Fare Choices

A Survey of Ride-Hailing Passengers in Metro Boston

Report #1

MAPC
METROPOLITAN AREA PLANNING COUNCIL

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Header Photo via Uber

Executive Summary

The ride-hailing industry, led by Uber and Lyft, has seen explosive growth in recent years. As more and more travelers choose these on-demand mobility services, they have the potential to transform regional travel patterns. These transformations may become even more profound if widespread adoption of autonomous vehicles makes on-demand mobility even less expensive and more efficient. Either way, it is likely that the use of ride-hailing today is but the tip of the iceberg, with an even greater expansion of these services to come.

This transformation in personal mobility is likely to bring a host of changes: some positive, others less so. For public agencies, planning for that transformation is made difficult by the paucity of information about ride-hailing trips. Conventional transportation surveys have been slow to measure the change in behavior; and transportation network companies see their data as a valuable commodity and are unwilling to provide it to transportation planners.

Photo via Lyft

Public sector access to these data is essential. **Only with a better understanding of this new mode of transportation can analysts develop better forecasts of travel behavior and infrastructure needs, measure the region's progress toward a more sustainable future, and establish more efficient operations and management practices for existing roadways.**

In an effort to begin filling those gaps in our understanding of the ride-hailing industry and its users, MAPC surveyed nearly 1,000 ride-hailing passengers in late 2017 and asked about their demographics, the nature of their trip, and why they chose ride-hailing over other modes of transportation.

The results confirmed many common assumptions about ride-hailing users; they also provided striking new insight into the ways that the services are changing travel behavior and affecting our existing transportation system. Not surprisingly, the survey found that **most ride-hailing users are under the age of 35, that most of them use the service on a weekly basis, and that most don't own a car.** Less predictably, we found that reported rider incomes are similar to the region overall, and a substantial number of trips are made by people from households earning less than $38,000 per year. (And no, they're not all students; most of those lower-income riders are in the workforce.)

The survey results also provide some hard data about the types of trips made via ride-hailing. Most trips start or end at home, but nearly one-third (31%) are from one non-home location to another. Ride-hailing usage is distributed throughout the day; the evening hours from 7:00 P.M. to midnight see the greatest frequency of trips, but about 40% of weekday trips take place during the morning or afternoon commute periods. People also like to travel by themselves: only one-fifth of customers opt for a truly shared ride (e.g., UberPOOL), and the majority of travel is for a single passenger. Riders are willing to pay a substantial premium for the convenience and predictability of ride-hailing. Nearly two thirds of trips cost more than $10, and one in five costs more than $20.

While the services are justifiably popular, their growing use may result in negative outcomes for traffic congestion, transit use, and active transportation. When asked how they would have made their current trip if

ride-hailing hadn't been an option, 12% said they would have walked or biked, and over two-fifths (42%) of respondents said they would have otherwise taken transit. Some of this "transit substitution" takes place during rush hours. Indeed, we estimate that 12% of all ride-hailing trips are substituting for a transit trip during the morning or afternoon commute periods; an additional 3% of riders during these times would have otherwise walked or biked. **Overall, 15% of ride-hailing trips are adding cars to the region's roadways during the morning or afternoon rush hours.**

Notably, we found that this "transit substitution" is more frequent among riders with a weekly or monthly transit pass. Those who ride transit more often are more likely to drop it for ride hailing, even while doing so at a huge cost differential, and even when they have already paid for the transit.

Riders without a transit pass opting for ride-hailing, on the other hand, means less fare revenue for the MBTA. After accounting for transit pass availability and substitution options, we estimate that **the average ride-hailing trip represents 35 cents of lost fare revenue for the MBTA.** This lost revenue exceeds the amount of the legislatively mandated 20 cent surcharge on each ride. That surcharge itself represents a remarkably small fraction of trip costs. When compared to reported fares, **the surcharge amounts to less than 2% of the cost for most rides.** Because it is a fixed fee, long and expensive rides that may have the greatest impact on traffic congestion and air quality pay 1% or less.

Photo by Anty Diluvian

These findings begin to provide a better understanding of this evolving mobility option that will undoubtedly continue to change the way people travel around the region. Our results raise concerns about how users are becoming accustomed to on-demand mobility, and what that means for the future of the region's transportation system. Even if future ride-hailing vehicles were fully electric and autonomous, the region's roadways could not accommodate unchecked growth in single-occupant vehicle travel. It is essential to ensure that the region has a reliable and effective transit system that—from the rider's perspective—is competitive with and complementary to on-demand mobility services. For transit to thrive, it must change, perhaps by incorporating the types of on-demand response and real-time information that riders value.

Meanwhile, there is a great need to understand the effects of ride hailing and to ensure a balance of benefits and costs resulting from these commercial services. Ride hailing is already having substantial impacts on congestion and transit revenue, the costs of which are not recouped by the small surcharge. A higher fee would provide more resources to mitigate the negative effects of ride hailing without substantially affecting rider costs. Even more preferable would be a fee structure proportional to the impacts of each ride on the transportation system. To the extent possible, such fees should also be structured to incentivize shared trips, thereby reducing overall impacts on the transportation system while also accommodating ride-hailing preferences. Of course, effective policy requires better data about when, where, and why ride-hailing trips are taking place. Only by understanding the current adoption of ride-hailing and on-demand mobility can we plan for its successful and sustainable future.

Introduction

All signs are that ride-hailing is just the beginning of a coming transportation revolution. In less than a decade, ride-hailing services[1] such as Uber and Lyft have dramatically altered the way that residents, workers, and visitors travel. Rider adoption of these services has proceeded much more quickly than our understanding of their impacts—which have been major. Public analysis of the effects of ride-hailing services on the transportation system has been hindered by a scarcity of meaningful data made available by the ride-hailing companies, which are private. Indeed, the public agencies responsible for managing congestion and providing transit service are unable to describe who uses ride-hailing services, what types of trips are being made with this new shared mobility option, what benefit riders gain from the service, and how the adoption of this emergent mode of transportation influences more established travel modes. Especially insofar as ride hailing may foreshadow the future of autonomous on-demand mobility, it is critical that public agencies have access to information that will allow them to plan for systems that are fair, efficient, and sustainable. Data about ride-hailing usage are essential for more accurate travel demand forecasting, real-time congestion management operations, and the creation of policies that will ensure the environmental sustainability of this new mode of travel.

In the face of this information scarcity, MAPC has undertaken an initiative to develop new sources of data and knowledge about ride-hailing and on-demand mobility. The first project in that initiative—an in-vehicle survey of ride-hailing users intended to assess who is using ride-hailing services and why—has yielded results of interest. Future work products will include more detailed analysis of these survey results and analysis of other data being collected about the location, volume, and routing of ride-hailing trips. In concert with other regional and national research on this topic, MAPC will provide information and insight that will allow for better ride-hailing-related public policy, including taxation policy, regulation, and public-private partnerships. MAPC will continue to analyze these survey results and plans to release them for investigation by others once our analysis is complete.

The main questions addressed in this report are as follows: Who is using ride-hailing services in the Metro Boston region? At what time of day? How often? For what kinds of trips? To what extent do ride-hailing services compete with or complement public transit and other travel modes? What is the extent of trip sharing? Is there evidence that ride-hailing trips are aggravating congestion? How much are people paying to use these services? Survey results confirm many assumptions about these questions, but also provide new insights that have immediate relevance for public policy.

The sections below describe the methods used to conduct the survey, provide an overview of the findings, examine key issues related to transit substitution and costs, and finally assess policy implications.

Background

The rapid growth in ride-hailing services nationwide has been accompanied by a contrastingly slow development of information and data about their use. This is unfortunate, because more information about ride hailing is needed to plan for the successful and environmentally sustainable future of this mode of transportation. Transportation modelers need information about personal choices so they can forecast future travel demand. Municipal planners need to understand how patterns of ride-hailing demand should inform building design and parking requirements. Public officials must ensure that certain neighborhoods are not being unfairly impacted or excluded from the services. All of these are critical public sector undertakings which require information about ride-hailing usage.

[1] For purposes of this report, the term ride-hailing services refers to an organization that uses mobile applications and the internet to allow people to secure individual and carpooling rides from drivers in non-commercial vehicles. The term ride-hailing services can be used synonymously with transportation network company (TNC).

However, the nature of ride hailing and its position outside of existing regulatory systems has made it difficult for public agencies to access the data they need. Ride-hailing companies view the information about their users and their users' trips as a significant data asset, and are therefore reluctant to share it with public sector agencies except in highly generalized formats.

