SEPTEMBER 2016

NORTH AMERICAN COLLEGE/UNIVERSITY MARKET CARSHARING IMPACTS:

RESULTS FROM ZIPCAR'S COLLEGE TRAVEL STUDY 2015

EFFECTS ON VEHICLE USE AND OWNERSHIP, TRAVEL BEHAVIOR, QUALITY OF LIFE, AND ENVIRONMENTAL IMPACTS

WORKING PAPER

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A. Stocker, J. Lazarus, S. Becker, and S. Shaheen. Working Paper. September 2016.

Acknowledgements

The authors would like to thank the Zipcar users that responded to the college/university survey questions, as well as Zipcar for their collaboration on the college/university survey, especially Kate Binette, Katelyn Bushey, and Justin Holmes. Dr. Elliot Martin and Rachel Finson of the Transportation Sustainability Research Center (TSRC) at UC Berkeley provided invaluable support throughout the study. We would also like to thank Charlotte Strem and Teresa Buika of the University of California for encouraging Zipcar to provide funding to support this study. The Innovative Mobility Research group at TSRC also provided funding and support for this study, along with funding contributions from the Stuttgart Research Center for Interdisciplinary Risk and Innovation Studies at the University of Stuttgart, Germany. Thanks go to the national university/college advisory group that provided feedback on the study and results.

About The Study

Researchers at the Transportation Sustainability Research Center (TSRC), UC Berkeley in partnership with Zipcar conducted a survey to better understand the impact that carsharing has on college member travel behavior, vehicle holdings and driving, quality of life, and transportation expense savings. The survey design was conducted as a joint effort among TSRC, Zipcar, and university representatives. The college/university carsharing market is a unique environment for both carsharing users and operators. Due to the particular living arrangements and travel needs of college members, carsharing usage on college/university campuses and the impacts of carsharing are different than the neighborhood carsharing market. One major distinction between college carsharing and carsharing in the general population is the difference between household and individual vehicle holdings and transportation decisions. Since many college students do not live in a typical household setting, impacts regarding vehicles and driving must be assessed on an individual basis (in contrast to the household level) for a majority of these users. The methodology employed in this survey accounts for this important distinction, whereas most of the previous carsharing studies use the household as the common unit of measurement.

Executive Summary

Carsharing is the shared use of a vehicle fleet for members on an as needed basis. There are four forms of carsharing in North America today: 1) roundtrip, 2) one-way, 3) peer-to-peer, and 4) fractional. In roundtrip carsharing systems, like Zipcar, members begin and end a trip at the same vehicle location. Zipcar currently offers over 10,000 vehicles in five countries across North America and Europe. In North America, Zipcar offers three program types: Zipcar for Everyone, Zipcar for Business, and Zipcar for Universities. The latter membership type is the focus of this study. This university-specific carsharing program typically houses carsharing vehicles on or near college campuses and gives students, staff, and faculty the opportunity to join a fleet of shared vehicles at locations in and around campus. Although Zipcar is the focus of this study, other operators, such as Daimler's car2go, BMW's ReachNow, and Enterprise Carshare, also operate on or near college campuses in the United States.

The impacts on student, staff, and faculty members who join campus-based carsharing have been sparsely studied. Most carsharing studies focus mainly on neighborhood carsharing programs, as these programs have historically been the largest and most robust. A main motivation of this study was to assess carsharing's impacts on the college/university market segment, since students are in a unique lifestage and have particular mobility needs that are different from those of the general population. For this reason, the study employed methodologies that attempted to capture differences in the college/university market compared to neighborhood carsharing. One of these differences includes assessing whether a member should be considered a household or an individual, when measuring the impact carsharing may have on vehicle holdings or transportation expenses. Since the majority of college/university carsharing members are students (many live in shared spaces with unrelated housemates), asking about a member's own personal vehicle holdings is more representative of their actual access to a private vehicle than is asking about their entire household's vehicle holdings. Due to these nuances, we implemented a methodology that took into consideration these key differences.

TSRC UC Berkeley researchers, Zipcar, and university partners created a survey that was deployed in November 2015 by Zipcar to all its North American members. The survey received 10,040 completed responses by college/university Zipcar members from across North America, whose responses to questions informed many of the study results. This study also used respondent and member activity data, including how many reservations were made and how much each member drove on Zipcars during the previous year.

The study results suggest that access to Zipcar has a diverse range of impacts on college/university market members, which vary depending on student, staff, or faculty type, geographic region of North America, and land-use context. Zipcar allows some students, staff, and faculty to get rid of a car or avoid acquiring one altogether. A higher proportion of members at urban campus settings sell a private vehicle due to Zipcar compared to those that do the same at suburban or rural campuses. However, the suppression effect due to Zipcar makes up the majority of personal vehicles removed from college campuses. Across all college/university members, 0.6% sold a vehicle and 4.6% suppressed a personal vehicle purchase due to the availability of Zipcar. This equates to 5.2% of college/university members that sold or postponed purchasing a vehicle due to Zipcar. These actions of a minority of drivers outweighs the extra driving on Zipcar vehicles. Reductions in vehicle miles traveled (VMT) range from 1% to 5%, depending on the region of North America and land-use context. This translates into a reduction in greenhouse gas (GHG) emissions, ranging from a 0.1% to a 2.6% reduction. The percent reduction in GHG emissions is not as large as the percent reduction in VMT, because suppressed vehicle miles make up a larger portion of removed miles than do miles removed from sold vehicles. Since we make a conservative assumption that suppressed vehicles have a fuel economy of 42 mpg, the impacts of VMT and GHG emissions are not linear. Nevertheless, a percent reduction of GHG emissions is witnessed across all regional and land-use contexts.

The impacts of carsharing on college/university member private vehicle holdings and miles driven are significant, but they are not as large as we have observed in previous carsharing studies most likely due to the unique makeup and travel behavior of college users. Ninety percent of the college/university market respondents are students, and 81% of all respondents do not currently own a personal vehicle. With only a small amount of users owning private vehicles, it makes sense that the percentage of college/university members who sell vehicles due to Zipcar is small (less than 1%) across all regional and land-use contexts. North American college/university student members are also less likely to need to travel similar distances and frequencies than typical roundtrip carsharing users, especially in contrast to the needs of the general North American population. These reasons contribute to the sold and suppressed vehicle purchase rates among the college/university population.

The study also found that college carsharing has a positive impact on members along many different aspects relating to quality of life. Some of the most highly affected aspects include things like variability in experiences, accessibility, and flexibility, meaning college carsharing improved members' access to places in their community, helping vary their lives. In addition, respondents residing in more central regions of the U.S. saw greater impacts in overall quality of life than experienced in other regions. This may be due to fewer transportation options in these regions comparatively, therefore leading to a larger quality of life impact due to a membership with Zipcar. Transportation expense savings is another metric we assessed. We found that the average college/university market respondent saved $17 per month due to Zipcar.

An area of interest in studying college/university carsharing is whether exposure to carsharing has any impact on student user future vehicle purchasing preferences, both in the near future and after graduating. The study found that 42% of respondents are less likely to acquire a car in the next few years due to the availability of Zipcar. Respondents were also asked if Zipcar had changed their desire to purchase a private vehicle after graduating. About the same proportion of undergraduate student respondents say Zipcar has given them less desire to purchase a vehicle after graduating as those that say it has given them more desire. However, a greater proportion of graduate students say Zipcar has given them less desire (34%) than those who have more desire (15%), showing that Zipcar affects vehicle purchasing decisions after graduating differently depending on the type of student. Overall, the results of this study suggest that Zipcar college/university carsharing is substantively impacting miles driven, GHG emissions, quality of life, travel behavior, personal vehicle purchasing intentions, and the transportation expense savings of members.

Background

The first carsharing program launched in the U.S. in 1994, and the industry has grown rapidly since. The neighborhood residential carsharing model continues to be the most common in North America; however, an array of market-specific programs are increasingly targeting additional market segments including: businesses, residential developments, government fleets, low-income markets, and college and university markets (Shaheen et al., 2015).

Carsharing on college/university campuses in the U.S. first developed in the mid-2000s. In 2005, researchers estimated that colleges and universities represented almost five percent of the American carsharing market (Shaheen et al., 2006), and carsharing was available on about a dozen campuses, although typically accessible to university faculty and staff only. Shortly after, several operators began to include student memberships and expand to more campuses throughout the United States. Many of these developments were due to colleges and universities guaranteeing carsharing revenue and sharing management responsibilities with the operator. By July 2008, 11 operators were providing services at more than 130 college or university campuses across the U.S. It also was estimated that approximately 300 vehicles were stationed at campuses through an official partnership or agreement with a college or university along with an additional 220 vehicles parked within a four-block radius of these campuses (Shaheen et al., 2009).

Universities have been enthusiastic to partner with carsharing services because they offer an amenity to faculty, staff, and students. They also help to project a progressive, environmentally-conscious image and reduce on-campus parking demand (Zheng et al., 2009). Access to the college/university market also allowed operators to gain a foothold into new local markets and access to individuals more likely to become members.

Today, Zipcar operates a fleet of over 12,000 vehicles in 30 major metropolitan areas and on more than 500 college campuses in the United States, Canada, the United Kingdom, Spain and Austria, France, Germany, and Turkey (Zipcar, 2016). Other major carsharing operators, such as Daimler's car2go, BMW's ReachNow (formerly DriveNow), and Enterprise CarShare also operate on or nearby college campuses in the United States. Zipcar provides a distinct membership option for college students, faculty, staff, and local residents living on or near college campuses, called "Zipcar for Universities." The effects of this membership program are the main focus of this study.

Data Collection

Zipcar distributed an online survey via email in November 2015 to all North American Zipcar members. Survey takers were entered for a chance to win an Amazon gift card. The survey was started by 41,806 members and completed by 27,781 respondents, 10,040 of which are current college/university students, staff, or faculty. Data collected by Zipcar using the online survey tool SurveyGizmo was transferred to TSRC, UC Berkeley for further analysis. Unique member identifiers were removed before the data transfer to UC Berkeley researchers, and the Committee for Protection of Human Subjects (CPHS) protocol was followed to ensure privacy of any identifying information.

Methodological Overview

Our study methodology includes seven key areas: 1) individual and household classification, 2) regional and land-use context, 3) impacts on personal vehicle ownership, 4) change in vehicle miles traveled, 5) change in greenhouse gas emissions, 5) quality of life metrics, 6) yearly trip frequency extrapolation, and 7) savings methodology.

Individual and Household Classification

Our questionnaire defined a survey taker as either a household or an individual in asking about vehicle holdings. This is important to correctly identify the number of vehicles each respondent owned themselves or realistically has access to as part of a household. We developed this methodology with consideration to the unique living situations of college/university students. Since many students live in large households with unrelated housemates (a dormitory building, for example), we wanted to be sure to ask questions about their individual vehicle holdings instead of their household vehicle holdings, since all vehicles in the household would be unrepresentative of the vehicles the individual has access. Likewise, some students live at home while attending college. In this case, it is important to inquire about household vehicle holdings, similar to past carsharing studies. The survey asked respondents about the relation they have to other members of their household, choosing from a combination of the following five options: Parent/Guardian(s); Relatives (e.g., siblings, etc.); Housemates/Roommates; Partner/Significant other; and Children (who are under your guardianship). We classified the respondent as an individual if they live by themselves, with only housemates/roommates, with housemates/roommates and a partner/significant other, or with housemates/roommates and relatives. We considered all other combinations of responses to be households. The proportions of how many and what type of respondents fall into individual or household classification categories are discussed later in this paper, but the majority of college/university market respondents were classified as individuals.

Regional and Land-Use Context

To analyze variations in impacts among college/university market carsharing members in different settings and environments, we defined regional and land-use context divisions. Our analyses throughout the paper are disaggregated by region and campus setting, where appropriate. For area of the country, we split respondents into either four regions or nine divisions of the United States, as defined by the U.S. Census Bureau Regions and Divisions and we assessed impacts by either region or division (U.S. Census Bureau, 2010). The four regions and their corresponding divisions (in parenthesis) are: Northeast (New England, Middle Atlantic); South (South Atlantic, East South Central, West South Central); Midwest (East North Central, West North Central); and West (Mountain, Pacific). The nature of travel behavior is often largely shaped by land-use context, so we also disaggregated results by campuses located in urban, suburban, and rural contexts. We defined urban, suburban, and rural classifications based on the College Board (The College Board, 2016) campus setting designation for each campus in the dataset. We assessed Canadian members as a single “region,” and we divided these campuses by land-use context as well.

Impacts on Personal Vehicle Ownership

One of the major impacts assessed in this study is the impact Zipcar has in enabling college/university members to sell or suppress the purchase of a personal vehicle. We asked respondents questions to assess whether they got rid of a vehicle due to the presence of Zipcar, as well as whether or not they would purchase or acquire a personal vehicle if Zipcar disappeared from their campus. In both cases, respondents had to indicate that Zipcar was a cause of getting rid of a vehicle or not acquiring one. If the respondent indicated they were able to sell a vehicle due to the presence of Zipcar, we performed a check on their vehicle holdings currently and before joining Zipcar. If the respondent claimed they were able to sell a vehicle due to Zipcar, and showed less vehicles at present than prior to joining Zipcar, we included that respondent in our vehicles sold calculation. We applied a conservative assumption that respondents could shed up to one vehicle maximum. We tabulated respondents as suppressing a vehicle if they indicated they would purchase or acquire a vehicle if Zipcar disappeared, and if they were not double-counted as having already sold a vehicle due to Zipcar. For both sold and suppressed personal vehicle rates, we performed a re-weighting to scale the sold and suppressed impacts to the broader population of college/university market Zipcar members. This re-weighting took into consideration the distribution of usage frequency in the population activity data, as compared to the usage frequency in the sample data. We applied population weighting factors based on usage frequency to the sold and suppressed rates of active respondents. We applied this method to balance survey responses considering

that more active users are more likely to sell/postpone a vehicle purchase. We defined active users as those that used Zipcar more than once a month over the study year.

We asked an additional vehicle suppression question to on-campus students only, which inquired whether or not they would have acquired or brought a car to campus when they first started school, if Zipcar had not been available. The results of this on-campus-specific question are discussed separately from the general personal vehicle suppression question, since it is asked of a subset of respondents. This question asks about a past event (would you have brought a car to campus) in contrast to a current hypothetical event (would you acquire a car right now), which warrants separate discussion and analysis.

Change in Vehicle Miles Traveled (VMT)

Carsharing's effect on college/university market member driving (vehicle miles traveled) is an important measurement in assessing the travel behavior and environmental implications of this carsharing market. We asked about the respondent's individual (or household) personal vehicle ownership both at present and prior to joining Zipcar. The survey also asked respondents to enter the make, year, and model of all personally owned/leased vehicles, miles driven on current vehicles in the last year, and miles driven in the year leading up to joining Zipcar on vehicles owned/leased during that year. In addition, we asked respondents who suppressed a personal vehicle purchase due to Zipcar to estimate how many annual miles they would have driven on the personal vehicle that they did not acquire. We also accessed member driving data from Zipcar outlining miles driven on Zipcar vehicles by each college/university market member. Using these data, we calculated change in yearly VMT. We calculated these impacts on a disaggregated basis, using both regional and land-use context breakdowns. This disaggregated approach portrays differences in VMT change regionally and by urban form to more accurately capture regional travel behavior and land use differences. We subtracted the miles driven on vehicles sold and suppressed due to Zipcar from the additional miles driven using Zipcars. We then calculated the change in miles driven due to Zipcar and a percent change in miles driven due to Zipcar.

Change in Greenhouse Gas (GHG) Emissions

Carsharing's effect on college/university member greenhouse gas (GHG) emissions is another measurement of interest in assessing the environmental implications of carsharing on college/university campuses. We calculated respondent change in yearly GHG emissions due to Zipcar using the responses to the previously described questions concerning vehicle ownership and miles driven on Zipcar vehicles. Using the make, model, and year of vehicles sold due to Zipcar in each disaggregated grouping, we found the average fuel economy of shed vehicles. We collected the associated fuel economy data using the United States Environmental Protection Agency's (EPA) fuel economy database. We assumed a fuel economy of 42 miles per gallon (mpg) for vehicles that would have been purchased in the absence of Zipcar and a fuel economy of 33 mpg for Zipcar vehicles. We subtracted the yearly GHG emissions from sold and suppressed vehicles from the GHG emissions produced from driving on Zipcar vehicles. Next, we calculated the change in GHG emissions due to Zipcar and the percent change in GHG emissions due to Zipcar.

