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AN EVALUATION OF FREE-FLOATING CARSHARING IN OAKLAND, CALIFORNIA

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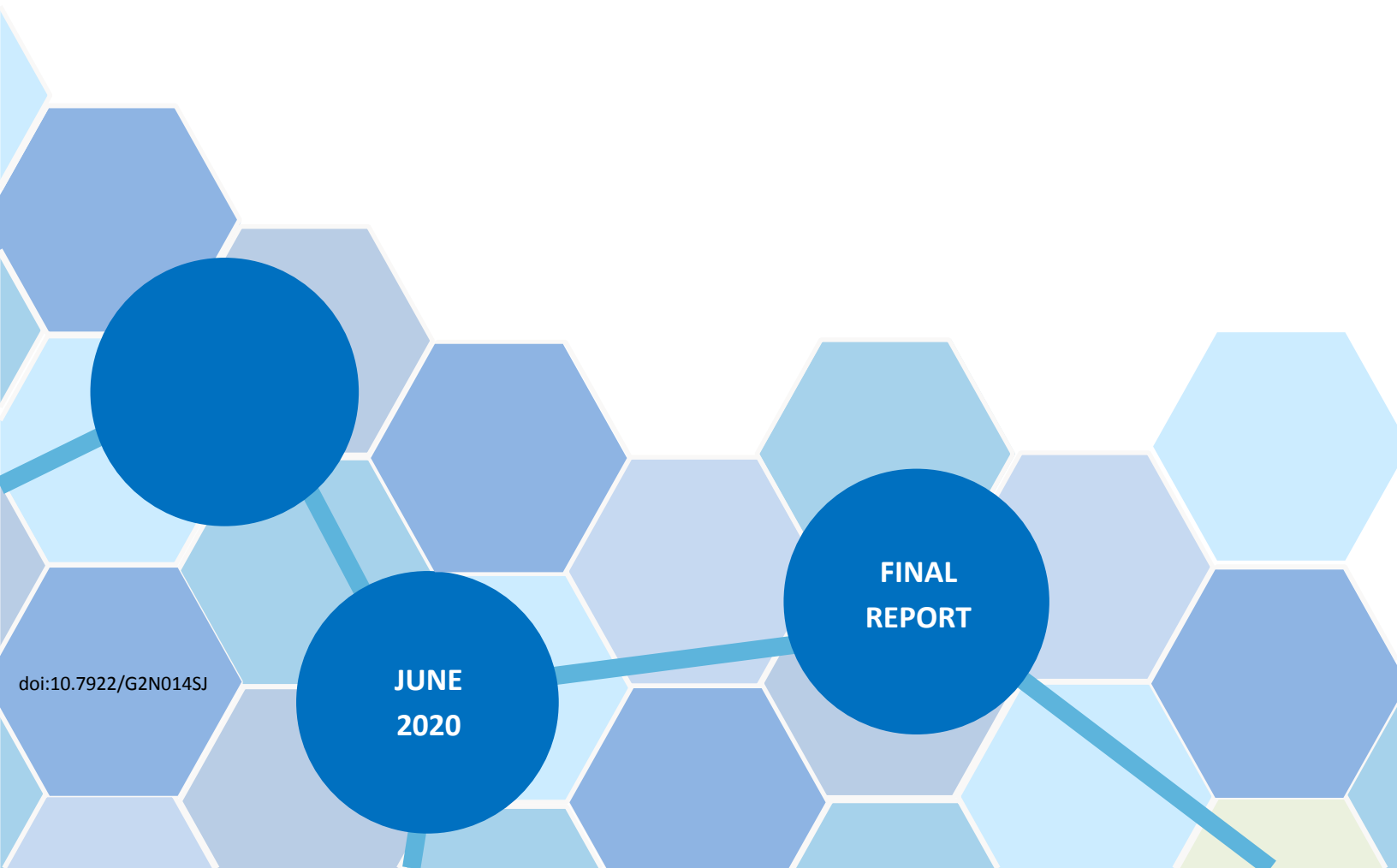

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Executive Summary

GIG Car Share is a free-floating carsharing system that began operations in the East Bay in April 2017. Similar to other free-floating carsharing systems, such as car2go and ReachNow (which later combined as ShareNow), members of GIG have access to a fleet of vehicles which they can book and unlock via an app. Once booking the vehicle, members can drive anywhere, but must park back in the home zone in order to terminate their session. The price of driving a GIG vehicle is charged per hour, per mile, or per day, and is calculated based on the lowest cost to the user.

This report uses the results from a pre- and post-survey of GIG members in Oakland to measure the changes in travel behavior, with special attention paid to changes in personal vehicle use that occurred as a result of joining GIG. The pre-survey (N = 362) was conducted in December 2017 and the post-survey (N = 221) was conducted in January 2019.

The demographics of GIG survey respondents in Oakland are similar to previous findings from evaluations of shared mobility in other cities. The sample of post-survey respondents was younger than the general Oakland population, with 50% of the sample under the age of 34 compared to 36% for the general population. The survey sample was also highly educated; 88% of respondents have at least a 4-year college degree, compared to only 40% in the general population. Income distribution was relatively similar, though GIG survey respondents had a slightly higher income than the rest of Oakland. However, the race/ethnicity distribution was more imbalanced, where 60% of survey respondents were White, while only 27% of the Oakland population is White. African Americans and Hispanic/Latinos were relatively underrepresented; 12% of survey respondents were African American compared to 23% of the Oakland population and 7% of survey respondents were Hispanic/Latino compared to 30% of the population. Table 1 presents a distribution of demographics for key attributes.

Table 1: Demographic Distributions

Demographic attribute	Oakland population	Oakland sample	Demographic attribute	Oakland population	Oakland sample
Gender	N = 425204	N = 218	Income (Households, $ US)	N = 425204	N = 218
Male (%)	49.2%	42.3%	Less than $10,000 (%)	5.9%	2.4%
Female (%)	50.8%	52.6%	$10,000 - $25,000 (%)	14.2%	5.3%
Non-binary	-	5.2%	$25,000 - $35,000 (%)	7.3%	7.7%
Prefer not to answer	-	2.3%	$35,000 - $50,000 (%)	9.7%	9.6%
Total (without Prefer not to answer)	100%	100%	$50,000 - $75,000 (%)	15.1%	18.8%
Age	N = 425204	N = 218	$75,000 - $100,000 (%)	11.6%	15.4%
18 - 24 (%)	12.5%	5%	$100,000 - $150,000 (%)	15.3%	19.2%
25 - 34 (%)	22.9%	48%	More than $150,000 (%)	20.8%	21.6%
35 - 44 (%)	19.1%	23%	Prefer not to answer	-	4.6%
45 - 54 (%)	15.1%	14%	Total (without Prefer not to answer)	100%	100%
55 - 64 (%)	14.4%	8%	Race/Ethnicity	N = 425204	N = 218
65 - 74 (%)	10.1%	3%	African American	22.9%	12.7%
75 or over	5.7%	0%	Asian	15.4%	13.7%
Prefer not to answer	-	2%	Hispanic or Latino	28.4%	7.1%
Total (without Prefer not to answer)	100.0%	100.0%	Native American or Alaskan native	0.6%	0.0%
Education	N = 425204	N = 207	Hawaiian or Pacific Islander	0.4%	0.0%
Did not complete high school (%)	18.5%	0.5%	White	27.0%	61.8%
High school graduate (%)	17.6%	3.9%	One other race alone	4.8%	0.5%
Some college (%)	18.6%	1.0%	More than two races	0.3%	4.2%
2-year college degree (%)	5.3%	4.9%	Prefer not to answer	0.0%	2.8%
4-year college degree (%)	23.9%	44.8%	Total (without Prefer not to answer)	100%	100%
Graduate degree (%)	16.2%	44.8%			
Other (%)	-	-			
Prefer not to answer (%)	-	2%			
Total (without Prefer not to answer)	100%	100%			

This study also analyzed GIG usage and travel behavior. The majority of respondents joined GIG in the absence of a personal vehicle to gain additional mobility. However, about 3% reported owning at least one vehicle and planned to get rid of a vehicle. Respondents were asked to estimate how many miles per month they drove using GIG. 65% of respondents drove an average of 20 miles or fewer per month, with 23% of the sample driving less than five miles per month. Some respondents reported higher monthly averages, with about 10% of respondents driving 100 miles or more per month.

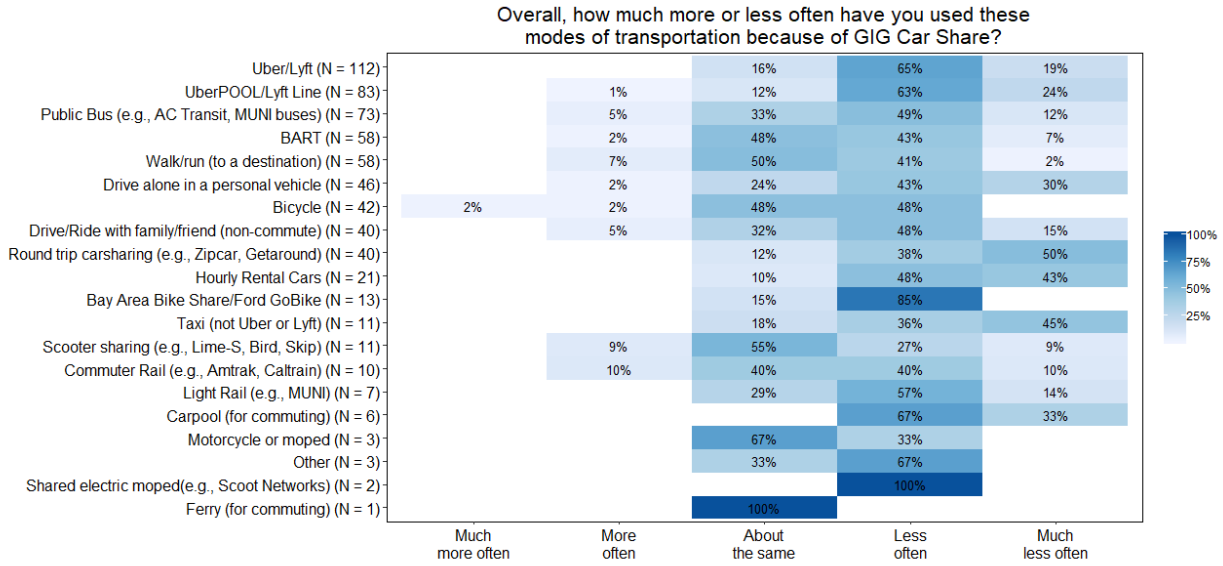
To understand how members are using GIG, we asked respondents questions about their most recent trip. 64% reported driving alone and 25% drove with one other person. The most common trip purposes were going to/from grocery shopping and commuting to/from work, followed by going to/from social/recreational trips that were not at a bar or restaurant. When respondents were asked why they selected GIG for this trip, about 45% cited flexibility, convenience, and speed compared to the mode they would have taken otherwise. Other reasons respondents gave were that GIG allowed them to better transport packages/groceries and needing to travel when and where public transit was not accessible.

We also studied the impact of GIG on other travel behavior. In terms of vehicle ownership, 57% of respondents reported not owning a vehicle. Weighted survey responses were used to estimate the

degree of vehicle shedding in the population. After weighting, it was determined that about 2% of the population got rid of a vehicle as a result of joining GIG. The survey also permitted the estimation of personal vehicle suppression. The weighted responses suggested that about 7% of the population suppressed the future purchase of a vehicle because of GIG (i.e., they decided not to acquire a vehicle because they had access to GIG). Similar to previous studies of carsharing services, the vehicle suppression effect of GIG was larger than the vehicle shedding effect. Overall, GIG was found to be lowering vehicle ownership of surveyed members. Usage of GIG also impacted the miles that respondents drove on their personal vehicles. GIG Car Share provided activity and frequency of use data to conduct a population level analysis of net VMT impacts. Taking these net impacts together, this analysis found that GIG Car Share reduced net annual VMT under baseline assumptions and that the estimated net reduction in VMT holds under a variety of assumptions. The overall net reduction does require that personal vehicle suppression is taken into account, pointing to the importance of personal vehicle suppression as a critical component of impact of the GIG Car Share system.

Survey respondents also reported using other modes less often as a result of joining GIG. The largest impact was on Uber/Lyft rides, followed by public bus and BART. For respondents who took public transportation less frequently as a result of GIG Car Share, the most commonly cited reasons were that GIG is faster, more flexible, more convenient, and allowed users to better transport packages and groceries. Figure 1 shows the distribution of mode shift as a result of GIG. Note that sample sizes decline across modes as respondents were only asked about the direction of mode shift if they reported that their use of the mode changed at all due to GIG. If respondents stated “no”, then they were not asked in follow up define the direction of mode shift.

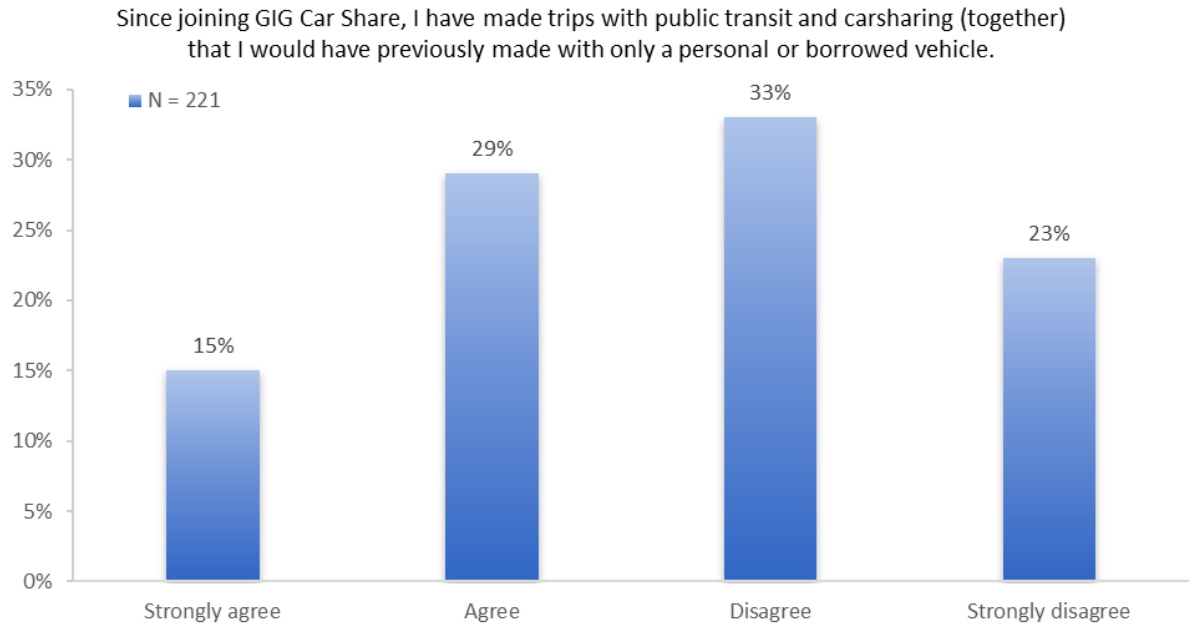
Figure 1: Mode shift as a result of GIG



Free-floating or one-way carsharing differs from roundtrip carsharing in that it can more easily allow users to use multiple modes in one trip. Survey respondents reported using GIG in combination with BART and with walking/running. Respondents were also asked whether they used GIG in conjunction

with public transit. About 44% of respondents reported that they had made trips with public transit and carsharing (together) that they would have otherwise previously made by a personal car. The distribution of responses is shown in Figure 2.

Figure 2: Use of Public Transit and GIG Carsharing Together



Overall, the survey results suggest that GIG has had a substantive impact on travel behavior among members and appears to have enabled a minority of the sample to reduce the number of personal vehicles they own. However, there are some limitations to the analysis. One limitation is sample size; while the sample size obtained is large enough to draw conclusions, there is uncertainty in some estimates that would be reduced from a higher sample. Another such limitation is possible incongruence of the sample and the user population with respect to demographics. Because there is no universal census of GIG Car Share users, correcting for any differences in these distributions is challenging. Given the present findings, the survey does find that the population still generally reflects the profile of the typical shared mobility user population. The GIG membership base shares a fair number of common attributes with the demographic profile of other shared mobility systems. This by itself suggests that additional outreach and policy may be needed to facilitate the use of GIG by the broader population of Oakland, including low-income households and people of color. These and other findings can help advance our understanding of how one-way carsharing impacts the population and advances mobility in the East Bay.

Introduction

This report presents the results of a study of free-floating carsharing in Oakland, California. The study focused on the introduction of GIG Car Share to the City of Oakland and evaluated the impact of its use by members. The evaluation is focused on understanding how the introduction of carsharing to the East Bay influenced travel behavior and Vehicle Miles Traveled (VMT). The study also provides background on low-income outreach programs that have been implemented in support of expanding access to shared mobility systems. The study asked questions of members to gain insights on how people within Oakland learned about the system and how users engaged with GIG Car Share over time.

GIG Car Share is a free-floating carsharing system that began operations in the East Bay on April 30, 2017. It began in Oakland and Berkeley, and has since spread to Albany, Alameda, parts of San Francisco and Sacramento (as a separate home zone and an all-electric fleet), with plans to expand to Seattle in early 2020. It was not the first one-way carsharing system in the Bay Area (that was BMW's DriveNow) but it was the first to operate as a free-floating zone in the region. It was also the Bay Area's only free-floating carsharing operating at the time of its founding and is still the only one operating in the region at present. It was the first one-way carsharing system to operate in the East Bay.

GIG operates similarly to other free-floating carsharing systems such as ShareNow (formally car2go and ReachNow). The vehicles (Prius C models in the Bay Area) are parked on the street and in designated lots within their home zone. Users of systems are called "Members" as is common with carsharing systems. They can access vehicles instantly without an advance reservation using the system app which reports vehicles that are available. Vehicles are unlocked and accessed via the app and operate without a key. The user can drive anywhere with the vehicle but must park it back in a home region to terminate their session. The pricing structure of GIG permits users to pay per hour, per mile, or per day, whichever is lowest for their trip. Pricing includes gas/charging, insurance, and parking. These all-included costs of driving are a mainstay of the underlying economic benefits of carsharing, allowing users to avoid the high fixed costs of vehicle ownership while still maintaining access to an automobile at variable cost. The pricing of GIG (and other shared mobility systems) can change with some frequency. To provide context of the relative costs, at the writing of this report, GIG charged $15.00 per hour, $.40 per minute (up to $15.00), $69 per day on weekdays, and $85 per day on weekends.

Study data was gathered through a survey of members deployed using a pre- and post-design (Before and After). The pre-survey was launched among new members in early December 2017 and the post-survey was launched about a year later in early January 2019. In addition, the study also evaluated activity data from GIG Car Share, which provided information on trips and miles driven by all members. These data are critical for developing estimates of impacts at the population level.

