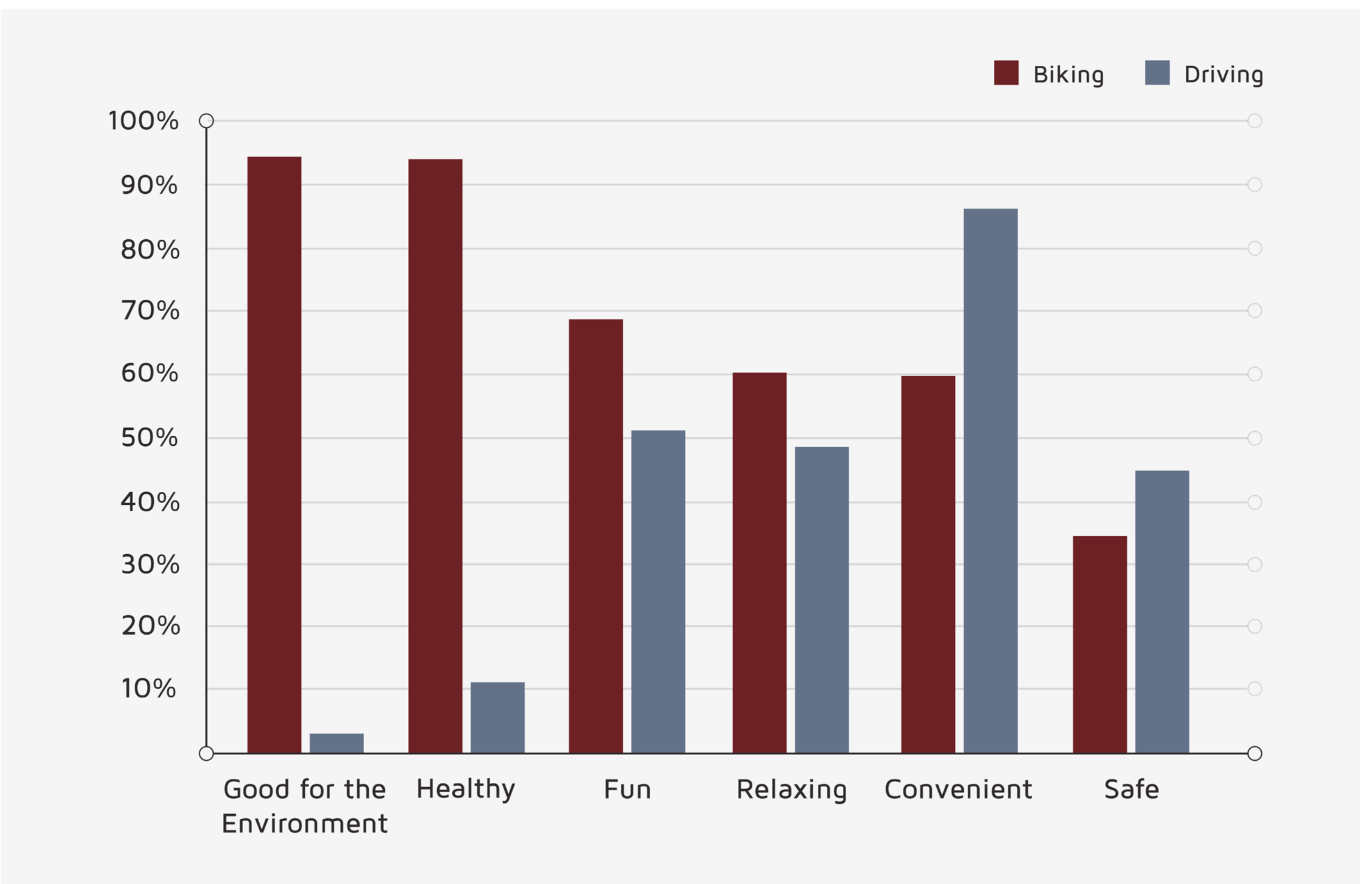