The Uber Movement[2] data product, for example, provides estimated travel times between traffic analysis zones or census tracts at various times of day or day of the week. While Uber Movement allows users to look at generalized patterns over a period of time, it provides no information about the number of trips to or from a given area, nor the time of day when travel occurred. In January 2015, Uber signed an agreement with the City of Boston to provide information about trips in the city, but the data was aggregated to zip codes and included little other information. Boston was also prevented by Uber from sharing the data with MAPC.[3]

In 2016, the Massachusetts Legislature enacted legislation regulating the ride-hailing industry.[4] That legislation established a regulatory structure and levied a 20 cent surcharge on each ride. In 2017, regulations were enacted that require annual data reporting requirements.[5] However, companies are required to report only the city or town where each ride began and ended, and highly aggregated data about route miles and time. As a result, the resulting submittals still fall short of the information needed to truly understand ride hailing in the region.

Despite the limited data sharing with the public sector, there is abundant information about ride-hailing customers that can be acquired on the private market. In addition to the ride-hailing applications themselves, the ride-hailing industry offers accessory applications that track mileage, calculate taxes, predict "surge pricing," find the cheapest gas, and more. Many of these applications also track the location of ride-hailing vehicles as well as information about each trip, and are willing (and permitted) to sell this information to other parties. However, even these data sources are off limits to public agencies, which, because of the state's public records law, cannot comply with strict nondisclosure agreements.

Due to these limitations on data availability, MAPC has begun an initiative to collect information about ride hailing directly from riders or other sources. The following section describes the results of our first survey effort which took place in late 2017.

Survey Administration

MAPC conducted an in-vehicle intercept survey of ride-hailing passengers during a four-week period in October and November 2017. The survey instrument was administered by ten ride-hailing drivers recruited and trained by agency staff. Each participating ride-hailing vehicle was equipped with an electronic tablet and printed signs asking riders to complete the survey during their trip. The survey instrument recorded passenger responses to questions about their socioeconomic background, specific trip context, and general travel patterns and behaviors. Survey questions were developed by MAPC staff in consultation with the Central Transportation Planning Staff, the agency responsible for travel demand modeling in the Metro Boston region. The survey contained 18 questions and took approximately three minutes to complete.

The survey instrument was administered using the Survey Monkey application installed on a cellular-enabled Samsung Galaxy Tab A 7" 8GB tablet. Both English and Spanish language versions of the survey were available on the tablet. The Spanish translation was prepared by a professional translation service.

[2] https://movement.uber.com/cities?lang=en-US

[3] Adam Vaccaro, *Highly touted Boston-Uber partnership has not lived up to hype so far,* Boston Globe; June 16, 2016. https://www.boston.com/news/business/2016/06/16/bostons-uber-partnership-has-not-lived-up-to-promise

[4] *An Act Regulating Transportation Network Companies* https://malegislature.gov/Laws/SessionLaws/Acts/2016/Chapter187

[5] 220 CMR: 274: Transportation Network Companies. https://www.mass.gov/files/220_cmr_274_00_final_9-22-17_1.pdf

I'm assisting the Metropolitan Area Planning Council, a state agency, to conduct a survey to learn more about transportation choices in the Boston region.

Would you help out by completing a short survey about this ride?

You can be eligible to enter a drawing to win a $100 Amazon gift card!

Thank you!

Estoy ayudando al Metropolitan Area Planning Council (MAPC), una agencia estatal, a realizar una encuesta para tener más información acerca de las opciones de transporte en el área de Boston.

¿Podría ayudarnos completando una breve encuesta sobre este "viaje" (*ride*)?

¡Puede participar en un sorteo de una tarjeta de regalo de Amazon por un monto de $100!

¡Gracias!

MAPC
METROPOLITAN AREA PLANNING COUNCIL

Image 1. Sign placed inside ride-hailing vehicle asking passengers to complete survey.

Riders were made aware of the survey via two bilingual laminated signs placed on the headrest and dashboard of each ride-hailing vehicle (**Image 1**). To promote survey responses, participating riders were offered the chance to win a $100 Amazon gift card in exchange for completing the survey and providing an email address after the last question. Two $100 Amazon gift cards were awarded to survey respondents selected by a drawing, and 75% of respondents entered the drawing.

Ride-hailing drivers were recruited in three ways. MAPC had previously conducted a focus group of ride- hailing drivers, and eventually recruited two drivers from this group. Second, MAPC worked with an app provider to send a message to their Boston area drivers about participating in a compensated study about travel choices in the Boston metro region. Two drivers were recruited by this method of outreach. MAPC then placed a recruitment posting on two ride-hailing Facebook user group sites[6] and recruited six drivers. Through these methods of outreach, nearly 50 candidate drivers expressed interest by responding to a short survey administered via SurveyMonkey. We selected the ten full-time interested, available drivers who had been driving the longest, who had expressed interest in participating, and who were available during the study period. The majority of selected drivers had been driving for ride-hailing companies between two–four years. Of the ten selected drivers, three drove exclusively for Lyft, one drove exclusively for Uber, three drove for Uber and Lyft, two drove for Uber, Lyft, and Fasten, and one drove for Uber, Lyft, and Safr.

The recruited drivers individually met with MAPC staff prior to survey implementation for an orientation that covered the survey content and tablet operations. MAPC provided an instruction sheet for each driver and installed two signs in each vehicle (dashboard and backseat) informing passengers about the survey. After the survey period, each driver received a $200 stipend for their participation. As an incentive for drivers to participate and to promote survey responses, MAPC provided an additional stipend to the drivers of $2 for each fully completed rider survey. The per-survey incentive was $1 at the beginning of the survey period, but was raised to $2 per survey about halfway through. Each completed survey also entered the driver into a raffle for a $100 Amazon gift certificate. During the survey period, each driver was periodically contacted by text message, and drivers were encouraged to contact MAPC if they had any questions. Drivers were compensated after the surveys were validated and the tablets returned.

Photo via Uber.

Following the survey period, MAPC audited the survey response time stamps from each driver to confirm response validity. A total of 944 completed and valid responses were collected during the four-week surveying period, with 927 surveys conducted in English.

[6] *Uber Lyft & Professional Boston Drivers and Boston Lyft Drivers*

Survey Findings

Demographics of Survey Respondents

Survey participants were asked a series of questions pertaining to their sociodemographic and economic background and mobility options. Specifically, self-reported answers of the respondent's age, gender, education, race and ethnicity, work status, and household income were provided; as well as information about vehicle ownership, transit pass possession, and home zip code. The responses to these questions provided meaningful insight into the profile of ride-hailing passengers in the Metro Boston region as well as a comparison point to those existing studies conducted in other major metro regions.

In our survey, the overwhelming majority of respondents (766 riders, 82% of the total) were born after 1983. Of this cohort, 603 reported being between 22 and 34 years old. This reported age group constituted nearly two-thirds of survey respondents, as compared to its representation as one-quarter of the overall population in the MAPC region **(Figure 1)**. The prevalence of this age group among ride-hailing users is much higher than observed in prior research, such as a 2017 study[7] of ride-hailing adoption in seven regions (including Boston), which noted that 18 to 29 year olds accounted for a mere 36% of ride-hailing users. It is possible that the predominance of these younger survey respondents may reflect some response bias if younger riders were more motivated by the $100 gift card incentive than were older and presumably more affluent riders. However, it remains reasonable to conclude that riders younger than 35 years old comprise a substantial share of ride-hailing users, and that their adoption of the services (in the Boston region, at least) may be even more prevalent than previously thought.

Survey results also show that older adults are much less likely to be using ride-hailing services. Residents 65 and over comprise 16% of the MAPC population but less than 1% of the survey respondents. With the aging of the Baby Boomers, people over 65 will be the fastest growing segment of the population in the coming decades, and their adoption (or lack thereof) of ride-hailing services could have a substantial impact on traffic congestion and senior mobility.

