What Affects Millennials' Mobility?
PART I: Investigating the Environmental Concerns, Lifestyles, Mobility-Related Attitudes and Adoption of Technology of Young Adults in California

May 2016

A Research Report from the National Center for Sustainable Transportation

Dr. Giovanni Circella, University of California, Davis

Dr. Lew Fulton, University of California, Davis

Farzad Alemi, University of California, Davis

Rosaria M. Berliner, University of California, Davis

Kate Tiedeman, University of California, Davis

Prof. Patricia L. Mokhtarian, Georgia Institute of Technology

Prof. Susan Handy, University of California, Davis

National Center for Sustainable Transportation

ITS UCDAVIS INSTITUTE OF TRANSPORTATION STUDIES

About the National Center for Sustainable Transportation

The National Center for Sustainable Transportation is a consortium of leading universities committed to advancing an environmentally sustainable transportation system through cutting-edge research, direct policy engagement, and education of our future leaders. Consortium members include: University of California, Davis; University of California, Riverside; University of Southern California; California State University, Long Beach; Georgia Institute of Technology; and University of Vermont. More information can be found at: ncst.ucdavis.edu.

Disclaimer

Acknowledgments

This study was funded by a grant from the National Center for Sustainable Transportation (NCST), supported by USDOT and Caltrans through the University Transportation Centers program. The authors would like to thank the NCST, USDOT, and Caltrans for their support of university-based research in transportation, and especially for the funding provided in support of this project. Additional funding for this project was provided by the UC Davis Sustainable Transportation Energy Pathways (STEPS) program. The authors are grateful for this support. All errors or omissions are the responsibility of the authors, and not the funding organizations.

The authors would like to sincerely thank Daniel Sperling, Ram Pendyala, Kay Axhausen, Joan Walker, Elisabetta Cherchi, Cinzia Cirillo, Kari Watkins, Scott Le Vine, Eric Gudz, Aliaksandr Malokin, Yongsung Lee, Gouri Mishra, Calvin Thigpen, Alvaro Rodriguez Valencia, Simon Berrebi, Alice Grossman, Sarah Ligday, Rubem Mondaini, Aniss Bahreinian (California Energy Commission), Katie Benouar, Melissa Thompson, Dillon Miner, Nicole Longoria and David Chursenoff (Caltrans), John Orr, Elisabeth Sanford and Guy Rousseau (Atlanta Regional Commission), David Ory (Metropolitan Transportation Commission), Mike Alba (LinkedIn Corp.), Ken Laberteaux (Toyota Motor Corp.), and Natalia Tinjaca Mora (Camara de Comercio Bogota, Colombia) for their thoughtful comments and useful suggestions during the design of the online survey and data collection process.

What Affects Millennials' Mobility? PART I: Investigating the Environmental Concerns, Lifestyles, Mobility-Related Attitudes and Adoption of Technology of Young Adults in California

A National Center for Sustainable Transportation Research Report

May 2016

Giovanni Circella*, Institute of Transportation Studies, University of California, Davis

Lew Fulton**, Institute of Transportation Studies, University of California, Davis

Farzad Alemi, Institute of Transportation Studies, University of California, Davis

Rosaria M. Berliner, Institute of Transportation Studies, University of California, Davis

Kate Tiedeman, Institute of Transportation Studies, University of California, Davis

Patricia L. Mokhtarian, School of Civil and Environmental Engineering, Georgia Institute of Technology

Susan Handy, Institute of Transportation Studies, University of California, Davis

***Principal Investigator, **Co-Principal Investigator**

NCST

[page left intentionally blank]

TABLE OF CONTENTS

What Affects Millennials' Mobility?
PART I: Investigating the Environmental Concerns, Lifestyles, Mobility-Related Attitudes and Adoption of Technology of Young Adults in California

EXECUTIVE SUMMARY

How do "millennials" make their mobility choices? What factors (e.g. lifestyles and personal preferences) affect their mobility-related choices? What are their future aspirations to purchase and use a vehicle vs. to use other means of transportation? How will millennials' behaviors shape future transportation demand and affect planning needs in the 21st Century?

Young adults (often referred to as "millennials" or "Generation Y") are increasingly reported to have different lifestyles and travel behavior from previous generations at the same stage in life. Among the observed changes, younger travelers tend to postpone the time they obtain a driver's license, often choose to live in more central urban locations and choose not to own a car, drive less even if they own one, and use alternative non-motorized means of transportation more often. Several possible explanations have been proposed to explain the observed behaviors of young adults, including their preference for more urban locations closer to the vibrant parts of a city, changes in household composition (e.g. delayed marriage and childbearing), and the substitution of travel for work and socializing with telecommuting and social media. However, the debate in this field is still dominated by speculations about the potential factors affecting millennials' behavior, and the previous studies that started to investigate millennials' travel-related decisions have been generally limited by the lack of adequate data.

The *connected* tech-savvy millennials are a very popular figure in the media headlines, and they certainly are a common presence in San Francisco, New York City, or any other major city in the country. Not all millennials fit this stereotype, though, and there are large masses of young adults that behave in a way that is more similar to older cohorts. They are more likely to get married while there are still in their 20s, live in single-family homes, drive alone for their commute, and will probably raise their children in a predominantly suburban environment.

Understanding the different patterns in lifestyles and behaviors among the various segments of the millennial population, and quantifying their impact on travel demand and the use of various means of transportation, is of extreme importance to researchers, planners and policy-makers. This study aims to fill this research gap, providing an important step in improving the understanding of mobility-related decisions of millennials in California, and of the factors that affect them. As part of the research, we designed and carried out a comprehensive and systematic data collection that aimed at collecting information on a number of key variables

that have been attributed an important role in affecting millennials' behaviors, including personal attitudes and preferences, individual lifestyles, and the adoption of new technologies and shared mobility services. We designed a very detailed and comprehensive online survey and administered it to a sample of more than 2400 residents of California, including more than 1400 *millennials* (young adults of ages between 18 and 34) and more than 1000 members of the previous *Generation X* (middle-aged adults, 35 to 50), who were included in the study for comparison purposes. We used a *quota sampling* process to ensure that enough respondents from both age groups were sampled in each combination of geographic region of California and neighborhood type where the respondents live, and controlled for demographic targets of the sample for five dimensions: gender, age, household income, race and ethnicity, and presence of children in the household.

The result is the *California Millennials Dataset*, an unprecedented dataset which contains detailed information on the respondents' personal attitudes, preferences and environmental concerns; lifestyles; adoption of online social media and information and communication technology (ICT); residential location; living arrangements; commuting and other travel-related patterns; auto ownership; awareness, adoption and frequency of use of the most common *shared mobility* services (including *car-sharing*, *bike-sharing*, *dynamic ridesharing* and *on-demand ride* services such as Uber or Lyft); major life events from the past three years; expectations for future events and propensity to purchase and use a private vehicles vs. to use other means of travel; political ideas and sociodemographic traits.

The analysis of the data collected in the study provides many insights into millennials' behaviors, their attitudes towards the adoption of technology and the influence of several factors on their mobility-related choices. After filtering out cases that contained inconsistent, frivolous, or severely incomplete information, the final sample used in the analyses presented in this report includes 2391 valid cases. Millennials are found, on average, to drive fewer miles by car (the average self-reported weekly VMT are 18% lower, in the unweighted sample) than members of the previous Generation X. The different driving behavior pattern among millennials and members of Gen X is confirmed among residents of both urban and suburban areas of California. Consistent with expectations, millennials are found to adopt technological solutions, and use smartphones for a number of purposes, more frequently than the members of Gen X. They report using the internet and/or smartphone apps more often than older adults to identify possible destinations (e.g. restaurant, café, etc.), learn how to get to new places, and decide which means of transportation, or combinations of multiple means, to use for a trip.

Millennials also report using their devices more often while they travel: from the analysis of data collected in this study, in all regions of California millennials systematically report higher engagement rates in "travel multitasking" during their commute. The impact of these patterns on the perceived value of travel time, the evaluation of the available travel alternatives and mode choice will be one of the objects of investigation in the future stages of the research. Millennials also show a stronger commitment to protect the environment, and seem to be less opposed than members of Gen X to policies that increase gas taxes in order to provide better funding for public transportation and reduce the environmental externalities of transportation.

Finally, millennials report higher rates of adoption of emerging transportation and shared mobility services. The impact of the adoption of these services on the use of other means of travel is not straightforward. While in most regions, and in particular among the members of Gen X, the use of on-demand ride services such as Uber or Lyft predominantly replaces the use of private cars, millennials often report a reduction in their use of public transportation and in the amount of walking or biking they do, as the result of the use of Uber/Lyft.

During the next stages of the research, we plan to develop more in-depth investigations of the data contained in the California Millennials Dataset and to integrate additional information available from other sources, including built environment and land use data for the neighborhoods where millennials live, and estimate multivariate statistical models of millennials' travel demand, current car ownership and propensity to purchase a vehicle. We also plan to develop a set of weights that will be applied to the dataset in order to correct for any deviation in the distribution of respondents' characteristics from the population of interest, and to make the dataset fully representative of the population of California through correcting for the effects of the quota sampling (with the oversampling of individuals that live in some regions of California, e.g. rural areas and less-populated regions). Future extensions of this multiple-year research program will also expand the study to other states in the United States, and internationally, through the comparison of the information collected in this dataset with the data collected in other regions.

Introduction

Almost 10 million young adults (*millennials*) of ages between 18 and 34 live in California, and they represent approximately 25% of the total population in the state. This extremely diverse, well-educated (compared to previous generations) and dynamic segment of the population is, at the same time, the object of popular attention in the media – millennials are often labeled as *social*, *independent*, *proactive,* or sometimes even as *spoiled*, *bold* or *presumptuous,* depending on the circumstances – and an important topic for scientific and market research. From many different perspectives, millennials' preferences as well as their consumer (and travel) behavior have an important effect in shaping society. Researchers are eager to better understand (and quantify) this effect.

Recent research suggests that per-capita car travel seems to have "peaked" in recent years in the United States and other developed countries (cf. Goodwin 2012; Metz 2012, 2013; Sivak 2014a). Americans drive less, on average, and the drop in miles traveled seems to be stronger among the millennials group. Several researchers have investigated this topic: they agree that the use of private vehicles seems to have peaked, at least temporarily, and a larger number of households are found to choose to own fewer or no cars in many metropolitan areas in the U.S., inverting the trends in vehicle ownership and travel demand from the previous decades (Sivak 2014b). Additional changes are observed, in particular, among younger travelers, who tend to postpone obtaining a driver's license, more often choose not to own a car, drive less even if they own one, and use alternative non-motorized means of transportation more often (Frändberg and Vilhelmson 2011; Blumenberg et al. 2012; Kuhnimhof et al. 2012; Polzin et al. 2014; McDonald 2015).

Several possible explanations have been proposed to explain these mobility trends, although no general agreement exists on the significance - let alone the magnitude - of the potential explanatory factors associated with the observed changes in driving patterns (Puentes 2013). The impact of the recent economic recession and the (temporary) increases in fuel prices, the high levels of traffic congestion in large metropolitan areas, as well as recent changes in the urban form and in household composition and personal lifestyles (Wachs 2013) are all possible factors influencing these trends. Many American cities are currently experiencing a process of regeneration of the central areas and a shift of economic activities and residences from suburban areas back to more historic and higher density areas. This trend, if matched with continued demand for more central locations and high-density development, can have important consequences in terms of further calming future travel demand, even in times of a growing economy, and can contribute to attracting residents to these areas, e.g. through a residential self-selection effect (Cao et al. 2009). Similarly, the potential substitution of physical trips with information and communication technologies (ICT), and the availability of new shared mobility options, such as car-sharing and on-demand ride services (e.g. Uber), might also impact the current trends in the use of private cars, at least among some segments of the

population, although there are not clear findings, yet, on what is the dominating impact of such services on the use of other means of travel.

Surveys of millennials report that the members of this age group seem to have stronger preference for dense urban areas, are more committed to the environmental causes and try to have healthier lifestyles e.g. adopting active means of transportation more often. It is still unclear, though, whether the impact of these motivations translates into more environmental-friendly behaviors, e.g. reducing the overall environmental footprint of an individual. Little evidence also exists, to date, on whether the observed trends in personal mobility represent only a temporary condition (e.g. they are the effect of the recent economic recession, and of the widening gap in salary levels), or if they represent a more permanent change. Will millennials continue to prefer active modes even when they age? Or are their travel patterns mainly the result of the specific *stage of life* in which young adults live, amplified by the contemporaneous effects of their weaker economic power and the changes in sociodemographics, e.g. delayed marriage and child-bearing?

The *connected* millennials, i.e. well-educated and tech-savvy young adults that live in the urban part of cities, use their smartphone as older generations habitually use their personal computer (to work, communicate, read news, transfer money, book a ticket, etc.), easily adjust and benefit from the latest advances of the sharing economy, and are already a common presence in San Francisco, Washington DC and any other large city in the developed world. Understanding their behavior is a priority for planners, to provide customized services (e.g. dedicated apps to access the information of interest) to support their use of transit or other transportation services. But in many parts of California, as well as other states and regions of the country, there is certainly a large component of this generation that shares habits that are more similar to those of the members of previous generations. They live in single-family homes, drive alone to work, get married in their 20s and raise their children in predominantly suburban settings. Understanding the different needs of the different components of the millennial population, and assessing the numeric proportion of members of each group, by geographic region, is of extreme importance to planning transportation services and policies that adequately address the needs of the different groups of users, while ensuring that the limited resources are properly invested and protecting the environment.

From many different perspectives, understanding millennials' behavior and attitudes towards the use of transportation is an important goal for the transportation research and planning communities. In addition, the topic has important connections with the target of increasing sustainability in transportation. California has set ambitious goals in terms of reducing greenhouse gas (GHG) emissions and increasing livability of communities. Understanding the way millennials make their decision regarding where to live, what to buy and how to travel is extremely important to achieving these goals. Young adults are already an important economic force, and represent a large market of potential home and car buyers, whose economic power and influence on society is still growing. Several studies have already attempted to explore the complicated mosaic of millennials' attitudes and travel-related decisions. However, their

results, to date, have been often limited, mainly because of the inadequacy of current data to investigate this topic.

This study provides an important step in improving the understanding of millennials' mobility-related decisions, and of the factors that affect them. As part of this research, we design and carry out a comprehensive and systematic data collection aimed at collecting information on a number of important variables, including personal attitudes and the adoption of new technologies and shared mobility services, which have been attributed an important role in affecting millennials' behaviors. As part of the project, a very detailed and comprehensive online survey is designed and administered to a sample of respondents. During the development of the study, the research team worked in close cooperation with colleagues from other research institutions, the California Department of Transportation, and planning organizations in California to identify the most pressing issues related to the understanding of millennials' behavior, the major priorities for planning purposes, and the specific content of the online survey.

In the project, we collect data from more than 2400 respondents, including 1400 members of the millennial generation (young adults of ages between 18 and 34) and 1000 members of the previous Generation X (middle-aged adults, 35 to 50), selected through a *quota sampling* process based on the geographic region and neighborhood type in which the respondents live. In this part of the project, we worked with a specialized commercial vendor (i.e. an online *opinion panel* company) which assisted the research team and helped reach enough respondents belonging to the desired segments of the population of California, and control for the distribution of the respondents included in the sample on five key sociodemographic dimensions: gender, age, household income, race and ethnicity, and presence of children in the household.

The result is the *California Millennials Dataset*, an unprecedented dataset which contains information on the respondents' personal attitudes and preferences, lifestyles, adoption of online social media and information and communication technology (ICT), residential location, living arrangements, commuting and other travel-related patterns, auto ownership, awareness, adoption and frequency of use of the most common shared mobility services (including car-sharing, bike-sharing, dynamic ridesharing and on-demand ride services such as Uber or Lyft), propensity to purchase and use a private vehicles vs. use other means of travel, major life events that have happened in the past three years and that might have influenced the current lifestyles, residential location and travel behavior, environmental concerns, political ideas and sociodemographic traits. The analysis of the rich amount of data contained in this dataset allows us to address a number of research questions that have received attention in recent years in the scientific and planning community.

This research aims to improve the current understanding of millennials' behavior in a number of ways. Its aims include (1) identify the key motivations affecting young adults' mobility-related decisions; (2) explore to what extent geographic location and local conditions, including the characteristics of the urban form, the characteristics of the transportation supply, and the

knowledge about the local transportation system, affect these decisions; (3) better understand the role of *stage in life* and other exogenous factors vs. the role of personal attitudes and preferences, including environmental concerns and motivations, in affecting young adults' travel behavior and their use (or non-use) of cars; (4) explore the role of cultural background (e.g. perception of car driving, role of young people and women in society, etc.) in affecting these processes; (5) investigate the relationships existing between the adoption of emerging transportation and shared mobility services such as Uber or Lyft and the use of other modes (in particular, in terms of promoting the use of alternatives to driving alone, or overall contributing to an increase in total VMT); (6) investigate the role of peers' influence and social interactions (also through the availability of new technologies, i.e. online social networks) in affecting travel-related decisions and private vehicle ownership; (7) better understand the aspirations of young individuals towards future travel patterns, and the purchase of private vehicles; and (7) obtain better insights into the potential responsiveness of young individuals to policies designed to increase energy efficiency and environmental sustainability in transportation, e.g. through price incentives, local or online advertisement, policies to support the adoption of more efficient or alternative fuel vehicles (AFVs), or to promote the use of public transportation.

Overall, the study allows researchers to provide better insights into the behavioral and attitudinal mechanisms that lead to the formation of millennials' travel-related decisions. First, by focusing on a representative sample of the population of young adults of California, the analysis of the information contained in this dataset allows us to improve the understanding of young adults' travel behavior and the propensity to buy and use private vehicles vs. to use other means of travel, drawing conclusions that can inform policies of interest for the entire population of young adults in the state. Second, the research uses a very systematic and rigorous approach that includes a large number of dimensions and variables that are controlled for. Thus, the study allows researchers to investigate the impact of the numerous groups of variables including personal attitudes and preferences, geographical location, urban form, cultural background, peers' influence, technological innovation and social networks, while controlling for the contemporaneous impact of local context conditions, the characteristics of the transportation supply and sociodemographic traits. As such, the research makes an important contribution to explaining and understanding young adults' mobility-related choices in California, and provides insights into the potential response of young adults to policies targeted at improving transportation sustainability, and their impact on future patterns of travel demand.

In the remainder of this report, we discuss the relevant literature in this field, our research approach, and the sampling method and data collection process that was used for the creation of the *California Millennials Dataset*. We then present the content of the survey, and the specific groups of variables that are controlled for in the study. Finally, we present descriptive statistics and discuss observed patterns in the collected data, and provide conclusive remarks on the research findings, and the next steps of this research project. Considering the complexity of the relationships among the variables that are studied, and the monumental data collection effort that is involved in this project, it is evidently not possible to present exhaustive data analyses for the entire dataset in this research report. Accordingly, the investigation of many of

the research questions related to millennials' mobility will be developed in the following stages of the research, including the next research grant that has been funded by Caltrans through the National Center for Sustainable Transportation, starting in October 2015. In this document, we present a preliminary analysis of the unweighted data and draw a roadmap of the next steps of this research project.

Literature review

Recent travel demand patterns in the United States have shown several modifications compared to previous years. An increasing amount of empirical research has analyzed these trends, suggesting that the United States as well as many other developed countries may be experiencing a *peak* in automobile use (Raimond & Milthorpe 2010; Kuhnimhof et al. 2013; Sivak 2013, 2014a; Zmud et al. 2013). Among the observed changes, the amount of vehicle miles traveled (VMT) by private vehicles, both in terms of total amount and on a per-capita basis, and vehicle ownership have plateaued, or even started to decline (in the case of per-capita VMT)[1]. Over the same period, the proportion of US households who live without a car (Sivak 2014b), as well as the amount of travel done by transit (American Public Transit Association 2014) and non-motorized modes, i.e. bike and pedestrian, have both increased by a tiny but significant percentage (McKenzie 2014). This contrasts the trends observed during the several previous decades, which experienced a robust and steady growth in both ownership rates and use of personal vehicles, while the ridership for public transit services steadily declined. It is unclear, though, whether the apparent peak in the use of private vehicles is only the temporary effect of some short-term factors, e.g. the weakness of the U.S. economy during the past few years, or if it represents a more permanent change in travel patterns.

Several measurements are useful to illustrate the recent changes in travel demand. First, focusing on vehicle ownership, the number of both privately owned and commercial light duty vehicles within the United States reached a maximum of 238 million in 2008, with a decrease of over six million vehicles by 2012. The decrease in the number of registered vehicles could be indicative of a car peak in 2008: its proximity to the economic recession of 2008/2009 has been offered as a possible, at least partial, explanation for this trend (Sivak 2013). However, specific rates of vehicle ownership - including the number of vehicles per person, vehicles per licensed driver, and vehicles per household - all reached their respective peaks in 2004, i.e. several years before the beginning of the economic crisis. Therefore, other non-economic factors such as changes in habits and lifestyles, at least among some segments of the population, the adoption of telecommuting and other technology-based solutions, the use of public transportation (Sivak 2013) and the possible substitution of some trips with non-motorized modes (walking or biking) might have had a prevalent role in affecting these patterns.

Similar trends have been observed in the numbers of vehicle miles traveled (VMT) during the past few years: the U.S. VMT per capita peaked in 2004, while total overall VMT has remained stagnant after decades of upward growth. Perhaps most importantly, according to data from the U.S. Federal Highway Administration (FHWA), total monthly vehicle travel in the U.S. declined significantly between 2008 and 2010, by about 3%, causing even greater reductions per capita (the change in travel demand in these years seems to be, at least in part, associated

[1] Total VMT have been declining during the recent years in the United States. The first half of 2015, however, has witnessed a sharp increase in total VMT (see Figure 1) and VMT forecasts for the entire year signaled a potentially historical record high. The factors behind this increase are still partially unknown. Even considering the recent increase in travel, per-capita VMT remain lower than the record levels from early 2000s.

with the economic crisis). On the other hand, total VMT has begun rising again in the past year: data from the first months of 2015 (Figure 1) show the highest monthly travel level of all time, even higher than the 2008 peak.

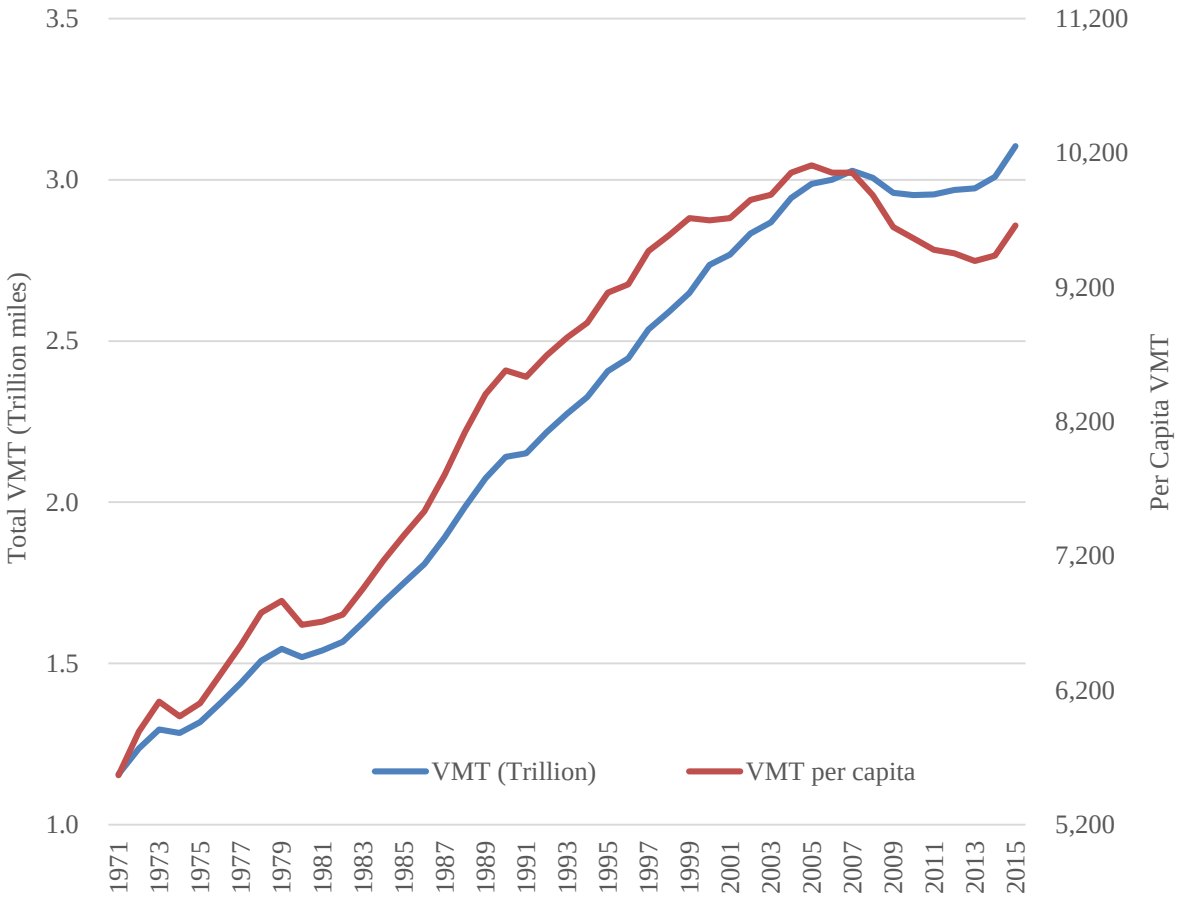


Figure 1. Total VMT and VMT per capita between 1970 and 2015 (created by the authors using FHWA and Census data for 1970-2014; forecast data for 2015 were added using information obtained from the moving monthly-average VMT data from FHWA, last updated in July 2015).

Several European studies have also documented signs of peak travel, in terms of the decline in automobile distance traveled per capita, with some signs of this as far back as the early 1990s. Kuhnimhof et al. (2013) analyzed data from the national travel surveys of France, the United Kingdom, the United States, and Germany over the last 25 years: in the 1990s, each of these countries experienced an increase in automobile travel per capita, though for different reasons. While an increase in automobile travel per capita was attributed to an overall increase in general travel in the United States and France, the increase observed in the United Kingdom and Germany was mainly due to an overall increase in automobile availability. During the following decade (2000 to 2010), though, all four countries experienced an overall decrease in automobile travel per capita. Despite some limited modal shift towards the use of the automobile, the majority of countries saw an increase in multi-modality and multi-modal behavior, with stronger tendencies in this direction observed in Germany (Kuhnimhof et al. 2013).

Newman and Kenworthy (2011) look at the historical trends from 17 cities across the globe to demonstrate that the developed world has experienced a peak in car use, providing some insights into why peak car use has occurred. They used their "Global Cities Database", which has been collected since the 1970s, and updated and expanded in recent years. At the time of publishing, their 2005/2010 data were not complete yet, but based on previous data, they noticed a decline in car use growth (Newman and Kenworthy 2011). They explored six factors that may be contributing to peak car use, which are, respectively: (a) hitting the "Marchetti wall" (related to travel time budgets and congestion, cf. Marchetti, 1994)[2]; (b) growth of public transit; (c) reversal of urban sprawl; (d) aging of cities; (e) growth of a culture of urbanism; and (f) a rise in fuel prices.

The growth of public transit has been, to some extent, suggested to be a factor in peak car use: in major US, Canadian, European and Australian cities, transit boardings from 1995 to 2005 grew at a rate comprised between 6% and 18%, while VMT fell from 1.2% to 15.2% in the same time period (Newman and Kenworthy 2011). This increase, however, was outpaced by the growth in auto use during the same period (before the "peak"): according to data from FHWA for the United States, total VMT grew 23% during these years, at least for some segments of the population (e.g. Millennials), the substitution of the use of personal cars with public transit is not considered a major factor affecting individual mobility during this period (McDonald 2015).

The mobility of millennials

Young adults (currently referred to as "Generation Y" or "Millennials") have received increased attention in transportation research in connection to the analysis of the current changes in travel demand patterns. This very dynamic segment of the population is credited for having rather different behaviors and lifestyles from older generations. The Millennials' *diversity* in lifestyles, attitudes and behaviors (as suggested in several marketing and consumers' behavior studies, cf. Costanza et al. 2012; Twenge & Campbell 2012) seems to particularly affect their travel patterns, auto ownership decisions, and the adoption of new technological solutions (e.g. new mobility options enabled by smartphone Apps, internet-based and shared-mobility services).

The terms Generation Y and Millennials are used fairly interchangeably both in the media and in the scientific literature, though the specific age definitions for this segment of the population can vary. Recent articles and reports (e.g. those published in 2014 or 2015) have typically included individuals aged 18 to 32 – with some going as high as 35 – and some including individuals from 16. In this study, we follow the definition of this generation that is consistent with the recent studies published by the Pew Research Center, which identify millennials as those individuals whose date of birth is comprised between 1981 and 1997 (i.e. they are 18 to 34 year old, as of 2015). This definition of Millennials identifies a specific segment of the

[2] In 1994, Marchetti suggested that in most cities individuals seem to have a "travel time budget" of about one hour. Other authors, however, have discussed the concept of "travel time budget", highlighting a more complex and multifaceted nature of travel time, and arguing that this measure should not be considered as a constant for individuals, and the amount of time spent traveling might depend on several additional factors.

population whose demographic and cultural attributes have been the object of many recent studies and report in the fields of psychology, marketing and social sciences. The Generation Y follows the group commonly known as "Generation X" (35+, in 2015), and is followed by the younger Generation Z (individuals mainly born in the 21st Century, who have not reached adulthood at the time of this study, and that we will not further consider in the analyses of this study).

Young adults aged 19-24 and 25-30 year olds (which roughly correspond to the commonly adopted categories of "younger" and "older" Millennials) drove 19-20% fewer miles per day than individuals in the same age groups in 1995 (McDonald 2015). According to recent studies, there are at least two main ways in which the behavior of the members of the Generation Y might differ from that of their older counterparts. First, the US millennials generation presents major differences in sociodemographic trends from previous generations (in this way, mirroring other existing trends in the society, and following similar trends observed already a few years earlier in some European countries). Among the observed changes, millennials tend to postpone the age they get married and/or otherwise create new households, tend to postpone childbearing, and have fewer children in total then previous generations. For example, in 2014, only 28% of 18 to 33 year olds were married compared to 38% in 1998 (Pew Research Center 2014). A second group of factors (in part also related to the previous) for which millennials' behavior differs from previous generations' behavior relates to the changes in the way the members of this generation deal with work commitments, organize their daily activities, adopt new technologies, and have different preferences and tastes from older adults. Garikapati et al. (2016) analyzed "older" and "younger" millennials, and found that older millennials have gone through the expected transitions associated with aging and are becoming increasingly like their Gen X counterparts at a similar age. However, it is unclear if millennials will adapt to the same travel patterns of the prior generations or if lingering differences will remain in their travel and time use patterns (Garikapati et al. 2016).