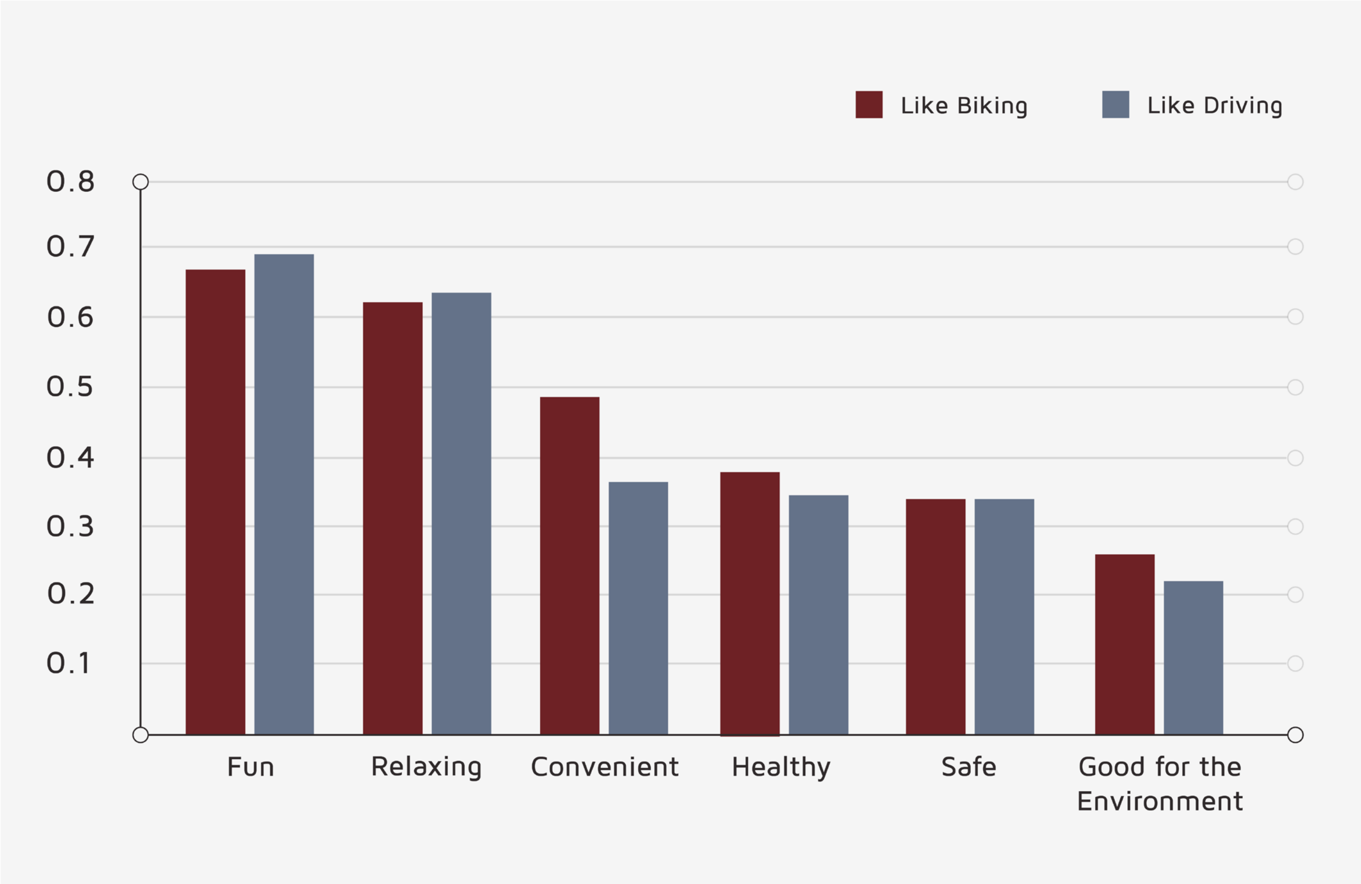