Quality of Life (QoL) Metrics

We developed a measure of Quality of Life (QoL) as part of the broader college/university study to assess the various potential impacts of Zipcar on individual well-being and the happiness of users. First, we chose 13 QoL indicators out of the 23 indicators from a commonly used psychological scale of multidimensionality (Poortinga et al., 2004). Second, we designed three new QoL aspects ("financial control and predictability," "flexibility," and "serenity") to cover the potential benefits of carsharing that may be important to QoL. We asked respondents to indicate how use of Zipcar may have changed each of these 16 QoL aspects. The answer options ranged from: (1) "Zipcar has made much worse," (2) "Zipcar has made worse," (3) "Zipcar has made slightly worse," (4) "Zipcar has not changed it," (5) "Zipcar has made slightly better," (6) "Zipcar has made better," and (7) "Zipcar has made much better." Table 1 shows the final list of the 16 different QoL aspects

used in the study.

Table 1: Definition of 16 QoL Aspects

Aspect	Wording in Survey
Safety	Being safe at home and in the streets. Being able to avoid accidents and be protected against criminality.
Accessibility	Being able to reach important objects like work or school with reasonable time and financial costs.
Variability in Experiences	Having a varied life. Experiencing as many things as possible.
Privacy	Having the opportunity to be myself, to do my own things, and to have a place of my own.
Comfort	Having a comfortable and easy daily life.
Social Justice	Having equal opportunities and the same possibilities and rights as others.
Environmental Quality	Having access to clean air, water, and soil. Maintaining good environmental quality.
Social Relations	Having good relationships with friends, colleagues, and neighbors. Being able to maintain contacts and to make new ones.
Money/ Income	Having enough money to buy and to do the things that are necessary and pleasing.
Freedom	Freedom and control over the course of my life and to be able to decide for myself what I will do, when, and how.
Nature/ Biodiversity	Being able to enjoy natural landscapes, parks, and forests. Assurance of the continued existence of plants and animals and maintaining biodiversity.
Leisure Time	Having enough time after work and being able to spend this time satisfactorily.
Health	Being in good health. Having access to adequate health care.
Flexibility	Being able to live a spontaneous life.
Financial Control and Predictability	Having control over my expenses. Being able to predict costs.
Serenity/ Lightheartedness	Having a life free from major concerns or worries.

In addition, we asked respondents to sum up the impact of Zipcar on their overall QoL ("Overall, to what degree has Zipcar changed your quality of life?"). From the total of 10,040 responses, a subsample of 9,655 remained after data cleaning. The cleaning process consisted of deleting all respondents who had chosen either solely the minimum or maximum answer on all 17 QoL indicators.

Yearly Trip Frequency Extrapolation

Zipcar provided respondent usage data, including each respondent's monthly trip counts over the previous year (11/1/14 – 10/31/15). Many of the respondents were Zipcar members for less than a full calendar year due to the cyclical nature of the college/university market, which is heavily student based. To ensure a standardized representation of respondent trip making, we employed a methodology that extrapolated usage to reflect a year-long trip frequency. We calculated a distribution of average trips per respondent for each month based on the monthly trip counts of respondents who joined Zipcar prior to November 1, 2014. Next, we calculated the percentage of total yearly average trips per respondent in each month. We extrapolated the total yearly trip count for respondents who were members for less than a year by dividing the sum of their observed monthly trip counts by the cumulative percentage of the yearly average corresponding to the months after they joined Zipcar.

Savings Methodology

We asked respondents about their individual (or household) monthly transportation expenses both currently and in the year before joining Zipcar. They were also asked whether they felt they saved money due to Zipcar or whether they felt they spent more. After determining whether savings or extra spending were due to the use of Zipcar, we calculated the average monthly transportation savings due to Zipcar. We disaggregated results by student type, region, and land-use context.

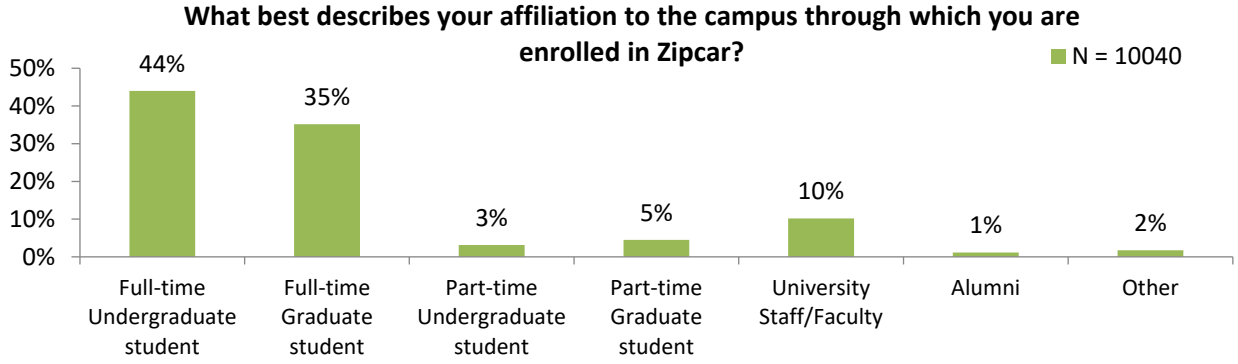
Demographics

Demographics of the college/university user population is diverse, as it includes: 1) full-time undergraduates, 2) full-time graduate students, 3) part-time students (undergraduate and graduate), and 4) faculty and staff. Our analysis provides an understanding of the demographics of this user population. We also examine respondent distribution by region and land-use context.

College/University Market Subgroups

Of the college/university market respondents, 90% are students and 10% are staff or faculty. Almost half of the student respondents are full-time undergraduates (44%), and 35% are full-time graduate students. Part-time undergraduate and graduate students made up 8% of college/university market respondents. Of the student respondents, 39% percent live on campus and 61% live off campus. It should be noted that the 'college/university market' refers to both current students and staff/faculty combined, whereas the term 'student members' refers only to the 9,019 current student members surveyed. Various subgroups of the 'student member' population are discussed further in this working paper, e.g., undergraduates or on-campus students. The respondent breakdown by student type is shown in Figure 1.

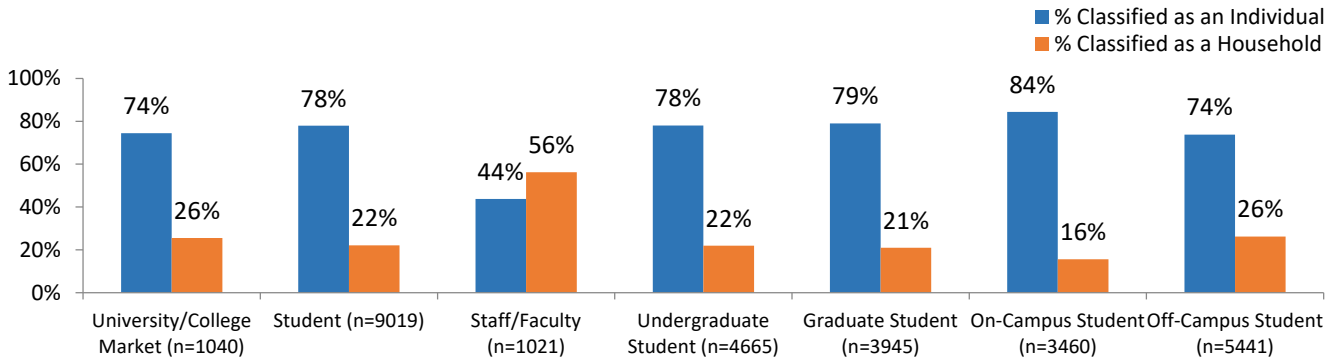
Figure 1: Respondents by Student Type



Individual and Household Classifications by Subgroup

Based on the household classification methodology employed in this study, 74% of the college/university market were classified as individuals, and 26% were households. This classification is particularly helpful in the context of individual or household vehicle holdings and transportation expenses. Not surprisingly, an even higher share of students (78%) were classified as individuals, and the on-campus student subgroup had the highest share of individuals at 84%. This is expected, as many students (especially on-campus students) live in shared housing and do not have access to the vehicles of other housemates.

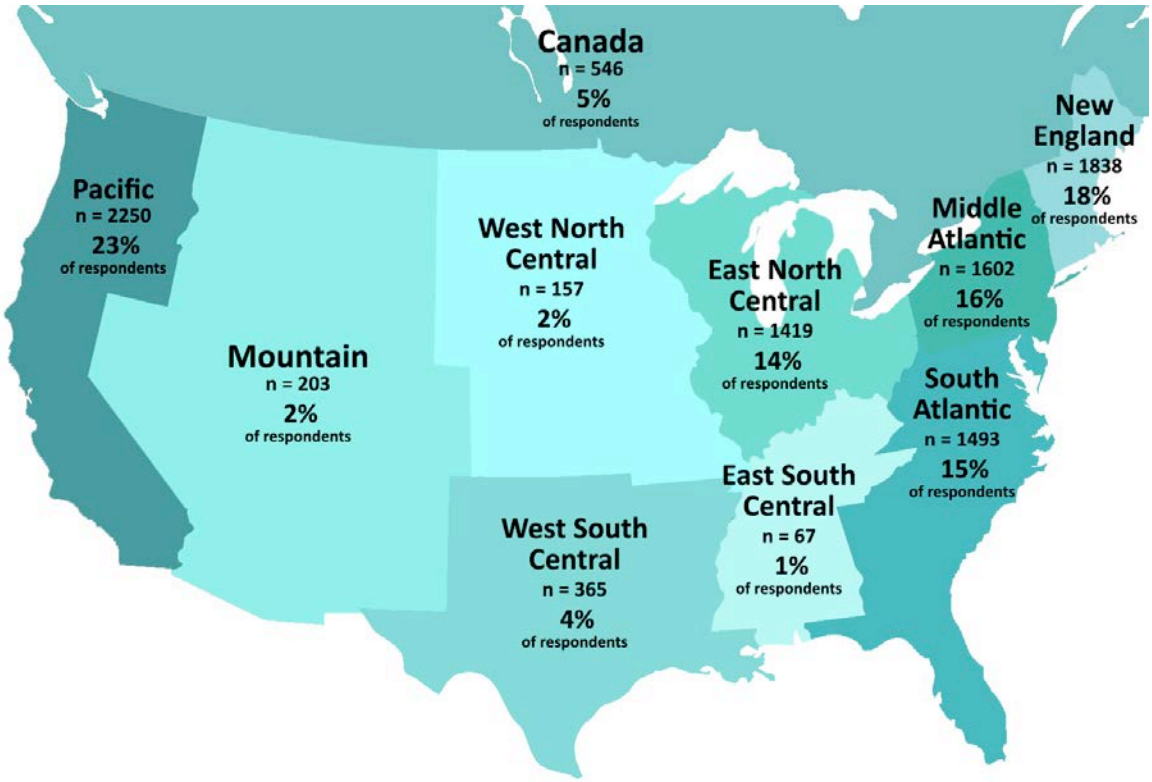
Figure 2: Individual and Household Classification by Student Type



Respondent Distribution by Region and Land-Use Context

To better understand how geographical differences play a role in impacts due to Zipcar, we also broke respondents out by region and land-use context. Figure 3 details the college/university market respondents by U.S. Census Division (and Canada). The regional respondent distribution matches very closely with the actual Zipcar college/university market user distribution, so our respondents closely reflect the regional breakdown of college/university market Zipcar users. The majority of college/university market users reside on the coasts (Pacific, New England, Middle Atlantic, and South Atlantic), with the middle of the country containing a lesser share of respondents. Canada makes up 5% of respondents.

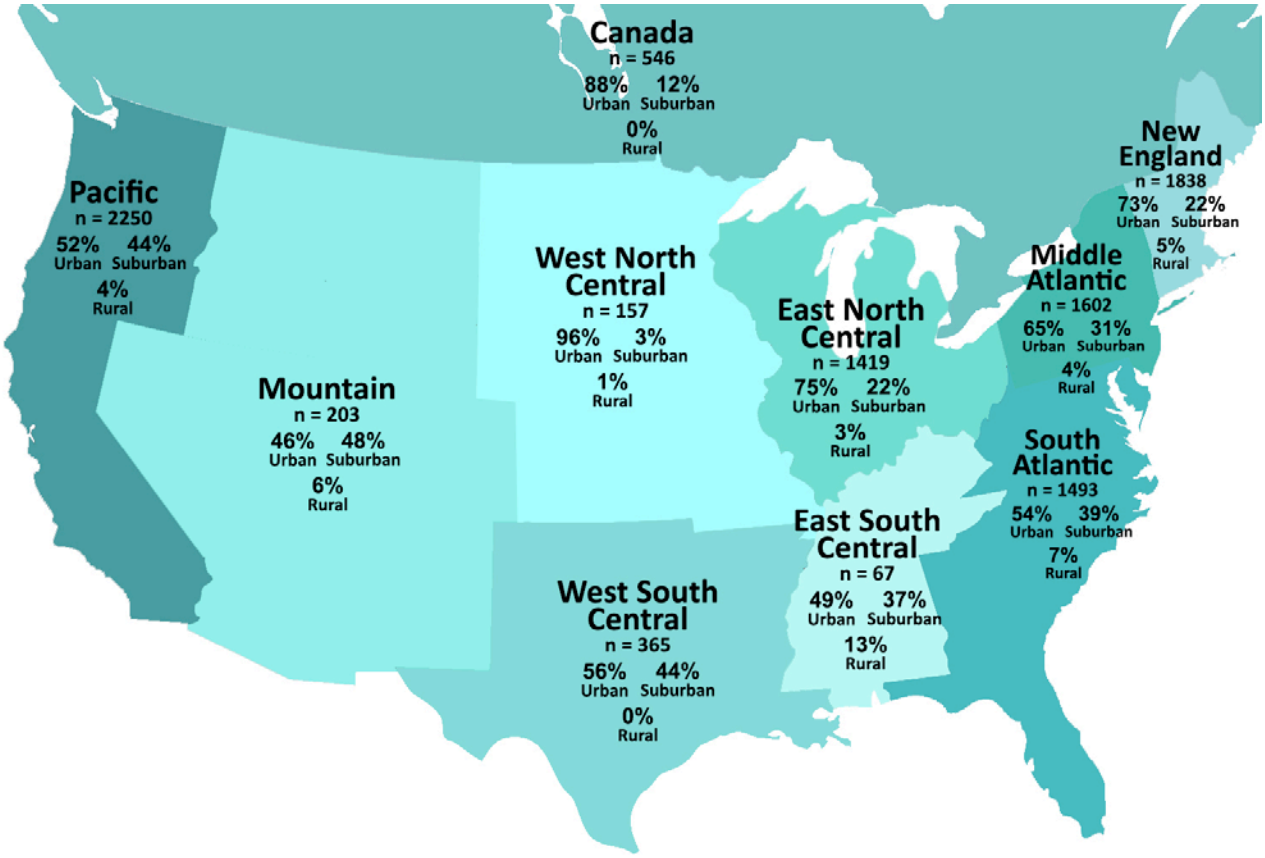
Figure 3: Respondent Distribution by U.S. Census Division



We also grouped respondents into urban, suburban, and rural campus designations as defined by the College Board. Sixty-four percent of respondents are affiliated with a school in an urban setting, followed by 32% in a suburban setting, and 4% in a rural campus setting. As an example, UC Berkeley is classified as urban campus; University of Massachusetts Amherst is classified as suburban; and Dartmouth College is classified as rural.

Combining both the divisional and land-use context classifications, Figure 4 below shows the portion of respondents affiliated with an urban, suburban, or rural campus, by division. The Northeast and East North Central areas have a higher share of urban campus respondents, while the rest of the country has closer to an even split between urban and suburban/rural campus respondents. This is most likely due to campus setting differences across the country. Here as well, the distribution of the entire population of Zipcar users matches closely with the respondent breakdown.