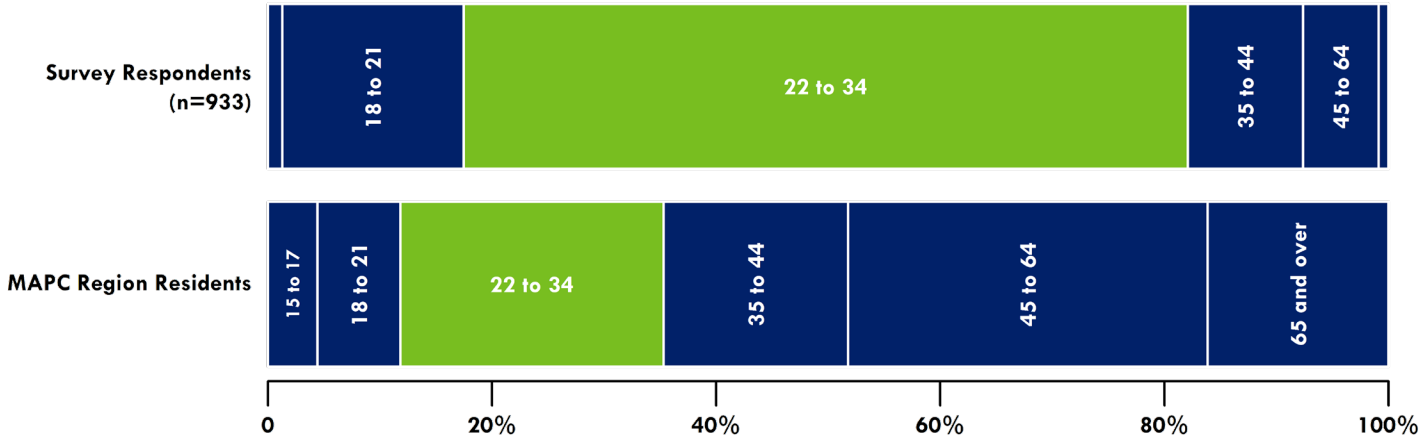

Figure 1. Age of surveyed riders compared to age distribution of region residents.

Survey results were evenly split by gender, with a slight majority of respondents identifying as female (55%).

Ride-hailing users are much more likely to be college graduates than the population overall. Two thirds of all respondents reported having a college degree (70%), and one-quarter of all those surveyed noted having an advanced degree, versus 36% with a college degree and 17% with an advanced degree regionwide.

7 Clewlow, R.R., & Mishra, G.S. (2017). Disruptive transportation: The adoption, utilization, and impacts of ride-hailing in the United States (Research Report – UCD-ITS-RR17-07).

In terms of race and ethnicity, 67% of respondents reported being White and non-Hispanic or Latino and 10% identified as Hispanic or Latino. Thirteen percent of riders were of Asian descent, and 7% identified as Black or African American. The overall distribution of surveyed riders was similar to the MAPC regional population distribution, with Asian (8% of population) passengers being oversampled and White (72% of population) passengers being slightly underrepresented in the intercept survey.

About three-quarters (74%) of the respondents reported having either full-time or part-time employment, including riders who are both working and enrolled in school (9%). Twenty-four percent of riders were students not currently working a full-time or part-time job. Only 2% of surveyed passengers were unemployed or retired. When combined with income, the additional aspect of labor force participation, the potential prevalence of ride-hailing services as a viable mobility option for lower-income households is highlighted.

The majority (85%) of surveyed ride-hailing passengers resided in Massachusetts. Of those respondents, 94% reported their home postal ZIP code was within the MAPC region, with 90% living in the inner core subregion. Nearly two-fifths (39%) of all surveyed riders were Boston residents.

The survey asked respondents to provide an estimate of their total household income **(Figure 2),** with income bands selected to correspond to the categories used for prior transportation surveys and existing travel demand models in Massachusetts. Over four-fifths (83%) of survey respondents provided a response to this question. Surprisingly, the highest frequency of respondents reported annual household earnings less than $38,000; and their share among ride-hailing users (26%) is comparable to the MAPC region overall, where 28% of households have incomes less than $40,000 per year. Among the riders in the lowest income category, 57% reported having part- or full-time employment, while 41% were students presently not employed. Riders with household incomes of $38,000 to $60,000 per year comprised the next largest category of respondents, 22% of the total, making them overrepresented among riders as compared to the region overall (15% of all households). Approximately 35% of riders are from households with incomes of $60,000 to $137,000 per year, a figure similar to the MAPC region estimate of 35%. Finally, highest income households (above $137,000 per year) were slightly underrepresented among the survey respondents, making up 17% of responses and 23% of the region. It should be acknowledged that 20% of respondents did not answer this question, and there is potential that the availability of the gift card incentive may have prompted a higher response rate among lower-income riders. Nevertheless, the results suggest an unexpected conclusion that ride-hailing users have incomes comparable to the region overall, and, if anything, may skew more to the low-middle of the range than the higher end of the income range.

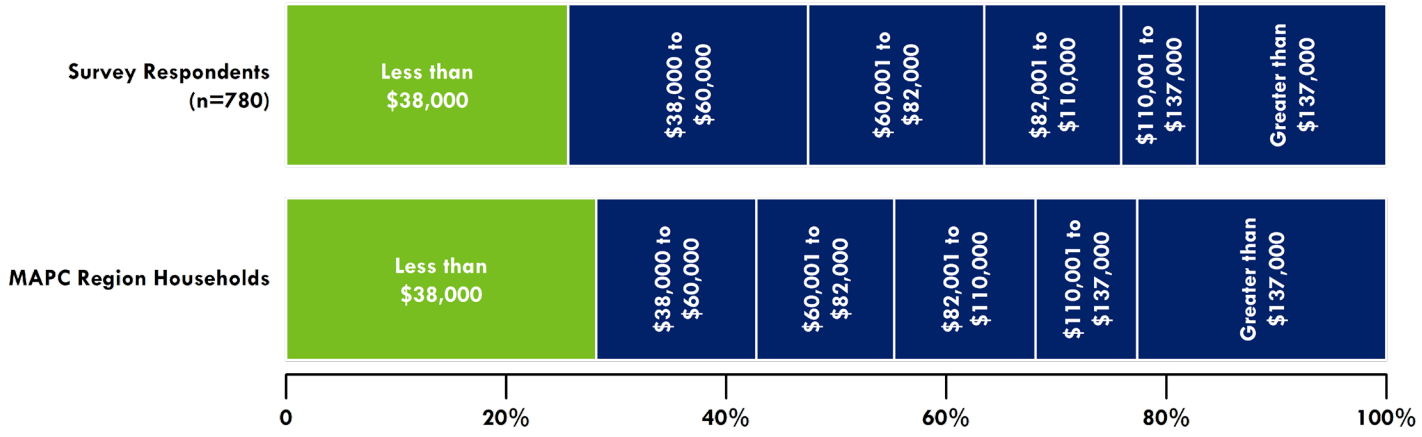

Figure 2. Annual household income of surveyed riders compared to income distribution of region households.

Survey respondents were asked to report what mobility options, other than ride-hailing services, were available to them **(Figure 3).** While nearly two-thirds (64%) of ride-hailing users lived in a household that owned at least one auto, only 45% of the riders had a car available for their own personal use. Fourteen percent of respondents without a personal vehicle had a carshare membership. When compared to the region, however, the

survey respondents were much more likely to come from a zero vehicle household and much more likely to own a T pass than the overall population. About 35% of riders have a weekly or monthly MBTA pass, indicating that a substantial share of ride hailing users are also regular transit riders. About one quarter (23%) of respondents noted having a personal bike.

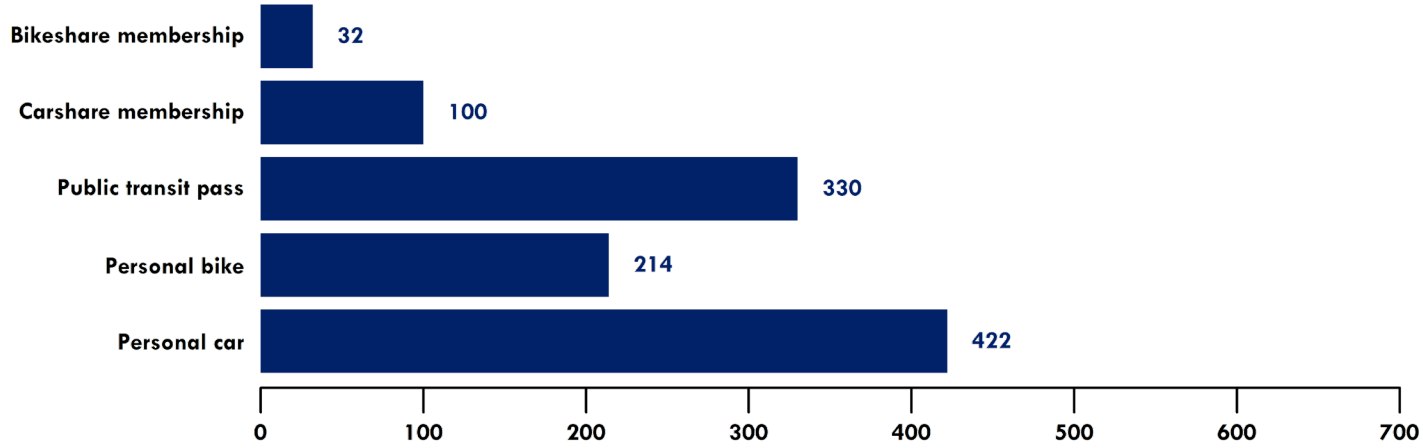

Figure 3. Mobility options of surveyed riders.

