A Before and After Evaluation of Shared Mobility Projects in the San Joaquin Valley

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16. Abstract

In rural areas, cost-effective transit service is challenging due to greater travel distances, lower population densities, and longer travel times than in cities. As a result, the people who rely on public transit contend with infrequent and slow service, and keeping a sufficient number of personal vehicles in reliable working order can be prohibitively expensive for low-income families. UC Davis partnered with the eight San Joaquin Valley Metropolitan Planning Organizations to identify and support development of three innovative mobility pilot concepts for the region. The first pilot is an electric vehicle (EV) carsharing service known as Míocar, located in affordable housing complexes in eight rural communities in Tulare and Kern counties. The second is a volunteer ridesharing service, known as VOGO, which supplements existing transit services in transport-disadvantaged rural areas in San Joaquin and Stanislaus counties. The third is a Mobility-as-a-Service (MaaS) platform that allows planning and payment for fixed and demand-responsive transit services, including VOGO, in San Joaquin and Stanislaus counties. These pilots seek to (a) provide improved access to destinations for individuals with limited transportation alternatives, (b) and achieve greenhouse gas reductions through mode shifts from traditional internal combustion vehicles to EVs, ridesharing, and fixed transit. This report presents the methods and results for "before" and "after" evaluations conducted by UC Davis researchers to assess the performance and impacts of each pilot. The evaluations incorporate service usage data including telematics and MaaS application data, and survey data collected from pilot participants, to assess the programs beginning with pilot launch (2019 and 2020) until November 2021. The results provide insights into participant characteristics and barriers to transportation, travel behavior, trip planning activities, and the extent to which the pilots addressed the travel needs of their target populations region.

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A Before and After Evaluation of Shared Mobility Projects in the San Joaquin Valley

A National Center for Sustainable Transportation Research Report

May 2022

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EXECUTIVE SUMMARY

In rural areas, cost-effective transit service is challenging due to greater travel distances, lower population densities, and longer travel times than in cities. As a result, the people who rely on public transit contend with infrequent and slow service, and keeping two (or sometimes even one) cars in reliable working order can consume an estimated 22% to 56%[1] of the household budget for low-income families in California. Rural residents often have lower incomes than their urban counterparts, and the most fuel-efficient vehicles, particularly electric vehicles (EVs), are outside their financial reach.

In this evaluation, UC Davis researchers summarize the data collected from three mobility pilot programs that were implemented to address these issues in the San Joaquin Valley. The first pilot is an electric vehicle carsharing service known as Míocar, located in affordable housing complexes in eight rural communities in Tulare and Kern counties. The second is a volunteer ridesharing service, known as VOGO, which supplements existing transit services in transport-disadvantaged rural areas in San Joaquin and Stanislaus counties. The third is a Mobility-as-a-Service (MaaS) platform that allows planning and payment for fixed and demand-responsive transit services, including VOGO, in San Joaquin and Stanislaus counties.

The evaluation collected data from the pilot launch dates (2019 to 2020) through November 2021. The purpose of this evaluation was to use data collected at the start of the study period ("Before Data") and throughout and at the end of the study period ("After Data") to understand the participation characteristics, transportation impacts, and other outcomes of each mobility pilot program. To accomplish this, UC Davis researchers coordinated with pilot program operators to collect data on service use throughout the study period ("Utilization Data"), such as the number of members, reservations, purchases, and other metrics, and linked these data to survey results to understand the patterns between member characteristics and service use.

Míocar

The results of the member and utilization data for Míocar show that over the course of the study period, 1,121 individuals began an application for the Míocar service, and 374 became members. Of the 374 members, 149 members used the service ("user members"), and 225 members did not use the service during the study period ("inactive members"). To address COVID-19 safety concerns and insurance issues, Míocar shut the service down between March 2020 and July 2020. Vehicle availability gradually increased after the reopening, but in July 2021, 17 of the 27 Míocar vehicles were impacted by the Chevy Bolt recall. Chevy struggled to

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[1] U.S. Department of Housing and Urban Development Location Affordability Portal. Geographies: census tracts.

address the problems in the recalled vehicles, and Míocar could only offer limited fleet access through the end of 2021.

Researchers administered surveys to Míocar members upon their enrollment in the service ("Before Surveys"). The results of the Before Survey provide insight into members' demographic attributes as compared to weighted averages of regional census data. Míocar members reported lower average household incomes and larger household sizes than the county averages. In terms of adults, most respondents indicated that they are either the only adult in the household or one other adult living in the home. Most respondents (72%) reported that they have one or two personal vehicles available to their households, which suggests a similar level of personal vehicle access as the regional county population.

Researchers also administered surveys to members following each of their Míocar reservations ("Post-Reservation Surveys"). This survey found that members most commonly accessed Míocar by walking (67% of all surveyed trips), and results suggest that members who live close enough to walk to a hub are more likely to use the service. However, the average distance from a member residence to the nearest Míocar hub is 7.4 miles. There may be an opportunity to explore the expansion of Míocar into additional communities, both to reduce reliance on personal vehicles for EV access and to meet the needs of current non-members and non-users.

The Post-Reservation Survey asked users whether and how they would have made specific trips if Míocar had not been available. Using the survey responses, researchers developed a counterfactual travel score for each Míocar reservation associated with a survey response. Researchers categorized each reservation as either Increased Mobility Travel, meaning a trip that would not have occurred in the absence of Míocar; Mode Shifted Travel, meaning a trip that would have occurred using another mode in the absence of Míocar; or Uncategorized Travel, meaning a trip for which there is insufficient data to determine whether the trip would have occurred in the absence of Míocar.

Figure 1 below shows the miles traveled by income category, as defined by 2021 State Income Limits, by the above travel types. This analysis shows that members in the lower-income groups account for most of the VMT associated with Increased Mobility Travel, or trips that would not have been taken in the absence of the service. In contrast, members in the higher-income groups account for most of the VMT associated with Mode Shifted Travel, or trips that would have still been taken but with other modes in the absence of the service.
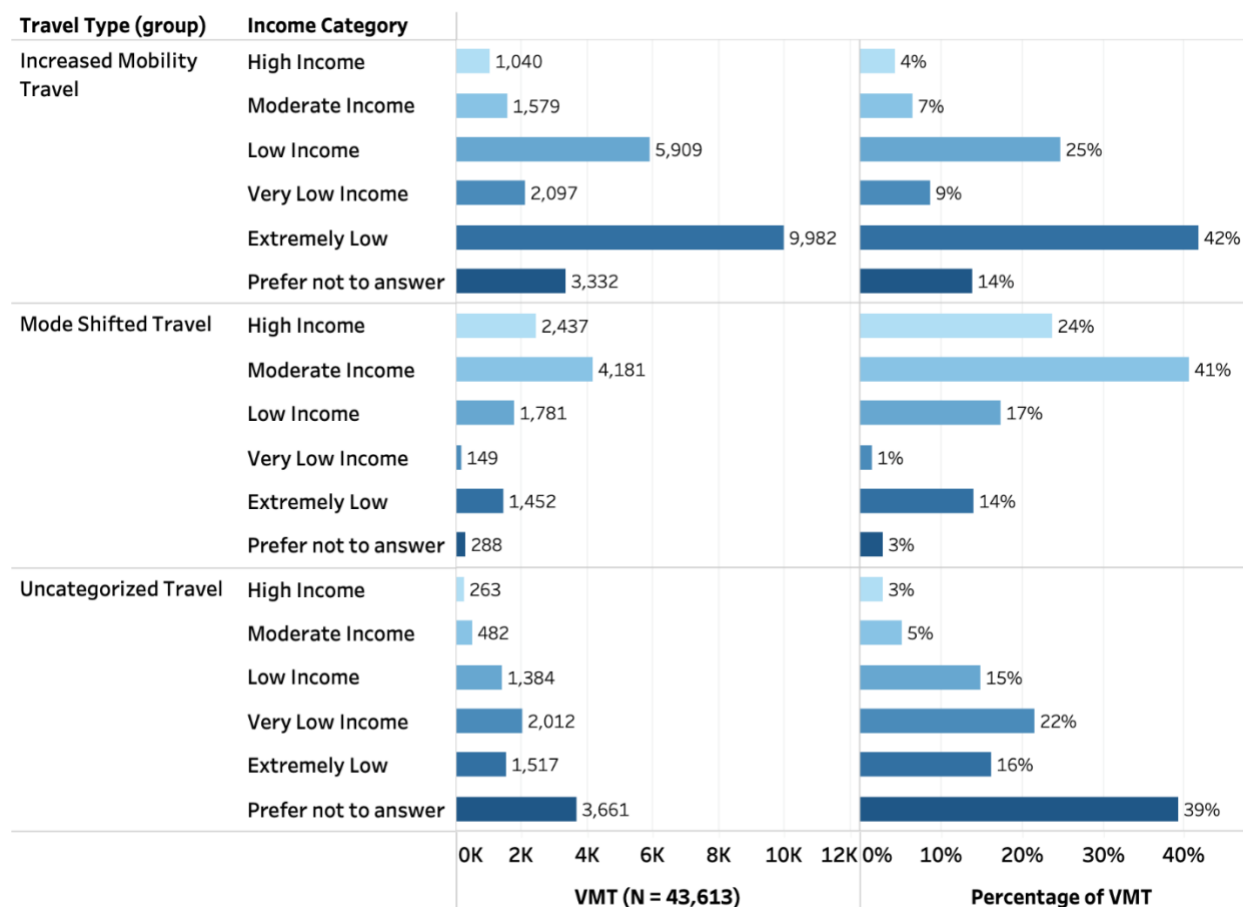
Figure 1. VMT associated with Míocar effects on travel by income category

Overall, the Post-Reservation survey results suggest that most Míocar trips (63%) would not have been taken in the absence of the service. For the 20% of Míocar trips that would still have occurred in the absence of the service, respondents indicated that nearly all (98%) would have traveled by personal internal combustion engine (ICE) vehicles or other ICE vehicles. Together, the Míocar member data and survey data suggest that Míocar is replacing ICE travel for higher-income households and providing improved mobility to lower-income households with fewer transportation alternatives. Additionally, the distances traveled during some reservations, and the counterfactual survey results, indicate that members use the service for inter-city and inter-county trips that cannot be accomplished by available transit service.

VOGO

By the end of November 2021, 52 members had used the VOGO service as riders, and there were 1,899 total VOGO reservations during the study period. The number of monthly reservations and riders first peaked in February 2020 before decreasing significantly with the onset of the COVID-19 pandemic and a pause in VOGO service in March 2020. Operations partially resumed during mid-2020, but VOGO was limited to providing essential rides such as medical trips, grocery shopping, and work-related trips for much of the year. VOGO operations increased in early 2021 with COVID-19 vaccine availability and with the service being open to all

types of trips. However, the issues presented by the pandemic are ongoing through the end of the study period, with direct effects on service operations and driver, rider, and trip counts.

Researchers administered surveys to VOGO members upon their enrollment in the service ("Before Surveys"), as they used the service each month ("Monthly Trip Surveys"), and at the end of the study period ("After Surveys"). Based on the results of the After Survey, VOGO members tend to be older, lower-income individuals who typically live alone or with one other person. Additionally, most respondents have access to zero personal vehicles (20/25 respondents), and few riders who have a vehicle reported being comfortable driving them.

The Monthly Trip Survey asked respondents to consider all of their trips with VOGO during the past month, and whether they still would have made these trips if VOGO were not unavailable during that month. As shown in Figure 2, respondents most commonly reported that they would not have made any of these trips in the absence of the VOGO service (58% of responses and 62% of members throughout the study period). Members who indicated that they would have made trips in the absence of VOGO predominantly reported that they would have ridden in a friend or family member's car to make these trips if VOGO were not available.
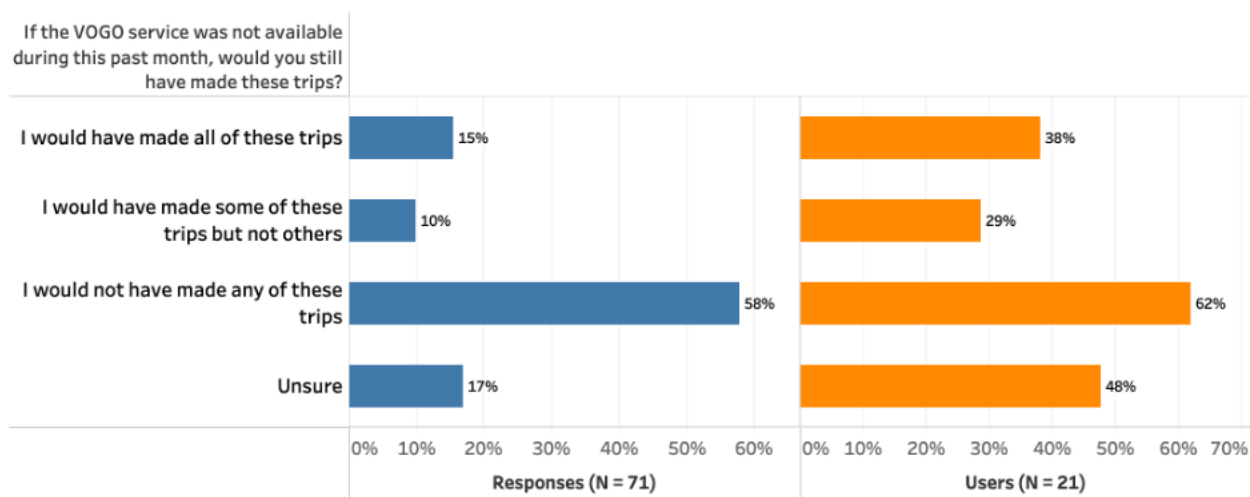
Figure 2. Counterfactual travel decisions in the absence of VOGO (monthly trip survey)[2]

Nearly all respondents to the Monthly Trip Survey indicated that VOGO had provided benefits including allowing travel to more destinations, saving money on transportation costs, and making it easier to travel during the study period. Overall, the evaluation demonstrates the functionality of VOGO and its role in filling transportation gaps for its target populations, and

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[2] The percentages shown for Users are based on unique VOGO users, and users were able to complete the Monthly Trip Survey during each month that they used VOGO between April 2021 and November 2021. Users may have selected different responses to this question during different months. The sum of percentages for Users therefore exceeds 100%.

suggests that VOGO provides a valuable transportation alternative to access essential destinations that riders may have difficulty accessing by other modes.

Vamos

By the end of November 2021, 281 unique users had used the Vamos application. Vamos allows users to search for travel routes and purchase transit tickets within the application. Utilization data suggest that Vamos is primarily used as a trip planning tool by most users; ninety-two percent of users (258 of 281) used the route search function, while thirty percent of users (85 of 281) purchased a ticket at least once. Both the number of users and route searches fluctuated significantly throughout the pilot period, which may be partially attributable to COVID-19 effects beginning in early 2020, and to promotional efforts conducted in 2021. Vamos coordinated with transit agencies in August 2021 to provide free transit fare credits to Vamos users, which corresponded to a substantial increase in route searches in 2021.

Purchase activity increased more steadily than route search activity, with fewer downward fluctuations between October 2020 and November 2021. An explanation for this trend may be that users conducting route searches may not need to rely on the trip planning function for their daily trips over time, while users who purchase tickets through Vamos would continue to need transit tickets for as long as they travel by transit.

Researchers administered surveys to enrolled users of the Vamos Mobility App ("Member Surveys") to collect member demographics, socioeconomic characteristics, and perspectives on the application and its effects on the transportation experience. Based on survey results, members tend to be between the ages of 25 and 44 years old (61% of respondents), have at least some college education (75% of respondents), and have roughly similar annual incomes and household sizes as the larger population of their surrounding counties. In contrast to the general population, 21% of user respondents reported that they do not have a personal vehicle compared to roughly 5% of the people in surrounding counties.

The survey asked these respondents whether they expected the application to affect their use of transit in the future (Figure 3). Most of these respondents expected to use transit more often due to the information and functionality provided by Vamos.

Because of the VAMOS app, I expect to use transit (bus/train):
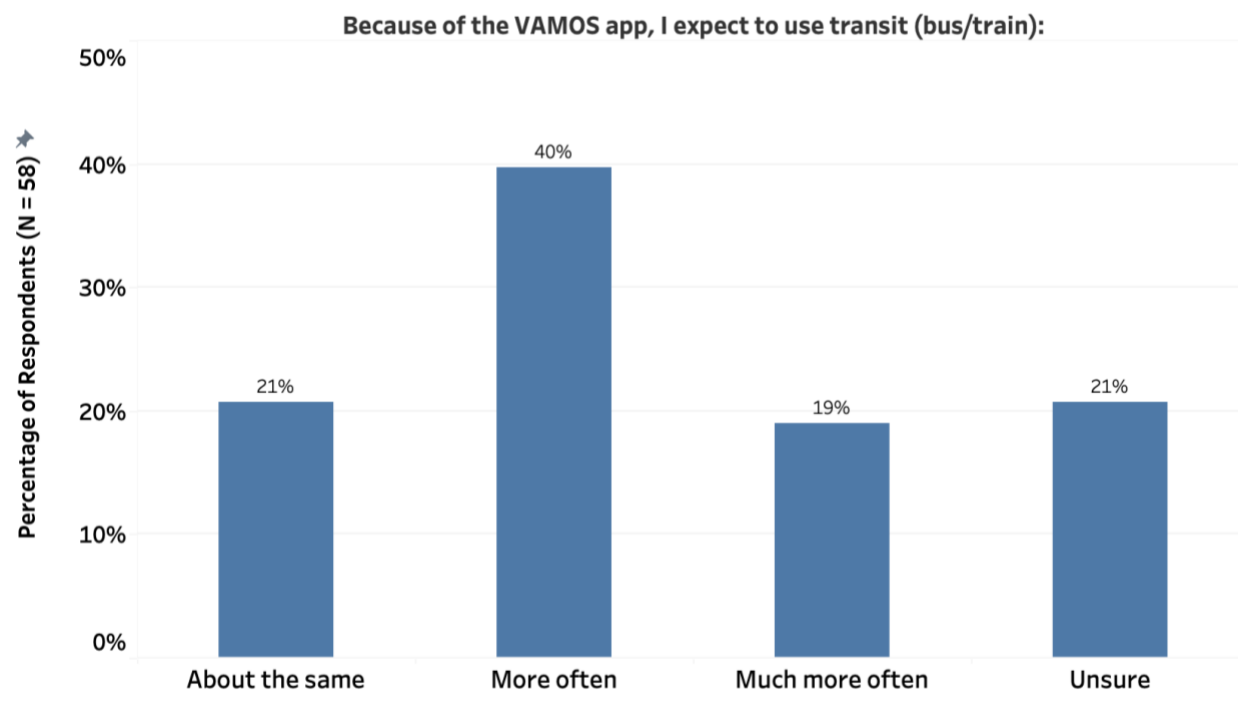
Figure 3. User reported expected impacts of Vamos on transit use

The 12 Member Survey respondents who indicated that they had used Vamos for more than one month at the time of the survey were asked about the transportation benefits provided to them by Vamos during the study period. The results suggest that a primary benefit of Vamos is that it provides a more efficient method of payment for users who need to purchase transit tickets. The data also suggest that Vamos has improved the user travel experience for a few users by providing the information or ability to travel to new transit destinations and/or by reducing transit travel times. However, the responses to these questions represent a limited sample size of eight to twelve respondents, and these results cannot be extrapolated to the user population.

Overall, the survey results suggest that Vamos is viewed as a valuable transit fare payment tool and contributes to an improved transportation experience for its active users, though the infrequent and short-term usage patterns in the utilization data suggest that there are opportunities to improve user engagement and retention. Further data collection from long-term users may help determine the extent of Vamos' role in shifting modes or improving mobility access for its target populations. The number of long-term users may grow as a result of increased user engagement as the application recruits a more extensive user base or expands its service area.

Introduction

In rural areas, cost-effective transit service is challenging due to greater travel distances, lower population densities, and longer travel times than in cities. As a result, the people who rely on public transit contend with infrequent and slow service. Access to a personal car is often essential to the quality of life for most residents, enabling them to readily access work, health care, education, healthy food, and other essential services. However, keeping two (or sometimes even one) cars in reliable working order can consume an estimated 22% to 56%[3] of the household budget for low-income families in California. Rural residents often have lower incomes than their urban counterparts, and the most fuel-efficient vehicles, particularly electric vehicles (EVs), are outside their financial reach.

UC Davis partnered with the eight San Joaquin Valley Metropolitan Planning Organizations (MPOs) to address these transportation issues by developing new shared mobility concepts for the region. This process resulted in identifying three pilots for implementation. The first pilot is an electric vehicle carsharing service known as Míocar, located in affordable housing complexes in eight rural communities in Tulare and Kern counties. The second is a volunteer ridesharing service, known as VOGO, which supplements existing transit services in transport-disadvantaged rural areas in San Joaquin and Stanislaus counties. The third is a Mobility-as-a-Service (MaaS) platform that allows planning and payment for fixed and demand-responsive transit services, including VOGO, in San Joaquin and Stanislaus counties.

In this evaluation, UC Davis researchers summarize the data collected from each pilot from their launch dates (2019 to 2020) through November 2021. For each pilot, the dataset links members and their service use data with results from member surveys. UC Davis researchers administered surveys to members upon their enrollment or first use of the services to collect information related to their transportation needs and characteristics before using the services (the "Before" period), and also administered surveys and observed service use over time to conduct analyses of pilot program impacts (the "After" period). The results provide insights into member characteristics, vehicle use, transit, trip planning activities, and measured and self-reported outcomes of the mobility pilots.

Regional Background

The San Joaquin Valley (Valley) is California's most productive agricultural region and one of the most in the U.S. However, the Valley also has some of the worst air quality in the nation and high rates of childhood asthma. California has classified most of the census tracts in the Valley as some of the most economically and environmentally disadvantaged in the State (see Figure 4 below).

California and other states in the U.S. implemented a cap-and-trade system as an alternative to a carbon tax to meet its greenhouse gas (GHG) reduction goals. This system caps companies'

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[3] U.S. Department of Housing and Urban Development Location Affordability Portal. Geographies: census tracts.

GHG emissions and trades their surpluses and deficits. California legislation (Senate Bill 535 and Assembly Bill 1550) requires that the state invests at least 25% of cap-and-trade revenues in projects within and benefitting disadvantaged communities and at least an additional ten percent for low-income households and communities. This legislation recognizes that the feasibility of shifting to more fuel-efficient vehicles and modes is significantly harder for disadvantaged communities. shows the locations of communities affected by the legislation.

Figure 4 Disadvantaged and low-income communities in California.[4]

In California, legislation (Senate Bill 375) requires metropolitan planning organizations (MPOs) to develop land use and transportation plans (or Sustainable Community Strategies) to reduce GHG emissions from passenger vehicle travel. Initially, the Valley MPOs expressed concern about creating regional community plans with measures typically applied in major urban areas, for example, transit-oriented development and expanded fixed-route transit. In addition, the

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[4] Source: https://ww3.arb.ca.gov/cc/capandtrade/auctionproceeds/lowincomemapfull.htm

MPOs were skeptical about the effectiveness of these measures, given the large share of the Valley's population that resides in rural and very low-density areas. As a result, in 2014, the California Department of Transportation funded a study to examine new technology alternatives to transit in rural communities that might better meet mobility gaps and reduce emissions.

Pilot Development

In partnership with Caltrans and eight San Joaquin Valley MPOs, researchers at UC Davis identified shared-use alternatives in rural disadvantaged communities that might reduce transit costs, increase travel access, and reduce GHGs. Researchers quantified the quality and price of transit services relative to shared-use options. They worked to gain regional consensus on the most promising shared-use mobility concepts and pilot locations. Researchers implemented surveys and focus groups exploring the need and interest for pilot services and undertook extensive stakeholder outreach to understand study-related concerns, goals, and analyses.

These efforts resulted in the identification, development, and launch of three mobility pilot programs, which would serve the highly disadvantaged San Joaquin Valley areas that contend with low inter-city transit access and low levels of vehicle availability. The three pilots were electric vehicle (EV) carsharing (Míocar), volunteer ridesharing (VOGO), and a MaaS platform (Vamos).

Overall Pilot Evaluation Approach

The purpose of this evaluation was to use data collected at the start of the study period ("Before Data") and throughout and at the end of the study period ("After Data") to understand the participation characteristics, transportation impacts, and other outcomes of each mobility pilot program. To accomplish this, UC Davis researchers coordinated with pilot program operators to collect data on service use throughout the study period ("Utilization Data"), such as the number of members, reservations, purchases, and other metrics.

Researchers also developed and administered surveys to users of the pilot programs as they enrolled in or first used the services to gain insight into their individual and household characteristics and better understand how and why they planned to use the services. Additionally, researchers developed and administered surveys to participants after using the services (e.g., after each use of the service, after a certain period, or at the end of the study period). These surveys assess how participants used the services and gather feedback on changes in travel behavior. Finally, for each pilot, researchers linked survey responses such as user characteristics to the collected Utilization Data to describe pilot participation further and understand how the user populations compared to the people of the overall service regions.