Figure 4: Respondent Distribution by Division and Land-Use Context



Income

The income distribution of respondents was broken out by students and staff/faculty due to expected income divides between the two groups. The income of student respondents in the college/university market is expectedly low, with 27% of American respondents making less than $10,000 a year, 29% earning between $10,000 and $50,000 a year, 16% making $50,000 or more a year, and 28% preferring not to answer. The incomes of Canadian student respondents are similarly low. Staff/faculty respondents tend to have higher incomes, with 58% of American staff/faculty respondents and 51% of Canadian staff/faculty respondents making $50,000 or more a year. Please see Tables 2 and 3 below.

Table 2: Income Distribution, U.S. Respondents

INCOME (USA)	Staff/ Faculty (n=1010)	Students (n=8645)	All Respondents (N=9655)
Less than $10,000	0.4%	27%	24%
$10,000 to $14,999	1%	7%	7%
$15,000 to $24,999	3%	8%	8%
$25,000 to $34,999	5%	8%	8%
$35,000 to $49,999	17%	6%	8%
$50,000 to $74,999	25%	7%	9%
$75,000 to $99,999	11%	3%	4%
$100,000 to $149,999	14%	3%	4%
$150,000 to $199,999	5%	1%	2%
$200,000 or more	3%	2%	2%
Prefer not to answer	15%	28%	26%

Table 3: Income Distribution, Canadian Respondents

INCOME (CANADA)	Staff/ Faculty (n=34)	Students (n=556)	All Respondents (N=590)
Under $5,000	0%	13%	12%
$5,000 to $9,999	0%	8%	8%
$10,000 to $14,999	3%	6%	6%
$15,000 to $19,999	3%	4%	4%
$20,000 to $29,999	0%	8%	7%
$30,000 to $39,999	3%	5%	5%
$40,000 to $49,999	6%	4%	4%
$50,000 to $59,999	3%	4%	4%
$60,000 to $79,999	12%	5%	5%
$80,000 to $99,999	9%	3%	3%
$100,000 to $124,999	12%	3%	3%
$125,000 to $149,999	6%	1%	1%
$150,000 and over	9%	3%	3%
Prefer not to answer	35%	33%	33%

Gender and Age

The distributions for gender and age of the respondents is shown in Table 4 below. The gender of respondents is fairly evenly split in the student population, with a slightly larger proportion of male respondents. Forty-eight percent of student respondents are female, 51% are male, and 1% prefer not to answer. In the staff and faculty respondent population, a greater proportion are female than male. Fifty-five percent of staff/faculty are female, 44% are male, and 1% prefer not to answer.

College/university market respondents are younger than the general population, with the majority (87%) of respondents under 35 years old. Forty-four percent of student respondents are between 20 and 24 years old, 30% are 25 to 34, 18% are 18 to 19 years old, and 7% are above the age of 35. Of the staff and faculty respondents, 40% are between the ages of 25 and 34, 26% are 35 to 44, 29% are 45 or older, and 4% are below the age of 25.

Table 4: Gender and Age of Staff/Faculty and Student Respondents

GENDER	Staff/ Faculty (n=1021)	Students (n=9019)	All Respondents (N=10040)
Female	55%	48%	48%
Male	44%	51%	51%
Prefer not to answer	1%	1%	1%

AGE	Staff/ Faculty (n=1019)	Students (n=9019)	All Respondents (n=10040)
18-19	0.1%	18%	16%
20-24	4%	44%	40%
25-34	40%	30%	31%
35-44	26%	5%	7%
45-54	17%	1%	3%
55-59	5%	0.3%	0.8%
60-64	4%	0.2%	0.6%
65-74	3%	0.2%	0.4%
75-84	0.1%	0.03%	0.04%
85+	0%	0.1%	0.1%
Prefer not to answer	0%	1%	1%

Ethnicity

The majority of American college/university market respondents identify as being white (43%) or Asian (26%). Hispanic or Latinos comprise 11% of the population, followed by African Americans at 10% of the overall surveyed population. The Canadian respondent population is similar in that white and Asian respondents make up the majority. South Asian respondents make up 12% of the Canadian respondent population. The staff/faculty respondent population is less diverse than the student population among both American and Canadian respondent populations. Sixty-nine and sixty percent of the American and Canadian staff/faculty respondents are white, respectively. Meanwhile, just 40% of the American student respondents and 33% of the Canadian student respondents are white. See Tables 5 and 6 below.

Table 5: Ethnicity of U.S. Respondents

ETHNICITY (USA)	Staff/ Faculty (n=1010)	Students (n=8645)	All Respondents (N=9655)
African American	6%	10%	10%
American Indian or Alaskan Native	2%	2%	2%
Asian	11%	28%	26%
White or Caucasian	69%	40%	43%
Hispanic or Latino	9%	12%	11%
Middle-Eastern	0.4%	3%	2%
Native Hawaiian or Pacific Islander	1%	1%	1%
South Asian	2%	8%	7%
Southeast Asian	1%	2%	2%
Prefer not to answer	6%	6%	6%
Other	1%	2%	2%

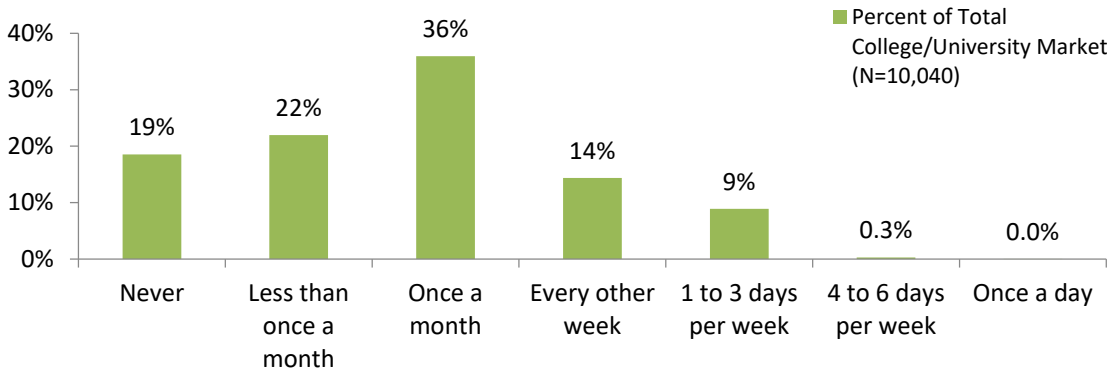
Table 6: Ethnicity of Canadian Respondents

ETHNICITY (Canada)	Staff/ Faculty (n=25)	Students (n=521)	All Respondents (N=546)
Black Canadian	8%	4%	4%
North American Aboriginal	0%	2%	2%
Asian	16%	26%	25%
White or Caucasian	60%	33%	34%
Latin American	0%	5%	4%
Arab	0%	7%	6%
Pacific Islander	0%	1%	1%
South Asian	4%	12%	12%
Southeast Asian	4%	6%	5%
Prefer not to answer	4%	9%	8%
Other	4%	3%	3%

College/University User Trip Frequency

The surveyed college/university market members who took any trips over the study year (11/1/14 – 10/31/15) made 20 Zipcar trips on average over the study year. This means the average college/university market respondent made close to two Zipcar trips per month. We created seven trip frequency bins for comparative purposes to see if impacts quantified in this study are correlated with usage frequency. The bins are represented as monthly estimates and correspond with extrapolated respondent yearly trip frequency data, defined as: 1) Never (0 trips), 2) Less than once a month (1 to 6 trips), 3) Once a month (7 to 20 trips), 4) Every other week (21 to 39 trips), 5) 1 to 3 days per week (40 to 156 trips), 6) 4 to 6 days per week (157 to 312 trips), and 7) Once a day (313 to 365 trips). Please note that we extrapolated the total number of trips for respondents who were members for less than a year to equal a yearly trip frequency, as discussed in the methodology section. The majority (77%) of college/university respondents fall into the once a month, less than once a month, or never bins, although a good proportion of respondents use Zipcar more frequently. It should also be noted that calculations for re-weighting purposes considered members who took more than 12 trips over the study year as active, for inclusion in our impact calculations. This active member definition is independent of the bins displayed in Figure 5.

Figure 5: Zipcar Trip Frequency



Usage varies among respondents depending on student or staff/faculty type. Of respondents who made trips during the study year, undergraduate students are some of the most active, taking 27 trips over the year on average. Graduate student respondents make 20 Zipcar trips on average per year, and staff/faculty respondents make 16 reservations per year on average. The respondent population of on-campus undergraduate students who made a trip during the year take 28 trips per year, on average.

Impact on Quality of Life (QoL)

<u>QoL Metric Average Scores</u>

We asked questions regarding the impact of Zipcar on member QoL to gain a better understanding of how Zipcar is affecting 16 aspects of QoL as well as overall QoL, as presented in the methodology portion of this paper. Zipcar made a positive average impact on all 16 aspects measured, and 67% of college/university market respondents say that Zipcar has made their overall QoL better. The highest rated category on average for college/university market respondents was variability in experiences (5.15), showing that Zipcar had the largest positive impact in enabling members the ability to have a varied lifestyle. The average overall QoL impact score (4.95) is about one full point higher than the neutral (4) answer of no change, meaning that Zipcar has made college/university market members overall QoL slightly better, on average. The results of the average QoL scores across all college/university market respondents is shown in Table 7 below.

Table 7: Average Quality of Life Impact Scores

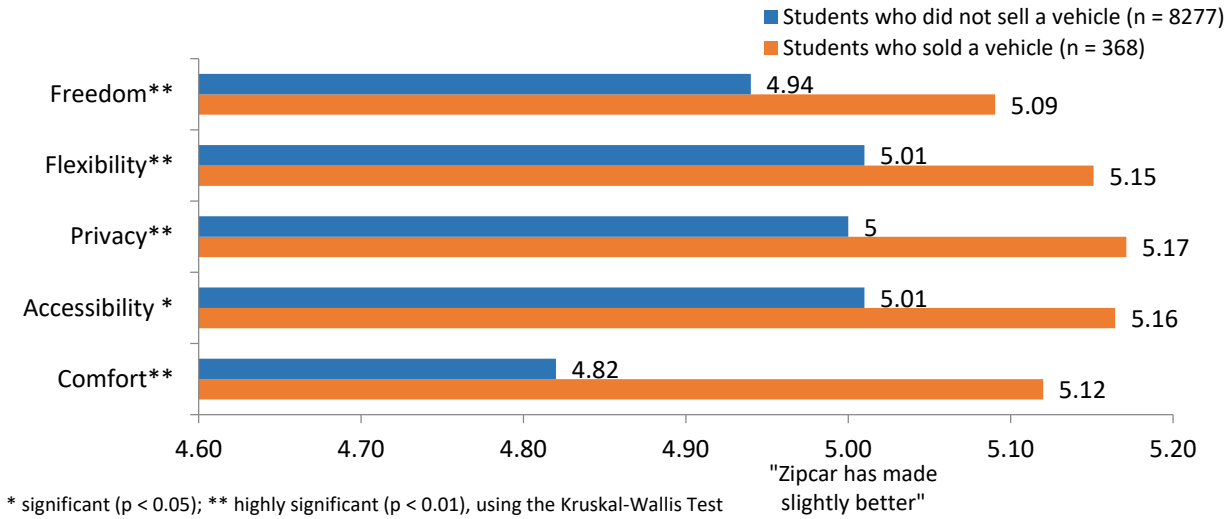
College/University Market QoL Impact Scores (N = 9523)		
QoL Metric	**Average**	**Standard Deviation**
Variability in Experiences	5.15	1.14
Accessibility	4.99	1.22
Flexibility	4.98	1.11
Privacy	4.96	1.16
Freedom	4.92	1.08
Nature/Biodiversity	4.81	1.14
Comfort	4.80	1.09
Social Justice	4.68	1.08
Financial Control and Predictability	4.60	1.13
Social Relations	4.57	1.04
Leisure Time	4.52	1.02
Safety	4.48	1.05
Environmental Quality	4.48	1.02
Serenity/Lightheartedness	4.46	1.02
Money/Income	4.41	1.19
Health	4.35	0.95
Overall	**4.95**	**1.00**

Note: 4.0 is the 'neutral' score for QoL impact questions and represents the answer option: "Zipcar has not changed it"

Key QoL Metrics Analysis

QoL metrics such as freedom, flexibility, privacy, accessibility, and comfort are important in contrasting student members who sold a car due to Zipcar with those who did not. Student members who sold a vehicle due to Zipcar do not only retain aspects related to a high QoL like freedom, flexibility, privacy, accessibility, and comfort, they show a slight improvement in these measures due to their Zipcar membership. Even though these members gave up access to a personally owned vehicle, they reveal higher average QoL impact scores than the rest of the student population among these five aspects, which are commonly associated with car ownership. See Figure 6 below.

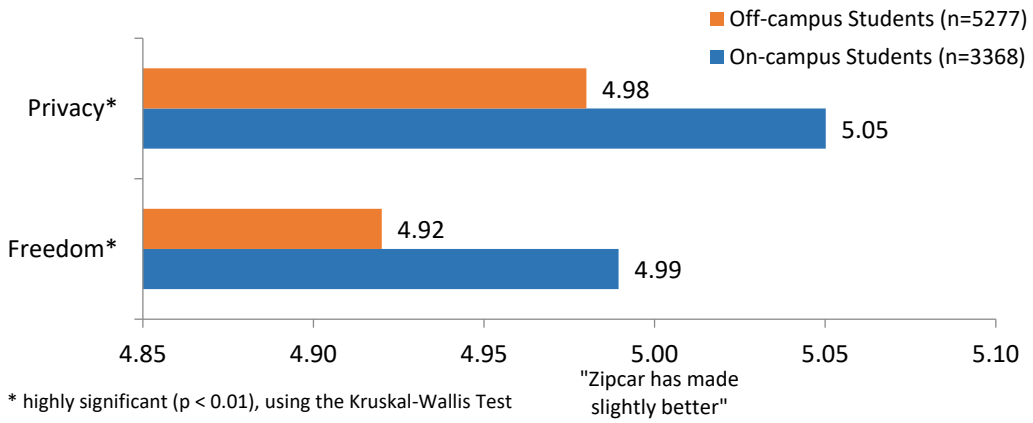
Figure 6: Average Key QoL Metric Scores, Students Who Sold a Vehicle



* significant ($p < 0.05$); ** highly significant ($p < 0.01$), using the Kruskal-Wallis Test

On-campus students reported higher average impact scores in privacy and freedom than the rest of the college/university market. On-campus living can lessen students' sense of privacy and of freedom, especially for those living in dormitories or residence halls where students often live in shared spaces. Travel options for on-campus students may also be constrained by their location on campus and their typically lower vehicle ownership rates. The fact that there are higher average impact scores reported by on-campus student respondents suggests that on-campus students are using Zipcar to improve their mobility in ways that mitigate their living environment. The changes observed in the average privacy and freedom impact scores are statistically significant at the 99% confidence level. See Figure 7 below.