Ride-hailing Trip Characteristics

In addition to user demographics, the survey also sought to describe the context of the recorded trip. In order to understand how individual travel behaviors are influenced by the emergence of this new mobility option, the survey included questions about the type of ride-hailing service chosen, the purpose and destination of the trip being conducted, and the approximate cost of the ride. This evidence is helpful to public agencies looking to understand why residents, employees, and visitors are adopting these services, and how their utilization may expand in the future.

Four-fifths of surveyed trips were performed using standard single-customer services rather than pooled options such as Lyft Line or UberPOOL. Across both service types, a majority of users noted being the sole rider in their party **(Figure 4)**, which substantiates the longstanding trend in private vehicle use toward single-occupant travel. The one-third share of two-plus-person parties among pooled rides suggests strategic requests for less-expensive, pooled services by larger parties who anticipate the driver will not be able to pick up additional riders because of vehicle capacity constraints.

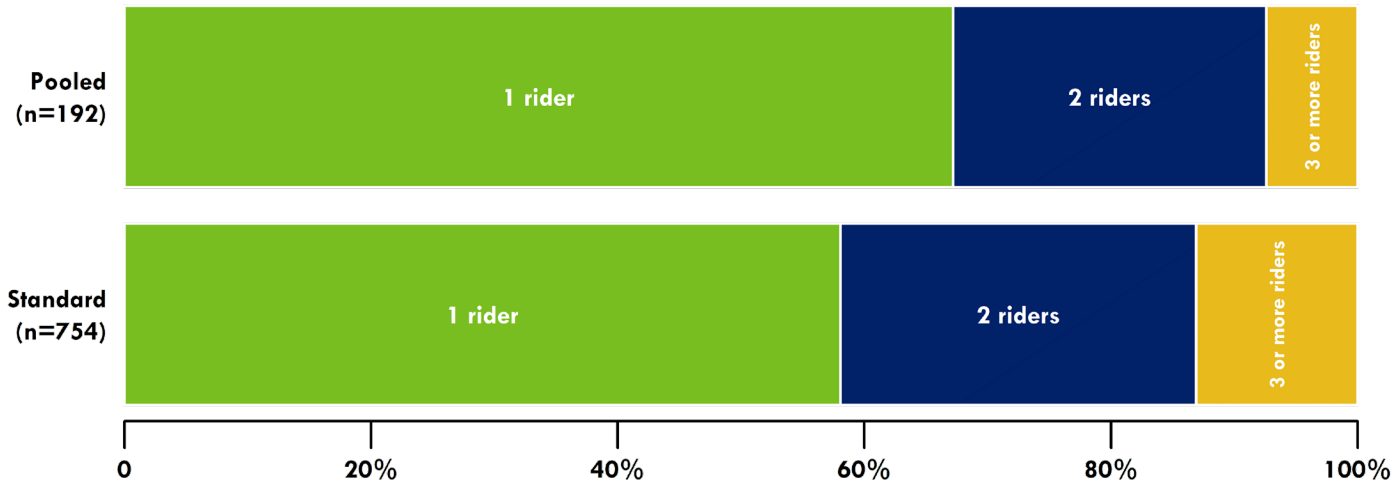

Figure 4. Party size per type of ride-hailing service for surveyed riders.

Unlike prior surveys of ride-hailing adopters, the cost of the ride was directly asked in our instrument **(Figure 5)**. About 36% of trips cost less than $10, roughly equivalent to a fare for a five-mile trip, not including any additional costs such as tolls, waiting time, surge pricing, or tip.[8] The largest share of trips (43%) cost between $10 and $20, and approximately 21% cost more than $20, which would be the fare for a 12-mile trip absent any additional costs. Comparing these results to the recently-enacted per-trip fee of $0.20 indicates that the fee on most rides is equivalent to less than 2% of the fare, and for the most expensive rides the fee is less than 1% of the total fare. With base fares of $5 for Lyft and $6.60 for Uber, the $0.20 fee is never greater than 4% of the total fare.

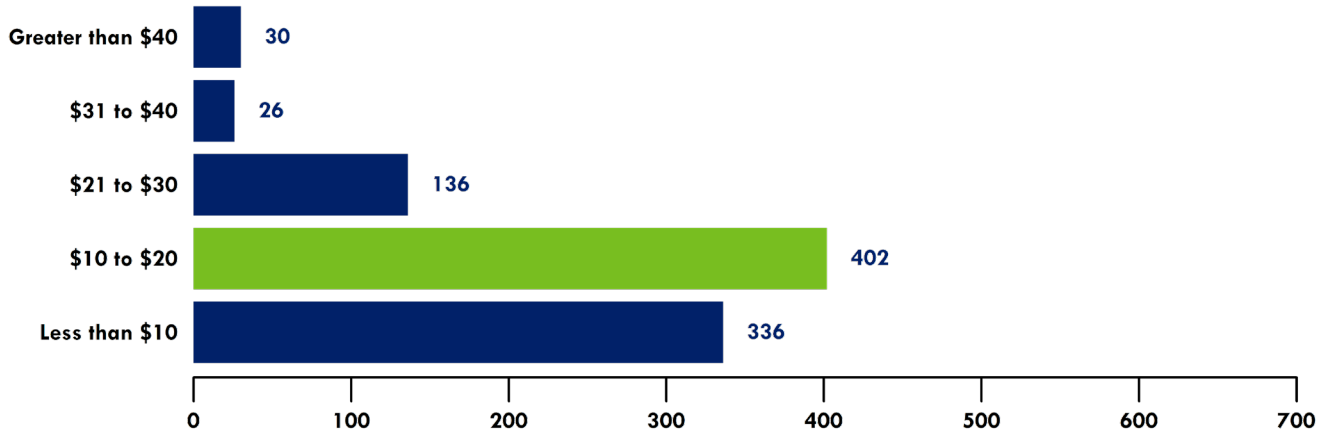

Figure 5. Monetary cost of surveyed trip.

The survey also asked about the nature of the trips for which riders are using ride-hailing services **(Figure 6).** About two-thirds (68%) of ride-hailing trips started at a location other than the respondent's home, and 58% of these trips ended at the rider's home. In other words, about 31% of ride-hailing trips start at home, and 40% end up there. For trips originating at home, the three most popular activities at the trip destination are work, entertainment, and social visit. For home-bound rides, about one-third (35%) originate from an entertainment venue. Approximately 31% of trips go from one non-home location to another, principally entertainment and work locations. This finding highlights the prominence of ride-hailing services as a mobility option for individuals traveling between multiple activity locations outside of the home. The survey did not provide much evidence that residents are using ride-hailing as a "first mile" or "last mile" connection to transit services that are nearby but beyond walking distance. About 9% of home-based ride-hailing trips were used to reach a transit connection, including subway stops, commuter rail stations, bus stops, and Logan Airport; whereas, 4% of trips returning home were from a transit connection.

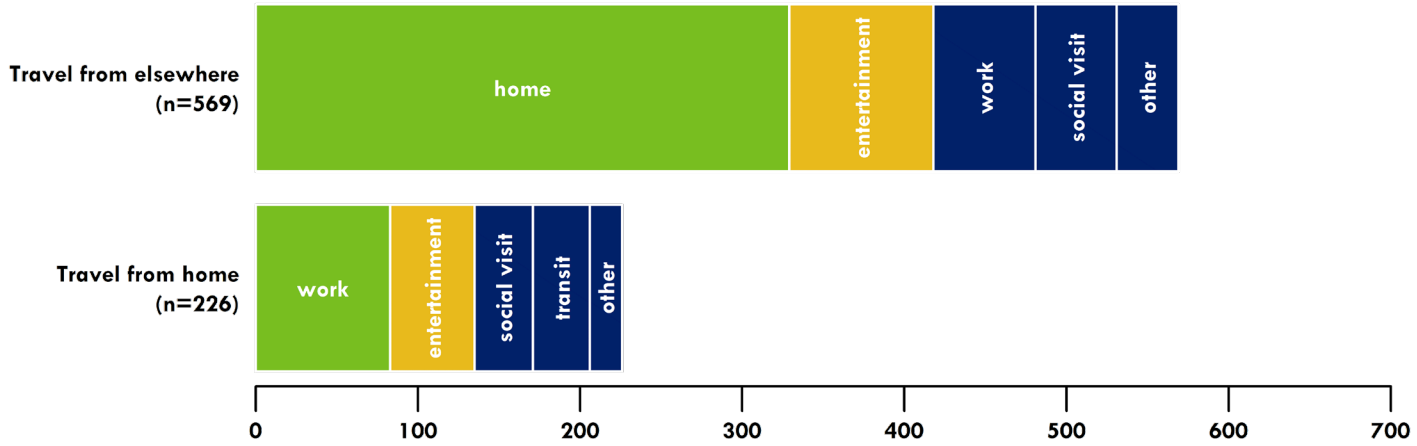

Figure 6. Top destination activities conducted for travel from home and other locations.

