Technical Appendix 4
Survey and Market Segmentation in Support of Chapter 4

LIST OF FIGURES AND TABLES

INTRODUCTION AND STRUCTURE

This Technical Appendix first reports on the major national survey conducted in 2016 for this TCRP project, and then summarizes the project's market segmentation program

PART ONE: THE 2016 PROJECT SURVEY

For this TCRP study, a major national survey was conducted in 24 metropolitan areas to shed light on issues associated with the relationship between key sociodemographics, attitudes/ preferences, and geographic characteristics with the future markets for public transportation in the United States. This section describes the survey methodology and the market segmentation that resulted from this effort. All of the data included in the figures and tables of this Technical Appendix are taken from the project's 2016 survey.

SURVEY METHODOLOGY

Sampling Plan

The objective of this study was to examine the relevant factors and anticipate trends that may affect future travel behavior in the United States. With this objective in mind, the sample for the study was comprised of transit and non-transit users from across the country. Quota sampling, a technique that sets a minimum number of respondents for each respective category, was be used to establish a diverse sample of respondents.

Respondents were recruited through a reputable online sample provider. Invitations to the online survey were e-mailed to respondents who resided in selected ZIP codes across the country. To ensure an equal representation of gender and a range of incomes and ages in the sample, minimum quotas were set for these categories. To be eligible to take the online survey, respondents must have lived in a qualifying region and be over the age of 18. The overall goal for the survey was to obtain 3,500 respondents (Table 1).

Demographic Quotas

Of interest to this study is understanding the current and future travel behavior of Millennials, the generation born in the mid-1980s and 1990s. To ensure a sufficient number of responses from this generation, the minimum quota for individuals under the age of 30 was larger than the other two age categories. Additionally, a roughly equal number of male and female respondents were sought.

Both transit and non-transit users were sampled, with a transit user defined as someone who had used transit in the past 30 days. The survey sought to obtain a relatively high proportion of transit users to get enough detail about these traveler's attitudes and behaviors.

TABLE 1. DEMOGRAPHIC QUOTAS

	MINIMUM QUOTA	MAXIMUM QUOTA
AGE		
Under 30	950	1,500
30-60	700	1,200
Over 60	700	1,200
INCOME		
Less than $25k	200	600
$25k-$35k	200	600
$35k-$50k	200	600
$50k-$75k	200	600
$75k-$100k	200	600
$100k-$150k	200	600
$150k +	200	600
TRANSIT USE		
Transit User	2000	2,250
Non-Transit User	750	1,500

Geographic Quotas

To ensure that the transit markets sampled were geographically distributed throughout the country, a minimum quota of 700 respondents was set for each region of the country – Northeast, South, Midwest, Mountain West/Southwest, and West (Table 2). Within each region, specific MSAs were sampled. A total of 24 MSAs were selected with the assistance of the Panel.

TABLE 2. PROPOSED QUOTAS, BY MSA

REGION	METROPOLITAN AREA	MINIMUM QUOTA	MAXIMUM QUOTA
Northeast	New York	175	400
	Boston	175	400
	Philadelphia	175	400
South	Atlanta	50	150
	Charlotte	50	150
	Dallas	50	150
	Gainesville	25	75
	Miami	50	150
	Raleigh/Durham	50	100
	Savannah	25	75
Midwest	Chicago	50	150
	Cleveland	50	150
	Kansas City	50	150
	Madison	50	150
	Milwaukee	50	150
	Minneapolis	50	150
Mountain West/Southwest	Denver	100	250
	Las Vegas	100	250
	Phoenix	100	250
	Salt Lake City	100	250
Pacific West	Los Angeles	100	250
	Portland	100	250
	San Francisco	100	250
	Seattle	100	250

QUESTIONNAIRE

A questionnaire was designed to understand present mode-choice behavior and the sociodemographic characteristics of each survey respondent. The survey instrument also collected basic information concerning longer-term values affecting longer-term decisions and shorter-term attitudes affecting the propensity to choose public transportation services. It also collected geographic data about the respondents' residential location to join the survey records with the EPA's SLD, as well as the US Census ACS.

The survey questionnaire was drafted and reviewed with the Panel. Once the questionnaire content was finalized, the web-based survey was programmed. The survey first asked a few demographic questions for screening purposes (to ensure the sample was in the geographic areas of interest and determine which quota cells respondents fell into). Next, respondents were asked about their typical travel in relation to transit, personal auto trips, and TNCs. Screenshots to illustrate the questionnaire format are shown in Figures 1-4.

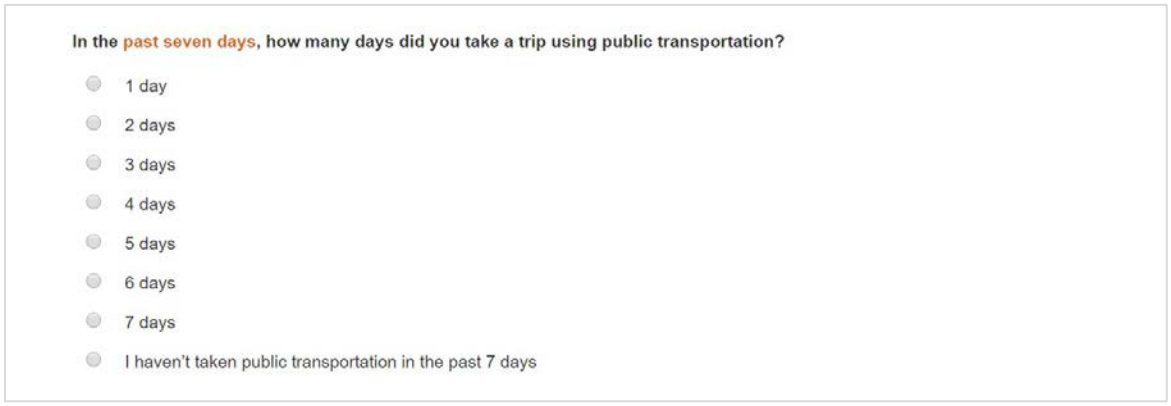

FIGURE 1. SURVEY SCREENSHOT OF FREQUENCY OF TRANSIT USE QUESTION.