Figure 7: Average Key QoL Metric Scores, On- and Off-Campus Students

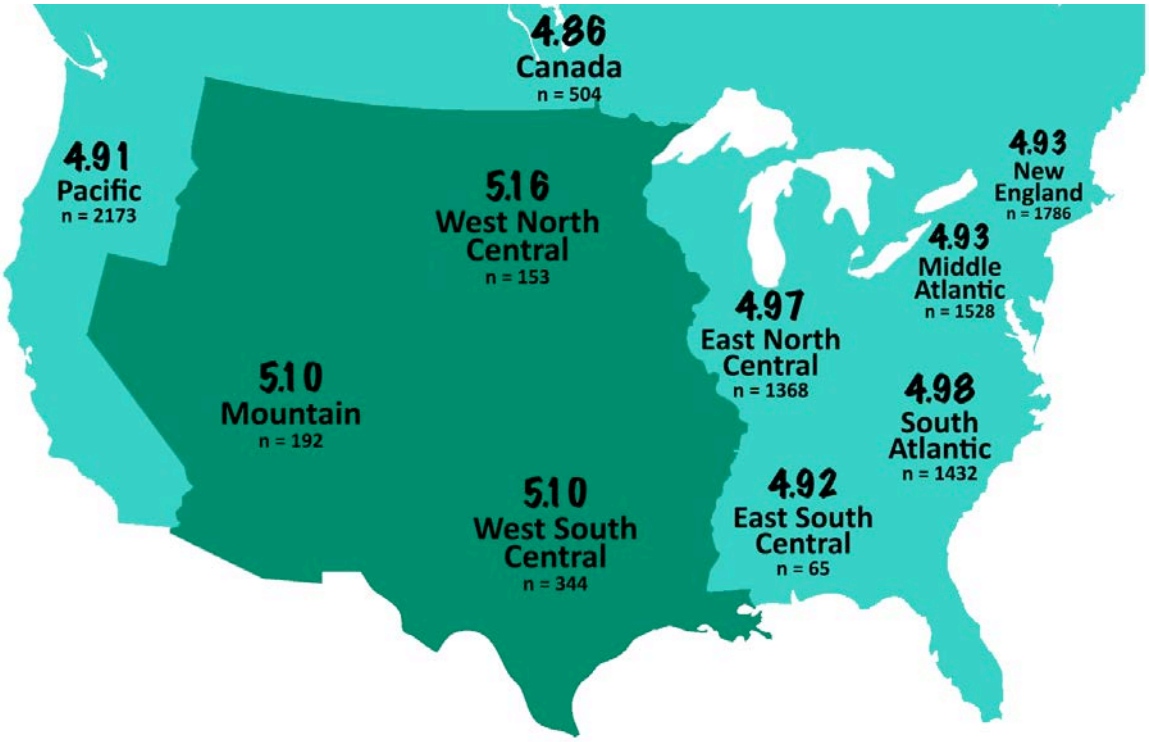


Zipcar is not only important to the overall QoL of college/university market members, but it is also important in contributing to their satisfaction with transportation, in general. Seventy percent of college/university market members surveyed claimed that Zipcar is important to them, and about the same proportion noted that Zipcar is important in contributing to their satisfaction with transportation, overall.

Overall QoL Impact Score by U.S. Census Division

Many factors play a role in how heavily Zipcar impacts average overall member QoL, including region of the country. Figure 8 below shows the average overall QoL scores for each of the nine U.S. Census Divisions. The West North Central, Mountain, and West South Central divisions all show a higher average overall QoL score at 5.16, 5.10, and 5.10 respectively, than do the other divisions of the country. Zipcar seems to have a higher overall impact on QoL in these central regions of the country than on the coasts. This could be due to transportation accessibility differences at college/univesrity campuses across the regions. Carsharing may be providing more access to transportation services in some of these areas of the country, which are not as dense and are less served by multiple transportation options.

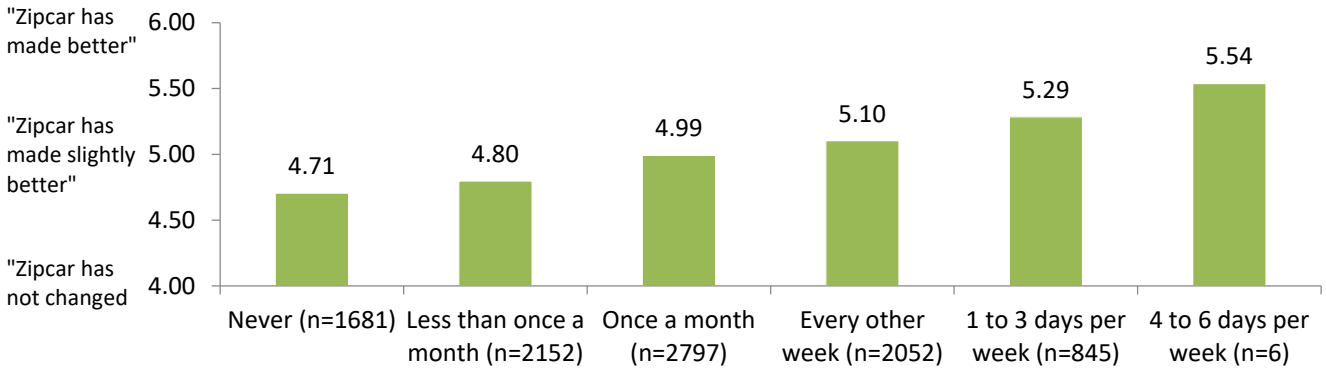
Figure 8: Average Overall Quality of Life Impact Score by U.S. Census Division



Overall QoL Impact Score by Trip Frequency

When looking at the average overall QoL score of college/university market respondents by number of trips made over the year, we see that overall QoL scores increase significantly with increased Zipcar use. By dividing active members into bins by the number of weighted trips they made over the study year, we see that the average overall QoL score climbs from 4.71 in the group that did not take any trips over the observed year, up to 5.54 in the 4 to 6 days per week group. All average overall impacts due to Zipcar are positive, but the overall QoL impacts are markedly higher among more frequent users. See Figure 9 below.

Figure 9: Average Overall Quality of Life Impact Score by Trip Frequency*



*The relationship between yearly trip frequency and overall QoL impact was found to be significant on a 95% confidence interval using the Chi-squared test for independence.

The finding that QoL ratings escalate with increasing levels of carsharing usage shows that respondents who use carsharing at a greater rate are more likely to experience a larger positive impact on their QoL. This may be because college/university market respondents who use carsharing at a higher rate are more aware of the service's importance in their life than are less active users.

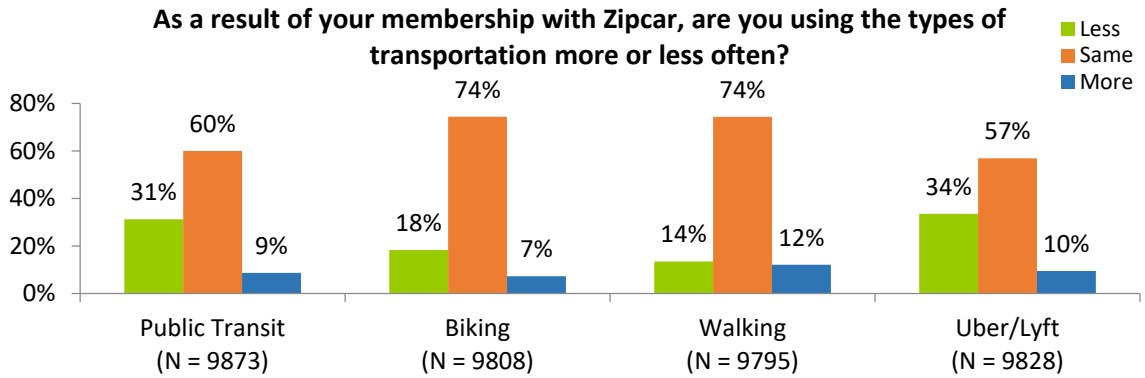
Modal Shift Analysis

In this section, we discuss: 1) modal shift due to Zipcar, 2) mode choice in the absence of Zipcar, and 3) frequency of use of other shared modes.

Modal Shift

Some college/university market members who join Zipcar shift how often they use other transportation modes due to joining. In general, college/university market respondents use public transportation and ridesourcing services (e.g., Lyft or Uber) slightly less, and they also bike slightly less due to Zipcar. They tend to walk about the same amount than they did before joining Zipcar. See Figure 10 below.

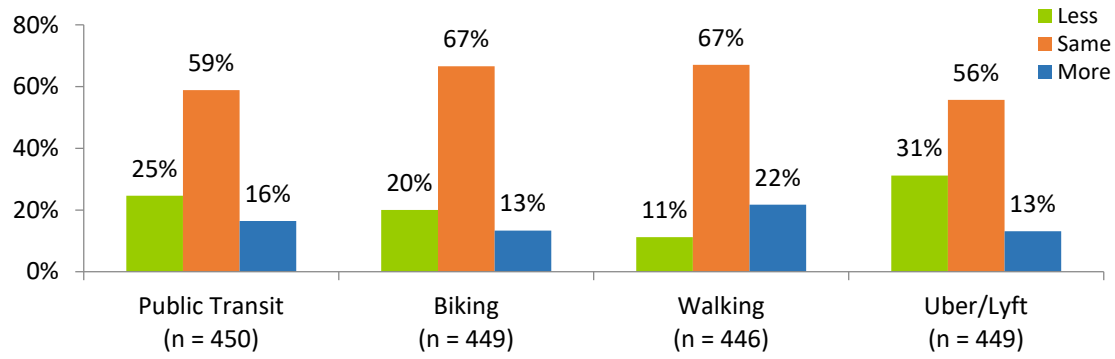
Figure 10: Modal Shift, Total College/University Market



Examining modal shift by land-use context, many of the same modal shift trends seen in the entire college/university market are presented. However, while 29% of college/university market respondents in urban settings use public transit less due to Zipcar and 9% use it more, 36% of suburban users report using public transit less and only 7% use it more often. Similarly, 38% of rural users take public transit less due to Zipcar, compared to 6% who claim to use it more. This suggests that while there is a trend toward less public transportation use of college/university market respondents due to Zipcar, this impact is not as great in urban areas as it is in suburban and rural areas. Following the same pattern, changes in biking and walking due to Zipcar seem to be not as heavily impacted in urban campus areas as they are in suburban and rural settings.

When looking at college/university market members who originally had at least one car, but then became zero-car owners as a result of joining Zipcar, we see that their modal shifts differ from the shifts observed in the total college/university respondent population. These respondents are now using public transportation less; this reflects a nine-percentage point decrease in public transport use overall in contrast to a 22-percentage point decline, which is observed in the entire college/university market population. These new zero-car owners also experience an increase in walking (i.e., an 11-percentage point increase). See Figure 11 below.

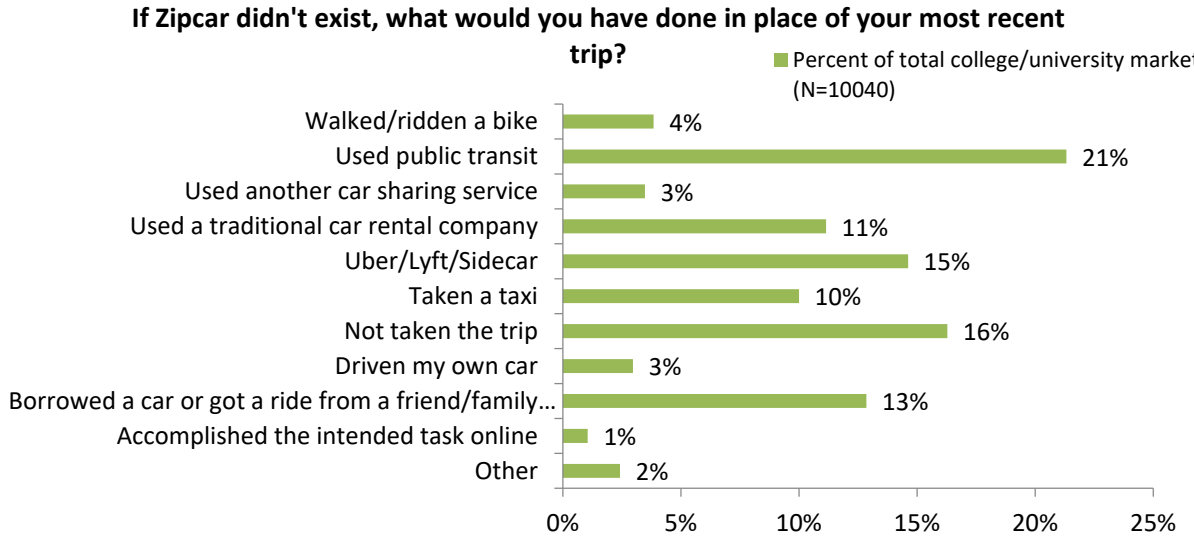
Figure 11: Modal Shift, Became Zero-Car Owner due to Zipcar



Modal Choice in The Absence of Zipcar

When asked how college/university market members would have traveled if Zipcar were not available for their last trip, 21% of college/university market members said they would have taken public transit, 16% said they would not have taken their most recent trip at all, and 15% said they would have used a ridesourcing service. The next most chosen alternative modes were to borrow a car or get a ride from a friend or family member, use a traditional car rental company, and take a taxi. See Figure 12 below.

Figure 12: Alternative Mode Choice in Absence of Zipcar, College/University Market Respondents



Breaking out by student and staff/faculty segments, student respondents stated that they would have used different modes than staff/faculty respondents, if Zipcar had not been available. The three most common alternative options for students are 1) public transit (22%), 2) not taking the trip (17%), and 3) Lyft/Uber (15%). In contrast, for staff/faculty, the three most commonly chosen alternatives include: 1) a traditional rental car company (22%), 2) public transit (17%), and 3) not taking the trip (14%). We see that more staff/faculty Zipcar users would have used a traditional rental car service than student respondents would have, and a greater portion of students would have used ridesourcing services than staff/faculty respondents would. These differences likely reflect generational modal choice contrasts between students and staff/faculty. See Table 8 below.

Table 8: Top Alternative Mode Choices by Student Type

Population Segment	Alternative Mode #1	Alternative Mode #2	Alternative Mode #3
Students (n=8881)	Used public transit (22%)	Not taken the trip (17%)	Uber/Lyft (15%)
Staff/Faculty (n=1019)	Used a traditional car rental company (22%)	Used public transit (17%)	Not taken the trip (14%)
Full-time Students (n=7824)	Used public transit (22%)	Not taken the trip (17%)	Uber/Lyft (16%)
Part-time Students (n=760)	Used public transit (19%)	Used a traditional car rental company (18%)	Not taken the trip (14%)
Undergraduate Students (n=4650)	Used public transit (24%)	Not taken the trip (20%)	Borrowed a car or got a ride from a friend/family member (15%)
Graduate Students (n=3934)	Used public transit (20%)	Uber/Lyft (16%)	Used a traditional car rental company (15%)
On-Campus Students (n=3451)	Used public transit (22%)	Not taken the trip (20%)	Uber/Lyft (17%)
Off-Campus Students (n=5422)	Used public transit (22%)	Not taken the trip (14%)	Uber/Lyft (14%)

Analyzing by land-use context, rural college/university market respondents have the largest proportion of respondents (23%) that claim they would not have taken their last trip in the absence of Zipcar. See Table 9 below. By contrast, only 15% of urban college/university market users said they would not have made the trip without Zipcar. This finding shows that college/university market users in rural campus settings experience a greater rise in mobility due to Zipcar than do those in urban settings. Respondents in rural areas have less access to a variety of mobility options than do urban respondents and thus may be more reliant on Zipcar for a greater proportion of trips.

Table 9: Top Alternative Mode Choices by Land-Use Context

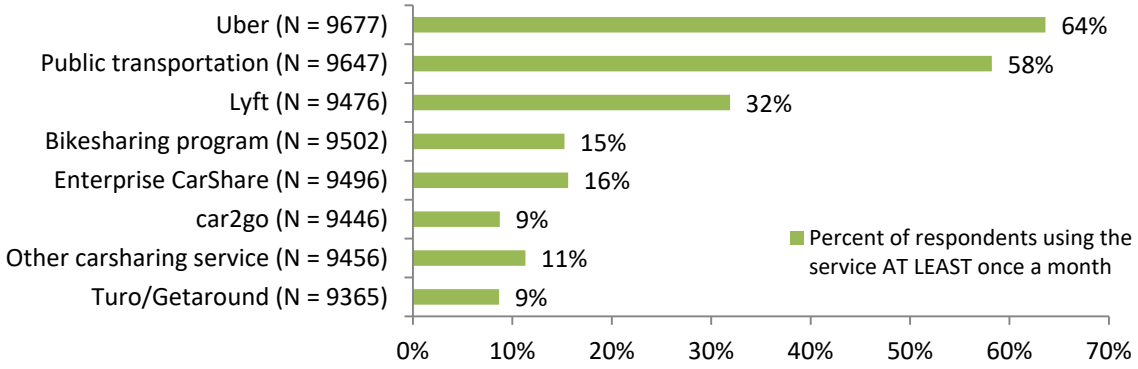
Urban Setting	Alternative Mode #1	Alternative Mode #2	Alternative Mode #3
Urban (n=6373)	Used public transit (21%)	Uber/Lyft (16%)	Not taken the trip (15%)
Suburban (n=3136)	Used public transit (21%)	Not taken the trip (17%)	Borrowed a car or got a ride from a friend/family member (15%)
Rural (n=422)	Used public transit (23%)	Not taken the trip (23%)	Borrowed a car or got a ride from a friend/family member (20%)

Public transit is the most common alternative among respondents across all three land-use contexts, and car borrowing seems to be more common in suburban and rural campuses than in urban areas. This is likely due to higher car ownership rates among peers in suburban/rural areas compared to peers in urban areas. It should be noted that while 15% and 20% of suburban and rural respondents, respectively, claimed they would have borrowed a car, only 11% of college/university market respondents both had access and are comfortable asking to borrow a vehicle. This suggests that many respondents would turn to borrowing a vehicle if they had to (if Zipcar were not available), but they are not fully comfortable in doing so and may prefer using Zipcar over making an awkward request.