[8] Based on 2018 fare structure information at www.lyft.com/cities/boston-ma and www.uber.com/fare-estimate

Ride-hailing Travel Patterns

The survey also provides some insight into the temporal and spatial patterns of ride-hailing trips. Although the results represent a fraction of total ride-hailing usage in the region, they can contribute to an initial understanding of when and where these services are being. This work begins to uncover how ride-hailing services may be adding congestion to the region's roadways and/or providing another mobility service to areas with existing public transportation access.

To understand how ride-hailing adoption varied across the time of day and day of the week, a time stamp was generated when respondents submitted their completed survey. A summary of these time-based data **(Figure 7)** revealed that ride-hailing trips were taken throughout the day, with the greatest share of trips taking place in the evening between 7:00 P.M. and midnight. A substantial number of trips took place during rush hours. On weekdays, 40% of recorded trips were taken during a four-hour morning or evening commute period.[9] This finding suggests that these services are likely adding traffic volume during periods that already have high traffic congestion issues. However, surprisingly, more weekday ride-hailing trips in our sample were conducted in the time block following the evening rush hour (7:00 P.M. to 12:00 A.M.). Similarly, 42% of ride-hailing use observed during the weekend occurred in this five-hour evening period. Relatively few rides (13%) were recorded between midnight and 3:00 A.M., though it is likely that some riders using these services during late night periods were not in any condition to complete the survey.

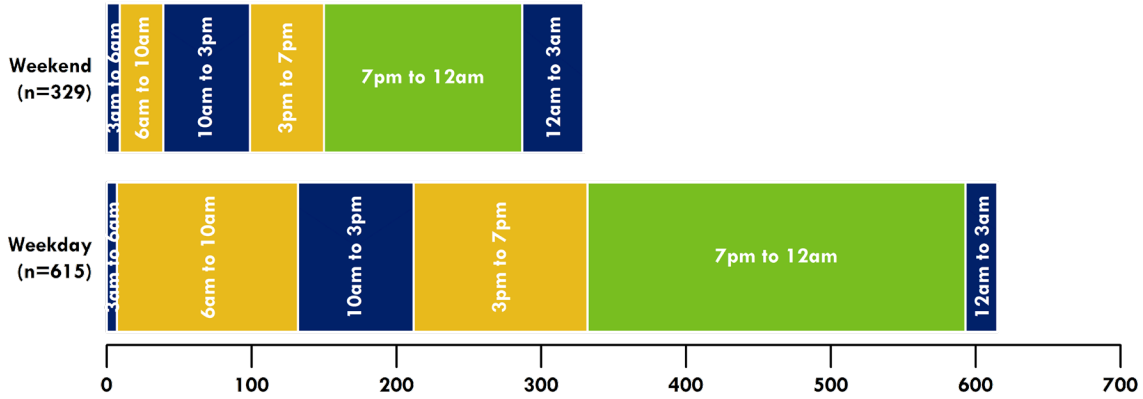

Figure 7. Distribution of start times for surveyed trips by travel day and time.

The results also indicate that most respondents use the ride-hailing services quite frequently **(Figure 8).** About two-thirds (66%) of surveyed passengers use ride-hailing services at least once per week, and many of those riders—29% of the total—use ride-hailing services at least four times per week. These findings support the notion that adopters of ride-hailing services have altered their travel behaviors and patterns to integrate this emergent mobility technology.

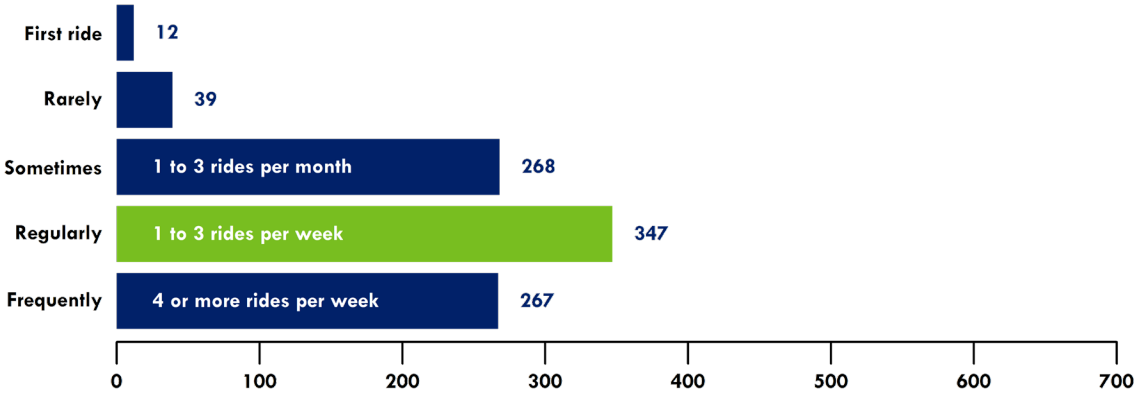

Figure 8. Rates of ride-hailing adoption for surveyed riders over the past three months.

[9] Rush hours are defined based on the periods used by Central Transportation Planning Staff for travel demand modeling peak period analysis: 6:00 to 10:00 A.M. and 3:00 to 7:00 P.M.

By collecting information on each ride-hailing passenger's home postal ZIP code, we were able to map the trips starting **(Figure 9)** and concluding **(Figure 10)** at the homes of surveyed riders. For sampled trips beginning at a passenger's residence, the most popular starting point was in Brighton, followed by two ZIP codes in Somerville and another in Allston. These areas are notable because of their limited access to rapid transit stations and their younger demographic composition. As for those trips ending at a ride-hailing passenger's residence, the neighborhood of Cambridgeport was the most frequent terminus, followed the Boston neighborhoods of Allston and Brighton. As the map shows, most of the trips to and from riders' homes began or ended in the core of the region, and in many cases they went to or from locations served by transit.

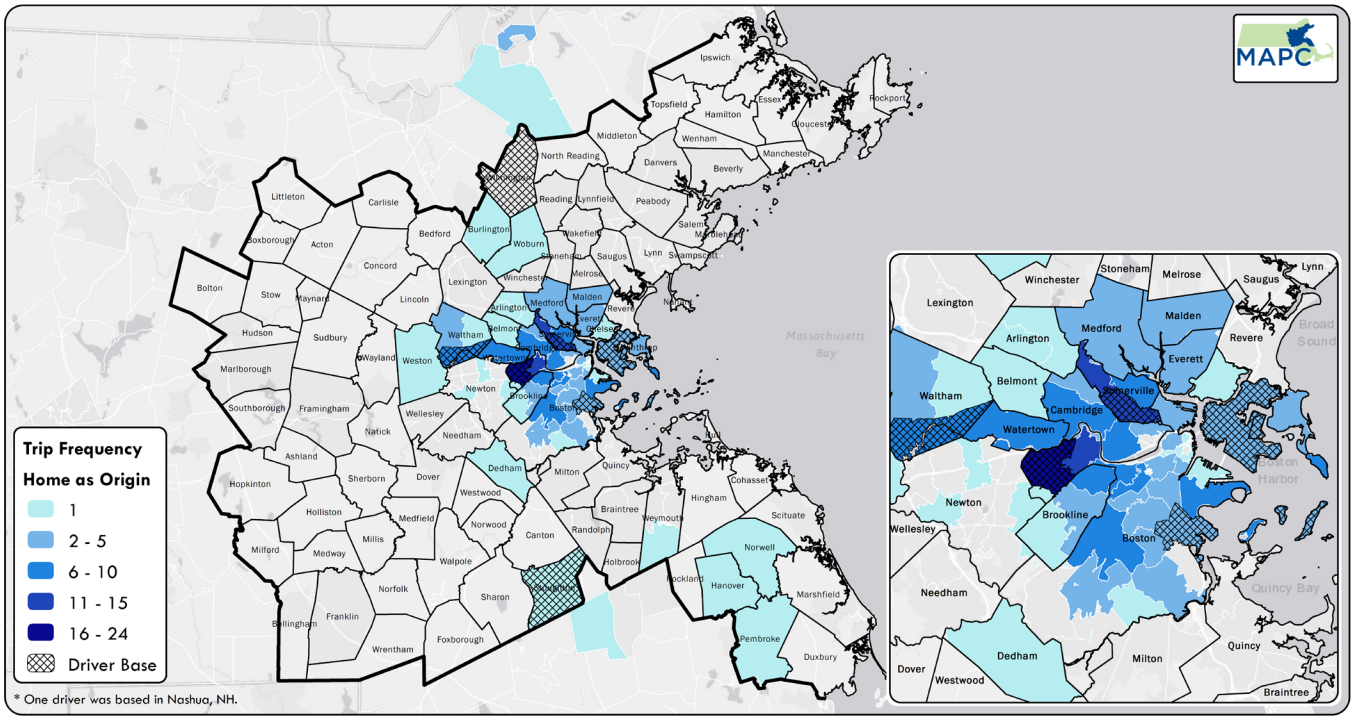

Figure 9. Distribution of trips starting at the homes of surveyed riders.