Figure 4. Correlation between liking and belief



than driving on being good for the environment and being healthy, and somewhat higher on being fun and relaxing, while driving won on convenience and safety (Figure 3). But while beliefs about the two modes differ significantly, the aspects most closely tied to liking are the same for both modes: Believing that the mode is "fun" and "relaxing" have the strongest correlations with liking the mode (Figure 4). Stay tuned for the results of my future exploration of what makes, at least for some of us, biking fun.

Hanging over this entire discussion is the question of whether students and employees are living outside of Davis by choice or necessity. If the latter, then another strategy for increasing commute quality is to increase the feasibility of living in Davis. The university already has plans for price-controlled housing for staff and faculty to be built on university-owned land; the city also has policies that encourage more affordable housing. For those who choose to live in Davis, the possibility of a high-quality commute by bicycle or at least a shorter and thus higher quality commute by car may help to compensate for higher housing costs, or even be a primary motivation for this choice. Land use policies are thus an essential complement to – and indeed an essential component of – strategies that aim to improve the quality of modes and encourage commuters to shift to higher quality modes.

Of course, this is Davis, and Davis is rather different from other places. Still, several of the findings here have general relevance to transportation professionals concerned about commute quality and its impact on well-being.

The contribution of the stress of the commute, the sense of wasted time, and the liking of the commute mode to overall commute satisfaction is certainly universal. The emergence of bicycling and walking as the highest quality and most satisfying commute modes echoes many previous studies, as does the finding that commuting by bus is far less satisfying and that train travel is far superior to bus. That some groups have worse commutes than others is also a problem everywhere, with the groups with the greatest constraints generally facing the least satisfying commutes. Together, these findings point to ways in which planners can improve commute quality. They are an important complement to the growing evidence that providing high quality options for both mode and residential location can improve commuters' quality of life.

This article is adapted from Handy, S., & Thigpen, C. (2018). Commute quality and its implications for commute satisfaction: Exploring the role of mode, location, and other factors. Travel Behaviour and Society; and Handy, S. (2019). The connection between mode beliefs and mode liking: biking versus driving. Transport Findings.

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Scaling the Summit: How De-emphasizing Transit Ridership Forecasts Inadvertently Improved Ridership Forecast Accuracy

Carole Turley Voulgaris

The history of transportation planning is rife with examples of how attempts to fix one problem have created more problems somewhere else. This is a twist on that trope: a story of how a failed attempt to fix one problem became the *solution* to an altogether different one.

In the early 2000s, the Federal Transit Administration (FTA) experimented with a new metric to better and more clearly describe the benefits of proposed transit projects, and introduced a software package called *Summit* to calculate it. The new metric largely failed to more clearly convey anticipated project benefits, but it unexpectedly and substantially improved the reliability of the most straightforward measure of transit benefits: ridership. I explore this turn of events through interviews conducted in 2016 with 13 transit professionals, composed of current and past staff from six transit agencies, three consulting firms, and the FTA (or its predecessor, the Urban Mass Transportation Administration). Collectively, the interviewees had more than 300 years of experience in the transit industry.

The problem with ridership

Ridership is the simplest way to measure the public benefits of public transit. Transit systems exist to move passengers, so the more that people ride, the greater the benefit. In prioritizing possible transit infrastructure projects, perhaps the simplest approach is to rank them based on projected ridership generated relative to its cost. When the federal government first got involved in funding new rail transit systems in the 1960s, this was the approach used. However, when these early urban rail projects started opening in the 1980s, a major problem emerged: The experts making ridership predictions were not very good at it.

In 1989, Don Pickrell published a study that painted a damning picture of the state of ridership forecasting for urban rail projects. In comparing observed ridership to forecasts for all 10 federally funded rail transit projects in operation, he found that forecast ridership exceeded actual ridership by an average of 65 percent, and as much as 85 percent. The effects of these forecasting failures continue to be felt to today. As one transit professional told me: “The Pickrell report documented some really horrendous misses, which is a reputation that the program has struggled to shake in all the years that have gone by since.”

Given that so many transit infrastructure investments had apparently been made on the basis of wildly inaccurate ridership forecasts, staff at transportation agencies responsible for allocating transit project funding looked for ways to improve forecast accuracy. As one contemporary observer told me about the reaction of federal officials to consistently over-optimistic patronage forecasts:

> I remember the Pickrell report back in the 1980s. … [In response], the Feds have said, "Alright, if the concern is that travel forecasting isn't being done right, we're going to have to spend a lot more time looking at it. …" So I think FTA has gotten more rules in as an equal and opposite reaction to other people coming in and being wide-eyed and rosy-colored glasses.