An early focus of the GIG Car Share launch was to engage low-income and other disadvantaged communities within the City of Oakland to advance shared mobility access to those that have traditionally seen lower usage and membership rates. Because of GIG's regional coverage within the East Bay, spanning areas of diverse income and ethnic backgrounds, the study presented an opportunity to explore the subject of equity and low-income outreach in shared mobility. In the sections that follow, we present a review of previous efforts and programs that have engaged communities with traditionally

lower access to carsharing. We follow this review with an overview of the study methodology. We then proceed with a presentation of results, and finish with a discussion of key takeaways and conclusions from the analysis of survey and activity data.

Shared Mobility Programs and Outreach in Low-Income Communities: Overview of Barriers to Usage and U.S.-Based Programs

Shared mobility, defined as the shared use of a vehicle, bicycle, or other low-speed transportation mode, is a transportation strategy that enables users to obtain short-term access to transportation on an as-needed basis, rather than requiring ownership (Shaheen et al., 2016). Shared mobility includes various forms of carsharing, bikesharing, ridesharing (carpooling and vanpooling), and on-demand ridesourcing services, among other modes of transportation. Shared mobility has the potential to increase mobility for users who are unable to access private vehicles and allows users who already own cars to drive them at a higher occupancy or forego ownership altogether. This can potentially reduce household transportation expenditures while providing more mobility options (Shaheen et al., 2017). However, past North American studies on carsharing and bikesharing have shown that shared mobility users are more likely to be white, male, between the ages of 20 to 35, and have higher levels of education than the general population (Shaheen et al., 2014; Dill et al., 2015). The demographics of shared mobility users suggests that although shared mobility has the potential to increase access to mobility among low-income populations, this has not, as yet, occurred on a significant scale. As shared mobility becomes more widespread, the viability of existing transportation options may be in jeopardy, resulting in reduced mobility among lower income populations and neighborhoods. A Transportation Research Board report on shared mobility suggests that some of the demographic differences among shared mobility users could be due to a lack of availability of services in low-income areas (National Academies of Sciences, Engineering, and Medicine, 2016). Lack of availability is just one of many barriers experienced by lower-income members of the community that results in lower usage and membership rates. This literature review aims to further understand barriers to shared mobility usage by examining what programs and outreach have been implemented so far and what could potentially be done in the future to mitigate these barriers.

In this report, we first classify, define, and discuss barriers to shared mobility in low-income communities and identify possible solutions to these barriers. Then, in order to understand what programs and outreach efforts have been undertaken or are operating at present, in the subsequent section we present an overview of U.S.-based carsharing, ridesourcing, and bikesharing programs specifically targeting low-income populations. Our review was conducted by searching online for relevant academic literature, press briefings, and online articles. While not a completely exhaustive list, it spans many low-income shared mobility programs across the nation and provides operational dates and locations of the programs. We also include a description of the low-income shared mobility program, related outreach efforts that aimed to promote or spread awareness about the program (if any), and what barriers the program attempted to address. This list of programs and outreach better informs what is being done at present, what has been done in the past, and what might be integral for future programs to effectively promote low-income shared mobility services.

Barriers to Shared Mobility for Low-Income Communities

In this section, barriers to shared mobility for low-income users are discussed in the context of three categories: 1) Spatial (including physical and logistical access), 2) Financial (including cost and payment options, and 3) Cultural (information and perceptions). For operators, some of the barriers to operating in lower income communities include cost and regulations.

Spatial Barriers

For members of low-income and rural communities, spatial and location-based barriers can often be a deterrent to accessing shared mobility services. In this section, we discuss spatial barriers to shared mobility usage including both 1) Physical Access and 2) Logistical Access.

Physical Access

One of the most obvious barriers to accessing shared mobility among low-income populations is a lack of stations or services in their neighborhoods. Station-based shared mobility such as roundtrip carsharing and station-based bikesharing often does not exist in low-income neighborhoods. Part of the reason is that stations are usually placed in neighborhoods with high population density (ITDP, 2014), since lower density areas create challenges to operators for providing a high quality, cost effective service. Communities that are far from the urban core with lower population densities often have longer trip distances and fewer mobility options. In addition, non-station-based services such as shared ridesourcing (e.g., UberPool, shared Lyft rides) have drivers that can exercise discretion about which areas to serve, which can often lead to drivers not entering a neighborhood due to personal biases (Ge et al., 2016).

Cities and public agencies should help foster demand and provide incentives for system operators to locate in low-income communities. Siting decisions by shared mobility operators are typically based on their operational model, the political context, and where expected usage rates are highest (ITDP, 2014). Providing clear incentives and strategic placement recommendations for shared mobility providers may reduce the effects of spatial inequality by providing modes that have greater geographic reach (Shaheen et al., 2017). In addition, communities that have poor access to public transit services could gain additional mobility if shared mobility services serve as a link to and from these public transit services, thereby filling gaps in the transportation network. Public transit stations themselves can also serve as access points for shared mobility services, increasing shared mobility connectivity to existing transportation options.

Logistical Access

Another spatial barrier is lack of access to mobile service and high-speed data which may be more limited in low-income and rural areas. Slower internet speeds can create challenges for shared mobility providers when locating users and processing real time transactions. This can deter operators from locating in areas without existing high-quality mobile internet infrastructure.

Possible solutions include streamlining paper membership applications for those without reliable internet access or offering advanced booking systems for those without smartphones where an operator can help interested users access the system (ITDP, 2014). Shared mobility providers could design "lite" versions of their mobile application that use less data and can supplement downloaded data through WiFi connections for locations with slow internet speeds. In application development, it is important for shared mobility providers to have in-app feedback mechanisms for how well these features are working (Shaheen et al., 2017).

Financial Barriers

Financial considerations can be a barrier to shared mobility usage among low-income populations. Some shared mobility services can be more expensive than other transportation alternatives and therefore are not used by some members of the community even though access to these services may improve job access and quality of life. We discuss issues regarding both the 1) User Costs and 2) Payment Options related to accessing shared mobility services.

User Costs

In many shared mobility systems, both recurring and one-time costs such as application fees, membership fees, usage fees, and overuse fines can be expensive and constitute a barrier for low-income users. In addition, shared mobility services are more expensive for longer trip duration and trip lengths, and those living far from the urban core may be more attracted to other modes of transportation for this reason. Transportation costs make up the second largest expense for American households, after housing, taking up to 19% of average income (Shaheen et al., 2017). If provided at an affordable rate to low-income communities, shared mobility services could help households save money on transportation expenses that could be used for other purposes as well as increasing the overall mobility of these households.

Some shared mobility operators have used discounts or subsidies to offer their services at a lower rate to select users. Depending on the program, users demonstrate eligibility for fee discounts by providing proof of income, public assistance, residence in public housing, or another form of proof to receive subsidized service. These programs can reduce or even eliminate membership and usage fees, and waive overtime fees (ITDP, 2014). Operators can achieve subsidized services through grants, partnerships with property managers and developers, partnerships with sponsors and private companies, or partnerships with public agencies. Public agencies can take a mixed approach to reducing cost on operators by reducing taxes and fees where appropriate and subsidizing shared mobility use for those unable to afford it (Shaheen et al., 2017). A program to reduce deductibles faced by low-income drivers in the event of an accident could also reduce user costs (Shaheen and Camel, 2014). For any subsidies or cost reducing programs, the source of funding needs to be assessed carefully to ensure it is not disproportionately impacting a particular disadvantaged group.

Payment Options

Many shared mobility services require usage of debit or credit cards for transactions (ITDP, 2014). However, some potential users do not have a bank account, debit card, or credit card, making it difficult to access services that rely on these forms of payment. According to a 2018 study by the Federal Deposit Insurance Corporation, the unbanked and underbanked population accounts for approximately 30 million households across the United States (Federal Deposit Insurance Corporation, 2018).

The recent introduction of general purpose reloadable (GPR) prepaid cards, available in convenience stores and financial institutions, has proved a successful option in helping to serve unbanked populations (Wolff, 2015). Some shared mobility programs have partnered with local credit unions or banks to be able to guarantee approval for an account for unbanked individuals (ITDP, 2014). In addition, companies could explore switching from card-based payment to having an option for prepaid account based payment.

Cultural Barriers

In addition to more immediately tangible spatial and financial barriers that can prevent low-income communities from accessing shared mobility services, cultural factors exist that may make it difficult or less desirable for some people to try and use shared mobility. We discuss issues relating to cultural barriers that include 1) Information Barriers and 2) Cultural Perceptions.

Information Barriers

Lack of information or education about the benefits and logistics of shared mobility systems is often in itself a barrier to uptake of shared mobility among low-income populations. Some users do not understand how shared mobility systems work and how they might be able to offer unique benefits for increasing their personal mobility. In some communities, language barriers exist in presenting the necessary information about the system and its potential benefits. For these reasons, targeted outreach efforts are a key part of encouraging uptake of shared mobility systems among lower income populations.

For shared mobility outreach, some efforts have partnered with an intermediary such as a local community organization to help with directing outreach to communities (ITDP, 2014). Local organizations can provide great benefits in outreach efforts, especially since many of them may have worked with a particular community before and have experience in providing targeted information and marketing. Outreach programs and information campaigns sometimes give hands-on support services to teach new users how to use the system, including how to reserve, pay, and combine shared mobility usage with other modes of public transportation (ITDP, 2014). Outreach in many languages is important as well to attract a wide array of potential low-income users. Setting up call centers to help with system issues is also important, and in some cases has been combined with existing public transit call centers (Espino and Truong, 2015).

Cultural Perceptions

Other cultural factors can also affect the uptake of shared mobility services in low-income communities. Discomfort with using formal shared services, distrust of authority, the status symbol of vehicle ownership, and perception of cycling and some other modes of transportation as "un-cool" are all cultural perception barriers to shared mobility usage (Shaheen et al., 2017). Other cultural perception barriers are more overt; a 2016 study (Ge et al., 2016) found that male passengers with names that were more commonly associated with African Americans were 3 times more likely to have ridesourcing trips canceled than the average passenger, and that female passengers were more likely to be taken for more expensive rides than male passengers. These problems can be partially mitigated by requiring high passenger acceptance rates as a condition for ridesourcing driver to receive bonuses and other incentives. They are hard problems to solve, however, as ridesourcing drivers still need the ability to deny a ride at their discretion.

Marketing and outreach in a tailored way to the community may foster more comfort with shared mobility systems and could help promote cultural affinity. Outreach programs that send the message that all users are valued and welcome could help break down cultural barriers to usage. In addition, it is vital that the messaging used in outreach campaigns is inclusive to the entire community and not just certain segments. Advertisements showing diverse users may then attract more diverse users. For example, active transportation shared modes like bikesharing can show advertisements of users of various fitness levels, indicating that the system is for everyone and not just those who might be considered "typical" bicycle riders.

Operator-Specific Barriers

While there are many barriers for low-income users or potential users to access shared mobility services, there also exist barriers for shared mobility operators that can keep them from entering a city or neighborhood. In this section, we discuss these operator-specific barriers at further length, with respect to both 1) Operator Costs and 2) Regulatory Barriers.

Operator Costs

The need for operators to achieve full cost recovery of services provided can limit the deployment of shared mobility in lower-density and low-income communities. Most public transit services in the U.S. are subsidized (MacKechnie, 2017) but shared mobility operators do not always receive similar subsidies to enter low-income areas and therefore do not serve cities or neighborhoods they believe will not be profitable due to low demand or other factors. Shared mobility operators may also be sensitive to perceived vandalism risk and lower revenue potential if their assets are stolen or damaged in these areas (Shaheen et al., 2017). In addition, taxation can sometimes keep operators from entering a particular area. For example, many states do not distinguish between traditional car rental and carsharing services when taxing these services. Car rental taxes are mainly used to tax out-of-town visitors and can sometimes be as high as 60% (ITDP, 2014). Since carsharing services typically serve local residents, a high taxation rate may not be appropriate in some cases.

Providing subsidies for shared mobility operators to enter areas they may not have otherwise entered is key to ensuring all members of the population have access to high quality transportation services. There have been a number of bikesharing programs that have provided financial assistance for users with financial barriers (Buck, 2012). This may be due to the generally lower costs of bikesharing infrastructure compared to other forms of shared mobility like carsharing, which includes the cost of purchasing or leasing automobiles, or ridesourcing, which includes the cost of paying a driver. Outreach programs are also important for operators and public agencies to increase demand for shared mobility services. Spending the time and resources necessary to design and implement effective outreach programs could help reduce cost recovery risk for operators. Liability and insurance concerns can also sometimes deter operators from deploying in a city or area. To address liability concerns unique to shared mobility providers, insurance networks such as Alliance of Non-Profits for Insurance (ANI) have emerged and provide specialized insurance plans for shared mobility services (ITDP, 2014).

Regulatory Barriers

At times, current or enacted regulations can be a barrier for shared mobility providers that desire to enter a city or neighborhood. In some instances, regulations on parking or access to right-of-way can keep carsharing and bikesharing operators from deploying their services in certain areas that might be beneficial to lower-income communities. Equity and level of service (LOS) requirements for publicly funded transportation that requires wheelchair-accessible vehicle wait times to be the same as non-wheelchair-accessible vehicles can be a barrier for some shared mobility providers to operating in broader geographic areas (Shaheen et al., 2017). In some cases, this may discourage operators from public-private partnerships that could benefit low-income communities.

Since shared mobility services operate across different cities and regions, there is sometimes confusion about what agency or level of governance should oversee the services. For example, ridesourcing services are regulated by state agencies in some circumstances and cities in others (Shaheen et al., 2017). This can prove burdensome for shared mobility operators and may discourage some from deploying in additional areas or cities. To overcome regulatory barriers for shared mobility operators, public sector entities must be more proactive in crafting rules and regulations instead of being passively reactive or outright barring new entrants or business models. With more streamlined and established regulatory processes, operators may be more willing to comply. Shared mobility regulations should guarantee minimum service levels for all neighborhood users and should include taxation mechanisms that ensure shared mobility providers are paying for external costs imposed by their services. In addition, a level of consistency that dictates the appropriate regulatory body to report to, as well as data sharing requirements, should be enacted among all regulated shared mobility operators to ensure fairness. This could include an agreement to share origin and destination data among other metrics to aid public sector agencies in their planning processes.

Catalog of U.S.-Based Programs and Outreach

In order to better understand shared mobility program and outreach efforts in low-income communities at present and in the past, we compiled a list containing many of these programs and associated

descriptions (Table 2). Table 2 also includes what equity issues the program or outreach attempted to address, as defined in the barriers section of this report. While this is not an entirely exhaustive list, it shows that there have been a number of significant programs and outreach efforts that have taken place in the U.S.

Table 2: Shared Mobility Systems Programs Engaged in Low Income Outreach (1)

Carsharing		
Company and Program Name	**Program Description**	**Outreach Description**
Ithaca CarShare Easy Access plan Ithaca, NY 2008-Present	Ithaca CarShare's Easy Access Plan has aimed to make the application process easier for applicants without internet access. Due to lack of funding, a relatively small percent of members have taken advantage of the Easy Access service. **Issues Addressed** • Logistical Access • User Costs • Payment Options • Information Barriers	In April 2010, Ithaca Carshare received around $60,000 to pursue an initiative to better serve low-income communities. These funds were used for outreach and subsidizing Easy Access memberships, which included things like streamlining the paper application process, making partnerships with local credit unions, and holding information sessions in low-income housing complexes and neighborhoods. (Dotson and Blair, 2011)
I-GO Car Sharing Chicago, IL 2002 to May 2013	Before I-GO Car Sharing was sold to Enterprise holdings in 2013, the carsharing program provided a means for users without bank accounts to sign up for and use the service. **Issues Addressed** • Logistical Access • Payment Options	N/A

Table 3: Shared Mobility Systems Programs Engaged in Low Income Outreach (2)

Company and Program Name	Program Description	Outreach Description
Buffalo CarShare Buffalo, NY 2008 to June 2015	Buffalo CarShare was formed specifically for residents with lower incomes. The system allowed unbanked users to pay fees by MoneyOrder. Two-thirds of BCS members represented households earning $35,000 or less. Members reported saving on transportation expenses while using the system. Buffalo CarShare's vehicles were absorbed by Zipcar in 2015 (Drury, 2015). **Issues Addressed** • Logistical Access • Payment Options	N/A
City Carshare, Low Income Flexible Transportation (LIFT) San Francisco, CA 2003 to 2006	The LIFT program by City Carshare offered subsidized membership services to communities in Bayview, California, specifically welfare-assisted families and residents receiving a Calworks grant, in order to provide shared mobility services in low-income communities. Members paid no application fee, no deposit, no monthly fee, and received a 50 percent discount on usage rates. Program participants saved up to $8,400 per year in costs associated with car ownership. **Issues Addressed** • User Costs • Information Barriers	City CarShare offered subsidies to LIFT participants referred by partner organizations and provided materials for organizations serving low- and moderate-income communities so that they could reach out to members of their communities. (ITDP, 2014)

Table 4: Shared Mobility Systems Programs Engaged in Low Income Outreach (3)

Company and Program Name	Program Description	Outreach Description
Flexcar, Flexcar Job Access Seattle, WA and Los Angeles, CA 2004 to 2007	The Flexcar Job Access program sought to help low-income job seekers, residents of low-income housing programs, those enrolled in a job training program at an approved institution or training organization, and clients of state, county, or city employment service agencies gain access to carsharing vehicles. The program reduced the costs for carsharing services which allowed low-income members to access Flexcar vehicles at a lower price. In addition, several vehicles were located at convenient access points for low-income members. Participants could also apply to the program without paying an application fee and receive their first year of membership at no cost. Flexcar merged with Zipcar in 2007. **Issues Addressed** • User Costs • Information Barriers	In Seattle, people received information about programs at their residence, from site managers at employment service agencies, workforce centers, affordable housing sites, and human service organizations. Flexcar also worked with case managers to reach out to their customers and provide outreach at job fairs and training programs (Flexcar, n.d.).
PhillyCarShare Philadelphia, PA 2002 to 2014	Philadelphia's PhillyCarShare program was established near low-income households and primarily served mixed-income neighborhoods. PhillyCarShare was acquired by Enterprise in 2014 (Lane, 2014). **Issues Addressed** • Physical Access • Information Barriers	PhillyCarShare tested a variety of methods of outreach in encouraging low-income households to join the program, made possible by various grants. (Ortega, 2005)

Table 5: Shared Mobility Systems Programs Engaged in Low Income Outreach (4)