Frequency of Use of Other Shared Modes

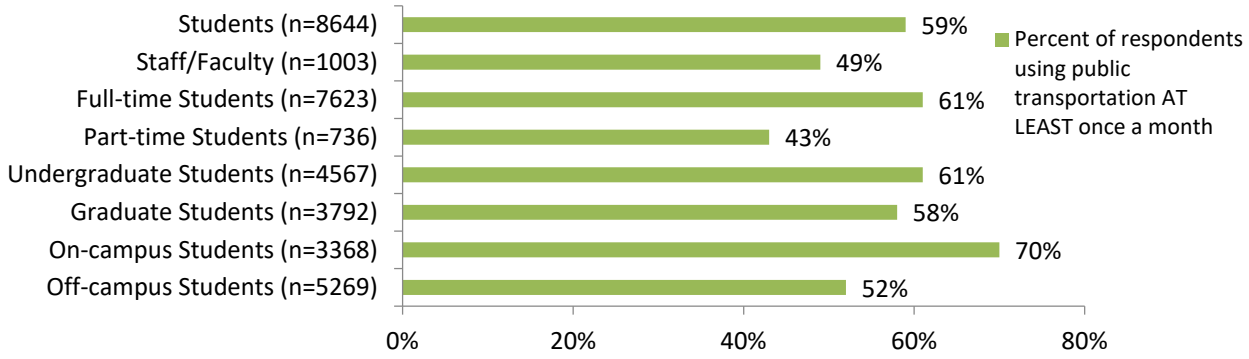
Zipcar college/university market members use other shared mobility services as well, with varying frequencies. Sixty-four percent of college/university market respondents use Uber at least once a month, 58% use public transportation at least once a month, and 32% use Lyft at least once a month. Zipcar college/university market members use other carsharing services less frequently than these other three services mentioned. See Figure 13 below.

Figure 13: Use of Other Shared Modes



On-campus student (n=3368) and full-time student (n=7623) respondents tend to use public transportation more frequently than off-campus students (n=5269) and part-time students (n=736). This is likely due to the lifestyle and travel need differences between these student population segments.

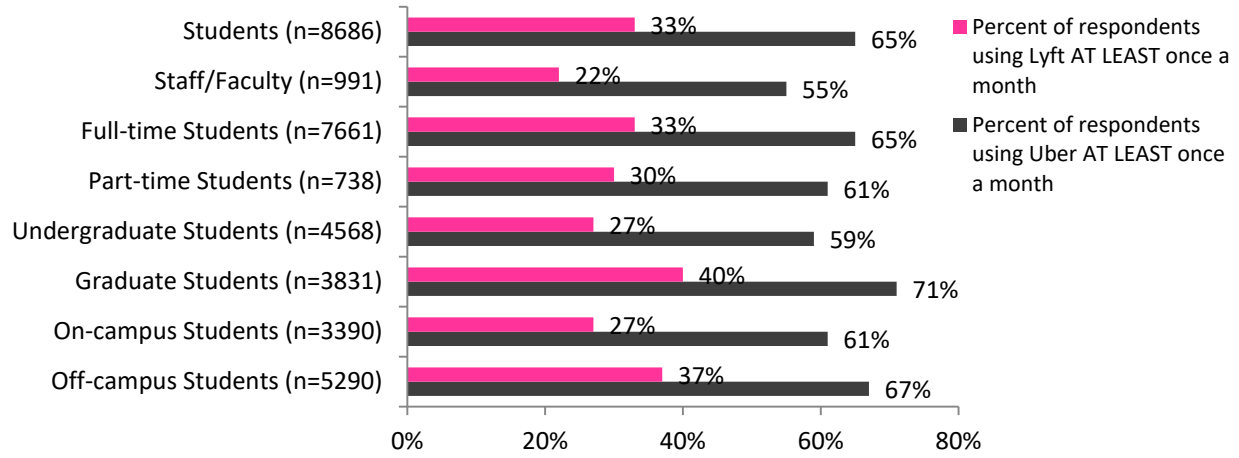
Figure 14: Public Transit Usage Frequency by Student Type



In addition, students tend to use ridesourcing services, like Lyft and Uber, more frequently than staff/faculty respondents, again most likely representing generational differences in travel mode choices. We also see that

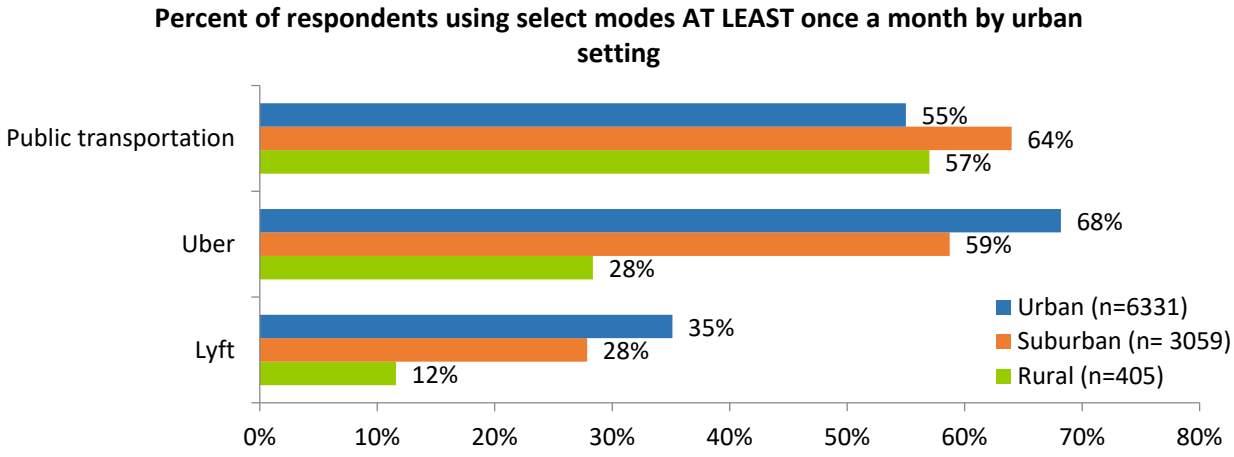
graduate students use ridesourcing services more frequently than undergraduate students. See Figure 15 below.

Figure 15: Ridesourcing Usage Frequency by Student Type



College/university market respondents at urban and suburban campuses also tend to use services like Lyft and Uber more often than those at rural campuses. This is likely due to the fact that these services are generally more prevalent in larger urban and metro areas. Surprisingly, suburban campus respondents have the highest proportion of respondents using public transportation more than once a month at 64%, compared to urban and rural campus respondents at 55% and 57%, respectively. This may be due to walking as a more prevalent mode at urban campuses as a viable alternative to public transportation in many cases. See Figure 16 below.

Figure 16: Public Transit and Ridesourcing Usage Frequency by Land-Use Context



Impacts on Personal Vehicle Holdings

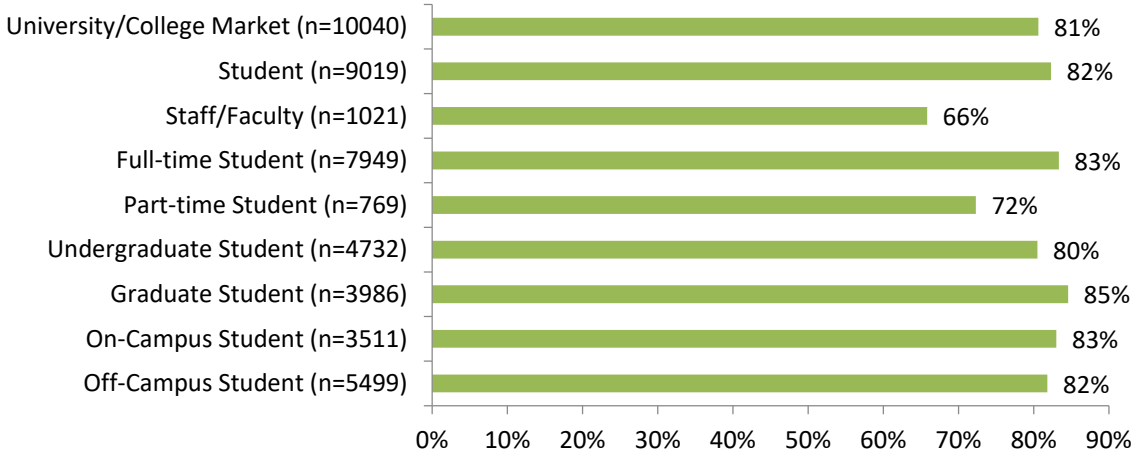
In this section, we discuss the impact of Zipcar on: 1) the private vehicle holdings of users, 2) vehicles sold and suppressed, and 3) vehicles avoided by on-campus students.

Private Vehicle Holdings of Users

Current vehicle ownership among college/university market Zipcar respondents differs among student type and staff/faculty status. In Figure 17, we see the percentage of respondents by student/staff grouping that

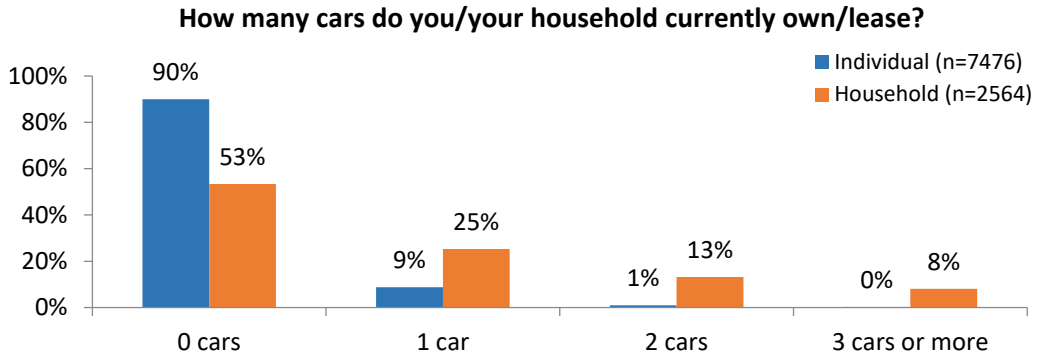
currently own zero vehicles. The numbers reflect all respondents, so the figure combines both zero-car individuals and zero-car households. Eighty-two percent of student respondents do not currently own a vehicle, whereas this rate drops to 66% for staff/faculty respondents. Graduate students have the highest share of zero-car owners out of the student types, with 85% that currently own no vehicles.

Figure 17: Zero-Car Owners by Student Type



The individual and household distinction also plays an important role when presenting vehicle ownership numbers. Based on how we classified the respondent in the beginning of the survey, they were subsequently asked about either their own individual or their household's vehicle holdings. This makes a large difference in number of vehicles owned/leased due to the distinction between an individual and household unit of measurement. Among college/university market respondents classified as individuals, only 10% own one or more vehicles, while 47% of households own one or more vehicles. Of respondents classified as individuals, 9% own one vehicle, and 1% own two or more vehicles, while 25% and 21% of households own one vehicle and two or more vehicles, respectively.

Figure 18: Vehicle Ownership by Individual and Household Classification



It should be noted that while individual and household classifications are undoubtedly important in contributing to vehicle holdings, the majority of students (78%) are classified as individuals and many own few or no cars, so the student respondents tend to own very few cars, in general.

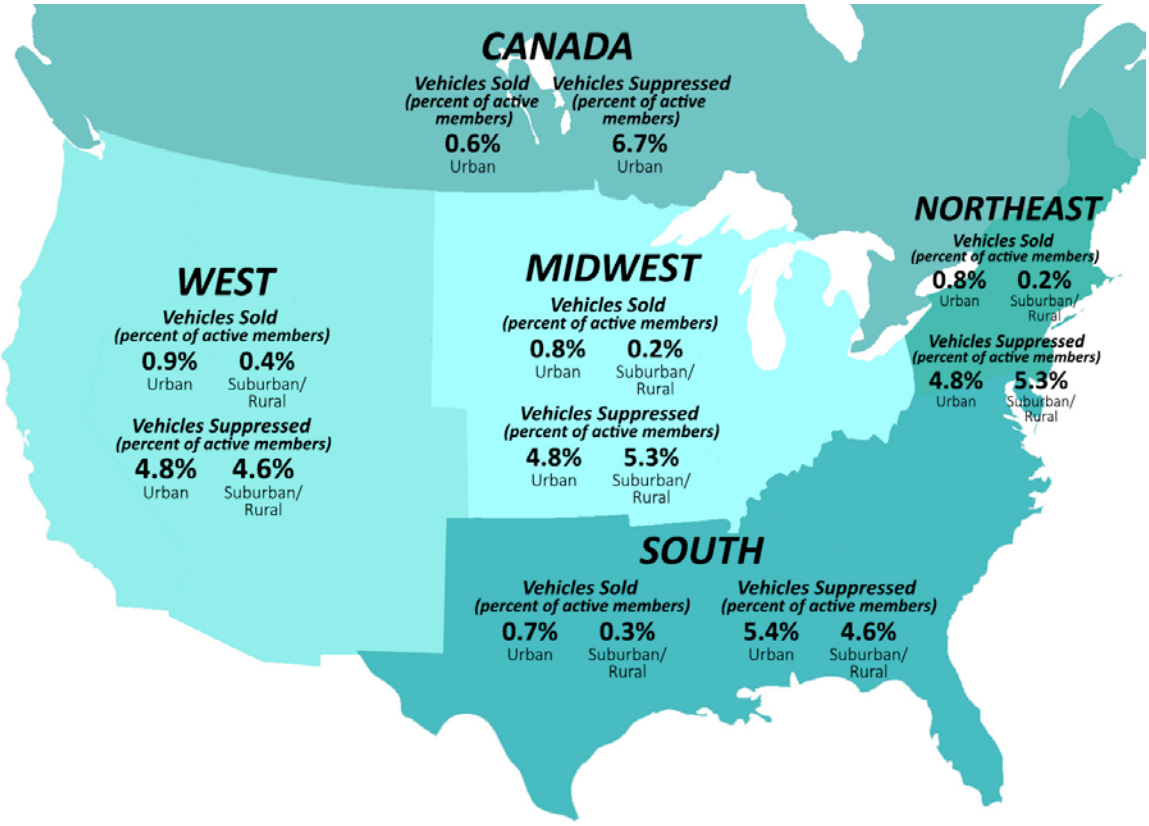
Vehicles Sold and Suppressed

A major impact of Zipcar, and carsharing in general, is that it allows some users to sell a previously owned personal vehicle due to joining a carsharing organization. In our study, this equates to vehicles of college/university market members that were sold due to Zipcar. In addition, Zipcar has a personal vehicle suppression effect as well, meaning that the availability of Zipcar removes the need for some members to acquire a vehicle. We measured these impacts by region and land-use context, and the results are displayed in Figure 19. Suburban and rural members were combined for this analysis because the respondent sample of rural users alone was small. Further, suburban and rural users display similar vehicle and driving impacts. For Canada, we only include the impacts on urban college/university market members because the Canadian suburban/rural respondent sample size was too small. We weighted the impacts on the surveyed sample by frequency of usage to reflect the entire Zipcar college/university member base, as discussed in the methodological section.