Míocar – An Electric Carsharing Service

Míocar is an EV carsharing pilot launched in August 2019 to explore the potential of a shared mobility service to offer a cost-effective mobility option for residents of rural disadvantaged communities and help reduce greenhouse gas emissions. Affordable housing complexes host the round-trip EV carsharing hubs in southern San Joaquin Valley (CA) communities with low intercity transit service and personal vehicles. (In round-trip EV carsharing, the user must return the car to the original pick-up point after using it.) The project seeks to provide carsharing at a price point that is more affordable than owning a personal vehicle to price-sensitive populations with low transit access.

EV carsharing programs, such as Míocar, are designed to achieve greenhouse gas (GHG) emissions reductions by shifting travel away from internal combustion engine (ICE) vehicles and improving access to travel for people with limited transportation alternatives. This pilot evaluation focuses on exploring the extent to which Míocar is achieving these impacts and equity outcomes, emphasizing the unique characteristics and usage patterns of EV carsharing in rural, disadvantaged areas. The evaluation builds upon past EV carsharing research by using member surveys to measure key travel metrics for the Before and After study period. In addition, the analysis links survey results to EV usage data to provide in-depth characterizations of pilot activity by trip purpose, member demographics, and type of travel change compared to a baseline or counterfactual scenario.

Pilot Description

There are eight Míocar hubs in six Míocar communities in Tulare and Kern counties. The EV carsharing pilot includes 27 vehicles, including BMW i3s, Chevy Bolts, and three hybrid Pacifica minivans. Míocar purchased many of these vehicles used with less than 30,000 miles. These pure electric vehicles have suitable ranges for rural driving (140-200 miles per charge).

The pricing for Míocar includes a $20 member processing fee, a $4 hourly rental rate, a $35 daily weekday rental rate, and a $45-weekend daily rate. There is a 35 cent per mile fee after the vehicle travels 150 miles during one reservation. The price of the rental includes insurance, roadside assistance, and electricity. Residents apply or reserve vehicles by the smartphone app, website, or phone call. Members must have a clean driving record (i.e., no major violations, excessive speeding, reckless driving, multiple moving violations, or driving without a license) and be 21 years of age or older.

Methods of Data Collection and Analysis

Evaluation of the Míocar pilot involved collecting a wide range of data from multiple sources that researchers categorize as Member Data, Utilization Data, and Survey Data. This section defines these data sources, describes the format and frequency of data collection, and summarizes the metrics associated with each source for program evaluation.

Member Data

Members provide member data to the service operator(s) as part of the application or enrollment process. Míocar collected member data continually as each member enrolled in the service and provided an export of member data to UC Davis every month. The member dataset provided to UC Davis for research evaluation purposes included metrics such as:

- Member ID
- Date of birth
- Gender
- Address census block
- Member status (e.g., active, inactive)
- Contact information (e.g., telephone/email address)

Míocar converted addresses to census blocks before analysis, allowing for the calculation of metrics such as members by census block, distance to the closest Míocar hub, and distance to other hubs and major cities.

Utilization Data (Application/Platform Data)

Míocar collects Utilization Data about individual EV reservations and trips and continually collects utilization data as members reserve and use carsharing vehicles. Míocar equips its vehicles with telematics software that allows for GPS tracking and on-board recording of vehicle usage (or "Utilization Data"). Thus, the program collects time and distance data for each Míocar vehicle, reservation, and member. Míocar provided an export of utilization data to UC Davis monthly. The information recorded and stored during each Míocar reservation includes:

- Member ID,
- Date and time of reservation start and end,
- Date and time of vehicle pick-up and drop-off,
- Duration of reservation (hours),
- Duration of travel (hours during which vehicle was moving), and
- Total miles traveled during the reservation.

The data also contain information about each vehicle, including year, make, model, and hub.

Survey Data

Survey data is self-reported data collected by surveying users before, during, and after participating in the service. UC Davis researchers administered a survey to members after they joined Míocar (i.e., a "Before Survey") to ask about their planned service use and demographic attributes. Míocar sent out survey invitations to the program members, who completed surveys online through Qualtrics. As an incentive to complete the survey, responding members received

five hours of Míocar driving credits for their next reservation. Before surveys collected the following information:

- Member ID,
- Information about member's vehicle(s) (i.e., number of vehicles available to their household and each vehicle's year, make, model, and estimated annual miles driven),
- Composition of member's household (i.e., population, number of adults, and relationship to other household members),
- Member's reason for joining the service,
- Member's expected use of the service (i.e., whether it will allow them to make more trips, expected types of trips, and what mode they will use to access the Míocar hubs),
- How the member first heard about the program,
- Member's level of education, and
- Household income.

Míocar asked members to complete these surveys after enrollment and before using the service. However, many members who did not initially respond later completed the Before survey after using the Míocar service.

To capture information related to individual Míocar reservations, UC Davis developed a survey to be completed after a reservation (i.e., a "Post-Reservation Survey"). Míocar sent invitations for these surveys by email to members who had completed a reservation within the previous week. As an incentive to complete the survey, Míocar rewarded responding members with one hour of Míocar driving credit for their next reservation. Members completed post-reservation surveys online through Qualtrics and collected the following information:

- Member ID,
- Purpose of reservation,
- Number of passengers in Míocar vehicle,
- Mode of travel to pick up Míocar vehicle,
- Counterfactual travel options (i.e., would travel have occurred without the Míocar service, and if so, with what mode), and
- Vehicle cleanliness rating and comments about the service.

Though the post-reservation survey does not ask members to indicate which Míocar reservation they are referencing for their responses, the survey instructs respondents to provide information about their *most recent* reservation when they complete the survey. As a result, each post-reservation survey completed by an individual member should refer to a separate Míocar reservation, which can be determined by reviewing the Míocar utilization data associated with that member.

All survey respondents were active members who had used the carsharing service and therefore had vehicle usage data associated with the Míocar. An anonymous identifier linked all

users and survey data to the vehicle usage data, allowing for analysis that integrates all data sets at the individual member level. In addition, UC Davis researchers offered surveys in both English and Spanish to accommodate the participant population.

Researchers linked Survey Data, Member Data, and Utilization Data to assess the overall performance of Míocar and develop key findings for the study period.

Before Survey

The member survey response rate, calculated as the ratio of people who completed Before Surveys to the total number of members in the program, was 26% (101/394). User members completed 78 Before Surveys. There were 149 user members of Míocar during the study period, so the response rate in terms of user members was 52% (78/149). Researchers conducted 2-sample t-tests to test whether the group of user members who filled out the Before Survey (N1) differed significantly group of user members who did not fill out the Before Survey (N2) with data available for all users. This data included driving distance from the home to the nearest Míocar and the nearest major city and median, frequency of Míocar use, and median reserved hours, actual duration, and distance for reservations. As shown in Table 1, there are no significant differences between the two groups for these measures.

Table 1. T-Tests results for users who did (N1) and did not (N2) complete the before survey

Variable	N1	N2	t-statistic	p-value
Driving Distance to Nearest Míocar (miles)	75	67	-1.038	0.303
Driving Distance to Nearest Major City (miles)	75	67	-0.991	0.325
Frequency of Use for Reserved Hours/Membership Duration[5]	78	71	0.243	0.808
Frequency of Use for Reserved Hours/Active Days[6]	78	71	-1.686	0.095
Median Reserved Hours	78	71	-1.035	0.303
Median Trip Hours	78	71	-0.919	0.36
Median Distance	78	71	0.463	0.644

Post-Reservation Survey

UC Davis researchers administered the post-reservation survey from August 2019 through November 2021. In total, researchers collected 881 responses to this survey from 72 unique Míocar users. The total number of Míocar reservations during the study period is 1,971, made by 149 individual users. Therefore, the response rate for all trips is 44.7% (881/1971), and the proportion of users who responded to the reservation survey is 48.3% (72/149).

Using the time of survey completion and information provided by respondents about their trips, UC Davis researchers linked responses to the Post-Reservation Survey with Míocar utilization data to match survey responses to individual Míocar reservations. In some cases,

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[5] Membership duration = Number of days from joined date to April 30, 2021
[6] Active days = Last reservation date − First reservation date + 1

researchers could not confidently match a survey response to a specific Míocar trip due to users taking multiple trips in a short period or completing multiple Post-Reservation Surveys at once. However, researchers could link 744 of the 881 Post-Reservation Survey responses to an individual Míocar reservation.

Researchers conducted t-tests to identify significant differences between observed reservation attributes linked to a Post-Reservation Survey and reservations not linked to a Post-Reservation Survey for all users and for all users who filled out the Post-Reservation Survey. The observed reservation attributes included reserved hours, actual hours, and VMT, as shown in Table 2. Reserved hours refers to the number of hours that members had vehicles reserved, while trip hours refers to the time between members entering a vehicle and returning a vehicle at the end of their reservation. The t-test assessed each of these metrics and evaluated their distribution for linked reservations and non-linked reservations. The results show that for all user members, there are no significant differences (at the 0.05 level) between reservations linked to a Post-Reservation Survey and reservations not linked to a post reservation survey. Similarly, Table 3 shows that for all users who filled out the Post-Reservation survey, there are no significant differences (at the 0.05 level) between reservations linked to a Post-Reservation Survey and reservations not linked to a post reservation survey.

Table 2. T-Tests results for reservations linked (N1) and not linked (N2) to post-reservation survey responses for *all users*

Variable	N1 (Reservations Linked to Surveys)	N2 (Reservations Not Linked to Surveys)	T-Statistic	P-Value
Reserved Hours	744	1227	-1.568	0.117
Actual Hours	744	1227	-1.490	0.136
VMT	724	1145	0.165	0.869

Table 3. T-Tests results for reservations linked (N1) and not linked (N2) to the post-reservation survey for *responding users*

Variable	N1 (Reservations Linked to Surveys)	N2 (Reservations Not Linked to Surveys)	T-Statistic	P-Value
Reserved Hours	744	956	-0.843	0.400
Actual Hours	744	956	-0.930	0.352
VMT	724	904	1.124	0.261

Finally, researchers compared the sample of user members who responded to one or more Post-Reservation Surveys and user members who did not respond to Post-Reservation Surveys.

As shown in Table 4, researchers conducted t-tests comparing attributes available for all members (i.e., reported home census block and observed usage data) between user members who did (N1) and did not (N2) complete Post-Reservation Surveys. The results show no significant differences (at the 0.05 level) between these two groups for driving distance to the nearest Míocar or major city, median reserved hours, median actual hours, or median VMT. In addition, the results show a p-value of less than 0.05 for frequency of use in terms of reserved hours per number of active days. Researchers found that the median number of active days for user members who did not respond to Post-Reservation Surveys is minimal, meaning that most of these non-respondents used Míocar very infrequently (Table 5). Additionally, comparing the two groups using a frequency of use metric of reserved hours throughout the duration of Míocar membership shows no significant difference between the two groups.

Table 4. Descriptive statistics for users who did (N1) and did not (N2) respond to the post-reservation survey

Variable	N1 (Users With Reservation Survey)	N2 (Users Without Reservation Survey)	T-Statistic	P-Value
Driving Distance to Nearest Míocar (miles)	70	72	0.932	0.355
Driving Distance to Nearest Major City (miles)	70	72	1.017	0.313
Frequency of Use for Reserved Hours/Membership Duration	72	77	0.739	0.462
Frequency of Use for Reserved Hours/Active Days	72	77	-2.777	0.007**
Median Reserved Hours	72	77	-1.763	0.081
Median Actual Hours	72	77	1.759	0.081
Median VMT	72	72	0.317	0.752

Table 5. Descriptive statistics for active days of use for users with reservation surveys and users without reservation surveys

	All Users	Users with Reservation Survey	Users without Reservation Survey
Count	149.00	72.00	77.00
Mean	216.44	339.46	101.40
Std	257.71	262.56	192.84
Min	1.00	1.00	1.00
25%	1.00	71.00	1.00
50%	71.00	315.50	6.00
75%	462.00	571.00	71.00
Max	847.00	847.00	653.00

NCST

Counterfactual Travel

Researchers developed a counterfactual travel score for each Míocar trip associated with a survey response using the survey responses. Researchers categorized the associated reservation for each post-reservation survey response as Increased Mobility Travel, Mode Shifted Travel, or Uncategorized Travel. These categories are defined as follows:

- Increased Mobility Travel: A trip that would not have occurred at all in the absence of Míocar.
- Mode Shifted Travel: A trip that would have occurred using another mode in the absence of Míocar. This category includes two subcategories:
  - Avoided ICE Travel: A trip that would have occurred using an ICE vehicle in the absence of Míocar.
  - Avoided Non-ICE Travel: A trip that would have occurred using a mode other than an ICE vehicle in the absence of Míocar.
- Uncategorized Travel: A trip that may or may not have occurred in the absence of Míocar; a determination cannot be made due to lack of data.

Researchers base this assignment on users' responses to the following questions:

- Q3: If Míocar was not available, would you have been able to travel to the primary destination of your last reservation?
- Q5: What mode of travel would you have used?

Where,

- A response of "No" to Q3 categorizes the reservation as "Increased Mobility Travel" (i.e., the trip would not have occurred in the absence of Míocar);
- A response of "Yes" to Q3, AND a response of "Driven a private vehicle," "Rented a car," "Taken a taxi, Uber, or Lyft," "Borrowed someone else's car" OR "Gotten a ride from someone" to Q5 categorizes the reservation as "Avoided ICE Travel" (i.e., the user would have taken the trip using an ICE vehicle in the absence of Míocar);
- A response of "Yes" to Q3, AND a response of "Walked," "Biked," "Taken a bus," "Taken a train," or "Other" to Q5 categorizes the reservation as an "Avoided Non-ICE Travel" (i.e., the user would have taken the trip using a mode other than an ICE vehicle in the absence of Míocar); and
- A response of "Unsure" to Q3, OR a response of "Yes" to Q3 and "Null" to Q5 categorizes the reservation as "Uncategorized Travel".

Table 6 displays the travel categories assigned to the 744 survey responses that researchers linked to specific reservations based on counterfactual survey responses. According to members, most Míocar trips (63%) are Increased Mobility Travel and would not have occurred in the absence of Míocar. UC Davis researchers also found that only one trip met the criteria for Avoided Non-ICE Travel as the user stated that they would have used a mode other than an ICE

vehicle to complete the trip in the absence of Míocar. Avoided ICE Travel accounts for 20% of all surveys linked to a specific reservation.

Table 6. How availability of Míocar affected travel (based on counterfactual survey responses)

Based on counterfactual responses	Mode Shifted Travel		Increased Mobility Travel	Uncategorized Travel*	Total
	Avoided ICE Travel	Avoided Non-ICE Travel			
Responses	151	1	472	120	744
Percentage of Responses	20.3%	0.1%	63.4%	16.1%	100%

*Insufficient survey data to make a determination for these trips.

Results

UC Davis researchers used the collected Member Data, Utilization Data, and Survey Data to analyze the participation and impacts of Míocar. The analyses included developing member and usage summaries, distilling survey results, linking survey data to utilization data to analyze service usage by key member characteristics, and comparing participant characteristics to regional census data. This section presents the evaluation results for the Míocar pilot study period of May 2019 through November 2021.

Member Use

In this report, Míocar "Members" include three types of participants: (1) active members who are still able to use the service; (2) inactive members who used the service at least once but the current Míocar status is inactive; and (3) canceled members who used the service at least once but are no longer members now.

In total, 1121 individuals began an application for the Míocar service, and 374 became members. Of the 374 members, 149 members used the service ("user members"), and 225 members did not use the service during the study period ("inactive members"). Inactive members may not have used the service because of the limited geographic locations of the hubs, failure to meet membership qualifications, and joined the service as a backup in case their car broke down. During the study period, researchers noted substantial increases in applications after the service made news on TV and radio and in the papers, first during the local launch events in August and September 2019 and again during the regional launch in November 2019.

Figure 5 shows the cumulative number of members and users, vehicles in service and vehicles used per month, and monthly reservation counts and VMT. Vehicle use peaked in March 2020, just before the onset of the COVID-19 pandemic. To fully address COVID-19 safety concerns and insurance issues, project partners shut the service down until July 2020. Thus the figures below do not include data from April through June 2020. Vehicle availability gradually increased after the reopening to address vehicle battery issues that resulted from non-use during the

shutdown. However, in July 2021, 17 of the 27 Míocar vehicles were impacted by the Chevy Bolt recall. Chevy struggled to address the problems in the recalled vehicles, and thus Míocar could only offer limited access to the fleet through December 2021.

Comparing the reservations and VMT below shows that monthly VMT for the Míocar fleet dropped more substantially than the monthly reservation count following the July 2021 vehicle recall. This trend is due to members taking more short trips on average during this period. Possible explanations for this trend may be that more members took shorter trips as they became familiar with the service during this period or that the vehicles affected by the recall were more likely to be used for long-term trips than the remaining vehicles.
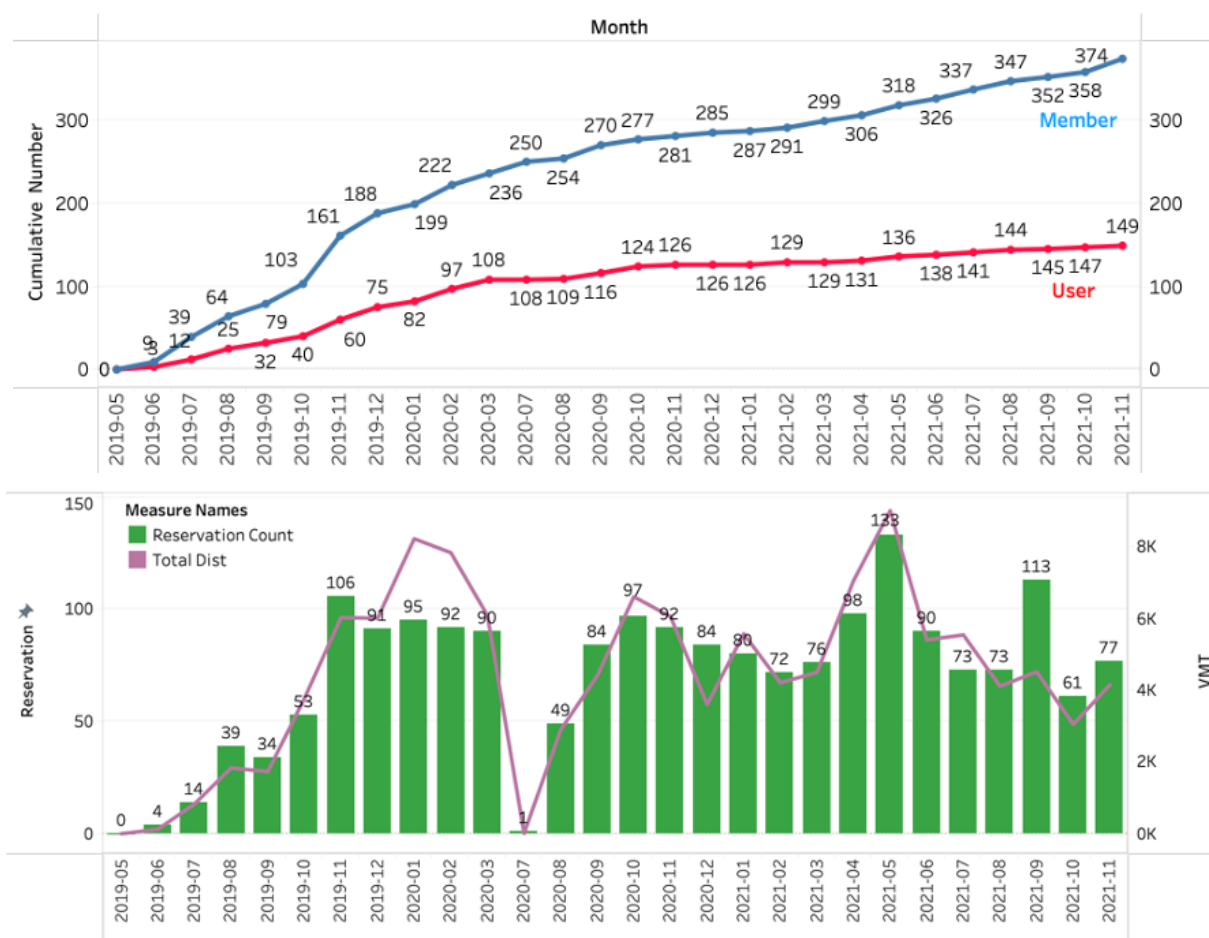
Figure 5. Changes over month: (top) numbers of registered members and members who used the service ("Users"); (bottom) number of reservations (green bars) and VMT (purple line).

Table 7 presents the summary statistics for user members, including monthly reservations, VMT, and hours of service use. Values vary because many members do not use the service every month, and some members use the service very frequently. However, on average per month, user members made 0.89 reservations and traveled 58.50 miles over 12.67 hours during the study period. The study period's median value (50th percentile) is 0.21 reservations per month, 14.31 miles per month, and 2.26 hours per month.

Table 7. Monthly use statistics for user members (N=149)

	Reservations/Month	VMT/Month	Hours of Use/Month
COUNT	149	149	149
MEAN	0.89	58.50	12.67
STD	2.85	143.86	37.27
MINIMUM	0.03	0.00	0.03
25TH PERCENTILE	0.07	4.36	0.61
50TH PERCENTILE	0.21	14.31	2.26
75TH PERCENTILE	0.62	45.24	8.36
MAXIMUM	28.12	1364.00	381.69

Table 8 presents the summary statistics for each reservation. The median reservation distance was 37 miles during the study period, and the duration was 3.5 hours. The maximum values are high because users reserve Míocar for as long as a week and make many trips during their reservations.

Table 8. Summary statistics for reservations

	VMT	Hours
COUNT	1869	1971
MEAN	65.93	12.12
STD	97.04	26.42
MINIMUM	0.00	1.00
25TH PERCENTILE	16.00	1.50
50TH PERCENTILE	37.00	3.50
75TH PERCENTILE	84.00	15.50
MAXIMUM	1389.00	336.00

Member Attributes

Members who responded to the Before Survey provided information about their household composition and other demographic variables. To better understand the differences and similarities between Míocar users and the county population, researchers also compared the summary statistics of demographic variables between users and the county population. Researchers developed a single weighted average of county-level results for the Míocar service areas of Kern County, Fresno County, Tulare County, and Kings County using the population of each county. Researchers based the weights on the frequency of members living in those counties. Table 9 displays the member attributes and weighted county population results.

Regarding household income, Míocar members reported lower average household incomes than the county averages. Most respondents (68%) have a household income of less than

$50,000, compared to the county data where most households (55%) have a household income of more than $50,000.

Table 9 also shows the income categories associated with Míocar survey respondents, based on 2021 State Income Limits and as prescribed by the Department of Housing and Urban Development (HUD). See Appendix A for more information about income categories and respondent assignments to those categories. Míocar members reported larger household sizes on average than the county population, with most respondents (62%) stating that their household has at least four residents, while 34% of households have four or more residents for the weighted county population sample. In terms of adults, most respondents indicated that they are either the only adult in the household or one other adult living in the home.

Míocar members are required to be 21 years of age or older. Members tend to be somewhat younger on average than the weighted county population, with less than 10% of Míocar members being 60 years old or older, as compared to 25% of the greater population.

Table 9. Míocar member demographic attributes

Demographic Attribute	Míocar Users	Population
Household Size	**N = 77**	**N = 777732**
1-person	10.4%	21.5%
2-person	13.0%	27.3%
3-person	14.3%	16.8%
4-person	32.5%	16.2%
5-person	18.2%	9.5%
6-or-more person	11.7%	8.6%
Total	100.0%	100.0%
Household Income	**N = 69**	**N = 77732**
Less than $10,000	8.7%	6.4%
$10,000 to $24,999	26.1%	15.7%
$25,000 to $49,999	33.3%	22.9%
$50,000 to $99,999	17.4%	29.6%
$100,000 to $199,999	14.5%	25.3%
Total	100.0%	100.0%
Income Category	**N = 70**	
Extremely Low	31.4%	
Very Low Income	18.6%	
Low Income	18.6%	
Median Income	4.3%	
Moderate Income	11.4%	
High Income	15.7%	
Total	100.0%	
Age	**N = 148**	**N = 1688279**
21 to 29 years	25.0%	20.5%
30 to 39 years	36.5%	21.3%
40 to 49 years	22.3%	17.2%
50 to 59 years	9.5%	15.9%
60 to 69 years	3.4%	13.3%
70 to 79 years	3.4%	7.8%
80 years and over	0.0%	3.9%
Total	100.0%	100.0%
Education Level	**N = 74**	**N = 1545936**
Above Master's degree	1.4%	1.9%
Master's degree	2.7%	4.1%
Bachelor's degree in college (4-year)	17.6%	12.5%
Associate degree in college (2-year)	17.6%	9.1%
Some college but no degree	31.%	23.3%
Trade or vocational	5.4%	0.0%
High school graduate (including GED)	21.6%	24.8%
Less than high school	1.4%	20.4%
No schooling completed	1.4%	3.8%
Total	100.0%	100.0%

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The survey asked users about the number of personal vehicles available to their households (Table 10). This number is similar to the weighted county averages, with most members (72%) reporting that they have one or two vehicles available (compared to 67% at the county level). Researchers also cross-tabulated the number of vehicles per household with the household size, which shows a similar distribution of vehicles per person in the household for Míocar members compared to the larger population.