Millennials are usually considered as a very dynamic segment of the population, who are able to adjust more easily to changes in the economy (including adverse economic conditions, and a volatile job market) and to the advent of new technologies. They are heavy users of information communication technology (ICT) devices and social media, and are reportedly more inclined to adjust easily to the opportunities offered by the *sharing economy*. Members of the Generation Y (or "Gen Y") have demonstrated a drastic modification in lifestyles and travel behavior, compared to previous generations at the same stage in life. Among the observed changes, younger travelers tend to postpone the time they obtain a driver's license, often choose to live in more central urban locations and choose not to own a car, drive less even if they own one, and use alternative non-motorized means of transportation (Blumenberg et al. 2012; Kuhnimhof et al. 2012; Frändberg and Vilhelmson 2011).

Millennials are also reported to be *less* materialistic than other generations, with one exception: smartphones and mobile devices such as tablets and laptops[3]. Even though adaptation of the new mobile communication device has been increased across the entire population, young Americans have been consistently among the early adopters, who changed their lifestyle based on these new technologies (Rainie, 2012). For instance, in a report published by PEW Research Center (2014), about 83 percent of American young adults (18-29 years old) owned some variety of smartphone, while this share is less than 53 percent of adults nationally. Similar trends have also been observed in terms of using the internet and online social media (*e.g.* Twitter, Facebook) [4] (FHWA, 2011)

Millennials use technology-enabled transportation more than other generation because they are optimistic tech-savvy generation[5]. As previous studies have highlighted, the millennial generation has been raised in an era characterized by the increasing availability of sophisticated information and communication technology (ICT) devices and are often called digital natives[6] (Garikapati et al. 2016). This has certainly contributed to affecting their lifestyles, social habits and mobility choices. Lyons (2015) and others have argued that technology may be also reshaping transportation needs, as seen in the first generation of digital natives. In addition, smartphones provide for young adults the freedom that was previously symbolized by the car (Lyons 2015). On average, Millennials are characterized by, among other things, the widespread adoption of the internet, cell phones, and social networks, which have been hypothesized as "game-changers" in terms of young adult mobility (Blumenberg et al. 2012).

This group is also faced with more hurdles to obtain driving licenses such as graduated driver licensure programs (GDLPs) in the United States as well as in some other countries such as Australia and the United Kingdom (Raimond and Milthorpe 2010; Blumenberg et al. 2012; Le Vine et al. 2014). Driver's licensing rates among young adults have been the focus of several studies that investigated the potential causes for car peak and changes in millennials' mobility patterns. For example, using an online questionnaire Schoettle & Sivak (2014) investigated the reasons for young adults not obtaining their driver's license (defined as 18-39 year olds in their study). The three most common responses for not having a driver's license were not having sufficient time either to learn how to drive or to prepare for obtaining a driver's license, issues with driving costs, and ability to obtain transportation from others. However, there was a significant difference in responses across age sub-groups: for example, 38% of the youngest respondents indicated that time constraints were their top reason for not obtaining a license,

[3] RAYNER, A., "The end of motoring" Guardian http://www.theguardian.com/politics/2011/sep/25/end-of-motoring2011

[4] PEW Research Center: Internet Use as of January 2014. Accessed http://www.pewinternet.org/data-trend/internet-use/latest-stats/

[5] CHAMORRO-PREMUZIC, T., "Are millennials as bad as we think?" Guardian http://www.theguardian.com/media-network/media-network-blog/2014/jan/24/millennials-generation-gap

[6] If millennials have been raised at a time in which personal computers, laptops and cell phones were already largely available, the following Generation Z can be properly identified as the first generation that has been entirely raised in the "internet" era. Still, millennials largely identify with the characteristics of digital natives and represent the first "connected" generation (differently from the members of the previous generations who had to learn how to use most internet-enabled devices already during adult age).

while only 17% of older respondents indicated time constraints as their primary reason (Schoettle & Sivak, 2014). Younger respondents also expressed more concern with financial burdens associated with obtaining a license than members of the older age groups. These findings suggest that travel attitudes and intentions change with age (or across particular life stages). Somewhat similar results were found in studies from other countries: for example, an analysis of younger individuals' travel behavior using data from the national household survey in Australia, showed a decrease in license holding, with a lower proportion of young individuals (below 35) in possession of a driver's license in 2009 compared to the rate observed in 2002. License-holding reached a peak for this age group in 1998, reaching 84%, before declining to 74% in 2009 (Raimond and Milthorpe 2010). The authors hypothesized that these changes were probably caused by the recent amendments to the regulatory licensing scheme in Australia, as well as possible changes in lifestyle preferences towards mobility (Raimond and Milthorpe 2010). Similarly, Le Line et al. (2014), investigated the relationship between internet use and car-driving-license holding in young adults using data from the Scottish Household Survey and the U.K. Opinions and Lifestyle Survey, and found that millennials with higher internet usage were more likely to have a driver's license. Beyond licensing rates, a range of studies have been published in recent years regarding a range of travel characteristics of Millennials and other groups of young travelers.

Several possible factors can contribute to explaining the observed behavioral changes of young adults, including the changes in the household composition (e.g. postponing marriage and procreation), the preference for more urban lifestyles and locations closer to the vibrant parts of a city, and the substitution of travel for work and socializing with telecommuting and social media (Polzin et al. 2014). However, the debate in this field has been so far often dominated by speculations about the potential factors affecting millennials' behavior. A number of studies has started to investigate the residential location and mobility choices of millennials through the analysis of disaggregate data that allow researchers to develop multivariate analyses and control for the partial effects of several covariates. However, some common limitations of these studies are associated with the *lack of information on specific variables*, such as personal attitudes and preferences, or the adoption of new technologies and emerging mobility services, for studies based on data from the National Household Travel Survey (NHTS) or other statewide or regional surveys, e.g. metropolitan planning organizations (MPO) household travel surveys.

A second group of studies referenced in the latter part of this section refers to studies that involved dedicated data collection efforts but that are usually based on the use of *non-random samples*, such as convenience samples drawn from specific segments of the population, e.g. university students. Even if these studies often provide useful information on the impact of some specific variables (and policies) on young adults' travel choices, their results cannot be easily used to draw conclusions that are of more general validity for the entire population of young adults. This is a research gap that we plan to fill with the current study.

Among the studies belonging to the first group, Blumenberg et al. (2012) carried out a detailed analysis of data from the Nationwide Personal Transportation Survey (1990) and the National Household Travel Survey (2001 and 2009), and compared the travel behavior of young adults

and teens (ages 15-26) with that of older adults (ages 27-61). The authors looked at key indicators of travel: personal-miles traveled, number of daily trips, commute mode choice, and mode choice for social trips, e.g. “visiting friends or relatives”, and “other social or recreational” purposes. Using a set of quasi-cohort models, the authors were able to investigate the *life-cycle* effects, *period* effects, and *cohort* effects on the travel behavior of youth relative to middle-aged adults (Blumenberg et al. 2012). Their findings suggest that there is no proof that graduated driver licensure programs (GDLPs) are affecting teen mobility. The study also suggests that there are rather limited differences in the factors that influence travel of middle-aged adults vs. young adults. Economic factors, in particular, seem to have a predominant influence on travel for both groups. Absolutely noteworthy are, however, the generational changes identified in the quasi-cohort model: the youngest cohorts make about 4% fewer trips and they travel about 18% fewer miles than the previous generation at the same stage in their lives, although no clear motivations behind this change are identified (Blumenberg et al. 2012).

In their analysis of the 2001 and 2009 NHTS data, Polzin et al. (2014) showed that millennials exhibit different travel behavior than the previous generations at the same age. From the two NHTS datasets, Polzin et al. (2014) show that 20-34 year olds in 2001 drove more miles per year than 20-34 year old in 2009. They identified several factors that are expected to influence travel demand of young adults in various ways. These include residential location, race, employment status, economic status, living arrangements, licensure status, car ownership, personal values, and technology as a substitution for travel. McDonald (2015) also analyzed 1995, 2001, and 2009 NHTS data to investigate different behavioral patterns among members of different generations at different stages in life. She highlights how all Americans traveled less from 1995 to 2009, but millennial travel decreased the most, and was not substituted by other modes. The study indicated that demographic shifts typical of the 18 to 34 age group (including changes in employment rates, education level and delay of marriage and childrearing) could only explain 10-25% of differences observed in travel patterns between millennials and their older peers. The author concluded that an additional portion (35-50%) could be explained by other variables such as changing attitudes or virtual mobility, even if she could only infer that this portion of behavioral changes are attributable to such factors, as NHTS data does not contain information for these variables. The remaining percentage is attributed the general decline in travel demand across all generations (McDonald 2015).

Similar experiences are available at the international level. Using data from the Swedish National Travel Survey, Frandberg and Vilhelmson (2011) assessed the changes in young adult mobility over the course of almost three decades (1978-2006), using descriptive statistics and cross-tabulations. They found that young people (ages 15-24) at that time made fewer long-distance trips per year. In addition, the average daily distance travelled by young adults has decreased from 1978 to 2006 by 11.9% (Frändberg and Vilhelmson 2011). However, it should be noted that this change is mainly due to a remarkable decrease in distance traveled by men; during the same period of time, women of age between 15 and 24 actually saw an increase in daily travel distance, while men saw a much larger decrease (in magnitude) in their daily travel distance. In 1978, the average daily travel for young women between 15 and 24 was 34 km per day whereas men in the same age group traveled 53 km per day; the combined daily travel for

this age group was 44 km. In 2006, young women traveled on average for 36 km per day, whereas men in the same age group traveled 41 km per day; the combined average daily travel in 2006 for this age group was 39 km. Women of age 25-34 traveled an average of 35 km per day in 1978, whereas men in the same age group traveled 63 km per day (with a combined daily travel average for this age group of 49 km). In 2006, women of age between 25 and 34 traveled on average for 39 km per day, whereas men in the same age group traveled 60 km per day (and the combined average daily travel in 2006 for this age group was 50 km). Thus, a lot of the changes in travel behavior for these age groups between 1978 and 2006 in Sweden seem to be associated with the closing of the *gender* gap, i.e. the difference in travel between men and women (something that had already happened in previous years in the United States). In terms of licensure, a greater percent of 18-24 year-olds had a driver's license in 2006 than in 1999; however, young people have less access to cars (computed as both having a driver's license and having a car in the household) than their older generational counterparts.

Kuhnimhof et al. (2012) review the travel behavior of young adults (different age ranges) in Germany, Great Britain, France, Japan, Norway, and the United States using national survey data (including data from over 20 surveys in total). They find that since 2000 there has been a small decrease in young adult licensure in France, Great Britain, Norway, United States, and Japan (with Germany being the only country included in the study in which young adult licensure has not significantly declined), from approximately 87% to 86%, in 2002 and 2008 respectively. However, comparing several countries based on survey data presents several problems, e.g. the lack of consistency across surveys in terms of age groups, the different definitions of vehicles (particularly important for the United States where SUV and light duty trucks (LDT) are a significant portion of the car fleet), the definition of travel modes (e.g. whether public transportation includes air travel), and the years to which survey data are referred. The authors attempted to harmonize their comparisons by using indicators that are as uniformly defined as possible for car availability, travel modes, travel distances, kilometers per trip per day per capita, and traveler age, analyzing three data points for each country, and focusing the analysis on the trends observed in travel behavior of young adults between 20 and 29. While five of the six countries included in the study have national level data, the Japanese surveys are an amalgam of data referred to 41 Japanese cities, making the comparison of these statistics with those from other countries even more difficult. Overall, Kuhnimhof et al. (2012) find a decrease in car availability for young adults for all countries, except Japan. The largest drop in car availability is observed from 1998 to 2005 in Norway where the percentage of young adults who have access to a car falls from roughly 79% to 64%. The drop in car access is larger for men than for women in all six countries. In Japan, women experienced a growth in car access, which is responsible for the overall increase in car access. No possible explanations for these patterns are discussed by the authors, although it is reasonable to assume that a large part of these trends is associated with changes in the social dynamics and the role of women, who tend to "catch up" with men reducing the gap in mobility between genders. An overall decrease in the distances traveled by car per person per day is observed in all six countries with the United States showing the steepest decline (Kuhnimhof et al. 2012). Consistent with the rest of the literature, the trends analyzed in their paper suggest that young adults in Great Britain and Germany experienced car travel peak in the late 1990s and that car peak for young

adults in the United States occurred somewhere close to 2001 (based on the availability of data, as no NHTS were collected between 2001 and 2009). Japanese young adults also have a small decline in the distance traveled by car. However, average car trip distances for the Japanese young adults are on average rather low, probably because the Japanese data are obtained from a compilation of data from cities rather than national data. Therefore, they reflect the influence of the urban form of these areas compared to the rest of the country. The authors also suggest that the decline in miles traveled in the United States was exacerbated by the economic crash in 2008 even if this was not the initial cause of the decline (Kuhnimhof et al. 2012).

Researchers have begun to explore the effects of urbanization of young adults and how it relates to their travel behavior and the observed travel trends in recent years. To some extent, Kalaee et al. (2009), Kamargianni and Polydoropoulou (2013), and Puhe and Schippl (2014) discuss the effects of the urban environment on travel behavior from young adults, reaching similar conclusions on their impacts. However, these studies rely on data collected among small groups or specific segments of the population, respectively students from elementary school, teenagers, or participants of focus groups. To the best of our knowledge, there have been no studies that discuss this topic using comprehensive data collection processes carried out at the national, regional or city level.

Kalaee et al. (2009) examined the factors that influence the mode choice for school trips in Mashad, Iran, through the estimation of a multinomial logit model. The authors surveyed 7,443 students ages 7-17 across 78 schools in 2008. Of the trips to school, 46.5% were completed by either biking or walking. This percentage increased to 50.1% for the return trips from school. In terms of car trips to or from school, 11% of trips were made by car when going to school but only 6.4% of trips were made by car going on the way back. Not surprisingly, the authors found that age was a significant factor affecting the choice to use a school bus and public transit: older students were less likely to take the school bus to school but more likely to use public transit. Low-income students are more likely than high-income students to travel by walking and biking than traveling by car. Since these are school-aged children, no conclusions can be drawn about their personal access to a car.

Kamargianni and Polydoropoulou (2014) surveyed Greek high school students aged 12-18 in 2011-2012 to investigate the relationship among the urban environment and walking to school, teenagers' perceptions towards walking, and how those perceptions influence mode choice. They surveyed three types of urban environments in Greece: Korydalos and Peristeri (urban areas with population densities of 7,361/km2), Alexandroupolis (a rural area with a population density of 35.21/km2), and Chios (an island with a population density of 59.06/km2). The urban and insular areas had high schools located in every neighborhood, while in the rural area the high schools were located in the southern part of the city. The students in every area could use cars, 2-wheelers, public transit, biking, or walking to get to school. The urban area had more diverse public transit options (tram, metro, train, and bus) whereas the rural area only had bus services as the only public transit option, with reduced frequency in the afternoons. The sample included 716 students from the urban area, 576 students from the rural area, and 696 students from the island of Chios. Most students' families owned at least 1 car – with the average

number of owned cars being 2.3, 1.7, and 1.8 respectively in the urban, rural, and insular areas. Roughly a third of the students from urban and insular areas walked to school, while 50% of students from rural areas walked. Public transit usage was highest in the urban areas, at 30%. Moreover, roughly a third of students were escorted by parents to school in each area. As expected, students living farther away from school were less likely to get to school by biking or walking, most significantly for rural area students. In addition, the authors noted that "the existence of wide sidewalks significantly affected the choice of active transport in urban and rural areas, while in the island area this variable is statistically significant at 90% level" (Kamargianni and Polydoropoulou, 2014, pp. 17). When students are able to use sidewalks that are aesthetically pleasing, students in all areas are more likely to walk or bike, thus confirming the important effect of the quality of urban street design and supply of pedestrian and bike infrastructures on the adoption of non-motorized modes of transportation.

Puhe and Schippl (2014) used *focus groups* in Copenhagen, Budapest, and Karlsruhe to qualitatively investigate the urban-transport-related habits and personal attitudes of 90 young adults of age 20-30. They found that young adults share a similar view towards public transportation: they desire a transportation system that is flexible, convenient, and possibly cheap. From the interviews and background information on participants, the authors observed that a majority of the young adults from Budapest walk and use public transportation on a daily basis. Most of the young adults from the three cities do not use a car on a daily basis. Furthermore, the environmental performance of the transportation modes does *not* affect their daily mode choice – environmental concerns only appear to influence the groups' concept of quality of life. More specifically, "CO2 is not something we can touch and feel. When it comes down to it, you don't think 'are electric cars the smartest and most eco-friendly mode choice?'. You think 'which is the quickest and easiest way to get to work?'" (Puhe and Schippl 2014, pp. 345). Additionally, young adults believe that having a car is necessary when the presence of children is involved, due to the difficulties encountered when travelling with children on public transportation.

The findings from Puhe and Schippl (2014) partially contrasted what Simons et al. (2014) iterated in their research: according to the latter study, personal factors of young adults shape their view and ultimately their decisions on mode choice. In their study, Simons et al. (2014) investigated whether the promotion of active transportation (walking, biking) can reduce the decline in public health of young adults through the analysis of data obtained from interviews of young adults from Antwerp, Belgium. They explored the factors influencing transportation mode choice for short-distance travel (<8 km) to various destinations in both working and studying young adults. Qualitative analysis revealed three major themes that affected young adults' travel decisions: (1) *personal factors,* including autonomy, finances, vehicle ownership, travel purpose, etc.; (2) *social factors*, including social influence, and (3) *physical environmental factors*, including travel time, access to facilities, weather, etc. In their focus group discussions developed as part of this study, almost all the young adults discussed the importance of *autonomy*: cycling allows autonomy, flexibility, and freedom to move around without relying on someone else, or a transit schedule.

Vehicle ownership is another personal factor that affects transportation mode. Many of the young adults who owned a car replaced bicycling trips with car trips, and those young adults who did not own a car would choose their mode of transportation based on their parents or friends' willingness to lend them a vehicle. Almost all the young adults were sensitive to the price of owning and operating a car, e.g. the financial burdens associated with driving a car to work or school (mainly including gas and parking costs). Some young adults also viewed public transit as an expensive option: one young adult commented that when they lost their transit pass, they biked for that month instead of paying for a replacement bus pass because the pass is very expensive when you have to pay for it (Simons et al. 2014). Trip purpose also affected the mode choice of young adults: if they were going to an activity, such as the gym or a sport match, they preferred to travel by car, but if they were going to a social outing (e.g. a bar or party), they preferred not to travel by car because they would be drinking alcohol. Many young adults stated that public transit provides minimal comfort. Others mentioned that car travel was very comfortable, or even luxurious. Health and comfort were not the reasons behind young adults choosing to cycle or walk to school or work. Many young adults reported that their friends were an influence when choosing between transport modes: for example, some individuals preferred to cycle in groups and others stated that if their friends have cars, they preferred to travel in a group by car (Simons et al. 2014). This confirms an important role of peer's influence, which is another topic that is explored in our research.

Similarly, Haustein et al. (2009) investigated how an individual's social environment during childhood influences the travel behavior during adulthood. Using an online student survey from the Ruhr-University Bochum in Germany, they examined how different aspects of travel socialization during childhood and adolescence may explain personal and social norms, car use habits, and travel mode choice in young adults (18-25 year olds) in order to see changes in car use behavior. However, the sample for this study only included individuals who have a driver's license and access to a personal car, as a way to verify that the individual had an actual choice of transportation modes, thus not enabling the researchers to analyze the behavior of individuals that do not have access to this mode.

Several additional studies have analyzed the mobility of *university students* and discussed factors that somehow affect the travel behavior of young adults, including the work from Shannon et al. (2005), Zhou (2012), Zhu et al. (2012), Eom et al. (2010), Limanond et al. (2011), Alistair et al. (2010), Mustard (2010), Thigpen (2015), Klockner et al. (2011), and Belgiawan et al. (2013). The next few paragraphs summarize the major findings from some of these studies. The student population is a very attractive segment of the total population of young adults, which is of particular interest to researchers, also because of the easier way to contact students and collect data. Even if these individuals come from different regions, cities, or countries, they are all easily contacted by means of the university where they are studying. The cost of surveying these individuals is often almost negligible because researchers have the means to contact them without seeking additional external support. Additionally, in most cases, college and university students tend to be of age between 17 and 25 in most countries, which matches the core group of the "younger" millennials (with graduate and postgraduate students filling the segment of "older" millennials).

Zhu et al. (2012) analyzed Chinese student attitudes on car ownership in two Chinese cities, Zhenjiang and Shanghai, using a logistic regression model. Using a classroom-based randomized sampling scheme, they gathered 410 responses from the university in Shanghai and 553 responses from the university in Zhenjiang, with response rates of 85% and 90%, respectively. They found that students from car-owning families had higher valuation of car ownership than students from families that did not own a car. Consistent with expectations, the authors also found that students in Shanghai were less likely to want a car than students in Zhenjiang: students in very urbanized and densely populated areas in China are less likely to want a car than students from less dense regions. Females had a higher *instrumental* value of cars and men had a higher *psychosocial* value of cars. Finally, 65% of the students agreed or strongly agreed that they would buy a car in the future if they had the financial means to do so. The psychosocial valuation index was the most influential determinant for a student's intention to become a car owner (Zhu et al. 2012), even if there is no certainty that such intention might translate in future actual purchases.

Limanond et al. (2011) used seven day travel diaries to study the travel patterns of 130 students who live on campus in a rural university in Thailand. The objective of the study was to investigate the travel patterns of students, and examine aspects of travel behavior including trip generation, mode split, travel distance, and travel time. They presented several descriptive statistics and cross-tabulations based on the analysis of their dataset, highlighting that students make more trips during weekdays, but make longer trips on weekends, and that individuals who own a vehicle relied heavily on driving their own vehicle, while those who did not own a vehicle mostly rode with a friend, drove a friend's vehicle, and took the bus.

Using a cross-sectional survey of three different university campuses of Queensland University of Technology in Brisbane, Australia, Kerr et al. (2010), analyzed the travel patterns and psychological factors influencing students' travel choices. A hierarchical multiple regression model was estimated "to assess the predictive ability of theory of planned behavior constructs in relation to current car commuting behavior as measured by self-reported car commuting behavior" (Kerr et al., 2010, pp. 7). They found that the participants who usually commuted by car had a very positive view about commuting by car - they believe that commuting by car is easy, gives them control, and that others would support their decision to commute by car (Kerr et al., 2010).

Mustard (2010) reported the key findings of a travel survey conducted at the University of Edinburgh, based on a sample of 3173 students who participated in the travel survey. Students at the University of Edinburgh mostly travel on foot: in 2010, 61% of students walked to get to the university, which is an increase of 7% from the 2007 survey. Car (driving alone) travel accounted for about 4% of student travel to the university which is an increase from 2007, where it accounted for about 3% of travel. Moreover, 10% of all students biked to campus in 2010, and bus travel accounted for about 18% of student travel to the university which is a decrease from 2007, when it accounted for 24% of travel. Turning to the motivations behind these trends, about 16.7% of students reported to prefer to travel on foot or by bicycle for their trip to the university, while a majority of students stated they were happy with their current

travel mode used to travel to the university, with only about 29.8% of student who would prefer to travel by a different mode (Mustard 2010). Klockner and Friedrichsmeier (2011) using an online survey of students at the Ruhr-University in Bochum, Germany analyzed mode choice in a student sample for four particular trip types: to school, to work, to a favorite leisure activity, and to a favorite store. They found that trip duration has a strong influence on car use: car trips tend to be shorter, while trips to work and trips to a leisure activity have a higher propensity to be taken by car. Not surprisingly, weekend trips are more likely to be completed by car, since they tend to be made for leisure purposes.

Shannon et al. (2006) used an online survey to examine the commuting patterns, potential for change, and barriers and motivators affecting transport decisions of individuals affiliated with the University of Western Australia. The online questionnaire was based on the Department of Environment's on-line TravelSmart Workplace questionnaire but adapted to make it more relevant for the UWA staff and students: the authors found that 46.8% of students and 21.8% of staff regularly use active transportation modes (defined as "walking, cycling and public transport") and an additional 30% of students and staff would consider switching to active modes if the existing barriers, e.g. high fares, long headways, poor land use, etc., to the use active modes were removed or softened (Shannon et al. 2006). Similar to the findings from Puhe and Schippl (2014), Shannon et al. 2005 found that increasing bus headways (service improvement) and introducing reduced fare options for university personnel would be instrumental in alluring non-active transportation users to public transportation.

In California, universities regularly analyze travel behavior of students, staff and faculty members, also a process of evaluation of their transportation demand management (TDM) policies. In the 2014-2015 iteration of the UC Davis Campus Travel Survey, Thigpen (2015) found that the share of individuals affiliated with the university physically traveling to the campus decreased by 2.6% from the previous academic year. Of those that traveled to campus, 45.6% did so by bike – a decrease of 1.2% from the 2013-2014 school year. Car travel accounted for 24.4% of campus travel in the 2014-2015 academic year, which is a small 0.5% increase from the previous academic year. The number of individuals walking or skating/skateboarding to campus increased by 1.8% during the 2014-2015 academic year. The overall decrease in the number of individuals physically commuting to campus might be associated with modified lifestyles and/or by an increased adoption of telecommuting. Zhou (2012) studied UCLA students' commute and housing behaviors using an online travel survey administered by email between May 2010 and June 2010. The final sample available for the analysis in the study included 769 students. Descriptive and spatial analyses were used to analyze the data, along with the estimation of a multinomial logit model quantifying how residence location and residence type affects a student's mode choice. A spatial distribution of the off-campus students' residences by mode choice is presented in the paper. The author found that most students commute during off-peak hours. Additionally, gender, student type (grad vs. undergrad), and age are significantly correlated with biking, walking, or public transit use: females and undergraduate students have a higher utility of biking or walking, while graduate students are more likely to telecommute than undergraduate students. The multinomial logit model indicated that students using multimodal trips were more likely to use modes such as

transit, biking, walking, carpooling, and telecommuting. Students who live alone are far more likely to commute by driving alone than other students. Having friends and classmates living nearby increases the utility of public transit (Zhou 2012).

Finally, Belgiawan et al. (2013) investigated car ownership motivations among undergraduate students in China, Indonesia, Japan, Lebanon, the Netherlands, Taiwan, and the United States, through the design of a dedicated survey and data collection among the population of students from eight universities in seven countries between January 2013 and June 2013. The survey was translated into the local language of each country with the exception of the Lebanese case – the survey in Lebanon was distributed to students at the American University of Beirut where the instruction language is English. A total of 1,229 undergraduate students completed the survey, with 84 students who completed the survey in the Netherlands, 142 in Japan, 226 in Berkeley, 139 in Taiwan, 200 in Indonesia, 167 in China, and 271 in Beirut. The authors found that although most students (with the exception of those from the university in Shanghai) grew up with regular access to a car, most of them did not have access during their studies. In fact, the only university samples with a percentage of car users greater than 60% were Beirut (89.7%) and Indonesia (64.5%). Motorcycle ownership was high for the students in Taiwan (68.3%) and Indonesia (51.5%), but the Japanese students who owned a motorcycle (about 15.5% of the Japanese sample) drove on average much more than students in Taiwan and Indonesia. Most students, other than those from Beirut, commuted to campus via public transportation, biking, or walking. More than 90% of the students from Utrecht (Netherlands) commuted by those three modes. About 70% of the students from Berkeley (United States) walked for their commute. Despite the proportion of students commuting by public transportation, biking, and walking, most students indicated that they planned to own a car in the future. The authors also examined the "emotional attachment" of these students to cars using a principal component analysis: they found that students from Utrecht and Japan do not perceive a car as linked with bringing them higher social status, and students from Berkeley most strongly believe that a car provides independence, in terms of flexibility to travel, convenience, and reducing travel time. Students in Beirut and Indonesia felt the most strongly about "cars giving an arrogant impression" compared to the students from other universities. In terms of car ownership aspirations, the study found that the students from Beirut had the strongest intentions to buy a car in the future. For all universities (except for Taiwan) the perceived independence that a car brings was positively and statistically correlated with the intention to buy a car (Belgiawan et al. 2014).

Even if the studies reported above investigate several traits of travel behavior of students, their importance in terms of interpreting the impact that sociodemographic traits, attitudinal variables and other factors can have on the general population of young adults is limited. University students are a very specific subset of the Gen Y population. Accordingly, studies that focus on university students provide some interesting information about the relationships existing among students' sociodemographic characteristics, their personal values and beliefs, the influence of the local place where they live, their current habits and future intentions to purchase a vehicle and to travel by different modes. Many young adults do not attend university, though, and many students' current behaviors (e.g. transit captive users) might be

associated with the specific stage in life in which students are or other temporary conditions (e.g. not having the means necessary to purchase a vehicle yet, or a place to keep it) that other segments of the population do not share. Further, in small communities or rural university campuses, the travel patterns of students tend to be homogenous and may not capture individuals' travel aspirations and other personal characteristics, but tend to be more largely affected by local conditions.

Overall, even if several possible explanations have been proposed to explain the observed behavioral changes of young adults, several limitations exist in the ways previous studies have investigated these phenomena. Understanding the characteristics of millennials' behavior, and their potential response to travel policies as well as their influence on future societal changes and travel demand, is a goal of major importance for planners, and represents an important steps to guide the development of transportation planning processes and investment decisions. So far, a lot of discussion has focused on the role of millennials in society, and their different habits and behaviors from older generations. Still, the debate in this field is still often dominated by speculations about the potential factors affecting millennials' behavior. The approach developed as part of this research offers an opportunity to investigate the impact of a wide range of factors that have been suggested as potential explanations for the observed changes in the mobility choices of millennials, using data specifically collected for the California population of young adults as part of this project. Thus, this study offers a possibility to fill an important research gap, while it overcomes some of the major limitations affecting previous studies in this field.

Shared Mobility and New Mobility Services

Rapid technological advances (in particular, the recent innovation in smartphone Apps and internet-based transportation-related services) as well as the growing interest, and investments, in the sharing economy have greatly expanded transportation choices, options and ownership models. Travelers now can rent a car or a bike, request a ride in real time, and book micro-transit services using the internet and their smartphone devices. Members of younger generations, and millennials in particular, have been credited to be heavy users of these technologies, also thank to their familiarity with the use of smartphone apps, and their increased propensity to try (and often adopt on a regular basis) new services and adapt to the modern sharing economy.

Hallock et al. (2015) provide a review of the availability of 11 groundbreaking technology-enabled transportation solutions in 70 U.S cities (including the primary cities of the nation's 50 largest metropolitan areas, and the largest cities in the states that do not have any primary city contained in the previous list). In their study, the authors determine the availability of different types of *car-sharing* services (including *fleet-based* services such as Zipcar or *peer-to-peer* services such as Relay Rides), *ridesharing* services (including *dynamic carpooling* such as Carma/Zimerman and *on-demand ride* services such as Uber/Lyft), *bike-sharing* services as well as different transit and multimodal trip planning smartphone applications, using internet searches, search of smartphone app stores and list of well-known companies in these fields. The results of their study show that in 2015 there are already 19 cities that have access to

nearly all new mobility options. In addition, 35 cities have access to most new options (but not all of them), and only 16 cities have access to fewer than half of the new mobility options. The authors of this study did not investigate the impact on travel behavior of each of these new mobility options.