A larger proportion of college/university members in urban campus settings sold a vehicle due to Zipcar than those in suburban/rural settings. Across the urban campuses, 0.6% to 0.9% of members sold a vehicle due to Zipcar in contrast to 0.2% to 0.4% of members across suburban/rural campuses. This pattern suggests that urban form plays a key role in enabling Zipcar members to shed a personal vehicle. This effect may be due to the breadth of transportation options available for urban users to rely on to get around than in suburban or rural campus settings. Private vehicle owners in urban areas are also likely to have higher costs of car ownership in the form of insurance costs and parking rates, which may also explain the difference in impact. All sold and suppressed vehicle rates are significant at the 95% level, with the exception of: South suburban/rural, Midwest suburban/rural, Northeast suburban/rural, and Canada urban.

Across all regions and land-use contexts, the suppression effect of Zipcar is larger than the shedding effect. Unlike the shedding effect, the suppression effect varies less by land-use context, but it depends more on the region of North America. The suppression percent ranges from 3.6% to 6.7% across all regions and land-use context groupings, meaning this percent range of college/university members put off buying a vehicle due to Zipcar. Canadian members residing in urban campus settings see the largest suppression effect, at 6.7 percent. Members affiliated with campuses in the Northeast U.S. have the lowest suppression rates, at 3.6% for urban campus members and 4.3% for suburban/rural members. This may be due to older, denser college campuses in the Northeast, where members feel there are more alternatives to meet their mobility needs. Therefore, Zipcar may have less of an effect on keeping members from purchasing a personal vehicle. This is contrasted with the suppression rates of schools in the South and Midwest, for instance, where 4.6% to 5.4% of members did not acquire a vehicle due to Zipcar. This suggests that the suppression effect of Zipcar is more pronounced among college/university members who reside in parts of North America that are traditionally more reliant on personal vehicles to get around. See Figure 19 below.

Figure 19: Sold and Suppressed Vehicle Rates by Region and Land-Use Context



In the overall college/university market, these impacts equate to 0.6% of members who sold a vehicle due to Zipcar, and 4.6% who suppressed (or avoided) a vehicle purchase because of Zipcar, meaning that 5.2% of college/university market members sold or put off purchasing a vehicle due to Zipcar. These rates are an aggregate of the weighted sold and suppressed rates by region and land-use context.

After re-weighting to determine which surveyed members sold a vehicle due to Zipcar, we see that certain types of members are more heavily represented than others. Sixty-one percent of respondents shedding a vehicle were classified as individuals, and 39% were classified as households. This represents a larger proportion of households than exist in the overall respondent sample, as only 26% are classified as a household across all the college/university market respondents. This suggests that respondents deemed households are slightly more likely to sell a vehicle due to Zipcar than are those defined as individuals. Similarly, 26% of shedding respondents are staff/faculty, whereas only 10% of the entire college/university market respondents are staff/faculty. In addition, 58% of the student respondents who sold a vehicle due to Zipcar are graduate students, while 44% of the student respondent population are graduate students. These respondent proportion comparisons show that some types of members might be able to more readily adapt to using carsharing in place of a vehicle they own.

It should also be noted that we quantified vehicle sold and suppression effects by region and land-use context and not by student and staff/faculty type because the re-weighting employed prohibited impacts to be calculated by this type of member disaggregation. Zipcar's member data do not track student type when a member signs up (e.g., undergraduate or graduate student). Thus, we could not weight the sold and suppressed rates by population usage frequency, as the data required to perform this weighting simply do not exist. However, from the preliminary unweighted analysis, students show lower sold vehicle effects than do staff/faculty likely due to lower vehicle ownership rates in general among the student population (students have less vehicles to sell). Students tend to show higher suppression rates than staff/faculty members, overall.

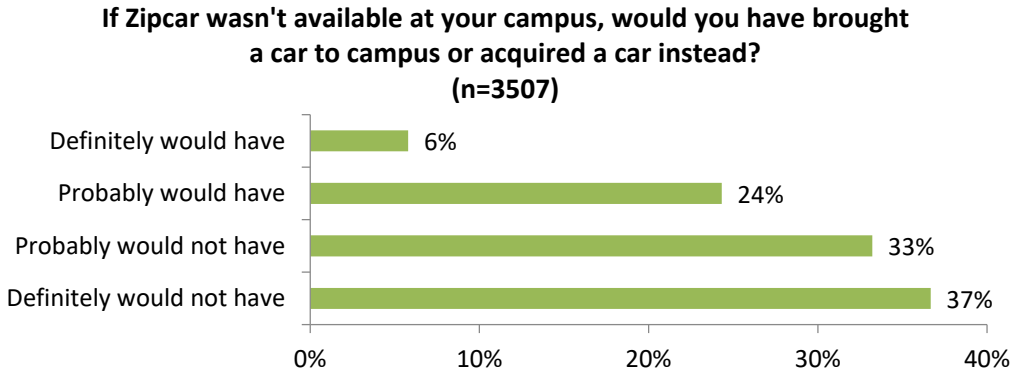
The subsequent VMT and GHG emission reduction sections use the same regional and land-use context groupings outlined in this section.

We witness lower sold and suppression effects in the college/university market than seen in previous carsharing studies, due to the unique nature of mobility needs and decisions among college/university users compared to the general population. Many college/university settings in North America are designed to be navigated without a vehicle, and the low incomes and low-distance travel needs of students contribute to low vehicle ownership rates among college/university members. This is a main reason why the sold and suppression effects of Zipcar are not as large as in previous studies because Zipcar acts more as an additional form of mobility for much of the college/university market instead of as a replacement travel mode for a personal vehicle. Many students do not have the financial means or routine travel demands that warrant purchasing a personal vehicle; thus, Zipcar's impact on vehicle holdings is inherently different for the college/university population. It augments local mobility, while substituting for personal vehicle ownership among a small portion of the population.

Vehicles Avoided by On-Campus Students

Also of importance to our study was the effect Zipcar has in preventing on-campus students from bringing a personal vehicle when first coming to campus or acquiring a vehicle when they arrived to campus. The survey asked respondents who identified themselves as on-campus students if they would have brought or acquired a vehicle when they came to campus, if Zipcar were not available. This metric is similar to the suppressed personal vehicle metric discussed earlier, but it is slightly different because it asks what the respondent would have done in the past. Out of the on-campus student respondents, 30% would have brought a car to campus or purchased a vehicle, if Zipcar had not been available at their campus. Although these are unweighted survey results, this finding shows that Zipcar is preventing many on-campus students from bringing a vehicle to campus in the first place by helping students adjust to a travel lifestyle without owning a personal vehicle at their new campus. See Figure 20.

Figure 20: On-Campus Students Who Did Not Bring Car to Campus



Impact on Vehicle Miles Traveled (VMT) and Greenhouse Gas (GHG) Emissions

In addition to reducing the number of vehicles owned by college/university market Zipcar members, we see a reduction in miles driven and GHG emissions by Zipcar members due to joining. These reduced vehicle miles come from members getting rid of their vehicles as well as members postponing a vehicle purchase, as discussed in the previous section. VMT and GHG reduction numbers were divided and displayed by region and land-use context to account for regional and land-use differences among college/university market members. The groupings line up with the same region and land-use context groupings used previously for sold and

suppressed vehicle calculations. Results are displayed in Figure 21 below.

Figure 21: VMT and GHG Reduction by Region and Land-Use Context

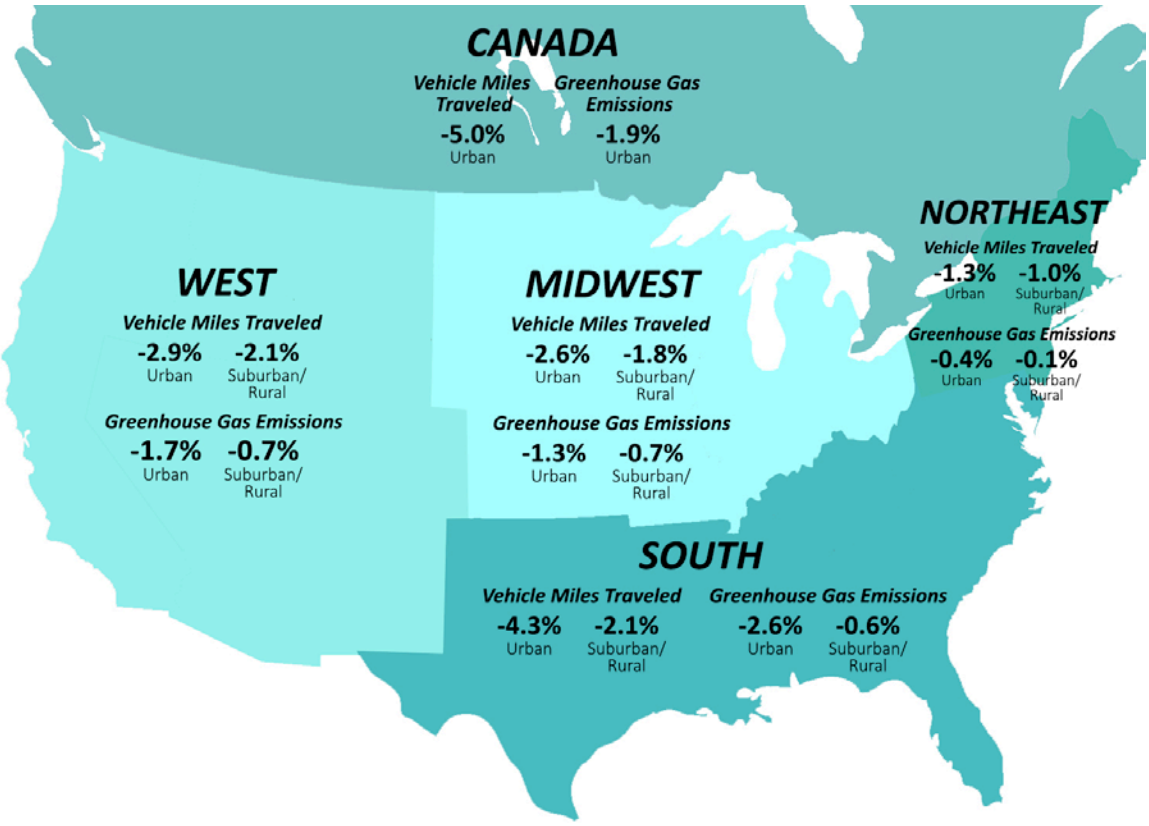


Table 10 below outlines the VMT reduction calculations in detail, and it shows the number of personal vehicles sold and suppressed for each region and land-use context group, the change in miles driven due to Zipcar, and the percentage change in miles driven due to Zipcar.

The VMT change results show that members in urban campus settings tend to have greater VMT reduction impacts than do members in their corresponding suburban/rural setting by region. This is due in part to the higher sold vehicle rates among urban campus members compared to suburban/rural campus members, as discussed earlier. Another factor is that members in suburban/rural settings also tend to have driven more miles on average before joining Zipcar than did members in urban settings. This leads to a comparatively smaller percentage reduction in VMT for suburban/rural campus members, because they were driving more on average before joining Zipcar than their urban campus counterparts.

Percent VMT reduction impacts also vary by region of North America, as members at Southern and Canadian urban campuses see some of the largest percent VMT reductions, at 4.3% and 5.0%, respectively. For Canadians, this is due to their large suppression rate and low miles driven before joining Zipcar, as 6.7% avoided purchasing a vehicle and the group drove the least on average before joining Zipcar (2,855 mi/year). Members at urban campuses in the South show similar patterns. Members in the Northeast show the lowest percentage VMT reductions comparatively due to their lower sold and suppressed vehicle rates and their large college/university market member base. The Northeast has the largest number of college/university market members of any region, so the absolute number of miles driven on Zipcars by members in that region contributes to lower percentage reductions in VMT. However, members at Northeastern urban campuses have

the third highest total net VMT change of any group, at a reduction of about 3.1 million miles per year.

Table 10: Vehicle Miles Traveled (VMT) Impact Estimates

	West		South		Midwest		Northeast		Canada
	Urban	Suburban /Rural	Urban	Suburban /Rural	Urban	Suburban /Rural	Urban	Suburban /Rural	Urban
Number of Vehicles Shed by Active Members	287	127	162	62	198	18	539	67	74
Number of Vehicles Suppressed by Active Members	1572	1475	1351	1043	1213	407	2516	1236	806
Annual VMT Reduced by Vehicles Shed (mi/yr)	1,803,662	661,851	1,340,912	366,203	1,319,298	157,283	3,835,932	543,920	440,571
Annual VMT Reduced by Vehicles Suppressed (mi/yr)	7,912,840	7,086,802	6,775,158	4,936,397	5,914,090	1,659,976	12,644,837	5,388,801	4,355,392
Total Estimated VMT Eliminated by Zipcar (mi/yr)	9,716,502	7,748,653	8,116,070	5,302,600	7,233,388	1,817,259	16,480,769	5,932,721	4,795,963
Number of College/ University Market Zipcar Members	32,621	31,924	24,811	22,898	25,380	7,645	69,000	28,556	12,082
Estimated Zipcar VMT (11/1/14 - 10/31/15)	6,200,802	5,278,668	4,386,747	3,672,087	5,007,504	1,195,540	13,367,512	4,705,536	3,057,894
Estimated Total Net VMT Change (11/1/14 - 10/31/15)	-3,515,700	-2,469,985	-3,729,322	-1,630,513	-2,225,884	-621,720	-3,113,257	-1,227,185	-1,738,068
Estimated Change in VMT per Member	-108	-77	-150	-71	-88	-81	-45	-43	-144
Average Before Zipcar VMT per Zipcar Member	3695	3767	3519	3440	3355	4476	3455	4220	2855
Percent Reduction in VMT per College/ University Zipcar User	**-2.9%**	**-2.1%**	**-4.3%**	**-2.1%**	**-2.6%**	**-1.8%**	**-1.3%**	**-1.0%**	**-5.0%**

Change in GHG emissions among college/university members due to Zipcar is an important metric in assessing the environmental impacts of campus carsharing, and follows closely with the regional and land-use context trends we see for VMT change. Similar to VMT impacts, Zipcar reduces GHG emissions for all region and land-use context groups. The percentage reductions in GHG emissions are not as large as the percent VMT reductions due to the conservative assumption that suppressed vehicles (personal vehicles that would be purchased today, if Zipcar were not available) get 42 mpg and are fairly fuel efficient.

Similar to the percent VMT reduction, urban campus areas tend to have greater percent GHG emission reductions than do their corresponding suburban/rural campuses by region. GHG emission reductions span from 0.4% to 2.6% among urban campuses settings by region and 0.1% to 0.7% for suburban/rural campuses by region, respectively. This is largely driven by the VMT reductions of the coinciding region and urban setting group. Unlike the percent VMT reduction patterns, urban campuses in the South see the highest percent GHG reduction impact out of the groupings, while urban Canadian campuses see the highest percent VMT change. This is due to differences in average fuel economy of shed vehicles between the groups (33.8 mpg urban Canada and 24.4 urban South) and to the higher proportion of VMT reduction due to suppressed vehicles among urban campus Canadian members. The GHG reduction impacts are not as large because the sold vehicles vary in how fuel efficiency and suppressed miles have a relatively lower impact due to the assumption that these vehicles attain 42 mpg.