Table 10. Míocar member vehicle availability

Demographic Attribute	Míocar Users	Population
Vehicles Available	**N = 77**	**N = 461758**
No vehicle available	10.4%	6.8%
1 vehicle available	32.5%	30.9%
2 vehicles available	39.0%	36.2%
3 vehicles available	13.0%	16.2%
4 or more vehicles available	5.2%	9.9%
Total	100.0%	100.0%
Household Size by Vehicles	**N = 78**	**N = 777732**
1-person household:	10.3%	8.9%
No vehicle available	2.6%	2.0%
1 vehicle available	3.8%	4.0%
2 vehicles available	2.6%	2.0%
3 vehicles available	1.3%	1.0%
4 or more vehicles available	0.0%	0.0%
2-person household:	12.8%	17.8%
No vehicle available	0.0%	1.0%
1 vehicle available	2.6%	4.0%
2 vehicles available	9.0%	11.9%
3 vehicles available	0.0%	0.0%
4 or more vehicles available	1.3%	1.0%
3-person household:	15.4%	14.9%
No vehicle available	3.8%	3.0%
1 vehicle available	3.8%	5.0%
2 vehicles available	6.4%	5.9%
3 vehicles available	1.3%	1.0%
4 or more vehicles available	0.0%	0.0%
4-or-more-person household:	61.5%	58.4%
No vehicle available	5.1%	5.0%
1 vehicle available	21.8%	17.8%
2 vehicles available	20.5%	21.8%
3 vehicles available	10.3%	10.9%
4 or more vehicles available	3.8%	3.0%
Total	100.0%	100.0%

The Before Survey also asked members about the model year of each vehicle available to their households. Researchers then calculated the average vehicle age for all user members. If the

number of reported personal vehicles was six or more, researchers used a vehicle quantity of six to calculate the average age. Table 11 summarizes the average vehicle age for vehicles reported by the user members who have at least one available vehicle. The median value of users' average vehicle age is 11.5 years, and 75% of users have an average vehicle age over 8.5 years.

Table 11. Summary statistics for average age of vehicles owned by users in years (N=89)

	Average Age of Vehicles
COUNT	89
AVERAGE	12.4
MEDIAN	11.5
STD	5.6
MINIMUM	3.0
25TH PERCENTILE	8.5
75TH PERCENTILE	16
MAXIMUM	33

Accessing Míocar

Figure 6 shows the Míocar hubs and the percentage of users in different towns in the San Joaquin Valley, based on member home zip code. Many Míocar members live in communities without Míocar hubs.
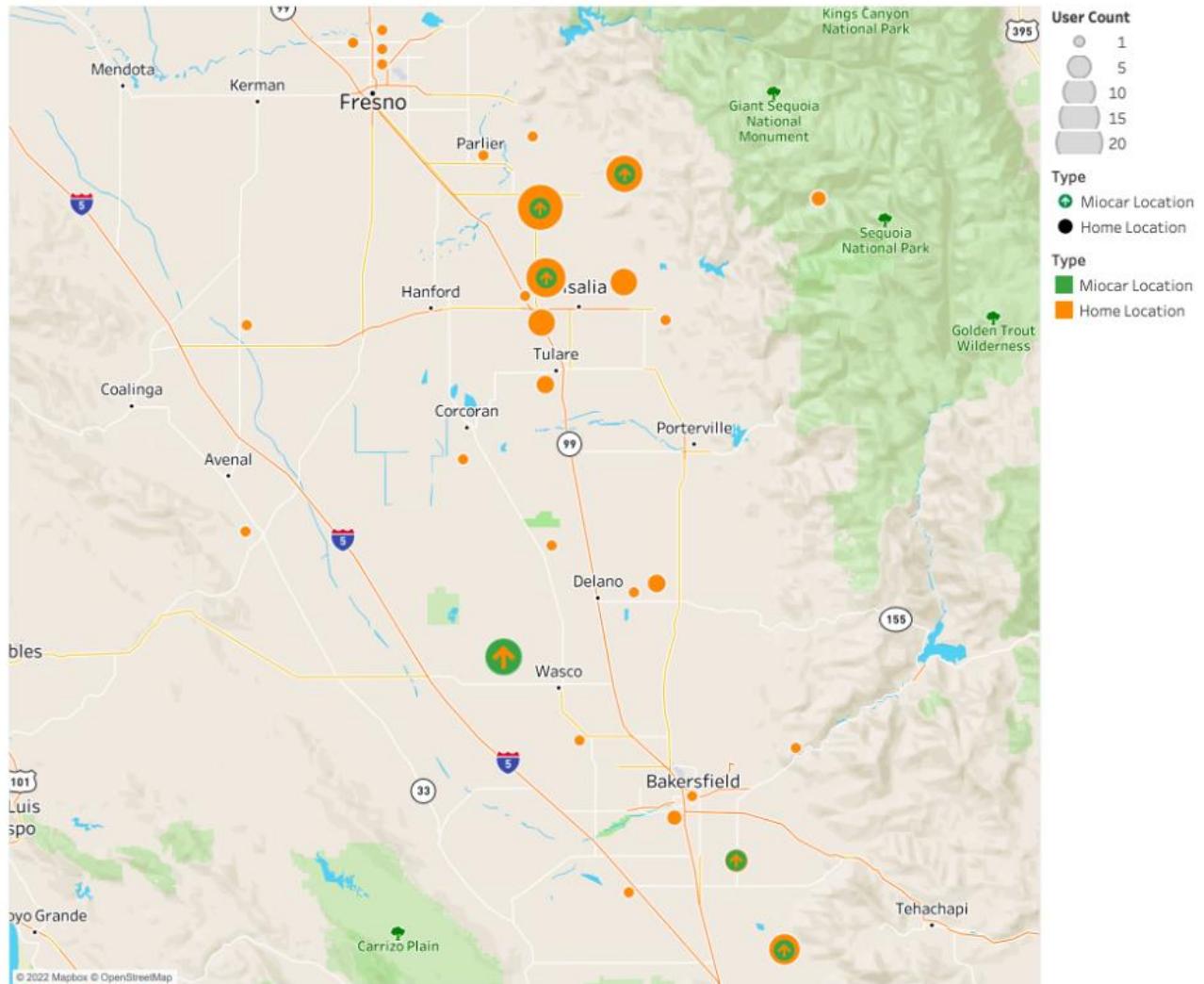
Figure 6. User members by home locations (Zip Codes)

Figure 7 shows the percentages of user members according to their travel distance from a Míocar hub. Of user members, 29% were willing to travel more than five miles from their home to access Míocar hubs. The average distance is 7.4 miles, and the median is two miles. The minimum distance is close to zero for members who live directly next to a Míocar hub, and the maximum distance is 142 miles. These results show that most user members do not have a hub within walking distance of their residence.

N = 141
Mean = 7.4
Median = 2.0

*There are seven incomplete addresses that can not be geocoded and one address outside of California, which are excluded in this figure.
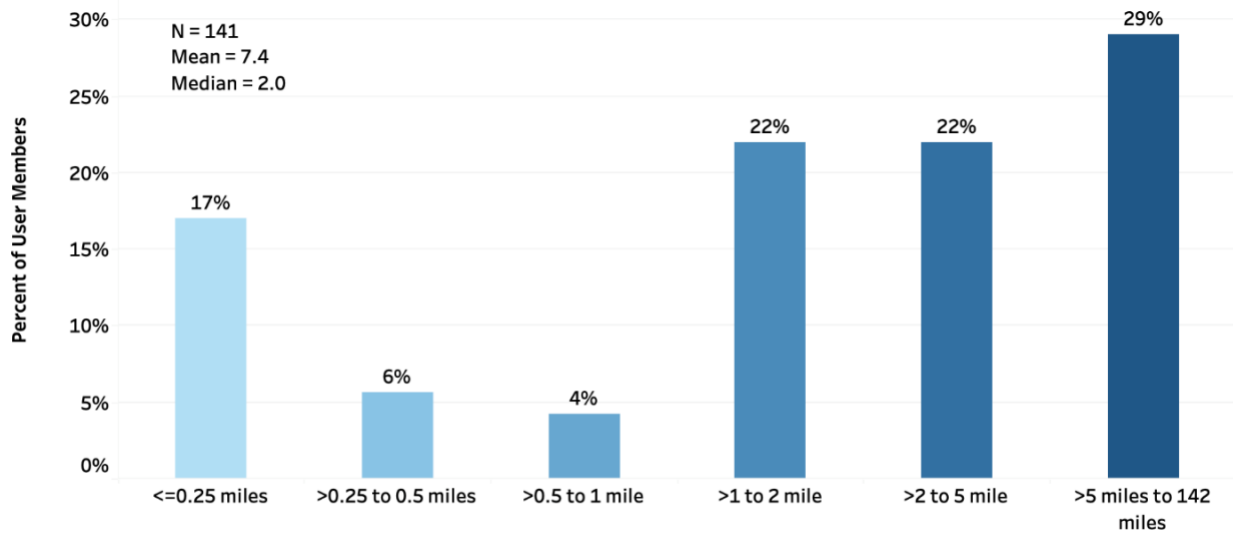
Figure 7. Driving distance from user member's local home location to nearest Míocar hub (N=141)

The Post-Reservation Survey asked how users traveled to the Míocar hub to pick up the vehicle they had reserved. As shown in Table 12, members walked to the vehicle for most reservations (67%). Still, more members reported using a private vehicle to travel to the Míocar hub (71% of members) than any other transportation mode. Together, these results suggest that users who live within walking distance of Míocar hubs used the service more frequently than others.

Table 12. Mode of travel to Míocar hub for most recent reservation

How did you travel to pick up the Míocar?	Percentage of Responses (N = 874)	Percentage of Respondents (N = 69)
Walk	67%	43%
Private Vehicle (car or truck)	23%	71%
Public Transit Bus	7%	12%
Taxi, Uber, or Lyft	3%	10%
Bicycle, Scooter or skateboard	2%	11%
Motorcycle	<1%	1%
Other	1%	13%

*Respondents were able to select more than one response. Thus, the total percent of respondents is greater than 100%.

Accessing Míocar: Discussion

While many individuals in the current user base are able to travel long distances to Míocar hubs using private vehicles or other modes, other individuals in their communities who do not have these transportation options may not be able to access Míocar and may not have signed up for the service as a result. These results suggest an opportunity to explore the expansion of Míocar into additional communities, both to reduce reliance on personal vehicles for EV access and to meet the needs of current non-members and non-users.

Travel Purposes

The Post-Reservation Survey asked users to indicate the primary purpose of their last Míocar reservation. As shown in Figure 8, respondents most commonly stated that the primary purpose of their reservation was to conduct family or personal errands (51% of all respondents and 35% of all reservations). Work-related activities were the second most commonly cited reservation purpose.

What was the primary destination for your last Míocar reservation?

	Responses (N = 881)	Respondent (N = 72)
Family/personal errands	35%	51%
Medical	7%	22%
Other	2%	17%
School	14%	18%
Shopping	11%	24%
Social/recreational	7%	38%
Work-related	24%	42%
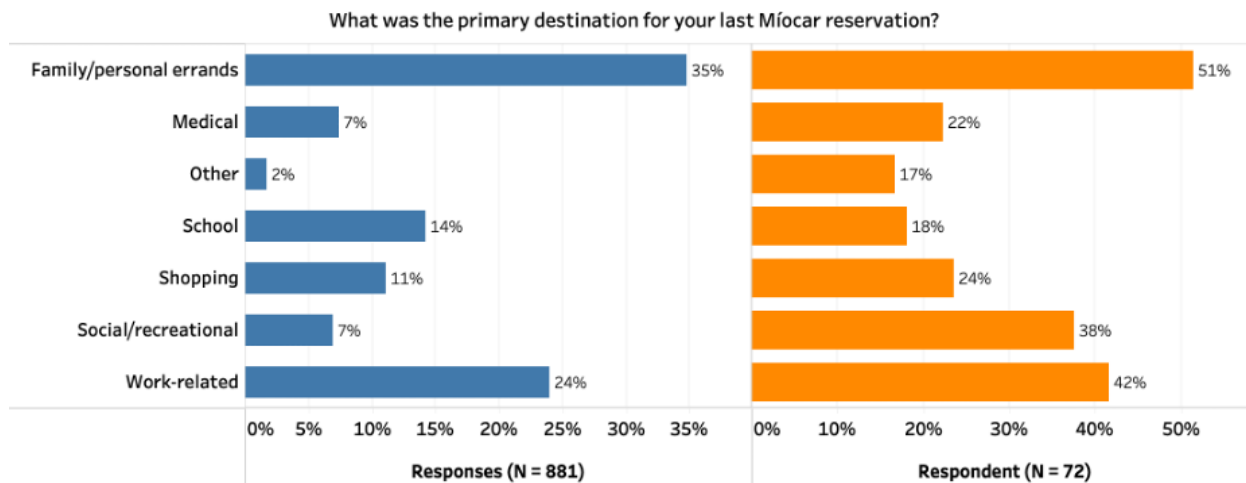
Figure 8. Primary purpose of the most recent reservation

Carpooling

When asked to report how many passengers, including themselves, were in the Míocar vehicle during the reservation, members most often reported that two or fewer people were in the vehicle (Figure 9). As indicated by the average and median values, Míocar vehicle reservations typically consisted of the driver and one other passenger.

Including yourself, how many passengers were in the vehicle during your reservation?

	Responses (N = 878)	Respondents (N = 71)
1	28%	66%
2	37%	56%
3	18%	34%
4	13%	23%
5	3%	14%
6	1%	6%

Mean = 2.3
Median = 2.0
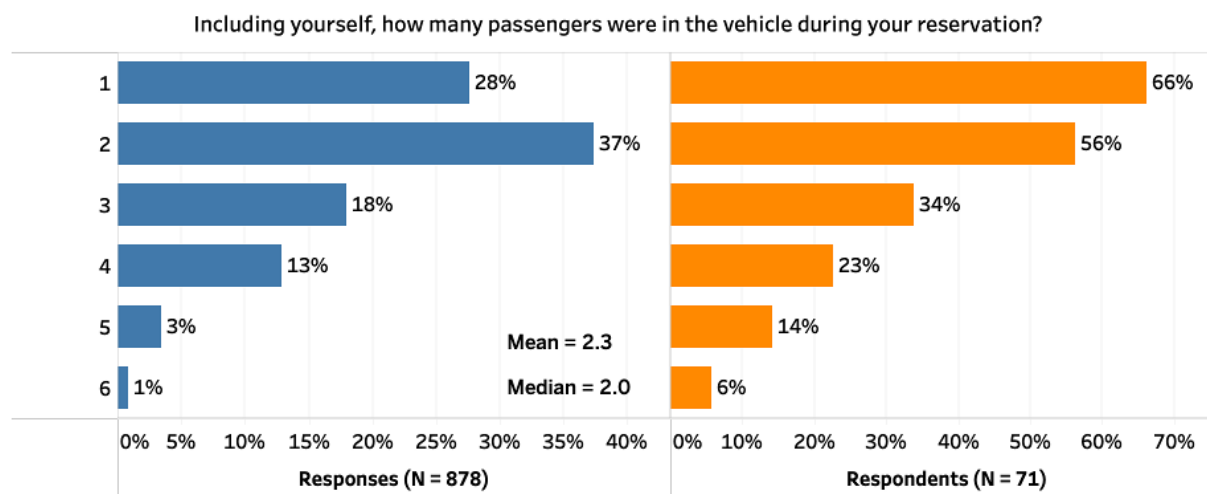
Figure 9. Number of people in vehicle for most recent reservation

Counterfactual Travel

The Post-Reservation Survey asked several questions to gain insight into members' possible counterfactual decisions about travel in the absence of Míocar. These questions related to alternative transportation options.

The primary question used to determine the likely counterfactual travel scenario asked respondents if they would have made the particular trip in question had Míocar not been available. Respondents most commonly stated that the trip would not have occurred in the absence of Míocar, suggesting that the availability of Míocar induced 68% of trips (Figure 10).

If Míocar was not available, would you have been able to travel to the primary destination of your last reservation?

	Responses (N = 848)	Respondents (N = 72)
Yes	16%	44%
No	68%	64%
Unsure	16%	46%
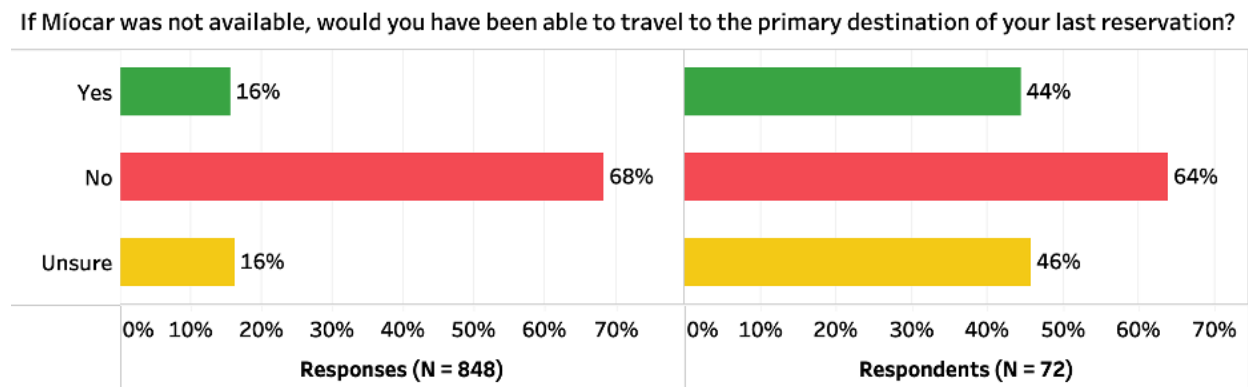
Figure 10. Counterfactual trip decision in the absence of Míocar

The Before Survey included questions related to new members' expected service use. First, the survey asked users whether they thought Míocar would increase the number of trips their household would make. As displayed in Figure 11, 45% of respondents expected that the service would increase their number of trips, while 34% of respondents were not sure.

Will Miocar increase the number of trips your household makes?

N = 59

Yes	No	I am unsure
45%	21%	34%
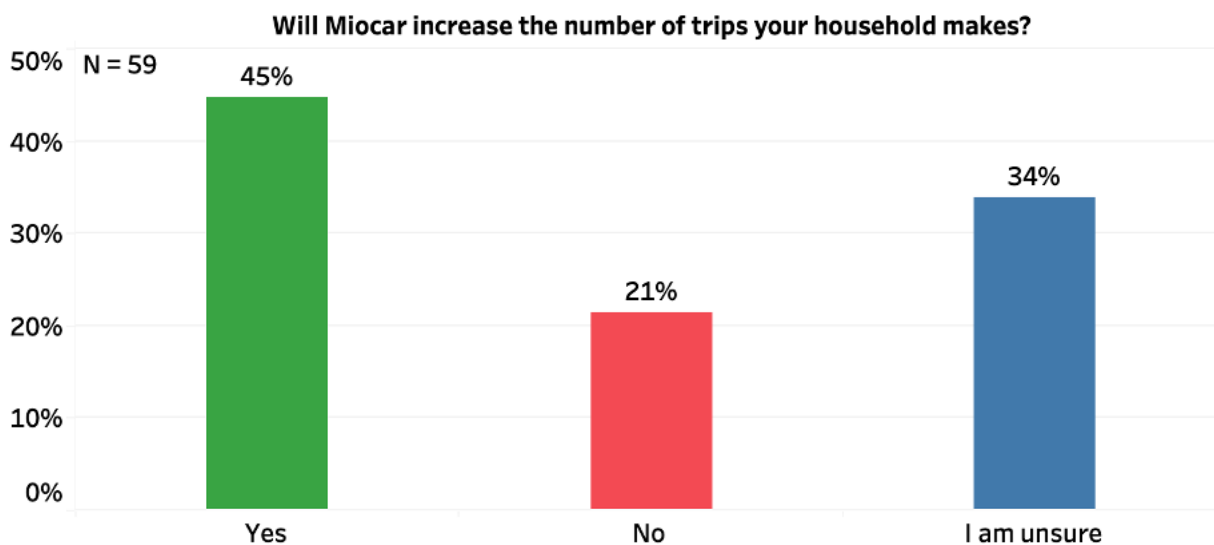
Figure 11. Expected change in trip making due to Míocar

For the responses stating that the trip would have been possible in the absence of Míocar, the Post-Reservation Survey asked members how they would have made these trips under this

counterfactual scenario. All members in this subset indicated that they would have used a different mode of travel to make the trip at least once (Table 13).

Table 13. Counterfactual mode in the absence of Míocar

How would you have made this trip without Míocar?	Percent of Responses (N = 132)	Percent of Respondents (N = 32)
I would have used a different mode of travel (for example, my own car or bus).	97%	100%
I am unsure.	3%	9%
I would have gone to a different location.	2%	6%

*Respondents were able to select more than one response. Thus, the total percent of respondents is greater than 100%.

When asked what form of transportation they would have used to make their trips in the absence of Míocar, members most often reported that they would have driven their car (Figure 12). Overall, 98% of responses indicated that trips that would have still been taken in the counterfactual scenario would have been completed using a motor vehicle (driving a car, getting a ride from someone, borrowing a car, renting a car, or taking a taxi, Uber, or Lyft).
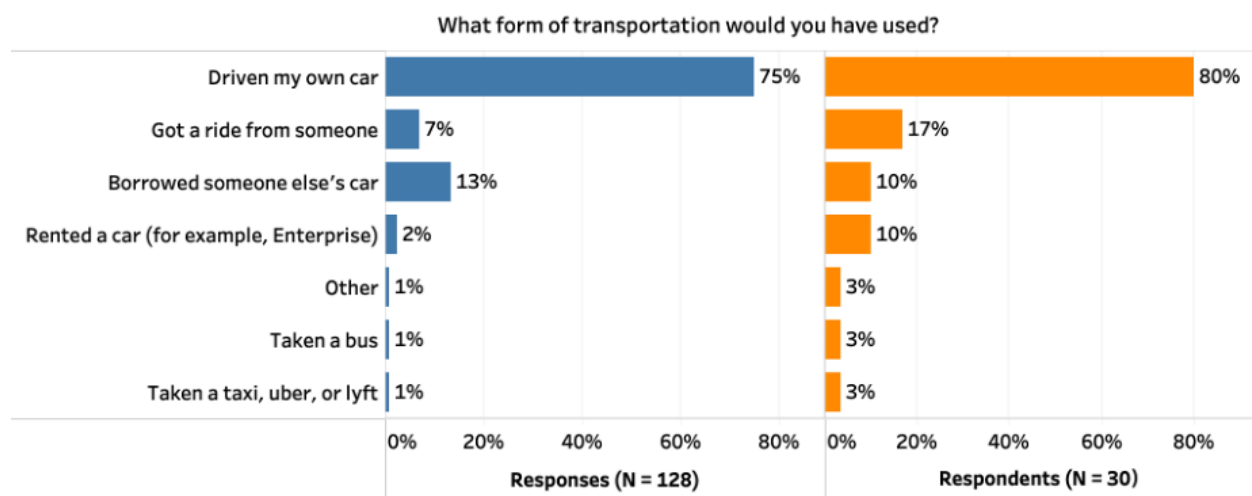
Figure 12. Counterfactual mode for trips taken with Míocar if service were not available

Change in Travel by Conventional and Electric Vehicles

Table 14 presents the results of applying the counterfactual travel analysis for each user to the total Míocar distance traveled within that member's surveyed reservations. The 744 survey responses confidently linked to a specific reservation account accounted for a total of 47,730 miles traveled. In this table, the column labels refer to the following:

- Increased Mobility Miles: Miles traveled with Míocar that would not have occurred at all in the absence of Míocar.

- Mode Shifted Miles: Miles traveled with Míocar that would have occurred using another mode in the absence of Míocar. This category includes two subcategories:
    - Avoided ICE Miles: Miles traveled with Míocar that would have occurred using an ICE vehicle in the absence of Míocar.
    - Avoided Non-ICE Miles: Miles traveled with Míocar that would have occurred using a mode other than an ICE vehicle in the absence of Míocar.
- Uncategorized Miles: Miles traveled with Míocar that may or may not have occurred in the absence of Míocar; a determination cannot be made due to lack of data.

According to members, the majority of miles traveled for these reservations (54% or 25,761 miles) would not have occurred in the absence of the service. Of the total miles traveled, 24% (11,578 miles) would have been traveled using an ICE vehicle in the absence of the service.[7]

Table 14. How availability of Míocar affected miles traveled (based on counterfactual survey responses)

Based on counterfactual responses	Mode Shifted Miles		Increased Mobility Miles	Uncategorized Miles*	Total Miles
	Avoided ICE Miles	Avoided Non-ICE Miles			
VMT	11,578	101	25,761	10,292	47,730
Percentage	24.3%	0.2%	54.0%	21.6%	100%

Figure 13 displays the distribution of reservations, users, and the VMT across income categories. A description of the method researchers used to categorize respondents to these income categories can be found in Appendix A. Extremely Low-Income households accounted for most reservations (57%) and the largest group of users (35%). Most miles traveled with Míocar were driven by users from Low-Income, Very Low-Income, or Extremely Low-Income households.