Company and Program Name	Program Description	Outreach Description
Getaround, Pilot Program with the Shared Use Mobility Center (SUMC) Chicago, IL March 2016	Getaround and SUMC partnered to launch a pilot to study the impact of carsharing usage in low- and moderate-income communities in Chicago while demonstrating the need for more equitable shared mobility options. The program includes 5,000 owners and renters and 75 vehicles, and was funded through a $715,000 Federal Highway Administration Grant (Lynch, 2016). **Issues Addressed** • Physical Access • Information Barriers	SUMC partnered with the nonprofit Centers for New Horizons to perform public outreach. Low-income clients and the Center's employees will receive outreach about the program.
BlueLA, Electric Vehicle Carsharing Program Los Angeles, CA 2017 to Present	Funded by a $1.7 million grant from the statewide program California Climate Investments, BlueLA will bring 100 electric vehicles and 200 EV charging stations to Westlake, Pico-Union, Koreatown, Echo Park, and downtown LA starting in summer 2017. Depending on the member's income, a 25% rebate will be available for those paying by the minute, and a 40% discount may be applied to the monthly subscription fee. (Spacek, 2017) **Issues Addressed** • Physical Access • User Costs • Information Barriers	The Shared Use Mobility Center, Move LA, NRDC, and three community-based organizations will help with outreach in the neighborhoods. The project aimed to recruit 7,000 commuters. LA also hosts a National Drive Electric week, where there are opportunities to test drive electric vehicles for free. (Coplon-Newfield, 2015)

Table 6: Shared Mobility Systems Programs Engaged in Low Income Outreach (5)

Bikesharing		
Company and Program Name	**Program Description**	**Outreach Description**
Boston Hubway Bikeshare Boston, MA 2011 to 2018	Boston residents that receive public assistance or live in low-income housing could receive a subsidized Hubway Bikeshare membership by registering online or at Hubway's offices. With the membership, users were charged a $5 annual membership fee and receive a free helmet. By July 2014, the program had sold over 1,300 subsidized memberships – 11% of whom identified as minority females and 48% of whom who are receiving public assistance. Hubway also featured a program where doctors can prescribe a subsidized membership for low-income residents through their "Prescribe-a-Bike" program. Bluebikes, the successor to Hubway, also has an income-eligible program, which cuts the annual membership fee by 50%, and the monthly fee by 75%. **Issues Addressed** • User Costs • Information Barriers	Representatives of Boston Bikes, the bike advocacy group of the Boston Department of Transportation, reached out to social service agencies in low-income neighborhoods to raise awareness around subsidized Hubway memberships. Most of the outreach was via phone and email, with some in-person meetings. (ITDP, 2014)
Citi Bike New York City, NY 2013 to Present	For public housing residents in New York City, Citi Bike memberships are subsidized and cost $5 per month, as opposed to the full price of $169 for an annual membership. Users can also set up a Citi Bike account with their local credit union if they do not have a credit or debit card. **Issues Addressed** • User Costs • Payment Options	NYC's Department of Transportation held more than two dozen public meetings aimed at introducing Citi Bike to low-income New Yorkers and gave away more than 100,000 free helmets. By January 2014, 285 people have signed up for subsidized Citi Bike memberships, though this amounts to less than 1% of total users (ITDP, 2014).

Table 7: Shared Mobility Systems Programs Engaged in Low Income Outreach (6)

Company and Program Name	Program Description	Outreach Description
Nice Ride Minnesota, Communities Putting Prevention to Work Minneapolis, MN 2010 to 2012	In response to health disparities, the Minneapolis Department of Health (MDH) used a portion of their Communities Putting Prevention to Work (CPPW) grant to expand Nice Ride into the neighborhood of Near North, a diverse low-income community in Minneapolis. **Issues Addressed** • Physical Access • User Costs • Information Barriers	As part of the expansion, MDH provided $27,000 for community engagement before the expansion. The engagement was overseen by Nice Ride, MDH, and a social service organization. It consisted of a community meeting to introduce the expansion and gather input, focus groups with city officials and local groups, and a final community meeting to present findings. (Stewart, 2013)
Nice Ride Minnesota, Neighborhood Pilot Minneapolis, MN 2014	Nice Ride's Neighborhood Pilot program lent participants in three lower-income neighborhoods high-quality commuter bikes equipped with lights, fenders, and a cargo rack in order to encourage active transportation for communities outside of the urban core. Participants of this program were expected to attend an orientation ride and participate in at least four Ride and Dine events. **Issues Addressed** • Physical Access • User Costs • Information Barriers • Cultural Perceptions	A total of 145 individuals attended an orientation where they received an orange branded bike and rode it at least two times a week while also attending Nice Ride Neighborhood (NRN) meetings. The goal was to surface deep and qualitative information about the NRN program and recommendations for future programming. (Nice Ride, 2015). The evaluation collected information documenting that individuals achieved short-term behavior changes and shifts in perception of bicycling as a mode of active transportation, with most participants having intentions to continue bicycle use.

Table 8: Shared Mobility Systems Programs Engaged in Low Income Outreach (7)

Company and Program Name	Program Description	Outreach Description
Capital Bikeshare, Community Partner Program Washington DC 2010 to Present	The Community Partners Program, funded by Better Bike Share, charges low-income users a $5 subsidized annual bikesharing membership fee. The membership includes a helmet, guided instructions on how to use the system, and cycling classes. To qualify, residents must receive needs-based services from the DC Department of Human Services, Unity Health DC, Whitman-Walker Health, Community of Hope or the DC Center for the LGBT Community and Back on My Feet DC. **Issues Addressed** • User Costs • Information Barriers • Cultural Perceptions	In January 2013, the Washington Area Bicyclist Association (WABA) developed an initiative to encourage cycling east of Anacostia, an area known for higher rates of poverty and unemployment. This initiative aimed to connect with residents who already cycle, inspire more bicycle use, and increase demand for biking infrastructure. Across three years, WABA hosted bike rides, bike classes, organized advocacy summits, attended local planning meetings and worked with The Bike House, a local bike co-op, to host 20 mobile bike shops. Additionally, they awarded 30 Capital Bikeshare memberships to residents (ITDP, 2014).
Austin B-Cycle Austin, TX 2015 to Present	The B-Cycle program in Austin unveiled a subsidized $5 annual membership for Austin residents who are not full-time students. There are 400 annual memberships available for people who are making $25,000 or less in a year. There were also three new bike share stations added to serve low-income communities (Austin B-Cycle, 2015). **Issues Addressed** • Physical Access • User Costs	N/A

Table 9: Shared Mobility Systems Programs Engaged in Low Income Outreach (8)

Company and Program Name	Program Description	Outreach Description
Indego, Better Bike Share Partnership (BBSP) Philadelphia, PA 2015 to Present	The Indego Better Bike Share Partnership (BBSP) in Philadelphia provides $5 monthly memberships to members who qualify for food assistance benefit programs. However, the program is not accessible to those without credit cards. **Issues Addressed** • User Costs	N/A
Ford GoBike (now Bay Wheels) Bay Area 2017 to Present	The Ford GoBike program (now Bay Wheels) offers Bay Area residents, who are 18 years or older and who qualify for Calfresh, SFMTA Lifeline Passes, or PG&E CARE utility discounts to apply for a one-time $5 annual membership fee. Users have the option to pay with cash if they do not have a credit or debit card and bike unlocking is compatible with the Bay Area's Clipper Card as well. **Issues Addressed** • Physical Access • User Costs • Payment Options • Information Barriers	OakMob 101 community engagement sessions took place in East and West Oakland during October 2016 to spread awareness about upcoming shared mobility expansions in low-income communities in Oakland.

Summary of Insights from Previous Work

While traditional public transit projects can take years or decades to complete, some shared mobility solutions can be deployed in underserved areas in much less time and at lower cost if the public sector leverages private sector investment and operation (Shaheen et al., 2017). Due to this and other factors, shared mobility services can be an opportunity for cities to provide high quality transportation to all members of the community. However, past research has shown that most members of shared mobility systems including carsharing, bikesharing, and ridesourcing are typically younger, more likely to be White, and have higher levels of education than the general public (Shaheen et al., 2014; Dill et al., 2015). To better inform why shared mobility is not reaching all members of the population, this report explored and categorized the potential barriers to usage among low-income populations. The report also provides a catalog of many past and existing programs and outreach efforts to better understand

what has been done thus far to attempt to expand the reach of shared mobility to low-income communities. The barriers, associated issues, select programs, and solutions outlined in this report include the following:

Spatial Barriers – One spatial barrier is lack of physical access that arises from operators not wanting to locate in low-income and low-density areas due to perceived low demand which leads to a lack of shared mobility services available in low-income communities. Logistical access issues such as poor mobile internet connections in rural or low-income areas may also exist which can make it difficult for community members to connect with shared mobility services. Many programs have attempted to address this issue by providing incentives or subsidies to operators to expand into areas they otherwise might not have.

Financial Barriers – Relatively high user costs can be one barrier to shared mobility usage among low-income populations since fees associated with use and membership are often out of reach of some members of the community. Lack of payment options can be an issue to usage as well. Many shared mobility systems require a credit or debit card to sign up, yet about 30 million households in the U.S. are unbanked or underbanked (Federal Deposit Insurance Corporation, 2018). Shared mobility programs have been implemented that subsidize use and membership fees for qualifying users and many have explored paper sign-up and alternative payment options that do not require a bank.

Cultural Barriers – A general lack of information can be an impediment to shared mobility usage among low-income populations, including language barrier issues and lack of understanding of how shared mobility systems work. In addition, cultural perceptions like distrust of authority and formal transportation services as well as a negative perception of biking and other modes of transportation can prove to be a barrier to shared mobility usage among some communities. Various informational outreach efforts, typically associated with a program addressing spatial or financial barriers, have been implemented that provide targeted information about shared mobility programs. Some outreach efforts, most notably efforts relating to biking and bikesharing, have hosted multiple events over a long period of time with the hope to promote active transportation usage among low-income community members.

Operator-Specific Barriers – Some barriers make it hard for operators themselves to deploy in low-income areas. The concern that their company will not recover their operating costs can keep providers from entering a city or area. At times, this is due to perceived low demand or vandalism risk in these areas but sometimes it is due to other factors like rental car taxes. Regulatory issues can also make it difficult for operators to deploy in certain areas, as access to right-of-way can be limited and level of service regulations can prove difficult to meet for some operators. Some shared mobility programs have been funded in large part by public grants or subsidies and reduce operator risk when deploying in areas they otherwise might not have entered.

Though many programs have been implemented that attempt to expand shared mobility to low-income communities, much more work has to be done moving forward to ensure that equitable shared mobility solutions are available for all members of society. Additional funding to support more pilot programs

and evaluations is needed to help inform and shape best practices for implementing shared mobility in low-income communities. Future pilot projects should be based on research of the actual transportation needs faced by low-income communities. So far, much of the research in this area has focused on access to jobs as the primary metric measured. There is considerably less research regarding other shared mobility trip needs among low-income community members that address essential services and goods like education, childcare, and healthcare (ITDP, 2014). Future research should also evaluate the viability of different shared mobility business models, especially those with cross-sector partnerships, to understand how best to provide transportation services for low-income communities. For future outreach efforts, a deeper understanding of the social context is important and can partially be achieved by partnering with local community groups, as seen in some outreach efforts so far. Developing appropriate marketing and educational materials and creating meaningful avenues for community input and feedback is key when designing these outreach programs. There is no single solution for successfully and sustainably implementing shared mobility in low-income communities. No one strategy, program, or outreach effort will be sufficient and programs that address multiple barriers will likely be more effective than those that only address one. Continued and expanded funding, pilot programs, and evaluations will be necessary to expand shared mobility to all members of the community.

In the section that follows, we introduce the study of GIG Car Share with a methodological overview describing data, study implementation details, and basic designs for impact assessment. We then follow with a presentation of results and key conclusions from the analyzed data.

Methodological Overview

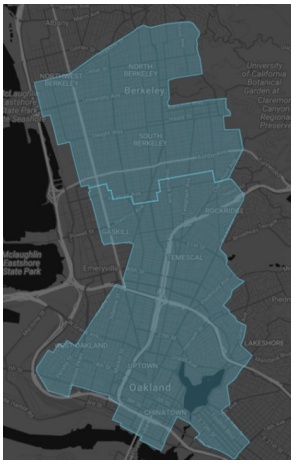
The study was conducted using a survey of GIG Car Share members. The survey employed a pre- and post-(Before and After) design. GIG members were first surveyed starting on December 8th, 2017 and surveyed again about year later starting on January 7th, 2019. The pre-survey was designed to capture information about member demographics as well as travel patterns and behavior before the impacts of the presence of GIG significantly manifested. The post-survey was designed to assess the change in behavior and evaluate the impacts that GIG had had on mode shift, vehicle ownership, driving, and other metrics of behavioral change. The analysis of the survey data was conducted using R and Excel.

With the launch of pre-survey, a total of N = 362 completed surveys were collected. The post-survey collected a total of N = 221 completed surveys. There was an incentive to take the survey in the form of a 1 in 20 chance to win a $20 Amazon gift certificate, separately drawn from each survey. The survey was deployed to respondents in both Oakland and Berkeley however the results in this report are isolated to the members who provided a home location in Oakland. Survey questions were designed to evaluate travel behavior change that occurred directly as a result of the presence of GIG. Survey questions also evaluated the demographics of respondents. The categories of the five key demographic categories were chosen to align with the categories used by the American Community Survey (ACS) to facilitate direct comparisons with the local population. GIG has expanded considerably since its establishment in 2017, when its region of operation, the “HomeZone”, covered much (but not all) of Oakland and Berkeley. By May 2020, the HomeZone covered most of Oakland, Alameda, Berkeley, Albany, and enclaves in San Francisco. Figure 3 shows the extent of this expansion since the system’s

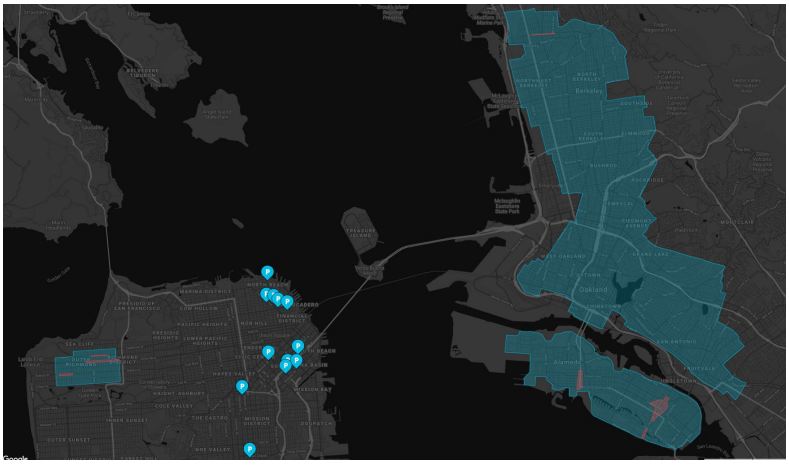
establishment. The Before Survey was conducted when the HomeZone looked like the map on the left in Figure 3. Although it had recently completed an expansion north within Berkeley and south within Oakland, it remained a two-city East Bay system. At the time of the After Survey, the HomeZone looked much like it does in the map on the right in Figure 3. This included Fruitvale in the south of Oakland, Alameda, Albany and the San Francisco enclave.

Figure 3: HomeZone Growth of GIG

HomeZone at System Inception



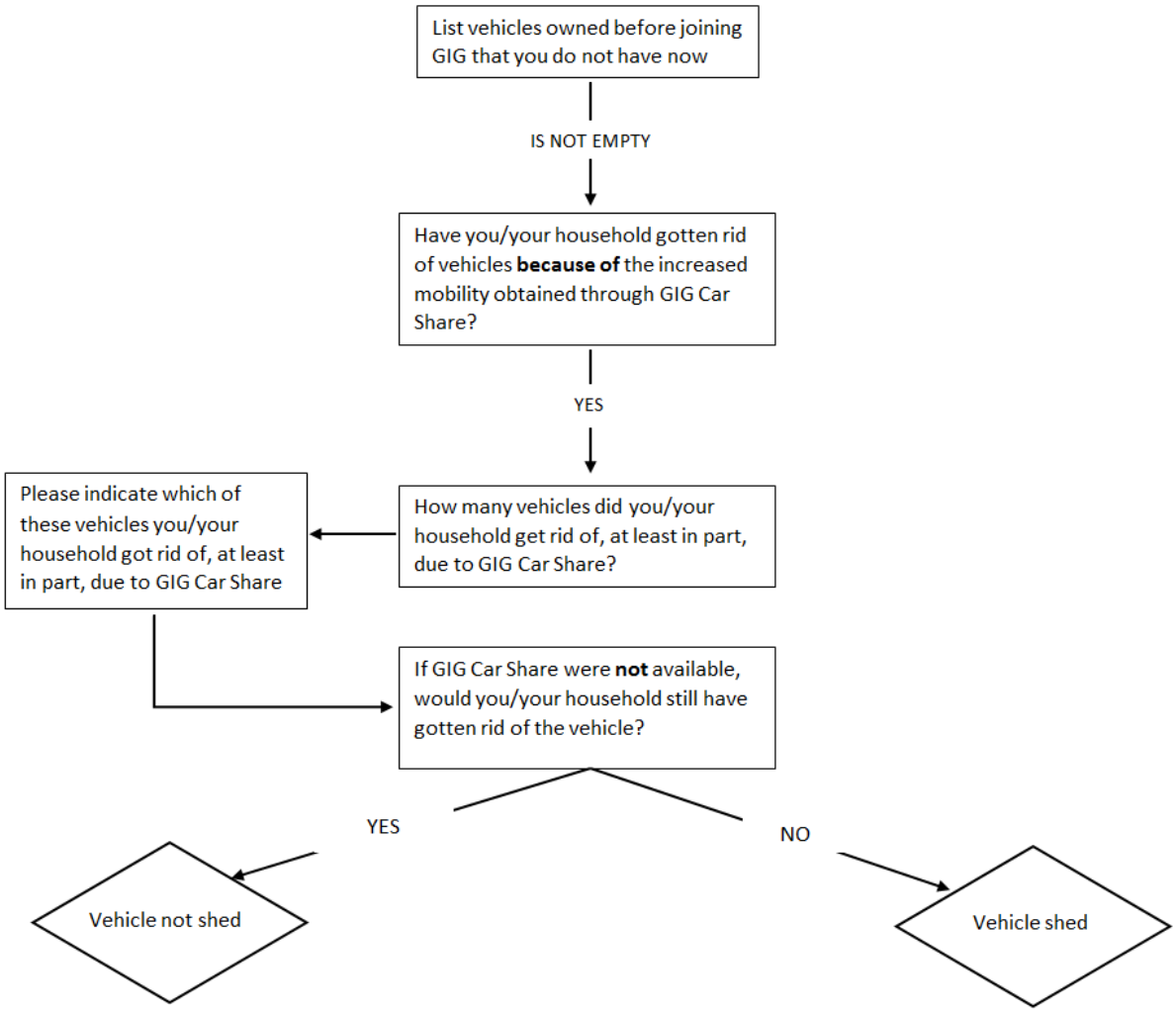
HomeZone November 2019



In collaboration with GIG, the study was also designed to employ the use of vehicle activity data. This data was designed to help researchers better understand activity patterns and travel of all GIG vehicles, not just survey respondents. This included understanding the number of trips taken over time as well as the distance traveled by the vehicles. The application of this activity data permits the analysis of the additional VMT that facilitates other decisions, including mode shift and the reduction or suppression of vehicle ownership.