There are expectations that these new transportation alternatives contribute to reducing vehicle ownership, providing an alternative to owning a car, without the fixed costs associated with it. The new shared mobility services can also provide an alternative to driving through the availability of more flexible and resilient alternatives, eventually decreasing the total vehicle miles driven (depending on the means of travel they substitute). They can even boost transit ridership by well serving the first and last miles and by improving the experience of riding transit services (Hallock et al., 2015; Shaheen et al., 2015), or providing the availability of a ride home outside the hours of operation of public transit (or at a time in which traveling by transit and/or walking to/from the transit stops may be considered unsafe). The universe of the technology-enabled transportation services is continuously evolving, and new services (and Apps) become available almost on a daily basis. Accordingly, providing a full review of the available options is almost impossible, and the number of studies exploring the expected results from the adoption of these modes is still limited. In the following paragraphs, we summarize some findings available from some major studies that are available to date and that have focused on the effects of these new mobility options.

In an overall review study developed by Caltrans (Caltrans, 2015), *car-sharing* is suggested as an efficient tool to achieve the reductions in VMT and greenhouse gas (GHG) emissions that have been targeted in the State for 2040. Caltrans forecasts that statewide VMT could be reduced by 1.1% with a 5% increase in the adoption of car-sharing. In another study, Cervero and Tsai (2004) found that 30% of the members of car-sharing programs want to sell one or more of their vehicles, and others postpone purchasing an additional vehicle after using car-sharing services for about 2 years. It is worth noting, though, that early adopters of car-sharing services (as well as other technology-based services) tend to be higher-income individuals, who often report car disposal or postponement or complete avoidance of a car purchase to fulfill their mobility needs (Shaheen 2012). However, the behavior of such early adopters may not be typical of later entrants to the car-sharing market. In another study, Martin and Shaheen (2011) surveyed members of car-sharing program in United States and Canada, and concluded that adding another vehicle to the fleet of shared car would replace 9 to 13 vehicles among the members of car-sharing services, which might contribute to a 27-43 percent reduction in VMT (Martin & Shaheen 2011).

Bike-sharing is another emerging transportation that offers a quick, flexible, healthy solution for short- and medium-distance trips. Bike sharing has been a popular presence in many European cities (with the first experiences dating back to many years ago in Paris and Vienna). The first bike-sharing program that was launched in the United States was a very small scale program with only 24 bikes that opened in Oklahoma in 2007 (Shaheen 2012). After three years, the first large-scale bike-sharing program was launched in Denver, CO, with approximately 400 shared bikes. Since then, the number of bike-sharing programs in the United

States has increased dramatically, increasing from the only service that opened in 2007 to approximately 50 bike-sharing programs available in 2014 (according to the estimates from the Earth Policy Institute, http://www.earth-policy.org/plan_b_updates/2013/update113, accessed on September 30, 2015). Shaheen et al. (2014); Shaheen et al. (2012) discuss the effects of bike-sharing programs on modal split in North American cities. The results show two counteracting effects in different neighborhood settings: while in small cities bike-sharing tend to increasing transit use through better serving the first and last mile access, conversely in large cities bike-sharing may reduce transit ridership through providing a faster and cheaper travel option for many trips.

Another fast growing technology-enabled transportation option include modern *on-demand ride* services, also referred to as *ridesourcing*, or *transportation network company* (TNC) such as Uber, Lyft, and Sidecar. Users of these services are connected to a community of drivers via a smartphone application and are able to solicit a ride within a short waiting time. On-demand ride services are different from regular taxi services with respect to picking up locations, as well as solicitation and payment methods. On-demand rides services have been evolving quickly during the last few years, and their rapid growth seems to have disrupted the use of classic taxi services as well as the activity and travel scheduling of many users by providing extended options for short-distance trips (Rayle et al. 2014). The democratization of enabling technologies such as smartphones created a class of "real-time riders" that include but are not limited to millennials (ITS America 2015). One of the latest type of on-demand ride services (and a spin-off alternative provided by the same companies that provide these services) are the *ridesplitting* services such as Uberpool or Lyftline, which allow riders with similar origin and destination, and automatically matched by the internet App, to split an on-demand ride. Overall, on-demand ride services may reduce the overall amount of driving (Rayle et al., 2014), as well as the use of shuttle services (e.g. to and from an airport). However, the overall effects of these services on travel demand and mode choice have not been quantified yet, and it is reasonable to expect them to vary depending on the local context, the characteristics of the users, the land use features and the transportation alternatives that are available.

As discussed by Shaheen et al. (2015), more research is needed to quantify the magnitude of changes in travel patterns and behavior associated with these emerging transportation services. Surveying travelers about how they used to travel before the introduction of the new transportation services and how they would have traveled in the absence of these services would be promising in terms of quantification of the magnitude of changes, and it is one of the objectives of the current research. Not surprisingly, millennials are reported as the most frequent users of these emerging transportation options. For example, according to a 2013 study commissioned by Zipcar, millennials are more willing to use technology-enabled transportation options than older users (Zipcar, 2013). Similarly, in a survey of bike-sharing users in Washington D.C., Buck et al. (2013) show that more than half of the annual members are in the age group between 25 and 34. This is also true for the users of on-demand ridesharing services: interviewing 380 users of on-demand ride services in San Francisco, Rayle et al. (2014) show that the majority of these users are composed of young and highly educated people. One of the potential reasons for which millennials are found to be heavy users of these

services, apart from the familiarity with technological solutions in general, may relate to the residential location of millennials, and the availability of the new mobility options. As discussed earlier, Millennials seem to be more interested in living in central, urban areas and more open to try means of transportation alternative to the use of a private car. If confirmed, the two factors combined would mean that not only millennials have higher accessibility to the new mobility options, but when exposed to them they would be also more inclined to adopt them. The relationship existing between the adoption of new mobility services and millennials' residential location and mobility choices is one of the topics that we explore in our research, in particular in terms of investigating the potential effects of the use of emerging transportation services on overall demand and the use of other modes.

Research Methods

In order to improve the understanding of Millennials' mobility-related decisions, and the factors that affect them, in this study we embarked in a comprehensive data collection effort that involved the design, pretest and administration of a detailed online survey that was distributed to a sample of more than 2400 respondents as part of the project. The online survey is designed to collect empirical data on young adults' travel behavior, lifestyles, residential location and other related variables that are useful to explain millennials' travel-related choices in California. We administered the survey to a sample of the population of young adults (millennials) and members of the previous Generation X in California. We used a commercial vendor (i.e. a web-based *opinion panel*) to invite members of these segments of the population to complete the survey, using a quota sampling method to ensure that we receive enough responses from each geographic region of California and neighborhood type (classified in predominantly urban, suburban and rural areas). In addition, sociodemographic targets were used to make sure that the sample mirrors the characteristics of the California population on five key sociodemographic dimensions: gender, age, income, race and ethnicity, and presence of children in the household.[7]

The data collection process was specifically designed to investigate the important relationships associated with the behavioral processes and mobility-related decisions of millennials, and to investigate the impact that several groups of variables, including changes in lifestyles, sociodemographic trends and the adoption of emerging mobility services, have on the travel decision this dynamic segment of the population. In addition, the presence of a *control group* composed of members of the older Generation X is useful to allow comparisons across generations in the study, using the same methodologies for data collection and selection of respondents for the entire sample.

The survey structure includes several sections, which collect information on several groups of variables including:

- *personal attitudes and preferences*, measured through the agreement/disagreement with a group of statements on a five-level Likert scale, for several dimensions including social habits, lifestyles, adoption of technology, environmental concerns, exercise/physical activity, time organization, etc.;
- *transportation-specific attitudes*, also measured on a five-level Likert scale, for several dimensions including mode perception, status symbol, time flexibility, comfort, cost/price sensitiveness, ability to carry things/perform activities while traveling, ability to coordinate trips with peers/friends/family members, attitudes towards waiting, etc., measured for a number of transportation modes, including private vehicles (cars and/or motorcycles), public transportation (bus or rail) and active modes (bike and pedestrian);

[7] In future stages of the research, we plan to expand the data collection distributing the online survey that we designed as part of this project also through other channels, including through the cooperation of other university campuses, metropolitan planning organizations, transit agencies, commuter clubs, non-profit organizations and major employers in California.

- *interaction with peers, friends and family members and living arrangements* (i.e. living alone, with the family of origin, with the spouse/partner, etc.)*;*
- *engagement in in-person and online social activities*, and the role of new media on affecting personal and travel choices (including online social networks, i.e. Facebook, Twitter, etc.);
- *cultural background*, measured according to a number of dimensions, including perceived expectations of the role of the individual in the society, ideas of collectivism/ individualism;
- *commute to work/school and other general measures of travel behavior*, including the use of private vehicles, public transportation and active transportation modes, information about average travel time and distance for a trip to work/school;
- *limitations to the use and/or availability of specific travel solutions*, including any disability or impairment to use some modes, or limiting the range of active modes, the availability of a car and/or other private vehicles, availability of a bike, accessibility/ availability of public transportation, employer/campus-provided buses/shuttles, other alternative modes (e.g. bike sharing, car-sharing, etc.) for the most common trip purposes, including commuting, shopping, leisure trips, etc.;
- *information about the residential location and location of the main place of work/study*, in terms of urban form, type of housing, etc.;
- *information about major life events* that have happened in the past three years, including marriage, birth of a child, relocation to a new city, state of country, etc., that might have affected the current residential location and travel behavior decisions;
- *future propensity to purchase and use a car vs. the use of other modes*, including intentions and expectations about changing the level of private vehicle ownership, starting or dropping the membership in a car-sharing program, expected major events that might cause a relocation or major changes in the level of individual mobility, etc.;
- *sociodemographic traits*, including gender, age, household size, individual and household income level, education, work/student status, university major/field of study, ethnicity, political affiliation, and sexual orientation.

We administered the survey to a sample of more than 2400 total respondents, which include 1400 members of Generation Y (Millennials, aged 18-34) and 1000 members of the previous Generation X (aged 35-50). The data collected with this survey allowed us to build a very rich and comprehensive dataset which includes several groups of relevant variables useful to explain young adults' travel behavior, their residential location, and their propensity to purchase a vehicle, and that allow a number of potential analysis, e.g. investigating the impact of individuals' attitudes, environmental concerns, cultural background and the influence of peers and social media on mobility-related decisions, while controlling for the influence of other circumstances, local context conditions, life events and sociodemographic traits. Other studies have attempted to study some components of these topics. However, to our knowledge, no study has ever attempted to collect and analyze such a large amount of information from the respondents, while at the same time controlling for the composition of the sample and building a sample that is representative of the population of residents in the area of study. Thus, the analysis of this dataset allows us to establish a very systematic and

rigorous investigation of the patterns and motivations associated with young adults' travel behavior in California, thus generating important insights that can be useful for planners, as well as important scientific findings that contribute to advancing knowledge in this field. The remainder of this section of the report provides additional details on the methodology and research approach that was followed in the design of the survey instrument that was used to collect information from the respondents.

Methodology, Scope and Main focus of the study

This project is designed as a self-contained cross-sectional study of the mobility of young adults, and the factors affecting their choices, in California (with the use of a control group of members of Generation X for comparison purposes). Accordingly, as part of this project, we designed a detailed cross-sectional survey that collects information on, and allows analyzing the relationships among, the personal attitudes and preferences, lifestyles, residential location and mobility patterns of young adults ("millennials"), and the factors that may affect these trends. The study is designed also in order to allow contacting the respondents at a later time for a follow-up survey after a period of time (e.g. two or three years) in order to control for the eventual persistence of some patterns in the respondents' behavior, and thus turning the study into a *panel* study. Additional data collection through future follow-up survey waves to be distributed to the same sample (longitudinal study) or other samples of millennials in the same area of study (repeated cross-sectional analysis) will provide additional information that will be useful to explore modifications of behaviors over time.[8]

The data collection developed as part of this project covers the entire state of California. The online survey was distributed to a sample of the population of young adults and members of the previous Generation X in California, stratified by geographic region and neighborhood type in which the respondents live. In addition, five key demographic dimensions (age, gender, income, race and ethnicity, presence of children in the household) were controlled for, in order to obtain a sample that mirrors the characteristics of the respective populations of residents of California. The structure of the survey, however, is useful also for potential extensions of the study to other regions beyond California. The same methodology developed as part of this project can be easily replicated and applied for future data collection in other US States and/or comparisons at the international level with other countries, as the research team plans to do in the future steps of this research.[9]

[8] Additional survey waves are planned as further extensions of the current study, but they are not included in the current scope of work and are not discussed in this report.

[9] At the time of writing of this report, the members of this research team were able to secure funding from the Georgia Department of Transportation to create a similar research study for that state. The comparison of the datasets collected in California and Georgia will allow developing many interesting analysis, in terms of the analysis of millennials behavior and its impact on travel demand, in presence of a variety of different land use types, socioeconomic conditions, cultural and political environments. The researchers are working in close cooperation with the National Center for Sustainable Transportation and other partners to further extend this research project to additional states and regions in the United States, and to other countries.

The content of the online survey spans several dimensions that have been suggested as important determinant of travel behavior for millennials (and more generally for the members of the two segments of the population). Our interest focuses in particular on residential location, travel behavior choices, the adoption of new technology (including new emerging transportation services, e.g. car-sharing or *on-demand ride services* such as Uber or Lyft), aspirations to purchase and use a vehicle vs. use of other modes, and motivations behind them.

The online survey collects information on several variables related to *travel behavior*, including:

a. Travel behavior by mode (VMT, frequency of use of car and of other modes, etc.)
b. Car ownership
c. Adoption of non-motorized modes
d. Impact of new emerging technologies, e.g. shared mobility services
e. Propensity to purchase and use a vehicle vs. other means of travel

The study is designed to investigate the impact of a number of factors on mobility choices, including both classical and speculative factors that have been suggested as potentially affecting millennials' mobility-related choices, such as:

- "Classical" explanatory factors:
    - Economic factors, e.g. economic cycles, income and transportation costs
    - Sociodemographics, e.g. employment, education, HH size, HH structure, etc.
    - Residential location and land use patterns, including the effects of the built environment/urban form, eventual self-selection, local vs. regional accessibility (by mode), connectivity, etc.
    - Geographic differences (urban vs. suburban location, etc.)
- "Speculative" factors often attributed a role in affecting millennials' behavior:
    - Personal attitudes and preferences (e.g. preference for "urban lifestyles")
    - Environmental concerns
    - Cultural background
    - Adoption of technologies and eventual substitution of travel with IT alternatives
    - Use of new transportation modes, e.g. car-sharing or on demand ride services such as Uber/Lyft;
    - Delayed HH formation and modifications in socio-demographics

The information that is collected in the dataset allows controlling for many groups of variables that have been attributed an important role in affecting Millennials' choices (see Figure 2), as discussed by Polzin et al. (2014).

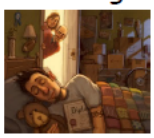
Economic	Auto Costs	Technology	Demographic Change
• Recession • Unemployment 	• Gasoline • Auto insurance • Driver's education • Auto repairs • Other fees	• Communication technology • Transportation technology (Über)	• Delayed marriage • Fewer children • Boomerang 
Residential Location	**Cultural**	**Regulatory Changes**	**Alternative Modes**
• More likely to move to and live in cities	• Environmentalists • Less materialistic 	• Graduated Driver's Licensing • Texting while driving laws	• **Better transit** • **Improved infrastructure for walking/biking**

Figure 2. Potential factors affecting millennials' choices
[Source: Evelyn Blumenberg, "Panel Discussion: Millennials' Travel Behavior", presented at the 94th Transportation Research Board Meeting, January 2014]

Research Questions

The data collected in the study allows investigating the impact of the various groups of variables on millennials' mobility choices, and will allow developing a number of in-depth analyses that were not possible with the data that were previously available.

Some of the major research questions that inspired the study and led the development of the data collection include:

- *Are the observed mobility patterns of millennials the results of economic cycles and millennials' residential location?*
- *How do the urban form of different neighborhoods and parts of cities and regions affect millennials' decision? What about the members of Gen X?*
- *What is the role of transportation policies and investments, and the recent changes in the structure of cities in affecting their mobility choices?*
- *Are young adults' mobility patterns the result of their desired lifestyles and personal preferences, or mainly an effect of where millennials live and work?*
- *Do young adults decide to relocate to these areas to fulfill their propensities towards mobility and lifestyles?*
- *Is there any evidence that millennials' plans for the future will shift from their current lifestyles and choices (and what differences exist – if there is a mismatch - between their current lifestyles and behaviors, and their aspirations for future mobility)?*

- *How do these relationships vary by geographic location, e.g. San Francisco Bay Area vs. rest of California, urban vs. suburban areas, big cities vs. rural counties?*
- *What is the contribution of permanent vs. temporary factors affecting the mobility-related decisions of the members of these generations?*

The analysis of this comprehensive dataset will allow researchers to explore a number of research questions, and develop a number of sophisticated analyses, some of them require rather detailed and sophisticated statistical approaches and the estimation of detailed multivariate models. In future stages of the research, we also plan to integrate this dataset with additional information, e.g. on land use features for the areas where respondents live, available from other sources. Many of these analyses will be developed in following stages of this research, including during a "Year II" research grant that was funded by Caltrans through the National Center for Sustainable Transportation, and that starts in October 2015.

Behavioral Framework and Groups of Variables Controlled for in the Survey

The following set of figures discusses the behavioral framework that was adopted to identify the important groups of variables, and some of the hypothesized relationships among them (i.e. *behavioral model* of millennials' vs. Gen Xers' travel choices) in the project.

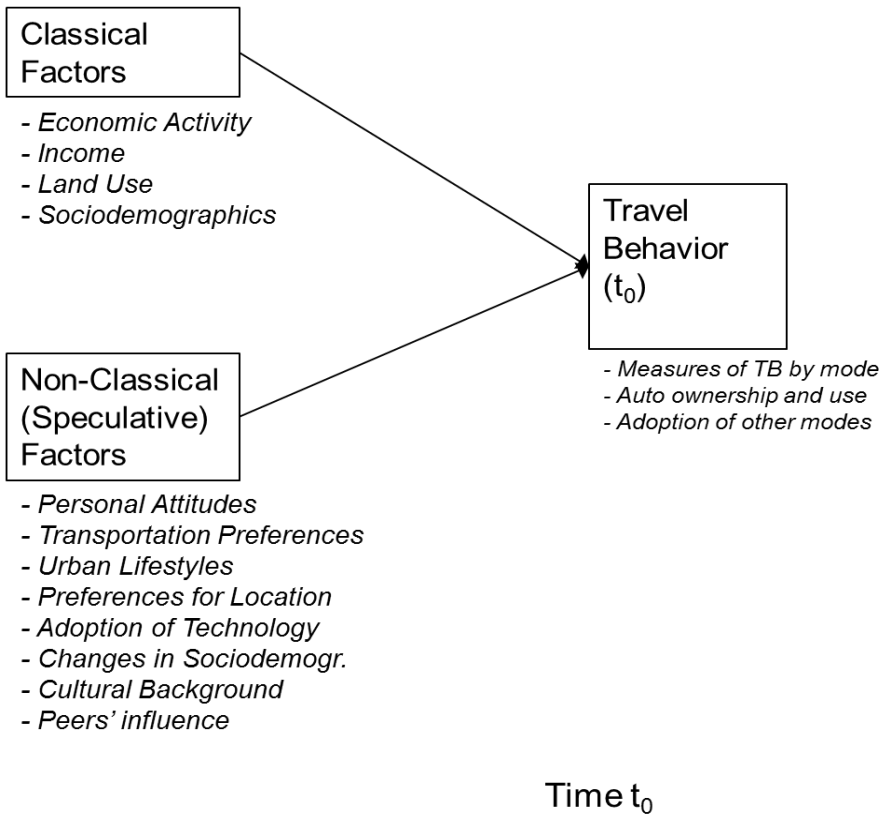


Figure 3. Classical and more speculative factors affecting millennials' travel behavior choices

Figure 3 summarizes the main groups of explanatory variables (as mentioned before), including both classical and more "millennials-specific" non-classical variables, and their relationships

with travel behavior variables. Please note that Figure 3 is, on purpose, an overly simplified representation of the relationships among variables for explanatory purposes. According, it contains only a summary representation of all relationships, as well as the main groups of variables that are considered in the project. Each group of factors includes several potential explanatory variables that might interact with each other, as well as with one or more dependent variables. All these variables are expected to some extent to affect (or, better say, interact with) the travel behavior choices.[10] Starting from Figures 5 and 6, we will also explicitly consider the relationships involving the *residential location*, and the related land use information.

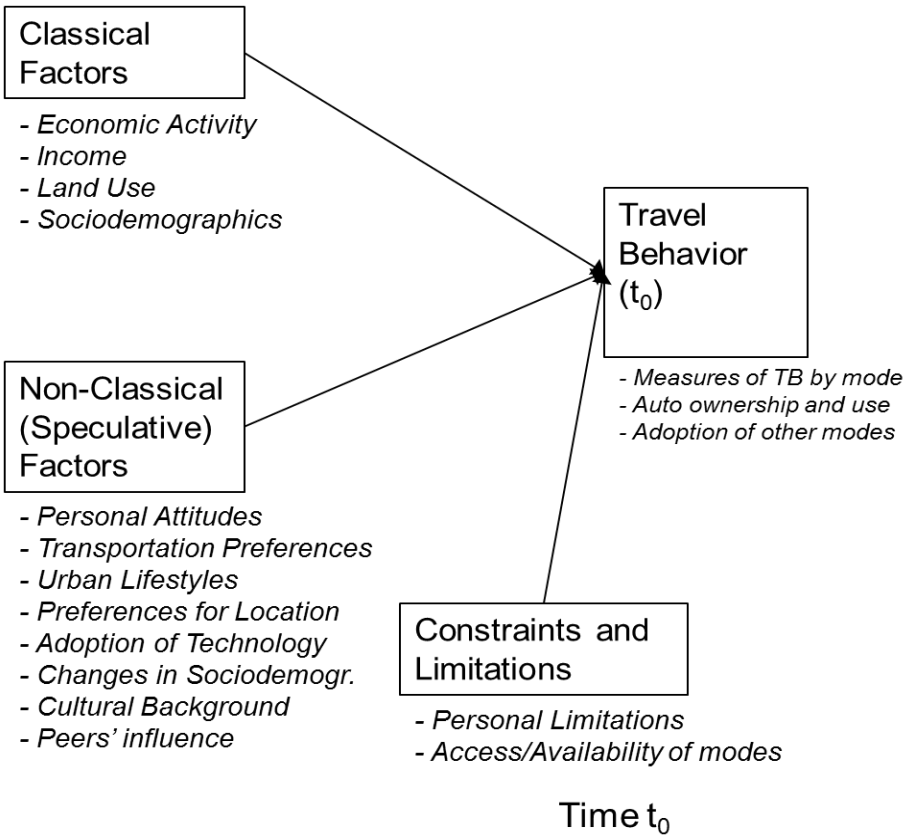


Figure 4. Impact of constraints and limitations on travel behavior

Another important group of variables affecting travel behavior includes the constraints and limitations affecting individuals' decisions, and which need to be measured in the study. These limitations may include:

- Individual limitations to the use of some options (e.g. disabilities, other constraints and limitations);

[10] In the remainder of this section, we discuss the hypothesized relationships among variables referring to millennials' choices. According to the research design, the same relationships are analyzed also for the members of the Gen X, allowing us to establish interesting comparisons on the main drivers of travel behavior (and their relative magnitude) among the members of the two generations, and depending on the geographic location (specific region) in California.

- Access and availability of some options (e.g. some areas are not well served by public transportation, and bike-, car- and ride-sharing options are not offered everywhere, etc.)

The diagram therefore becomes the one in Figure 4. Again, please note that the figure is only a simplified scheme that highlights the potential groups of variables of interest for this study, and it does not aim to provide a comprehensive representation of the complex pattern of *causal relationships* among the various variables. Accordingly, the arrows connecting the groups of variables reported in the figure are only examples of the potential relationships relating the main groups of variables, and not an exhaustive representation of the complex "landscape" of relationships among all variables. For example, the "cultural background" might also affect the "constraints and limitations" (in several ways), and the "constraints and limitations" might also affect "residential location" (which is added to the behavioral framework in Figure 5, with only a few hypothesized relationships in the graph, again for explanatory purposes, not to overly complicate the figure).

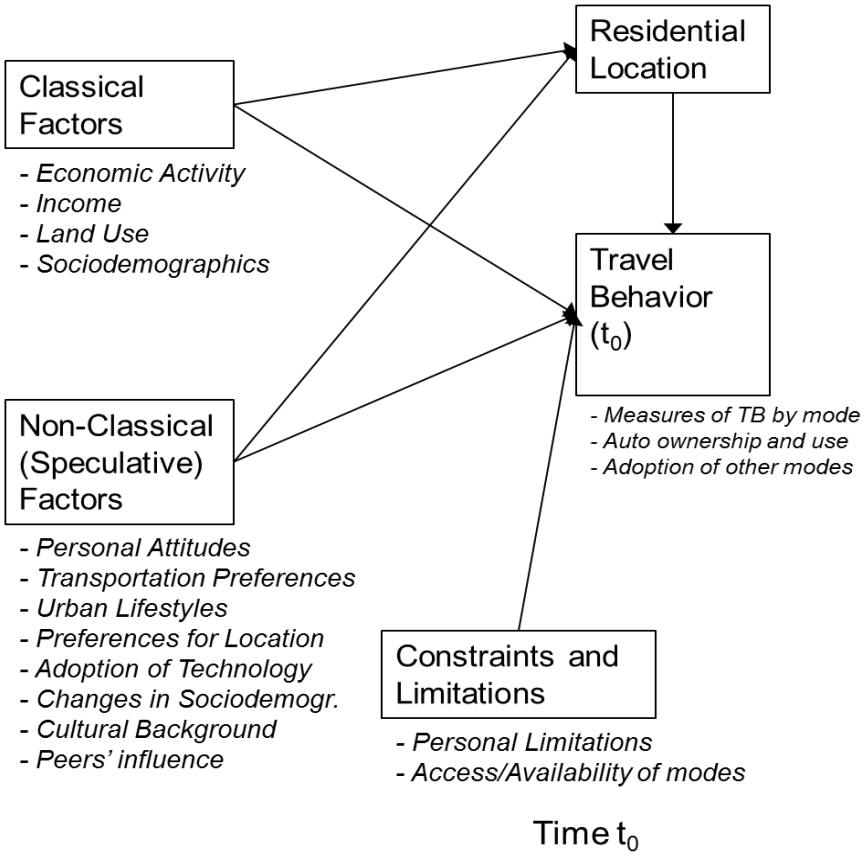
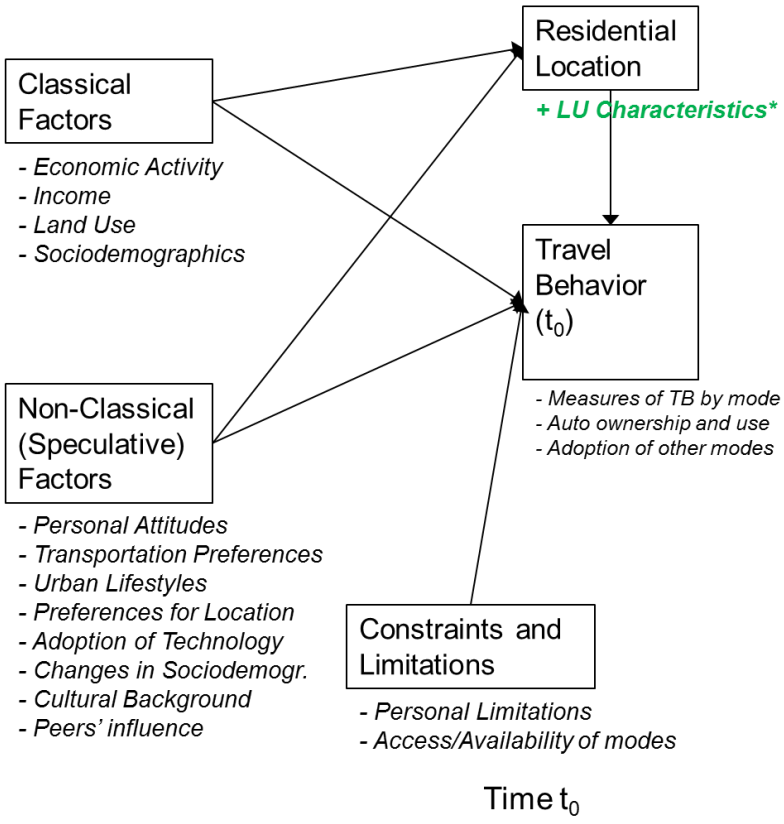


Figure 5. Role of residential location as a choice influenced by the other factors, and as a factor affecting travel behavior

We collect information about the residential location of respondents (and the school/work location). Through the geocoding of the information about location, we can import a set of

additional pieces of information related to the land use characteristics of the neighborhoods in which the young adults live and/or work or study, available from other sources:



**Measured with external data (e.g. US EPA Smart Location data), after geocoding of residence (X, Y)*

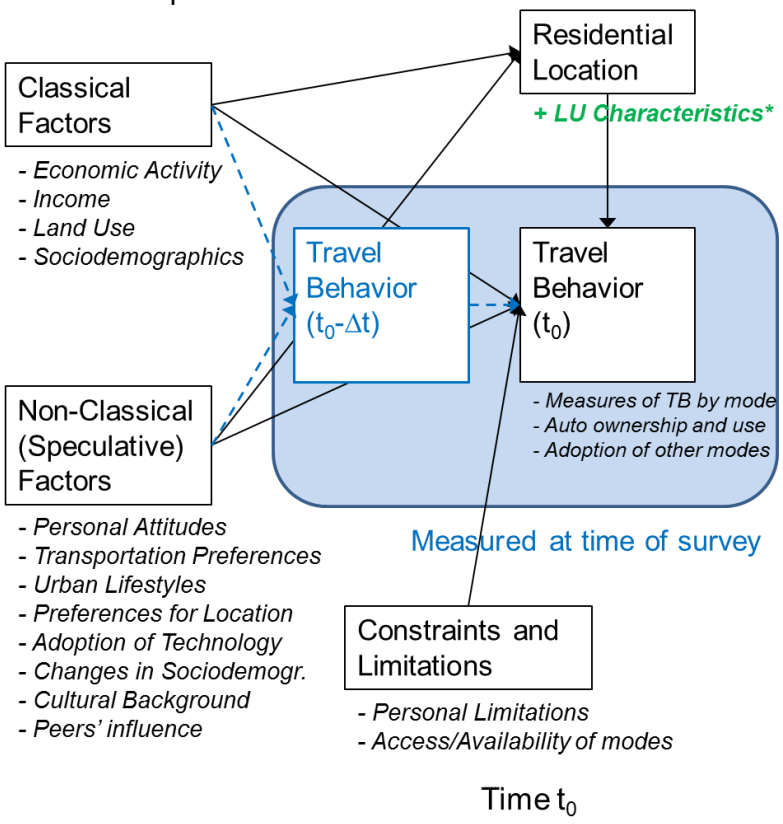
Figure 6. Additional land use variables (e.g. measuring the characteristics of the built environment) are imported from other sources, after geocoding the residential (and work) location of respondents

The imported land use variables might include multiple measures of the characteristics of the built environment. Potential data include, for instance, information obtained from the US EPA Smart location data and from other studies (e.g. land use data developed as part of previous research projects developed at UC Davis). A large part of these activities (i.e. merging other LU data from different sources) will be developed under the following phase of the research[11].