Table 11: Greenhouse Gas (GHG) Emissions Impact Estimates

	West		South		Midwest		Northeast		Canada
	Urban	Suburban /Rural	Urban	Suburban /Rural	Urban	Suburban /Rural	Urban	Suburban /Rural	Urban
Average Fuel Economy of Shed Vehicles (mpg)	23.3	27.2	24.4	27.3	24.6	28.0	27.3	24.9	33.8
Fuel Not Consumed by Shed Vehicles (gallons of gasoline)	77,491	24,322	55,013	13,411	53,606	5,617	140,328	21,854	13,029
Annual GHG Emissions Prevented by Shed Vehicles (t/yr)	689	216	489	119	476	50	1,247	194	116
Fuel Not Consumed by Suppressed Vehicles (gallons of gasoline / yr)	188401	168733	161313	117533	140812	39523	301068	128305	103700
Annual GHG Emissions Prevented by Suppressed Vehicles (t/yr)	1674	1500	1434	1045	1251	351	2676	1140	922
Estimated Zipcar Emissions (t/yr)	1670	1422	1181	989	1349	322	3600	1267	824
Net Annual Emissions Change due to Zipcar (t/yr)	-697	-296	-740	-175	-380	-78	-331	-67	-226
Annual Emissions Change per Zipcar user	-0.02	-0.01	-0.03	-0.01	-0.01	-0.01	0.00	0.00	-0.02
Average Before Zipcar GHG Emissions per user	1.26	1.32	1.15	1.18	1.13	1.50	1.19	1.57	0.91
Percent Reduction in GHG per Zipcar user	**-1.7%**	**-0.7%**	**-2.6%**	**-0.6%**	**-1.3%**	**-0.7%**	**-0.4%**	**-0.1%**	**-1.9%**

Generally, these are lower VMT and GHG reduction impacts than we have witnessed in previous carsharing studies due to the unique travel needs of college/university carsharing members. The VMT and GHG reduction from vehicles shed alone does not offset the additional VMT and GHG emissions due to driving on Zipcars, which is a unique finding of the college/university carsharing market. As discussed, college/university members are a lot less likely to have the financial means or social need to own a personal vehicle and thus have lower driving and emission impacts due to Zipcar. Overall, when considering both sold and suppressed vehicles, the VMT and GHG impacts are negative (reductions) across all regions and land-use contexts.

We calculated the VMT and GHG reduction numbers by region and land-use context and not by student and staff/faculty type due to data weighting limitations as noted earlier. Although a weighted number by student type is not able to be calculated as part of this study, we do know that the unweighted vehicle sold rate is higher for staff/faculty than for students, but the suppressed vehicle purchase rate is higher for students than it is for staff/faculty. Much of the VMT and subsequent GHG emission reductions among the college/university

market are driven by the suppression effect and although a greater proportion of faculty/staff sell vehicles due to Zipcar, the VMT and GHG reduction among students is likely an overall reduction, as well, due to a larger proportion who postpone purchasing a vehicle due to Zipcar.

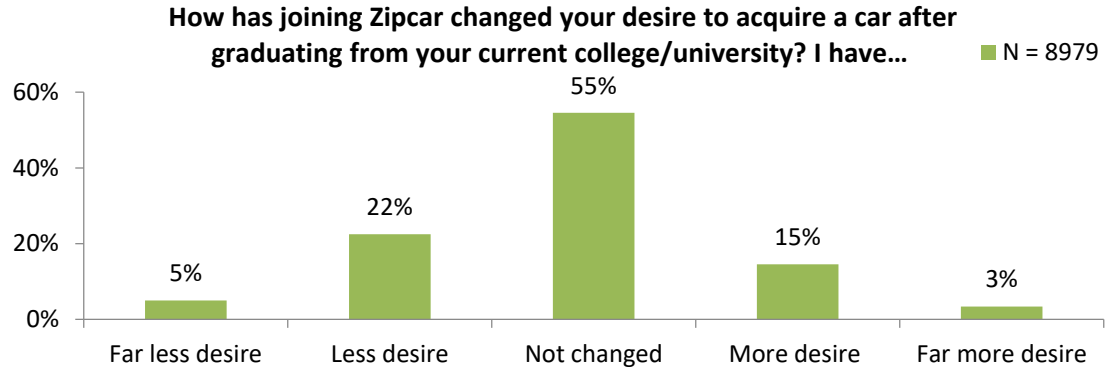
Impact on Future Vehicle Intentions of Students

A long-standing question in college/university carsharing has been the impact of this mode on future vehicle purchasing intentions. In this section, we discuss Zipcar's impact on future vehicle purchasing behavior and the future vehicle wants and needs of students.

Zipcar's Impact on Future Vehicle Purchasing Behavior

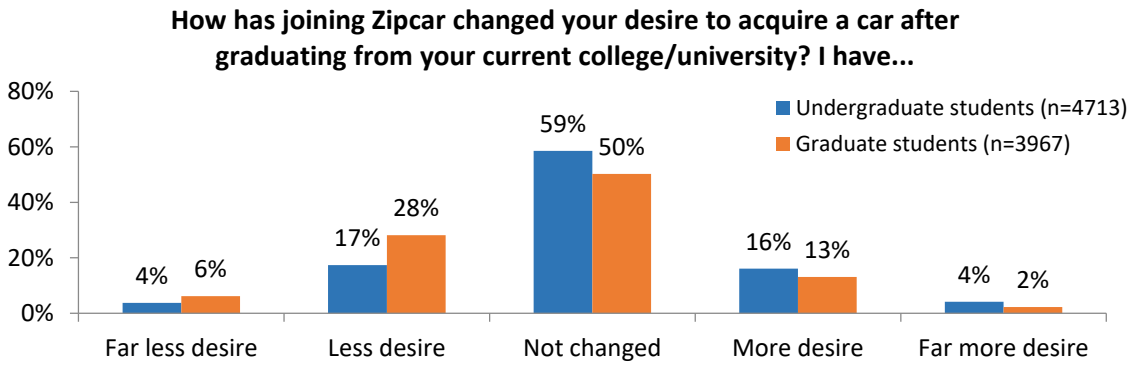
As a result of joining Zipcar, 42% of college/university market members are less likely to acquire a car in the next few years. This impact still exists, but it is slightly diminished when student respondents are asked about their desire to acquire a car after graduation. Twenty-seven percent of college/university student members claim Zipcar has decreased their desire to acquire a vehicle after graduating in contrast to 18% claiming that Zipcar has increased their desire to obtain an automobile after graduating. See Figure 22 below.

Figure 22: Zipcar's Impact on Future Vehicle Purchase Intentions of Students



Due to Zipcar, we see a stronger impact on desire not to acquire a car after graduation among graduate student respondents and a weaker future suppression effect for undergraduates. Of undergraduate student respondents, 21% claim to have less desire to purchase a car after graduating due to Zipcar, and 20% have more desire— equating to an almost neutral overall response. However, 34% of graduate student respondents have less desire to purchase a vehicle after graduation due to Zipcar, compared with only 15% who claim to have more desire. This difference between undergraduate and graduate students is likely due to the projected lifestyle change of undergraduates, who expect that their living and/or working situations will change dramatically in the near future, which could require them to obtain a vehicle. Graduate students who are older and less likely to vary their lifestyle in the next few years show a larger impact of suppressing a vehicle in the future due to Zipcar. See Figure 23 below.

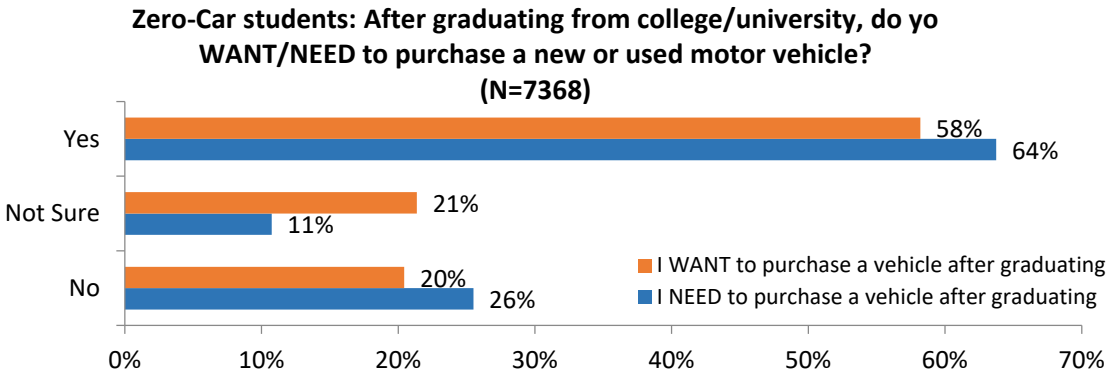
Figure 23: Zipcar's Impact on Future Vehicle Purchase Intentions, Undergraduate vs. Graduate Student



Future Vehicle Wants and Needs Analysis of Students

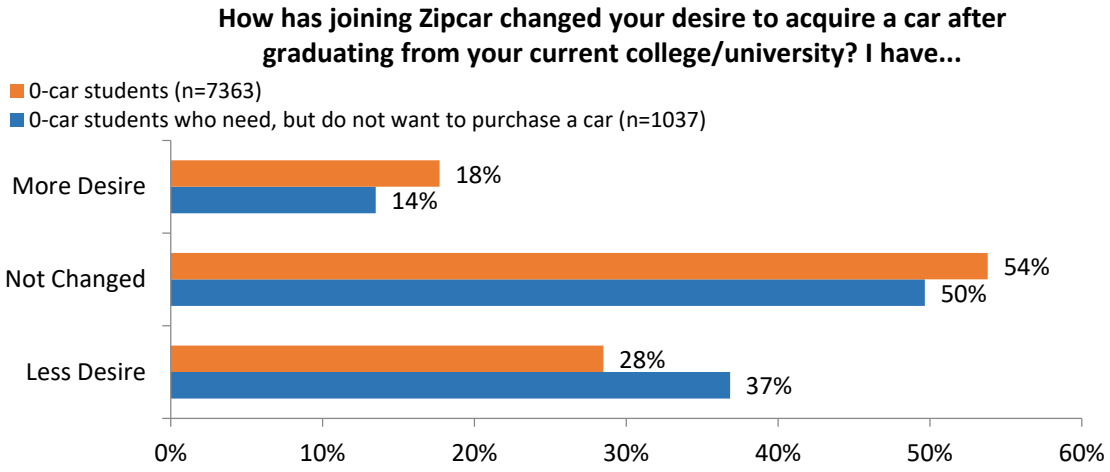
We asked student members a few additional questions regarding their future vehicle wants and needs after graduating from their current university. For student vehicle wants and needs after graduating, we focused on students who own no cars at present and compared this population's projected vehicle wants with their projected vehicle needs. As seen in Figure 24 below, there is a larger proportion of students who claim they will need a vehicle after graduating than who want a vehicle after graduating. There is also a good proportion of students who are not sure if they want to purchase a vehicle after graduating (21%), whereas students tend to have a more definite idea of their vehicle needs after graduating (only 11% are not sure of their vehicle needs).

Figure 24: After Graduating Vehicle Desires of Zero-Car Students



We find that there is a significant portion of respondents (n=1,037 or 14% of zero-car students) that claimed they will need to purchase a vehicle after graduating from their current university, but they do not want or are not sure, if they want to purchase a vehicle after graduating. These members who feel they need, but do not necessarily want, to purchase a vehicle after graduating represent a population that is undecided but realistic about possible car ownership. When we look at these 1,037 respondents, we see that Zipcar more heavily decreased their desire to own a car after graduation than it did for the entire zero-car student population. Thirty-seven percent of these respondents have less desire to own a car after joining Zipcar, compared to 28% of the overall zero-car student population who have less desire. This finding suggests that Zipcar encourages students who are unsure of their vehicle intentions after graduating to continue living a car-free or car-light lifestyle even after college. See Figure 25 below.

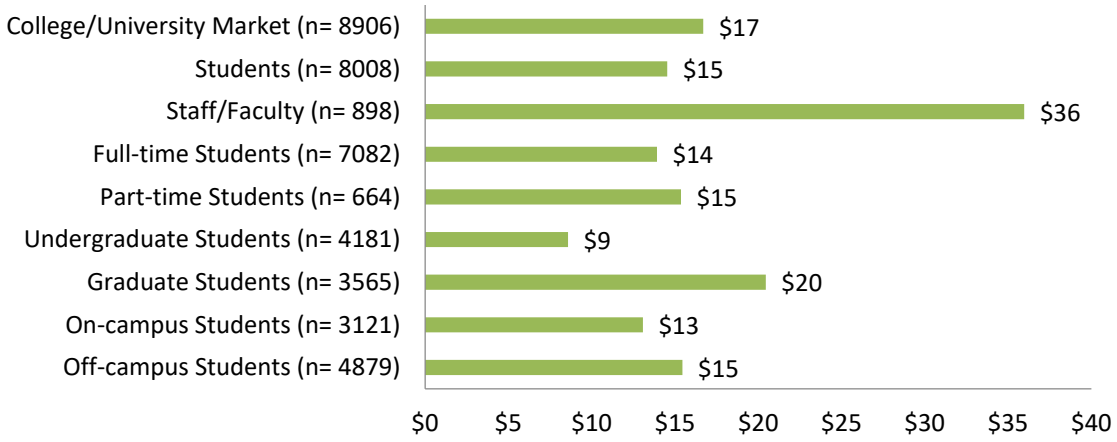
Figure 25: Zipcar's Impact on Future Vehicle Desire of Zero-Car Students Who Need But Do Not Want A Personal Vehicle



Savings Analysis

Forty-three percent of college/university market respondents say that they save money on transportation due to Zipcar. Of these members, groceries/food, savings, and school expenses are the three most common categories in which they spend that money saved. The average amount of money saved on transportation as a result of joining Zipcar for the overall college/university market is $17 per month. Staff/faculty respondents save the most amount of money on transportation expenses on average at $36 per month, and undergraduates save the least amount of money per month at $9. These transportation savings differences among the populations reflect that users who had higher transportation expenses before joining Zipcar (staff/faculty, graduate students) saved more money than those who were less likely to have high transportation expenses before joining (undergraduates, full-time students). Not surprisingly, the savings were more pronounced among the college/university market segments that started with higher transportation expenses before joining Zipcar. See Figure 26 below. It is important to note that some students had higher transportation costs due to the costs of Zipcar membership and low overall transportation costs.

Figure 26: Average Monthly Savings on Transportation Expenses by Student Type



Of respondents indicating they save money due to Zipcar, groceries/food and savings are the two most popular spending categories of saved money for all college/university market population segments. The third most

popular spending categories vary across student and staff/faculty segments, with generally younger students (full-time, undergraduate, and on-campus students) electing to spend the saved money on school expenses, while older students (part-time, graduate, and off-campus students) and staff/faculty choosing to spend savings on rent/mortgage payments. See Table 12 below.

Table 12: Top Transportation Expense Savings by Student Type

Population Segment	Category #1	Category #2	Category #3
Students (n=3734)	Groceries/Food (56%)	Savings (52%)	School (41%)
Staff/Faculty (n=466)	Savings (54%)	Groceries/Food (39%)	Rent/Mortgage Payment (36%)
Full-time Students (n=3284)	Groceries/Food (57%)	Savings (52%)	School (42%)
Part-time Students (n=321)	Savings (49%)	Groceries/Food (47%)	Rent/Mortgage Payment (40%)
Undergraduate Students (n=1778)	Groceries/Food (60%)	Savings (52%)	School (51%)
Graduate Students (n=1827)	Groceries/Food (52%)	Savings (51%)	Rent/Mortgage Payment (35%)
On-Campus Students (n=1375)	Groceries/Food (58%)	Savings (53%)	School (49%)
Off-Campus Students (n=2356)	Groceries/Food (55%)	Savings (51%)	Rent/Mortgage Payment (40%)

Key Takeaways

We found that Zipcar has a diverse range of impacts on college/university carsharing members, and the magnitude of impacts often depend on student, staff, and faculty type, region, and land-use context. Many of the college/university market members do not own a personal vehicle, and thus the impacts of carsharing on this population follow certain patterns.

Due to the availability of Zipcar, a higher proportion of college/university market respondents use public transit and ridesourcing services less often than those who use these services more often. This result is driven by generally low vehicle ownership rates among the respondent population. Given access to a vehicle in a shared fleet with no prior access to any vehicles, college users substitute Zipcar trips for trips they used to make using the modes for which they had access.

A small proportion of college/university members either sell or postpone purchasing a personal vehicle due to Zipcar, largely due to the low vehicle ownership rates and incomes, as well as unique travel needs among the college/university population. The suppression effect of Zipcar is larger than the shedding effect due to low vehicle ownership rates and the fact that carsharing is now a known option among most college students, many of whom view shared mobility options like Zipcar as commonplace. A higher proportion of members at urban campus settings sell a vehicle due to Zipcar than those that do the same at suburban or rural campuses. Zipcar also has a sizeable effect on encouraging on-campus students to leave a vehicle at home, as 30% of on-campus respondents claim, if Zipcar were not available they would have brought a car to campus.