Even before the publication of the Pickrell report in 1989, Congress had authorized the Project Management Oversight program to hire independent consultants to monitor local transit agencies' development of federally funded projects to ensure that schedules and budgets were reasonable and that transit agencies adhered to them. However, this oversight did not extend to ridership forecasts, partly because they are too complex to be easily audited by people who were not involved in the process. In some cases, when the person preparing the forecasts was not involved in developing the model used to generate them, even the forecaster might not know whether the model was appropriate to the scenario being forecast. In such cases, the forecasters treat the model as a "black box" into which they input project information and accept the output ridership forecasts without knowing much about the assumptions and processes behind them.

This modeling process is incredibly complex, with opportunity to introduce error — either intentionally or accidentally — at each stage. Ridership forecasts are commonly based on regional travel demand models. Forecasters and modelers develop and maintain these models to describe all travel within a region, and apply them to a wide variety of transportation planning decisions. Travel demand models use a series of several regression equations to estimate the total number of trips that people are predicted to take between every possible pair of origin and destination neighborhoods within the region, as well as the share of trips by each travel mode (e.g., transit, driving, walking) and the specific routes travelers are expected to take.

At each stage of the modeling process, the forecaster must make assumptions about future changes in the population and economic characteristics of the region, and how people will respond to changes in travel times and costs. The output of one step in the modeling process is the input to the next. Thus, even small differences in assumptions (or math errors or typos) can be magnified with each step, having a large effect on the total ridership estimate.

Troublingly, forecast errors may not always be the result of technical errors. Forecasters may intentionally introduce error into forecasts in response to implicit or explicit pressure from clients or employers who wish to see proposed projects cast in a favorable light. In some cases, the distinction between mistakes and deliberate distortions might be unclear. If the ridership forecast for a project is surprisingly low, the forecaster (whose client or employer might hope the forecast will justify the project) can analyze the model to determine whether the low ridership forecast is the result of an error. However, if a ridership forecast is surprisingly high, the forecaster might just accept it as good news, rather than expending resources to look for an error. According to one forecaster I interviewed:

> Despite our best efforts, sometimes there are errors. … As we're doing these projects, even though they take years to go through the planning process, it seems like every time … we need a decision made and we're putting together the data, things get rushed. … And it seems like every time we do a new model run, we find something that we were missing before. … They're not just tweaks, but they're catching omissions or errors. … Those are the types of quick things that should be done regardless of where you are, but just because of time constraints, you may not focus on them unless you're running into issues with [low ridership].

Transit planners may lack motivation or resources to rigorously detect and correct for modeling errors, and these potentially flawed models are often reused for many projects over time. Given these factors, Pickrell's finding that ridership forecasts were often wildly inaccurate comes as no surprise.

Looking beyond ridership

In reaction to the demonstrated failures of ridership forecasts and subsequent attempts to improve their accuracy, some practitioners argued that emphasizing ridership as the sole or central measure of a project's potential benefits might be misplaced. Couldn't new transit projects generate benefits beyond just attracting new riders? Certainly. Transit projects might contribute to economic development or congestion relief, for example. But the economic development benefits of transit flow largely from people riding transit — to work or shop at local businesses. Congestion relief is likewise achieved when travelers choose to ride transit rather than drive their own vehicles.

But not all transit project benefits flow from added riders. Transit projects can improve service for existing riders, which isn't measured by the number of new riders. In 2001, the FTA introduced Transportation System User Benefits (TSUB) to replace ridership as the primary measure of benefits in proposed transit projects. This new measure combined the projected travel time savings for existing riders with the number of new riders to produce a dollar value of the total project benefits. Although the logic behind this calculation had a firm theoretical basis in microeconomics, it was less intuitive for those without an economics background. Relative to a simple ridership metric, the TSUB metric was hard to understand or succinctly explain.