All the variables that have been measured so far are measured at the time t_0 in which the survey is administered to the sample of respondents. In addition, information related to previous patterns of travel behavior is also collected through the use of some retrospective questions about millennials' previous behavior at the time t_0-Δt (see Figure 7). In this study, we adopt an interval Δt of three years: in a dedicated section of the survey we ask respondents for

[11] The integration of the current dataset with the additional land use data available from other sources (including the US Smart Location Data and other research projects developed at UC Davis) is part of the scope of work for the Year II Research Grant funded by Caltrans through the National Center for Sustainable Transportation, which builds on the analysis of this dataset. The Year II Research Grant starts in October 2015.

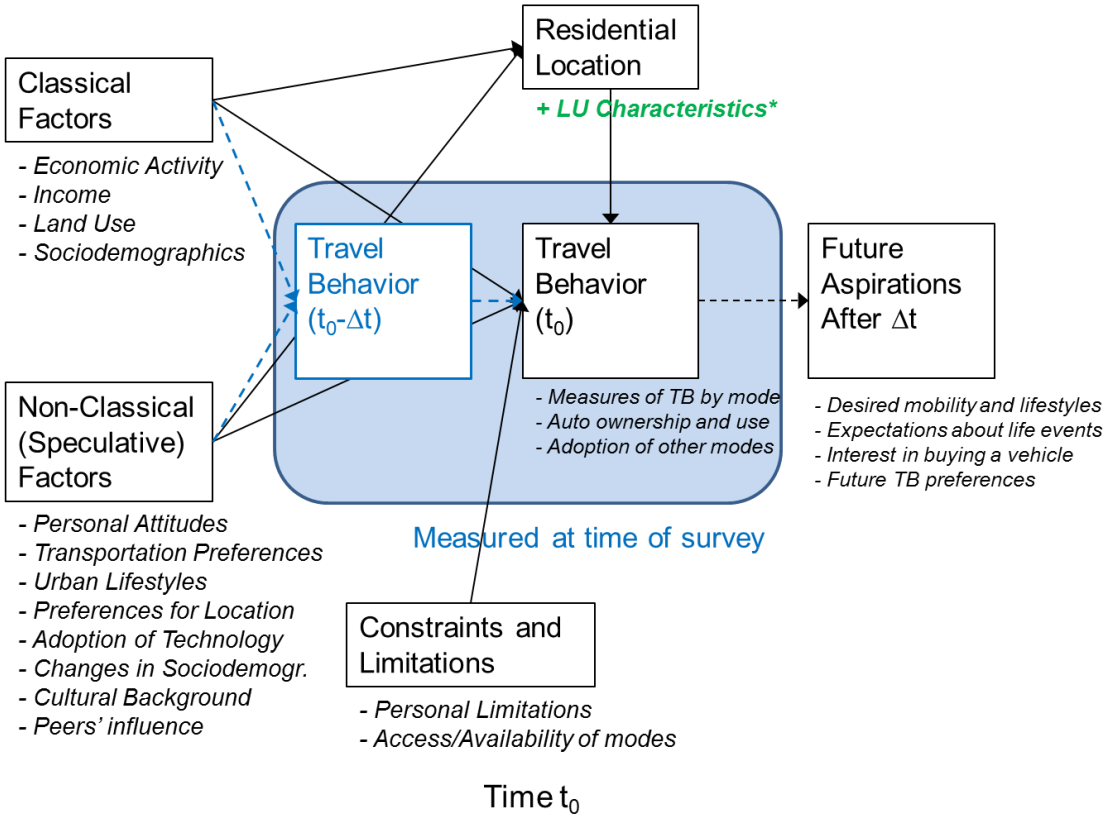
any major *life events* (e.g. change of residential location, enrollment in a study program, marriage, birth or adoption of a child, e.g.) that might have occurred during the previous. Contextually, we also ask for information on any major differences existing between the previous travel behavior (three years before the time of the current data collection) and the current travel patterns.



**Measured with external data (e.g. US EPA Smart Location data), after geocoding of residence (X, Y)*

Figure 7. Retrospective questions about previous travel behavior of millennials

Our interest also includes the exploration of future aspirations in terms of desired mobility and lifestyles, and expectations about future life events (change of job, marriage, childbearing, etc.) in the near future (e.g. following three years), as well as respondents' interest in purchasing and/or using a private vehicle (e.g. car or motorcycle, vs. a bike, etc.) vs. using other means of transportation (see Figure 8 below). All these pieces of information are collected at the time of the survey, and represent the "aspirational" components towards future lifestyles and mobility.

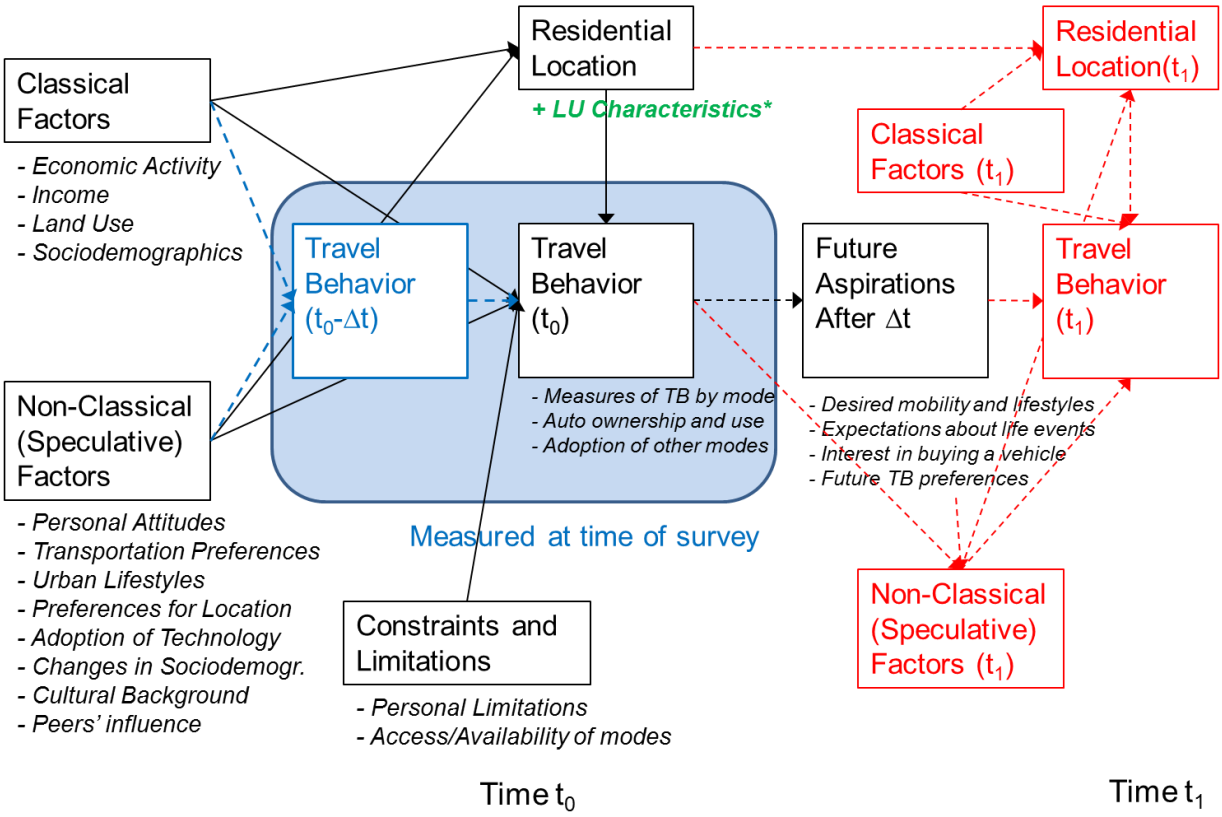


Measured with external data (e.g. US EPA Smart Location data), after geocoding of residence (X, Y)

Figure 8. Personal aspirations for future mobility (and expectations about life events, etc.)

The content of the current cross-sectional version of the survey that is administered as part of this project ends here. Figure 9 represents the complete behavioral framework including the possibility of deploying an additional "follow-up survey" (e.g. after 2-3 years, contacting again the respondents of the first survey), as a future extension of the current project. This additional wave of survey provide the opportunity to measure many of the variables that have been controlled in this study also at a future time t_1, overcoming many limitations of *cross-sectional* datasets, and allowing us to investigate the impact of a number of changes and life events over time in the life of young adults. In this way, the study would assume the structure of a *panel* study, adding the longitudinal component that would be extremely beneficial to investigate the relationships behind millennials' travel behavior and controlling for a number of components of these dynamic behavioral processes *over time*. For example, among the purposes of this part of the research would be the investigation of the impact of generational factors vs. temporary factors associated with a specific *stage of life* on millennials' behaviors (with both groups of variables having been suggested in the literature as potential factors explaining millennials' travel behavior). Figure 9, below, identifies the future wave of survey that is envisioned in the next stage of the research, and that will collect information from respondents at the time t_1 of the follow-up survey.[12]

[12] Depending on funding availability, we plan to deploy the future survey wave two or three years after the initial data collection.



**Measured with external data (e.g. US EPA Smart Location data), after geocoding of residence (X, Y)*

Figure 9. Complete framework for the data collection in the longitudinal study of Millennials' mobility

Sampling Method

The data collection plan was designed with the goal of collecting a dataset containing the relevant information to analyze the relationships between personal attitudes, lifestyles, residential location and travel behavior of millennials, and obtain a dataset that mirrors the characteristics of the population of California in terms of five major demographic traits.

In the defining the sampling method and data collection strategy, one important requirement was the need to control for the impact of the location of respondents, and the predominant land use types in which they live, on travel behavior and related decisions. Accordingly, a *quota sampling* process was used to ensure that an adequate number of respondents from each of the major regions of California was included in the dataset. Figure 10 identifies the six regions of California included in this study.

Figure 10. Regions of California included in this study

For the purposes of these studies, we divide California in six major regions, respectively:

- MTC – Metropolitan Planning Organization (San Francisco Bay Area)
- SACOG – Sacramento Area Council of Governments (Sacramento region)
- SCAG – Southern California Council of Governments (Los Angeles/Southern California)
- SANDAG San Diego Association of Governments (San Diego region)
- Central Valley (eight counties in the central San Joaquin Valley)
- Northern California and Others (rest of State not included in previous areas)

The definition of the six regions of California is consistent with the boundaries from the four large metropolitan planning organizations, and with the eight counties in the San Joaquin Valley (hereafter referred to as “Central Valley” in this study). The remaining counties, which are predominantly located in the northern part of California, the Pacific Coast and in the mountain region, were aggregated in the “Northern California and Others” region.

In order to control for the effects of land use characteristics on the mobility patterns of respondents, specific quotas were defined for each combination of the region of California the predominant neighborhood type in which the respondents live. Three dominant neighborhood/land use types were considered in this study to *profile* respondents and assign them to a quota. The three land use/neighborhood categories included areas considered to be predominantly *urban*, *suburban* or *rural*, respectively.

The initial plans for the research planned the collection from at least 700 millennials in California. Thanks to additional resources and a revised scope of work in the project, the data collection plans were revised and the sample size increased. Accordingly, we designed a quota sampling plan to collect a total 1400 millennials and 1000 members of the previous Generation X in California. The following Table 1 and Table 2 report the quotas that were defined for the subsamples of members of the Generation Y (millennials) and Generation X, respectively.

Table 1. Quotas by region and neighborhood type for Generation Y ("Millennials", 18-34)

	Urban	***Suburban***	***Rural***	***Total***
MTC	145	145	25^	*315*
Central Valley	60	60	25^	*145*
SACOG	105	105	25^	*235*
SANDAG	105	105	25^	*235*
SCAG	170	170	25^	*365*
NorCal and Others	35^	35^	35^	*105*
Total	*620*	*620*	*160*	*1,400*

Note: ^ identifies "soft" quotas

Table 2. Quotas by region and neighborhood type for Generation X (35-50)

	Urban	***Suburban***	***Rural***	***Total***
MTC	103	103	18^	*224*
Central Valley	43	43	18^	*104*
SACOG	75	75	18^	*168*
SANDAG	75	75	18^	*168*
SCAG	120	120	18^	*258*
NorCal and Others	26^	26^	26^	*78*
Total	*442*	*442*	*116*	*1,000*

Note: ^ identifies "soft" quotas

The quotas for Northern California and the rural areas were defined as “soft” quotas. These are more flexible quotas, to be filled as possible, and subject to more flexibility in the distribution by region and land use type, due to the increased difficulties of surveying respondents in the rural areas of the state (especially with an online survey) and in less populated regions.

In addition, we used demographic targets to ensure that the collected sample mirrors the characteristics of the population on five demographic dimensions: *gender*, *age*, *household income*, *race and ethnicity*, and *presence of children in the household*. We used different demographic targets, whenever possible, to build subsamples that matched the specific demographic traits of the populations of the two generations in California (thus, controlling for the demographic target separately for the two subsamples). For example, the millennials generation is a much more ethnically diverse generation than older generations in California. Accordingly, detailed information about race and ethnicity from the American Community Survey was used to build different sociodemographic targets for the two segments of the population of Generation Y and Generation X, and building a sample of millennials that included a larger proportion of non-white respondents and of Hispanic than their Generation X counterpart.

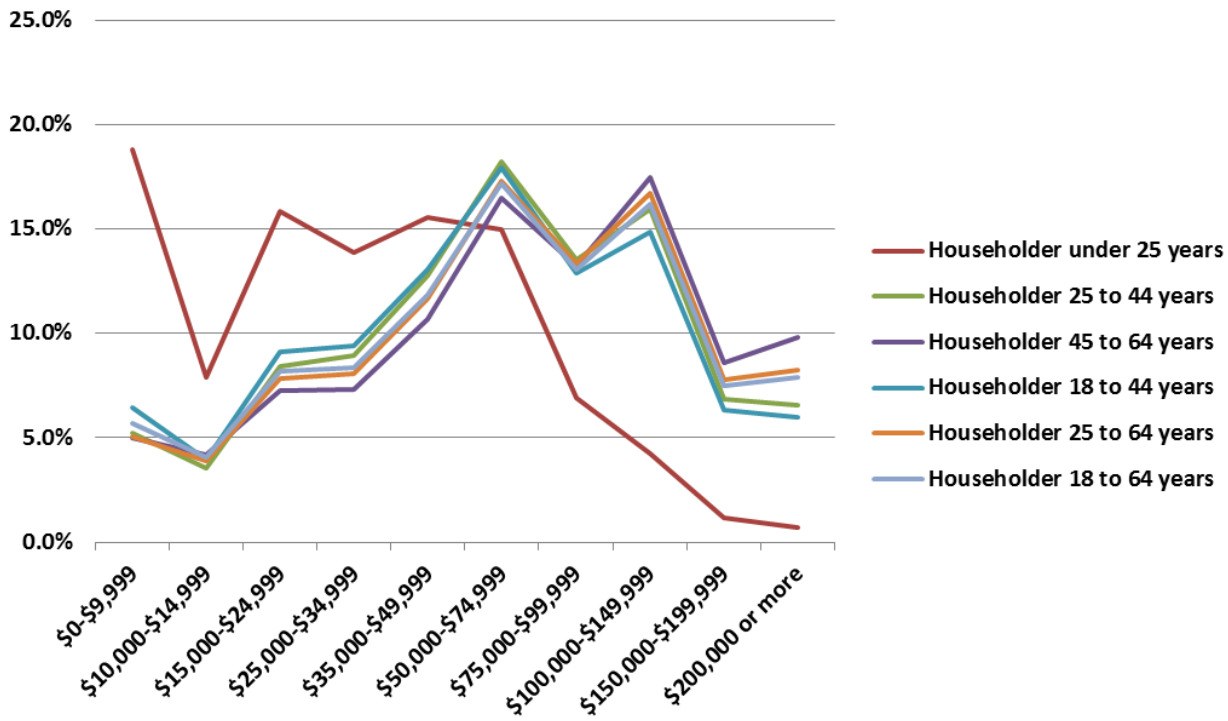


Figure 11. Household income distribution in California by age of the householder

A more complicated demographic target was the household income of respondents. In the survey, we control for information on both individual and household incomes. However, we used official statistics referred to the Californian population to build the target distribution for household income. The problem with this type of measure is that it is not easy to build separate household income distribution targets for the members of the two generations using official

statistics: in fact, we could access official statistics of household income by the income of the householder (i.e. the lead of the household), but this does not necessarily mirrors the distribution of household income of millennials, in particular. Figure 11 illustrates this problem. Figure 12 represents the income distribution of Californian households by age of the householder. As visualized in the figure, the income distributions of Californian households are very similar for all age groups, apart from the very small group of households that are run by a young millennials (i.e. the head of the household is below 25 year old), for which it is completely different, with a much larger prevalence of lower income households. However, this group accounts for a very limited number (barely 4%) of households in California (Figure 12). Therefore, the probability that even a young millennial younger than 25 live in such a household is rather low: in many cases, young millennials are financially dependent from at least an older adult, being he/she a parent, an older sibling, or an older partner.

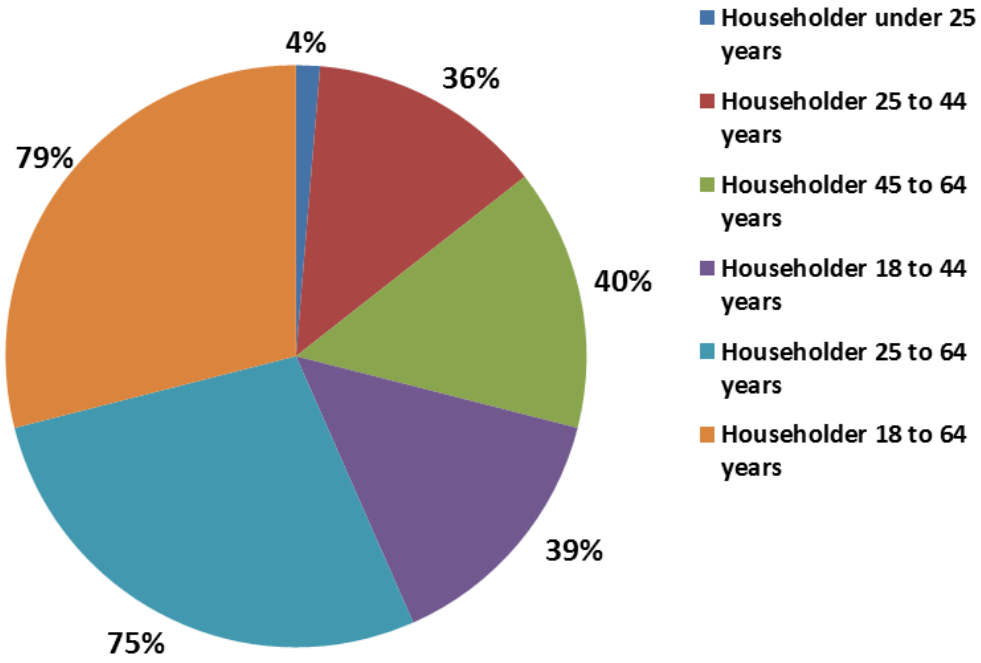


Figure 12. Proportion of households in California by age of the householder

Accordingly, it would not make sense to create a different income distribution for this age group (it would actually be counterproductive in terms of representativeness of the population, because it would reduce the likelihood that the demographic target mirrors the actual income distribution in the real population. For this reason, due to the impossibility to assess with a clear rule the age of the householder, and considering the very similar household income distributions for all other age groups, in the development of the sociodemographic targets, we used the same household income distribution targets, for both millennials and members of the Generation X.

Survey Design and Data Collection

The final survey tool that was used in this project includes 11 sections, which collect information on different groups of variables considered to be relevant for the analysis of various aspects of millennials' mobility-related decisions. The remainder of this section discusses the process that was used for the definition of the final content of the survey, and presents the content of each one of the 11 sections of the survey, which collect information respectively on:

A. *Individual Attitudes and Preferences (general, environmental, technology)*
B. *Use of Online Social Media and Adoption of Technology*
C. *Residential Location and Living Arrangements*
D. *Employment and Work/Study Activities*
E. *Transportation Mode Perceptions*
F. *Current Travel Choices*
G. *Emerging Transportation Services*
H. *Driver's License and Vehicle Ownership*
I. *Previous Travel Behavior and Residential Location*
J. *Your Ideas about Future Mobility*
K. *Sociodemographic Traits*

Involvement of relevant stakeholders in the survey design

During the process of survey design, a careful process of engagement of relevant stakeholders was developed in order to further improve the content of the survey and converge to the final version. During the stage of survey design, the research team worked in close contact with colleagues at other research institutions, staff from Caltrans, metropolitan planning organizations and other partner organizations, with the purpose of discussing the content of the research, establish the main planning and research priorities for the data collection, develop a first draft of the survey and converge to a final structure of the survey tool.

After preparing the research methodology protocol and draft survey outline, a meeting with the project advisory panel from Caltrans was organized to provide members of the advisory panel and other stakeholders with an opportunity to offer feedback on the research approach and draft outline of the project. Another meeting was organized to discuss the research approach and scope of the project with planners from the Sacramento Area Council of Governments.

In a second stage, when the final draft version of the survey was assembled, the research team engaged in a process of discussion with other peers. Staff members from Caltrans, the California Energy Commission, other state and regional agencies in California, other US states and foreign institutions were invited to provide their feedback on the draft survey. Colleagues from more than ten research institutions and universities provided useful feedback that was used to improve the content of the survey. Finally, the research approach and content of the online survey was presented at the International Association of Travel Behavior Research meeting in London in July 2015. All comments received by researchers, planners and other

relevant stakeholders were carefully annotated and used in each round of further revision of the survey, until converging to the final version.

Final Survey Structure

The following sub-sections of the report present the content of each section in the final version of the survey that was used for data collection in the project. According to extensive pretests developed before the launch of the survey, an average respondent is expected to take about 30 minutes to complete the online survey. Actual time of completion might vary, though, based on the specific characteristics of the respondents, and due to the logic/branching adopted in the survey.

Section A: Individual Attitudes and Preferences (general, environmental, technology)

After the cover page and some brief instructions are provided to respondents, Section A opens the data collection in the survey. This section collects information on personal attitudes and preferences through the respondent's agreement with each one of 52 attitudinal statements, measured on a 5-level Likert scale. The attitudinal statements were designed in order to collect information on personal attitudes and preferences related to 20 dimensions, including:

- Change vs. routine;
- Collectivism vs. individualism (e.g. an individual's reluctance or willingness to put the needs of others before themselves);
- Environment concerns (e.g. an individual's concern for the environment, air quality, carbon emissions, etc.);
- Exercise (e.g. the importance of exercise in an individual's life);
- Land use preferences;
- Life satisfaction (e.g. an individual's satisfaction with their personal life, career, etc.);
- Masculinity (e.g. the role of men and women in society);
- Materialism;
- Means of transportation (e.g. an individual's opinion of biking, car ownership, use of public transit, role of car, opinion of commute, etc.);
- Multi-tasking;
- Peer-pressure;
- Price-sensitivity;
- Role of government;
- Shopping (e.g. an individual's opinion about e-shopping or in-store stopping);
- Social media (e.g. role of social media in enriching the daily life);
- Status symbol;
- Technology (e.g. an individual's opinion about using technology including smartphones and Wi-Fi/Cellular data/3G/4G/LTE data connections;)
- Time pressure;
- Travel (e.g. general perceptions about the pleasantness of travel);
- Trust (e.g. trust in unknown individuals).

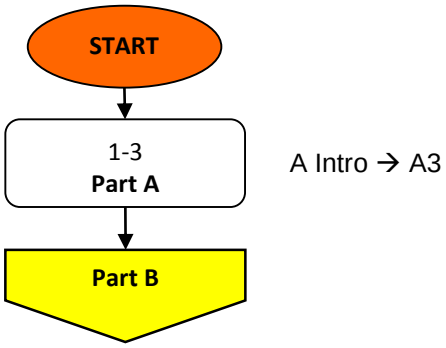


Figure 13. Logic flow and branching for Section A

In order to reduce the respondent's burden, and provide natural breaks during the section, the attitudinal statements were grouped in three blocks of statements, which respectively included 18, 16 (including a trap statement for validation purposes), and 19 statements. The five column headers "Strongly disagree" to "Strongly agree" were repeated every four statements, in order to make it easier for the respondent to identify the correct cell, and reduce errors due to the effects of fatigue. A trap question, which invited the respondent to select "Strongly disagree" for quality assurance purposes (e.g. make sure that the respondent is actually paying attention to the text of each statement) was included among the statements in block A.2. Every respondent was required to complete section A, and no additional logic/branching structure was included in this section (see Figure 13).

Section B: Use of Online Social Media and Adoption of Technology

This section of the survey collected information about a number of measures related with the familiarity of respondents with a number of technology-enabled devices and services.

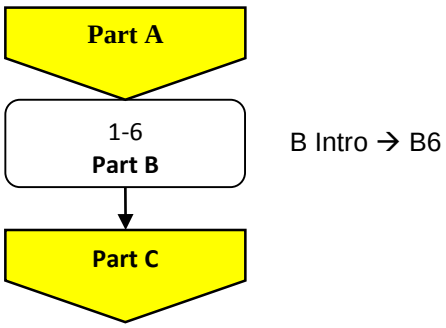


Figure 14. Logic flow and branching for Section B

Questions in this section of the survey asked information about the availability of ICT devices, including desktop and laptop computers, iPad/Tablets, smartphones, etc., the frequency of use of smartphone apps to complete a number of transportation-related tasks, information about the use of social media (including Facebook, Twitter, etc.), the adoption and eventual frequency of internet shopping (e-shopping). Every respondent was required to complete the entire

section B, and no additional logic/branching structure was included in this section (see Figure 14).

Section C: Residential Location and Living Arrangements

Section C collected information about the residential location of respondents, including the exact address or the intersection of two streets closest to the place of residence for those respondents that preferred not to provide their exact address for privacy reasons. In the section, we ask respondents information about the type of residence in which they live, the tenure (own or rent), and living arrangements (relationship with the other people living in the same unit, e.g. spouse/partners, parents, children, siblings, roommates/flatmates, etc.). As represented in Figure 15, only one "skip" option was present in this section: respondents that live in a dormitory/university housing were not asked for information about housing tenure.

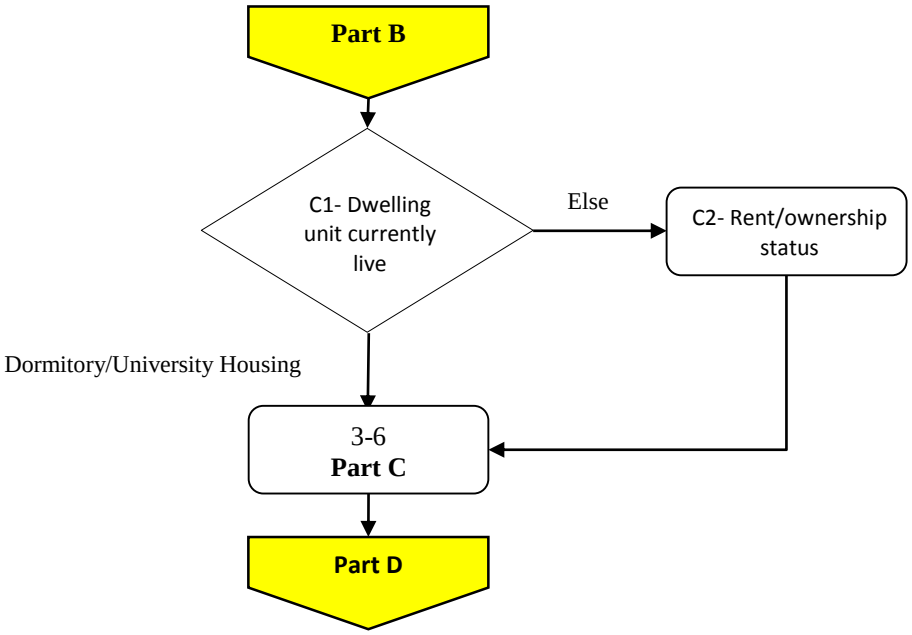


Figure 15. Logic flow and branching for Section C

Section D: Employment and Work/Study Activities

This section collected information on the student and employment status of the respondents. If students, respondents were asked to complete specific follow-up questions, as needed, in order to provide additional information on the level of education and field of study. Workers were also asked additional information on the main occupation, the type of job and schedule (and the eventual engagement in more than one jobs), the specific industry sector, number of hours worked in an average week, type of schedule, number of hours dedicated to any additional unpaid activities, e.g. including unpaid internship, or volunteering activities, and the availability and eventual frequency of adoption of telecommuting (i.e. working remotely from home) for their main work activity. Figure 16 illustrates the logic and branching structure for Section D.