An important impact of carsharing is the effect on the vehicle ownership of carsharing members. To determine the impacts on vehicle shedding, survey respondents were asked a series of questions to confirm that GIG was the primary reason for shedding a vehicle. Figure 4 presents a schematic with simplified answers (e.g., simplified to Yes/No) illustrating how question responses would or not qualify for the vehicle shedding impact. Respondents had to first indicate that they owned fewer vehicles now than before joining GIG. Respondents were then asked a question about whether GIG was the reason for shedding a vehicle. Finally, respondents were asked whether they would have shed the vehicle had GIG not been available. If the answer to this question was “No, I would probably (or definitely) still have the vehicle”, then GIG was confirmed to be the primary reason for shedding the vehicle.

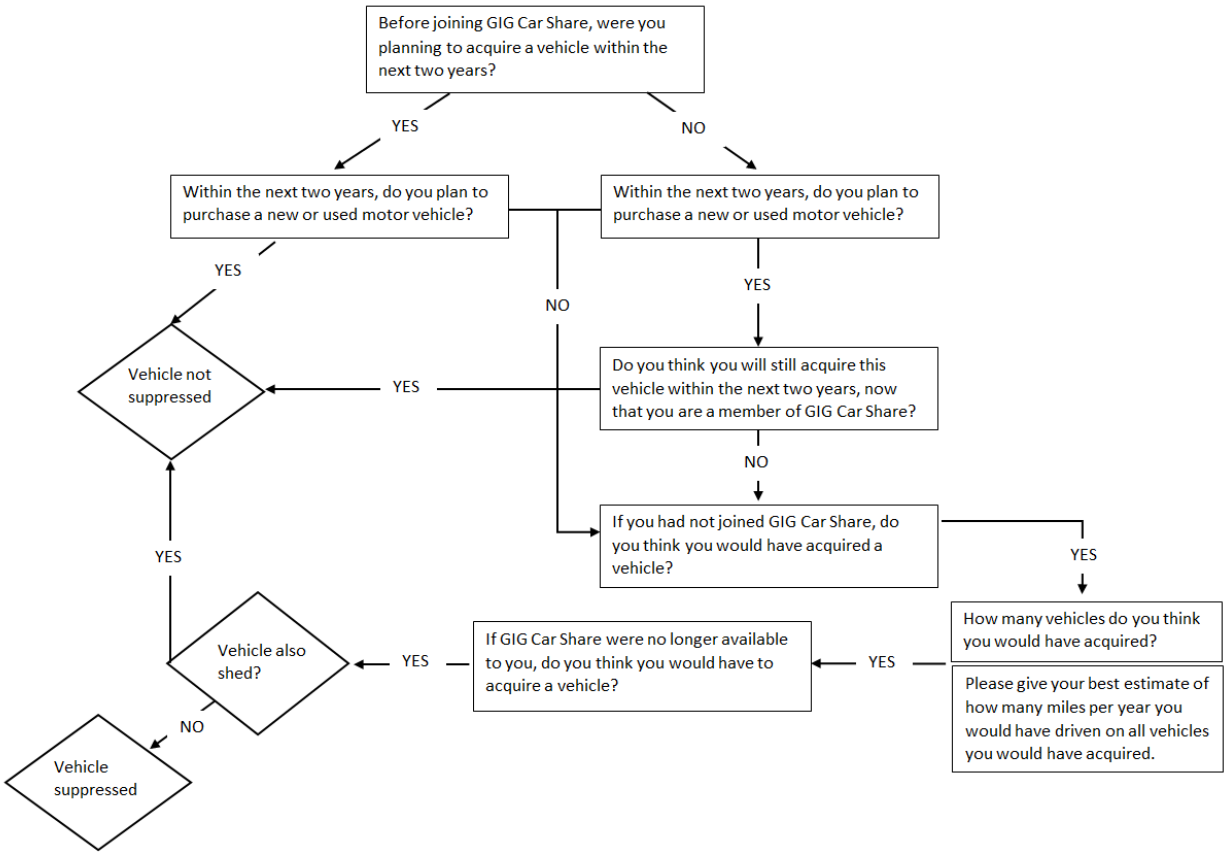
Figure 4: Question Structure Evaluating Vehicles Shed



Carsharing also impacts future vehicle purchasing plans. Respondents were asked a series of questions to confirm if access to GIG Car Share had contributed to suppressing the purchase of a new or used vehicle. Similar to Figure 4, Figure 5 analogously presents a schematic with simplified answers illustrating how question responses would or not qualify for the vehicle suppression impact. Respondents were first asked about vehicle purchasing plans before they joined GIG. If they answered no, they were asked whether they currently had plans to purchase a vehicle, and then whether they still planned to purchase this vehicle now that they were a member of GIG. For respondents who answered that they no longer planned to purchase a vehicle, we verified their response in two ways. First, we asked whether respondents would have acquired a vehicle if they had not joined GIG. This question assesses the necessity of a vehicle to satisfying the respondent's travel needs. Second, we asked whether respondents would have to acquire a vehicle if GIG were suddenly unavailable to them. This question assesses how much GIG contributes to suppressing the need to acquire a vehicle. Answering

affirmatively (i.e., “Yes I would have to acquire a vehicle if GIG were suddenly unavailable”) implies that GIG is fulfilling a need to travel by car that otherwise would have been fulfilled by personal vehicle ownership.

Figure 5: Question Structure Evaluating Vehicles Suppressed



Note that if a respondent also shed a vehicle, which we confirmed in a separate set of questions, we would not count any vehicles that were also suppressed. In section that follows, we present results from the survey analysis, followed by a discussion of key takeaways and conclusions that can be derived from the data obtained.

Survey Analysis Results

Demographics

To determine whether the survey sample was representative of the broader Oakland population, the post-survey sample was compared to overall demographic characteristics for each city. A demographic profile of Oakland was created using the 2017 American Community Survey (ACS) 1-Year estimates to compare income, gender, age, educational attainment and race statistics between the city populations and the survey sample. The data from ACS was aligned to the relevant survey categories as necessary to

create comparable distributions of the demographic attributes. Table 10 shows these comparisons for Gender, Age, and Education.

Table 10: Demographic Distributions of Gender, Age, and Education

Demographic attribute	Oakland population	Oakland sample
Gender	N = 425204	N = 218
Male (%)	49.2%	42.3%
Female (%)	50.8%	52.6%
Non-binary	-	5.2%
Prefer not to answer	-	2.3%
Total (without Prefer not to answer)	100%	100%
Age	N = 425204	N = 218
18 - 24 (%)	12.5%	5%
25 - 34 (%)	22.9%	48%
35 - 44 (%)	19.1%	23%
45 - 54 (%)	15.1%	14%
55 - 64 (%)	14.4%	8%
65 - 74 (%)	10.1%	3%
75 or over	5.7%	0%
Prefer not to answer	-	2%
Total (without Prefer not to answer)	100.0%	100.0%
Education	N = 425204	N = 207
Did not complete high school (%)	18.5%	0.5%
High school graduate (%)	17.6%	3.9%
Some college (%)	18.6%	1.0%
2-year college degree (%)	5.3%	4.9%
4-year college degree (%)	23.9%	44.8%
Graduate degree (%)	16.2%	44.8%
Other (%)	-	-
Prefer not to answer (%)	-	2%
Total (without Prefer not to answer)	100%	100%

Table 10 shows that the distribution of the survey sample departs from the Oakland population in several categories. The most closely aligned category is gender, where the share of females is equivalent in both the population and sample. However, our survey contained additional gender categories of “non-binary” and “prefer not to answer”, two categories not in the ACS but that were collectively selected by about 5% and 2% of the survey sample, respectively. The non-binary category mostly drew from the male gender, suggesting that our sample had males in lower proportions than the general population. The other demographic categories of age and education also exhibited dissimilarities from the sample. The sample was found to be younger, with over 50% of the sample under the age of 34. Though the Oakland population is also relatively young with 36% of 18+ population under the age of 34, the sample of GIG users is still younger than the Oakland population. Finally, the sample is relatively higher-educated as compared to the Oakland population, as 88% of respondents have at least a 4-year

degree. Though the Oakland population has a relatively high level of education, with about 40% of the population having completed at least a 4-year degree, it is still much lower than the 88% found in the GIG survey.

Table 11 shows the comparative distributions of income and race for the sample and population. The distribution of income is relatively similar, though the carsharing sample has, on balance, a higher income than the Oakland population. While the difference is evident in the distribution, it is not overly imbalanced. The race/ethnicity distribution shows some more significant differences between the sample and the population. About 60% of the sample is White, compared to only 27% of the Oakland population. Similarly, nearly 30% of the Oakland population is Hispanic or Latino, while only 7% of the survey sample reported being a member of this demographic. About 23% of the Oakland population is African American, while this demographic represents only 12% of the survey sample. The survey sample and population shares of Asians align most closely, at 13% and 15% respectively.

Table 11: Demographic Distributions of Income and Race/Ethnicity

Demographic attribute	Oakland population	Oakland sample
Income (Households, $ US)	N = 425204	N = 218
Less than $10,000 (%)	5.9%	2.4%
$10,000 - $25,000 (%)	14.2%	5.3%
$25,000 - $35,000 (%)	7.3%	7.7%
$35,000 - $50,000 (%)	9.7%	9.6%
$50,000 - $75,000 (%)	15.1%	18.8%
$75,000 - $100,000 (%)	11.6%	15.4%
$100,000 - $150,000 (%)	15.3%	19.2%
More than $150,000 (%)	20.8%	21.6%
Prefer not to answer	-	4.6%
Total (without Prefer not to answer)	100%	100%
Race/Ethnicity	N = 425204	N = 218
African American	22.9%	12.7%
Asian	15.4%	13.7%
Hispanic or Latino	28.4%	7.1%
Native American or Alaskan native	0.6%	0.0%
Hawaiian or Pacific Islander	0.4%	0.0%
White	27.0%	61.8%
One other race alone	4.8%	0.5%
More than two races	0.3%	4.2%
Prefer not to answer	0.0%	2.8%
Total (without Prefer not to answer)	100%	100%

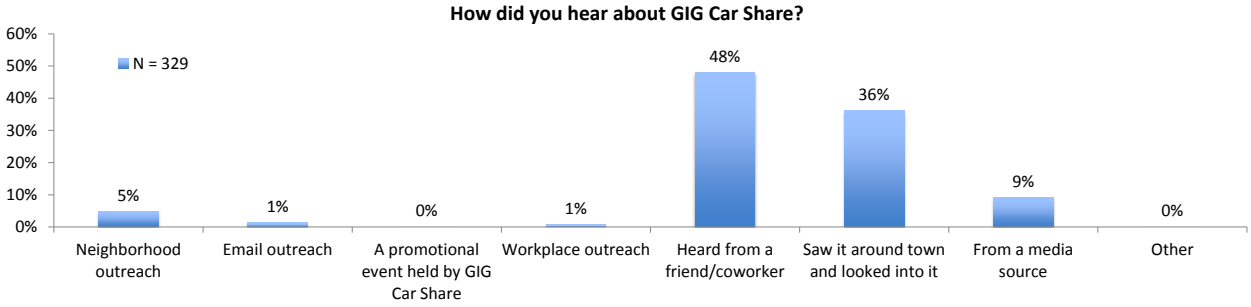
The pre-survey sample was different from the post-survey sample, though opportunities to link users across the surveys were very limited. The population of the pre-survey was also predominantly White,

but with greater representation of Asian and Hispanic/Latino populations, and lower representation of African Americans. Other demographic responses showed that the pre-survey was more dominated by college students, as 46% stated that they were currently in a 4-year college and 27% reported incomes less than $10,000 per year. Because of these responses and the evolving nature of the membership, particularly in the early months of the system operation, we consider the demographic distributions from the post-survey to be more reflective of the current user population.

Adoption of GIG

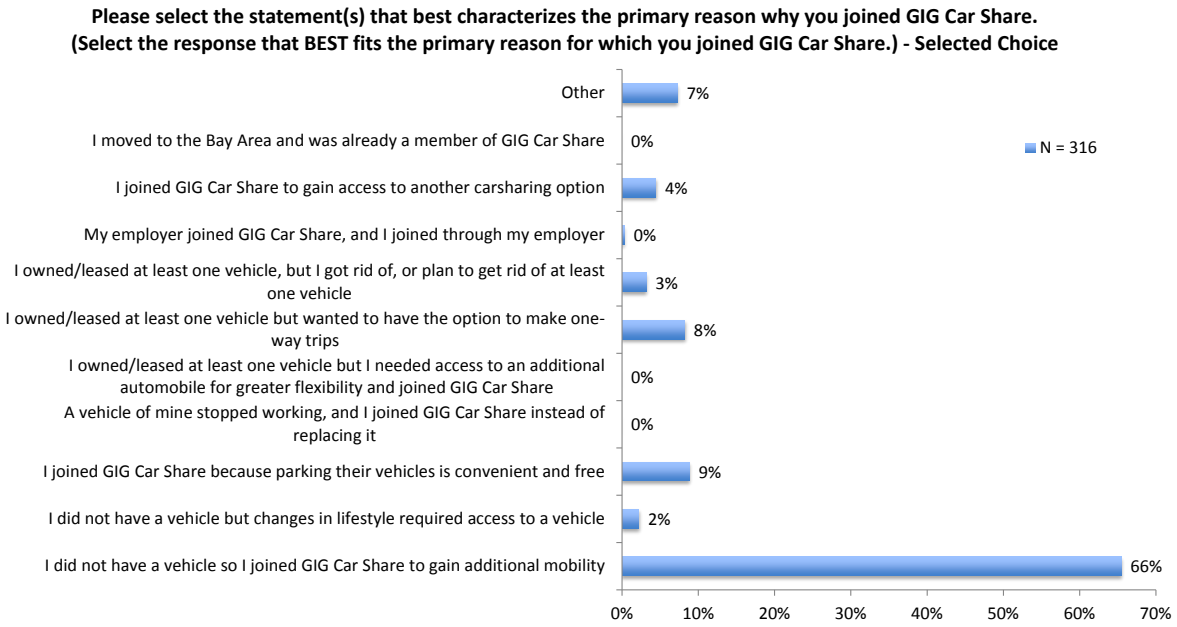
Respondents to the pre-survey were asked questions about how they heard about GIG Car Share. Almost 50% of respondents reported that they heard about it from a friend/coworker. Another 36% saw the vehicles around town, while the remaining respondents reported hearing about GIG from social media, neighborhood outreach, or an email or work outreach. The distribution of responses is shown in Figure 6.

Figure 6: How pre-survey respondents heard about GIG



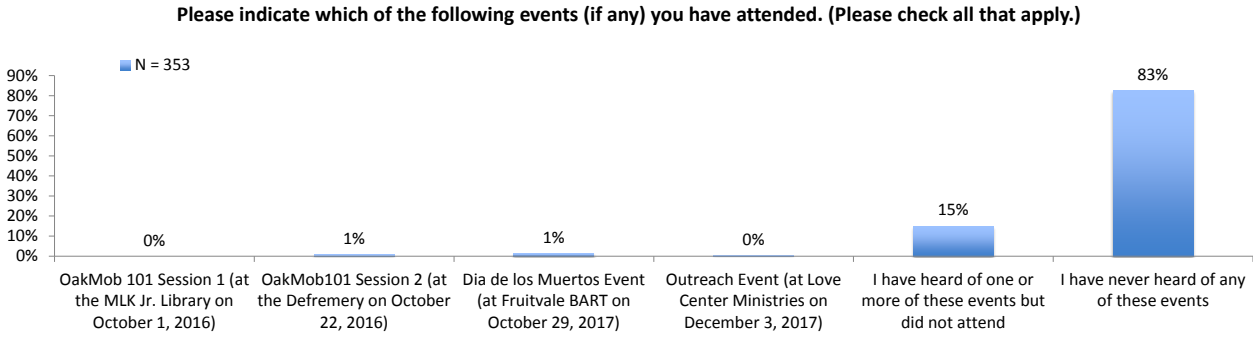
Respondents to the pre-survey were also asked about why they joined GIG. The majority of respondents stated that it was purely to gain additional mobility in the absence of a vehicle. This sentiment was also reflected in other responses. However, 3% did report that they owned at least one vehicle, and planned to get rid of that vehicle. The distribution of responses is shown in Figure 7.

Figure 7: Reasons why people joined GIG Car Share



Additionally, several outreach events were held in the lead up to the launch of GIG as well as several months after launch. Pre-survey respondents were asked whether they had engaged these events or had at least heard of them. The vast majority had no knowledge of these events, but about 15% had heard of them. About 1% had attended the Dia de los Muertos event at the Fruitvale BART station in October of 2017. The responses are shown below in Figure 8.

Figure 8: Outreach Events attended by Pre-survey respondents



Recent Trip Characteristics

Respondents were asked a series of questions related to the characteristics of their most recent trip taken with GIG Car Share from Oakland members. The analysis herein draws from the post-survey that was administered in early January 2019.

The trends identified in the sample show that the majority of respondents drove using GIG Car Share for local errands and cross-city transit, with trip mileage and rental length reflecting shorter trips. While there were trends in usage towards weekend and morning trips, there was relatively even dispersion of trips throughout the week and time of day. Trip purposes were primarily identified as replacing a trip using a different mode, with secondary reasons related to running errands and accessing local neighborhood services or domestic activities. Most respondents made trips by themselves, and cited the flexibility, convenience and relative speed of the GIG Car Share service compared to other modes of transportation.