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[7] Two of the reservations linked to survey responses had a recorded distance of 0 in the utilization data. UC Davis researchers found that this was due to an error with the telematics software, and therefore removed these 0 values prior to completing this portion of the analysis. Both of these reservations were completed by users who had completed a single survey, so the removal of these distance values does not affect the calculations for any other reservations.
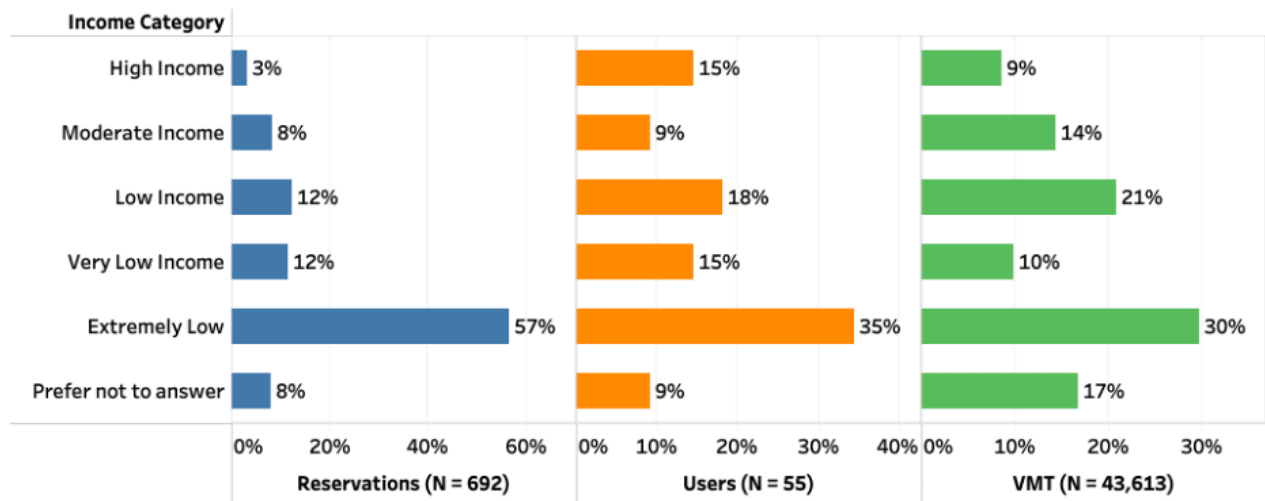
Figure 13. Summary of reservations by user's income category

Figure 14 shows the miles traveled by income category by VMT types. The proportion of trips categorized as Increased Mobility trips is highest for the Extremely Low-Income user population at 42% of all trips. The proportion of trips categorized as Mode Shifted Travel, which includes Avoided ICE Travel and Avoided Non-ICE Travel, is highest for the Moderate-Income and High-Income user populations, at 41% and 24% of all trips, respectively.
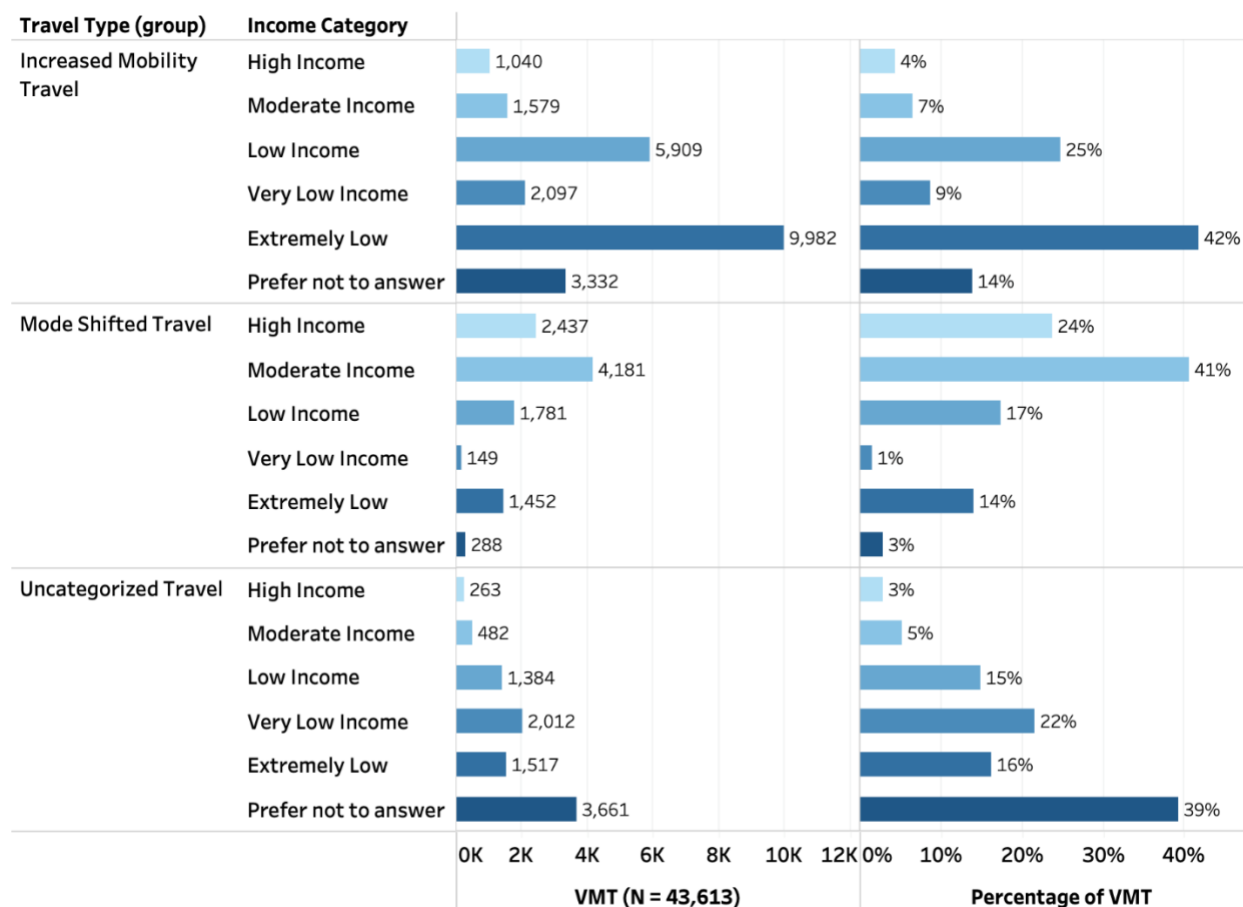
Figure 14. VMT associated with Míocar effects on travel by income category

Table 15 summarizes the counterfactual travel analysis by reservation purpose, which involves cross-referencing the counterfactual survey responses with the stated reservation purpose from the Post-Reservation Survey.

The trip purposes with the highest proportion of trips categorized as Increased Mobility Travel were School trips, Family/personal errands, and Medical trips, where user responses indicated that 84%, 75%, and 74% of these trips would not have occurred in the absence of Míocar, respectively. Conversely, the trip purpose with the highest proportion of trips categorized as Mode Shifted Travel was Social/recreational. Users indicated that about half of these trips (49%) would have used a different mode in the absence of Míocar.

Table 15. Counterfactual trip summary by purpose of reservation

Primary Destination	Mode Shifted Travel (N = 136)	Increased Mobility Travel (N = 448)	Uncategorized Travel (N = 108)	Total (N = 692)
Family/personal errands	8%	75%	16%	100%
Medical	9%	74%	17%	100%
Other	21%	50%	29%	100%
School	13%	84%	3%	100%
Shopping	22%	62%	16%	100%
Social/recreational	49%	40%	11%	100%
Work-related	34%	43%	22%	100%
Total	20%	65%	16%	100%

Counterfactual Travel: Discussion

The counterfactual travel analysis shows that members in the lower-income groups account for most of the VMT associated with Increased Mobility Travel. In contrast, members in the higher-income groups account for most of the VMT associated with Mode Shifted Travel. The results suggest that Míocar is predominantly providing access to essential destinations for individuals who do not have sufficient transportation alternatives.

Conclusion

The before and after evaluation of Míocar provided several insights into who is using the service, how they are using it, and how EV carsharing affects transportation behaviors within the membership population.

Míocar membership grew throughout May 2019 through November 2021 study period. However, barriers to growth included the onset of the COVID-19 pandemic in March 2020 and a major vehicle recall in July 2021. On average, user members traveled about 59 miles per month over 13 hours. The median reservation distance was 37 miles with a duration of about 3.5 hours, though members tended to make shorter reservations on average during the last few months of the study period. Fluctuations in vehicle availability likely affected the frequency and type of reservations completed. Further observations of the pilot at full operational capacity would be needed to forecast use estimates under typical conditions.

A total of 149 individuals became members of Míocar and used the service during the study period, and 78 of these individuals completed the Before Survey (52%). Based on this survey, Míocar members tend to have larger household populations and lower household incomes than the average for their surrounding county populations.

While Míocar members have roughly the same number of personal vehicles per household as the overall county averages, many members expected that Míocar would increase the number

of trips their households could make (45% of members in the Before Survey). The role of Míocar as a method of improving household mobility is further evidenced by the after data collected in the form of a Post-Reservation Survey. This survey suggests that most Míocar trips (63%) would not have been possible in the absence of the service. For the 20% of Míocar trips that would occur in the absence of the service, respondents indicated that nearly all (98%) would have traveled by personal ICE vehicles or another ICE vehicle.

A cross-tabulation of counterfactual trip scores with member income categories suggests that Avoided ICE VMT is positively correlated with household income. This means that higher-income households would be more likely than lower-income households to complete the same trips, using an ICE vehicle, in the absence of Míocar. Conversely, the results suggest that Increased Mobility VMT is negatively correlated with household income, meaning that lower-income households are less likely to complete trips in the absence of Míocar. Together, these results suggest that Míocar is replacing ICE travel for higher-income households and providing improved mobility to lower-income households with fewer transportation alternatives. Additionally, the long distances traveled during some reservations, and the lack of members citing transit as a counterfactual mode of travel, indicate that members use the service for inter-city and inter-county trips that cannot be accomplished by available transit service.

The Post-Reservation Survey found that members use Míocar for a wide variety of trip types, including family and personal errands, work- and school-related travel, accessing medical appointments, and traveling to social activities. In addition, most respondents who provided information about a medical, school, or work-related trip in the Post-Reservation survey indicated that they would not have been able to make these trips in the absence of the service. Thus Míocar is providing increased access to essential destinations.

The results also suggest that additional carsharing hubs may improve the accessibility and use of Míocar for current members and future members. Of the user members, 29% were willing to travel more than 5 miles from their homes to access Míocar hubs, and 71% of Post-Reservation Survey respondents reported that they drove private vehicles to Míocar hubs to pick up the EVs. However, many members live in communities without Míocar hubs, and 60% of individuals who signed up to use the service did not complete a Míocar reservation during the study.

Future Research

Míocar is continuing to operate and seeks to expand into new counties with additional vehicles and hubs. Given the long travel distances to Míocar from member residences, the results of this research have identified an opportunity to study the demand for EV carsharing in regions surrounding existing hubs, such as through working with operators to forecast the cost-effectiveness of expansion in specific areas. Additionally, researchers are currently implementing a retrospective telephone-based survey with Míocar users to gain detailed information about their transportation capabilities and challenges, and how EV carsharing has improved the mobility of themselves and other members of their households. This survey data may further inform strategies for service expansion and provide insights for further studies that analyze the equity and emissions effects of rural EV carsharing.

VOGO-A Volunteer Rides Program

Introduction

VOGO is a volunteer ridesharing service where volunteer drivers use their vehicles to provide rides to VOGO members within Stanislaus and San Joaquin counties. VOGO aims to provide a transportation alternative to individuals who may not have access to personal vehicles, are unable to drive, or have limited access to transit.

VOGO and similar programs, generally categorized as Volunteer Driver Programs (VDPs), mainly focus on improving transportation equity by reducing transportation costs and barriers to travel for their participants. This pilot evaluation explores the equity impacts of VOGO by using surveys to identify member characteristics and barriers to transportation. In addition, researchers assess members' perspectives on service benefits. Finally, researchers analyze usage data to understand how VOGO meets the travel needs of its target population.

VOGO Pilot Description

VOGO is a volunteer ridesharing service launched in late 2019 to supplement existing transit services in San Joaquin and Stanislaus counties in disadvantaged rural areas. Residents can use VOGO for trips that begin or end in disadvantaged rural communities with limited transit service (see Figure 1 above and Figure 19 below). Volunteer drivers use their vehicles to provide rides to VOGO members, and VOGO reimburses drivers at the standard IRS reimbursement rate.[8] MOVE Stanislaus (MOVE) administers VOGO with the Volunteer Transportation Center (VTC). MOVE is a non-profit volunteer service provider that recruits and enrolls volunteer drivers into the program. VTC is a high-volume volunteer transportation service responsible for scheduling, dispatching, and conducting other backend operations of VOGO. VOGO aims to provide a transportation alternative to individuals who may not have access to personal vehicles, are unable to drive, or are otherwise limited in their ability to travel using currently available transit.

Methods of Data Collection and Analysis

Evaluation of the VOGO pilot involved collecting data exports from service operators and self-report data from riders who used the service. The sources used for this evaluation fall into the following categories: Member Data, Utilization Data, and Survey Data. This section defines these data sources, describes the format and frequency of data collection, and summarizes the metrics associated with each source for the program evaluation.

Member Data

Members provide data to the VOGO as part of the application or enrollment process. Therefore, VOGO collected member data continually as members signed up to use the service.

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[8] Approximately 58 cents per mile as of the study period.

Member data collected to support the research evaluation primarily consisted of member contact information.

Utilization Data

VOGO continually collected and maintained data about individuals' use of the volunteer ridesharing service. The dataset included the following information:

- Member ID: A unique identifier for the rider;
- Driver ID: A unique identifier for the volunteer driver;
- Trip ID: A unique identifier for the trip;
- Date and time of member pick-up and drop-off;
- Date and time of driver-vehicle operation start and end;
- Census block of member pick-up and drop-off;
- Census block of driver-vehicle operation start and end;
- Type of trip (trip purpose); and
- Miles traveled during the trip.

The data includes the origin and destination of each trip leg within a reservation to capture each drop-off and pick-up location for members who used the service to travel to multiple destinations in a single day.

Survey Data

VOGO collected self-report data through surveys of users before, during, and after participating in the service. UC Davis developed initial member surveys (i.e., a "Before Survey") administered by one MOVE Stanislaus staff member to newly enrolled VOGO members by telephone between March 2020 and November 2021. The Before Survey offered a $10 gift card to members who participated in the Before Survey. Topics addressed and information collected by the Before Survey include:

- Member ID;
- Number of vehicles available to member households;
- Member's level of comfort with driving a vehicle (and reasons they may not be comfortable, such as medical issues);
- Member's expected use of the service (i.e., whether it will allow them to make more trips, and expected types of trips);
- Composition of member's household (i.e., population, number of adults, relationship to other household members);
- Member's residence type;
- Member's age;
- Member's level of education;
- Ethnicity; and

- Household income.

Throughout the pilot period, active VOGO members completed surveys monthly (i.e., a "Monthly Use Survey") to provide information about how they had used the service. One MOVE Stanislaus staff member administered the survey by telephone to members who had used VOGO during the past month, from April 2021 to November 2021. VOGO offered a $5 gift card as an incentive for participating in the survey. Topics addressed and information collected by the Monthly Usage Survey included:

- Member ID;
- Number of passengers in VOGO vehicle;
- Types of trips made with VOGO in the past month (e.g., work-related, social/recreational, medical-related);
- Counterfactual travel (i.e., would travel have occurred without the VOGO service, and if so, with what modes);
- Impacts of VOGO on transportation;
- Whether VOGO enabled travel to more destinations;
- Whether VOGO made it easier to travel to necessary destinations; and
- Whether VOGO helped to save money on transportation costs.

Researchers administered the Monthly Trip Survey to active members monthly from April 2021 through November 2021. Some members responded multiple times throughout the study period, and others responded once or not at all during this period.

Finally, UC Davis developed a survey administered to members at the end of the pilot evaluation (i.e., the "After Survey"). The survey assessed changes over time by collecting similar information as the Before Surveys, with additional questions based on topics identified during the pilot period. Like the Before Survey and Monthly Usage Survey, one MOVE staff member administered the After Survey by telephone in December 2021. In addition, the survey offered a $20 gift card incentive for participating in the survey. Topics addressed and information collected by the After Survey included:

- Member ID;
- Number of vehicles available to member households;
- Member's level of comfort with driving a vehicle (and reasons they may not be comfortable, such as medical issues);
- Whether members have sold, scrapped, or stopped the lease on vehicles since joining VOGO (and whether this was due to VOGO);
- Whether members would have purchased or started the lease on vehicles in the absence of VOGO;
- COVID-19 impacts on member use of personal vehicles;
- COVID-19 impact on member use of VOGO;
- Whether VOGO has allowed members to make more trips, and types of trips;

- Member ability to travel to necessary destinations before joining VOGO vs. since joining VOGO;
- Presence of health-related difficulties (e.g., vision or ambulatory difficulties) for members and their households;
- Member's residence type;
- Member's age;
- Member's level of education;
- Ethnicity; and
- Household income.

All survey respondents were riders of VOGO and therefore had trip data associated with the service. UC Davis researchers linked Utilization Data and Survey Data by the anonymous and unique Member ID, which allowed for analysis that integrated all data sets at the individual participant level. Finally, researchers used the data to assess the overall performance of VOGO and develop key findings for the study period, as described in the section below.

Estimation of Rider Home Locations

To provide context to rider trips and understand the geographic distribution of riders, researchers incorporated the census block of members' home residences into the service usage analysis. While neither the Member Data nor the Utilization Data included member home addresses, researchers estimated the home census block of riders using member pickup addresses and appointment times. This method assumes that riders are picked up at home for most of their trips, meaning that for each rider, the address with the largest number of pickups is the most likely to be their home location. If more than one address has the same number of pickups, researchers assign the one with the earliest pickup time(s) for each reservation day as the home location.

Although this rule typically identified a consistent home location for riders from month to month, riders can move to a new residence during the study period. Researchers reviewed all riders' reservations to account for this possibility and identified instances where a rider's usual pickup address changed from one consistent location to another consistent location. Researchers used this method to infer an approximate date of the residence location change.

Assignment of Trip Purposes

The utilization data received from VOGO included information on the trip purpose of each reservation. UC Davis researchers define reservations as when a rider enters and exits a VOGO vehicle. Thus, riders may make multiple reservations per day to travel to different destinations before returning home. When riders make a reservation, they describe the purpose of their trip so that VOGO staff can maintain a record of trip types.

Researchers made several modifications to the categorization of trip types within the VOGO utilization data to more clearly convey how riders used the service. First, in instances where

riders made a round-trip from their home to a destination and then back home, researchers considered the trip purpose of the return-home reservation to be the same as the trip purpose for the reservation that began at their home. So, for example, a rider who made a reservation to travel to a grocery store and then made a reservation to travel back home would have both reservations categorized as "Grocery Shopping."

Second, VOGO categories some reservations as "Other" when riders travel one way from another location to their home. To reflect one-way trips taken from other locations to a rider's home more precisely, researchers created the "Home" trip purpose category and applied it to these types of reservations.

Finally, if a rider used VOGO to travel from their home to a destination, then used VOGO to travel to a second destination, and finally used VOGO to travel home, researchers categorized the final return-home reservation with both of the trip purposes of the previous two reservations. Therefore, these types of return-home trips are counted towards more than one trip purpose, meaning that the sum of individual trip purposes slightly exceeds the total number of trips taken.

Results

Using the collected Member Data, Utilization Data, and Survey Data for the study period of November 2019 through November 2021, UC Davis researchers analyzed VOGO participation levels, including the number of riders, number of drivers, total number of reservations, and frequency of use per rider. In addition, researchers linked rider surveys to reservation data to understand the types of trips taken with VOGO, transportation alternatives available to riders in the counterfactual absence of the service, and the overall impacts of VOGO on rider mobility. Due to service interruptions and limitations resulting from the COVID-19 pandemic, researchers do not consider VOGO operations during the study period to represent typical transportation conditions and pilot performance. However, the evaluation provides insight into the characteristics and travel needs of riders who may benefit from this type of service and highlights the role of VOGO as a transportation solution for accessing essential services.

Member Use

By the end of November 2021, 52 members had used the VOGO service as riders during the two-year evaluation period, and 25 members had made at least one reservation as riders in the final three months of the study period, September to November 2021 (referred to as "active riders"). Excluding canceled and "no-show" reservations, there were 1,899 total VOGO reservations during the study period.

The number of enrolled VOGO riders, volunteer drivers, and reservations per month fluctuated throughout the study period due to various factors, including the COVID-19 pandemic and related operational changes, community outreach efforts, and the relationship between rider demand and driver availability. As shown in Figure 15, the number of monthly reservations and

riders first peaked in February 2020 before decreasing significantly with the onset of the COVID-19 pandemic. VOGO operations paused on March 20, 2020. Due to state and county health mandates, the service provided only medically necessary rides, such as traveling to urgent and acute medical treatment. During this period, the number of volunteer drivers decreased to two. As a result of outreach efforts by VOGO staff, volunteers increased to five by June 2020.

VOGO received another county mandate to scale back operations to essential rides only in July 2020 due to ongoing COVID-19 impacts, and thus trip counts decreased from July to August 2020. While VOGO staff continued to conduct member outreach activities to increase participation as the service re-opened, service restrictions and possible hesitation from members in using transit travel limited the ability of the service to recruit new riders.

In alignment with changing health mandates, VOGO slowly resumed operations during the third quarter of 2020, when the definition of essential trips expanded to include a broader range of trip types, such as grocery shopping and work-related. In October 2020, the service opened to all types of rides, which led to a significant increase in service use during that month.

VOGO again encountered service limitations due to COVID-19 in the final months of 2020, before gaining additional operational productivity in early 2021 as riders and drivers could obtain vaccinations for COVID-19. However, while riders were previously able to share rides with other riders before the COVID-19 pandemic, this option has not been allowed since March 2020, limiting the service's capacity. The issues presented by the pandemic are ongoing through the end of the study period, with direct effects on service operations and driver, rider, and trip counts.
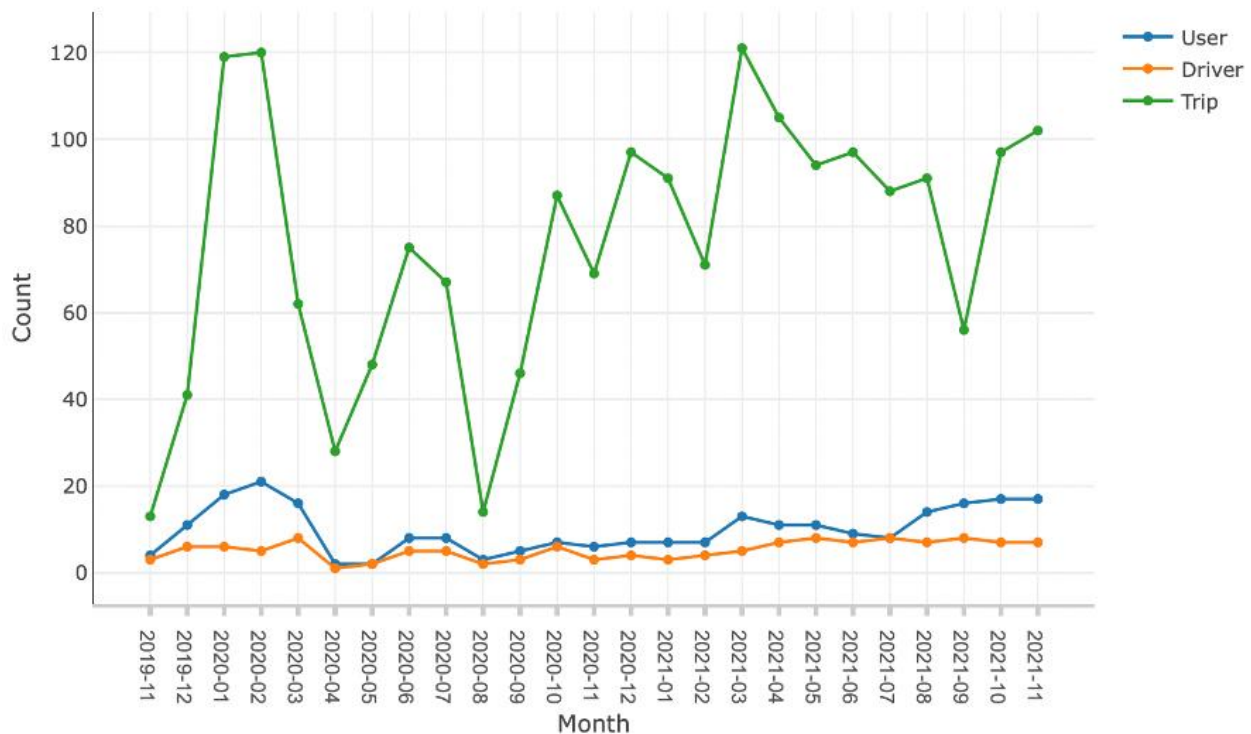
Figure 15. Monthly VOGO reservations, riders, and volunteer drivers

Table 16 displays summary statistics of VOGO usage by the number of riders, volunteer drivers, reservations, and VMT throughout the 25-month study period. VOGO achieved an average of 76 monthly reservations and had a high of 121 reservations in a single month. The average number of riders per month was 10, with 21 riders using the service in its most active month.