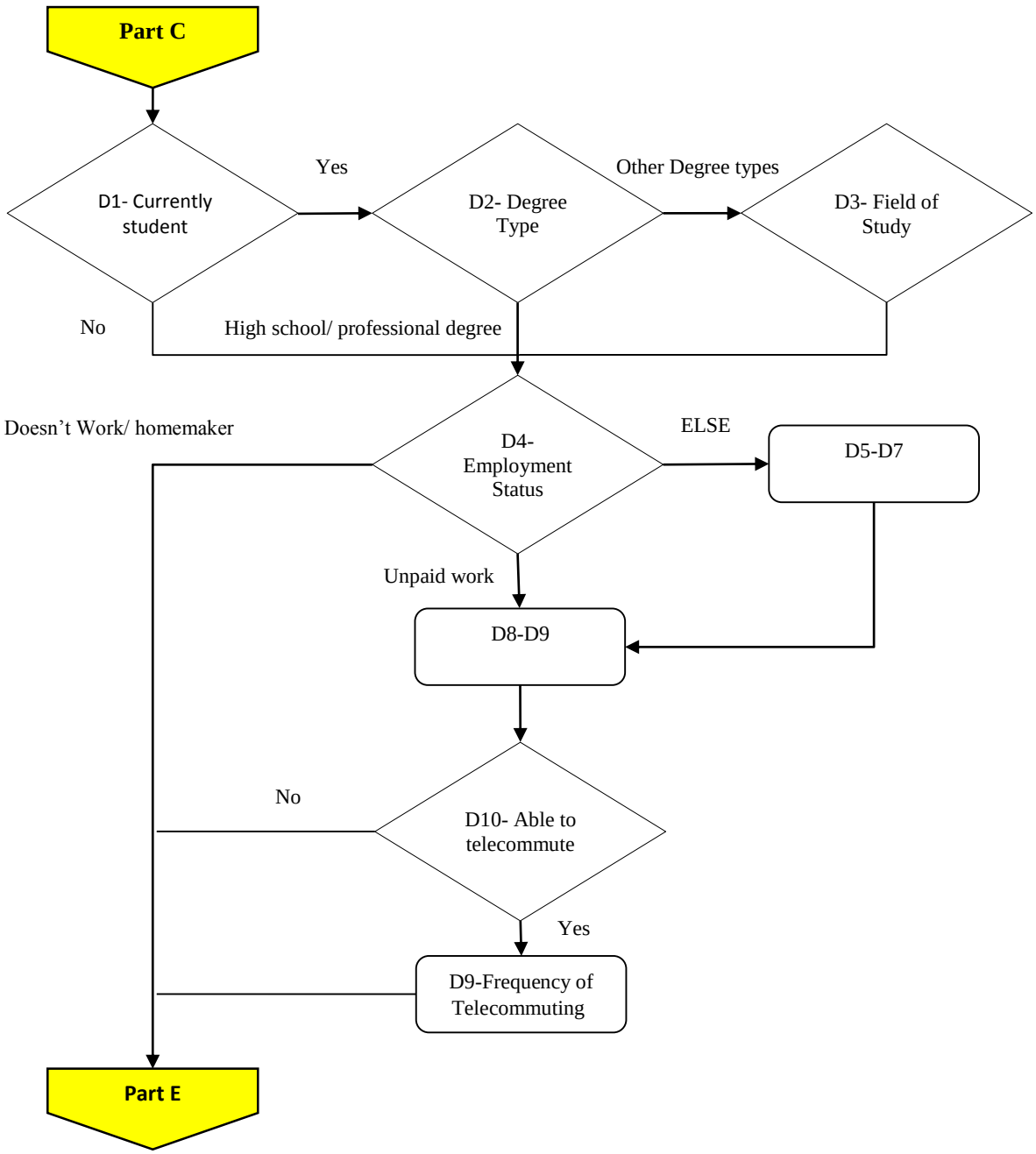


Figure 16. Logic flow and branching for Section D

Section E: Transportation Mode Perceptions

This section collects information about the users' perception of a set of transportation-specific attributes, measured on a five-level Likert scale, for several dimensions including overall mode perception, comfort, time flexibility, cost/price sensitiveness, availability, safety and security, ability to carry things during a trip, ability to perform activities while traveling, impact on the environment, among others. Respondents were requested to complete an evaluation of the set of attributed three times, evaluating each item on a five-level scale from "very bad" to "very good", respectively for personal vehicles (cars and/or motorcycles), public transportation (bus

or rail) and active modes (bike and pedestrian). Section E did not include any logic or branching (see Figure 17).

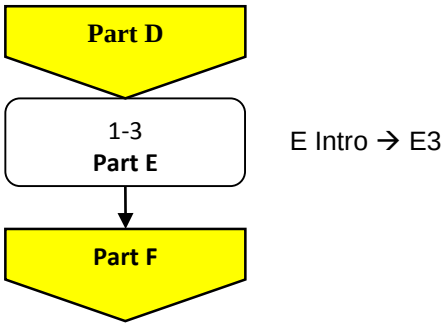


Figure 17. Logic flow and branching for Section E

Section F: Current Travel Choices

Section F collects information on a number of travel-related information (see Figure 18). The section makes large use of branching options in order to separate respondents that commute only to school from those that commute only to work. Respondents that during the same week typical commute to more than one destination including both work and school are asked to report which work or school destination they commute more often, and are asked to complete the remainder of the section answering questions related to the commute to/from that destination.

The section collects detailed information about the means of transportation that are available for the commute and their frequency of use. Respondent are invited to report their work address, and the time and distance associated with their usual commute. Detailed information is collected for the most recent commute: respondents are invited to report the primary means of travel (e.g. the means that they used for the longest part of the trip) on the way to work/school, any secondary means of travel that was used in addition to the primary means, and any activities that were conducted during the commute for either work or leisure purposes. In case the respondent did not return home with the same means of travel that was used on the way to work/school, he/she is invited to report detailed information for the return trip from work/school back home (or to another destination). An additional set of questions ask detailed information about availability and frequency of use of various means of transportation for non-commute trips developed for other purposes.

The following questions of this section collect information about the number of long-distance trips (trips longer than 100 miles, one way) that were carried out during the last 12 months for either work or leisure purposes. Finally, respondents are invited to report their personal level of satisfaction with the amount of travel they do.

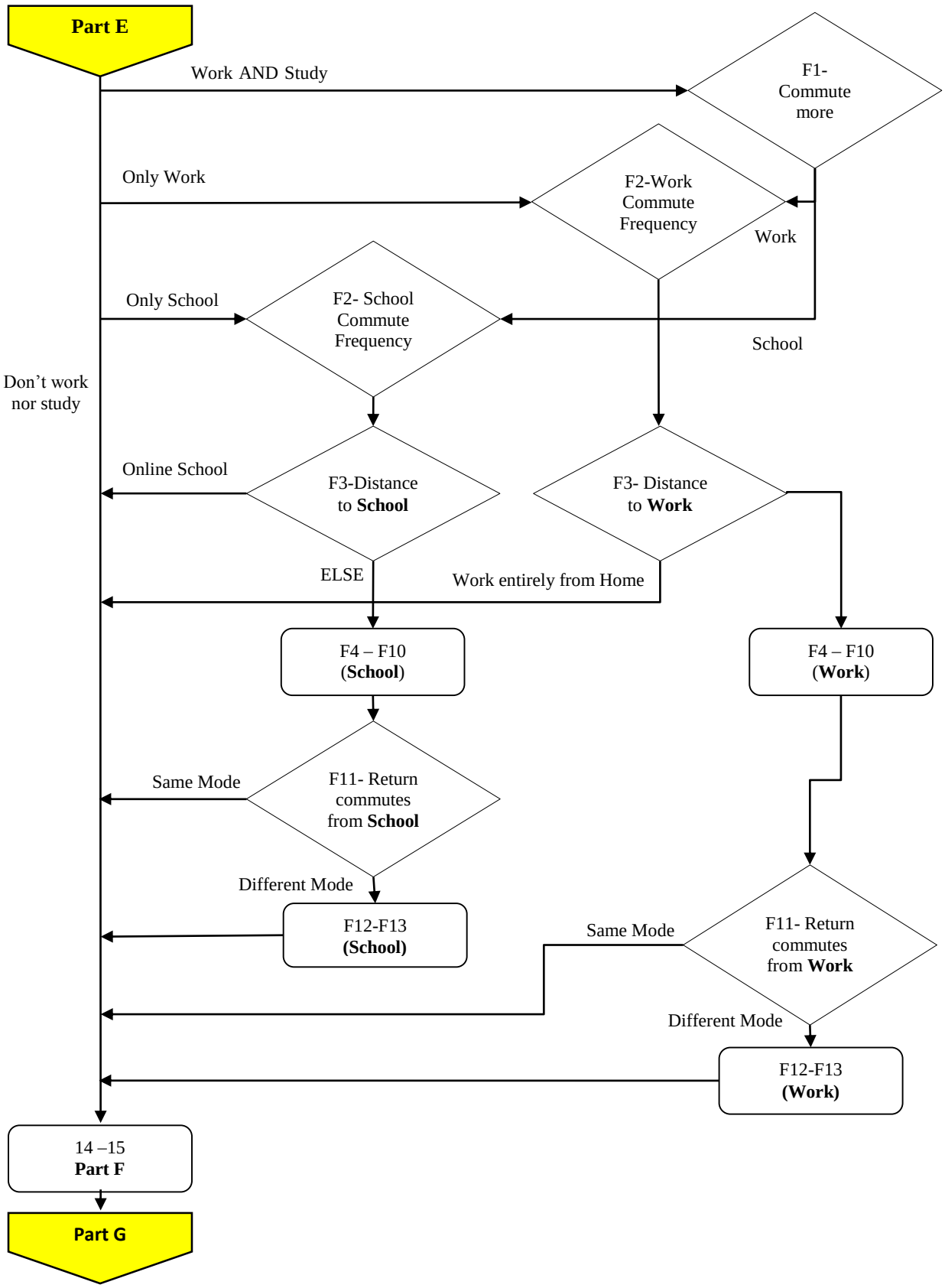


Figure 18. Logic flow and branching for Section F

Section G: Emerging Transportation Services

Section G collects information about a respondent's familiarity and frequency of use of seven transportation services including *carsharing* programs (e.g. Zipcar), *peer-to-peer carsharing* (e.g. Relay Rides), *on-demand ride services* (e.g. Uber), *dynamic carpooling* (e.g. Zimride), *peer-to-peer carpooling* (e.g. carpooling groups on Facebook), *bikesharing* (e.g. Bay Area Bike Share), and conventional *taxi* services. As in Section F, this section relies on branching and logic to provide respondents with a less overwhelming survey experience: respondents are invited to complete follow-up questions only for the transportation services they indicated they had used already, or at least heard of, in the past. Follow-up questions include

The section collects detailed information about respondent's familiarity and usage of the emerging transportation services listed above: respondents are asked if they have heard of and/or used these programs. If they have never heard of any of these programs, they are directed to section I. For the services they have heard of but never used before or the have used only far from home, they are asked about availability of the programs at their home location. For the services they have already used before, they are asked for their current frequency of use (including for each service an option also for respondents that have used the service in the past, but do not currently use it anymore). Those who indicated they had already used on-demand ride services are directed to questions about their most recent experience with these services, and the eventual impact of the use of these services on the use of other modes. Moreover, respondents are asked to provide information about their monthly spending habits on Uber/Lyft as well as the motivations behind their decision to use Uber/Lyft, and the eventual factors that might limit them from using these services. Finally, respondents are asked a question about whether they do work as an Uber/Lyft driver, or they plan to become a driver in the future.

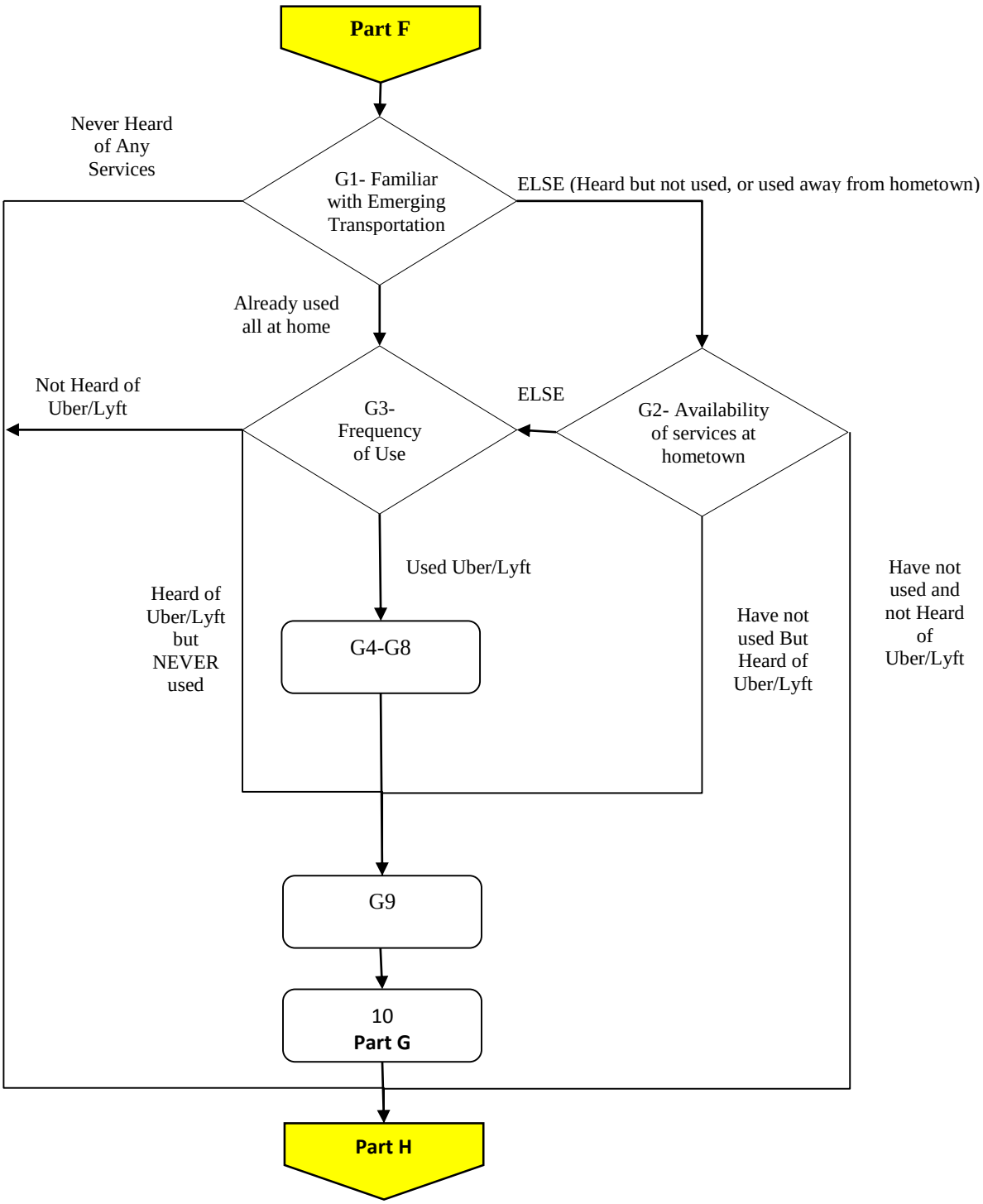


Figure 19. Logic flow and branching for Section G

Section H: Driver's License and Vehicle Ownership

Section H collects information on a number of variables related to driver's licensing status, level of vehicle ownership in the household (controlling separately for the presence of cars, motorcycles/motor scooters, and bikes), and the availability of parking space at the residential location and adoption of a public transit pass.

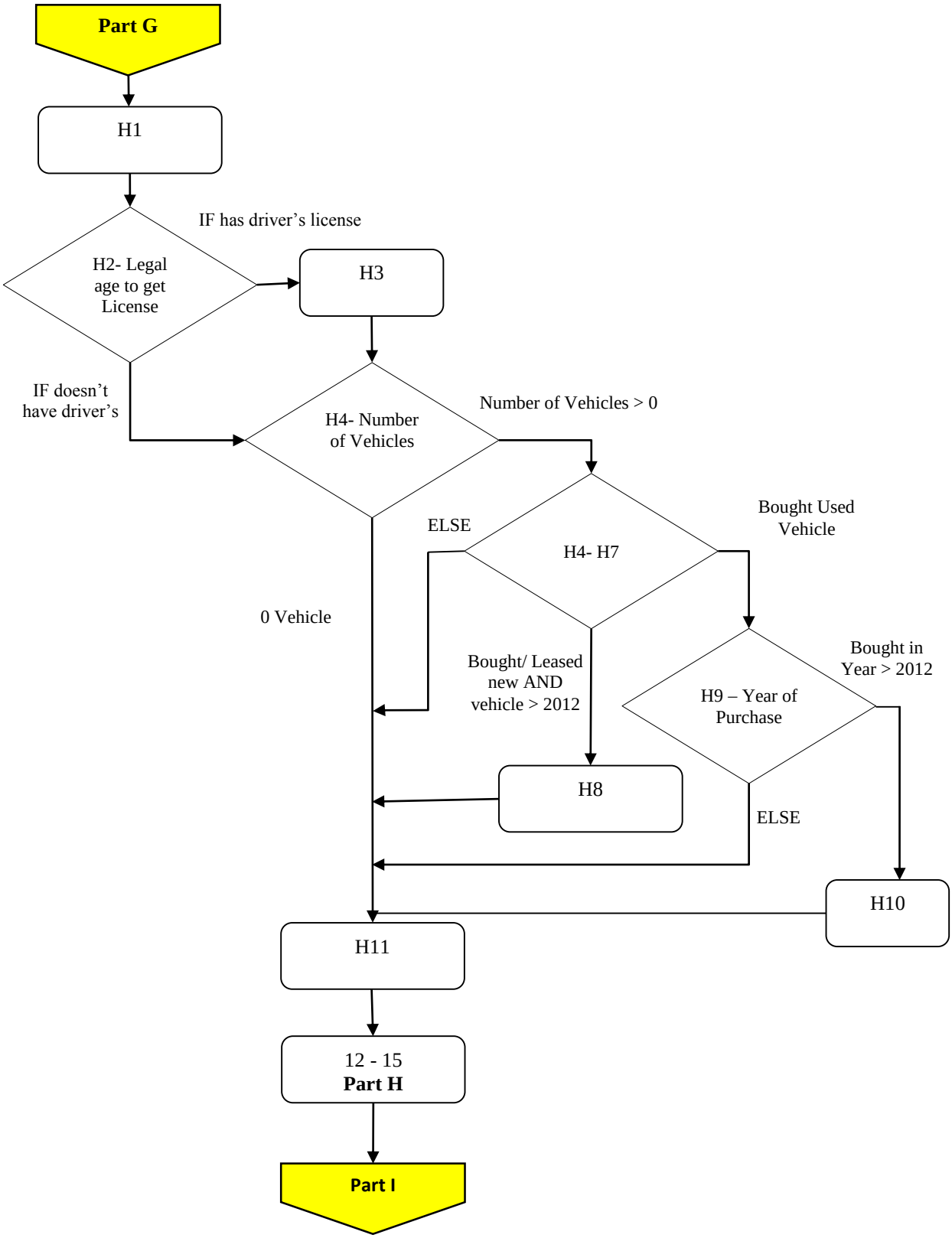


Figure 20. Logic flow and branching for Section H

More specifically, the first set a questions collect information on whether a respondent has a driver's license as well as at what age they *could* receive a driver's license in the place where they were raised, and at what age they *did* receive their driver's license. The following set of questions collects information about the number of vehicles (e.g. cars, motorcycles, and bicycles) available to the respondent in the household, and what percent of time the vehicles are available to them to use. Moreover, the respondents are asked about the year, make and model of the vehicle they use the most (if any), and (for respondents who live in a household with at least one vehicle) if they bought, leased, or received their vehicles as a gift. If they bought or leased a new vehicle after 2013, they are asked about the top three reasons why they bought/leased that particular vehicle. Similarly, if they bought a used vehicle after 2012, they are asked about the top three reasons for purchasing that vehicle. We then ask all respondents about their weekly vehicle-miles traveled by car, the average amount of biking for either recreational and non-recreational purposes, and the type of parking that is available to them (e.g. private garage, street, off-street, etc.) at home. Respondents are also asked whether they have a public transit pass, and about the presence of any physical conditions that might prevent them from walking, taking public transit, driving, or bicycling. Finally, respondents are asked to rate their ability to ride a bike.

Section I: Previous Travel Behavior and Residential Location

Section I collects information about the major life events that may have occurred in the past three years. This section starts by asking the respondent to indicate if any events from a list of options (e.g. the birth of a child, change in residence, completion of studies, etc.) have occurred in the last three years. Respondents that indicated they moved to a different address, moved to a more urban or suburban location, moved to another city, state, or country, moved out of their family's house, moved in with some family members, or moved in with their spouse, are asked a set additional questions. These questions ask the respondents to evaluate the impact of a list of factors, including housing costs, geographic location, characteristics of the neighborhood, proximity to school/work location, distance to family and/or friends, quality of the local school district, etc., on their choice to more to their current residence. The final two questions in Section I ask all respondents to report their level of vehicle ownership three years earlier, and to self-assess the amount of travel they do now compared to three years earlier. Respondents are asked to report whether they now travel by car, bus, train, air, foot, and bike more, less, or the same amount as compared to three years ago.

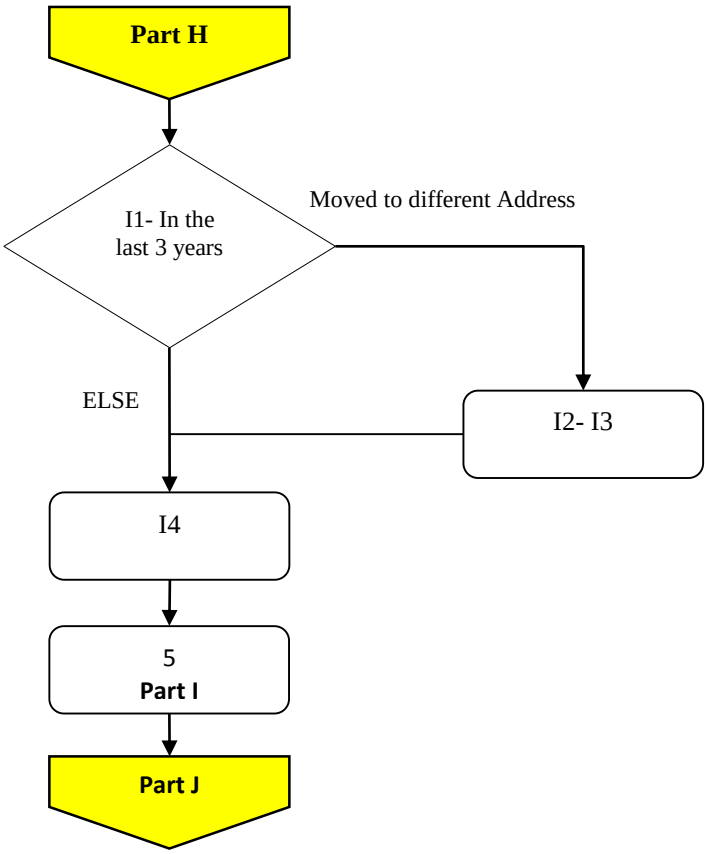


Figure 21. Logic flow and branching for Section I

Section J: Your Ideas about Future Mobility

In contrast to Section I, Section J collected information about a respondent's expectations about where they will live and how they will travel three years from now. Section J begins by asking respondents to evaluate whether or not certain events are likely to occur in the next three years, e.g. whether they expect to change their residential location, start a new job, get married, move in with a partner, etc. The respondent are also asked about the neighborhood type they expect to move to in three years. After that, the respondents are asked about how they would *like* their amount of travel, by mode, to be in three year and how they *realistically expect* their amount of travel to be in the next three years, compared to how they travel now.

We also ask respondents if they planned to buy or lease a vehicle in the next three years. Those that plan to buy a vehicle are asked two follow-up questions regarding the vehicle type they would be interested in acquiring, and their interest in purchasing alternative fuel vehicles. All respondents were also asked about their plans to sell or otherwise give away their current vehicle (if they have one), and whether this would be part of a plan to replace it with another vehicle or not. We also ask the respondents who had heard of or already used carsharing programs (e.g. Zipcar) about their plans to either enroll in and/or drop their membership in these programs in the next three years. To complete the section, the respondents are presented 14 attitudinal statements related to vehicle ownership, car travel and the

environmental impacts of transportation. Respondents are asked to evaluate their agreement with each statement on a 5-level Likert scale, from “Strongly disagree” to “Strongly agree”. The final question in Section J asked the respondent to evaluate their overall satisfaction with their current level of travel.

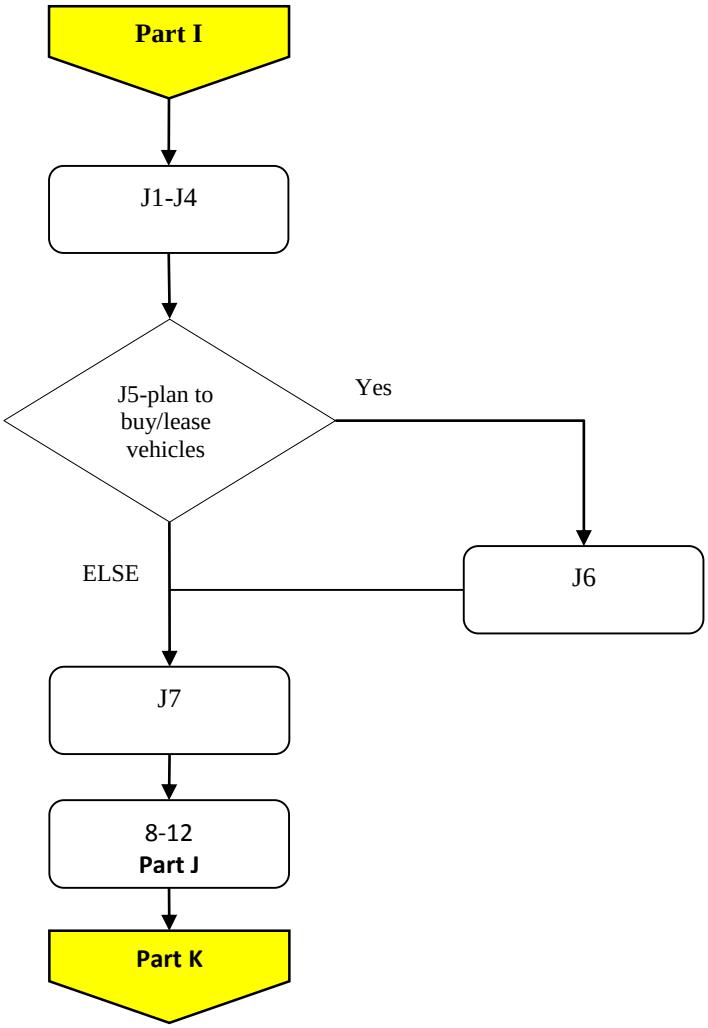


Figure 22. Logic flow and branching for Section J

Section K: Sociodemographic Traits

Section K collects information on some major socio-demographic traits of the respondents, their households, and their family members. In the opening questions of the section, the respondents are asked about their year of birth and the country where they were born. We provide respondents with a map of the United States where respondents can identify the region in the United States in which they were raised among several options including California, the rest of the Pacific region, and standard regional classifications for the remaining nine regions of the US (including separate regions for Hawaii, Alaska, and offering an option for “Another country”). Those who were born and/or raised outside the United States are asked

how long they had lived in the US. We then ask more information about the predominant neighborhood type in which the respondents were raised.

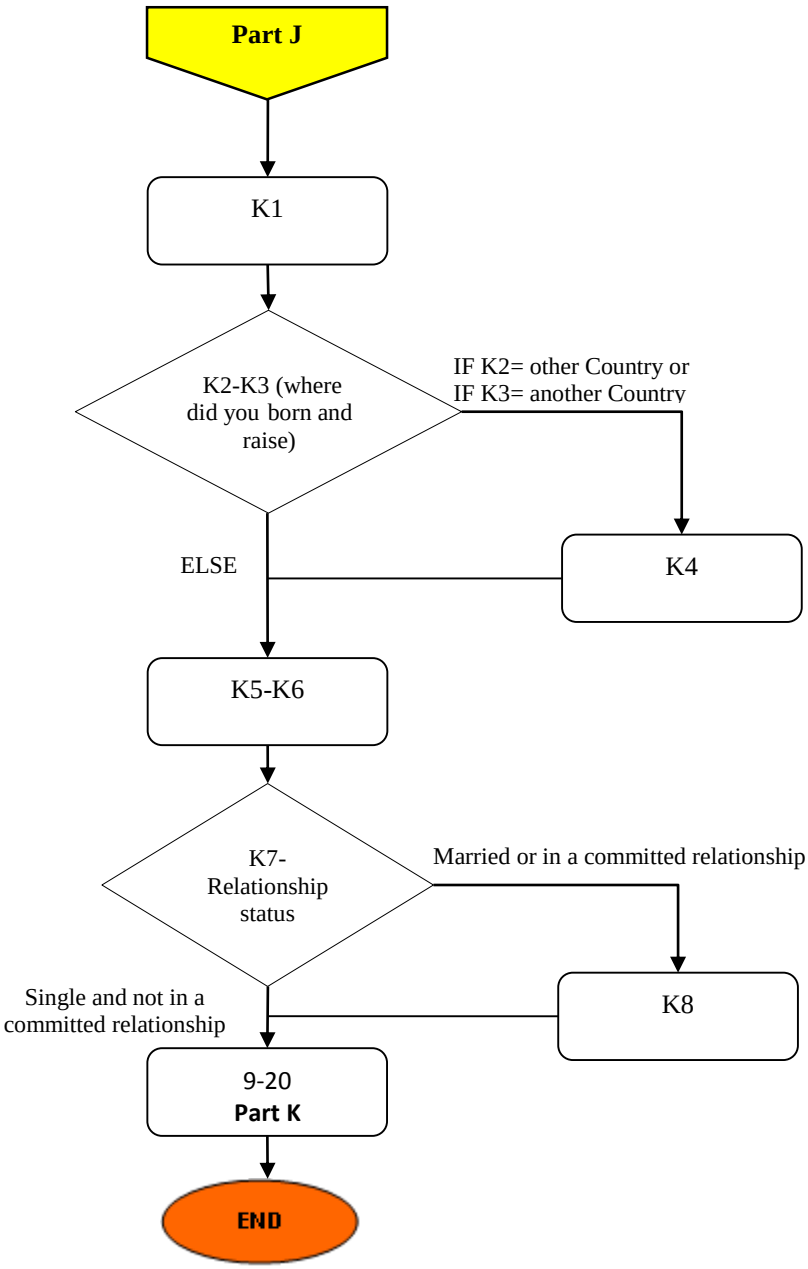


Figure 23. Logic flow and branching for Section K

The following questions in the section collect information about the racial/ethnic identity and marital status of the respondents, and (if the respondents are married or in committed relationships) where their partner/spouse live (e.g. with them, within a five-mile radius, or farther away). Finally, we collect information about political party affiliations and political leanings of the respondents, gender identity and sexual orientation, household size, number of

people in the household by age group, number of licensed drivers in the household, individual pre-tax annual income, household pre-tax annual income, if the respondent has outstanding student loans, and information about the respondent's education level. Finally, we ask for the highest level of education attained by the respondent's parent/guardian who has the most education, as a proxy for the socio-economic status of the household in which the respondents have been raised. All sociodemographic are made mandatory in the survey, but a "Prefer not to answer" option is provided, to allow respondents that are concerned about their privacy not to disclose these pieces of information.

Quality Assurance and Use of Trap Questions

In order to enforce strict quality control in the collection of respondents, reduce the amount of inconsistent responses, identify potential cheaters and "flatliners" (respondents who, for either fatigue or lack of interest, answer entire sections of the survey always in the same way), we devised several measures that were useful to identify, eventual remove, problematic or inconsistent cases in the dataset. Among the strategies that were developed for purposes of quality assurance, we used a common quality assurance practice in the form of two "trap" questions that were included in the survey. In addition, as discussed in the following section dedicated to the results of the study, speed checks were also used to validate individuals' responses and "flag" suspiciously fast respondents.

We developed two trap questions that were placed in specific sections of the survey to check the level of attention of respondents. The first trap question appeared in Section A. The 11th statement in the second set (A.2) of attitudinal statements in Section A, which read "For quality assurance purposes please select 'Strongly disagree'", served as the first trap question. All respondents were forced to answer the first trap question.

The second trap statement, "For quality assurances purposes please select 'It somewhat limits'", appeared in Section G: Emerging Transportation Services. As a result of survey logic, many respondents did not have the second trap statement displayed – this question was presented only to respondents that had at least heard before of (but not necessarily used) on-demand ride services such as Uber/Lyft.