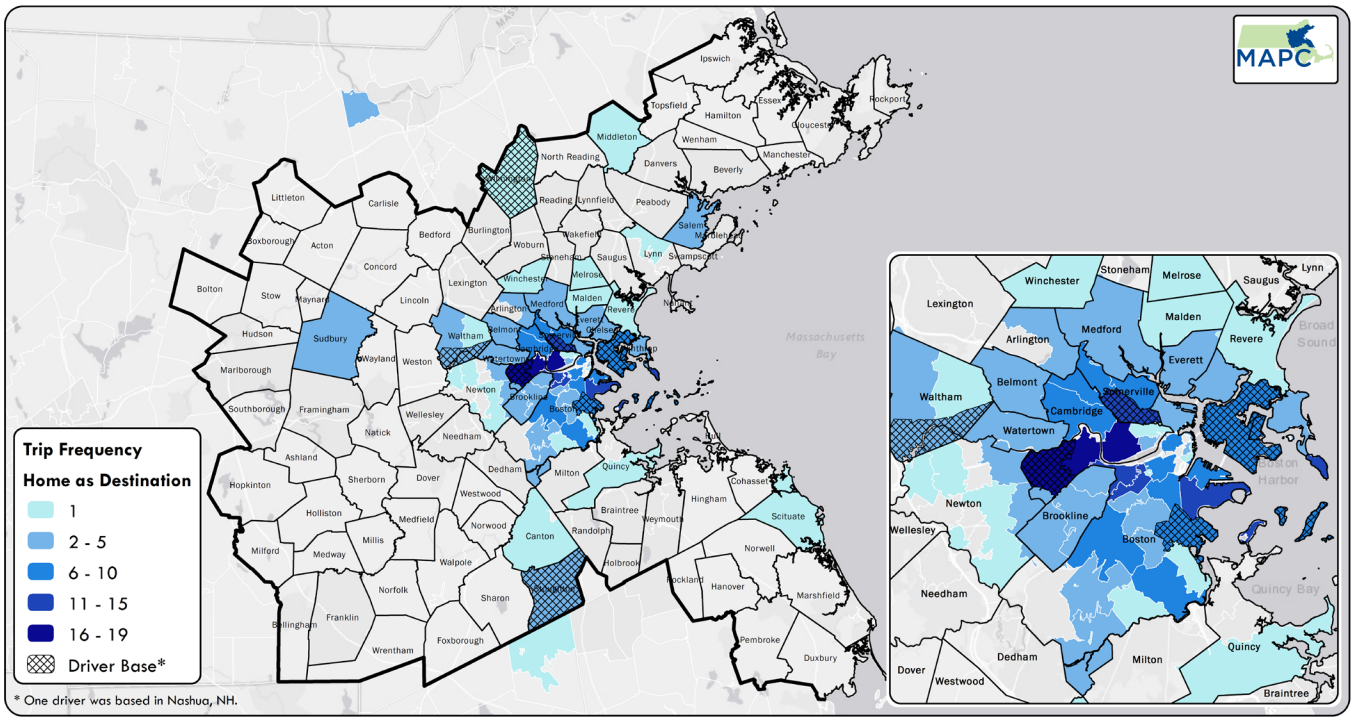

Figure 10. Distribution of trips concluding at the homes of surveyed riders.

Since drivers may be more likely to pick up their first passenger close to home, and may request a fare back to near their home at the end of their shift, we considered whether the home location of the drivers could influence the survey's results regarding pick-up and drop off locations. The maps above depict the home ZIP code of the driver in cross-hatching.

Ride-hailing Trip Adoption

Prior research on ride-hailing utilization has indicated that many riders may be substituting ride-hailing for transit, and the maps above reinforce this notion. To assess how ride-hailing is replacing or substituting other modes, survey participants were directly asked how they would have traveled for their trip if ride-hailing services had not been available. Survey results **(Figure 11)** indicate that 42% of passengers would have used public transit for their trip if ride-hailing services had not been available. Approximately 12% would have walked or biked, and 5% would not have made the trip at all. In other words, 59% of all ride-hailing trips are adding additional cars to the region's roadway system.

The remaining 41% of trips would have taken place in the rider's own vehicle or via taxi. Notably, the 42% transit substitution rate is higher than observed in other studies, which found that 15%[10] to 22%[11] of ride-hailing passengers were being drawn away from public transportation. It is especially concerning in light of a recent MBTA customer satisfaction survey,[12] which found that 30% of MBTA passengers reported reducing their transit use because of ride-hailing services.

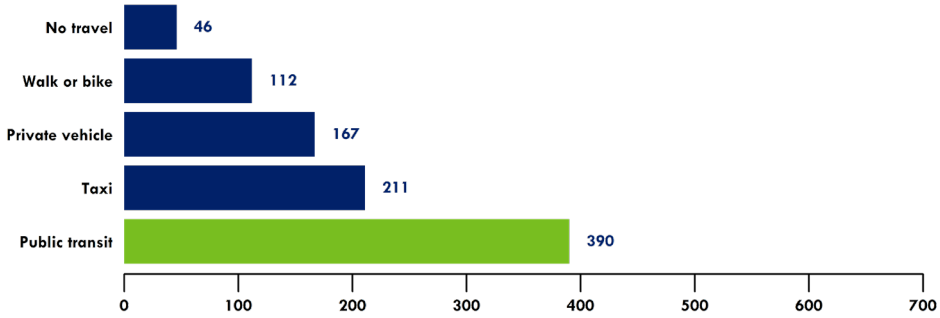

Figure 11. Travel mode being substituted by ride-hailing services for sampled trips.

Survey results also offered insight into both the reasons for ride-hailing utilization **(Figure 12).** Given the prior finding regarding transit substitution, it is perhaps unsurprising that a majority of ride-hailing users indicated a main reason for using these services is that they are quicker than public transportation. The other most popular reasons for selecting a ride-hailing service were that passengers either had no available car for their recorded trip or believed parking at their destination to be difficult or expensive.

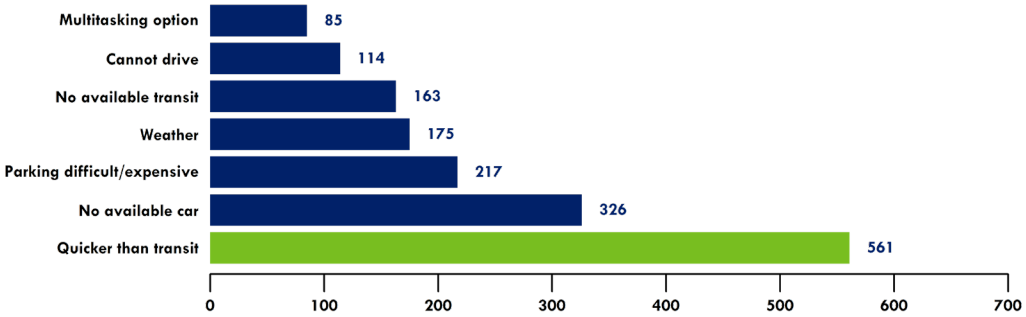

Figure 12. Reasons for ride-hailing adoption for surveyed riders.

[10] Clewlow, R.R., & Mishra, G.S. (2017). Disruptive transportation: The adoption, utilization, and impacts of ride-hailing in the United States (Research Report – UCD-ITS-RR17-07).

[11] Henao, A. (2017). Impacts of ridesourcing—Lyft and Uber—on transportation Including VMT, mode replacement, parking, and travel behavior (University of Colorado at Denver).