Riders made an average and median of four reservations per month, with the most active rider making 31 reservations per month or roughly one per day. The average VMT per month was 101 miles, with the lowest monthly VMT for a rider being 6 miles and the highest monthly VMT being 646 miles. In terms of VMT per reservation overall, the average distance of the 1,899 VOGO reservations during the study period was 21 miles, and the median reservation was 19 miles (Table 16). The longest distance for a single VOGO reservation, meaning a single ride, was 90 miles.

The frequency of use and distance of VOGO reservations varied widely among VOGO riders because of COVID-19 restrictions. Table 16 displays summary statistics for the monthly reservations and VMT for the 52 VOGO riders. UC Davis researchers calculated reservations and VMT per month for each rider between the rider's first reservation date and last reservation date (or membership duration). Then, researchers divided membership duration by 30 days to calculate the approximate number of months the member participated in the program. Next, researchers divided total reservations and VMT by membership months to estimate monthly reservations and VMT for each rider.

Table 16. VOGO summary statistics of riders, drivers, reservations, and VMT

Variable	N	Mean	Std. Dev.	Min	Pctl. 25	Median	Pctl. 75	Max
Monthly Rider Count	25	10	5	2	7	8	14	21
Monthly Driver Count	25	5	2	1	3	5	7	8
Monthly Reservations	25	76	31	13	56	87	97	121
Monthly VMT	25	1589	709	156	1261	1807	1980	2837
Reservation/Month	52	4.4	4.6	0.4	2	3.8	5.2	30.7
VMT/Month	52	101.3	114.5	5.7	38.3	75.8	111.7	646.4
VMT/Reservation	1899	20.9	12	1	13	19	28	90

Member Attributes

The After Survey included questions to categorize VOGO member demographic, socioeconomic metrics, and household characteristics. Researchers compared the attributes of VOGO members to the regional population to assess the similarities and differences between these groups. Researchers developed a single weighted regional average of town-level results for the four cities with the highest concentration of VOGO members and survey respondents: Riverbank, Escalon, Manteca, and Lathrop. Table 17 displays the member attributes and weighted regional population results.

The After Survey included two questions regarding member ethnicity and origin. Table 17 shows that 21% of respondents to the After Survey reported being of Hispanic, Latino, or Spanish origin. This share contrasts somewhat with the regional average, where 43% of individuals are of Hispanic, Latino, or Spanish origin, according to census data.

VOGO members represent an older age group on average than the overall population. Nearly two-thirds of respondents were 70 years of age or older (64%), while this age range represents approximately 11% of the regional population. In addition, none of the VOGO survey respondents were less than 50 years of age.

Additionally, VOGO members reported substantially lower income levels than regional averages, with 90% of respondents stating that their household income was less than $25,000 per year. In contrast, 14% of households in the region have an income of less than $25,000.

A majority of VOGO members stated that they live alone (70% of respondents) compared to 16% of individuals for the regional average. In addition, only one of 23 respondents reported having a household size of more than three individuals.

Overall, these results suggest that VOGO members tend to be older individuals who typically live alone or with one other person and have lower than average income levels.

![NCST logo]

Table 17. VOGO member demographic attributes

Demographic Attribute	After Survey Respondents	Regional Population (Riverbank, Escalon, Manteca, Lathrop)
Hispanic or Latino Origin	**N = 24**	**Population (N = 133490)**
Hispanic, Latino, or Spanish origin	21%	43%
Not Hispanic, Latino, or Spanish origin	79%	57%
Total	100%	100%
Ethnicity	**N = 23**	**Population (N = 133490)**
American Indian or Alaska Native	9%	3%
Asian	4%	11%
Native Hawaiian or Other Pacific Islander	9%	1%
White	70%	67%
Other	17%	18%
Total	>100%	100%
Household Income	**N = 20**	**Households (N = 40433)**
Under $10,000	40%	3%
$10,000 to $24,999	50%	11%
$25,000 to $49,999	10%	18%
$50,000 to $99,999	<u>0%</u>	<u>34%</u>
$100,000 to $199,999	0%	28%
More than $200,000	0%	6%
Total	100%	100%
Age	**N = 25**	**Population (N = 133490)**
20 to 29 years	0%	20%
30 to 39 years	0%	20%
40 to 49 years	0%	19%
50 to 59 years	20%	18%
60 to 69 years	16%	12%
70 to 79 years	32%	7%
80 years and over	32%	4%
Total	100%	100%
Household Size	**N = 23**	**Households (N = 40433)**
1-person household	70%	16%
2-person household	13%	30%
3-person household	13%	17%
4-person household	0%	17%
5-person household	4%	11%
6-or-more person household	0%	8%
Total	100%	100%

VOGO provides an alternative form of transportation for individuals who may be unable to operate personal vehicles or travel by other modes, potentially due to health-related challenges. The After Survey asked respondents whether anyone in their household has one or

more health-related difficulties (Table 18).[9] Respondents were able to select multiple responses to this question. Respondents most commonly reported that someone in their household had challenges with walking (ambulatory difficulty) or vision challenges, followed by independent living and hearing challenges. Of the 25 respondents to the After Survey, 17 respondents (68%) reported at least one of these health-related difficulties in their households, four respondents (16%) reported no health-related difficulties, and four respondents (16%) chose not to provide an answer to this question.

Table 18. Health-related difficulties within VOGO member households

Please tell me if any individuals in your household have the health-related difficulty. (N = 21)

Ambulatory difficulty	8
Hearing difficulty	1
Independent living difficulty	2
Vision difficulty	8
Cognitive difficulty	0
Self-care difficulty	0
No health-related difficulties	4

Regarding vehicle access, Table 19 displays the distribution of personal vehicles available to VOGO members according to the After Survey, compared to the regional weighted average of census data. A majority of VOGO members (80%) reported having zero vehicles available to their household, in contrast to 4% of households in the regional population. Since most respondents also live alone, this lack of personal vehicles suggests that these members may face significant barriers to travel in the absence of on-demand transit services.

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[9] The list of health-related difficulties included as response options for this question is based on the disability categories used in the current American Community Survey (ACS) and referenced by the United States Census: https://www.census.gov/topics/health/disability/guidance/data-collection-acs.html

Table 19. VOGO member vehicle availability

Demographic Attribute	After Survey Respondents	Regional Population (Riverbank, Escalon, Manteca, Lathrop)
Available Vehicles	**N = 25**	**Households (N = 40433)**
No vehicle available	80%	4%
1 vehicle available	12%	23%
2 vehicles available	4%	39%
3 vehicles available	0%	22%
4 or more vehicles available	4%	12%
Total	100%	100%
Household Size by Vehicles	**N = 23**	**Households (N = 40433)**
1-person household:	70%	16%
No vehicle available	61%	2%
1 vehicle available	4%	11%
2 vehicles available	0%	2%
3 vehicles available	0%	1%
4 or more vehicles available	4%	0%
2-person household:	13%	30%
No vehicle available	0%	1%
1 vehicle available	9%	6%
2 vehicles available	4%	16%
3 vehicles available	0%	6%
4 or more vehicles available	0%	1%
3-person household:	13%	17%
No vehicle available	13%	0%
1 vehicle available	0%	3%
2 vehicles available	0%	7%
3 vehicles available	0%	5%
4 or more vehicles available	0%	2%
4-or-more-person household:	4%	37%
No vehicle available	4%	0%
1 vehicle available	0%	4%
2 vehicles available	0%	13%
3 vehicles available	0%	11%
4 or more vehicles available	0%	9%
Total	100%	100%

Researchers asked the five After Survey respondents who reported having one or more personal vehicles available to their household about their comfort level driving their vehicles. Three of these respondents stated that they were not comfortable driving these vehicles, and the remaining two said they were only comfortable driving in some situations.

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Member Attributes: Discussion

The collected data on member attributes suggest that VOGO is reaching its intended user population of lower-income individuals in disadvantaged communities who may not have access to reliable vehicles. In addition, member responses regarding vehicle availability and driving comfort levels suggest that even for the small subset of members who have access to personal vehicles, VOGO may represent a safer or more reliable transportation option.

Travel Origin and Destination Locations

Figure 16 displays the estimated rider home locations as of the end of the study period, using proportional circle symbols to represent the population of members in each census block. The center of each circle is the centroid of the census block. Most member home locations are within and near Riverbank, CA, with the remaining home locations centered around Escalon and Manteca, CA.
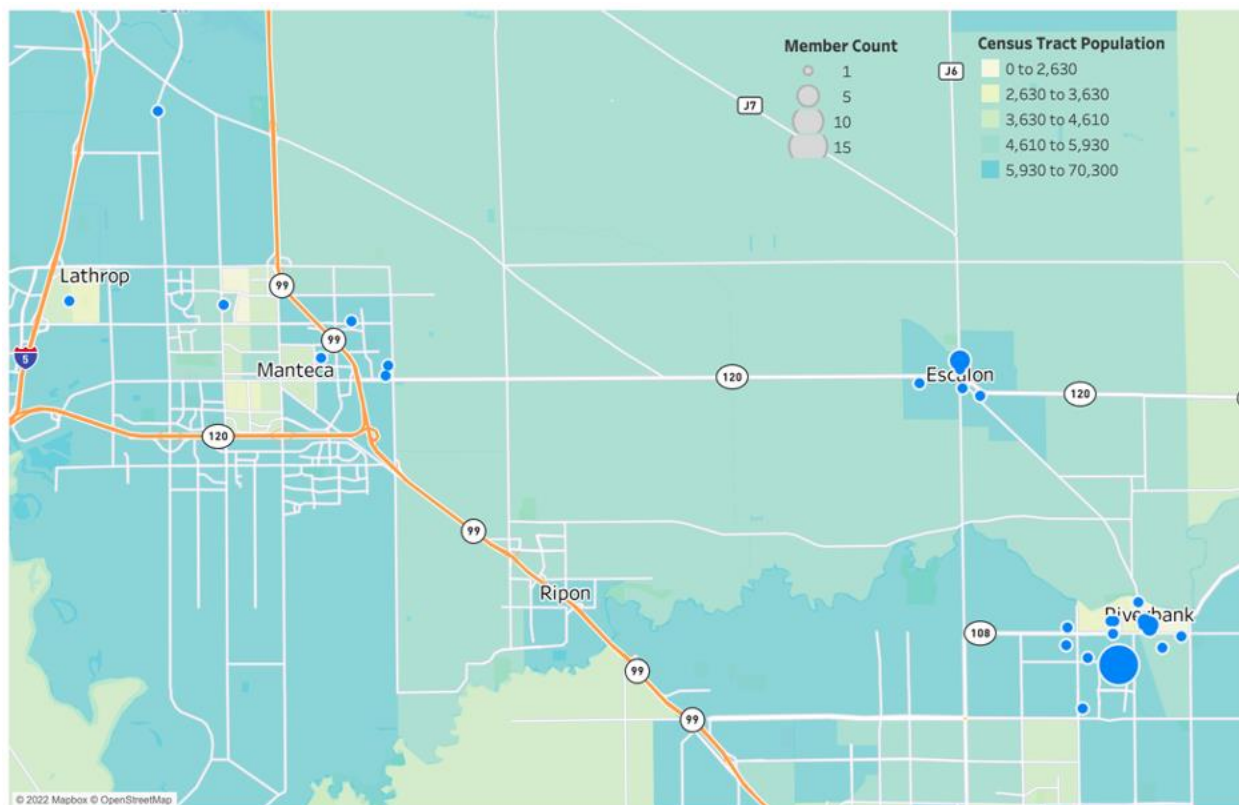
Figure 16. VOGO member home locations

Figure 17 displays a census tract heat map of VOGO trips that originated from a member's home location. The highest concentration of trips originating from home occurred in and near Riverbank, CA. Riders also initiated trips from their homes in and near Escalon, Manteca, and Stockton.

Figure 18 displays a census tract heat map of VOGO trip destinations, not including VOGO trips ending at riders' estimated home locations. The purpose of this figure is to show the non-home destinations that VOGO riders traveled to during the study period. This figure shows that VOGO riders traveled to many locations throughout the region, and the geographic distribution of non-home destinations is much broader than the distribution of rider residences. Riders frequently traveled from their home census tract to another census tract. Many destination census tracts are commercially centralized areas in Stockton or Modesto that do not contain a rider residence.

Figure 17. Heat map of VOGO trip origins by census tract
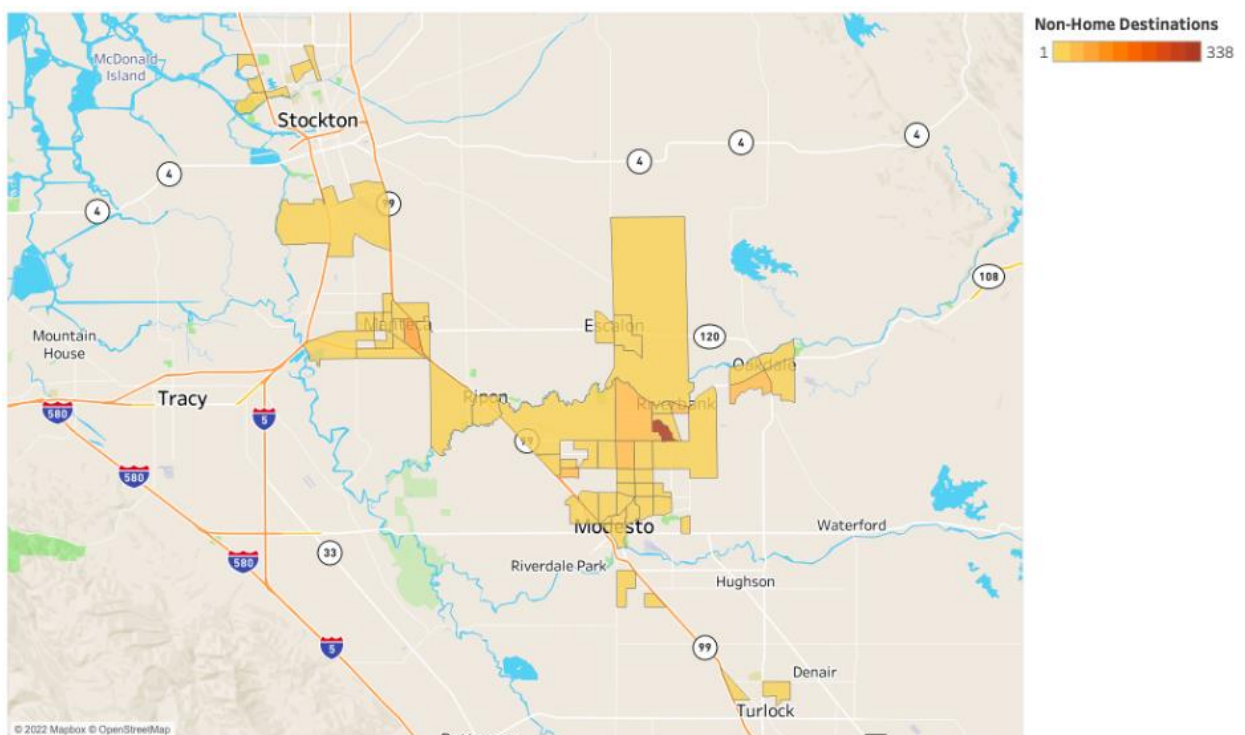
Figure 18. Heat map of VOGO trip destinations by census tract

Figure 19 displays a census tract heat map of VOGO trip destinations to non-home locations, color-coded by the number of unique riders ending a trip in each census tract. This map provides a visualization of activity at the individual rider level to account for differences in frequency of use by different riders. For example, while southern Riverbank had the highest concentrations of overall trips (Figure 18), Figure 19 shows that the census tract destinations with the most users were within Modesto and between Ripon and Riverbank.
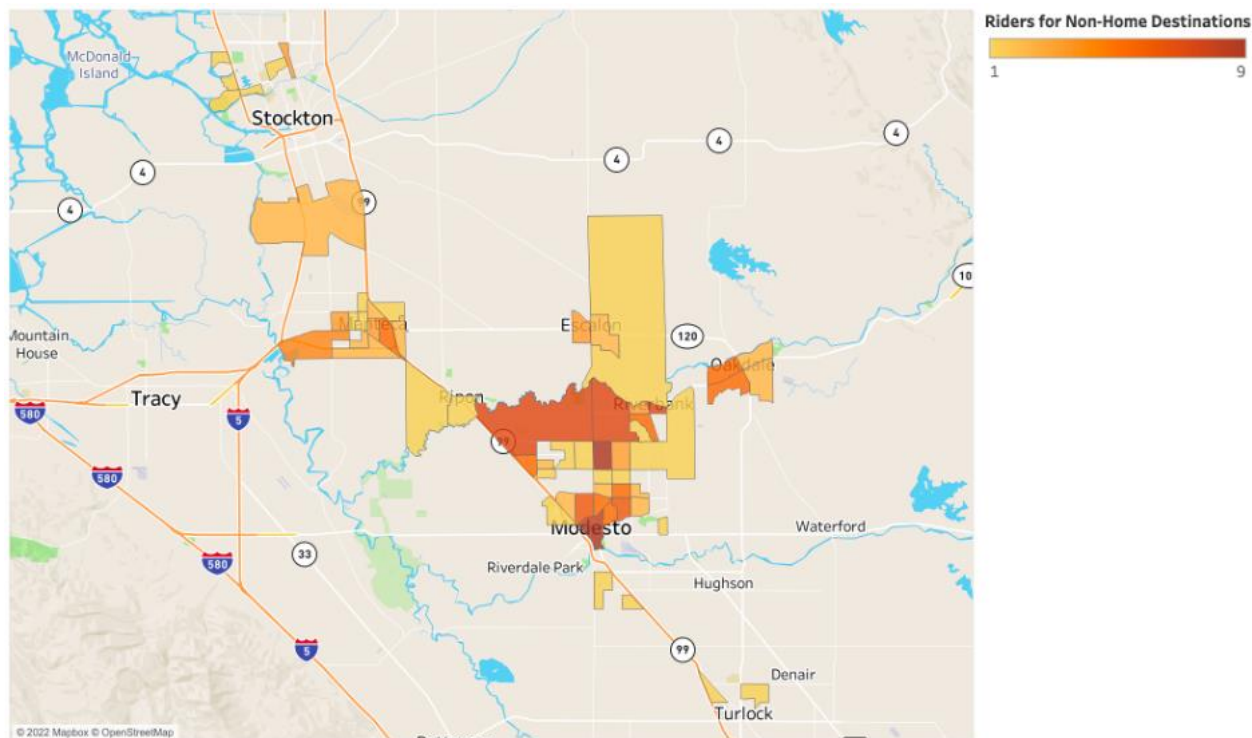
Figure 19. Heat map of VOGO unique riders by census tract for trip destinations

Travel Purposes

Researchers used the trip purposes provided within the VOGO utilization data, along with an analysis of individual trip legs and separation of return-home trips from one-way home trips, to depict the distribution of trip purposes for the study period.

Table 20 displays the trip purposes as percentages of all reservations, riders, and VMT. Work-related trips accounted for the greatest share of both reservations and VMT (38% and 39%, respectively), followed by medical trips (29% of all reservations and 32% of VMT). However, more riders used VOGO for medical trips than any other trip type, followed by grocery shopping and other undefined trip types. While only four percent of riders used VOGO for work-related trips, these riders used the service frequently. The COVID-19 pandemic and resulting business health mandates likely affected the trip purposes associated with VOGO use. The service was limited to offering rides for essential trips during much of 2020. The definition of essential trips

also changed throughout this time, moving from medical trips only; to medical, grocery, and work-related trips.

Table 20. VOGO reservations, riders, and VMT by trip purpose

Trip Purpose	Reservations	Riders[10]	VMT
Work	38.0%	3.8%	39.3%
Medical	29.2%	84.6%	31.9%
Other	19.4%	51.9%	16.0%
Grocery shopping	8.0%	26.9%	6.0%
Nursing home visit	3.9%	1.9%	4.6%
Home	1.5%	11.5%	2.0%
Support group	0.2%	1.9%	0.3%
Dental	0.1%	1.9%	0.1%
N[11]	**1,899**	**52**	**39,715**

VOGO Effects on Mobility

The Before Survey, Monthly Trip Survey, and After Survey each included questions related to the transportation impacts of VOGO and the resulting benefits to members. UC Davis researchers included similar questions in the Before and After Survey to allow comparisons.

The Before Survey asked respondents whether they expected that VOGO would allow them to take more trips than they had previously. All but one Before Survey respondent (35 of 36) indicated that they did expect VOGO to enable them to take more trips. For comparison purposes, the After Survey administered in December 2021 asked respondents whether VOGO had allowed them to take more trips than they could before they joined the service. As shown in Table 21, approximately three-quarters of respondents (76%) confirmed that VOGO had allowed them to take more trips.

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[10] Many riders took more than one type of trip during the study period, so the sum of these percentages exceeds 100%.

[11] A small number of reservations were categorized with more than one trip purpose, and therefore appear within more than one of the categories listed in this table. The sum of reservations and VMT in the table therefore exceeds 100% of the N value displayed.

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Table 21. Expected and realized increases in trips attributable to VOGO

Increases in Trips	Before Survey: Will VOGO allow your household to take more trips? (N = 36)	After Survey: Has VOGO allowed you to take more trips than you could before you joined the service? (N = 25)
No	3%	16%
Unsure	0%	8%
Yes	97%	76%
Grand Total	100%	100%

In both Before and After Surveys, researchers asked respondents who reported that their household would complete more trips because of VOGO what types of additional trips they expected to complete. As shown in, most of these respondents (80% and 79%, respectively) reported that they could take more medical trips because of VOGO. Additionally, many respondents to the After Survey stated that VOGO had allowed them to take more shopping trips (53%). Improving access to medical appointments and care is a primary objective of VOGO. One of its proposed use cases was to provide transportation to individuals who could not operate a personal vehicle due to a medical difficulty. Additionally, medical trips accounted for most or all trips during some portions of the study period due to operational limitations presented by COVID-19 health mandates.

Table 22. Expected increased trips vs. realized increased trips by trip purpose[12]

Trip Types	Before Survey: For these new trips that VOGO will allow you to make, where will you go? (N = 35)	After Survey: For these new trips that VOGO allowed you to make, where have you gone? (N = 19)
Work	6%	1%
Medical	80%	79%
Shopping	29%	53%
Family/Personal	20%	32%
Social/Recreational	31%	21%
Other	9%	1%

The Monthly Trip Survey asked several questions to gain insight into members' counterfactual decisions about travel in the hypothetical absence of VOGO. While UC Davis researchers linked Míocar trip surveys to individual reservations, which allowed for estimation of service impacts on mode choice at the trip level, the VOGO Monthly Trip Surveys focus on VOGO use at the monthly level instead of an individual trip. Therefore, rather than estimating VMT impacts based on counterfactual responses, this section presents respondents' perspectives on travel

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[12] Respondents were able to select multiple responses to these questions. The percentages shown are percentages of responses rather than percentages of respondents. The sum of percentages therefore exceeds 100%.

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decisions in the absence of the service. Nevertheless, these responses provide a general sense of counterfactual travel options.

The Monthly Trip Survey asked respondents to consider all of their trips with VOGO during the past month. In addition, researchers asked respondents whether they still would have made these trips if VOGO were not unavailable during that month. Results for this survey are presented in the aggregate and include all responses from each member for each month. Monthly Trip Survey may be most reflective of the most active users who responded to survey requests.