The trap questions served as a way to identify individuals who did not pay enough attention to the question in the survey, including those who were randomly clicking radio buttons and "flatliners" (e.g. respondents that answered "Agree" for all questions on one page) in Section A and Section G.

In addition to the trap questions, we implemented a set of very carefully-designed consistency checks throughout the survey. These consistency checks also included verifying the speed with which respondents answered the survey: the survey was designed to take respondents approximately 30 minutes to complete, depending on their employment situation, school enrollment, recent life events and their familiarity with new transportation services. As a result, respondents who took less than 15 minutes to complete the survey were identified as speeders. Additionally, those who took the survey in less than 20 minutes were also flagged as

potential speeders, and subject to more careful scrutiny. We also used additional metrics to identify potential problems in the quality and consistency of responses, as described in the "Data Cleaning and Filtering out Cases" section presented later in this report.

Online Platform and Additional Technical Details

The survey was designed using the online survey platform powered by Qualtrics. During the early stages of the survey design, several different survey providers were evaluated. The list of commercial platforms that were tested includes QuestionPro, SurveyMonkey, SurveyGizmo and Qualtrics. Other platforms were also considered initially, but were disregarded in early stages of the evaluation due to either technical and/or financial considerations.

The final version of the online survey was designed using the Qualtrics platform: this platform allows very flexible options for the design of the survey, with the inclusion of all complex types of logic and branching that were required by this project, and large flexibility in the definition and customization of the graphical details of the survey. The survey was designed using the standard UC Davis template for surveys designed in Qualtrics, which included the university logo on the cover page and an institutional look for the survey. This, together with the cover page signed by the Principal Investigator of the research and that also contained the contact details of an additional member of the research team, contributed to establish a relationship of trust in the respondents, who were made aware that the survey was part of a research project developed at the University of California, Davis, and informed about the finalities of the research, and the way their personal data would be used.

The final protocol for the data collection and use of data referred to human subjects as part of this research was reviewed by the Institutional Review Board (IRB) of the University of California, Davis, and authorized to begin the data collection in July 2015.

In order to make the survey convenient for respondents, the survey was optimized for the resolution of most common screen sizes of desktop and laptop computers, allowing respondents to always adjust the size of the survey window according to their desires and up to the maximum width of their screen. The survey was also accessible in all major internet browsers for both Mac and Windows computer.

A specific option to maintain complete compatibility with mobile devices (including smartphone and tablets) was also considered, but it was not adopted for the final version of the survey. This was due to two main reasons: maintaining full compatibility with mobile devices for all questions would have cause, in the Qualtrics platform, to give up on some additional features that made the survey better suited for visualization on regular desktop and laptop computers. Therefore, and also in consideration that a long survey (as this one) is not well-suited for completion on a mobile device, we did not maintain full compatibility with mobile devices. Even if the survey was not optimized for visualization on mobile devices, a few respondents left positive comments in the final open textbox at the end of the survey, mentioning that did complete the survey on a mobile phone, and signaling that the survey worked well also on that devise.

One difficulty in the design of this survey was dealt with the delicate trade-off between the complexity of the content of a survey (and the amount of information it collects) and the time required to complete the survey. Long surveys discourage respondents, and the longer the time to complete the survey, the higher the likelihood that a respondent might not complete the survey. In an attempt to quantify this effect, Axhausen et al. (2015) discuss the response burden associated with a number of different survey structures and types of questionnaires. They forecast the response rate as a function of survey length and complexity of questions, using data collected from 52 surveys designed and distributed by their institution, the ETH Institute for Transportation and Mobility System, in Switzerland. The result confirms that increasing the response burden (complexity of questions and survey length) lowers the response rate substantially. However, additional efforts in the research design of a study to provide useful information about the scope of the research to engage the respondents, and the use of an incentive system to reward participants can partially offset these effects.

In the study, we tried to reduce the length of the survey to the possible extent while at the same time retaining all important sections (and questions) that were needed to collect the required pieces of information and control for the groups of variables that are relevant to the topic of the research. In order to minimize fatigue and stimulate the engagement of the respondents, we spent additional efforts to describe the scope of the research, and the content of each survey section, in details and engage respondents through careful design of the question and a pleasant layout of the survey.[13]

A progress bar was included at the bottom of the survey page, in order to allow respondents to check their progress towards the completion of the survey. The survey also allowed respondents to save and continue later: this important feature for a long survey allowed respondents to resume the survey session, if needed, at a later time. Appropriate instructions in the cover page of the survey informed the respondents that in case they decided to drop the survey (or the internet connection dropped, etc.) when they clicked again on the original survey invitation they received, the survey would resume from the place where they left.

Additional particular care was focused on keeping the language in the survey questions simple. All questions and sections of the survey were tested through multiple rounds of pretesting involving both expert pretesters with background in transportation planning and/or experience in survey design, as well as non-expert pretesters, in order to check the clarity of the language and collect feedback on the overall feelings answering the survey, as well as fatigue effects and any technical difficulties or other issues encountered while completing the survey.

[13] The success of these efforts was later confirmed by the large amount of positive comments received from participants, who often left comments of appreciation for the topic of the research, the content and design of the survey and the way questions were framed and choice options were presented.

Survey Launch and Data Collection

In order to select the commercial vendor that would assist with the administration of the online survey, we reached out to eleven different panel companies that operate in the state of California. Based on the evaluation of several attributes including reputation, previous experience with some of the companies, number of members in the opinion panel and referrals from other research teams, we narrowed down the search to three companies, with whom we discussed the research approach and data collection requirements for this project, and invited to provide cost estimates.

After further discussion of the details of the research, we contracted Decision Analyst, a marketing research company that manages the American Consumer Opinion panel (ACOP). One of the advantages of this vendor is the large size of American Consumer Opinion online panel, which includes over eight million consumers in the United States and other countries. The panel vendor designed a short online "screener" survey that was used to classify respondents and identify those that qualify based on the quotas by California geographic region and neighborhood type and the sociodemographic targets for the five dimensions of interest. The screener was integrated with the survey link for the online survey for this project: if a user completing the preliminary screener survey qualified to become a respondent for our study, he/she was automatically routed to the survey online platform to complete the 30-minutes survey. Respondents that completed the survey received a credit represented by a predetermined number of points in the ACOP platform, which they can later redeem for cash, as a token of appreciation for their time filling in the survey. Respondents that completed the screener but did not qualify to be part of the research received partial credit.

Before the official launch of the data collection, an extensive process of pretesting was carried out, involving a number of volunteers that pretested the survey and provided feedback before the survey went public. This process led to several improvement in the structure and content of the survey. As the last stage of the pretest campaign, we contacted a group of students from the University of California, Davis, as well as additional volunteers recruited through other channels, and asked them to pretest the final version of the survey. Below is a copy of the invitation letter sent to the pretesters:

> *Dear ITS students,*
>
> *Our research team at ITS Davis is about to launch a new important mobility survey, and we would like your feedback!*
>
> *Please click on the following link and complete the survey:*
> *< survey link >*
>
> *This study focuses in particular on the lifestyles and travel behavior of young people ("millennials") and the adoption of new mobility services - we think you will find its content interesting!*
>
> *We welcome your comments (e.g. if anything in the language is not clear, something in a question seems wrong or does not make sense, if we are using terms that are unknown to you, etc.) and any other suggestions that you might have on the content and style of the survey.*

You can type your comments in the textbox on the last page of the survey, or simply send them back by email to me at gcircella@ucdavis.edu. As we plan to launch the survey very soon, we hope to receive your comments in the next few days!

We really appreciate your cooperation with this task. If you have interest in the topic, stay tuned! We will share the results of this study with the ITS Davis community soon (in the meantime, please keep the survey link confidential and do not share it with others outside the ITS community, as the survey is still being pretested and is not open to the public yet).

Thanks a lot!

The research team,

Giovanni, Lew, Aria, Farzad, Kate, Susan and Pat

The feedback received during the final pretest allowed us to make final adjustments and polish the survey content before the launch. Among the changes that were prompted by the pretest, comments from pre-testers identified a problem with the *progress bar* of the online survey, which progressed very slowly during the first pages of the survey, and could even reflect 0% progress after several questions were answered. As a result, we recoded the attitudinal statements in Section A, grouping them in a different way, and thus providing a better user experience thanks to a more gradual advancement of the progress bar.

The survey was launched in September 2015. The time of the launch was selected in order to avoid the summer season, and launch the survey at a time in which K-12 schools as well as most university and colleges are already in session in California.

An email invitation invited selected participants to fill in the screener question. The email invitation contained the following text (and did not disclose information that could make respondents identify the type of study or the type of participants that were needed):

We would like you to answer a few screening questions to see if you qualify for one of several survey opportunities. The survey incentive will range between 100 and 1000 Points depending on the length of the survey.

We are working with a survey partner on several new projects. These questions are to better identify you for a final survey.

Upon clicking the link provided in the email, survey takers were first directed to complete the panel screener to determine if they qualified to take part in this study. If the participant did qualify to be part of the study, they were redirected to the first page of the survey, which contained a summary presentation of the study and information about confidentiality of the responses (see Figure 24).

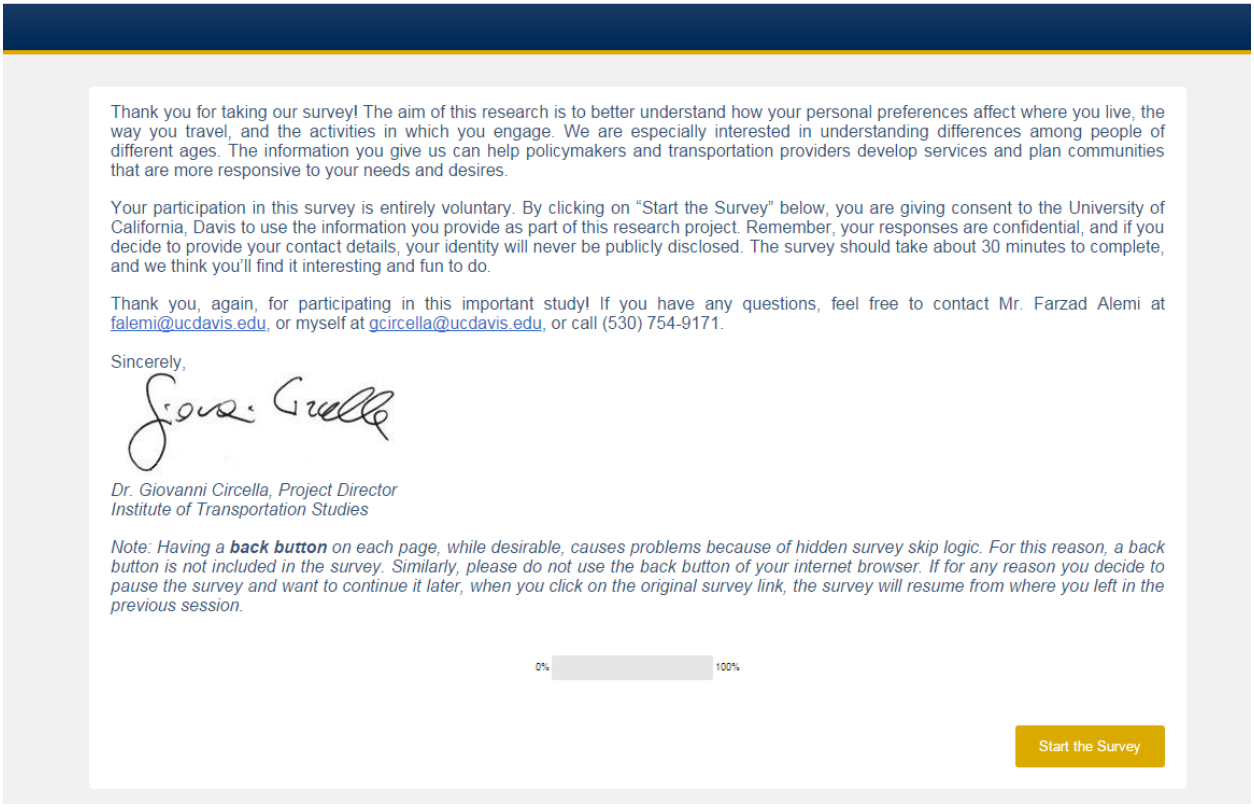


Figure 24. Cover page of the online survey

Results

A total of 5466 (4491 passed the screener) invitations were sent out to individuals fulfilling the requirements to be part of this dataset, and 3018 complete cases were collected. The rather high response rate of 46.3% is not particularly surprising considering the data collection that was used for this project. All respondents that completed the survey were already members of one or more opinion panels that routinely invite individuals subscribed to their services to complete surveys.[14] Therefore, these panel members are already individuals who voluntarily decided to "opt in" and be part of the opinion panel. As such, they tend to be more responsive to survey invitations, and have a higher response rate than the general population.

The method used for the data collection in this project allowed the research team to reach a large number of both millennials (Gen Y) and members of Generation X (Gen X), using a quota sampling method based on geographic region and predominant land use type of where the respondents live. In addition, we were able to control for the distribution of the demographic traits of the respondents and make sure they matched the characteristics of the population of residents in California on five important demographic dimensions: gender, age, household income, race and ethnicity, and presence of children in the household. All these tasks were possible with a rather limited budget that would have not allowed us to reach similar results in the data collection using other methods of recruitment of participants at the statewide level.

However, the distribution of the survey among the members of an online opinion panel is not free from limitations: one main limitation of this method relates to the potential bias associated with the type of respondent that sign up for such opinion panel services. These panel members may include a higher number of respondents with a high propensity to answer surveys for various reasons, including personal intellectual curiosity and willingness to help with the scope of a research, larger amount of spare time or boredom at home, and interest in the rewards associated with the completion of the surveys. Thus, the characteristics of the respondents recruited through any opinion panel may somewhat differ from the average characteristics of individuals in the general population.

Minimizing this potential bias is not easy. However, the choice of a panel company that has a larger base of subscribed members increases the probability of obtaining a sample that is closer to the characteristics of the true population of interest, and reduces (but does not eliminate) the potential sampling and self-selection biases associated with the data collection. While the presence of these biases can somewhat limit the validity of the generalization of the research results from this sample to the entire population of interest (e.g. all millennials in California), the method used in this study remains very valid for providing useful comparisons of results among the two subsamples of respondents composed of millennials (Gen Y) and members of Gen X that were recruited with the same methodology. The use of a sampling method that allows controlling for the distribution (and representativeness) of each subsample on a number

[14] Due to the large sample size required for this project, the commercial vendor that administered the recruitment of respondents was also allowed to contact members of the opinion panels managed by third companies.

of major sociodemographic traits of these populations further increases the ability to build robust analyses of these data.

The use of *weights* will be introduced during the next stages of the research with the aim of reducing any effects of eventual non-representativeness of the subsamples on specific characteristics of the respondents, which could be relevant for this analysis. The sample will be weighted to represent the distribution of the California population of Generation X and millennials by neighborhood type and region. We also plan to use an iterative proportional fitting (IPF) raking approach to match the distribution of the California population for gender, employment, race, ethnicity, presence of children and household income. The weighting process will therefore compensate for the effects of the *quota sampling* process used in the data collection to obtain enough respondents from each of the geographic regions and neighborhood types of California, and build meaningful analysis for each one of these groups and valuable comparisons among groups. Accordingly, residents of major metropolitan areas, mainly Los Angeles and San Francisco, are slightly underrepresented in the sample, while members from the remaining cities and in particular individuals who live in rural counties and less populated regions of California are oversampled.

In addition, during future stages of the research, we plan to expand the data collection for this research distributing the survey that has been designed as part of the project also through other channels, including through the cooperation of state and planning organizations, universities, transit agencies, commuter clubs, non-profit organizations and major employers in California.

Data Cleaning and Filtering Out of Cases

We used several measures to identify potential cheaters and speeders, remove inconsistent, frivolous and severely incomplete cases from the dataset, and enforce strict quality control. In addition to the use of *trap questions* (as described in the previous section of this report) and test for speeders, we also developed a number of *hard* and *soft* "flags", which were used to identify potentially inconsistent and questionable cases.

Hard flags were used to identify signs of more serious flaws in the information contained in each case. The main hard flag checks that were used during the data cleaning and filtering process were:

- *HFlag1: Failed Quality Assurance Question 1 (Trap 1):*
  This check identified respondents that failed to respond correctly to the first *trap question* included in Section A.

- *HFlag2: Failed Quality Assurance Question 2 (Trap 2):*
  This check identified respondents that failed to respond correctly to the second trap question included in Section G.

- *HFlag3: Speedy respondents:*

This check identified *speeders*, i.e. respondents that completed the survey in less than 15 minutes.

- *HFlag4: Not qualified based on the reported age:*

This check identified respondents whose age was not included in the acceptable range for the two segments of the population of interest (we included a *buffer* to allow for potential errors in reporting the age, and the hard flag identified respondents that were either younger than 17 years old, or older than 51).

- *HFlag5: Home zip code is located in outside of CA state:*

This check identified non-residents of California that were included by mistake in the dataset.

- *HFlag6: Nonsensical comments:*

This check identified respondents that left nonsensical comments in the open textbox for comments at the end of the survey.

A number of additional soft flags were also used to identify additional patterns in the cases that were identified as "suspicious" and more carefully analyzed for the revision of the information they contained. The most important soft flag checks included detecting respondents that:

- answered sections of the survey as *flatliners* (e.g. reporting the same answer to a number of questions in a section);
- were *moderate* speeders (e.g. completed the survey in less than 20 minutes);
- did not have plans to move nor to remain in the current housing unit where they lived;
- expressed contrasting preferences when answering to *different* statements in the attitudinal sections of the survey (e.g. expressed agreement with liking to have a larger house in the suburbs and a smaller home with better accessibility near the central part of the city).
- reported a VMT of more than 500 miles in a week

While these minor inconsistencies can be quite legitimate, e.g. somebody might be attracted by more than one types of housing units and/or preferred neighborhood types, or might not have *any* plans for the future, the soft flags were used to identify cases that deserved additional attention, and that were analyzed more carefully in order to assess their quality and internal consistency. A total of 16 soft flags has been introduced, to date, in the dataset, and the use of these variables has proved to be extremely useful during the process of initial assessment of the quality and legitimacy of cases in the dataset.

The use of the HFlag6 check proved to be particularly demanding, as it required the manual review of all comments left by respondents in the open textbox at the end of the survey. A total of 874 respondents left a message at the end of the survey. A vast majority of these comments expressed appreciation for the interesting content of the survey and the design of the questionnaire, while only a few complained about the total length of the survey and the amount of time required to complete it. Many of the positive comments on the content of the

survey included appreciation for the content and style of the survey, and appreciation for the topic and focus of the research. The following are examples of some of the remarks that were received:

- *"This was probably one of the best surveys I have taken in a long time."*
- *"Interesting survey indeed! I hope my responses help."*
- *"I hope my input on this survey helps the cause."*
- *"It was very comprehensive and interesting on a relevant topic."*
- *"Very good survey, brings up important subject."*
- *"This was very fun and I enjoyed it a lot."*
- *"This was really interesting. I provided my [residential] address since I wanted you to get the best results."*
- *"This survey was very detailed and very excellently written."*
- *"This is awesome experience! I love the topic in this survey."*
- *"I found this survey to be thought-provoking and a positive experience."*
- *"I was very impressed with the thoroughness of this survey. I feel it really got my full opinion on the subjects involved."*

Many respondents also left thoughtful comments on the topic of the study and that have some relevance for transportation planning purposes. The comments fitting in this category have been compiled and added in Appendix A, at the end of this report. Unfortunately, some other respondents left nonsensical responses, which varied from something like "I like pizza" to random sequences of letters, words or even sentences without any apparent logical meaning.

All suspicious cases with a nonsensical comment were the object of a thorough review of the data that were provided (for instance, for the risk of a *webbot*, i.e. a software automatically filling in the responses), which in most cases led to the exclusion of the problematic cases from the dataset. A few respondents were also excluded from the dataset for writing profanities in the comment textbox (a quick review of these cases confirmed several other inconsistencies in the information reported by these respondents).

The analysis of all hard and soft flags led to the identification of 619 problematic cases, which were filtered out from the dataset because contained information that was considered inconsistent, fake or extremely unreliable.

Final Dataset

After excluding the 619 cases that were found to be problematic, eg severely incomplete, inconsistent or containing non-genuine and unreliable information, the final working dataset available for this study include 2399 valid cases. This number is considerably larger than the initial expectations for the study.[15]

[15] At the time the study was launched, we envisioned a sample of at least 700 cases selected among the population of California millennials for this research. The size of the sample size was later increased through the recruitment of additional participants in the study, and also a control group composed of members of Generation X, which was not included in the original scope of the research, was added.

Table 3 and Table 4 below summarize the distribution of cases in the California Millennials Dataset by geographic region and predominant neighborhood type where the respondents live, respectively for the sub-samples of *millennials* and members of the Generation X.

Table 3. Sample distribution by region and neighborhood type for members of Generation Y ("Millennials", 18-34)

	Urban	***Suburban***	***Rural***	***Small town***	***Total***
Central Valley	63	71	21	40	195
MTC	123	137	10	15	285
NorCal and Others	21	30	22	44	117
SACOG	69	94	17	18	198
SANDAG	91	112	12	12	227
SCAG	133	173	6	19	331

Table 4. Sample distribution by region and neighborhood type for members of Generation X ("Gen X", 35-50)

	Urban	***Suburban***	***Rural***	***Small town***	***Total***
Central Valley	38	59	15	19	131
MTC	105	135	5	12	257
NorCal and Others	10	35	19	31	95
SACOG	34	83	10	9	136
SANDAG	64	98	3	3	168
SCAG	100	134	9	16	259

In the definition of the quotas for the data collection, and during the recruitment and selection of respondents in the screener, we controlled for three predominant land use/neighborhood types - *urban*, *suburban*, *rural* – where individuals live. However, for the purposes of data analysis, we further identified respondents that lived in a *small town*, and treated them separately. This was consistent with the expectations that individuals that live in small towns tend to have distinct characteristics from residents of both rural and suburban areas (and this often translates in different travel behavior patterns and dynamics associated with their decision choices). Accordingly, the information in the dataset classifies respondents in four predominant land use/neighborhood types: *urban*, *suburban*, *small town* and *rural.*

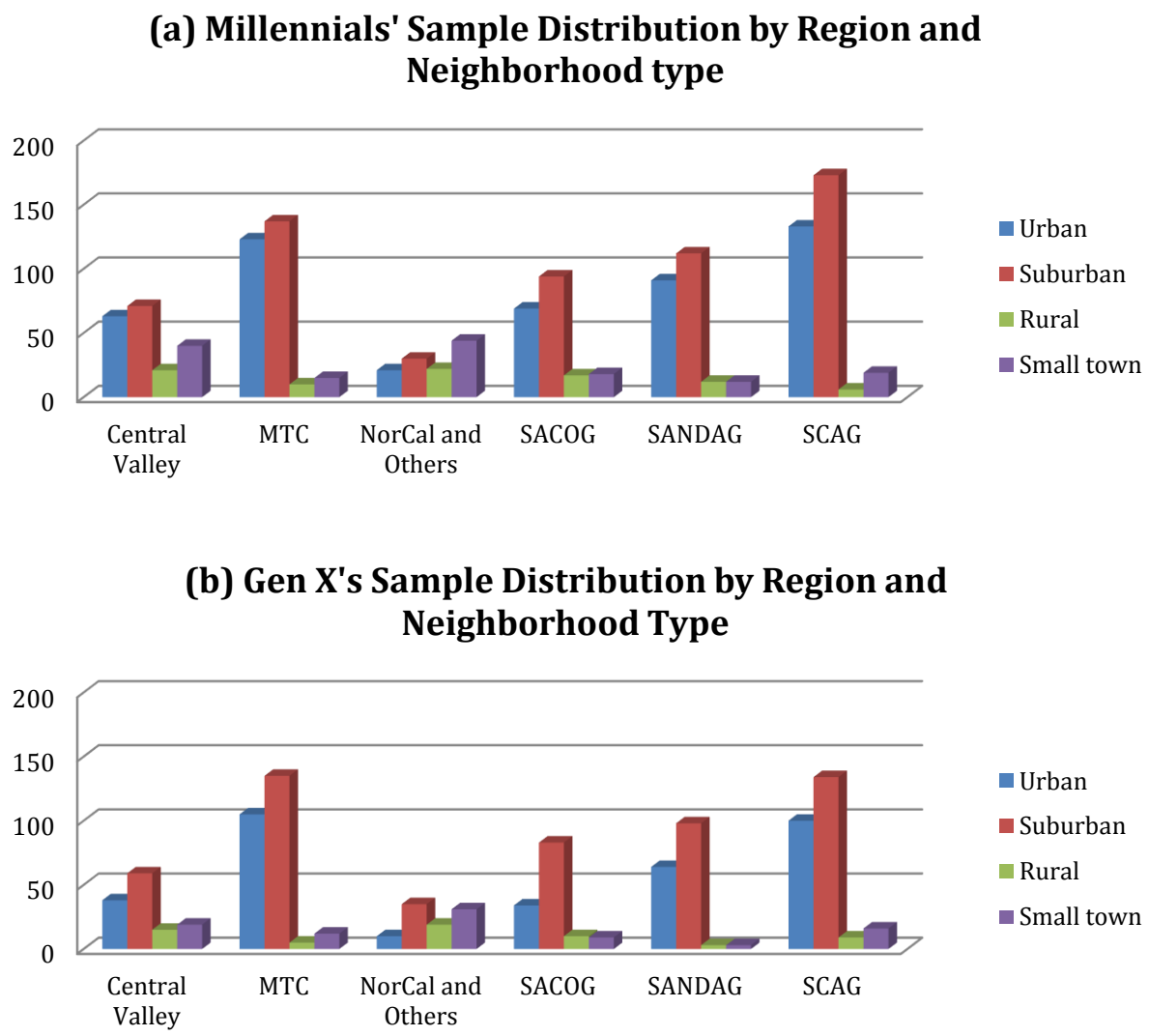


Figure 25. Sample Distribution by Region and Neighborhood Type for (a) Millennials, and (b) Gen X

Figure 25 and Figure 26 summarize the sample distribution for millennials and members of the Generation X, by region of California and neighborhood type. The distribution of cases by region is very similar for the two subsamples.

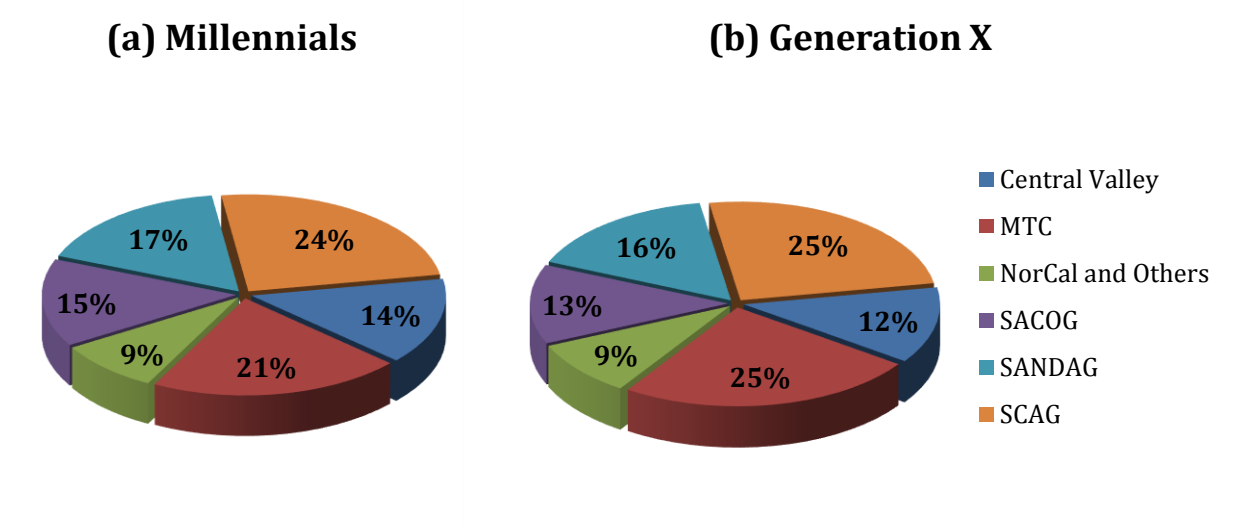


Figure 26. Sample distribution by region of California for (a) Millennials, and (b) Gen X

The distribution by neighborhood types highlights some difficulties in recruiting respondents from specific neighborhood types (e.g. members of Gen X from urban areas in Sacramento and San Diego). While this distribution might represent a trend observed in the population of interest (e.g. there might be fewer adults of ages between 35 and 50 that live in the urban areas of Sacramento and San Diego, and therefore they are more difficult to sample), this fact might be due to different response rates in the different subgroups, and it is worth it further investigation.

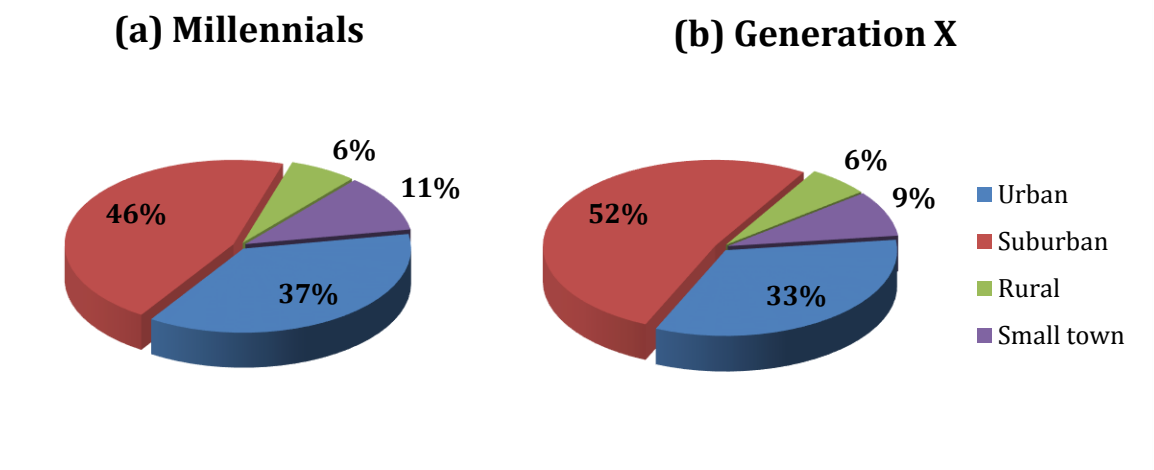


Figure 27. Sample distribution by neighborhood type for (a) Millennials, and (b) Gen X

Table 4 summarizes the sample distribution for some major demographic dimensions that were controlled in the study. In the recruitment of participants, we used demographic *targets* to control for the distribution of respondents in the dataset, and collect a sample that mirrors demographic traits in the population of interest as well as possible.