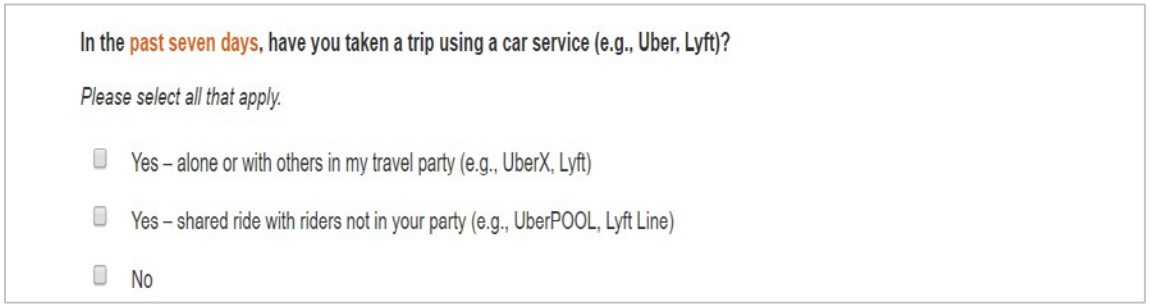

FIGURE 2. SURVEY SCREENSHOT TNC USE QUESTION.

Next, respondents were asked about their current residential location, what factors influenced their choice of location, and what factors they imagined would affect their choice of a future location if they were to move.

After the section about residential location, respondents were asked about what major life events they had experienced to date (e.g., getting married, having children, retiring) to help understand where these respondents might be in their life cycle. Respondents were then asked about which of these events they expected to experience in the next 10 years and questions about how their travel behavior might change in this time frame. Respondents were then put through a battery of approximately 60 attitudinal questions about travel, land use, residential location preferences, etc.

FIGURE 3. SURVEY SCREENSHOT OF LIFE EVENTS QUESTION.

After the attitudinal battery, respondents were asked to report the details of a recent trip, including the trip purpose, origin/destination, mode used, party size, trip duration, and trip costs.

This information was used to construct a series of Stated Preference (SP) trade-off experiments. They were asked to trade-off between the following modes:

Auto (if available to respondent)

Bus

Train

Car service

Shared car service

Not all modes were necessarily available in every city, but respondents were asked to imagine a situation in which the modes shown were available to them. In each experiment, the travel times, costs, and other details were varied.

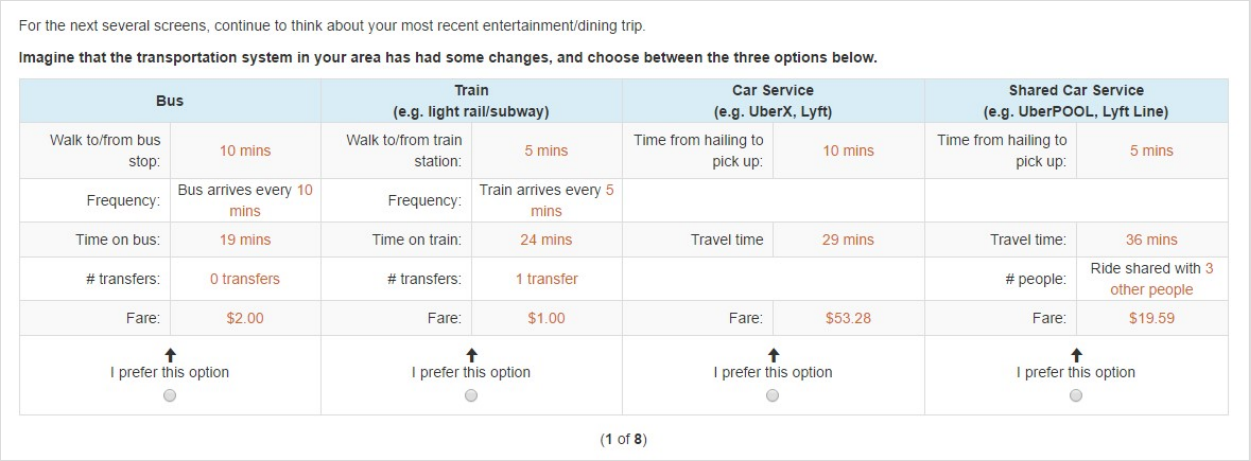

FIGURE 4. SURVEY SCREENSHOT OF SP EXERCISE.

The survey concluded with final demographics and questions about technology use.

SURVEY ADMINISTRATION

Pretest

On December 8, 2016, the survey was pretested with a group of 50 respondents. RSG analyzed the pretest data and ran preliminary SP models to ensure everything was working as planned. Once it was confirmed that respondents understood the SP section and that reasonable coefficients could be obtained from the design, the survey was launched in full.

Full Field

The full field effort occurred between December 10th and December 23rd. Prior to beginning analysis, the records were reviewed to identify potentially bad data. Two criteria were used to identify bad respondents:

1. The respondent had taken the survey in an unreasonably quick time (under 8 minutes)
2. The respondent provided the same response for all 60+ attitudinal questions.

Respondents meeting these criteria were removed from the dataset and new respondents were recruited to complete data collection. The tables and charts below provide an information about the sample makeup.

Table 3 shows the number of completed surveys by metro area and by region with the targeted sample sizes included for reference. The study team aimed to collect 700 completed surveys per region to provide enough sample for analysis and came close to meeting that goal for nearly all the regions. The sample came up slightly short in the Mountain West/Southwest region and in the Southern region, but are close to 700 and provided enough sample for analysis. At the metro

area level, the targeted sample sizes were met for 21 of the 24 areas. The sample fell slightly short in Salt Lake City, Savannah, and Gainesville.