As shown in Figure 20, respondents most commonly reported that they would not have made any of these trips in the absence of the VOGO service (58% of responses and 62% of members throughout the study period). Members who completed the Monthly Trip Survey more than once did not necessarily select the same answer to this question each month. Eight of 21 unique members who responded to the Monthly Trip Survey (38%) reported that they still would have made all of their trips during at least one month within the study period.
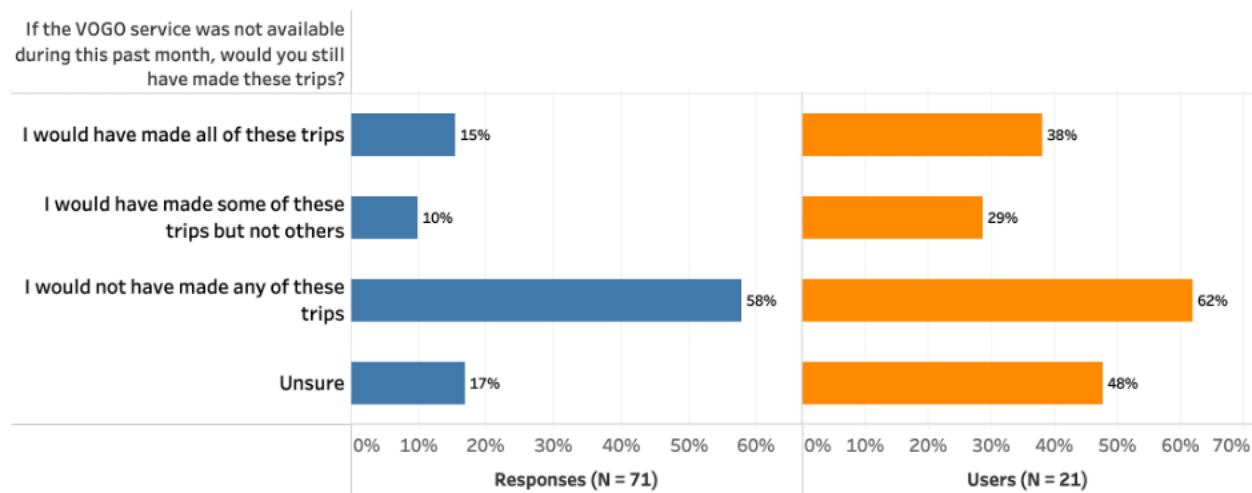
Figure 20. Counterfactual travel decisions in the absence of VOGO (monthly trip survey)[13]

UC Davis researchers asked respondents who indicated that they would have made some or all of their trips without VOGO what mode of transportation they would have used to make these trips. As shown in Figure 26, members predominantly reported that they would have ridden in a friend or family member's car to make these trips if VOGO were not available. However, one respondent indicated that they would have driven their car to make trips without VOGO.

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[13] The percentages shown for Users are based on unique VOGO users, and users were able to complete the Monthly Trip Survey during each month that they used VOGO between April 2021 and November 2021. Users may have selected different responses to this question during different months. The sum of percentages for Users therefore exceeds 100%.

If the VOGO service was not available during this past month, are there any other forms of transportation that you would have used for the trips that you needed to make?
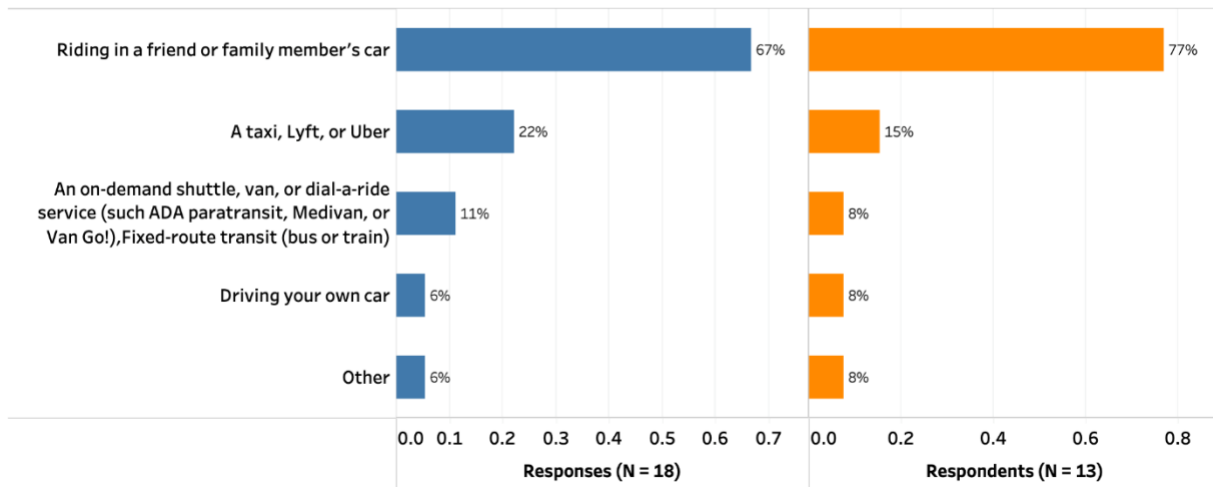
Figure 21. Counterfactual travel modes in the absence of VOGO (monthly trip survey)

To further assess VOGO effects on members' transportation experience, the Monthly Trip Survey included a series of statements and asked respondents to indicate their level of agreement with each statement. These statements related to whether VOGO had allowed members to travel to more destinations, whether it had saved them money on transportation costs, and whether it had made it easier for them to travel. Table 23 presents the statements and percentage of respondents selecting each response. Again, members who completed the Monthly Trip Survey more than once did not necessarily choose the same response each month. However, nearly all respondents selected the answer of "Strongly Agree" for each statement at least once during the study period. No respondents selected the response of "Strongly Disagree" for any of these statements during the study period.

Table 23. Transportation benefits provided by VOGO (monthly trip survey)

This past month, VOGO…		1 (Strongly Disagree)	2	3	4	5 (Strongly Agree)
Allowed me to travel to more destinations	Users (N = 21)	-	10%	14%	14%	90%
Allowed me to save money on transportation costs	Users (N = 21)	-	5%	5%	5%	95%
Made it easier for me to travel	Users (N = 21)	-	5%	10%	14%	100%

As a final assessment of VOGO effects on mobility, the After Survey included two questions to determine whether members had experienced a change in overall mobility during the study period. The first question asked respondents how often they could travel to where they needed to go before joining VOGO, and the second question asked respondents how often they could travel to where they needed to go since joining VOGO. As shown in Table 24, 42% of respondents reported that they could always travel to where they needed to go before joining

VOGO. In comparison, 63% of respondents said they can always travel to where they need to go since joining VOGO. Overall, 11 respondents (46%) reported that they can now travel to where they need to go more often since joining VOGO than before joining VOGO.[14]

Table 24. Overall mobility before joining VOGO vs. since joining VOGO (after survey)

Response	How often were you able to travel to where you needed to go before joining VOGO? (N = 24)	How often are you able to travel to where you need to go since joining VOGO? (N = 24)
Never	8%	0%
Rarely	4%	4%
Sometimes	25%	0%
Usually	21%	33%
Always	42%	63%
Grand Total	**100%**	**100%**

VOGO Effects on Mobility: Discussion

While one objective of shared transit services such as VOGO is to reduce personal vehicle use, the current VOGO user base has relatively limited practical access to personal vehicles and may instead view the service as a method of improving their mobility to destinations that they would have difficulty traveling to on their own. Most users agreed that VOGO had improved their transportation experience in several ways during the study period, and nearly half of surveyed users reported that they are now better able to travel to where they need to go since joining VOGO. Overall, the survey results suggest that VOGO improves members' access to more destinations, saves them money, and makes it easier to travel.

Conclusion

The pilot evaluation of VOGO presented challenges due to the onset of the COVID-19 pandemic and its effects on both individuals' transportation behaviors and transit operations. VOGO was limited in its ability to recruit riders and drivers during much of 2020 and 2021 due to ongoing effects of COVID-19. These included county and state health mandates halting or limiting business operations, removal of the ride-sharing option for groups of VOGO riders, and overall health and safety concerns from riders and drivers. Researchers do not view the data collected during this evaluation as representative of typical volunteer ridesharing transit operations but find that the utilization data and survey results help to demonstrate the functionality of the service and its role in filling transportation gaps for its target populations.

Throughout the study period, VOGO provided 1,899 trips (referred to as "reservations") to a total of 52 members (referred to as "riders"), averaging 76 reservations and ten unique riders

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[14] One respondent reported that they are able to travel to where they need to go less often since joining VOGO as compared to joining VOGO, and the remaining respondents reported that their ability to travel to where they need to go has not changed since joining VOGO.

per month. VOGO maintained a fleet of between five and eight volunteer drivers throughout most of 2020 and 2021, and the number of reservations increased between the first and second halves of the study period. The average distance during the study period was 21 miles, with a median of 19 miles. Riders made an average of four reservations per month, though there were a few very active riders who used VOGO several times per week.

Survey results show that VOGO riders tend to be 50 years of age or older (25/25 respondents), live in households alone or with one other individual (19/23 respondents), and have household incomes of less than $25,000 per year (18/20 respondents).

VOGO riders used the service for many purposes, including traveling to medical appointments, work-related trips, and grocery shopping trips. The distribution of trip purposes was likely affected by health mandates which limited VOGO to providing essential trips (medical, grocery, and/or work-related trips) for several periods during the study. More riders used VOGO for medical appointments than any other purpose (85% of riders), and medical trips accounted for 29% of all reservations during the study period. Riders who used VOGO for work-related trips used the service frequently; work-related trips accounted for 38% of all VOGO trips, all of which were completed by two riders.

The evaluation results suggest that VOGO is improving the mobility of its rider base by removing barriers to travel. In response to the Before Survey, nearly all rider respondents (35/36) expected that VOGO would allow them to take more trips than they could without the service. After Survey confirmed these results: most riders (19/25) reported that VOGO had allowed them to take more trips than they could before joining the service. Additionally, most respondents to the Monthly Trip Survey reported that if VOGO had not been available, they would not have made any of the trips made with VOGO (58% of all Monthly Trip Survey responses). In both the Before Survey and After Survey, respondents predominantly reported that VOGO would help or had helped them make medical-related trips. Twenty-eight of 35 Before Survey respondents and 15 of 19 After Survey respondents who indicated that VOGO helped them make more trips also revealed that those trips were for medical purposes.

For trips that riders would still have been able to make in the absence of the service (less than 25% of trips according to the Monthly Trip Survey results), riders most commonly reported that they would primarily rely on rides from friends or family members. Twelve of the 18 Monthly Trip Survey respondents who would have taken some or all of their trips without VOGO also cited rides from friends or family as their counterfactual mode. Based on survey results, most VOGO riders do not have access to a personal vehicle (20/25 respondents), and few riders are completely comfortable driving their vehicles, even if they have one. Between the Before and After Survey, only one rider reported that they both had a personal vehicle and were completely comfortable driving it. Based on these results, VOGO provides a reliable transportation alternative to access essential destinations that riders may have difficulty accessing by other modes.

In addition to providing increased access to destinations, the survey results suggest that VOGO is helping its riders save money on transportation costs and is making it easier for them to

travel to where they need to go. Overall, nearly all After Survey respondents (23/24) reported that they are now "Usually" or "Always" able to travel to where they need to go since joining VOGO, as compared to 63% of respondents (15/24) for the period before they joined VOGO.

Future Research

At the time of this report, VOGO is seeking funding to continue the operation of the service beyond the current study period. Due to the study limitations introduced by COVID-19 restrictions and associated service interruptions, data collected for a fully operational pilot program may provide more representative findings regarding the role of volunteer ridesharing in filling the transportation gaps of transit and personal vehicles in the San Joaquin Valley. Additionally, given the utilization and survey data highlighting the importance of VOGO in providing rides to medical destinations and other essential locations, further study of VOGO in comparison to the cost, availability, and structure of available medical and demand responsive transportation services may be valuable in understanding how this type of service may be deployed in other areas that have similar available mode choices and geographic characteristics.

Vamos – Mobility as a Service

Introduction

Vamos is a Mobility-as-a-Service (MaaS) platform that provides trip planning and payment capabilities for fixed transit lines and demand-responsive transit services, such as VOGO. Users can search for routes using Vamos and have the option of purchasing transit tickets for a selected way within the MaaS application or purchasing their tickets for a specific transit line without conducting a route search.

As a MaaS application, Vamos seeks to provide users with efficient access to comprehensive local transit information and encourage the use of transit by offering a single purchase point for transit fares. The evaluation of the Vamos pilot observes the program over 23 months from January 2020 through November 2021 to assess trends in application usage and collect data regarding how Vamos may have affected user travel. In addition, the evaluation emphasizes the distinction between Vamos as a route planning tool and as a transit fare payment tool. Finally, it analyses user engagement and perspectives on each of these features.

Vamos Pilot Description

Vamos first launched for testing in early 2019 and was fully operational in January 2020. Initially, Vamos included trip planning for transit and bike travel. Transit travel consists of the services of all transit agencies, including general use microtransit (Van Go!) and on-demand shuttles, in San Joaquin and Stanislaus counties. Vamos provides real-time arrival information for transit when it is available from a transit agency. In addition, it is possible to reserve a VOGO trip by Vamos if a trip begins or ends in a VOGO service area and transit is not reasonably available. If a user selected a travel result that included Van Go! and an on-demand shuttle, the app would present a link or a phone number to reserve a ride on the service. In 2021, project partners expanded Vamos services to include mobile transit ticketing for San Joaquin County transit agencies. Project partners will implement these services for Stanislaus transit agencies in the Spring of 2022.

Methods of Data Collection and Analysis

This section describes three types of data used in the evaluation, including Member Data, Utilization Data, and Survey Data. Data descriptions include methods of collection and content.

Member Data

Members provide data to the service operator(s) as part of the application or enrollment process. Vamos collected member data continually as each member signed up to use the Vamos Mobility App. DemandTrans, a transportation analytics provider, administers the Vamos data and coordinates with UC Davis to provide updated member lists to contact members for surveys and analyze participation levels. Member data collected to support the research evaluation primarily consisted of member contact information. Rather than receiving a list of member email addresses or other personal contact information, DemandTrans provided UC

Davis with access to Intercom, a customer engagement software platform. This access allowed UC Davis to send survey invitations to the population of active members based on specified criteria, such as members who had used the service within the last 90 days.

Other information collected from members to engage in the service, such as payment information, was not requested by UC Davis for this evaluation.

Utilization Data (Application/Platform Data)

The Vamos Mobility App includes data on individuals' use of the mobility-as-a-service platform. Project partners DemandTrans, Trillium, and Masabi LLC implement and manage the Vamos Mobility App technology, including collecting and retaining data related to Vamos trip planning, mobile ticketing, and integrated carshare/bikeshare booking. Partners collected Utilization data continually as members accessed the application, searched for routes, and purchased transit tickets. In addition, DemandTrans provided an export of utilization data to UC Davis monthly. The dataset provided to UC Davis for research purposes included the following metrics:

- Member ID: A unique identifier for each user;
- Date and time of the route search request;
- Routing ID (unique ID for the searched route);
- Order in which results were presented to the member;
- Mode(s) involved in the results presented to the member;
- Departure time for the results presented to the member;
- Minimum and maximum travel time for results presented to the member;
- Census blocks for the start and end of results presented to the member;
- Which result was the final result viewed by the member in the search session;
- The source of data for results presented to the member;
- (For purchased transit trips) Start and end location of trip (e.g,. name of stop);
- (For purchased transit trips) Start and end time of trip;
- (For purchased transit trips) Name of transit service/line; and
- (For purchased transit trips) Price paid for trip.

Survey Data

Researchers collected self-report data by surveying users before, during, and after participating in the service. UC Davis administered initial member surveys (i.e., a "Member Survey") to enrolled users of the Vamos Mobility App. UC Davis recruited members recruited using contact information that they had already provided as part of signing up for the application (see "Member Data" above). Researchers administered the Member Survey after they joined the service. This survey captured data for the "before" period of the evaluation but also included questions related to users' experiences with Vamos and associated outcomes (e.g., the "after" period) for users who were already active and had made purchases or conducted route

searches within the application. Topics addressed and information collected by the Member Survey included:

- Member ID (embedded in the response data through Intercom);
- Composition of member's household (i.e., population, number of adults, relationship to other household members);
- Information about member's personal vehicle(s) (i.e., number of vehicles available to their household and vehicle years/makes/models and estimated annual miles driven);
- How long the member had used Vamos (i.e., not at all, less than a month, more than a month);
- Initial effects of Vamos on member's use of transit;
- Awareness and importance of Vamos mobile ticketing and bikeshare/carshare booking features;
- Primary trip planner used by member and satisfaction with how it compares to Vamos;
- How the member first heard about the service;
- Age;
- Level of education;
- Ethnicity;
- Household income; and
- Zip code, street of residence, and cross streets near the residence.

Initially, the UC Davis team developed and administered a Weekly Usage Survey to collect details about the types of trips taken with the help of Vamos, how members' travel would be affected in the absence of Vamos (i.e., the counterfactual scenario), and other feedback on the service. However, this weekly survey received low response rates. UC Davis determined that the frequency of member outreach needed to support a weekly survey would likely be perceived as overly burdensome by the member population. In response, UC Davis discontinued the Weekly Usage Survey in September 2021 after obtaining 16 responses. Following this, UC Davis developed a survey to be administered every three months (i.e., a "Quarterly Usage Survey") to replace the Weekly Usage Survey. Researchers developed the Quarterly Usage Survey close to the end of the current grant period. UC Davis plans to administer this survey as part of another evaluation grant. Due to these challenges, this report presents the results of the Member Survey, which includes some findings related to the outcomes of Vamos (e.g., the "after period") as reported by Member Survey respondents who had sufficiently interacted with the application at the time that they completed that survey.

UC Davis sent survey invitations through Intercom, which were delivered to members by email or through in-app push notifications and provided a link to the online Qualtrics survey instruments. In addition to the initial invitation, members received up to four reminder messages to complete the Member Survey. In addition, UC Davis researchers offered surveys in both English and Spanish. Researchers provided a $20 gift card for completing the Before Survey and a $5 gift card for completing the Weekly Usage Survey.

![NCST logo]

All survey respondents used Vamos, and therefore had route search or ticket purchase data associated with the application. In addition, researchers linked utilization Data and Survey Data by the unique and anonymous Member IDs, which allowed for analysis that integrated all data sets at the individual participant level.

Survey Data, Member Data, and Utilization Data were linked and incorporated into the research evaluation by UC Davis researchers to assess the overall performance of Vamos and develop key findings for the study period.

Member Survey

Table 25 shows the number of respondents to the Vamos Member Survey by user type. Vamos allows users to search for travel routes and purchase transit tickets within the application. Users may choose to conduct route searches without purchasing transit tickets ("Search Only" users), to buy transit tickets without conducting route searches ("Purchase Only" users), and to both conduct route searches and purchase transit tickets ("Search and Purchase" users).

In total, there were 91 respondents to this survey. Approximately 65% (59) of the respondents used the Vamos service at least once, either for route searches or ticket purchasing. The Non-user category consists of respondents who downloaded Vamos and completed the survey but did not use the application. In addition, this category includes six respondents whose user IDs were missing from the survey data due to a database error and are assumed to be Non-users.

The distribution of user types within the Member Survey sample is similar to the full user population, with user survey respondents most commonly being Search Only users (34% of the sample), followed by Search and Purchase users (24% of the sample) and Purchase Only users (about 7% of the sample).

Table 25. Member survey respondents by user type

User Type	Count
Purchase Only	6
Search and Purchase	22
Search Only	31
Non-user	32

As shown in Figure 22, users who filled out the Member Survey were somewhat more active within Vamos on average, with approximately 58% of Member Survey respondents having used Vamos for more than one day.

Figure 22. Percentage of member survey respondents vs. non-respondents by total days using Vamos

Before analyzing survey results, researchers removed non-user survey respondents and user respondents outside the general Vamos service region of the San Joaquin Valley as part of the data cleaning process. Figure 23 below displays the residence zip code distribution for respondents to the Member Survey. All eight respondents located outside of California are non-users. Four of the five users within California located far outside the San Joaquin County and Stanislaus County areas are non-users. The remaining user, who lived near Los Angeles, used Vamos for three route searches total. As this user is outside the Vamos service region and has relatively minimal application use, researchers excluded their survey responses. As a result, the total number of Member Survey respondents in the final sample is 78. Figure 24 displays the zip code distribution of these 78 respondents.[15]

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[15] Two active user respondents did not provide an accurate zip code and are not included in the map.
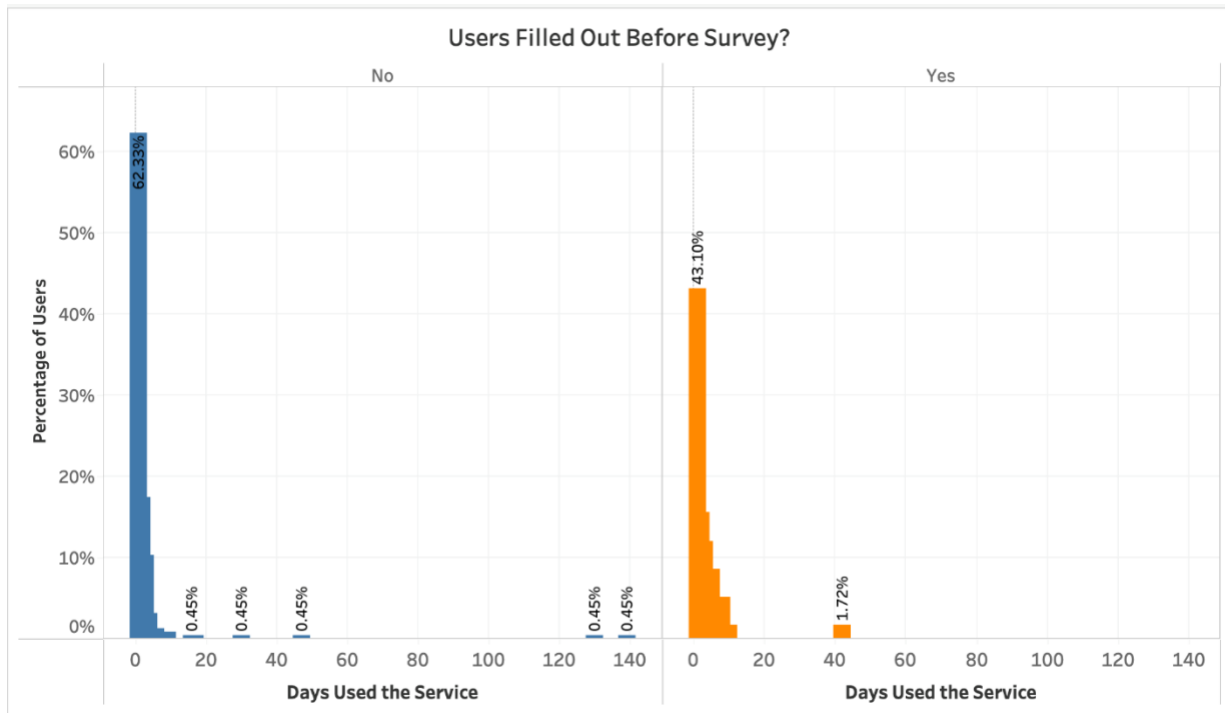
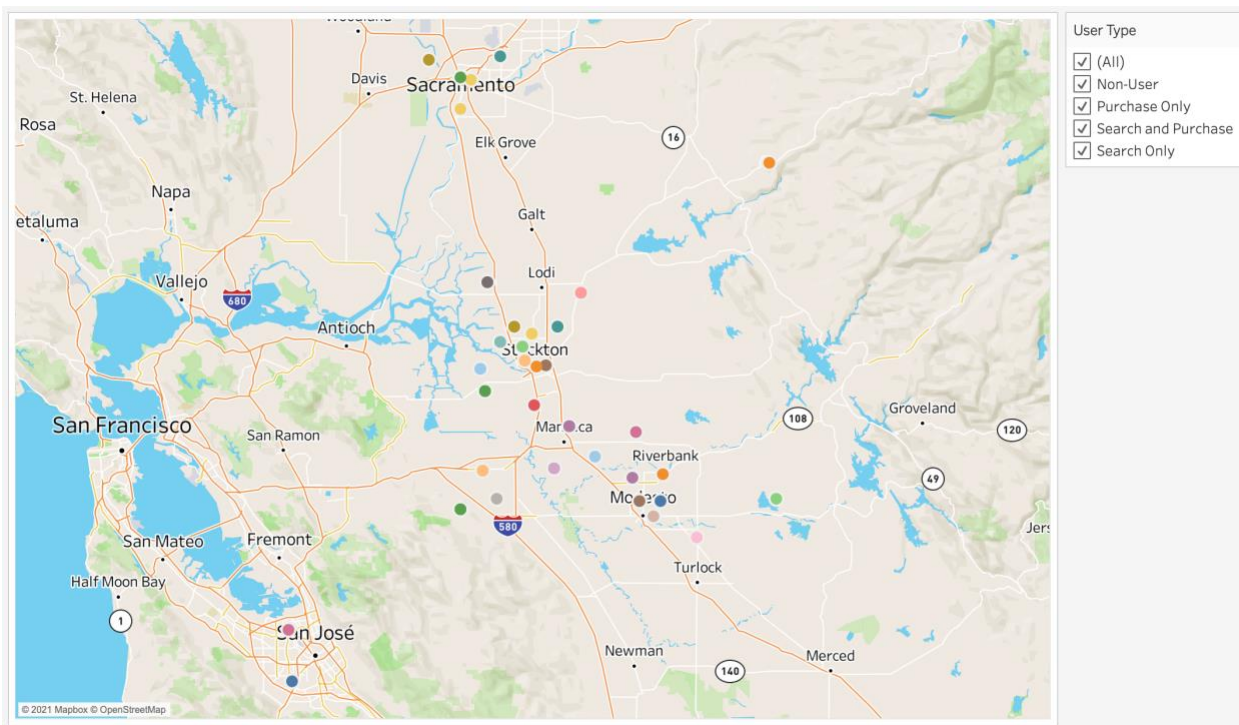**Figure 23. Zip code distribution of all member survey respondents**

Figure 24. Zip code distribution of valid member survey respondents for analysis

Results

This section presents the Vamos pilot study's evaluation results from January 2020 through November 2021. The results include a summary of member-specific attributes within the context of the larger regional population, an analysis of application usage over the course of the study period with particular consideration of usage for each major Vamos feature (route searches and mobile ticketing), and a summary of survey results related to the effects of Vamos on user travel experiences.