[12] Massachusetts Department of Transportation (2017). MBTA ridership update FY15-FY17. Retrieved from: https://d3044s2alrsxog.cloudfront.net/sites/default/files/fmcb-meeting-docs/2017/october/2017-10-23-fmcb-ridership-update-fy15-fy17-corrected.pdf

How Ride-hailing is Supplanting More Sustainable Modes

The findings above indicate that ride-hailing trips are replacing more sustainable modes of transportation (transit, walking, and biking) at an alarming rate. The nature and reasons for this replacement warrant additional investigation, given their implications for congestion, transit demand, and GHG emissions. While much of the previous focus on ride-hailing substitution has been on transit, we are also concerned about the impacts of ride-hailing on active travel modes. As our study found, 12% of ride-hailing passengers said they would have walked or cycled if these services were not available for their recorded trip.

As noted previously, one concern about passengers who replace a transit mode with ride-hailing is that they are adding additional volume to the region's already-congested roadways. This is particularly problematic if this substitution happens during the peak (rush hour) periods when roadways are already congested. To better understand whether this increase in vehicle trips is adding traffic volume during periods of high demand for roadways, the start times for substituted trips were examined **(Figure 13).** For riders who took transit instead of ride-hailing, the trip time distribution is similar to all surveyed riders. This means that the largest share of trips occurred between 7:00 P.M. and midnight, with a substantial share of trips also occurring during the weekday morning and afternoon rush hour periods (29% combined).

This similarity to trips overall is still cause for concern. If 42% of ride-hailing trips would have been taken by transit, and 29% of those trips took place during the morning and afternoon commutes, then 12% of all transit-substituted ride-hailing trips are adding cars to the region's roadways during rush hour. Curiously, the respondents who substituted ride-hailing for walking or biking were much less likely to be traveling during the morning commute, and much more likely to be doing so in the afternoon. Overall, we estimate that 25% of the ride-hailing trips substituted for walking and biking take place during weekday morning or afternoon commutes, equivalent to 3% of all surveyed ride-hailing trips. Combining the peak-period trips substituted for both transit and walking or biking, we estimate that 15% of all ride-hailing trips replaced a more sustainable mode during the morning and afternoon commutes.

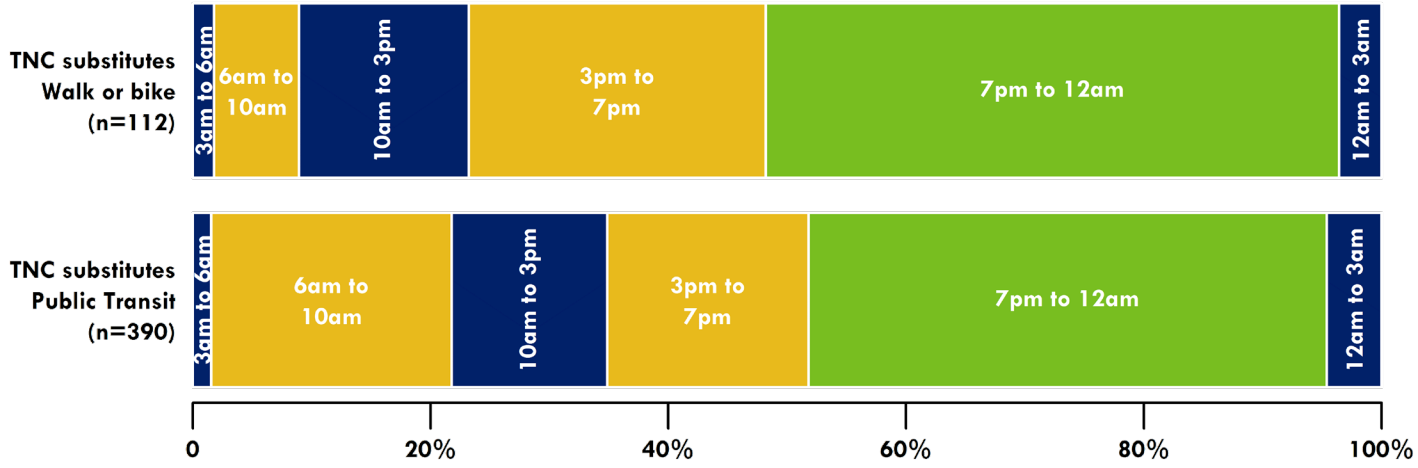

Figure 13. Start time of travel for surveyed riders who substituted transit use, walking, or cycling.

As described above, the most common reason for utilization of ride-hailing services is that they are quicker than transit. Of riders who used ride-hailing instead of transit, 40% identified speed as a main reason. The rapidity of door-to-door also comes with a price: most ride-hailing trips cost more than $10, whereas a one-way local bus ride is only $1.70 for CharlieCard holders.[13] For travelers who already have a weekly or monthly transit pass, each additional bus or subway trip is effectively free, and the substitution of a ride-hailing trip for an available transit alternative incurs a substantial cost differential in the price of the trip. In an effort to understand riders' willingness to pay for a ride-hailing service, we investigated the ride costs and transit pass availability for respondents who indicated that they would have traveled via public transportation for the current trip if ride-hailing were not available.

[13] https://mbta.com/fares/bus-subway

As described above, approximately 35% of surveyed riders have a weekly or monthly transit pass. However, riders with a transit pass make up approximately half (51%) of those who opted for ride-hailing instead of transit, and there was no significant variation based on the cost of the trip **(Figure 14).** Whether an individual who substituted transit for ride-hailing use paid less than ten dollars, more than 20 dollars, or somewhere between had no bearing on the fact that a transit ride would have added no incremental monetary cost for them to reach their destination. These findings suggest that even the MBTA's core riders—those with regular passes—are willing to pay a substantial premium to take ride-hailing, even when a transit option is available and the increase in cost is $20 or more. It also indicates that the MBTA may experience declining ridership due to ride-hailing: 21% of all trips were made by someone who would have otherwise traveled via transit, and who would have purchased a fare to do so. If the MBTA is losing $1.70 for each of those trips, it means that the average ride-hailing trip results in $0.35 of lost revenue for the MBTA.

Of note, MBTA has reported[14] that bus ridership is down by about 6% during the weekdays and 9-10% on the weekends over the past year; however, ridership on commuter rail has remained largely unchanged. These changes in transit ridership are consistent with nationwide trends for large cities.[15][16]

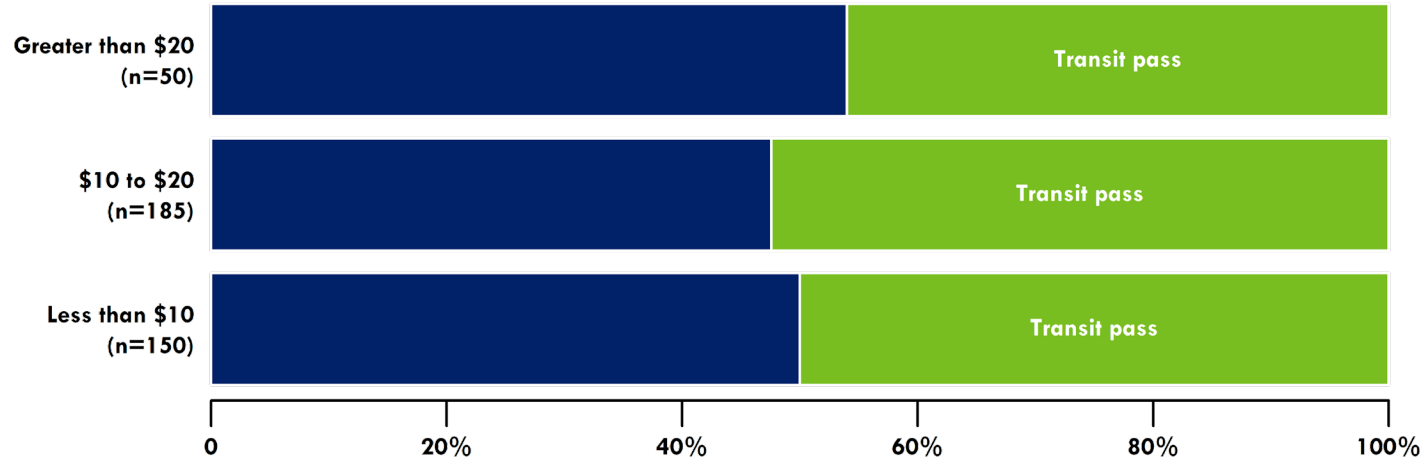

Figure 14. Transit pass possession for surveyed riders who substituted transit use.