TABLE 3. SAMPLE QUOTAS AND COMPLETED SURVEYS, BY GEOGRAPHY

REGION	METROPOLITAN AREA	MINIMUM QUOTA	MAXIMUM QUOTA	ACTUAL # SURVEYS	% SURVEYS	ACTUAL # SURVEYS BY REGION
Northeast	New York	175	400	290	8%	750
	Boston	175	400	224	6%	
	Philadelphia	175	400	236	7%	
South	Atlanta	50	150	157	4%	649
	Gainesville	25	75	15	0%	
	Miami	50	150	154	4%	
	Raleigh/Durham	50	100	84	2%	
	Savannah	25	75	14	0%	
Midwest	Chicago	50	150	150	4%	699
	Cleveland	50	150	125	4%	
	Kansas City	50	150	93	3%	
	Madison	50	150	54	2%	
	Milwaukee	50	150	127	4%	
	Minneapolis	50	150	150	4%	
Mountain West/ Southwest	Denver	100	250	229	7%	667
	Las Vegas	100	250	149	4%	
	Phoenix	100	250	218	6%	
	Salt Lake City	100	250	71	2%	
Pacific West	Los Angeles	100	250	209	6%	727
	Portland	100	250	136	4%	
	San Francisco	100	250	169	5%	
	Seattle	100	250	213	6%	

The survey obtained a good mix of male and female respondents with a slight skew toward women (56%). Table 4 shows that the minimum quotas were nearly met for each age group as well, providing a robust sample for analysis and the ability to compare between each of the generations. However, individuals under 30 years old proved to be more challenging to survey than the other age groups and the sample fell slightly short of the minimum target for that group. Additionally, transit users (defined as someone taking transit in the past month) were somewhat more difficult to obtain than expected (Table 5) and it resulted in a sample that fell short of the goal by about 340 surveys; however, nearly 1,700 transit users were obtained for analysis, which provided an ample sample size for the analyses.

TABLE 4. SAMPLE QUOTAS AND COMPLETED SURVEYS, BY AGE GROUP

	MINIMUM QUOTA	MAXIMUM QUOTA	ACTUAL # SURVEYS	% SURVEYS
AGE				
Under 30	950	1,500	938	27%
30-60	700	1,300	1,271	36%
Over 60	700	1,300	1,283	37%

TABLE 5. SAMPLE QUOTAS AND COMPLETED SURVEYS, BY TRANSIT USE

	MINIMUM QUOTA	MAXIMUM QUOTA	ACTUAL # SURVEYS	% SURVEYS
TRANSIT USE				
Transit User	2,000	2,250	1,659	48%
Non-Transit User	750	1,500	1,833	52%

The sample also has a good distribution across the various income levels (Table 6).

TABLE 6. SAMPLE QUOTAS AND COMPLETED SURVEYS, BY INCOME

	MINIMUM QUOTA	MAXIMUM QUOTA	ACTUAL # SURVEYS	% SURVEYS
INCOME				
Less than $25k	200	600	287	8%
$25k-$35k	200	600	281	8%
$35k-$50k	200	600	466	13%
$50k-$75k	200	600	626	18%
$75k-$100k	200	600	690	20%
$100k-$150k	200	600	672	19%
$150k +	200	600	464	13%

Note: 6 respondents did not provide an income.

PART TWO: MARKET SEGMENTATION

To better understand the preferences and needs of different subgroups of the traveling population, Latent Class Cluster (LCC) analysis was applied to the collected sample. This approach attempts to segment the population into a finite number of classes based a combination of characteristics observed in the data, in this case, attitudinal statements. LCC allows subgroups of the transit market to be segmented on dimensions beyond basic demographics. Respondents within in each class share similar preferences, values and characteristics that distinguish them from the respondents in other classes.

METHODOLOGY

The segmentation process began with over 60 attitudinal statements ranging from environmental concerns to future transit use. Attitudinal statements with relatively minor variation between the classes were dropped and iterations of the segmentation process continued. Ultimately, 13 attitudinal statements segmented the collected sample into five distinct classes. The 13 attitudinal statements, shown below, primarily revolve around preferences regarding transit, the environment, personal safety, the influence of friends and family, driving and commuting.

I like the idea of doing something good for the environment by riding public transportation.

I think that environmental concerns are overblown.

Traveling by transit would be a more pleasant experience than driving

I would definitely consider using public transportation more often

In a world with driverless cars, I really would not see much role for buses and subways anymore.

My spouse/partner/family would approve of me taking public transportation.

In the future, people who are important to me will approve of me taking public transportation.

If they had to make a trip, most people who are important in my life would take public transportation.

My family and friends typically use public transportation.

I enjoy meeting people on the bus or train.

Because of new services helping me make trips, I feel less need to own a car.

As I get older, I expect I'll have to drive more than I do now.

I would be willing to commute an additional 45 minutes to live in a larger home

RESULTS

Overview of Classes

Five clusters emerged from the LCC segmentation, with the proportion of each cluster in the sample shown in Figure 5. However, we determined that about 8% of the sample was responding in an inconsistent manner to the attitudinal questions, possibly due to fatigue or simply misunderstanding the questions; this cluster did not add to our understanding of the issues at hand. Therefore, our team has not included these respondents in the charts and tables in this report. Their responses to other portions of the survey made sense and so they were retained for the other analyses. The remaining sample produced four interesting clusters helpful for understanding the attitudes, preferences, and mode and residential location choices of our respondents.