One transit manager described how the ranking of transit projects changed when travel time savings were incorporated into the measure of project benefits:

> When I started working in project development, it was a pretty simple calculation of cost versus ridership. … Then FTA changed that to look at user benefits. And user benefit measured whether there were travel-time savings that happen from the project. When they went from just riders to that travel-time saving measure, it really changed the kinds of projects that could qualify for New Starts funds. It really benefitted long-haul light-rail projects. It benefitted commuter rail projects. Streetcar projects didn't really show particularly well because they're not really saving anybody travel time.

On the other hand, a consultant observed that, perhaps surprisingly, projects performing well by one measure generally performed well by the other:

> We did a little exercise to see how cost per hour of user benefit … correlated with cost per project trip, just to see if it really changed the playing field. To my surprise, it really didn't. The ones that were good under the old measure are still good under the new measure. So maybe it's okay.

If selecting projects based on the projected number of new riders produces roughly the same outcome as a complicated user benefits measure, then why bother with the more complicated measure? Ultimately, the complexity of the TSUB metric was its undoing. One transit manager I interviewed described how he never really understood what the TSUB measure was supposed to represent, even after sitting down with economists to have them explain it to him. Another explained how the concepts behind the TSUB measure were so complicated that when Congress passed the Moving Ahead for Progress in the 21st Century Act (MAP-21) — its surface transportation bill in 2012 — they required FTA to abandon TSUB in favor of a return to a simpler measure of ridership.

> I think the switch to user benefits was significant because it did try to capture all of the transportation benefits of a project, not just new riders. But in part it was the seeds of its own undoing because it got really complicated and it required sophisticated modeling. … In MAP-21, Congress said "Enough of that! That's too complicated!" I think this administration was also trying to step away from that kind of a measure. We ended up with cost per project trip, which to me is a step backwards because I don't think that measure is a particularly good indicator of benefit at all. You can have a lot of people riding on a project, but are they better off?

In the end, TSUB may have been a more complete measure of project benefits than ridership alone, but it was too complicated to convey those benefits in a meaningful way. On the other hand, it was complicated enough to address a major fault of using ridership as a measure of future project benefits: a lack of confidence in ridership forecasts.

Summit saves the day

The TSUB metric wasn't just complicated to understand — it was complicated to calculate, especially for a forecaster who had become accustomed to treating a travel demand model as a "black box." To make things easier, the FTA introduced a software package called *Summit* in 2003 to assist project sponsors in calculating the TSUB metric.

An FTA staff member described how the introduction of the *Summit* software package was a watershed in evaluating the underlying assumptions used in ridership forecasts. Although the purpose of *Summit* was to assist project sponsors in computing travel time savings, it had the additional effect of providing greater transparency about a travel demand model's underlying assumptions:

> An ancillary, but it turned out — in my view anyway — a more important result of the *Summit* software was that, for the very first time, it produced detailed reporting of the ridership forecasts. That was the equivalent of shining a light into a really dark box, and there was all sorts of pretty ugly stuff going on that you would normally have a very hard time finding because of the complex nature of ridership forecasting. … There were all sorts of unintended things happening. And all of a sudden, the ridership stuff got a lot more rigorous.

A consultant confirmed that, although *Summit* was no longer used after the requirement to report travel time savings was discontinued by FTA, it had a permanent effect on the accuracy of ridership forecasts. *Summit* allowed modelers to correct persistent errors in their models and improve their knowledge and understanding of travel-demand modeling:

> [*Summit*] was a big game-changer because you could actually identify and describe the major problems that the model had. Previously, you would just be lost and swimming in too many numbers, and you couldn't actually figure out what the hell was going on except at a very deep level. *Summit* allowed you to look at it … and actually see that the model's not doing a very good job at all. It found that the model-development practice and model-application practice was pretty bad. And I would say bad to the point of being almost criminal or fraudulent. … That was a complete watershed moment. We unlearned more about what we knew than I had ever learned. I've learned more about forecasting in the last 13 years than I had in the previous 13, by a country mile.

Improving existing travel demand models (and forecasters' understanding of them) was not the intended purpose of *Summit*. However, many persistent modeling errors that had been difficult to catch in black box models became obvious — and easier to correct — when forecasters started using *Summit*. The software thus became a much-needed source of quality control for travel demand models. This unintended benefit of *Summit* was soon recognized by federal staff evaluating proposed transit projects. In testimony before Congress in 2004, the inspector general of the Department of Transportation described the *Summit* software as "an important step … to help identify problems with ridership forecasts."