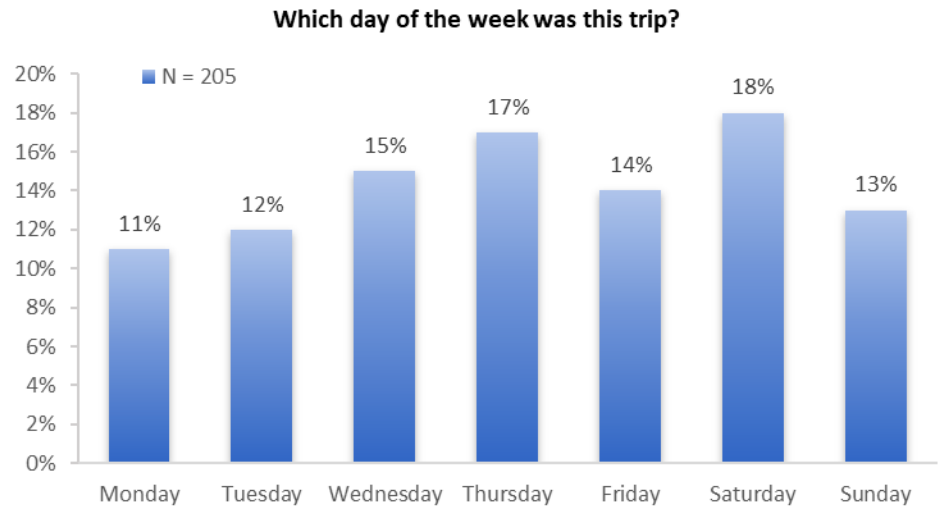
Day of week of most recent trip

We asked on which day of the week respondents most recently used GIG Car Share vehicle in order to determine which days had relatively higher representation across the sample. This question was asked to assess trends on weekday and weekend usage and complements another survey question about usage by time of day to assess diurnal patterns of use.

The sample showed that slightly more respondents drove with GIG Car Share towards the end of the week and on weekends. Monday and Tuesday accounted for only 23% of all trips, while Friday, Saturday and Sunday accounted for 45% of all trips in the sample. At the same time, there was a relatively even distribution of users over the course of the week, with no day comprising less than 10% of the total.

Trip purposes also changed for the weekday and weekends along with trip volume. Trip purposes related to commuting to work/school, going to public transportation, and grocery shopping were more common during Monday through Thursday, and trip purposes related to recreation and social trips were more common during Friday, Saturday, and Sunday.

Figure 9: Day of the week of most recent trip taken

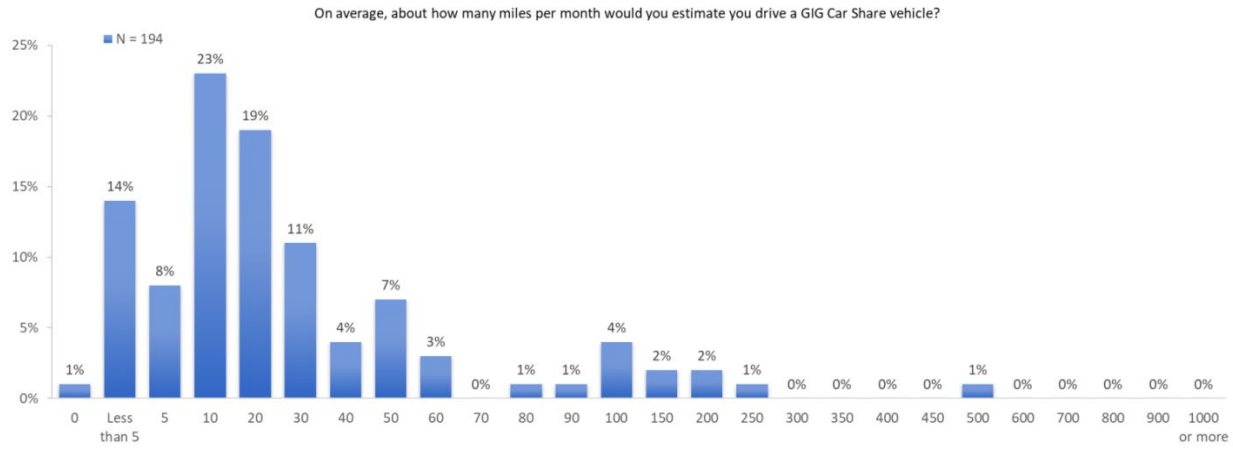


Monthly average mileage

We asked a question about monthly average mileage estimates driven using GIG Car Share vehicles in order to determine trends in distances travelled. The trends that emerged from the sample were evident in three segments of average mileage: respondents who drove 20 miles and fewer per month; respondents who drove between 30 and 90 miles per month; and respondents who drove over 100 miles per month.

Over half of survey respondents reported driving less than 20 miles per month. Fewer respondents drove a GIG Car Share vehicle for the other two segments. Approximately 27% of the sample drove an average between 30 and 90 miles per month, and 10% of respondents had higher mileage averages of 100 miles and above per month.

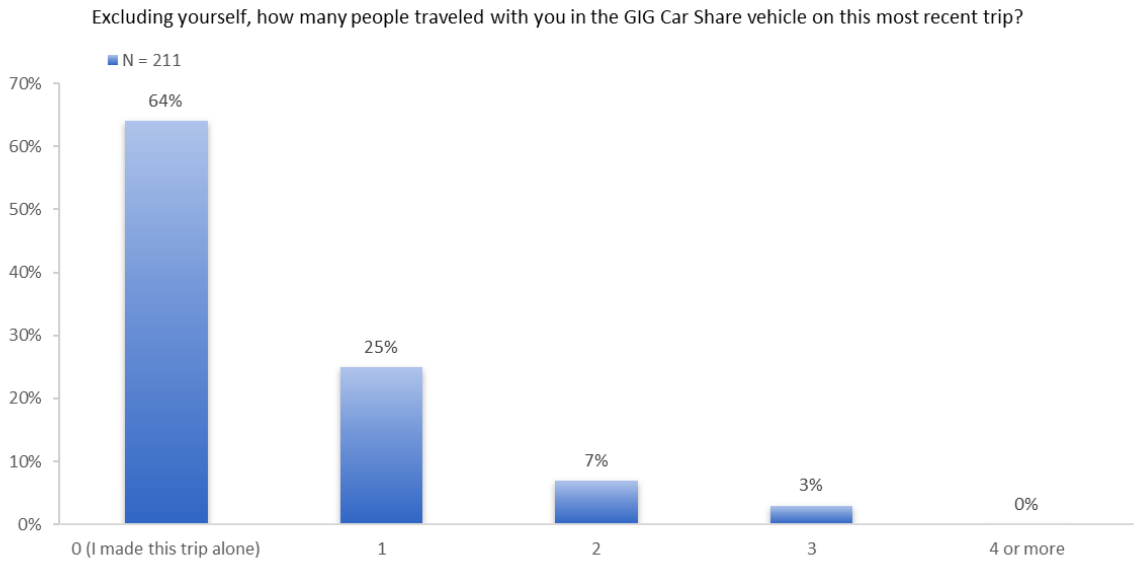
Figure 10: Monthly mileage estimates



Trip Occupancy

We asked questions about how many people travelled with the respondent during their most recent trip. We asked this question to gauge how many respondents were driving alone versus driving with other people. On their most recent trip, 64% of respondents reported driving by themselves and 25% of respondents reported driving with one other person. Only 10% of the sample indicated driving with two or more people in addition to themselves. This may suggest that the majority of GIG members only require a car for transporting themselves and running individual errands, versus using a car for trips with multiple riders.

Figure 11: Number of travelers in most recent trip



Trip Purpose

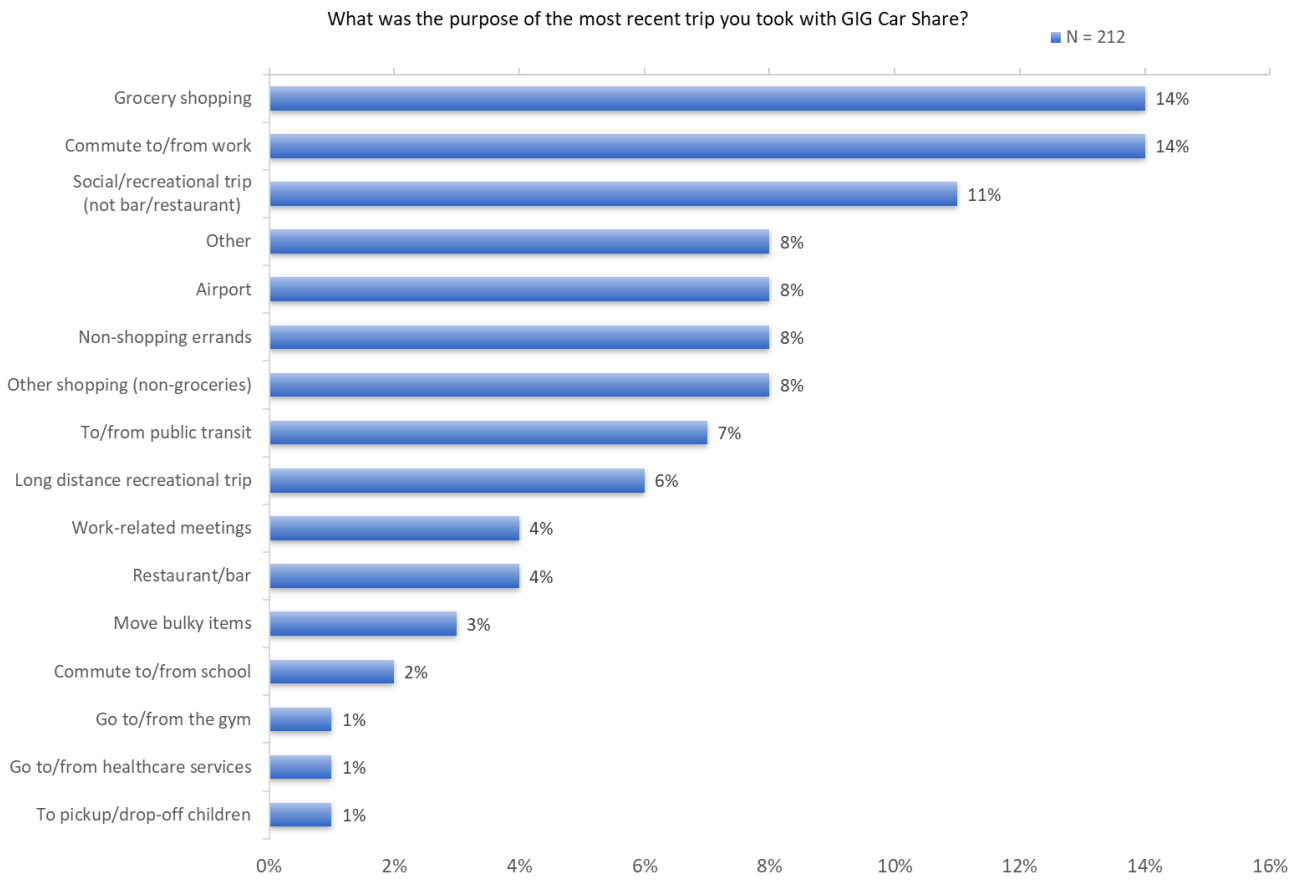
We asked a question about the purpose of the respondent's most recent trip using GIG Car Share. We asked this question in order to assess the types of activities for which respondents needed to use carsharing services, and to see if trends emerged based on similar purpose characteristics.

As shown in Figure 12, the top three purposes listed for using GIG Car Share were for grocery shopping, commuting to and from work, and for social and recreational use, comprising nearly 40% of all responses. The next most represented purposes identified were related to local trips and comprised of approximately 24% of respondents. These included taking trips to airports for pick-up or drop-off, going to and from public transit, and running errands or other non-grocery shopping. The least represented trip purposes were those that could not be reliably fulfilled through public transit, including taking long distance recreational trips, moving bulky items, or travelling to and from work-related meetings during the day.

Responses under the "other" category included GIG usage as a substitute for when a respondent's personal car breaks down or is inoperable, vacation rentals, and for cases in which a personal bicycle or public transit is inaccessible.

A relatively large share of respondents earning less than $50,000 listed using GIG Car Share for long distance recreational trips, work commutes, and grocery shopping. Commutes to and from work were more common with respondents earning less than $100,000.

Figure 12: Purpose of most recent trip

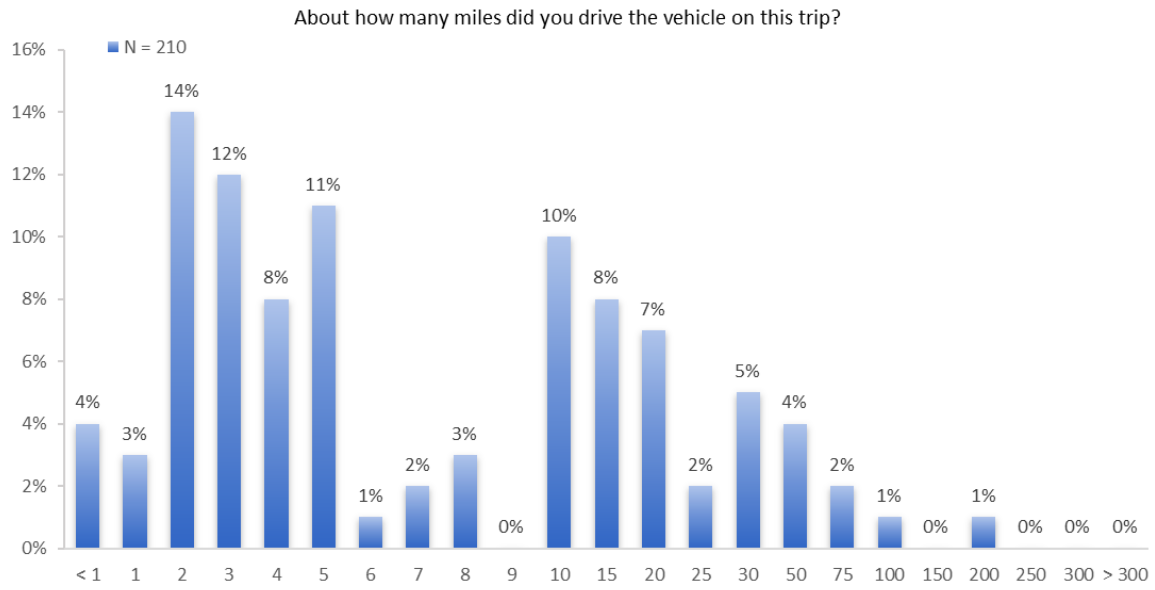


Estimated mileage

We respondents about the distance traveled in their most recent trip using GIG Car Share. A majority of the sample (52%) indicated that they had driven five or fewer miles on their most recent trip, including 21% who had driven two or fewer miles. These amounts are consistent with highly represented trip times and purposes that reflect GIG Car Share usage for local-level service and access. Oakland and Berkeley are relatively dense cities, so the GIG Car Share trips in these cities can be expected to be of lower mileage.

Longer trips are less represented in this sample. Approximately 32% of the sample indicated that they had driven between 10 and 30 miles on this trip, and relatively fewer respondents (8% of the sample) indicated a trip length of over 50 miles. The trip purposes that were longer included airport trips and of course long-distance recreation trips.

Figure 13: Miles driven on most recent trip



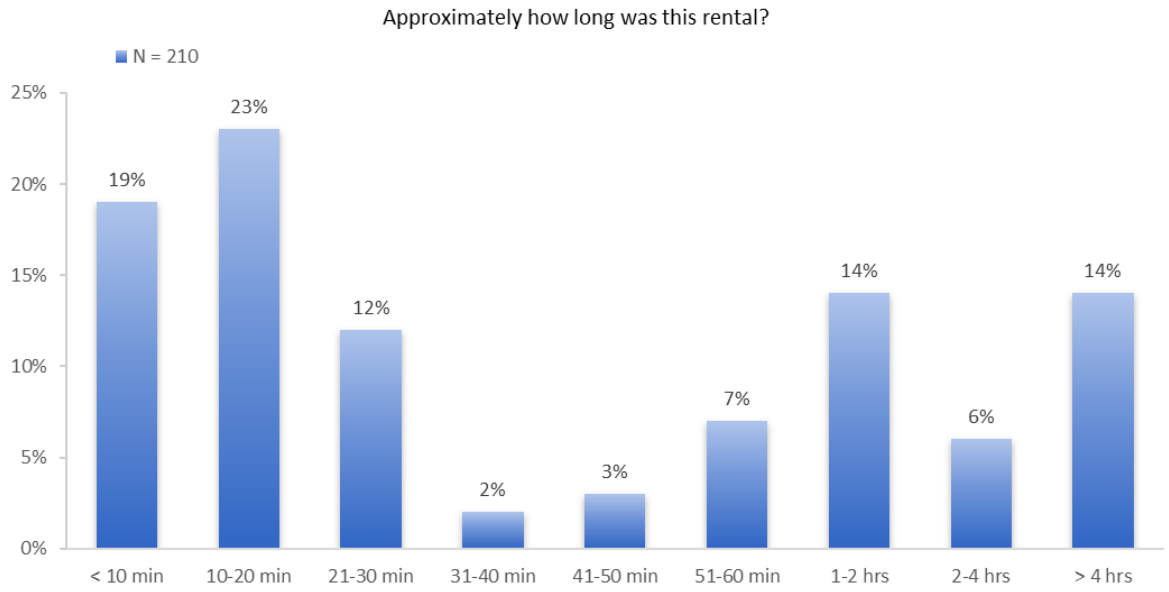
Duration of Trip

We asked questions about the approximate time duration of the respondent's most recent trip with GIG Car Share. Vehicle rental length durations fell into two broad categories: rental periods at 30 minutes and under and rental periods of multiple hours.

Over half of respondents indicated that their rental lasted 30 minutes or less. The trip purposes for 30 minutes and under spanned all trip purposes, including a high representation for both work/school commutes as well as for neighborhood-level services and errands.

Trips lasting at least one hour comprised approximately 34% of the sample, with 20% of all rentals being longer than four hours. Trip purposes for longer rental periods included grocery shopping, travel for social and recreational trips, and long-distance recreation trips. Consistent with rental mileage, shorter trips (trips lasting less than 10 minutes, between 10 and 20 minutes, and between 21 and 30 minutes) were the most common across all income segments in the sample. The number of trips decreased across all rental lengths as respondent income increased.