For the purposes of making the clusters more understandable for the reader, each cluster has been given a descriptive name:

Urban Commuters

Single Millennials

Occasional Users

Car Lovers

Each of these clusters varies in their demographic makeup, their travel behavior, and their attitudes and preferences. This Appendix will provide a summary of each of the clusters in terms of these aspects; however, this chapter is primarily focused on the demographics of each cluster. Appendix #6 explores these clusters in relation to attitudes, preferences, travel behavior, and land use.

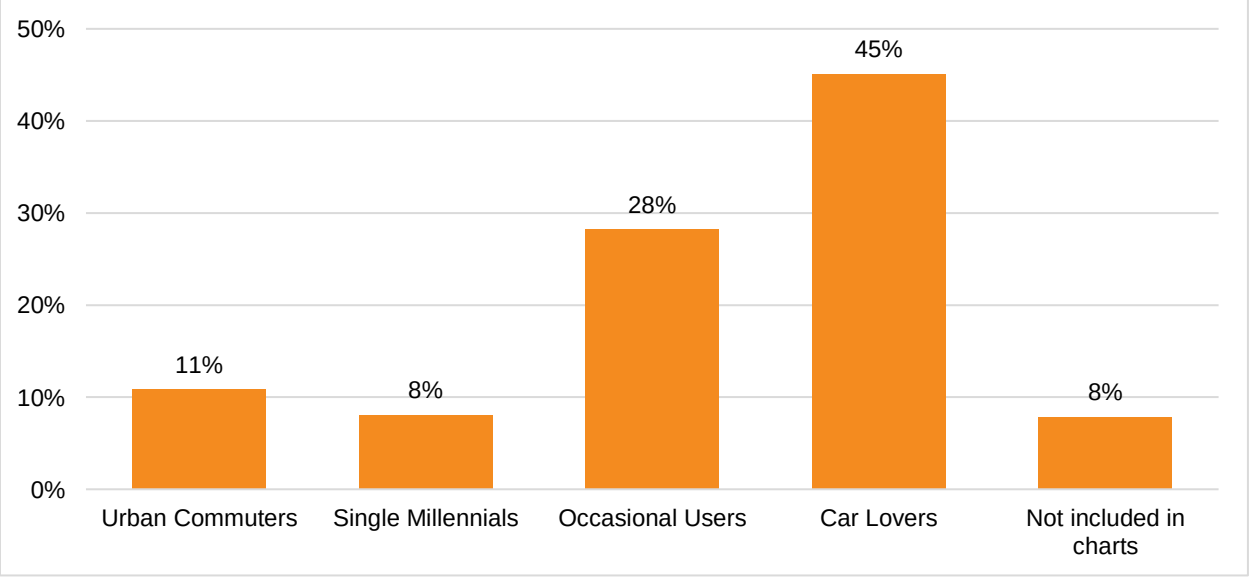

FIGURE 5. PROPORTION OF EACH CLUSTER IN THE SAMPLE (CLUSTER SIZES).

The least likely cluster to have used transit in the past month are the Car Lovers, as one might expect, with only 26% having used it (Figure 6). Meanwhile, the Urban Commuters and Single Millennials are the most likely to have used transit, with over 70% of respondents in each group using it.

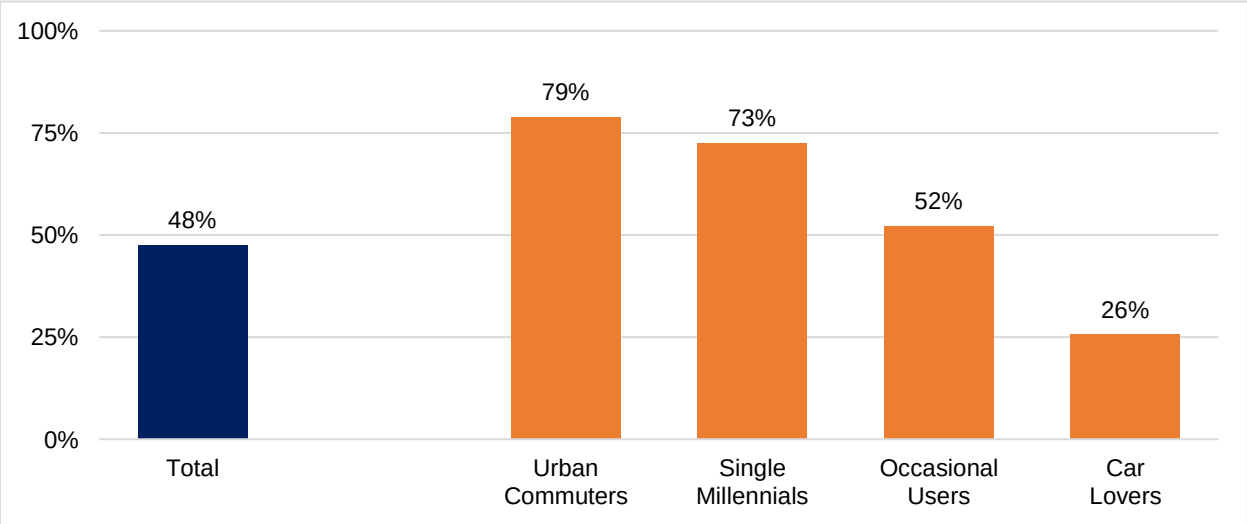

FIGURE 6. PROPORTION OF EACH CLUSTER THAT HAS USED TRANSIT IN THE PAST MONTH.

There is also wide variation in the choice of services provided by Transportation Network Companies, such as Uber and Lyft, by market segment as shown in Figure 7. The youngest market segment, the Single Millennials, have the highest propensity to choose these services, while it is important to note how few trips are reported by any segment. This highest segment reports approximately one half of one trip per week in this survey, with the lowest use reported by the Car Lovers, with about one tenth of one trip per week.