In order to better understand this apparent cost-insensitivity and willingness to pay a premium for ride-hailing convenience, we examined the household income of passengers who substituted ride-hailing services for a more sustainable travel option **(Figure 15)**. The 112 respondents who indicated that they took ride-hailing instead of walking or biking had income levels comparable to ride-hailing users overall: about 25% were in the lowest income category, and about 24% were in the highest income category. This finding indicates the potential for ride-hailing availability to reduce active transportation is across the income spectrum. The patterns were quite different for riders who opted for ride-hailing instead of transit: these riders were much more likely to be in the lowest income category (32%); and much less likely to be high income (16%) as compared to all surveyed passengers. This makes intuitive sense: higher-income households are more likely to own a car, and would therefore have the opportunity to use it if ride-hailing were not available. Conversely, individuals from lower-income households are more likely to be carless and therefore lack the "private vehicle" option if ride-hailing were not available. Some of these differences may also be attributable to differential access to transit facilities (low-income households are more likely to live near bus stops and MBTA stations). However, the implications are clear: even lower-income travelers are willing to pay a substantial premium for ride-hailing when there are cheaper transit options available.

[14] Massachusetts Department of Transportation (2017). MBTA ridership update FY15-FY17. Retrieved from: https://d3044s2alrsxog.cloudfront.net/sites/default/files/fmcb-meeting-docs/2017/october/2017-10-23-fmcb-ridership-update-fy15-fy17-corrected.pdf

[15] American Public Transportation Association (2017). Transit Ridership Report: Third Quarter 2017. Retrieved from: www.apta.com/resources/statistics/Documents/Ridership/2017-q3-ridership-APTA.pdf

[16] Massachusetts Department of Transportation (2017). MBTA ridership update FY15-FY17 [Slides 7,8, and 9]. Retrieved from: https://d3044s2alrsxog.cloudfront.net/sites/default/files/fmcb-meeting-docs/2017/october/2017-10-23-fmcb-ridership-update-fy15-fy17-corrected.pdf

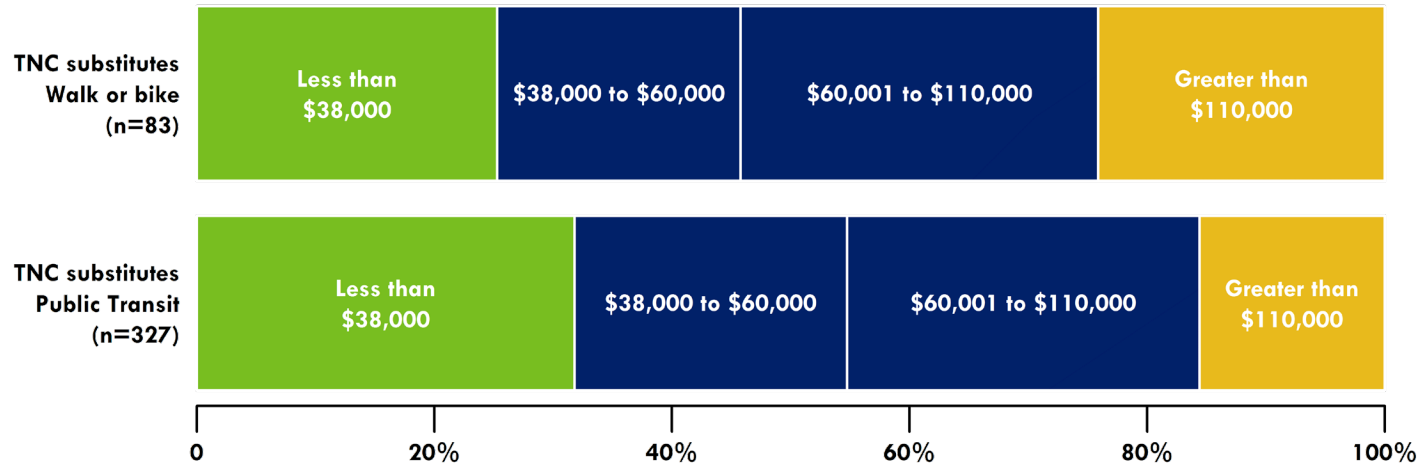

Figure 15. Annual household income of surveyed riders who substituted transit use, walking, or cycling.

For those riders without a transit pass, the cost of a single ride on the MBTA results in a smaller cost differential between transit and ride-hailing. Therefore, we investigated whether the influence of trip costs on mode choice varied with respondents' household income, with whether respondents had a transit pass, and whether a transit option was available **(Figure 16).** When examining only ride-hailing trips that substituted for a transit option, we found that an individual who is from a lower-income household and who has a transit pass is more likely to use ride-hailing for shorter, lower-cost trips than longer, higher-cost trips, when compared to similar individuals from higher income households. While this may have something to do with the nature of the types and distances of trips made by individuals from lower-income households, it likely reflects some sensitivity to cost as the price of the trip rises. Nevertheless, it raises troubling concerns regarding the level of utility provided by the MBTA, if lower-income households are willing to pay such a substantial premium for short trips that could otherwise have been made via transit.

Figure 16. Trip cost by annual household income for surveyed riders with a transit pass who substituted transit use.

Conclusions and Policy Implications

The survey results described here provide a new window into ride-hailing utilization in the Boston Region. Our findings confirm many widespread assumptions about ride-hailing, but also provide new insights into previously unexplored and unmeasured topics. Ride-hailing is used by a wide variety of Metro Boston residents, and riders are relatively representative of the region in terms of race and income. While students make up a disproportionate share of ridership, there are also a large number of non-student riders from lower-income households.

The disproportionate use of ride-hailing among younger residents (under age 35), as well as the frequency with which they use it, suggests that ride-hailing has been quickly adopted as a standard mode of getting around the region. The transit substitution patterns show that many of these riders also have a tendency to opt for ride-hailing instead of transit. As these users develop the habit of using ride-hailing or other on-demand mobility services on a frequent basis, it will become even more difficult to entice them to use conventional scheduled transit services, absent some radical change in the cost differential, speed of transit, and convenience of the service.

The survey results substantiate and add detail to the concerns regarding riders who are opting to use ride-hailing instead of transit. Approximately 42% of ride-hail trips would have been taken via transit if the ride-hailing were not available, and an additional 12% would have been taken by walking or biking. As a result, ride-hailing is adding new auto trips to the region's roadways. We estimate that 15% of ride-hailing trips are taken during rush hour by someone who would have otherwise taken transit. This finding is another piece of evidence that these commercial services are exacerbating congestion on the region's roadways.

Ride-hailing users are paying a substantial premium for the service, even when a far less expensive (or even incrementally free!) transit option is available. A substantial majority of trips cost more than $10, and one-fifth of trips cost more than $20. These findings regarding the fare structure suggest that the $0.20 per-trip surcharge assessed by legislation adopted in 2016 (M.G.L. c159A½) is a startlingly small percentage of the fares: less than 2% for most riders, and less than 1% for riders on longer trips. Not only is the surcharge a tiny proportion of the fare, but it is not proportional to the impact. Long trips, as well as those taken in congested areas during rush hour, create more impacts than short trips at uncongested times. Future adjustments to the fee structure should be considered to promote more shared rides and take into account congestion as well as length of trip and time of day.

Furthermore, given the level of substitution for transit trips, we estimate that the Commonwealth may still be losing out: we estimate that each ride-hailing trip results, on average, in the loss of $0.35 in revenue for the MBTA. As a result, the assessed fee isn't even sufficient to make up that revenue loss. While addressing this revenue loss is worthwhile, it's even more essential to examine how transit could become both more competitive with ride hailing, as well as more complementary. Greater integration of modes and services is essential to keep transit riders from shifting more heavily to ride hailing, and to introduce ride-hailing users to transit. This could be done through integrated mobile apps and unified platforms for payment, scheduling, and routing. Public agencies should explore joint marketing efforts that promote the advantages and flexibility of using ride-hailing and public transit together (e.g., first mile/last mile). In addition, there must be significant investment in the MBTA system to make public transportation as competitive a service.

Finally, our survey results raise as many questions as they answer, and highlight the need for more information about this important and expanding mode of transportation that has such potential to reshape our region. It is unfortunate that the business model for the ride-hailing industry does not encourage companies to share data with the public agencies responsible for maintaining the roads and highways essential for ride-hailing success. Nevertheless, accessing this data is essential. Both the state legislature and relevant state agencies should seek opportunities to mandate the provision of additional data. Such a mandate would give public agencies the

information they need, and can be done so in a way to protect rider privacy. With access to this data, public agencies will be in a better position to make informed planning, policy, operational, and infrastructure investment decisions. Additionally, a data management plan will enable establishing performance measures that address equity and environmental goals (e.g., vehicle occupancy, auto ownership, travel time, shared vs. non-shared service). Only by understanding the current adoption of ride-hailing and on-demand mobility can we plan for its successful and sustainable future.