The switch back to ridership

With the passage of a new federal surface transportation bill (MAP-21) in 2012, Congress abandonewd the TSUB as a measure of project benefits, opting instead for returning to ridership as a simpler, albeit less comprehensive, performance measure. However, the decade of experimentation with TSUB forced forecasters to examine their models and ultimately improve the reliability of ridership forecasts.

For the 15 federally funded new rail projects completed between 2008 and 2011, forecasts still exceeded observed ridership by an average of 48 percent, but this was an improvement over the average error of 65 percent that Pickrell had found for projects in the 1980s. An even more promising sign is that, where Pickrell had found that ridership forecasts were higher than actual ridership in *every* case, four of the 15 projects (27 percent) that opened between 2008 and 2011 had actual ridership that was *higher* than the forecasts.

Furthermore, a 2016 paper by David Schmitt found that there was a significant improvement in forecast accuracy for transit projects that opened after 2007 — the year in which projects incorporating forecasts completed after the introduction of *Summit* first began to open for service. In trying (and perhaps failing) to come up with a measure of project benefits to replace ridership, the FTA improved the usefulness of ridership forecasts as performance measures.

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About the Author

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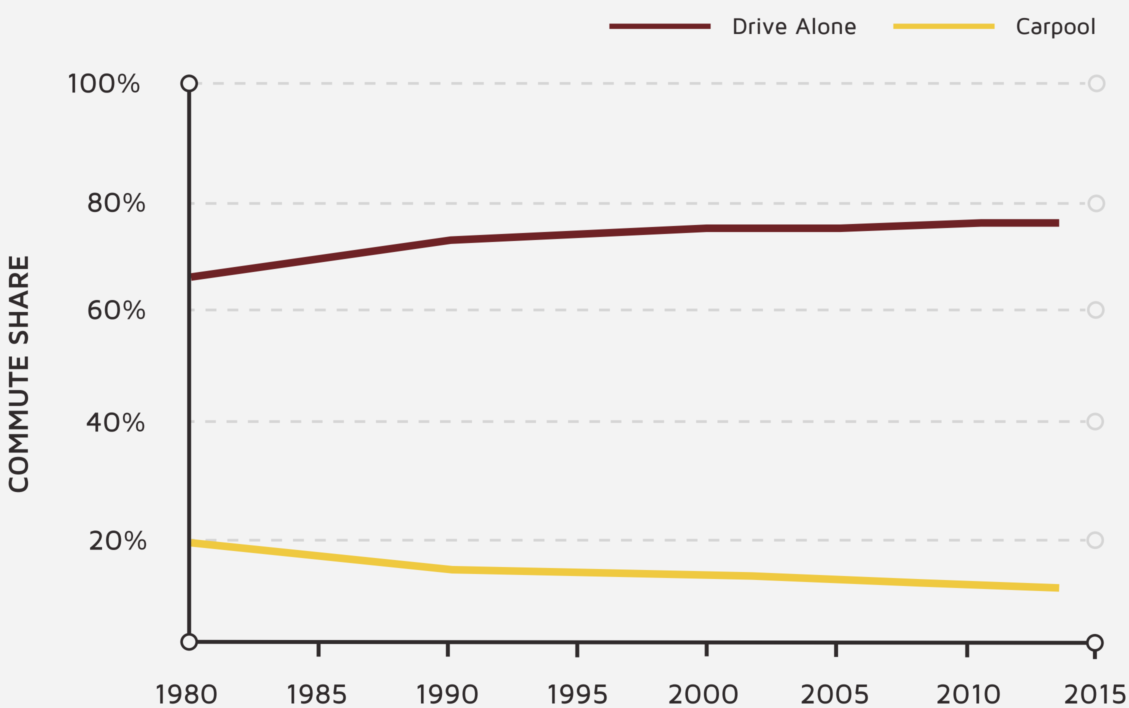
Opinion: How Lyft and Uber Can Fix — Not Cause — Congestion

Dan Sperling and Austin Brown

Studies suggest that Uber, Lyft, and other app-based ride-hailing services increase congestion by shifting some travelers away from mass transit. Such a shift is to be expected. Ride-hailing services offer users many of the same advantages as mass transit, such as the ability to avoid parking and the opportunity to travel without a driver's license. These services also typically provide greater comfort and convenience than transit while remaining relatively affordable.