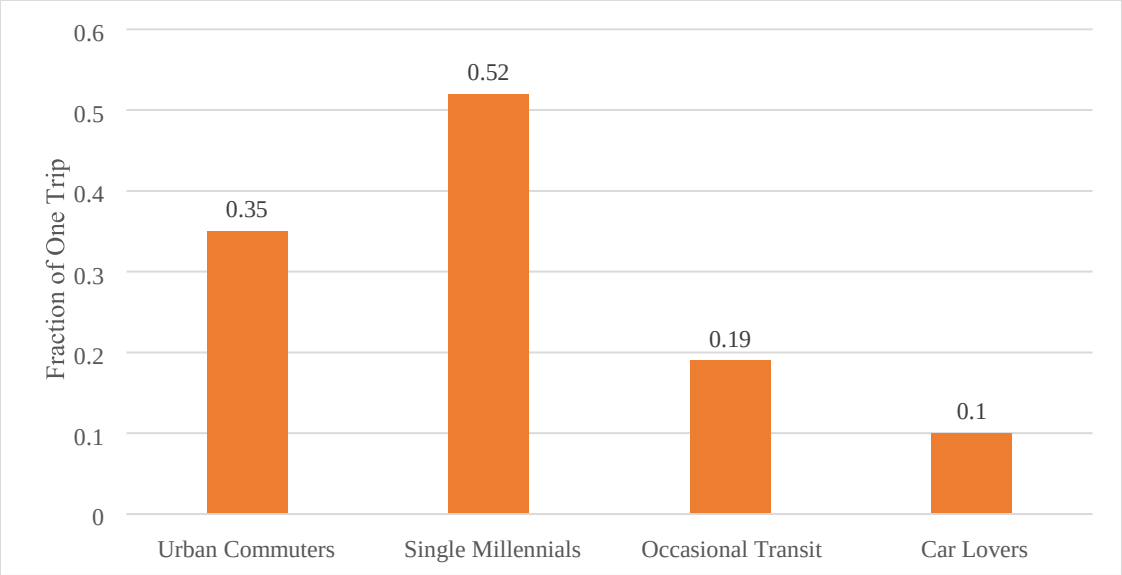

FIGURE 7. NUMBER OF TRANSPORT NETWORK COMPANY TRIPS IN PAST 7 DAYS.

Description of Classes

Urban Commuters

This cluster comprises professionals who live and work in a big city. Nearly all Urban Commuters would consider using transit more often and the majority believe that traveling by transit is a more pleasant experience than driving. Proximity to public transportation is important to these commuters and was often the primary selection criterion in choosing their current home. They are the least likely cluster to cite that environmental concerns are overblown; the Urban Commuter believes that riding transit is a way to do something good for the environment.

Friends and family approve of the Urban Commuter's choice to ride transit but do not typically use transit themselves. The Urban Commuter is quick to adopt to ridesharing services and thus feels less need to own a car. This class is the least likely to have typical access to a vehicle.

Single Millennials

Single Millennials expressed an openness to all transportation options. Single Millennials are willing to consider using public transportation more often but acknowledge that traveling by transit is not as pleasant as driving. Friends and family of these Millennials approve of their transit use but are not likely to take transit themselves. Much of this group expects to drive more in the future and despite the increasing availability of ridesharing services, still feel owning a car is a necessity. In a world with autonomous cars, these Millennials do not see much of a role for transit. This group's interest in owning and using cars aligns with their neutral stance toward the environment. Interestingly, this cluster would be willing to extend their commute by 45 minutes in exchange for a larger home. This may speak to the expectation of an increasing family size in the future.

Occasional Users

These semiretired suburban environmentalists like the idea of doing something good for the environment by riding transit. This cluster is open to using transit more often but currently choose to ride transit only on occasion. The reluctance to use transit can be explained by the cluster's disinterest in riding on transit with strangers and the belief that driving is more pleasant than traveling by transit. Nearly half of the cluster cited no transit use in the past month and for those who ride transit, it is often on an infrequent basis. Important people in their lives approve of their transit use but rarely use transit themselves. Interestingly, despite their occasional transit use, these drivers were the strongest advocates of the role of transit in an imagined autonomous car world. This cluster does not expect their driving habits to change in the future and are unaffected by the development of new services that help make trips.

Car Lovers

The least transit-friendly cluster, this group of retired Boomers are the least likely to express a willingness to change their traveling habits. They live in suburban and rural neighborhoods and prefer it that way. The cluster is most united by their belief that environmental concerns are overblown. This class does not currently use transit and is the least likely to consider using transit more often. This class is also the least likely to enjoy being with strangers on transit. Similarly, friends and family of this cluster do not use transit and do not approve of transit use. If these Boomers take transit it would not be motivated by environmental concerns. These Boomers do not like the idea of doing something good for the environment by riding transit. In the future, this cluster does not expect to drive more and will likely never adopt new ridesharing services.

DEMOGRAPHIC COMPARISON OF MARKET SEGMENTS

Figure 8 shows the proportion of Millennials within each of the clusters and illustrates that, as the name of the cluster implies, the Single Millennials cluster is made up of over two-thirds Millennials. The Urban Commuter cluster is also younger than the other clusters; these two clusters are the most likely to use transit. These two clusters are also the most likely to be single and least likely to have had children yet (Figure 9 and Figure 10). These charts are ordered by the likelihood to use transit, and Figure 11 illustrates that the groups most likely to use transit are the least likely to have children and vice versa. A summary of the demographics is provided here as Table 7.