Table 5. Demographic statistics in the California Millennials Dataset

	Millennials		Gen X	
	Number of cases	Percentage of total	Number of cases	Percentage of total
Total	1353	100%	1046	100%
Gender				
Male	569	42%	439	42%
Female	764	56%	600	57%
Transgender	8	1%	2	0%
Decline to Answer	12	1%	5	0%
Presence of Children in the Household				
Household without Children	749	55%	461	44%
Household with Children	602	45%	585	56%
HH income				
Prefer not to answer	105	8%	69	7%
Less than $20,000	145	11%	83	8%
$20,001 to $40,000	286	21%	148	14%
$40,001 to $60,000	248	18%	166	16%
$60,001 to $80,000	204	15%	184	18%
$80,001 to $100,000	129	10%	138	13%
$100,001 to $120,000	100	7%	84	8%
$120,001 to $140,000	39	3%	51	5%
$140,001 to $160,000	37	3%	50	5%
More than $160,000	60	4%	73	7%
Age				
Younger Millennials (18 - 26)	616	46%	--	--
Older Millennials (27 - 34)	737	54%	--	--
Younger Generation X (35-43)	--	--	613	59%
Older Generation X (44 - 50)	--	--	433	41%
Ethnicity				
Hispanic	340	25%	167	16%
Non-Hispanic	1013	75%	879	84%
Race				
Asian/Pacific Islander	200	18%	147	16%
White/Caucasian	650	58%	601	64%
Black/African American	50	4%	52	6%
American Indian/Native American	15	1%	6	1%
Other/multi-racial	198	18%	117	12%
Decline to Answer	17	2%	20	2%

Different response and completion rates among specific groups of respondents, and the exclusion from the dataset of cases that are inconsistent or otherwise problematic, may generate some deviation from the initial demographic target. In the following stages of the research, we will use a number of strategies to reduce the effects of any deviation in the sample distribution from the demographic statistics of the population interest. These strategies include (a) the recruitment of additional cases to further expand the sample size, while offsetting any deviation in the demographics of the sample, and (b) the use of a set of weights that can correct for any additional deviation in the distribution of cases, and make the sample truly representative of the population of interest in California.

The following set of figures illustrate the distribution of respondents by annual household income (Figure 28) and annual individual income (Figure 29) for both millennials and Gen X. Not surprisingly, in particular the individual income tends to be lower among millennials, who are often still studying, and more in general closer to the beginning of their career and still climbing the income ladder.

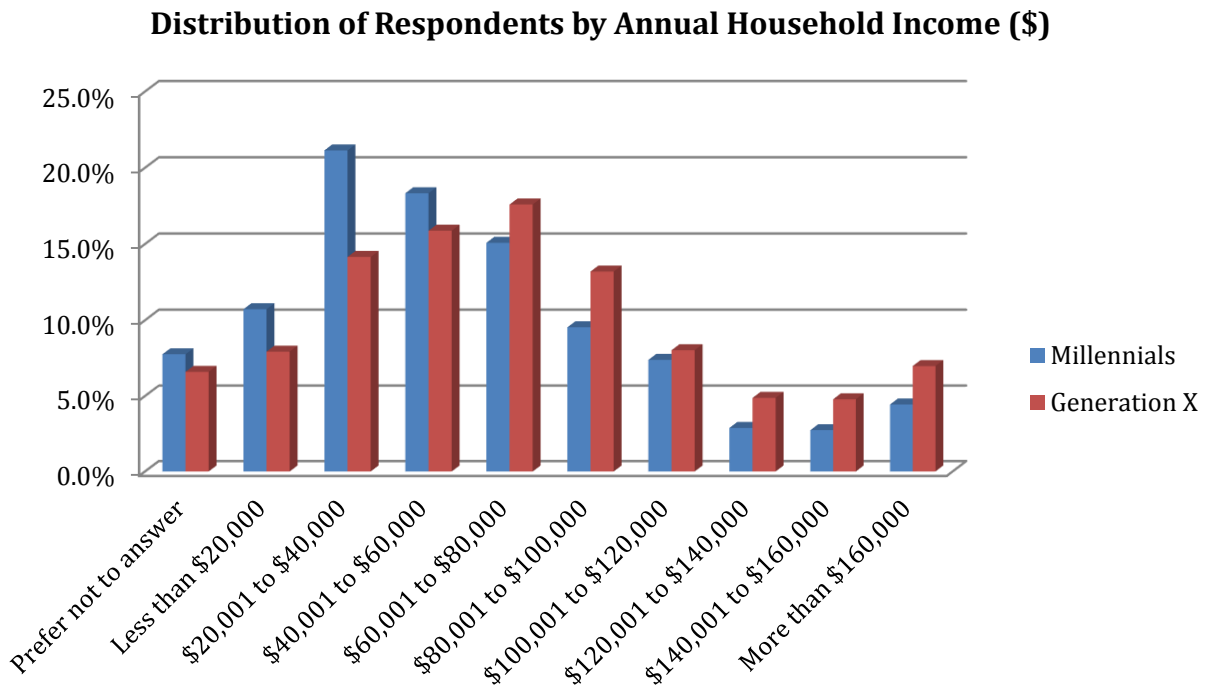


Figure 28. Distribution of respondents by household income level

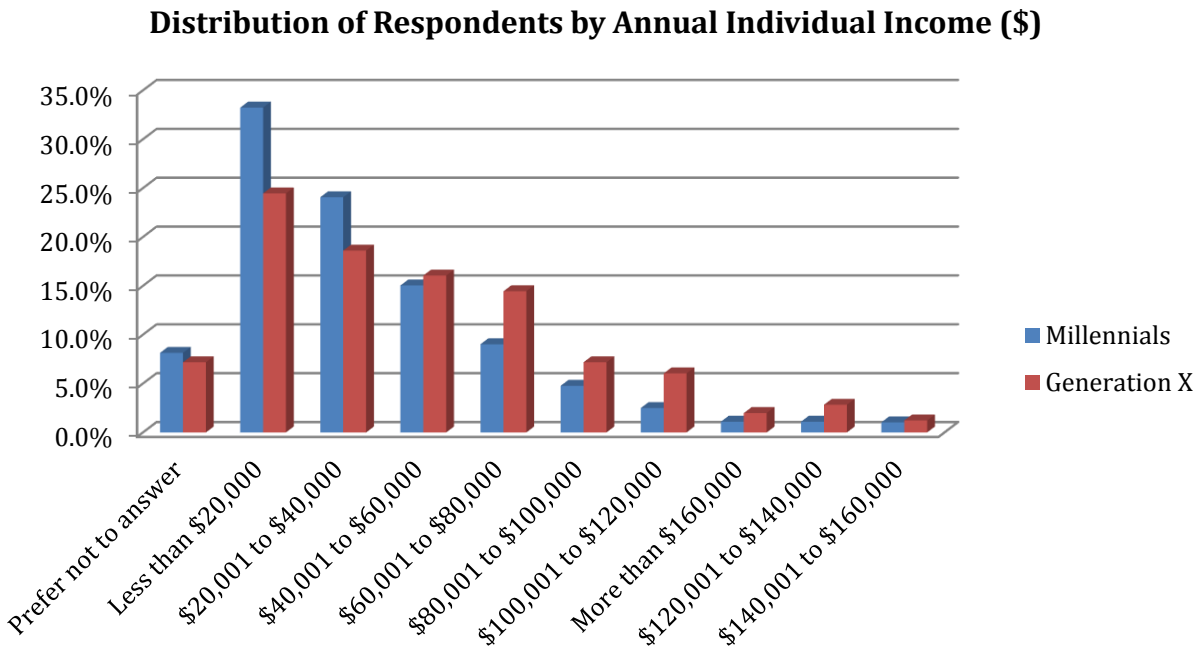
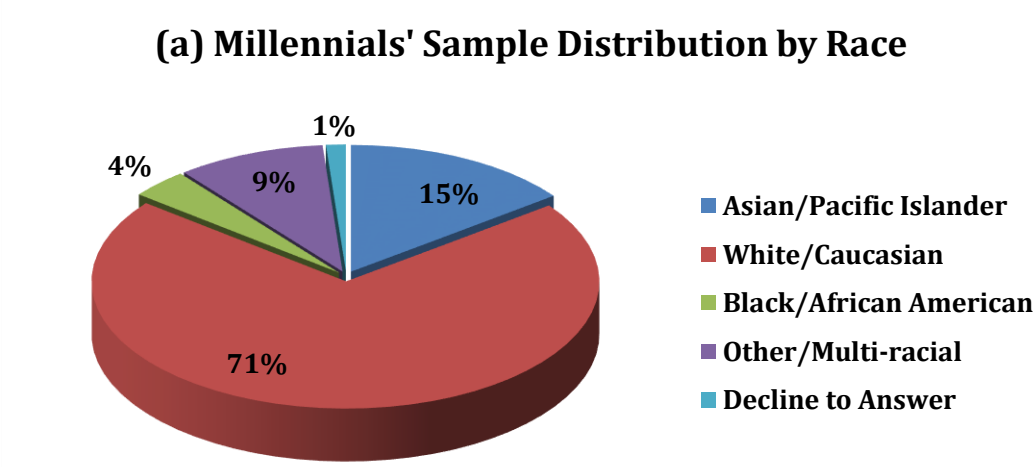


Figure 29. Distribution of respondents by individual income level

Millennial respondents included in the sample are also more diverse in terms of race and ethnicity (see Figure 30 and Figure 31, respectively), mirroring the similar patterns in the general population. In particular, the proportion of non-white, Hispanic/Latinos and multiracial respondents is higher among millennials than among the members of Gen X in California.



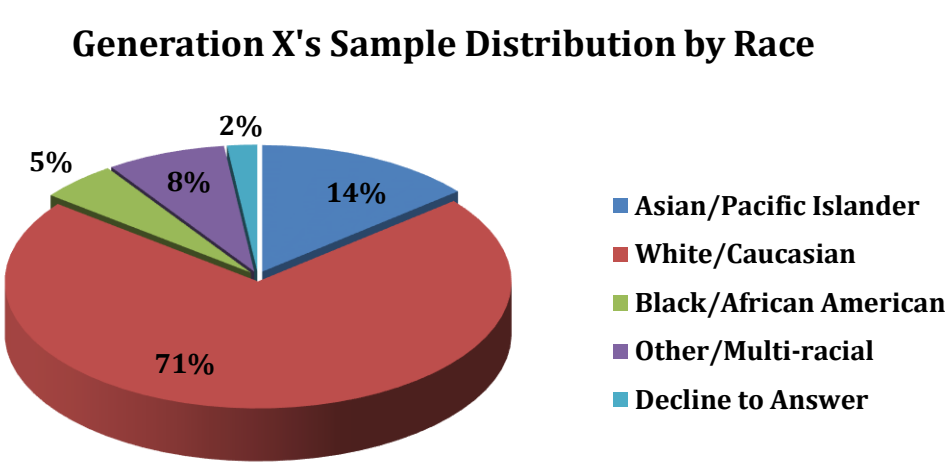


Figure 30. Sample distribution by race for (a) Millennials, and (b) Gen X

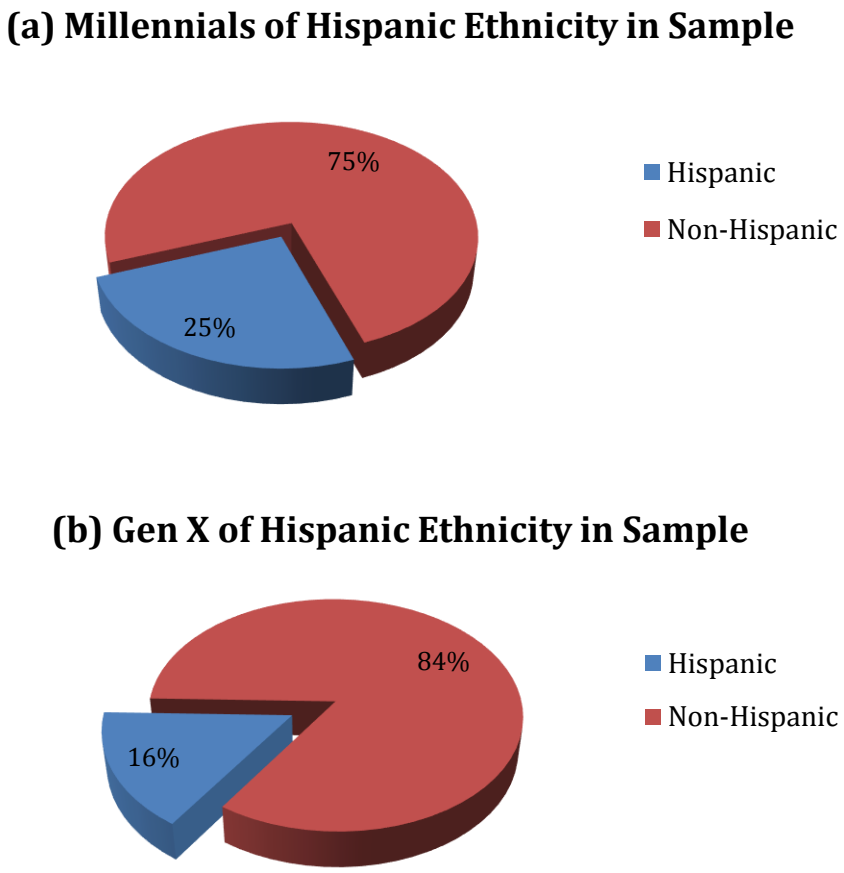


Figure 31. Proportion of respondents of Hispanic ethnicity in the sample of (a) Millennials, and (b) Gen X

The proportion of millennials of Hispanic ethnicity in the population of California, in particular, is even higher than what accounted for in the dataset collected for this study. The underrepresentation of this segment of the population in the sample might be caused by several reasons, including the difficulty to reach the members of this segment of the population with an internet-based survey, as well as the fact that the participation in this study involved the use of a rather lengthy survey entirely written in English.[16]

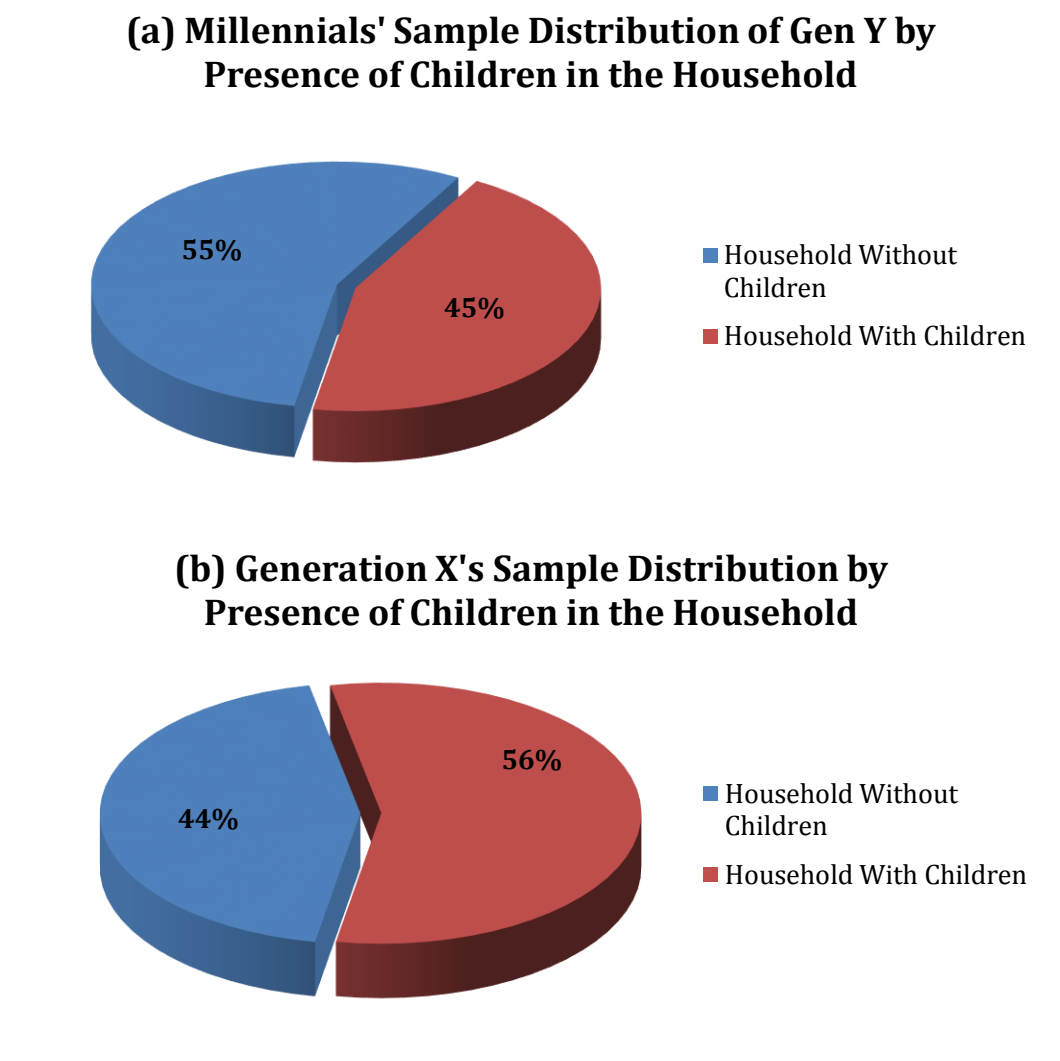


Figure 32. Sample distribution by presence of children in the household for (a) Millennials, and (b) Gen X

Figure 32 represents the distribution of respondents for the two subsamples of millennials and Gen X, in terms of presence of children under 18 years old in the household. Not surprisingly, the number of millennials that live in a household with young children is lower among millennials in California, who are less likely than the older members of Gen X to have children.

[16] The underrepresentation of this segment of the population if a topic that deserves additional attention in the future stages of the research. The strategies to deal with this issue include the use of weights in the analysis of the data collected for the study, as well as the eventual distribution of a paper version of the questionnaire, and/or the creation of a version of the survey in Spanish.

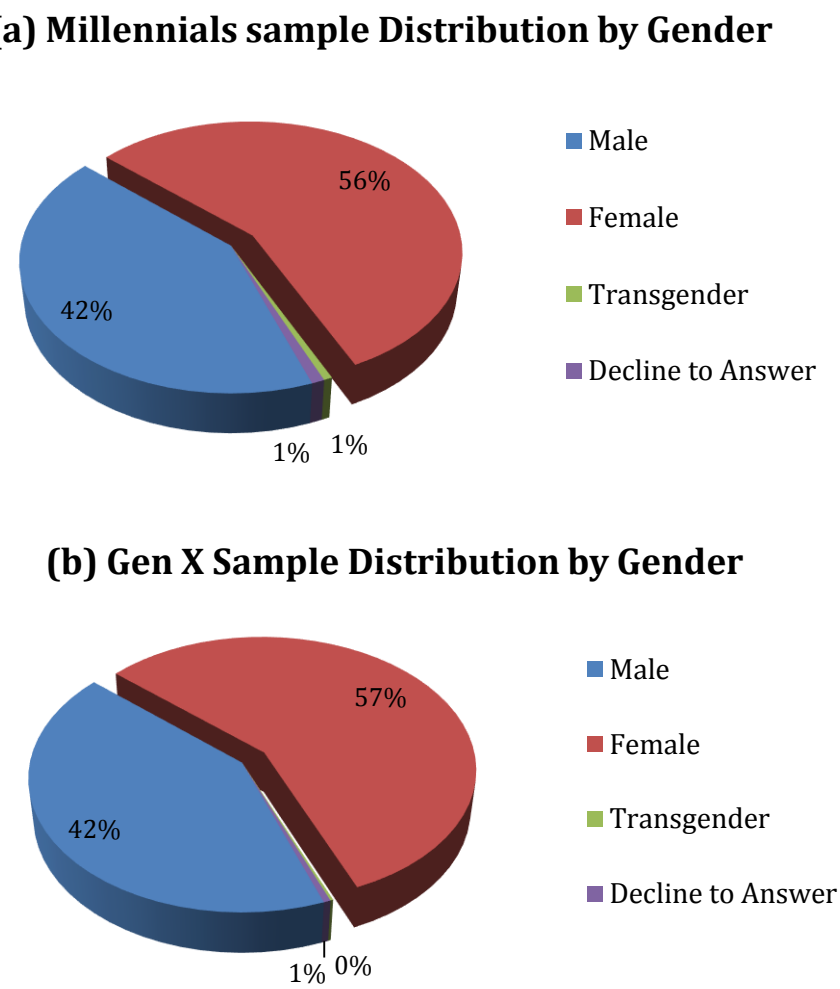


Figure 33. Sample distribution by gender for (a) Millennials, and (b) Gen X

The composition of the sample by gender is rather unbalanced, with a higher proportion of women in both subsamples of millennials and Gen X, also due to the impact of the 370 cases that were filtered out from the dataset because containing information that was inconsistent, frivolous or otherwise problematic. In fact, more cases that are problematic were identified among male respondents. This issue exacerbated the proportion of cases in the sample by gender in the sample, which was already unbalanced due to a higher response rate among women.

Mobility Choices of Millennials vs. Members of Gen X

Then analysis of the data in the California Millennials Dataset allows investigating several trends associated with the personal travel-related attitudes of millennials and their measures of travel behavior, and compare them with the attitudinal and behavioral patterns observed among members of the older Generation X.

Figure 34 reports the average self-reported number of weekly vehicle miles traveled (VMT) for the two groups of millennials and members of Generation X in the dataset. Please note that this measure represents a self-reported measure of the miles traveled by driving alone in a "typical week". As such, this measure may underestimate the actual average number of weeks made by travelers. Respondent, for example, may forget to include in this self-reported "average" measure the miles associated with infrequent trips such as work-related or leisure trips that are made with low frequency (less than once per week), summer vacations, etc. which account for a substantial amount of the vehicles miles traveled on average by Americans during a year.

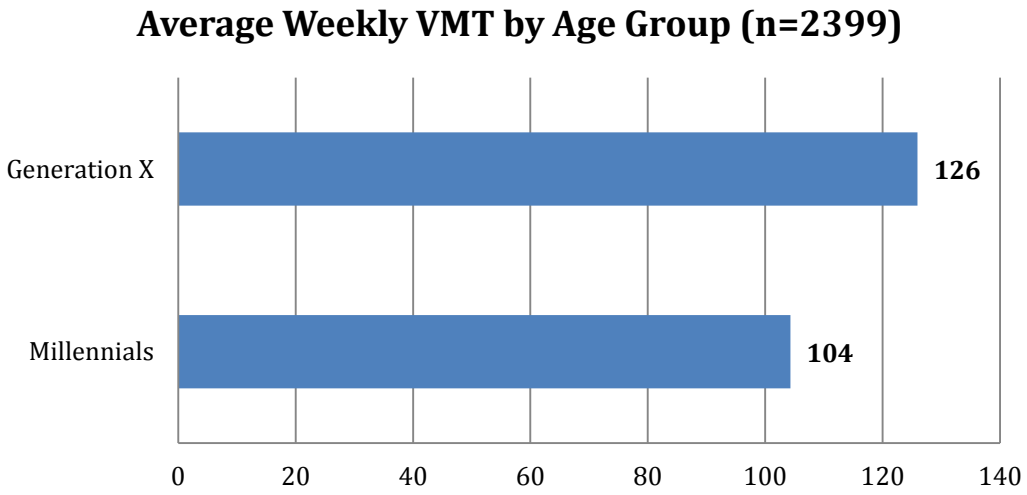


Figure 34. Average self-reported VMT for millennials and members of Gen X

Similarly, the numbers in Figure 34 are computed as the unweighted average across all cases in each subsample of millennials and Gen X that reported a weekly number of VMT in the dataset, and the absolute numbers might deviate from the population averages due to the way the dataset was collected (e.g. online survey) as well as the composition of the sample, e.g. oversampling residents in some regions compared to others. The use of an appropriate set of weights might compensate for these issues. Having discussed these caveats about the absolute numbers reported in the figures, a more meaningful finding relates to the comparison of the self-reported weekly VMT among different age groups in the sample. Millennials are found to report, on average, a number of weekly VMT that is about 18% lower than their peers belonging to the Generation X.[17] This measure mirrors similar differences that are observed in the number of individuals that live in household without a car, and measures of mode choice, as reported later in this section.

[17] While a larger proportion of respondents in the Generation X in this dataset lives in suburban neighborhoods, and this might partially explain the differences in the weekly VMT reported by participants, there are reasons to believe that the larger proportion of millennials living in urban areas in the dataset actually mirrors similar trends in the population of California. Detailed analysis of land use data, in later stages of the research, will allow the researchers to investigate this topic in more details.

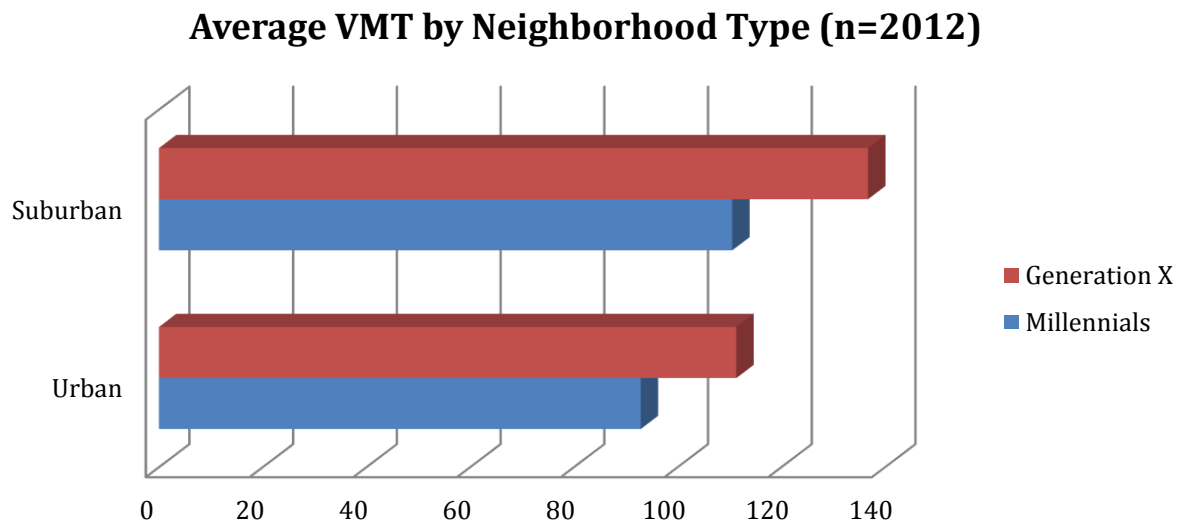


Figure 35. Average self-reported VMT for millennials and members of Gen X, by neighborhood type

In order to further investigate the effects of neighborhood type and sample composition on the amount of car travel of the members of the two generations, Figure 35 reports the average self-reported weekly VMT for the groups of millennials and Gen X that live in neighborhoods that can be respectively classified as predominantly urban vs. suburban. Among residents of both urban and suburban neighborhoods, millennials tend to drive less (a number of reasons might be associated with this trend, including the different stage in life of the individuals, the presence of children in the household, as well as the impact of personal attitudes and preferences, as discussed in the following sections).

Consistent with what has been identified in the literature as a potential explanatory factor for the observed differences in travel behavior, and the lower use of the private cars in particular, a higher number of millennials in the dataset report not to have a valid driver's license. Approximately 13% of millennials in the dataset report not to have a valid driver's license at the time they complete the survey, compared to only 7.9% without a valid driver's license among the members of Gen X. All millennials that participated in the study were at least 18 years old at the time they completed the survey, and no large differences are recorded in the average age at which respondents obtained the license among the two groups (among those that have a drivers' license). This seems to suggest that, even if a larger proportion of millennials does not have a driver's license, those that have one tend to obtain it more or less at a similar stage of life than their older peers in the previous Generation X.

Moving to the personal characteristics of the individuals, millennial respondents confirm their characteristics of a transient generation, who are still at the beginning of their career, and do not feel well-established in the field in which they work. Figure 36 and Figure 37 report the degree of agreement, measured on a 5-level Likert scale from "Strongly disagree" to "Strongly Agree", with the statements "*I'm still trying to figure out my career (e.g. what I want to do, where I'll end up)*" and "*I'm already well-established in my field of work*", among millennials and

members of Gen X. These statements are part of the 66 statements that were included in the attitudinal sections of the survey (Section A and Section J).[18] Millennials clearly tend to agree to a greater extent with the first statement, while they tend to be much less in agreement with the second statement regarding being well-established in their field of work.

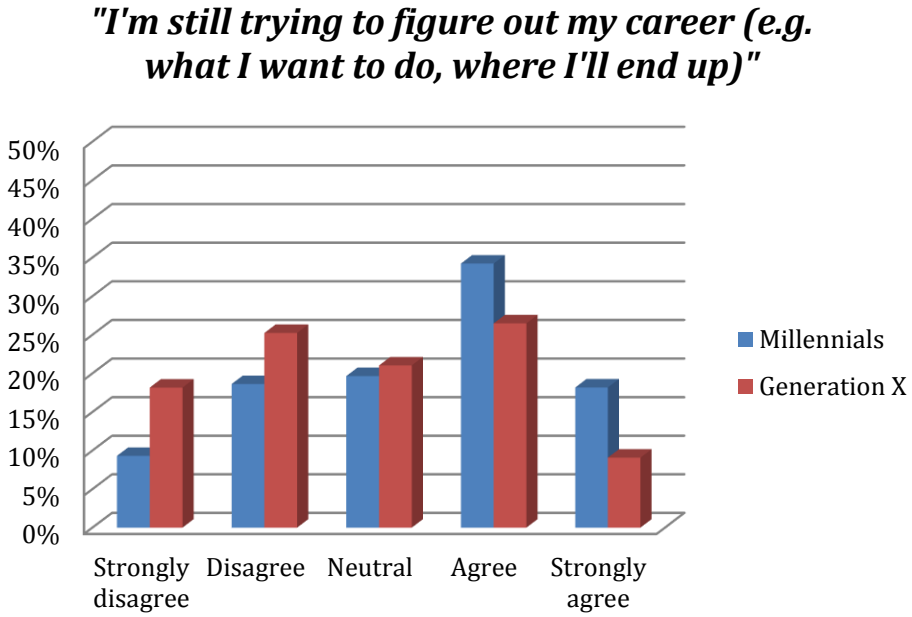


Figure 36. Respondents' agreement, by age group, with the attitudinal statement "*I'm still trying to figure out my career (e.g. what I want to do, where I'll end up)*"

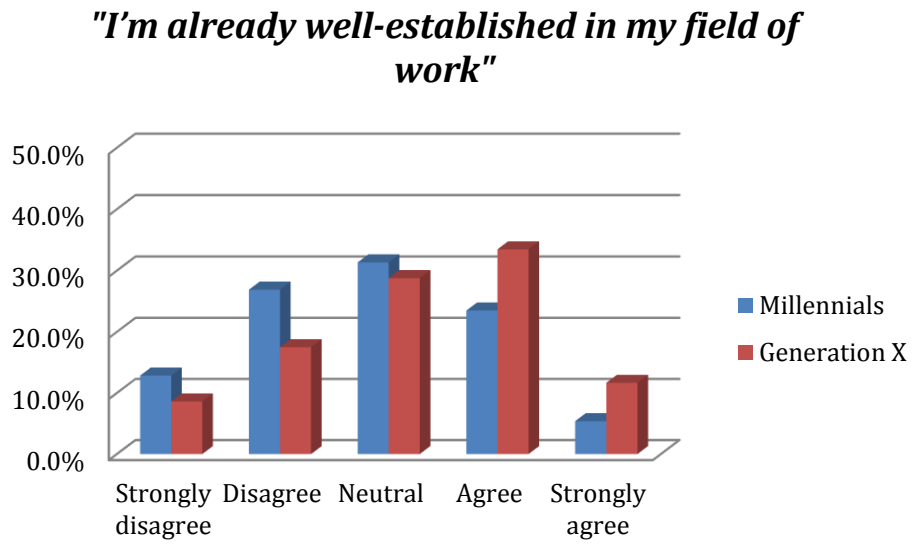


Figure 37. Respondents' agreement, by age group, with the attitudinal statement *"I'm already well-established in my field of work"*

[18] In the future stage of the research, we do plan to further analyze these statements through the use of factor analysis and cluster analysis techniques, in order to analyze the emerging attitudinal patterns among respondents, and we will investigate the relationships existing among personal attitudes and specific travel-related choices through the use of multivariate statistics.