We should not overlook the possibility that ride-hailing increases congestion by diverting trips from transit into multiple smaller vehicles. But neither should we overlook the even greater, yet largely ignored, potential for ride-hailing to reduce net

Figure 1: The share of workers commuting by carpool has fallen steadily since 1980.



Data from the U.S. Census Bureau

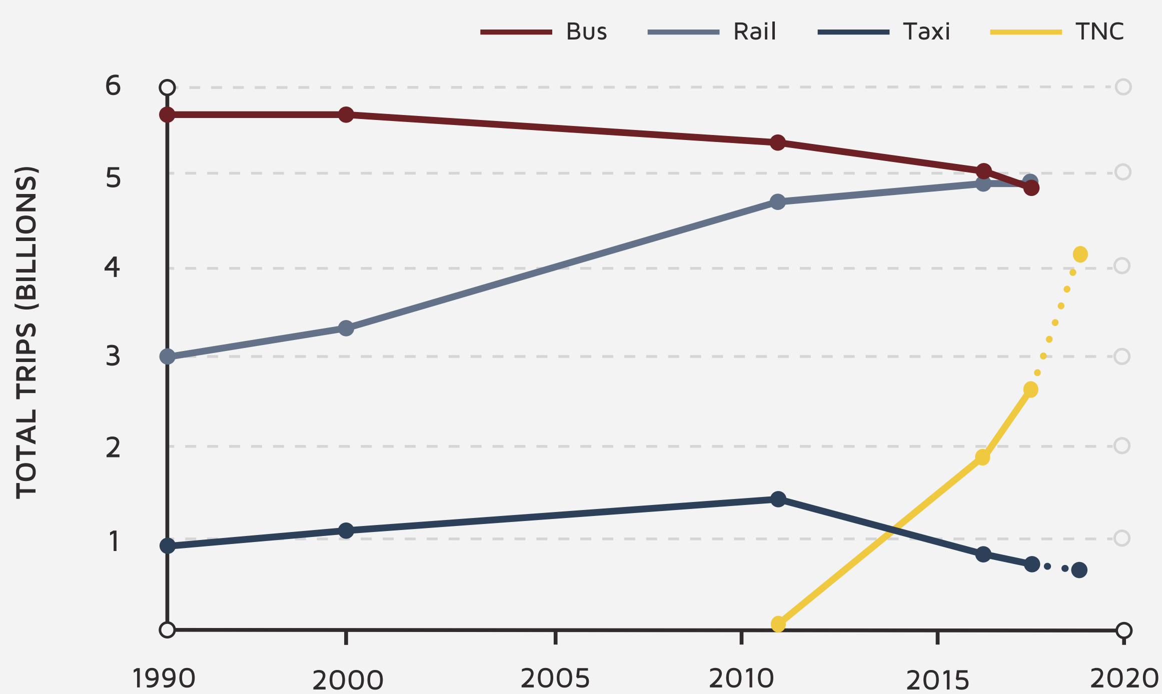
congestion — namely, by facilitating multi-passenger pooling.

Since the 1970s, policymakers have invested billions of dollars building a web of carpool lanes in most major U.S. cities. Yet pooling never caught on widely. Indeed, pooling steadily declined from about 20 percent of commute trips in the 1970s to less than 10 percent now (Figure 1). Each car on the road in the United States today contains an average of 1.6 passengers, and more often than not vehicles are occupied only by the driver.

Ride-hailing services could vastly increase the market share of pooling. The popularity of services such as Uber, Lyft, and Via proves people will pool as long as it is easy, convenient, and reliable. And when people pool, everyone wins. Sharing a ride with just one other passenger effectively halves the travel cost per rider and reduces negative externalities of driving — including congestion — for society as a whole. This is particularly important for work commuters, since their trips tend to occur during peak hours, in peak directions of travel, and originate in or end at business districts where both parking and road space are at a premium.