TABLE 7. DEMOGRAPHIC CHARACTERISTICS OF FOUR MARKET SEGMENT

SEGMENT	% USED TRANSIT IN MONTH	% MILLENNIAL	% SINGLE	% HAVE HAD CHILDREN	% STUDENT	% EMPLOYED FULL TIME	% NONWHITE	% HISPANIC
Urban Commuter	79	44	41	35	9	61	23	6
Single Millennial	73	68	46	40	11	73	33	10
Occasional User	52	28	28	49	5	54	13	4
Car Lover	26	19	22	53	3	51	13	3

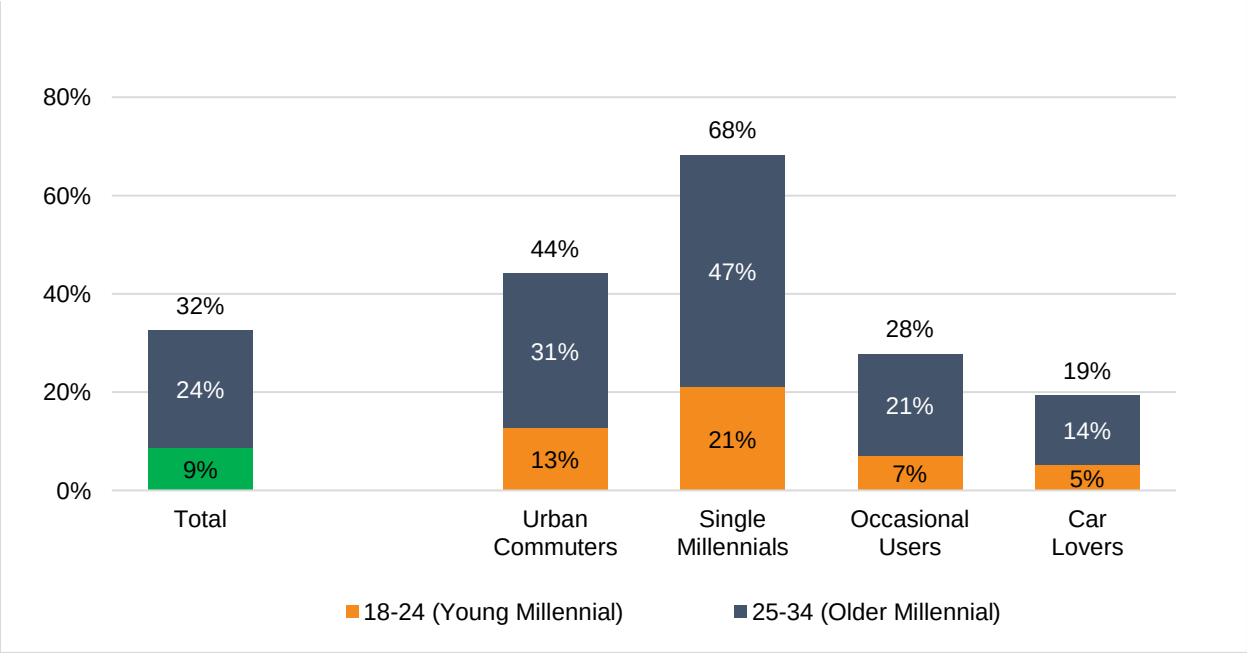

FIGURE 8. PROPORTION OF MILLENNIALS IN EACH SEGMENT.

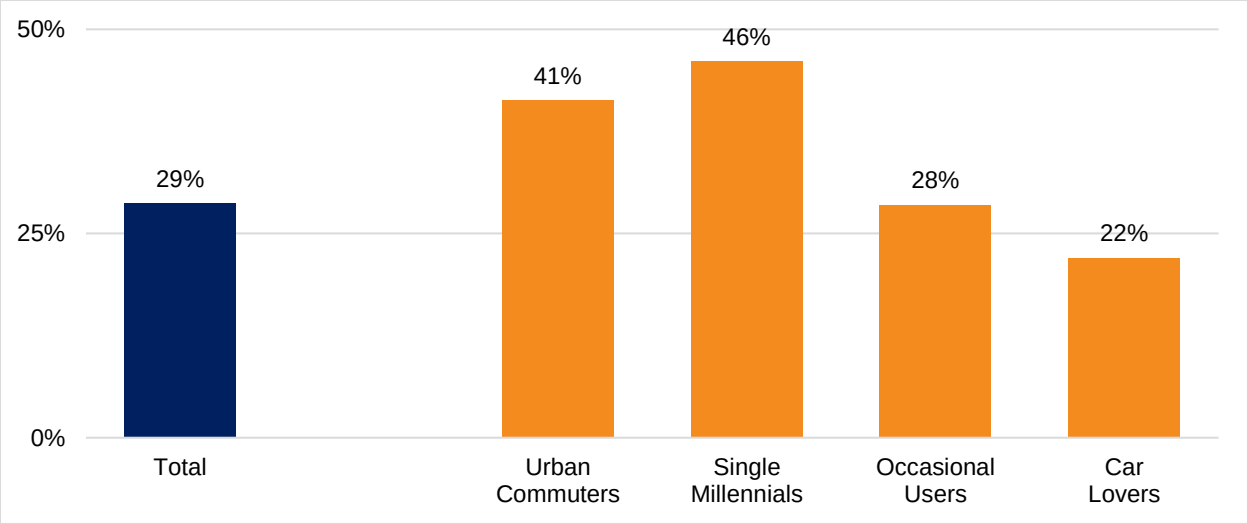

FIGURE 9. PROPORTION OF EACH SEGMENT THAT IS SINGLE (NOT MARRIED OR IN UNMARRIED PARTNERSHIP).