Member Attributes

The Member Survey included a series of questions to capture user socioeconomic metrics, household characteristics, and other demographics. To compare the Vamos user population to the broader population of residents in the region, the tables below present data from the Member Survey alongside a weighted average of census data for the Vamos service regions of Stanislaus County and San Joaquin County. Descriptions of the table columns are as follows:

- All Respondents: Data representing responses from all Member Survey respondents
- County Resident Respondents: Data representing responses from Member Survey respondents who live in Stanislaus or San Joaquin counties
- Regional Data: Weighted averages for the populations of Stanislaus County and San Joaquin County based on census data

As shown in Table 26, most Vamos Member Survey respondents are between the ages of 25 and 44 years old (61% of all respondents and 61% of county resident respondents). Less than 10% of survey respondents reported an age of 60 years or older. According to census data, approximately 19% of residents in Stanislaus and San Joaquin counties are 60 years old or older.

Vamos respondent household income levels are slightly lower than the weighted county average, with approximately 10% of county resident respondents having a household income of less than $10,000 as compared to about 5% of households in the region.

Regarding education, respondents most commonly reported either having a high school education or some college, though nearly one-half of the respondents indicated that they had an associate degree or higher, as compared to 27% of individuals in the weighted county average.

The distribution of Hispanic, Latino, or Spanish origins is fairly similar between the Member Survey respondent population and the weighted county average.

The reported household size (number of people living in the home) is relatively similar between Member Survey respondents and the weighted county averages. Individuals in each group most commonly have a household size of one or two individuals.

Table 26. Vamos member demographic attributes

Demographic Attribute	All Respondents	County Resident Respondents	Regional Data (San Joaquin County, Stanislaus County)
Hispanic or Latino Origin	**N = 62**	**N = 55**	**N = 1312808**
Hispanic, Latino, or Spanish origin	37.1%	40.0%	44.3%
Not Hispanic, Latino, or Spanish origin	62.9%	60.0%	55.7%
Total	100.0%	100.0%	100.0%
Age	**N = 76**	**N = 67**	**N = 404939**
Under 20	0.0%	0.0%	29.7%
20-24	13.2%	13.4%	6.7%
25-34	23.7%	22.4%	14.1%
35-44	36.8%	38.8%	13.1%
45-54	11.8%	11.9%	11.8%
55-59	5.3%	4.5%	5.9%
60-64	2.6%	3.0%	5.4%
65-74	5.3%	6.0%	7.7%
75-84	0.0%	0.0%	3.9%
Over 85	1.3%	0.0%	1.5%
Total	100.0%	100.0%	100.0%
Household Size	**N = 68**	**N = 60**	**N = 404939**
1-person	27.9%	26.7%	20.1%
2-person	29.4%	28.3%	29.4%
3-person	13.2%	13.3%	15.9%
4-person	13.2%	13.3%	15.7%
5-person	10.3%	11.7%	10.6%
6-or-more-person	5.9%	6.7%	8.3%
Total	100.0%	100.0%	100.0%
Household Income	**N = 71**	**N = 63**	**N = 404939**
Under $10,000	8.5%	9.5%	4.6%
$10,000 to $24,999	18.3%	17.5%	11.4%
$25,000 to $49,999	23.9%	25.4%	20.8%
$50,000 to $99,999	26.8%	28.6%	31.8%
$100,000 to $199,999	18.3%	14.3%	24.7%
More than $200,000	4.2%	4.8%	6.7%
Total	100.0%	100.0%	100.0%
Income Category		**N = 56**	
Extremely Low		16.1%	
Very Low Income		8.9%	
Low Income		26.8%	
Median Income		12.5%	
Moderate Income		1.8%	
High Income		33.9%	
Total		100.0%	

Demographic Attribute	All Respondents	County Resident Respondents	Regional Data (San Joaquin County, Stanislaus County)
Education Level	**N = 78**	**N = 68**	**N = 1312808**
Less than high school	3.8%	2.9%	20.1%
High school graduate (including GED)	21.8%	23.5%	29.7%
Some college but no degree (including trade or vocational)	25.6%	25.0%	23.4%
Associate degree in college (2-year)	11.5%	13.2%	7.9%
Bachelor's degree in college (4-year)	26.9%	26.5%	13.4%
Master's degree	9.0%	8.8%	3.7%
Above master's degree	1.3%	0.0%	1.8%
Total	100.0%	100.0%	100.0%

The Member Survey asked respondents to state how many personal vehicles they have available to their household, defined as a vehicle that they own, lease, or regularly borrow. Table 27 shows a substantial difference between vehicle availability for Member Survey respondents as compared to county census data, with 21% of county resident respondents reporting that they have zero vehicles available to their household, in contrast to about 5% of households in San Joaquin and Stanislaus counties.

Table 27. Vamos member vehicle availability

Demographic Attribute	All Respondents	County Resident Respondents	Regional Data (San Joaquin County, Stanislaus County)
Available Vehicles	**N = 76**	**N = 66**	**Households (N = 404939)**
No vehicle available	19.7%	21.2%	5.2%
1 vehicle available	28.9%	27.3%	26.5%
2 vehicles available	27.6%	28.8%	36.4%
3 vehicles available	15.8%	15.2%	20.1%
4 or more vehicles available	7.9%	7.6%	11.7%
Total	100.0%	100.0%	100.0%
Household Size by Vehicles	**N = 67**	**N = 59**	**Households (N = 404939)**
1-person household:	28.4%	27.1%	20.1%
No vehicle available	10.4%	11.9%	2.9%
1 vehicle available	11.9%	10.2%	12.6%
2 vehicles available	6.0%	5.1%	3.7%
3 vehicles available	0.0%	0.0%	0.5%
4 or more vehicles available	0.0%	0.0%	0.4%
2-person household:	29.9%	28.8%	29.4%
No vehicle available	3.0%	3.4%	1.3%
1 vehicle available	11.9%	10.2%	7.1%
2 vehicles available	9.0%	10.2%	14.7%
3 vehicles available	4.5%	3.4%	4.7%
4 or more vehicles available	1.5%	1.7%	1.7%
3-person household:	13.4%	13.6%	15.9%
No vehicle available	4.5%	5.1%	0.5%
1 vehicle available	4.5%	5.1%	2.9%
2 vehicles available	1.5%	1.7%	6.2%
3 vehicles available	3.0%	1.7%	4.4%
4 or more vehicles available	0.0%	0.0%	1.9%
4-or-more-person household:	28.4%	30.5%	34.6%
No vehicle available	0.0%	0.0%	0.6%
1 vehicle available	3.0%	3.4%	3.9%
2 vehicles available	11.9%	11.9%	11.8%
3 vehicles available	7.5%	8.5%	10.6%
4 or more vehicles available	6.0%	6.8%	7.8%
Total	100.0%	100.0%	100.0%

Member Attributes: Discussion

Vamos users reported a lower level of personal vehicle access than the weighted regional population data, and this attribute represents the most substantial difference between the

Vamos respondents and the surrounding population among all metrics assessed. While one objective of Vamos is to reduce reliance on personal vehicles, it also seeks to improve transportation accessibility for people who do not have alternatives to transit, biking, or walking. Individuals without access to personal vehicles or fewer personal vehicles than the number of drivers in their households may be more likely to seek out and use transportation planning applications and transit services.

Member Use

Figure 25 displays the cumulative number of users who made transit ticket purchases and route searches, ("Search and Purchase"), purchased tickets but did not conduct route searches ("Purchase Only"), and conducted route searches but did not purchase tickets ("Search Only") over time for the study period of January 2020 through November 2021. By the end of November 2021, 281 unique users had used the Vamos application for a route search and/or ticket purchase. Seventy percent of the users (196 out of 281) used the route search function only, eight percent of the users (23 out of 281) used the purchase function only, and the remaining twenty-two percent of users (62 out of 281) used both the route search and purchase functions.

Although the Vamos trip planning function provides search results for routes associated with various modes, including bus and rail transit, walking, bicycling, and on-demand ridesharing, many searches are not associated with a possible transit ticket purchase. However, these data suggest that Vamos is primarily used as a trip planning tool by most users, with approximately 30% of users (85 out of 281) making a ticket purchase at least once.
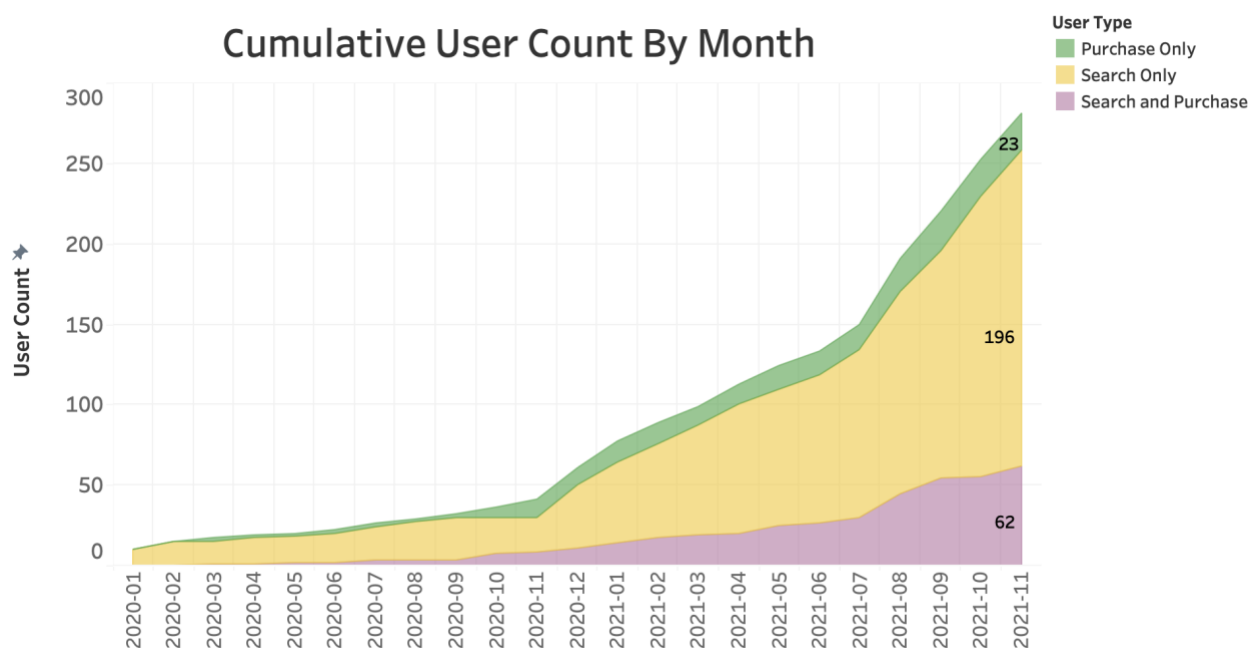

Figure 25. Cumulative unique Vamos users by user type and month

Figure 26 below displays the distribution of users' total number of days using Vamos for route searches or ticket purchases. A majority of all users (58%) used Vamos for one day and did not continue using the application after their first day of use. Less than three percent of users used Vamos for more than a total of ten days during the study period.
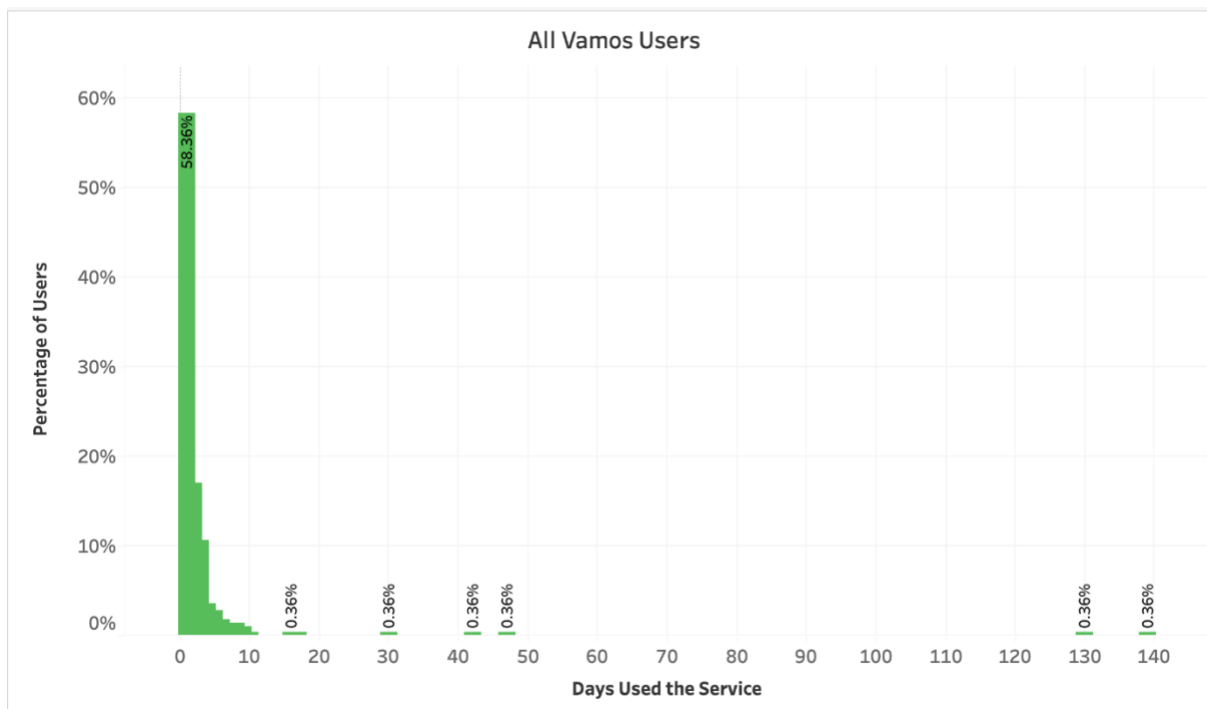

Figure 26. Percentage of users by total days using Vamos

Table 28 provides summary statistics of Vamos member count, route search activity, purchase activity, and revenue for the study period of January 2020 through November 2021. On average, Vamos users made 23 monthly ticket purchases and approximately 102 monthly route searches. There were roughly twice as many monthly users conducting route searches (15 on average) as users conducting ticket purchases (7 on average) within the study period.

Table 28. Monthly Vamos usage summary statistics

Variable	Mean	Std Dev	Min	Pctl 25	Median	Pctl 75	Max
Monthly Route Search Users	14.7	14.6	0.0	3.5	13.0	19.5	47.0
Monthly Route searches	101.5	119.0	0.0	20.5	65.0	127.5	430.0
Monthly Purchase Users	7.0	7.3	0.0	0.0	8.0	10.0	29.0
Monthly Purchases	23.0	24.4	0.0	0.0	18.0	42.0	78.0
Monthly Revenue	93.2	116.3	0.0	0.0	30.9	169.1	387.5

Route Search Activity

Figure 27 displays monthly counts of unique users who conducted one or more route searches and total route searches per month during the study period. The number of users conducting route searches peaked at the end of the study period in November 2021 was 47, while the number of route searches peaked several months earlier in August of 2021 at 430 searches. Both the number of members conducting route searches and the total number of route searches fluctuated significantly throughout the pilot period, which may be partially attributable to the COVID-19 pandemic and its effects on transportation behavior and other external factors. Additionally, Vamos coordinated with transit agencies in August 2021 to provide free transit fare credits to Vamos users, which corresponds to a substantial increase in route searches during that month. Based on the activity for August 2021 and later, these promotional efforts may have had a somewhat lasting effect on awareness and use of the application towards the end of the study period.
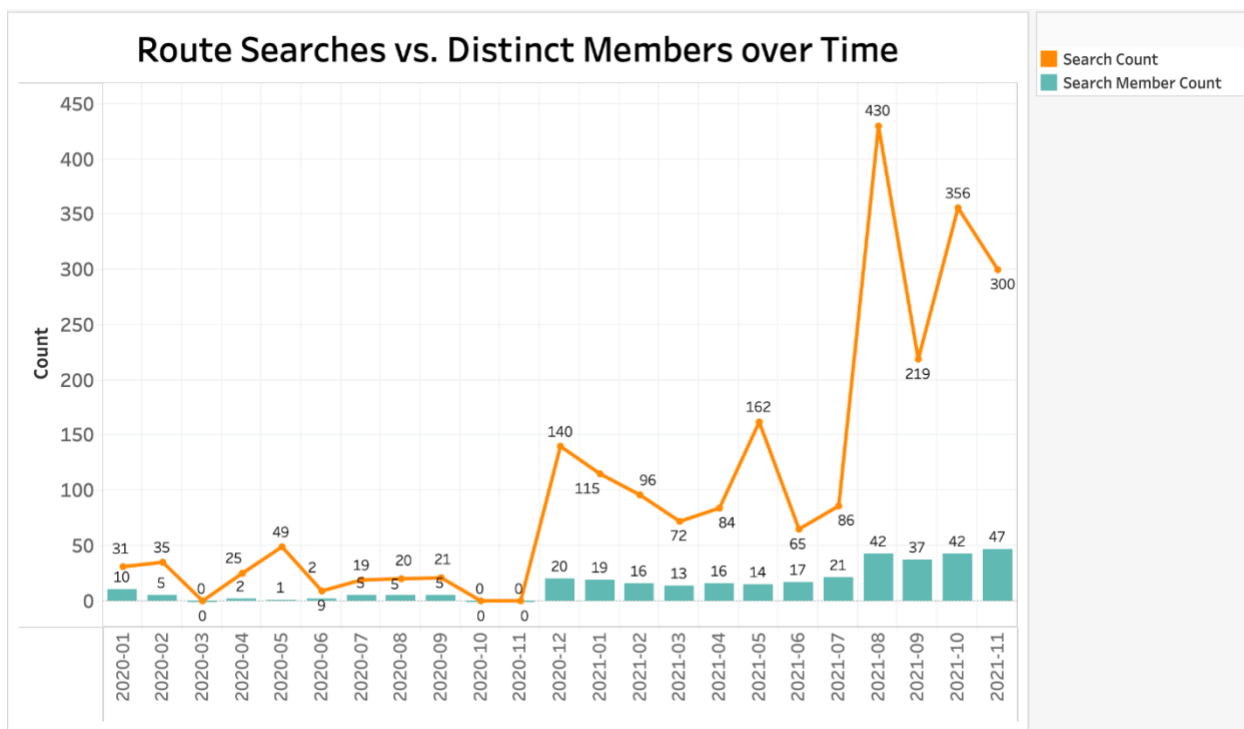

Figure 27. Unique route search users and total route searches by month

Figure 28 and Figure 29 display maps of Vamos route search activity by census tract, based on each search's origin and destination location. As shown in Figure 28, origin locations for route searches were most concentrated within and near Stockton, Tracy, CA (west of Manteca), and Riverbank, CA. The census tract with the most route origins was within Stockton, with 188 total searches. In terms of destinations, users commonly searched for route destinations within Stockton and around Tracy, CA.
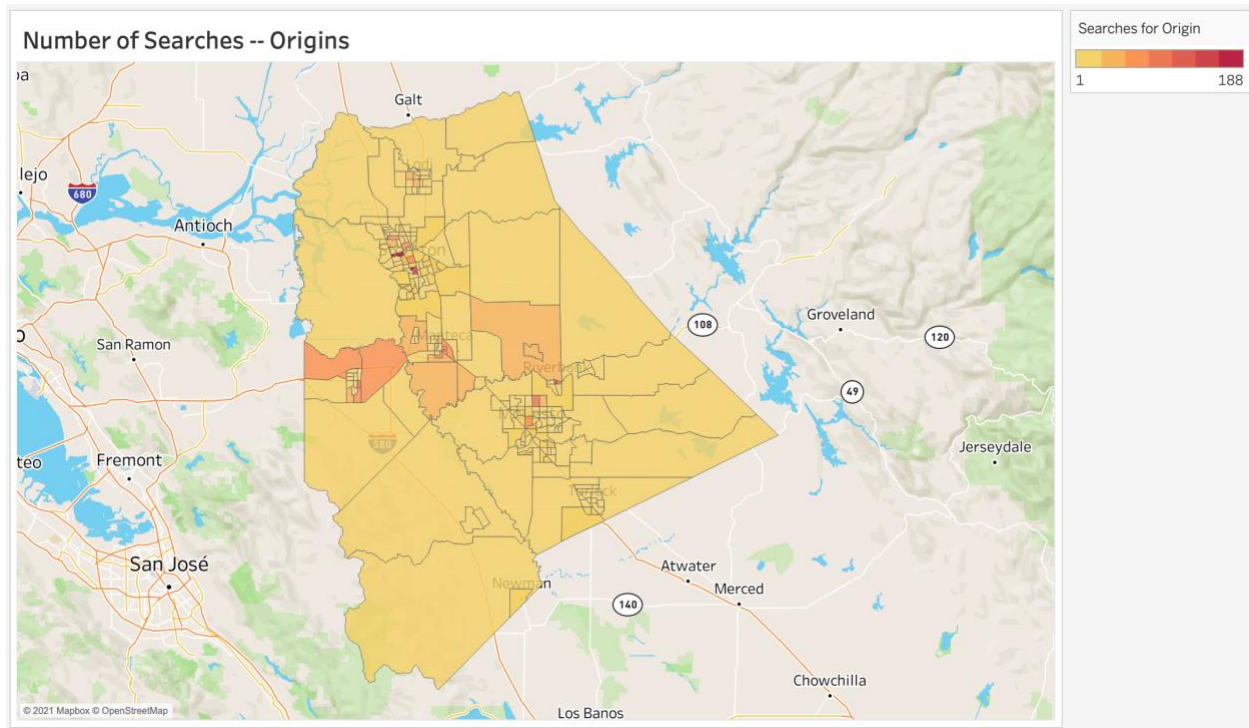
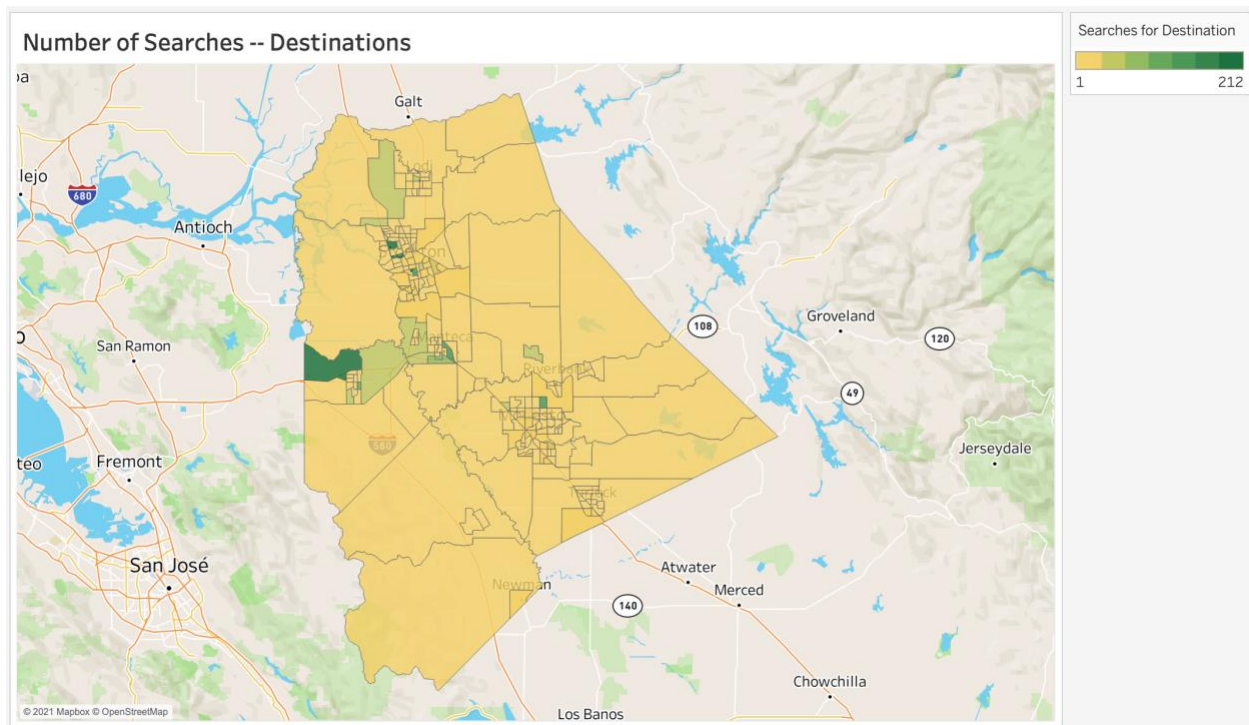**Figure 28. Heat map of total route search origins by census tract**