What's more, app-based pooling can increase equity by expanding transportation options for those not eligible to drive, who can't afford a car, and/or are poorly served by transit. Pooling can also reduce noise, local air pollution, and greenhouse gas emissions by providing more transportation service per mile of vehicle travel. Fully realizing these benefits involves addressing some open challenges. Service providers will need to figure out how to best serve the unbanked and those without access to smartphones, while policymakers will need to figure out how to incentivize use of electric vehicles in pooling fleet.

Figure 2. Transportation network companies (TNCs), like Uber and Lyft, have rapidly surpassed taxis' trip share and are approaching that of buses and rail.



Source: American Public Transportation Association, U.S. Census, Schaller Consulting (2018)

In “Three Revolutions: Steering Automated, Shared, and Electric Vehicles to a Better Future,” we argue that pooling is one of the most important innovations for achieving sustainable transportation.

Public officials should not just allow app-based pooling systems — they should champion them. We acknowledge valid concerns that app-based pooling may detract from public transit in some areas. But transit is already suffering across the country. Bus ridership has been declining for the past two decades (Figure 2) and funding for improving mass transit is limited. When thoughtfully deployed, app-based pooling can do much to support and improve public transit. For example, app-based pooling can provide first/last mile access to major transit stops and stations. It can also provide coverage during times when transit is not cost-effective, such as at night.

Unfortunately, policymakers have been generally slow to embrace these solutions. Chicago, for instance, imposes an $0.72-per-ride fee on all ride-hailing companies. This blanket fee does not differentiate between single-rider trips, which do little to reduce the negative external costs of driving, and pooled trips, which do. Chicago is not unique. As we go to press in May 2019, nine cities and 11 states have some sort of ride-hailing fee on transportation network companies (TNCs) like Uber and Lyft. Only New York City provides any citywide break for pooled rides.

New York City also recently approved congestion pricing in lower Manhattan — a move that will incentivize pooled travel for personal vehicles. In an open letter to the governor, a diverse coalition of transportation experts and stakeholders supported lower congestion fees for pooled travel. We agree and suggest a very steep discount for pooled trips, which will help manage congestion and address legitimate equity concerns.

Many transit agencies and other regional actors are experimenting with partnerships that take advantage of ride-hailing services while meeting transportation goals. For example, UCLA partnered with Lyft to offer flat Lyft Shared rates in the UCLA area. Lyft has also set up a large and growing number of pilot projects with transit providers.

Airports are also setting good examples for smart pooling policy. Airports are often governed by special districts that can set fees outside of state and local rules. Some airports are taking advantage of this capacity to manage ride-hailing traffic by encouraging pooling. In October 2019, for instance, the Massachusetts Port Authority will reduce fees by $1.75 for rides that are shared at Boston Logan Airport. Ride-hailing services will also be required to use “ride-matching” programs that discourage travel without passengers.

Ride-hailing companies loom large in public discourse, but still account for a relatively small share of trips taken in the United States — and hence have so far had relatively modest impacts on driving behavior, public transit use, and congestion. This may change with the advent of automated vehicles that could dramatically reduce ride-hailing service costs, leading to dramatic increases in ride-hailing use.

Now is a critical time to develop policy frameworks favorable to pooling in an era of wide availability of ride-hailing.

Cities reasonably want to regulate app-based ride-hailing services to protect public transit and to generate income. Such policies should be carefully designed to support pooling, discourage empty miles, and encourage transportation innovation. The vast majority of congestion, pollution, and equity problems that our societies face stem from the dominance of private vehicles in transportation systems, not from ride-hailing. Strategic, research-based policy can steer these systems to a more sustainable future.

A version of this article was originally posted as a blog in Planetizen. It has been updated and revised.

Further Reading

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About the Authors

Dan Sperling is founding director of the UC Davis Institute of Transportation Studies and distinguished professor of civil engineering and environmental science and policy. He also is a member of the California Air Resources Board and lead author of "Three Revolutions: Steering Automated, Shared and Electric Vehicles to a Better Future."

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