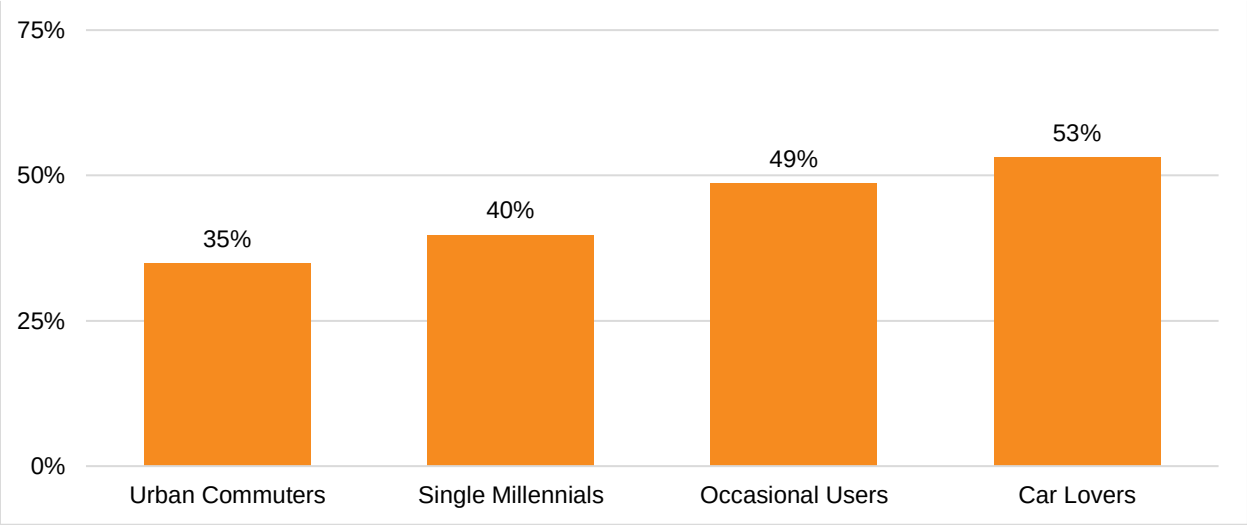

FIGURE 10. PROPORTION OF EACH SEGMENT WHO HAVE HAD CHILDREN.

Most people in each cluster have a college or graduate degree (Figure 12). Car Lovers and Single Millennials are the least likely to hold one of these degrees, although, the Single Millennials are the most likely group to still be in school and therefore still working on their degrees. The Single Millennials are also the most likely groups to be employed or students (Figure 13). This is mainly because these groups have the lowest numbers of people over 65 years old in the clusters.

The average household income levels are relatively consistent across the four clusters.

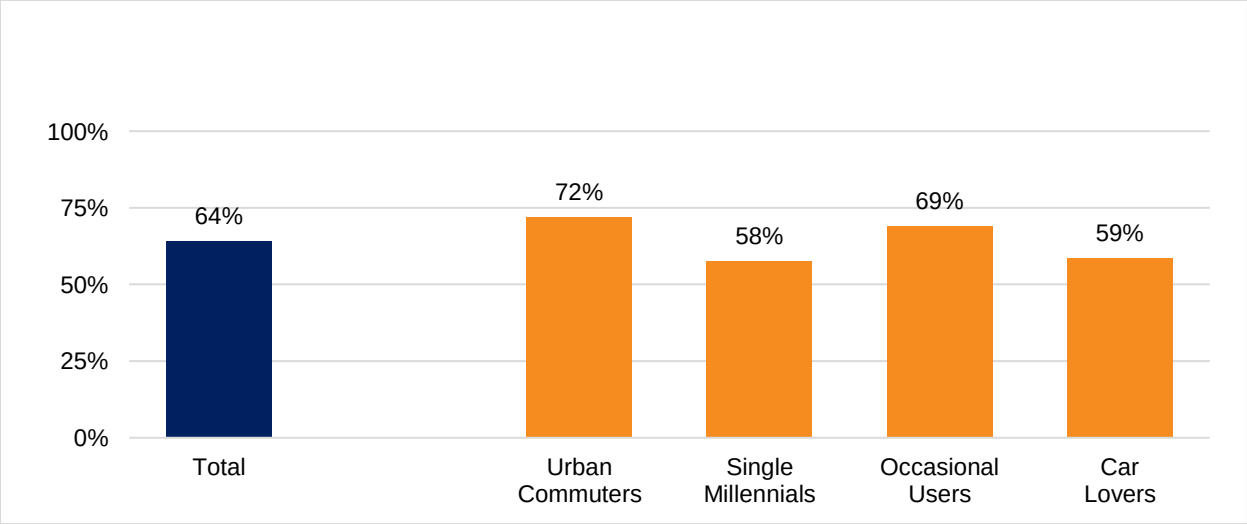

FIGURE 11. PROPORTION OF EACH SEGMENT WITH A COLLEGE OR GRADUATE DEGREE.