Figure 14: Most recent rental trip duration



Time of Day

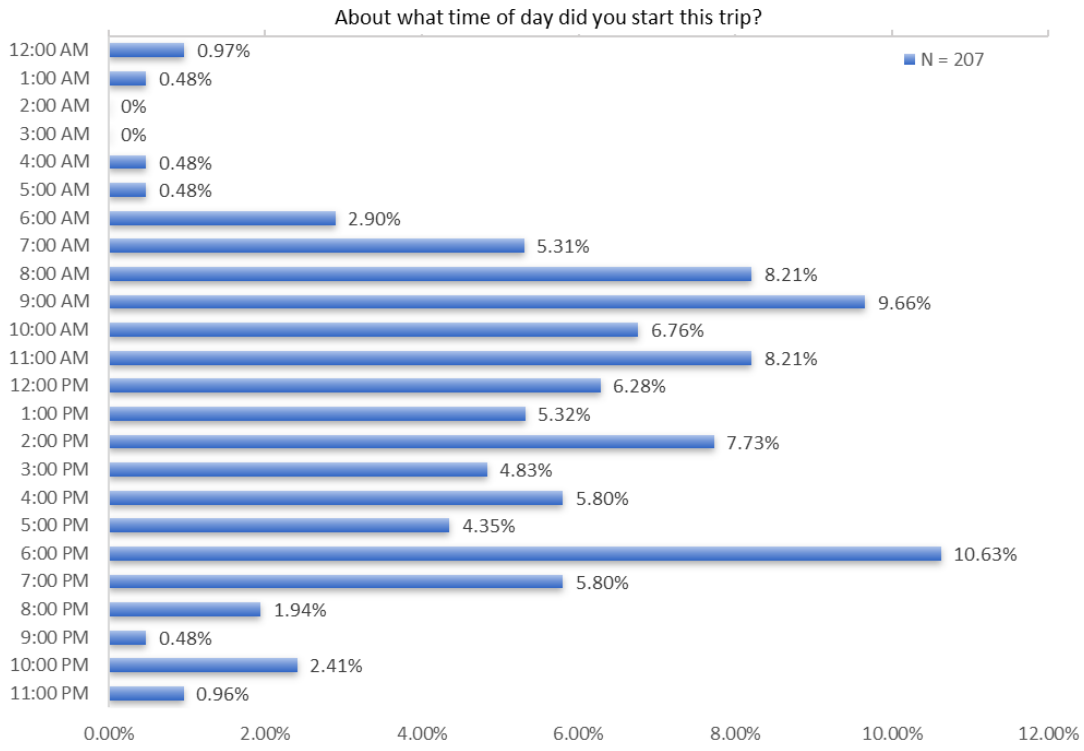
We asked a question about the approximate time of day that respondents began driving with a GIG Car Share vehicle. This question was asked in order to determine trends in respondent behavior arising from when they needed a carsharing vehicle.

Morning trips (started between 6:00AM – 12:00 PM) comprised 41% of the trip start times, with 18% of the sample starting trips between 8:00AM and 10:00AM. Morning trips accounted for the majority of trip purposes related to commuting to and from work, public transportation and airports, as well as for long distance recreational trips.

In this sample, trip purpose and volume largely shifted with time of day. Afternoon trips (started between 12:00PM – 6:00PM) comprised 34% of the sampled trip start times. Evening trips (started between 6:00PM – 10:00PM) comprised approximately 19% of the sampled trip start times, including the most represented interval of the sample at 6:00PM (~11% of all trips). Travel purposes that started primarily in the afternoon or evening were more often related to social or recreational trips, grocery shopping and other non-shopping errands.

Late evening and early morning trips (10:00PM – 6:00AM) were the least represented trip start times in the sample, and comprised 8% of the sampled trip start times. Most trip start times were not significantly altered due to differences in education attainment or age.

Figure 15: Time of day when most recent trip was started

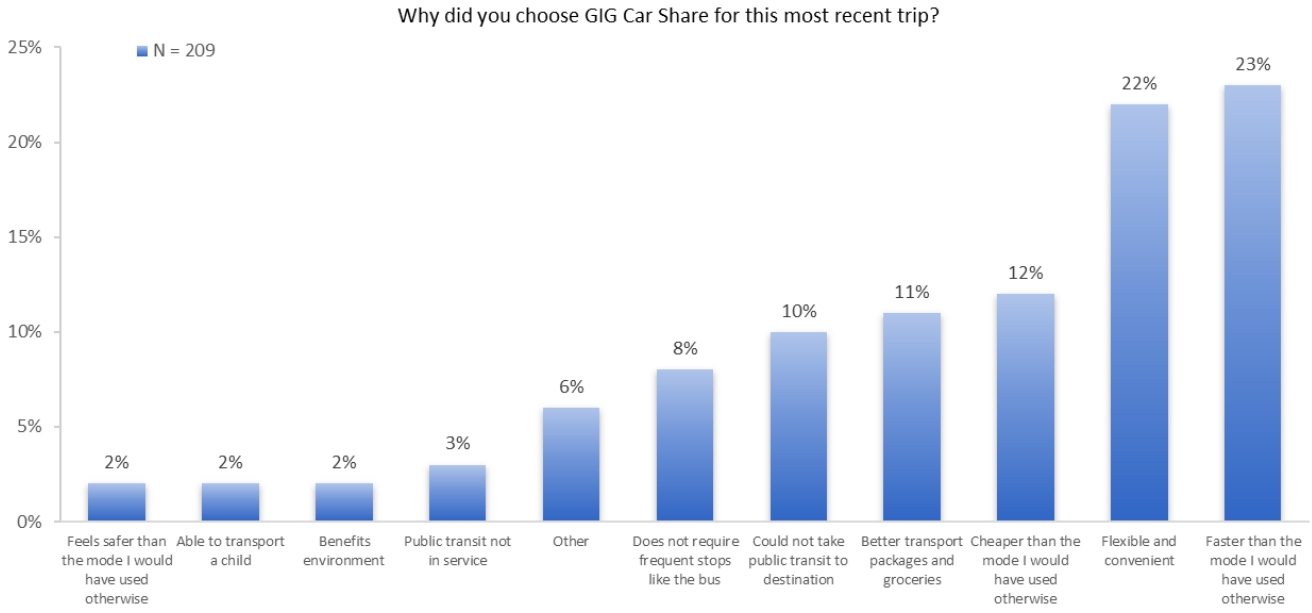


Reason for selecting GIG

We asked why respondents selected GIG Car Share for their most recent trip. This question was asked to determine what aspects of carsharing, either with GIG Car Share or with the carsharing in general, led them to use the service.

Respondents cited the flexibility, convenience and speed of travelling as compared to the mode they would have otherwise taken, with approximately 45% of respondents citing these reasons for selecting GIG Car Share. Approximately 21% of the sample explicitly stated that GIG Car Share was a better alternative than public transit (reasons related to transit making frequent stops, destination not accessible via transit, or travel plans not aligned with service hours). Other categories respondents listed were cost savings compared to other modes, improved ability to run errands, as well as being a more efficient option compared to public transit.

Figure 16: Reasons for selecting GIG Car Share



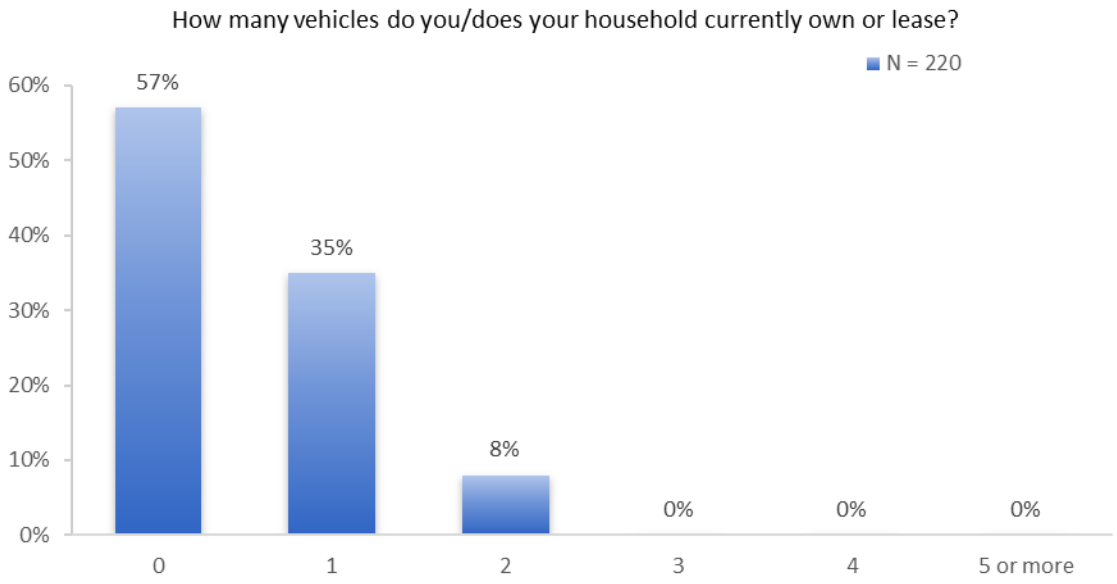
Impact of GIG Car Share on Travel Behavior

Previous research on carsharing has found that members of carsharing organizations change not only their personal driving behavior but also use of other modes, such as public transit or ridesourcing (Martin & Shaheen, 2016; Cervero et al., 2007). For example, free-floating carsharing can provide users with a flexible and convenient alternative to public transit if they need to travel when or where public transit is not available. Carsharing can also provide additional mobility to non-car owners, enabling these users to make a trip that they otherwise would not have made. The post-survey for GIG members asked respondents to report any changes in travel behavior that were a direct result of being a member of GIG Car Share. In particular, we analyzed the impacts of GIG on vehicle ownership, future vehicle purchasing plans, and changes in miles driven. We also quantify the impacts of GIG on public transit, ridesourcing, active transportation, and other transportation modes available in the Bay Area.

Impact of GIG Car Share on Vehicle Ownership

The majority of survey respondents did not own a vehicle at the time of the survey (Figure 17). For respondents who were car owners, a small percentage either got rid of or sold a vehicle because of the availability of GIG. For respondents who were not car owners, a small percentage acquired a vehicle and reported that it was partially due to GIG not meeting their needs either in terms of cost or convenience. Carsharing services can also impact future vehicle purchasing decisions, and our analysis shows that, compared to shed vehicles and acquired vehicles, GIG had the largest impact on personal vehicle suppression. In this section, we will discuss the impact of GIG on vehicle holdings.

Figure 17: Current vehicle holdings of GIG survey respondents



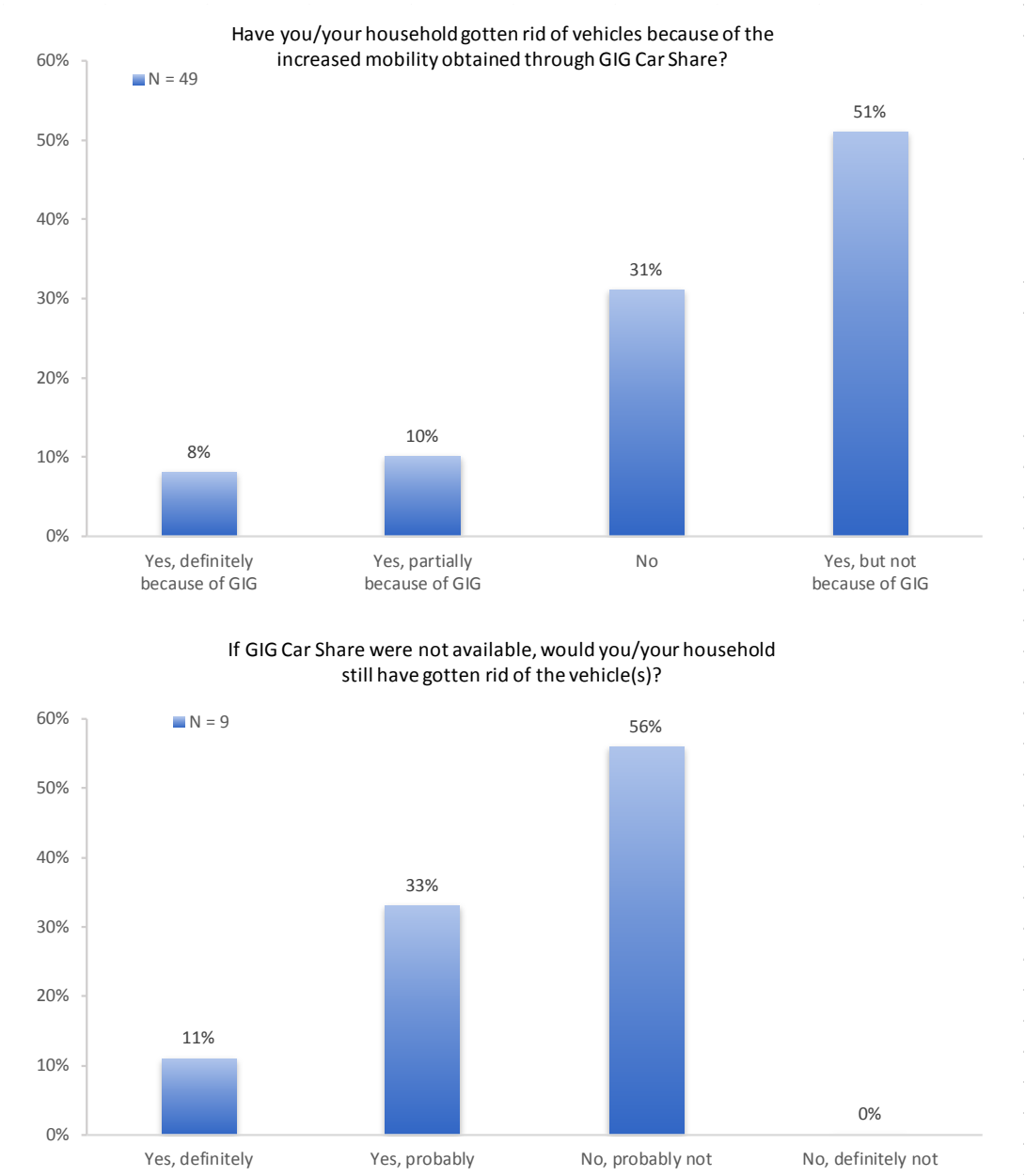
Vehicles purchased

About 2% of survey respondents in Oakland reported that they purchased a vehicle partially because of GIG Car Share. The main reason given for purchasing a vehicle was that the costs of owning a vehicle were roughly equivalent to what respondents were spending on GIG. Additionally, respondents also stated that they disliked paying for GIG every time they used it and that there were too many steps required to reserve a vehicle. None of these respondents had vehicles at the time of the survey. The responses to these questions effectively state that GIG did not provide enough of a benefit to these respondents to justify remaining carless. In this sense, these respondents reported that the GIG did not work for them (either in cost or convenience) in a way that would eliminate the need for them to acquire a personal vehicle. Hence, such vehicles would likely have been acquired anyway in the complete absence of GIG.

Vehicles shed by GIG Respondents

Shed vehicles are vehicles that respondents either got rid of or sold due to the availability of GIG Car Share. We first asked respondents to list any vehicles they owned prior to joining GIG that they do not currently own, a sample of about 49 respondents. We then asked these respondents whether they had gotten rid of their vehicles because of the additional mobility provided by GIG (Figure 18, top). 18% of the sample responded that GIG definitely or partially contributed, while 51% of the sample responded that other factors contributed to getting rid of the vehicle.

Figure 18: Vehicles Shed Due to GIG Car Share



We then asked questions to confirm that the availability of GIG was the primary reason for shedding the vehicle. Respondents who answered that GIG had definitely or partially contributed to shedding a vehicle were asked whether they still would have shed the vehicles had GIG not been available (Figure 18, bottom). If a respondent answered affirmatively, then GIG was not the primary reason for shedding the vehicle, since the respondent would have gotten rid of the vehicle even if GIG did not exist. 56% of the sample that previously stated that they shed a vehicle because of GIG confirmed that they would not have shed the vehicle had GIG not been available to them, representing 5 users. We also applied the criteria that respondents had to be active users of GIG, or use GIG at least once a month, to have shed a vehicle due to GIG. This removed one user from the shed vehicle sample, resulting in 4 total users who

shed a vehicle due to GIG, or about 2% of the survey sample. Of these respondents, the most common reason for shedding a vehicle was that a vehicle of theirs stopped working, and they joined GIG instead of replacing it. However, there were also respondents who sold a vehicle as a result of joining GIG.

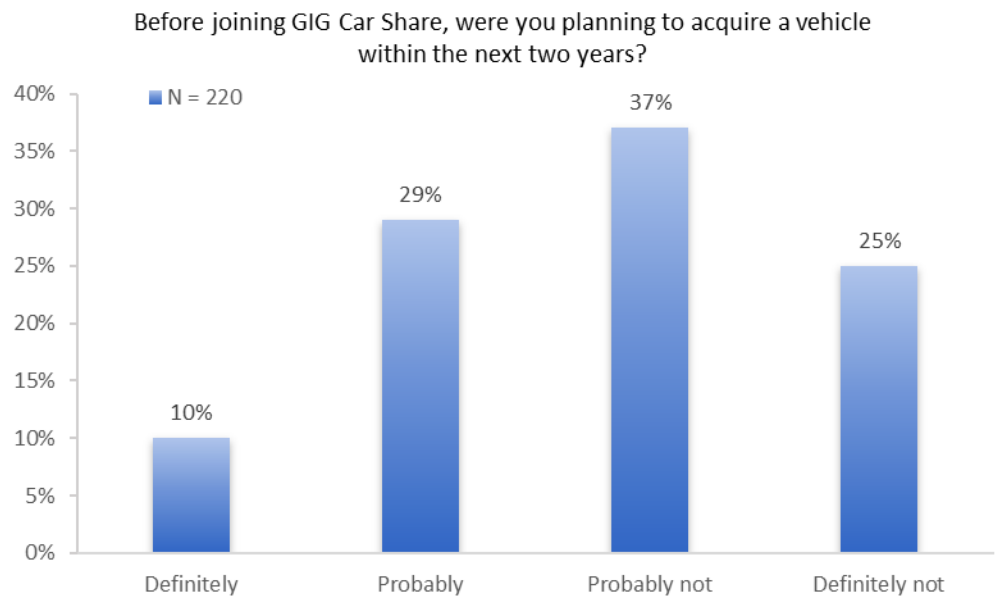
To extrapolate these findings to the broader GIG user population, we re-weighted the survey responses according to the frequency of use distribution from the GIG activity data. Our survey sample is susceptible to response bias, as those who use GIG more frequently may be more likely to respond to a survey about GIG. We compared the frequency of GIG use among our survey sample to that of the entire GIG member population, which we extrapolated from activity data provided by GIG, and determined weighting factors based on the difference in these two frequencies. After re-weighting the survey responses, we estimate that 1.6% of all GIG members shed a vehicle because of GIG Car Share, compared to 2% of our survey sample.

Vehicles suppressed

Personal vehicle suppression is a critical component of shared mobility impacts. Suppression is the prevention of vehicle ownership, where the user or member of a system decides not to acquire a vehicle because the mobility that is provided by carsharing is sufficient to cover mobility needs that would be otherwise served by a personal vehicle. Several questions were applied to evaluate the degree to which GIG Car Share suppressed vehicle purchases. As noted in the methodology, a series of questions were asked of respondents exploring personal vehicle suppression. This section explores the distributions of some of those questions used to evaluate vehicle suppression within the sample. The key objective of the suppression analysis is to understand whether GIG Car Share is presently suppressing vehicle demand and also suppressing demand in the foreseeable future (sustained suppression). The combination of these impacts is required for the vehicle suppression to count in the analysis. Also, to avoid double counting, if a household shed a vehicle, then any recorded vehicle suppression is not counted, even if the conditions within the responses are otherwise met. This is because the respondent is likely reporting that they are not going to re-acquire the vehicle that they already shed.