Figure 29. Heat map of total route search destinations by census tract

Similarly, Figure 30 and Figure 31 show the number of unique users who made route searches beginning and ending in each census tract.
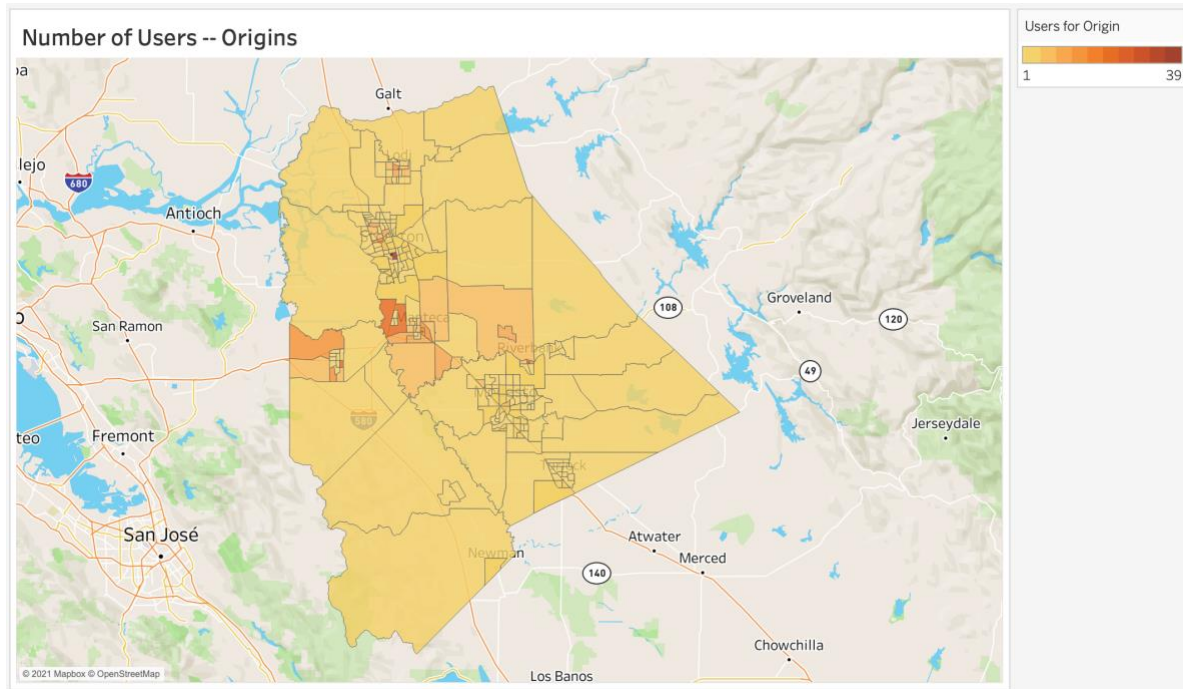

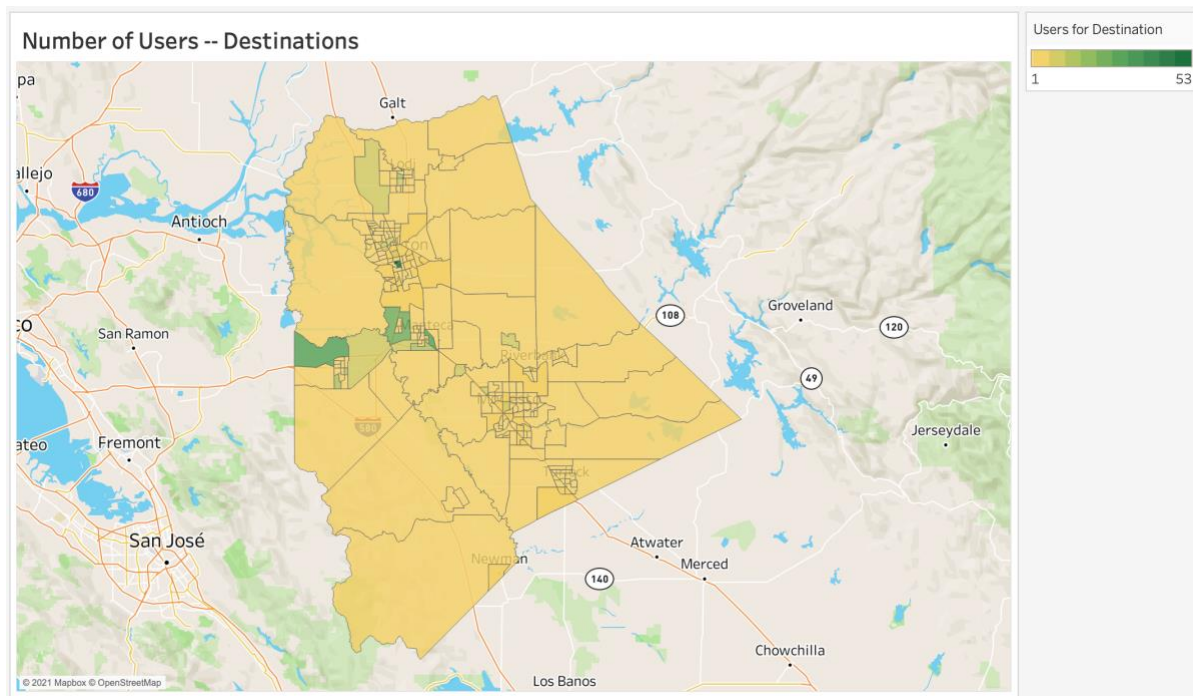**Figure 30. Heat map of route search origins for unique users by census tract**

Figure 31. Heat map of route search destinations for unique users by census tract

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Ticket Purchase Activity

Figure 32 displays monthly counts of unique users who purchased one or more transit tickets through the Vamos app and total ticket purchases per month during the study period.[16] As with total route searches above, ticket purchases peaked in August 2021, with 78 tickets. The number of unique users purchasing tickets also peaked during the same period at 29 users. Overall, ticket purchase user counts and purchase activity remained relatively low until October 2020. Still, purchase activity increased more steadily than route search activity, with fewer downward fluctuations between October 2020 and November 2021.
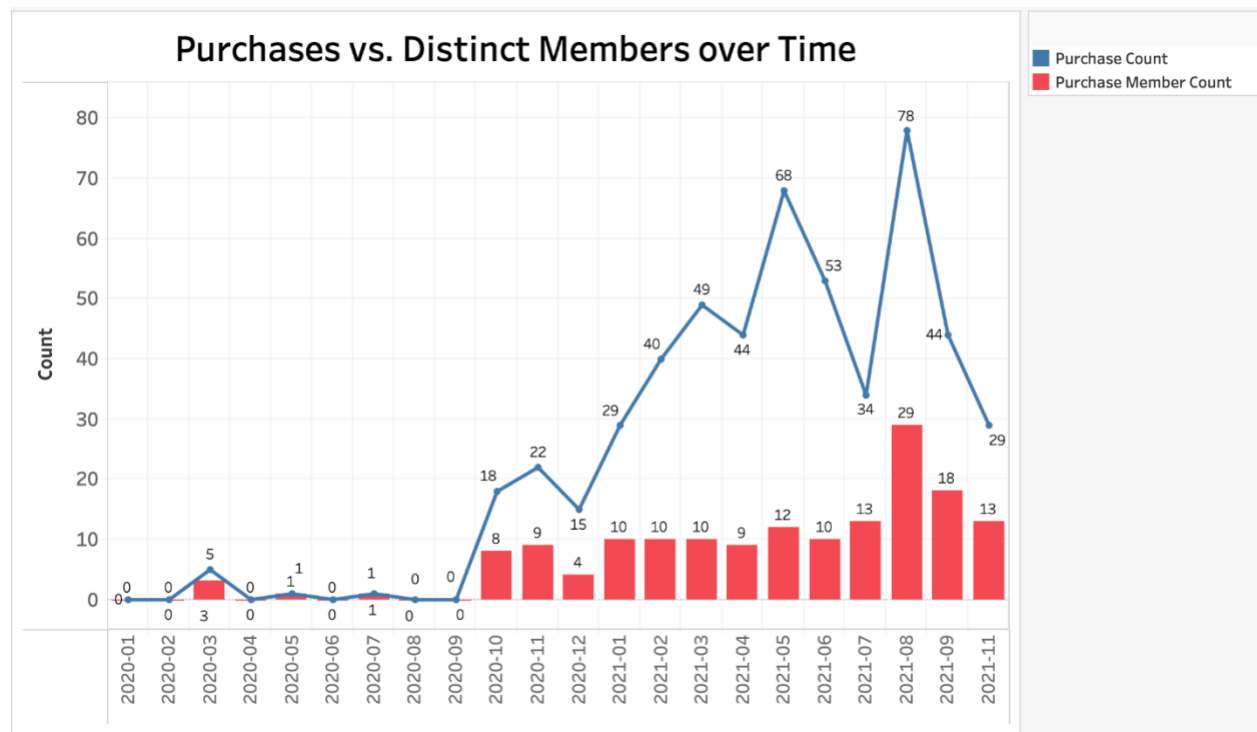

Figure 32. Unique ticket purchasing members and total ticket purchases by month

Users purchased transit tickets for a wide range of bus and rail travel types during the study period, and Table 29 displays the top ten fare types purchased. The Vamos database includes the fare types listed in the Table for different transit services and categories.[17] Users most commonly purchased full-fare day passes (52% of purchases). The next most popular ticket type was full-fare for a single one-way ride, which accounted for 34% of all purchases. This ticket type included the "1-RIDE PASS – Full Fare" category, the "Adult One Way" category, and the "General Public One-Ride" category). There were a total of 24 purchases for VOGO volunteer ridehailing service trips during the study period, accounting for 5% of all purchases.

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[16] Due to a database error, the purchase data for October 2021 were not recorded in the Vamos database and are therefore not displayed in this figure.

[17] San Joaquin Regional Transit District Fare Descriptions and Costs: https://sanjoaquinrtd.com/fares/

Table 29. Ten most common fare types purchased with Vamos

Product Names	Purchases	Percentage
1-RIDE PASS - Full Fare	121	26%
Acerail	5	1%
Adult One Way	14	3%
DAY PASS - Full fare	254	54%
Discount One-Ride	9	2%
Fixed Route Adult One-Ride	19	4%
General Public One-Ride	27	6%
Senior One Way	5	1%
VOGO	7	1%
Youth One Way	6	1%

Member Use: Discussion

The Vamos utilization data show that most users access the application for a short time before discontinuing use, though the reasons for this pattern are not clear from the available data. A small percentage of users continue to use the application for several days or longer, resulting in a subset of active users who are more likely to repeatedly use the platform for purchasing tickets than conducting route searches over time. This pattern may be partially due to the functional difference between route searches and ticket purchases. Users conducting route searches may have decreased reliance on the trip planning function for their daily trips over time. Users who purchase tickets through Vamos will continue to need transit tickets for as long as they travel by transit. Overall, these data suggest that there may be opportunities for increasing user retention, such as through expanded application functionality, additional promotional efforts, or targeted outreach and recruitment.

Impacts on Transportation Experience

The Vamos Member Survey included a series of questions related to users' perspectives on how the MaaS application has affected or will affect their transportation behaviors. As users had different experience levels with Vamos when they completed the Member Survey, this section of the survey included a screening question about how long the user had been using the Vamos application. Researchers asked respondents who indicated they had used Vamos for more than one month questions about their experience with the application and how it affected their transportation use. Respondents who stated that they had not yet used Vamos, or had used Vamos for less than one month, were instead asked whether they expected Vamos to affect their use of transit.

Expected Impacts on Transit Use

Of the 78 respondents to the Member Survey, 58 respondents (74%) reported that they had not yet used Vamos or used Vamos for less than one month. These respondents were asked whether they expected Vamos to affect their use of transit in the future. As shown in Figure 33,

respondents most commonly reported that they expected to use transit "more often" because of Vamos (40%), while 19% of respondents expected to use transit "much more often," and 21% expected to use transit "about the same" amount. Thus, most of these respondents expected to use transit more often due to the information and functionality provided by Vamos.
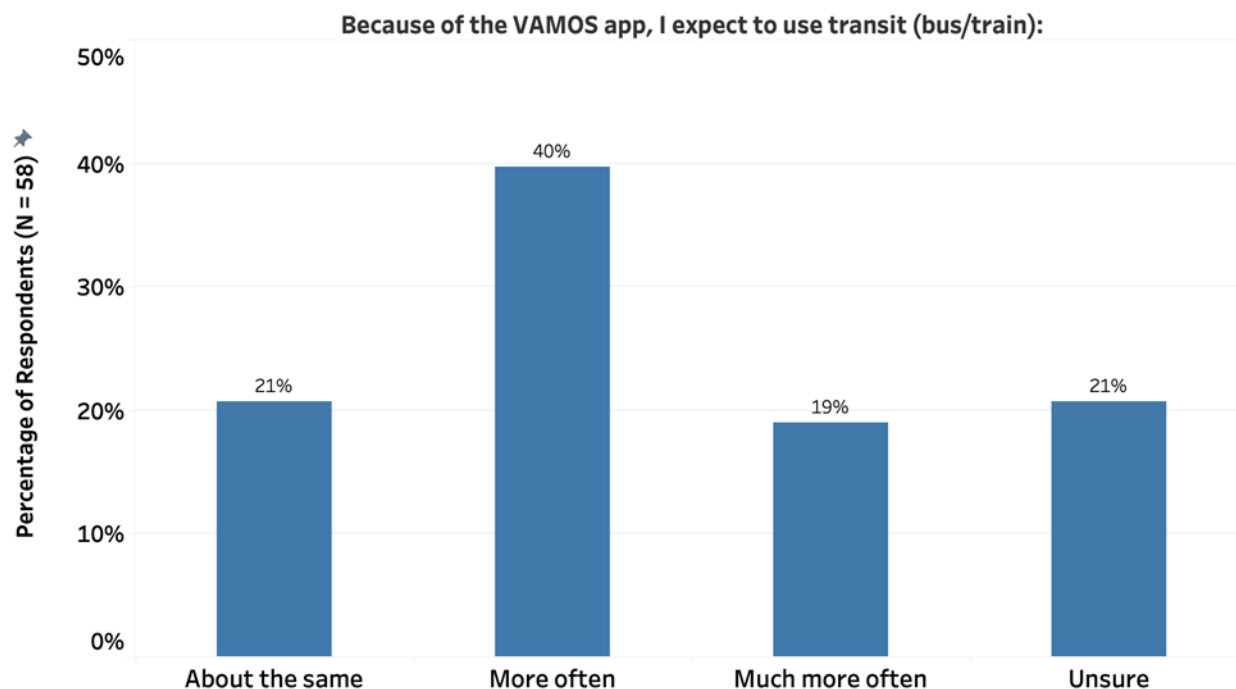
Because of the VAMOS app, I expect to use transit (bus/train):

Figure 33. User reported expected impacts of Vamos on transit use

Realized Impacts on Transportation Experience

Of the 78 respondents to the Member Survey, 12 respondents (15%) reported using the Vamos application for more than one month. The survey presented respondents with a series of statements related to how Vamos may have affected their travel experience and asked respondents to rate the statements on a scale of *1* to *5*, where *1* is "Strongly Disagree", and *5* is "Strongly Agree". Table 30 presents these statements and the results. Due to the limited sample size, researchers display results as the number of respondents instead of the percentage of respondents.

Regarding whether Vamos had given them the information or ability to use transit to access new or additional destinations, most respondents (7 of 12) provided a rating of *4* or *5* in agreement with this statement. Most respondents (7 of 12) provided a neutral rating of *3* to the statement about whether it had taken them less time to travel by transit since using Vamos, as well as the statement about whether Vamos had resulted in them using their personal vehicle(s) less. No users provided a rating of *4* or *5* in agreement with the statement about Vamos causing them to bike or walk more. The statement receiving the highest level of agreement was "It has been easier to pay for a transit (bus/train) trip," with 8 of 12

respondents providing a rating of *5* in strong agreement. These results suggest that for the sample of Member Survey respondents, improvements in payment efficiency may be the most commonly recognized impact of Vamos on the transportation experience.

Table 30. User-reported realized impacts of Vamos on transportation experience

Scale	I can use transit (bus/train) for more destinations.	It has taken me less time to travel by transit (bus/train).	I have used my personal vehicle(s) less.	I have biked and/or walked more.	It has been easier to pay for a transit (bus/train) trip
1 – Strongly Disagree	0	0	1	3	1
2	2	3	2	3	0
3	3	7	7	6	2
4	4	1	0	0	1
5 – Strongly Agree	3	1	2	0	8
Total	12	12	12	12	12

Respondents who reported using Vamos for a month or more were also asked whether they had used Vamos to plan trips using the route search function, purchase transit tickets, or both. Nine respondents reported that they had used Vamos for trip planning, and these respondents were asked to state whether the trip planning feature had affected their use of transit. Seven of these nine respondents (78%) reported that they had used transit "about the same" amount, one respondent said that they had used transit "much more often" because of the Vamos trip planning feature, and one respondent reported that they were "unsure."

Similarly, respondents who indicated that they had used Vamos to purchase transit tickets were asked whether this feature had affected their transit use. Of the eight respondents who answered this question, five respondents (63%) reported that they had used transit "about the same" amount, two respondents (25%) said that they had used transit "more often" because of the ticket purchasing feature, and one respondent reported that they had used transit "much more often" due to this feature.

Impacts on Transportation Experience: Discussion

The results of the Member Survey questions related to the realized impacts of Vamos on transportation behaviors suggest that a primary benefit of Vamos is that it provides a more efficient method of payment for users who need to purchase transit tickets. Additionally, the trip planning and ticket purchasing functions may increase transit use and decrease personal vehicle use for a minority of the user population. The data also suggest that Vamos has improved the user travel experience for a few users by providing the information or ability to travel to new transit destinations and/or by reducing transit travel times. However, the responses to these questions represent a limited sample size of eight to twelve respondents, and these results cannot be extrapolated to the user population.

Conclusion

The pilot evaluation for Vamos followed the launch and ramp-up of the service as it recruited users from January 2020 through November 2021 and provided insight into how users interact with the application to improve their travel experience. By the end of the study period, 281 unique users had made route searches or ticket purchases through Vamos, and 30% of users (85/281) purchased at least one ticket through the application.

Most Vamos users were short-term users and accessed the application for less than two days total during the study period, and less than three percent of users continued to use Vamos for more than ten days total. Of the 281 users who interacted with the application, an average of 12 users purchased tickets, and 25 users conducted route searches each month during the last year of the study period (December 2020 through November 2021).

The results of the Member Survey show that Vamos users tend to be between the ages of 25 and 44 years old (61% of respondents), have at least some college education (75% of respondents), and have roughly similar annual incomes and household sizes as the larger population of their surrounding counties. In contrast to the general population, 21% of user respondents reported that they do not have a personal vehicle compared to roughly 5% of the people in surrounding counties.

UC Davis researchers encountered challenges in obtaining a representative survey sample from Vamos users after they had used the service, which may be partially attributable to most users engaging with the service for a short time. For example, while the Member Survey was administered to Vamos users after they had signed up for the application and asked them for feedback on their experiences, few users had engaged with Vamos long enough to provide this perspective (12/78 respondents). In addition, efforts to administer a Weekly Usage Survey met barriers in the form of low response rates and the fact that few users continued to engage with Vamos every week. However, researchers expect that data collection in a Quarterly Usage Survey may be more effective in capturing feedback from users who may interact with the service less frequently and plans to explore this option for future surveying efforts.

When asked about how Vamos had affected their transportation experience, most active user respondents who had made purchases or route searches through Vamos strongly agreed that the application had made it easier to pay for transit trips (8/12). Most active users also agreed that Vamos had helped them discover that they could use transit for more destinations (7/12). Still, few agreed that Vamos had helped reduce their transit travel times (2/12), reduced their use of personal vehicles (2/12), or increased their use of biking or walking as a mode of transportation (0/12).

While users reported that Vamos provides a more efficient way to pay for their transit travel, the impacts of Vamos on transit use overall are unclear. Most Member Survey respondents stated that they expected Vamos to increase their use of transit (59%), but 71% of active user respondents (12/17 who had purchased tickets or planned routes) indicated that they used transit "about the same" amount as they had before Vamos. Four users who had planned

routes or purchased tickets and responded to the Member Survey reported that Vamos had increased their transit use. However, these findings cannot be extrapolated to the user population due to the small sample size.

Overall, the survey results suggest that Vamos is viewed as a valuable transit fare payment tool and that it contributes to an improved transportation experience for its active users, though the infrequent and short-term usage patterns in the utilization data suggest that there are opportunities to improve user engagement and retention. Lower survey response rates from members who had only used the application limit insights into the effectiveness of the platform for short-term users.

Future Research

Further data collection from long-term users may help determine the extent of Vamos' role in shifting modes or improving mobility access for its target populations. The number of long-term users may grow as a result of increased user engagement as the application recruits a more extensive user base or expands its service area. Researchers will also consider adding questions related to user retention to the Member Survey or Quarterly Usage Survey, such as to assess the factors contributing to long-term use or discontinued use of the application.

References

Míocar

California Greenhouse Gas Reduction Fund Project Map. California Air Resources Board. https://ww3.arb.ca.gov/cc/capandtrade/auctionproceeds/lowincomemapfull.htm.

Location Affordability Portal. U.S. Department of Housing and Urban Development

VOGO

Health and disability data. American Community Survey. United States Census Bureau. https://www.census.gov/topics/health/disability/guidance/data-collection-acs.html

VAMOS

San Joaquin Regional Transit District Fare Descriptions and Costs. https://sanjoaquinrtd.com/fares/.

Data Summary

Products of Research

This study collected service usage data from operators of mobility pilot programs, survey data from members and users of the mobility pilots, and data from publicly available resources including pilot operator websites, and other public websites. Sources for publicly available data used in this study are cited in the report references lists.

Service usage data collected for this study included records of carsharing and volunteer ridesharing reservations, instances of trip planning searches and transit ticket purchases, and associated metrics such as time, location, and distance of trips. Survey data collected for this study included member and user demographics, household and vehicle characteristics, information about transportation behaviors and decisions, and feedback on experiences with the mobility pilots. Detailed descriptions of the service usage data collected from mobility pilot program operators, and survey data collected from pilot members and users, can be found in the "Methods of Data Collection and Analysis" sections of each of the three mobility pilot chapters in this report.

Data Format and Content

Records of service usage data are stored in spreadsheet format for each mobility pilot. Usage data files include individual records of service use including individual carsharing reservations (Míocar), volunteer ridesharing reservations (VOGO), and route planning searches and instances of transit ticket purchases (Vamos).

Data Access and Sharing

The publicly available data sources are cited in the report reference list. Aggregated exports of utilization data for the three pilot programs are available from the research team upon request. Individual survey responses are not available due to privacy considerations, to protect the confidentiality of information provided by service users.

Reuse and Redistribution

All cited publicly available documents and data are available to be accessed and distributed by readers through conventional channels.

Records of mobility pilot usage data are anonymized for privacy purposes and personally identifiable information is not available to the public.

Appendix A: Income Categorization Method for Míocar Respondents

The income limits reflect updated median income and household income levels for extremely low-, very low-, low-, and moderate-income households for California's 58 counties.[18] Users with confidently matched reservation surveys came from Fresno, Kern, and Tulare County. The 2021 income limits are the same for these three counties, as displayed in `Table 31`. Based on the income limits and users' reported household income in the member survey, the correspondence table for classifying users' income category is shown in `Table 32`.

Table 31. 2021 income limits ($) for Tulare, Kern, and Fresno County

Household Size	1	2	3	4	5	6	7	8
Extremely Low	14700	17420	21960	26500	31040	35580	40120	44660
Very Low Income	24500	28000	31500	34950	37750	40550	43350	46150
Low Income	39150	44750	50350	55900	60400	64850	69350	73800
Median Income	49500	56550	63650	70700	76350	82000	87650	93300
Moderate Income	59400	67900	76350	84850	91650	98450	105200	112000

Table 32. Correspondence Table for Income Limits and Income Category

What is your household's income level?	Midpoint Value	1	2	3	4	5	6 or More
Less Than $10,000	5000	Extremely Low	Extremely Low	Extremely Low	Extremely Low	Extremely Low	Extremely Low
$10,000 TO $24,999	17500	Very Low Income	Very Low Income	Extremely Low	Extremely Low	Extremely Low	Extremely Low
$25,000 TO $49,999	37500	Low Income	Low Income	Low Income	Low Income	Very Low Income	Very Low Income
$50,000 TO $99,999	75000	High Income	High Income	Moderate Income	Moderate Income	Median Income	Median Income
$100,000 TO $199,999	150000	High Income	High Income	High Income	High Income	High Income	High Income

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[18] The 2021 State Income Limits are on the Department of Housing and Community Development (HCD) website at https://www.hcd.ca.gov/grants-funding/income-limits/state-and-federal-income-limits.shtml

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