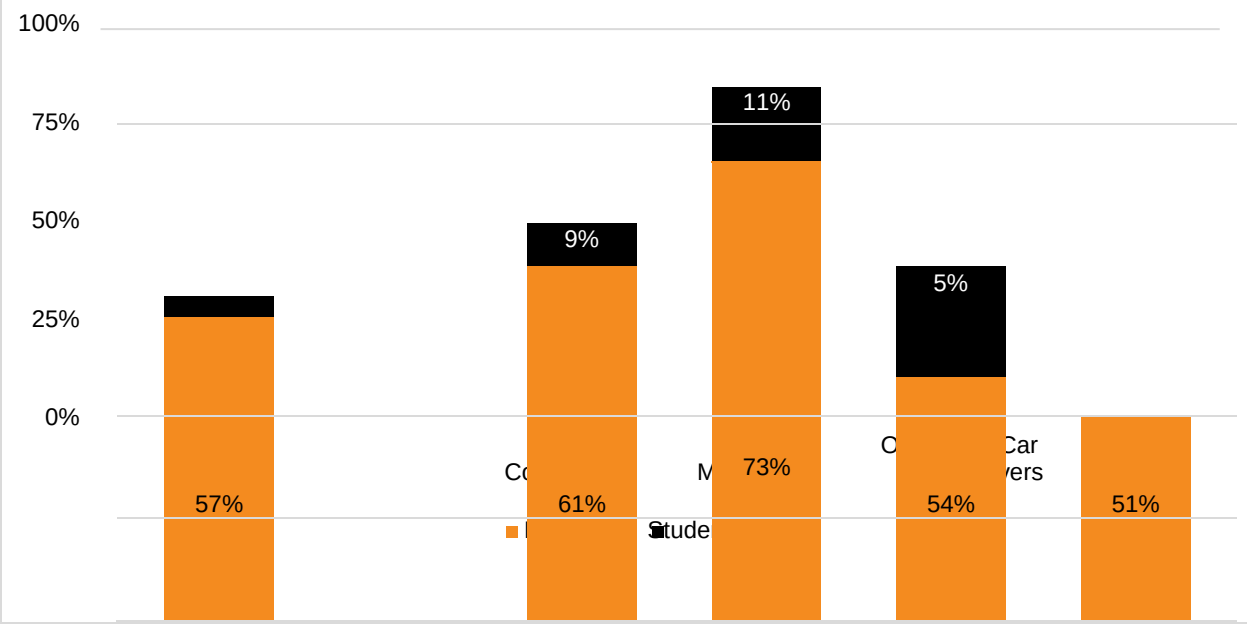

FIGURE 12. EMPLOYMENT AND STUDENT STATUS, BY SEGMENT.

The Single Millennials are the most likely to be non-white or of Hispanic origin (Figure 13). Also of note is the fact that the clusters most likely to be current transit users are also the most likely to have been born outside the United States (Figure 14).

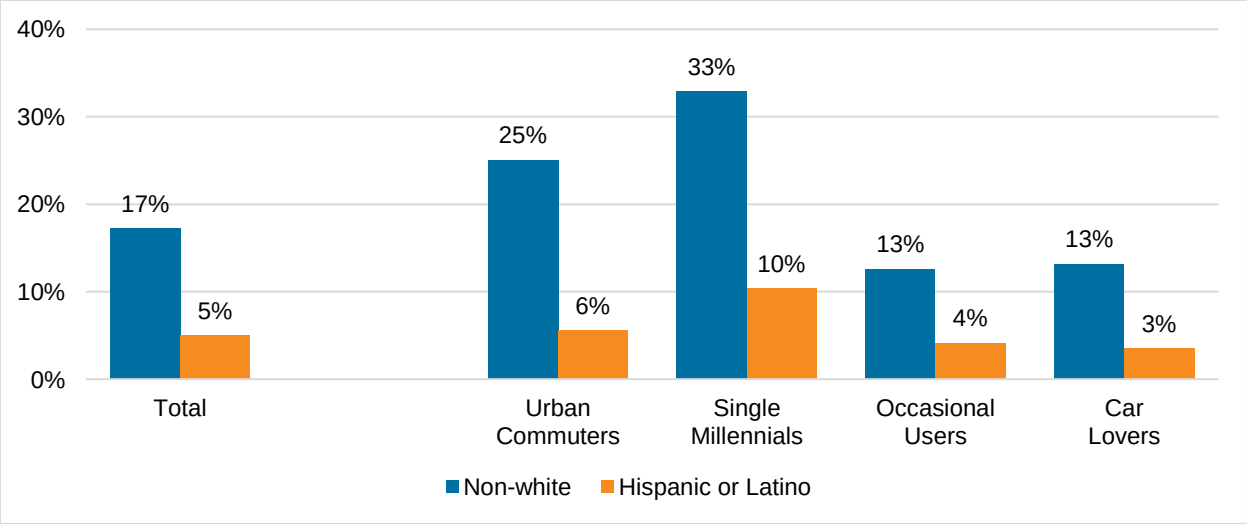

FIGURE 13. EMPLOYMENT AND STUDENT STATUS, BY SEGMENT.

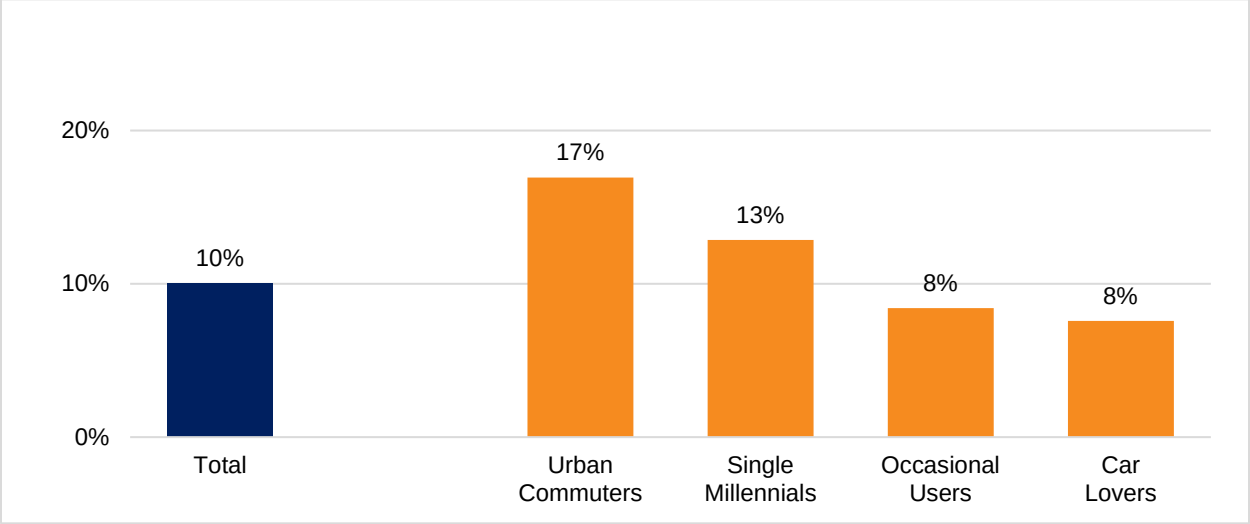

FIGURE 14. PROPORTION OF EACH CLUSTER BORN OUTSIDE US.