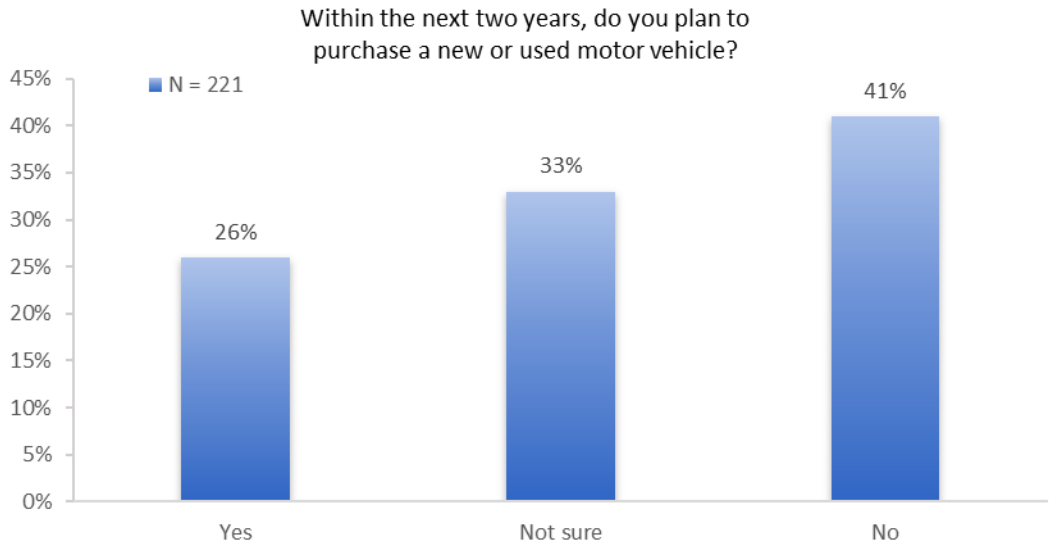
To lead off the assessment of vehicle suppression, respondents were asked whether they were planning to acquire a vehicle within the next few years. The distribution of responses is shown in Figure 19 below.

Figure 19: Vehicle Acquisition Plans before GIG Car Share



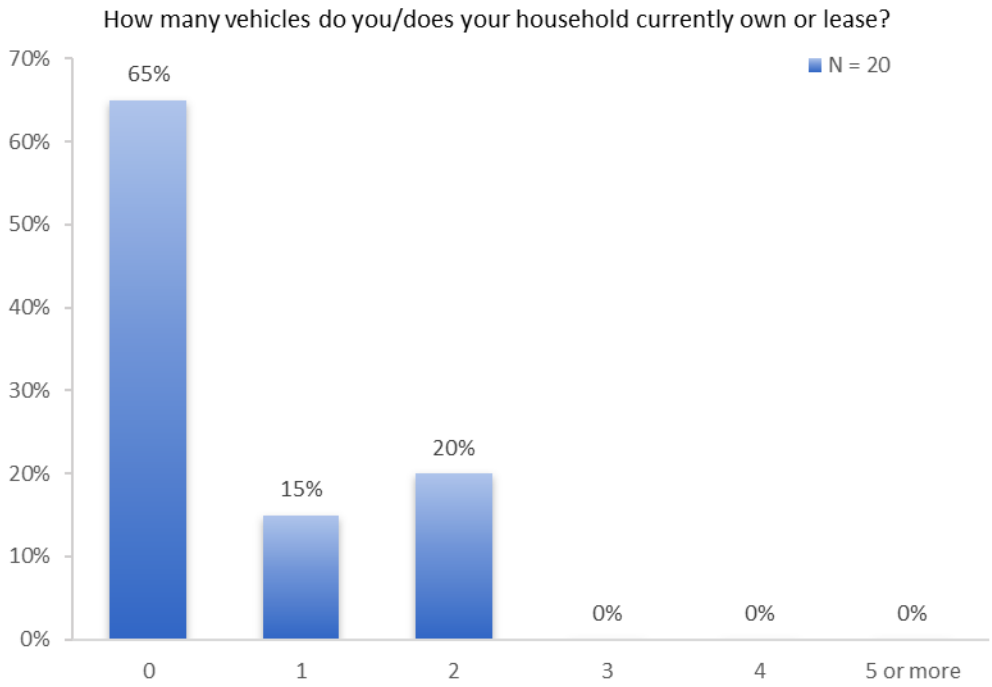
The results in Figure 19 show that before joining GIG, 86 people (39%) of respondents had plans to acquire a vehicle in the next two years. Respondents were then asked if within the next two years, they were planning to purchase a new or used vehicle. The raw distribution of responses is shown in Figure 20.

Figure 20: Vehicle Purchase Plans within the Next 2 Years



We then measured the number of vehicles that respondents would have acquired had GIG not been available, or the number of vehicles suppressed. The impact of GIG on vehicles suppressed was greater than vehicles shed; 9% of respondents in the sample suppressed vehicles because of GIG. Of these respondents, most were not car owners (Figure 21). Although these members have a net gain of VMT, their effect is less than if they had acquired a vehicle. Previous studies have shown that members of carsharing organizations practice judicious mobility when they are more aware of the marginal costs of driving a car (Cervero et al. 2007; Martin and Shaheen, 2011). Non-car owners who choose to use a carsharing organization when they need a car accumulate fewer VMT than if they had purchased a personal car.

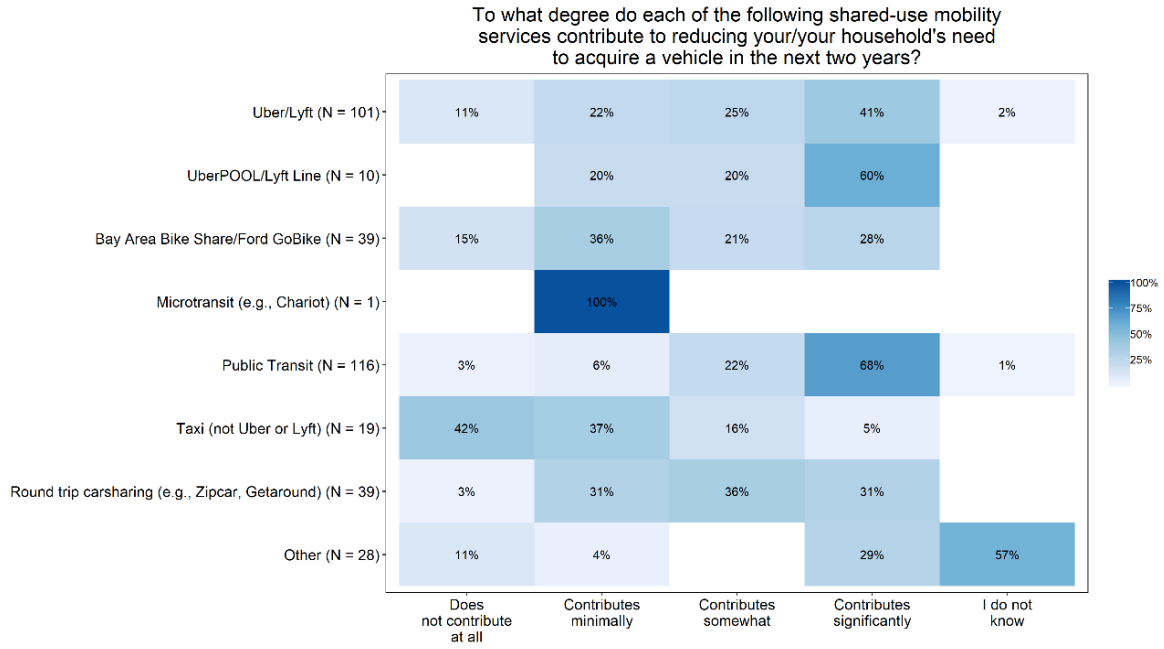
Figure 21: Vehicle holdings of respondents who suppressed vehicle purchase



We applied the same re-weighting procedure to suppressed vehicles to extrapolate our findings from the survey respondents to the whole population of GIG members. After re-weighting, we estimate that 7.2% of all GIG members suppressed a future vehicle purchase due to GIG.

About 60% of respondents stated that they Probably or Definitely were not planning to buy a vehicle within the next two years (Figure 19). To understand what other transportation modes might be influencing future vehicle purchasing decisions, we asked those respondents what other modes contributed to their lack of plans for purchasing a vehicle. The results are shown in Figure 22. The largest contributions from other modes came from ridesourcing and public transit.

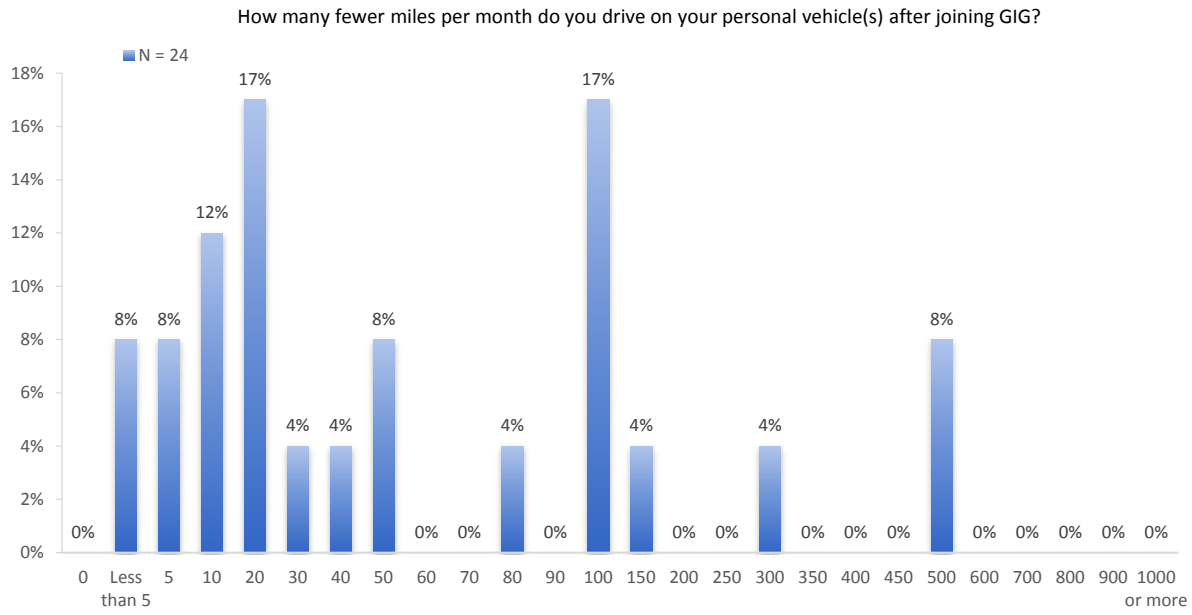
Figure 22: Contribution of Other Modes to Reduced Need to Acquire Vehicle



Impact of GIG Car Share on Miles Driven for Survey Respondents

Questions in the survey asked respondents about the impact that GIG Car Share had on the driving of vehicles that they already owned. The responses showed that 42% of survey respondents who owned at least one vehicle reported that their use of GIG impacted the amount that they drove their personal vehicles. Of these respondents, all but one reported that their personal vehicle use decreased after joining GIG. A total of 24 survey respondents reduced personal vehicle use, and 3 of those respondents decreased use on more than one of their vehicles. Figure 23 shows the distribution of reported change in personal vehicle use. The figure shows the reported change in miles driven per month for each individual respondent as a result of GIG.

Figure 23: Decrease in miles driven on personal vehicle(s) after joining GIG



The distribution shows that most respondents reduced their driving by 50 miles or less per month, with some respondents driving more than 100 miles less per month. We found a median response of 35 fewer miles driven per month. After re-weighting these responses to account for response bias, we found that 9.3% of all GIG members would decrease miles driven on their personal vehicles by an average of 67 miles.

Impact of GIG Car Share on Total VMT Driven in Oakland

The activity data provided by GIG included total miles driven during trips taken by individual members. We used the total miles driven by all members to calculate the VMT impact of GIG Car Share in Oakland. There is an analytical challenge with attributing miles driven to a specific city when several cities are within a contiguous operating region. GIG members are not only driving in Oakland but all over the Bay Area and California. We developed criteria for attributing VMT to Oakland even if the miles were technically driven outside of Oakland. First, the VMT for all trips that *started* in Oakland were considered Oakland-based VMT. For example, if a member took a GIG from downtown Oakland to Sacramento, all VMT from that trip are attributed to Oakland-based use of GIG. This is naturally because the presence of GIG in Oakland enabled that member to take the trip to Sacramento, where they would have otherwise taken another mode or would not have taken the trip at all. Second, the VMT for all trips that *ended* in Oakland were also considered Oakland VMT with the exception of trips that started in Berkeley. Since Berkeley is also a GIG HomeZone, any trips that started in Berkeley would be included in a total Berkeley-based VMT calculation and not Oakland's. However, trips that started elsewhere in California but ended in Oakland were still attributed to Oakland since these are trips of vehicles returning to the Oakland GIG HomeZone. Note that the activity data does not include any vehicles that are part of the Sacramento fleet of electric vehicles.

During the 18-month study period, a total of 3.98 million miles were driven on GIG vehicles. Based on our criteria, about 2 million miles or 51% of total miles were generated from GIG use to and from Oakland. 1.3 million miles or 33% of total miles were generated from GIG use to and from Berkeley. The remaining miles were from trips that started *and* ended outside of Berkeley and Oakland. Since the trip data did not have user ID, it was not possible to attribute these miles definitively to either Berkeley or Oakland. As a worst-case scenario, all of these miles would have been generated from multi-day, long trips that originated in Oakland. This analysis was used to inform the lower bound and upper bound of miles driven in Oakland due to GIG. To align the net impact analysis with the annual periodicity of the survey data, we considered only the GIG miles recorded from December 2017 to December 2018, towards the end of activity data period. Across these 12 months, we estimated the lower bound of GIG vehicle miles to be 1.5 million and the upper bound of GIG vehicle miles to be about 2.1 million.

To elevate the behavioral change impacts estimated from the survey sample to the broader member population, we computed the size of the member population in Oakland, based on data provided by GIG. We computed a lower bound and upper bound member population size reflecting an approximate range of GIG's membership base during the study period. We then used the survey results assessing the impact of GIG on miles driven and the impact on vehicle holdings to estimate the total reduction of VMT due to GIG Car Share for the entire GIG member population. Recall that we found that 1.6% of the member population would shed a personal vehicle because of GIG and a further 7.3% were suppressing the purchase of a personal vehicle. These changes in vehicle ownership or future decisions about vehicle ownership have an impact on VMT. While these impacts do manifest themselves in VMT reductions, there is a degree of uncertainty around how much someone would have continued to drive on a personal vehicle that they sold, and particularly how much they would have driven on a vehicle they would have acquired in the absence of GIG, but did not.

For suppressed vehicles, we estimated the number of miles that would have been driven on these vehicles by first finding the average miles driven on personal vehicles of all survey respondents. We conducted a sensitivity analysis on the impacts of vehicle suppression, using 20%, 40%, 60%, and 80% of the average miles driven per vehicle (Average Annual PVMT) as the projected miles that would have been driven on a suppressed vehicle. We extrapolated the average miles driven for suppressed vehicles to the total GIG population using the weighted, estimated percent of vehicles suppressed and the estimated Oakland GIG user population. A summary of this analysis is shown in

Table ***12***.

Table 12: Estimated Miles Driven on Suppressed Vehicles

Impact	Suppressed Miles by Percent of Average Annual PVMT			
	20%	40%	60%	80%
Population impact – lower bound	571,256	1,142,512	1,713,768	2,285,023
Population impact – upper bound	839,588	1,679,177	2,518,765	3,358,353

To calculate the VMT impacts of shed vehicles, we used the reported annual mileage driven on vehicles that respondents stated were shed as a result of becoming a GIG member. However, the sample size of these records was relatively small, yielding a weighted value of 13,800 miles per year. This exceeded average annual PVMT driving of the sample, which was 7,700 miles per year, by almost a factor of two. Due to the small sample size of this particular impact and in the interests of maintaining conservative estimates of impact, we applied the average PVMT value of the sample to the population analysis. We combined the estimated VMT reductions from shed and suppressed vehicles with the general VMT reductions on personal vehicles and the VMT generated from GIG Car Share. This calculation estimates the net impact of GIG Car Share on reducing VMT, accounting for changes in travel behavior that occur as a result of GIG. These results are summarized in

Table **13**. We also show the net impact of GIG Car Share on VMT in general, accounting for miles driven with GIG, which we calculated from the activity data. The miles driven by GIG vehicles were calculated from December 2017 to December 2018. This maintained an annual periodicity to the activity in which the system had achieved its highest growth during the evaluation period.

Table 13: Summary of Estimated VMT Impacts under Baseline Assumptions

Category	Impact
VMT change	
Average change per user	67 miles
Estimated % user population that decreased PVMT through substitution	9.33%
Population impact – lower bound	↓31,721 miles
Population impact – upper bound	↓46,621 miles
Vehicle Shed	
Average miles on shed vehicles	7,700
Estimated % user population that shed a personal vehicle	1.6%
Population impact – lower bound	↓627,122
Population impact – upper bound	↓921,695
Vehicle Suppressed	
Average miles on suppressed vehicles	6,160
Estimated % user population that suppressed a personal vehicle	7.3%
Population impact – lower bound (miles per year)	↓2,285,023
Population impact – upper bound (miles per year)	↓3,358,353
Total Impact from Behavioral Change (Annualized VMT Change by Population)	
Lower bound population (miles per year)	↓ 2,943,866
Upper bound population (miles per year)	↓ 4,326,669
Miles Driven by GIG Vehicles (Dec 2017 to Dec 2018)	
Lower bound attributed miles (miles per year)	↑1,496,136
Upper bound attributed miles (miles per year)	↑2,062,150
Net Impact (Annualized Net Change in VMT)	
Worst case - Lower bound population & upper bound miles per year	↓881,716
Best case - Upper bound population & lower bound miles per year	↓2,830,533

The summary of estimated impacts suggests that the GIG Car Share is on balance reducing VMT in Oakland. As with other carsharing systems, a major driver of the impact is personal vehicle suppression, which is the prevention of vehicle ownership. Vehicle suppression is a powerful impact, because it is large impact and because it is easy for a consumer to not purchase vehicle. Yet, it is also subject to some uncertainty due to the fact that it is the measurement of a hypothetical event that did not happen, and the hypothetical miles attributed to this event. A vehicle not acquired is a vehicle not driven. Those miles unseen as a result is a substantial impact; even though the assumed magnitude of personal vehicle suppression (PVMT) of 6,610 miles per year is relatively a low amount of driving by typical household standards. What is notable is that the carsharing system evaluated here only needs to suppress personal vehicle purchasing by 7.3% of the member population for this powerful impact to result in a reduction in VMT. To understand how our assumption of annual miles per suppressed vehicle impacts reduction in VMT, we conduct a sensitivity analysis. Table 14 below shows how the calculated net impact under the baseline assumptions of

Table **13** would change under different assumptions of personal vehicle suppression miles. The worst case and best case shown are the same as those defined in

Table **13**.