The impact on driving and GHG emissions of Zipcar on the college/university market is a net reduction in both

measures. Percent VMT and GHG emission reductions vary by region and land-use context, and users in urban campus settings have greater percentage reductions than do members in their corresponding suburban/rural campuses by region. This effect is due to the higher sold vehicle rates among urban campus members, and the fact that suburban/rural members drive more miles on average than do urban members before joining Zipcar. Although the impacts on VMT and GHG emissions are not as sizeable as in past neighborhood carsharing studies, the impact is a net reduction.

Carsharing improves quality of life (QoL) of college/university members across many aspects (e.g., variability in experiences, accessibility, and flexibility, among others). These impacts vary by usage, geographic region, and student type. Surprisingly, students who sold a vehicle due to joining Zipcar experience an increase in QoL aspects associated with car ownership like freedom, flexibility, and privacy, when compared to students who did not sell a vehicle.

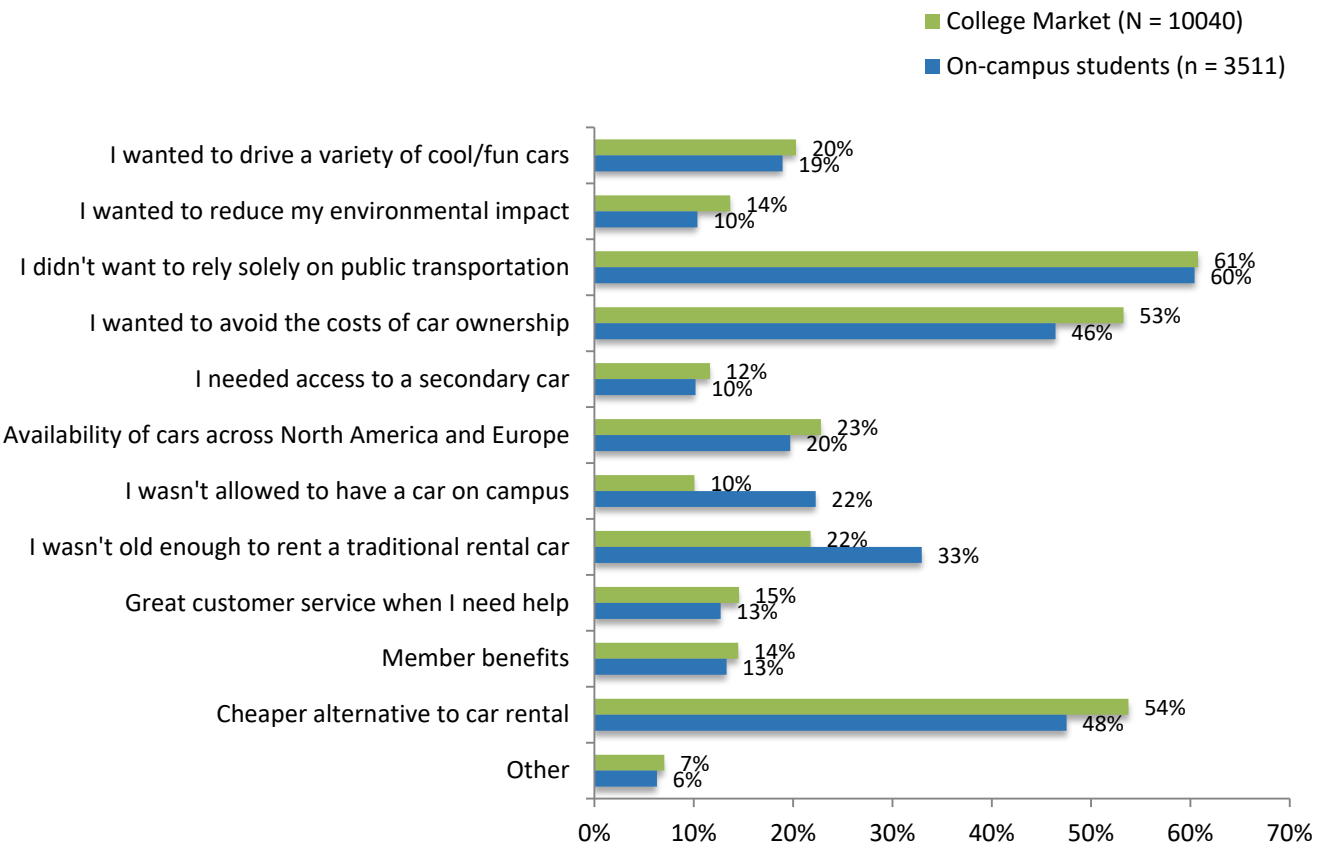
Another finding is the impact college carsharing has on future vehicle purchasing. There is a group of student respondents who claim to need a private vehicle after graduating but do not want or are not sure if they want to purchase a vehicle after graduating. Among this group, Zipcar has more heavily decreased their desire to own a car after graduation than it did for the rest of the population. For some members, Zipcar acts as a training period to encourage future vehicle-light lifestyles of certain members, even after graduating from their current college or university. Overall, the results of this study suggest that Zipcar college/university carsharing is notably impacting miles driven, GHG emissions, quality of life, travel behavior, personal vehicle purchasing intentions, and the transportation expense savings of members.

Appendix

Reasons for Joining Zipcar

College/university market members joined Zipcar for a variety of reasons. The top three reasons members joined Zipcar were: 1) they did not want to rely solely on public transportation; 2) it is cheaper than car rental; and 3) they wanted to avoid the costs of car ownership. Twenty-two percent of the college/university market cited that they were not old enough for traditional car rental as a reason for joining.

Figure A1: Reasons for Joining Zipcar

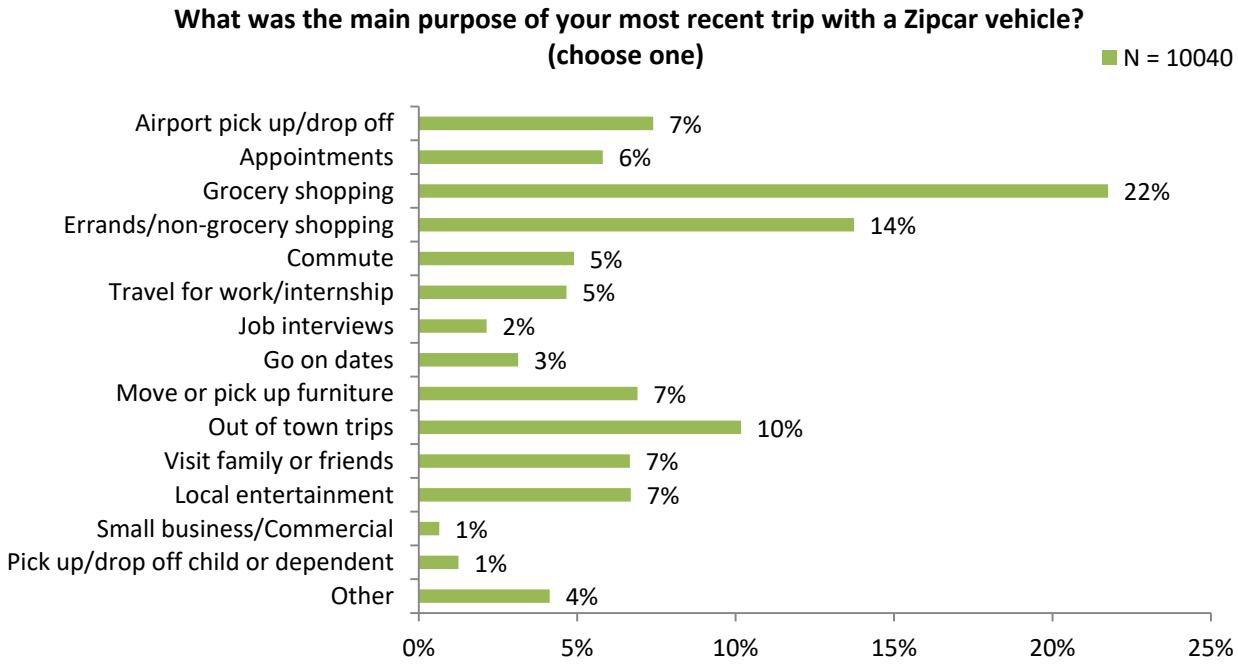


Among on-campus student Zipcar respondents, 22% claimed they were not allowed to have a car on campus as a reason, and 33% claimed they were not old enough to rent from a traditional car rental company.

Trip Purposes

The survey also asked respondents to categorize their most recent trip with a Zipcar vehicle. We gave the respondents a series of possible trip purposes and asked them to choose the one that best described their most recent trip.

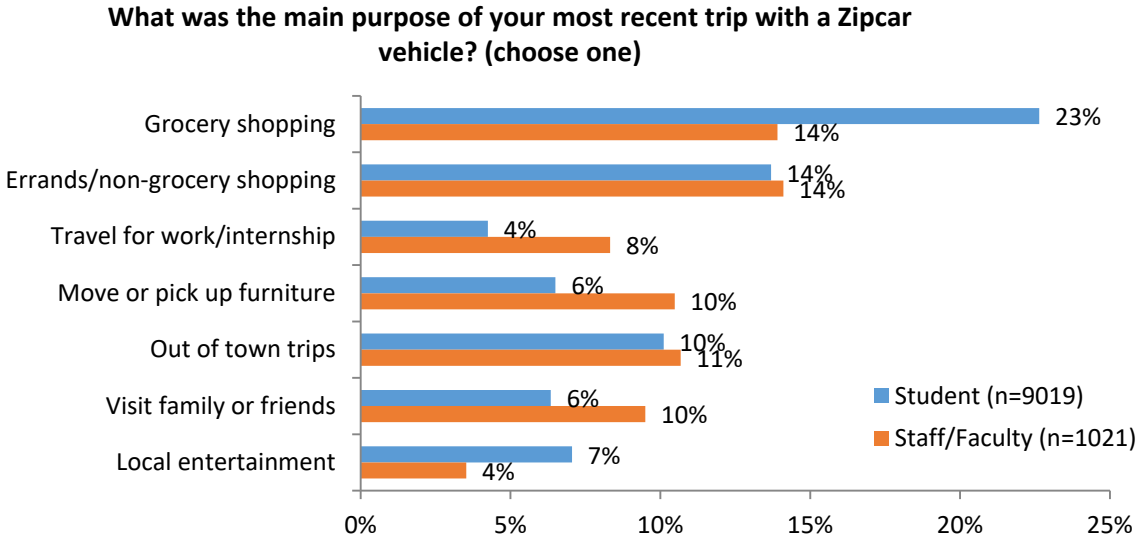
Figure A2: Purpose of Most Recent Zipcar Trip



Grocery shopping is the most common Zipcar trip purpose among college/university market respondents for their most recent trip, followed by errands, out of town trips, airport pick up/drop off, and local entertainment.

For most recent trip purpose, we observe some differences between the types of trips taken by students and the types of trips taken by staff/faculty.

Figure A3: Purpose of Most Recent Trip, Student and Staff/Faculty



Student respondents tend to take grocery shopping trips using Zipcar more often than do staff/faculty respondents. Staff and faculty members use Zipcar more often than students for trips like visiting family or friends. This may be due to the more geographically-condensed nature of social activity among

college/university students, where many of their friends live close by. Staff/faculty may have friends and family that they visit frequently over a wider geographic area, which could constitute vehicle trips for this purpose.

Land-use context also plays a factor in trip purpose, 11% of urban campus college/university market users took an out-of-town trip for their most recent trip, as compared to 8% of suburban respondents who made an out-of-town trip. This shows that Zipcar allows urban college/university market users to take a break from the city compared to suburban users who use it slightly less often for this purpose.

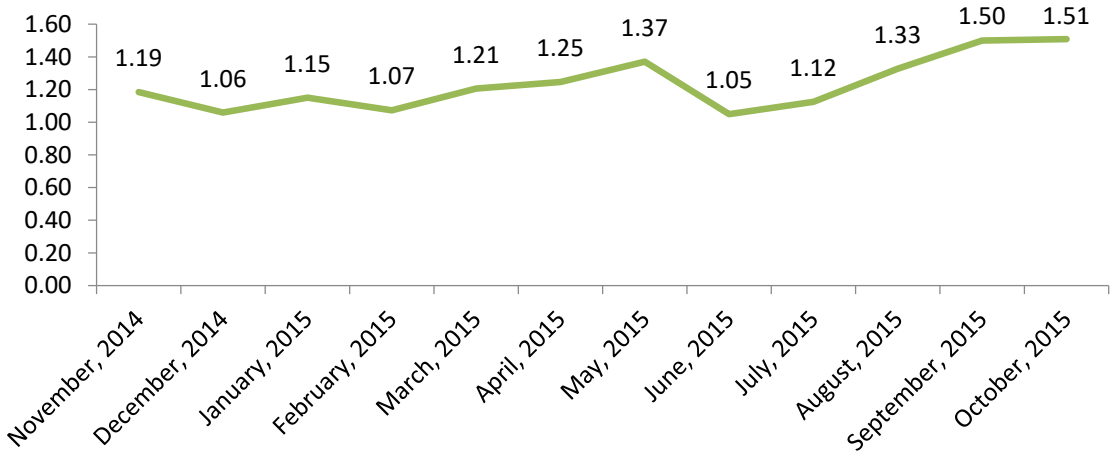
Table A1: Top Trip Purposes by Land-Use Context

Urban Setting	Trip Purpose #1	Trip Purpose #2	Trip Purpose #3
Urban (n=6373)	Grocery shopping (20%)	Errands/non-grocery shopping (13%)	Out of town trips (11%)
Suburban (n=3136)	Grocery shopping (24%)	Errands/non-grocery shopping (15%)	Out of town trips (8%)
Rural (n=422)	Grocery shopping (26%)	Errands/non-grocery shopping (15%)	Local entertainment (10%)

Average Trip Frequency by Month

Zipcar usage among the college/university market also depends on time of the year. In Figure A4, we calculated the average number of trips taken during each month by respondents that were members over the entire month. The months of September and October see the highest average number of reservations at 1.50 and 1.51, respectively. The winter months (December, January, and February) demonstrate lower average trips taken, as do the summer months (June and July). This peak in the fall and drop in the winter and summer is expected due to the cyclical nature of needs among the college/university market.

Figure A4: Average Trip Frequency by Month



Average Trip Distance and Duration

We received average distance (in miles) and duration (in hours) of Zipcar reservations made by each respondent during the study year. Tables A2 and A3 display the average trip distance and durations of respondents who made one or more reservations over the study year, broken out by respondent segments. Average distance per trip varies depending on land-use context, with rural members driving 69 miles per trip on average, and both urban and suburban respondents driving only 50 and 47 miles, respectively.

Table A2: Average Trip Distance and Duration of Reserving Respondents by Land-Use Context

Urban Setting	Avg. Miles/Trip Reserving Respondents	Avg. Hours/Trip Reserving Respondents
Urban (n=5563)	50	6.4
Suburban (n=2664)	47	5.4
Rural (n=352)	69	6.5

In addition, trip distance and duration varies by student and staff/faculty segment. On-campus students and graduate students tend to drive fewer miles during an average Zipcar reservation than do other student segments. On-campus students also reserve Zipcars for the shortest amount of time in contrast to any student segment, at 5.1 hours per trip on average.

Since we received average trip distance and duration data, multi-day long-distance trips are reflected in the averages. Therefore, the results displayed do not necessarily reflect the distances and durations of the trips made most often, which are likely not as long as the averages suggest. Trip-level data would be needed to explore further nuances with regard to Zipcar trip distance and duration trends.

Table A3: Average Trip Distance and Duration of Reserving Respondents by Student Type

Population Segment	Avg. Miles/Trip Reserving Respondents	Avg. Hours/Trip Reserving Respondents
Students (n=7740)	49	6.0
Staff/Faculty (n=838)	51	7.4
Full-time Students (n=6829)	48	5.6
Part-time Students (n=651)	60	8.6
Undergraduate Students (n=4044)	52	6.1
Graduate Students (n=3436)	46	5.7
On-Campus Students (n=3000)	47	5.1
Off-Campus Students (n=4733)	51	6.5

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