Table 14: Sensitivity Analysis of Net Impacts by Personal Vehicle Suppression Miles

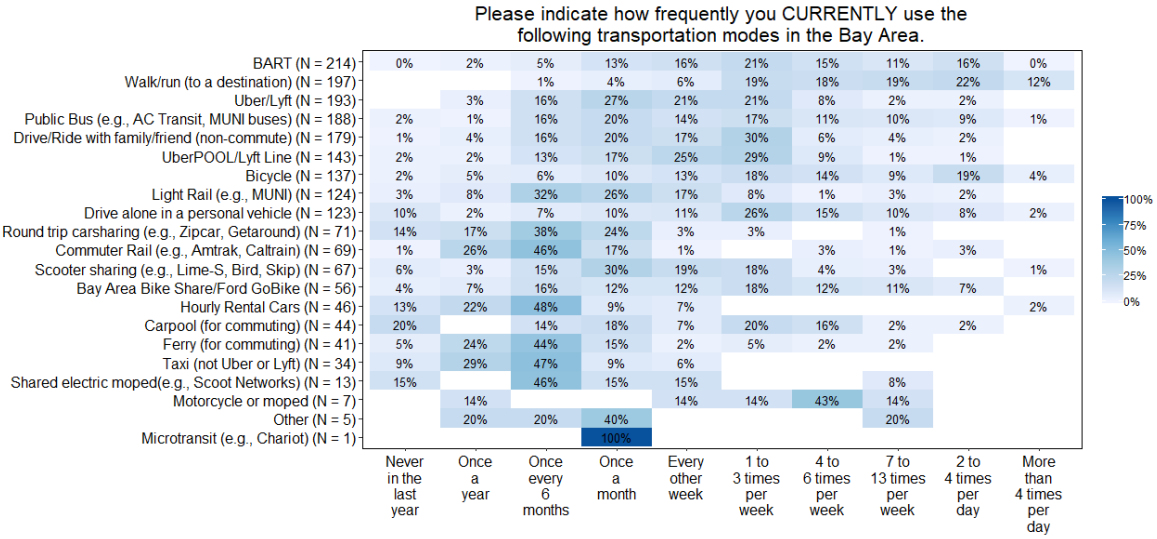
Personal Vehicle Suppression Miles Estimate	20% of Average Annual PVMT	40% of Average Annual PVMT	60% of Average Annual PVMT	80% of Average Annual PVMT (Baseline)
Net impact				
Worst case	↑832,051	↑260,795	↓310,461	↓881,716
Best case	↓311,768	↓1,151,357	↓1,990,945	↓2,830,533

The results of Table 14 shows that the net impact of suppression miles is generally robust to a number of conservative assumptions regarding the annual miles displaced by a suppressed vehicle. Only under the worst case assumptions, where the population is at the lower bound and the miles attributed to the Oakland system is at the upper bound, does the sensitivity analysis find an increase of net VMT when suppression miles is 20% or 40% of the annual average PVMT of survey sample. This would describe the circumstances in which the suppression impact is not powerful enough to overcome the miles driven by GIG Car Share vehicles during the evaluation period. Overall, these findings suggest that the presence of GIG Car Share is reducing net VMT in Oakland.

Impact of GIG Car Share on Other Modes

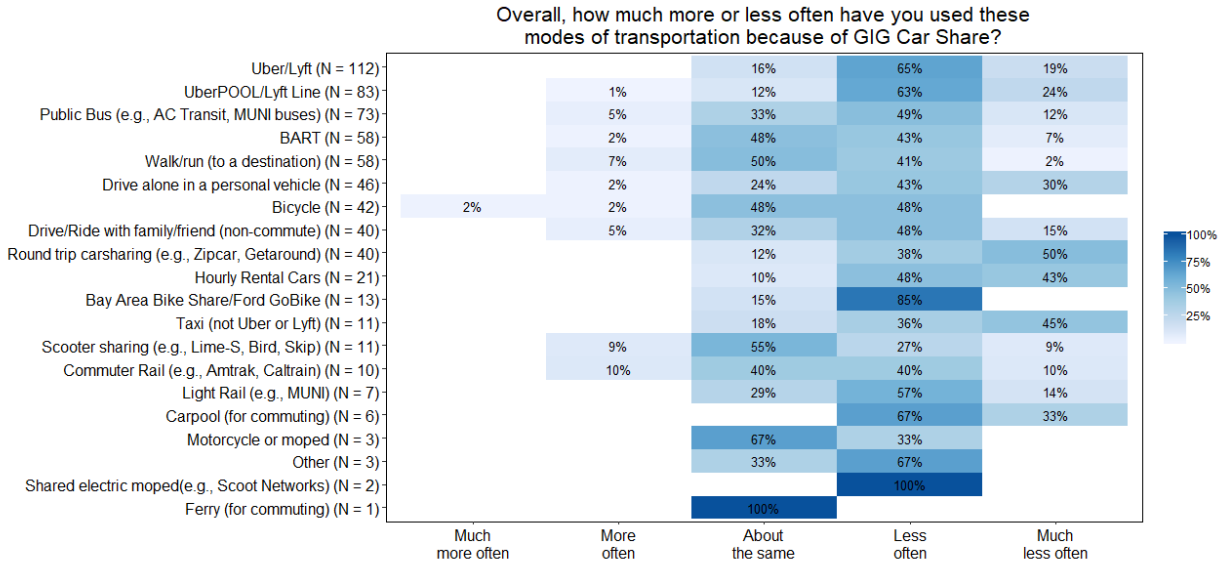
We asked survey respondents to report how their use of other transportation modes changed as a result of using GIG Car Share. To begin, we evaluated the current (at the time of the survey) frequency of use of other modes, as shown in Figure 24. The most frequently used modes included public transit (BART public buses), active transportation (walking, running, and biking), and various forms of car travel (Uber/Lyft, driving or riding in a personal vehicle).

Figure 24: Frequency of use of other modes



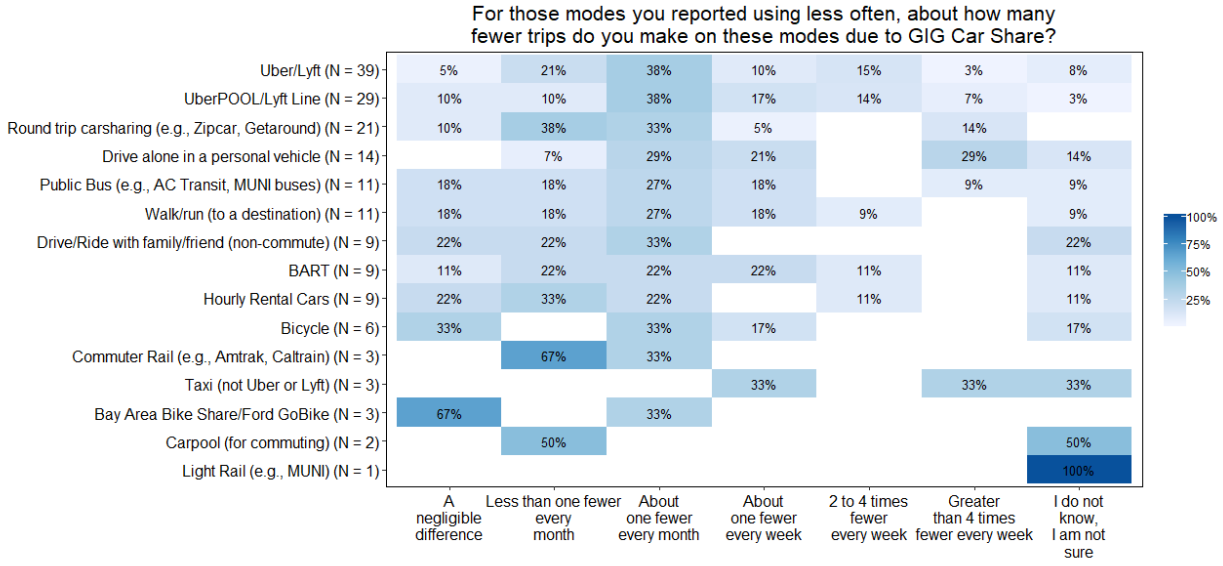
Most survey respondents indicated that they were using other modes less often as a result of GIG Car Share (Figure 25). The largest impact was on Uber/Lyft rides, including Uber and Lyft's carpooling services, with over 60% of previous Uber/Lyft users reporting that their usage was less frequent and around 20% reporting that their usage was much less frequent. Public transit was also used less often, though the shift was less than that of Uber/Lyft. About half of BART riders reported taking BART less often while a much smaller percentage reported taking BART much less often. For public bus riders, again about half reported taking the bus less often and a smaller percentage much less often. For respondents who took public transportation less frequently as a result of GIG Car Share, the most commonly cited reasons were that GIG was faster, more flexible, more convenient, and allowed members to better transport packages and groceries. As will be shown in subsequent discussion to follow, respondents reported that GIG Car Share would also serve as a complement to public transit for a fair share of trips.

Figure 25: Usage shift in modes as a result of GIG Car Share



We also quantified the magnitude of changes in usage of other modes by asking how many fewer trips were taken on those modes. The responses were varied but most reported taking one fewer trip per month on other modes (Figure 26).

Figure 26: Number of fewer trips taken on other modes due to GIG Car Share

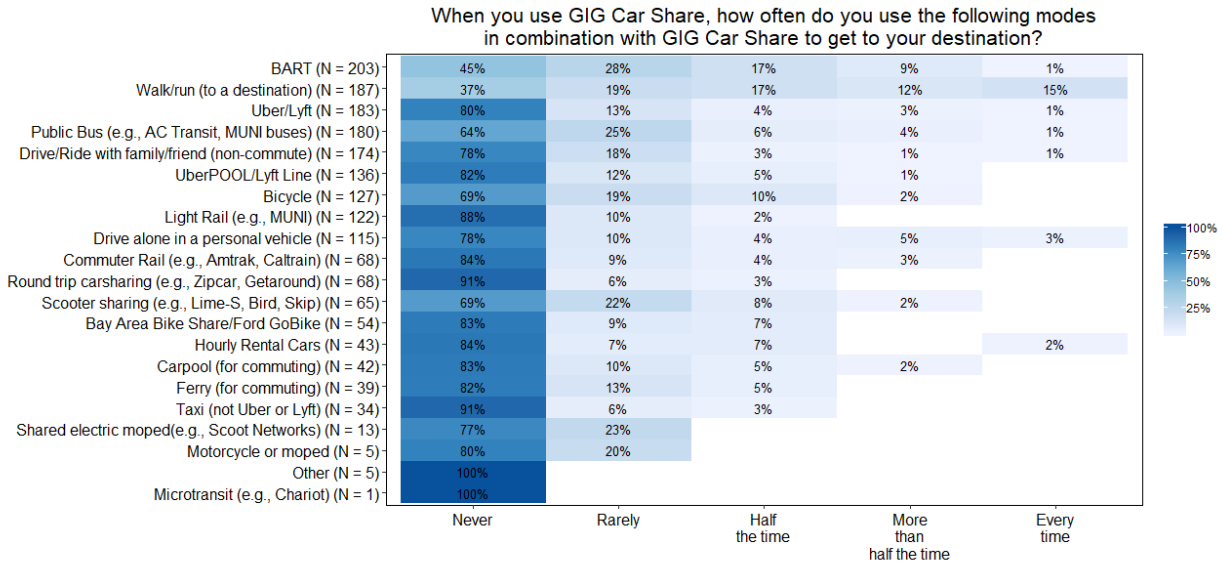


Multimodal Trips

A unique characteristic of free-floating carsharing, compared to roundtrip carsharing, is that it can more easily allow members to use multiple modes on a single trip. We asked survey respondents to report

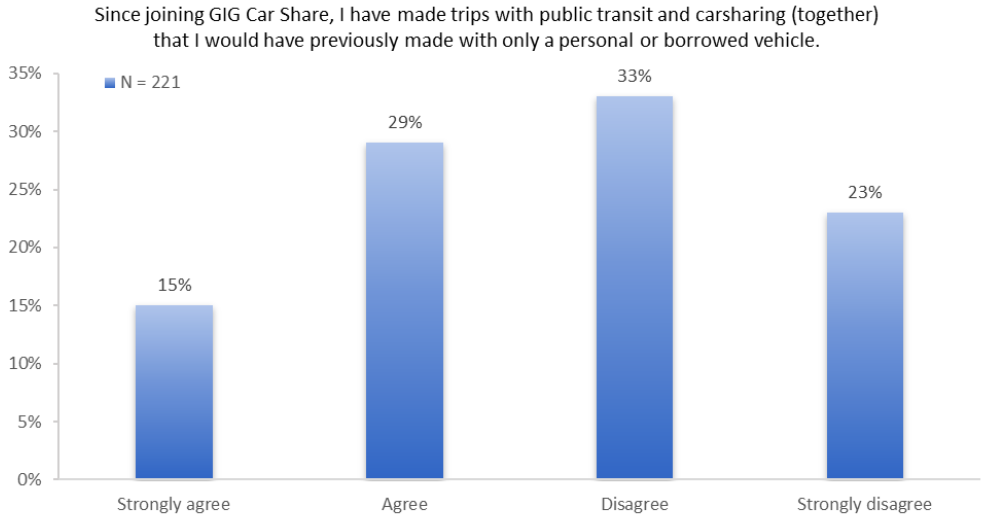
how often they used GIG in combination with another mode. The most commonly used mode with GIG was BART and walking or running (Figure 27).

Figure 27: Modes used in combination with GIG Car Share



Our findings suggest that trips made with public transportation and GIG Car Share together contribute to reducing trips taken in personal vehicles. We asked survey respondents whether a trip that combined public transportation and GIG would have been taken otherwise in a personal vehicle, and 44% answered affirmatively. Figure 28 shows the distribution of responses below.

Figure 28: Impact of trips combining public transportation and GIG on usage of personal vehicles



This finding suggests that respondents are using GIG in conjunction with public transit at least some of the time and that those trips are otherwise replacing car trips. This result does not explicitly quantify

how many car trips are being replaced but does show that about half of respondents report making trips with GIG and public transit.

Summary and Discussion

This study presents results from a survey of GIG Car Share members in Oakland. The survey findings suggest that while GIG operates in a number of diverse communities, the balance of members fit the more typical profile of carsharing members. As noted, there are some limitations to the analysis. Sample size is often a limitation of surveys when drawing inferences about a broader population. While the sample size obtained in this study is large enough to draw conclusions, some uncertainty remains with the estimates. This is particularly the case with samples of impacts where the number of respondents reporting impacts is small. For example, the number of respondents reporting shedding impacts was relatively small, because the shedding impact itself only applies to a small share of the population. This can influence the assumptions about impact factors that are ultimately subject to some estimation and uncertainty. Despite the verification completed with questions related to vehicles shed, the average annual miles found to be driven on vehicles shed by the sample was relatively high as compared to vehicle miles traveled on other vehicles. Another such limitation is an inherent bias that can exist with respect to demographics that respond to surveys. Such biases can potentially skew the demographic distributions, towards a particular gender or education level, and can result in distributions that do not reflect the true demographic distributions of the member population. There is no universal census of GIG Car Share members, which makes correcting for such skewness is challenging. With respect to impacts, we consider the more important bias to be frequency of use, and this is accounted for in this analysis. Taking these limitations into account, the study found that members of GIG tend be predominantly White (~60%) relative to the general population of Oakland (24%). After Whites, the disparity between the sample and the population is largest for the Hispanic/Latino population, followed by African Americans, where the share of the sample is about half of the population. The income distribution of the population and sample align relatively closely as does the gender balance, but the sample does exhibit higher income than the general population. Additionally, the sample is exceptionally young and well-educated relative to the population.

Most trips taken by GIG Car Share appear to be short, with about 50% of the sample reporting their most recent trip as spanning 5 miles or fewer. Despite the relatively low mileage, the trip duration exhibited a wider spread and longer times. Just under 20% of respondents reported their trips lasting 10 minutes or less, while nearly 50% reported their trips lasting over 30 minutes. The car was likely parked for some of the duration time of these trips. The most common trip purpose included grocery shopping, commuting to work, and going to and from social or recreational activities. Other common trip purposes included going to the airport, or running other non-shopping errands. GIG was generally selected by respondents because it was cheaper, more flexible, faster, or permitted the carting of packages and groceries.

The survey has found that respondents are shedding and suppressing vehicles as a result of GIG Car Share. A series of questions were asked to ascertain and confirm that GIG members shed a vehicle specifically due to GIG. Based on their collective response, we found that about 1.6% of the weighted

sample, reflecting an estimate of the population impacts, shed a vehicle in response to GIG Car Share. Note that a majority of sample respondents were carless. Vehicle suppression was found to be higher. Estimates from the weighted sample suggest that about 7.3% of the member population were not purchasing or acquiring a vehicle due to GIG. The actions of shedding and suppressing vehicles are the largest VMT reducing impacts from behavior change. An analysis of VMT impacts from the behavioral change found that GIG Car Share reduced net VMT under baseline assumptions of the member population and VMT from shed and suppressed vehicles. These findings hold under a variety of assumptions with regards to VMT prevented by suppression. But finding a net reduction does require that personal vehicle suppression is considered. That is, in the absence of considering vehicles not purchased and driven due to the availability of GIG Car Share, observed VMT would appear to increase. Such dynamics point to the importance of accounting for personal vehicle suppression in the assessment of systems that directly impact personal vehicle ownership.

In terms of mode shift, the survey did find that about 44% of respondents have used GIG in combination with taking public transit, instead of traveling in a personal vehicle. However, in terms of mode substitution, GIG most often was found to compete with public transit and TNCs. At the same time, the combined use of these same modes with GIG contributed to reducing the need for respondents to purchase a vehicle in the near future.

Overall, the survey results suggest that GIG has had a substantive impact on travel behavior among members and appears to have enabled a minority of the sample to reduce the number of personal vehicles they own. The survey does find that the population still generally reflects the profile of the typical shared mobility user population. The GIG membership base shares a lot of common attributes with the demographic profile of other shared mobility systems. This by itself suggests that additional outreach and policy may be needed to facilitate the use of GIG by the broader population of Oakland. These and other findings can help advance our understanding of how free-floating carsharing impacts the population and advances mobility in the East Bay.

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