It is also interesting to explore the relationship of millennials vs. members of the older members of Gen X with technology and social media among. Figure 38 and Figure 39 reports the distribution of self-reported agreement with a set of technology-oriented and social-media related statements. Consistent with expectations, millennials are more likely to agree with a positive role of social networks such as Facebook in making their life "more interesting". Millennials also recognize a stronger role of smartphones in making it easier to "go around", and appear less concerned than the members of Gen X in learning how to use new technologies (Figure 40).

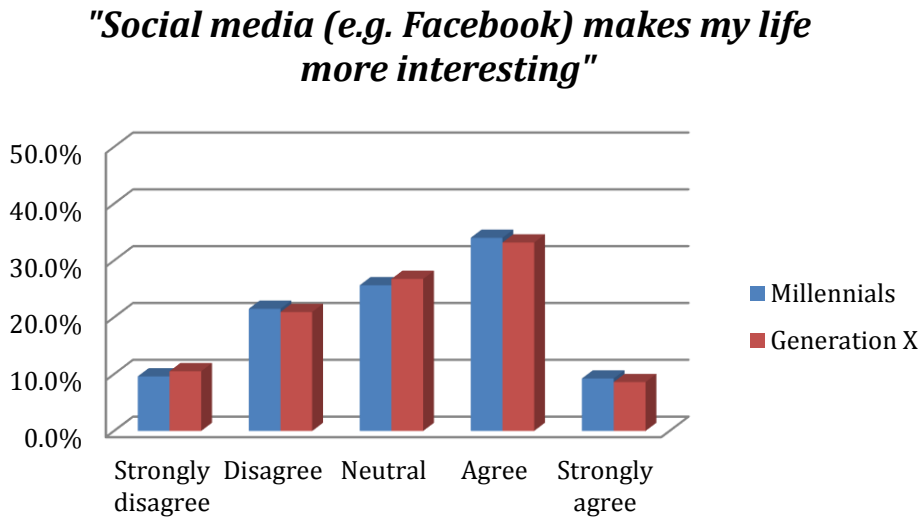


Figure 38. Respondents' agreement, by age group, with the attitudinal statement *"Social media (e.g. Facebook) makes my life more interesting"*

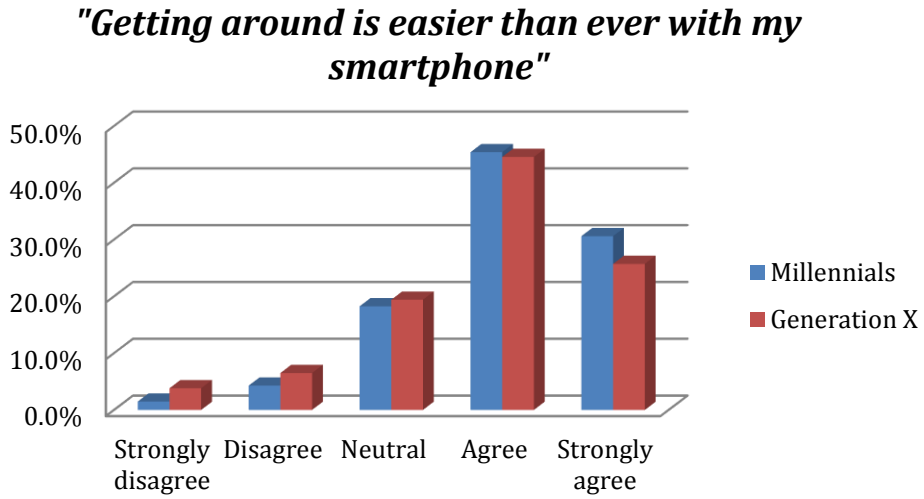


Figure 39. Respondents' agreement, by age group, with the attitudinal statement *"Getting around is easier than ever with my smartphone"*

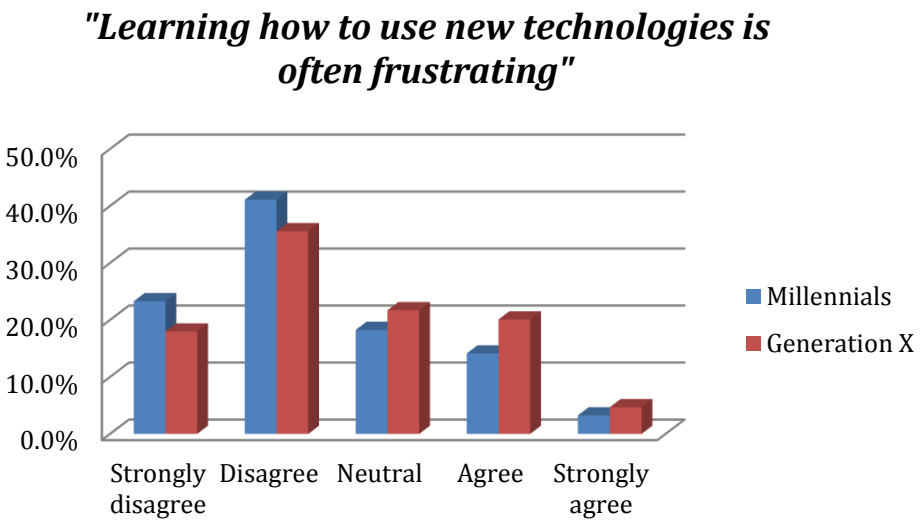


Figure 40. Respondents' agreement, by age group, with the attitudinal statement *"Learning how to use new technologies is often frustrating"*

Respondents belonging to the younger millennial generation also appear to be more at ease at doing more than one activity at the same time (Figure 41), i.e. what is commonly named "multitasking", which has been increasingly recognized as a relevant factor affecting the travelers' perceived value of travel time, mode choice, and an overall trip experience (cf. Ettema et al., 2012; Mokhtarian et al., 2014; Malokin et al., 2015).

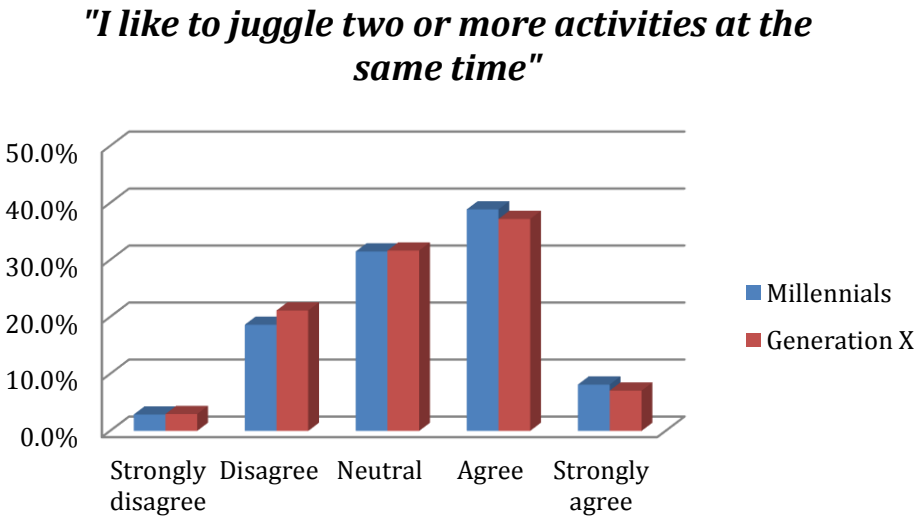


Figure 41. Respondents' agreement, by age group, with the attitudinal statement *"I like to juggle two or more activities at the same time"*

The need to be always "connected" and use smartphones, tablets and other internet-enabled devices for a number of purposes is associated with the large importance associated with having a Wi-Fi and/or 3G/4G internet connection available at all times (Figure 42).

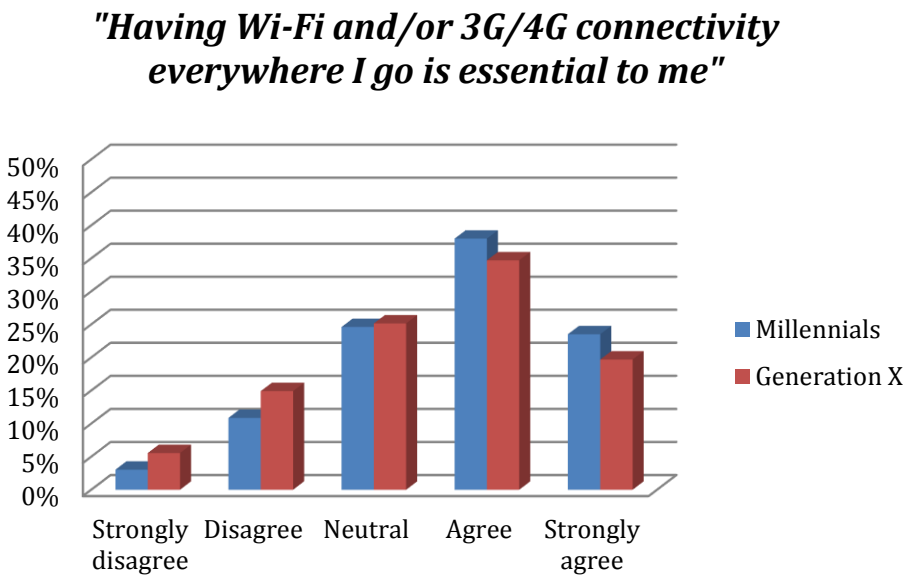


Figure 42. Respondents' agreement, by age group, with the attitudinal statement *"Having Wi-Fi and/or 3G/4G connectivity everywhere I go is essential to me"*

These findings are consistent with the stereotypical idea of millennials who make a larger use of technology (smartphones, in particular) as a way to simplify their life and to adjust to a more dynamic and *mobile* life organization. In another section of the survey, we collected information about the frequency with which respondents use their smartphone Apps in order to conduct a number of activities, including "*Identify possible destinations (e.g. restaurant, café, etc.)*" (Figure 43), "*Learn how to get to a new place*" (Figure 44), "Decide which means of transportation, or combinations of multiple means, to use for a trip" (Figure 45), "Check traffic to plan my route or departure time" (Figure 46), and "*Navigate in real time (e.g. using Google Maps or other navigation services)*" (Figure 47).

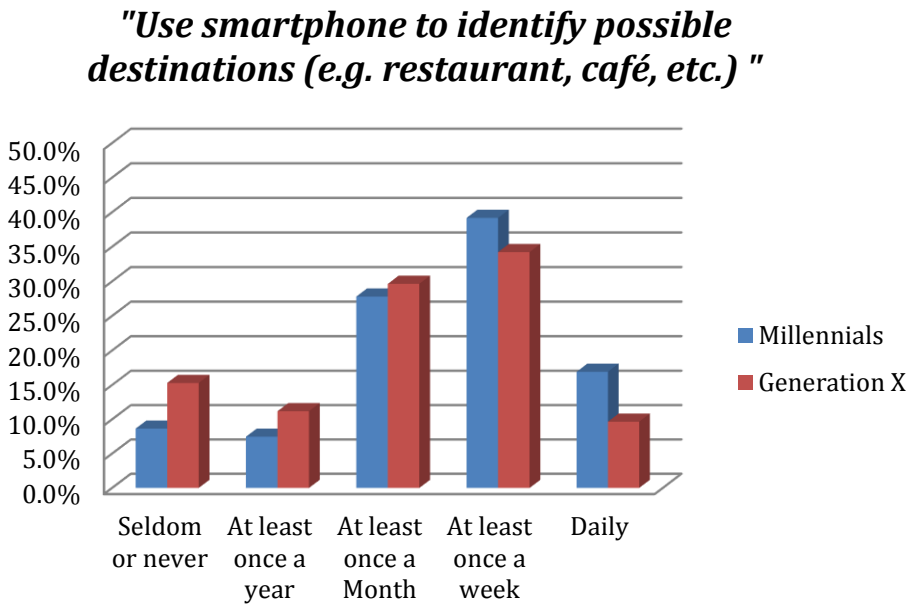


Figure 43. Frequency of use of the internet and smartphone Apps to "*Identify possible destinations (e.g. restaurant, café, etc.)*"

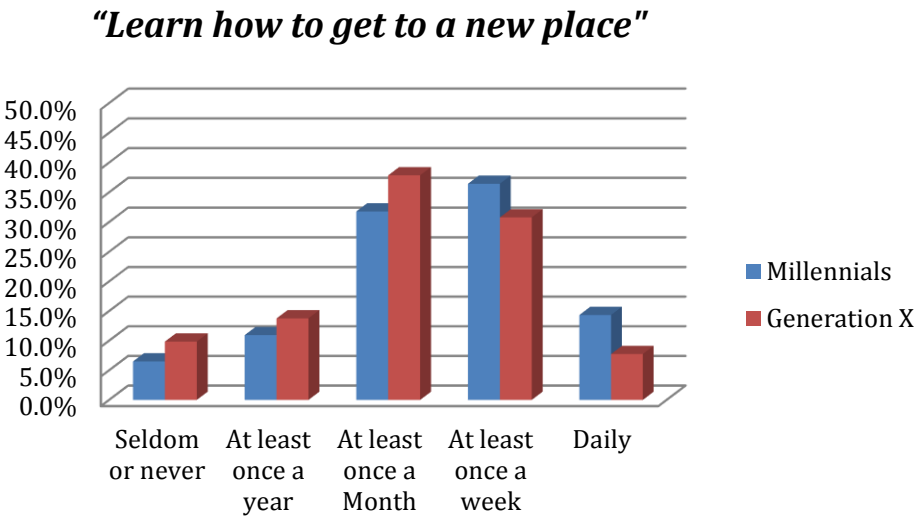


Figure 44. Frequency of use of the internet and smartphone Apps to "*Learn how to get to a new place*"

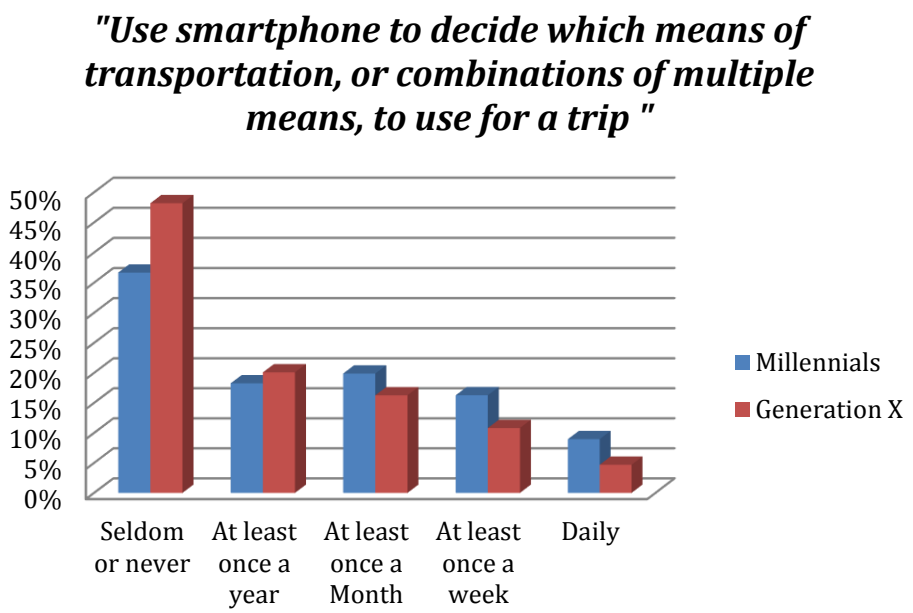


Figure 45. Frequency of use of the internet and smartphone Apps to *"Decide which means of transportation, or combinations of multiple means, to use for a trip"*

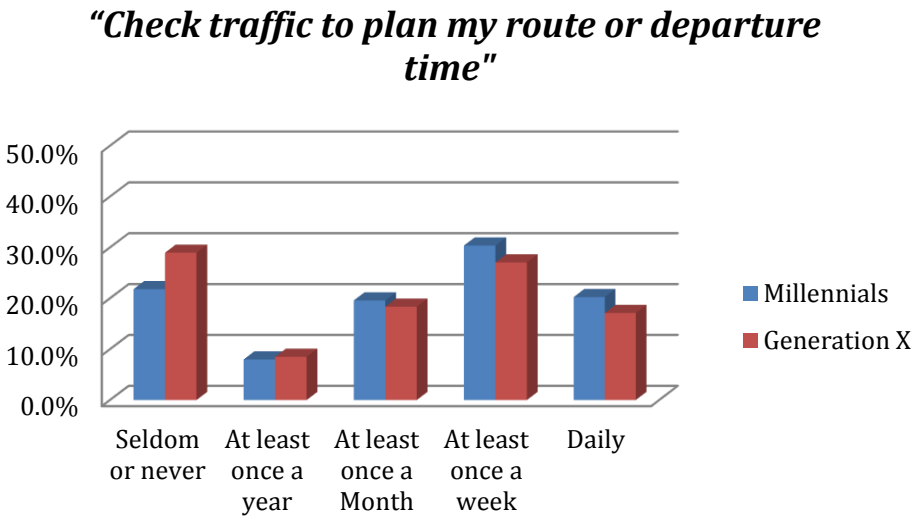


Figure 46. Frequency of use of the internet and smartphone Apps to "*Check traffic to plan my route or departure time*"

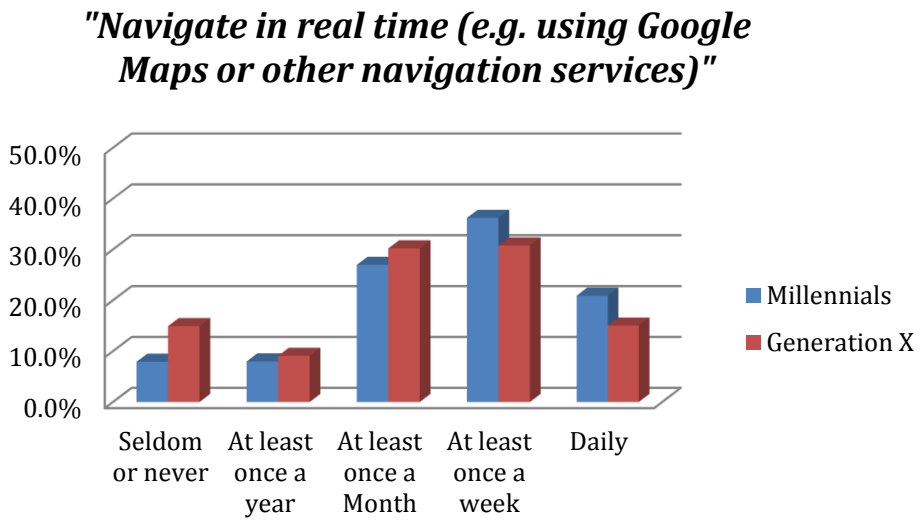


Figure 47. Frequency of use of the internet and smartphone Apps *"Navigate in real time (e.g. using Google Maps or other navigation services)"*

The members of the millennial generation also appear to be more interested, on average, in having "a lot of luxury things", if compared to the members of the previous Generation X (Figure 48), and they tend to be more affected by *peers' influence*. Even if most respondents from both age groups tend to disagree with being subject to this influence, on average, millennials are slightly more likely to admit that they would "avoid doing things that they know their friends would not approve" (Figure 49).

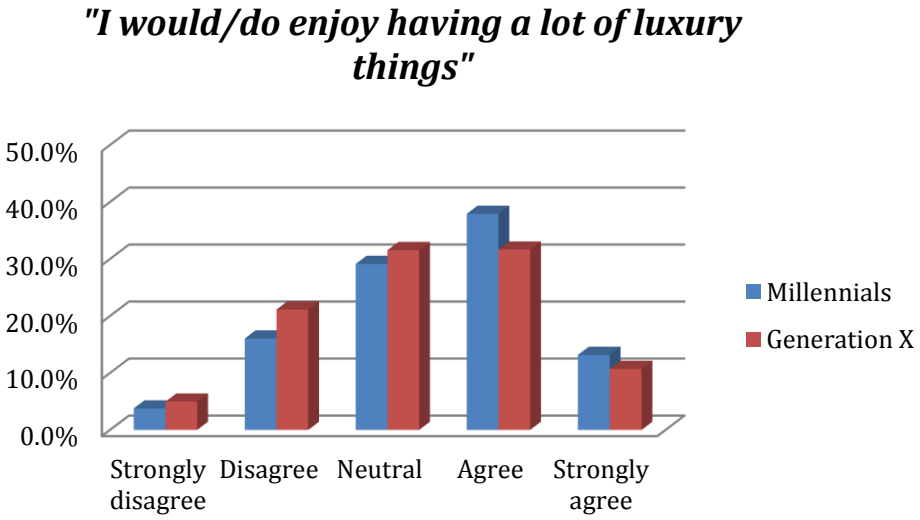


Figure 48. Respondents' agreement, by age group, with the attitudinal statement *"I would/do enjoy having a lot of luxury things"*

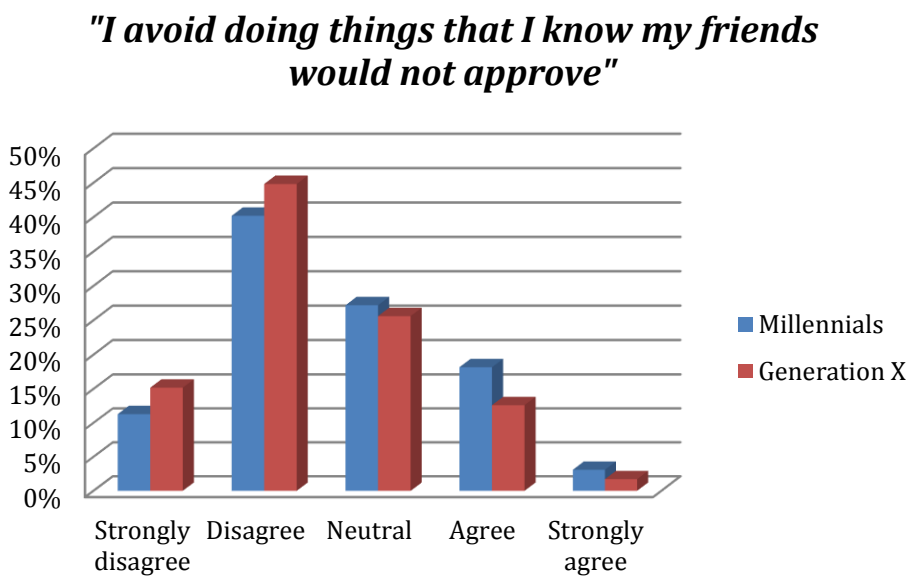


Figure 49. Respondents' agreement, by age group, with the attitudinal statement *"I avoid doing things that I know my friends would not approve"*

Many generational differences in the level of agreement with these attitudinal questions tend to be rather small in magnitude. Still, at the margin, they are a sign of some differences in the personal and behavioral traits between millennials and older individuals. In future stages of the research, the research team will analyze the full set of attitudinal data collected in the California Millennials Dataset also through the use of factor analysis and cluster analysis, and they will investigate the relationships among the emerging attitudinal profiles of respondents and travel related-choices through the use of multivariate statistics.

Figure 50 and Figure 51 report the employment distribution for the two subsamples respectively of millennials (Figure 50) and members of the Generation X (Figure 51), in each region of California. On average, the members of the millennial generation tend to be more likely to work only part-time, only do unpaid work, and have two or more jobs, than the members of the Generation X. Also, the percentage of individuals that do not work at all tends to be larger among millennials than among members of the Generation X (due to both higher prevalence of non-working students and of unemployed respondents among the millennial group).

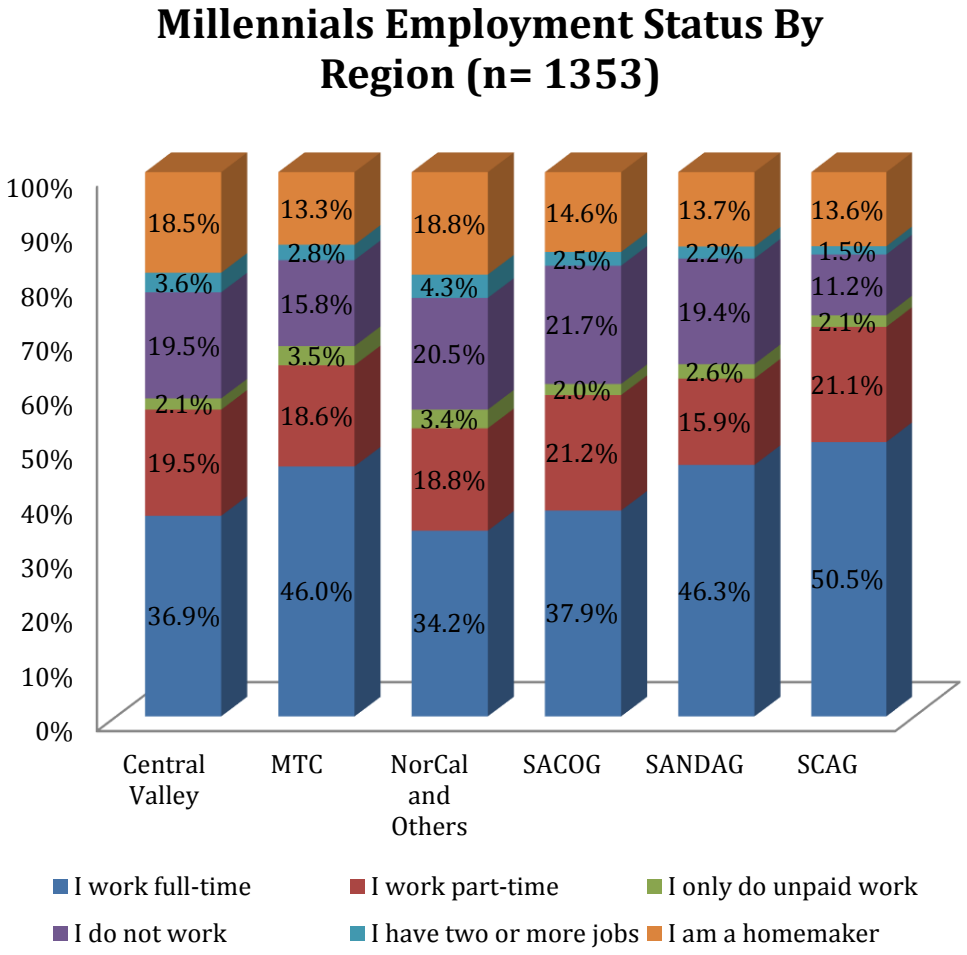


Figure 50. Millennials' employment status by region of California

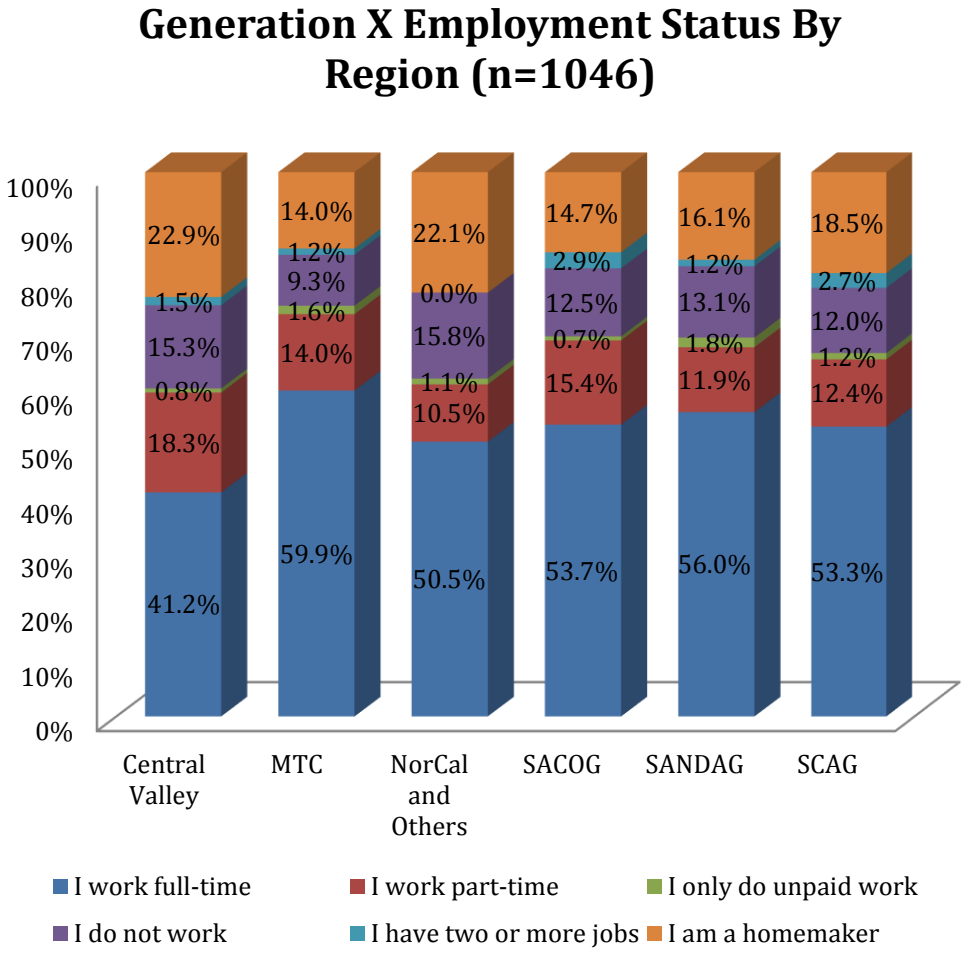


Figure 51. Generation X's employment status by region of California

In our sample, millennials (Figure 52) drove less for their recent commute mode (69%) than Gen X members (75%). A greater percentage of millennials use active modes such as walking and biking, as well as public transit.

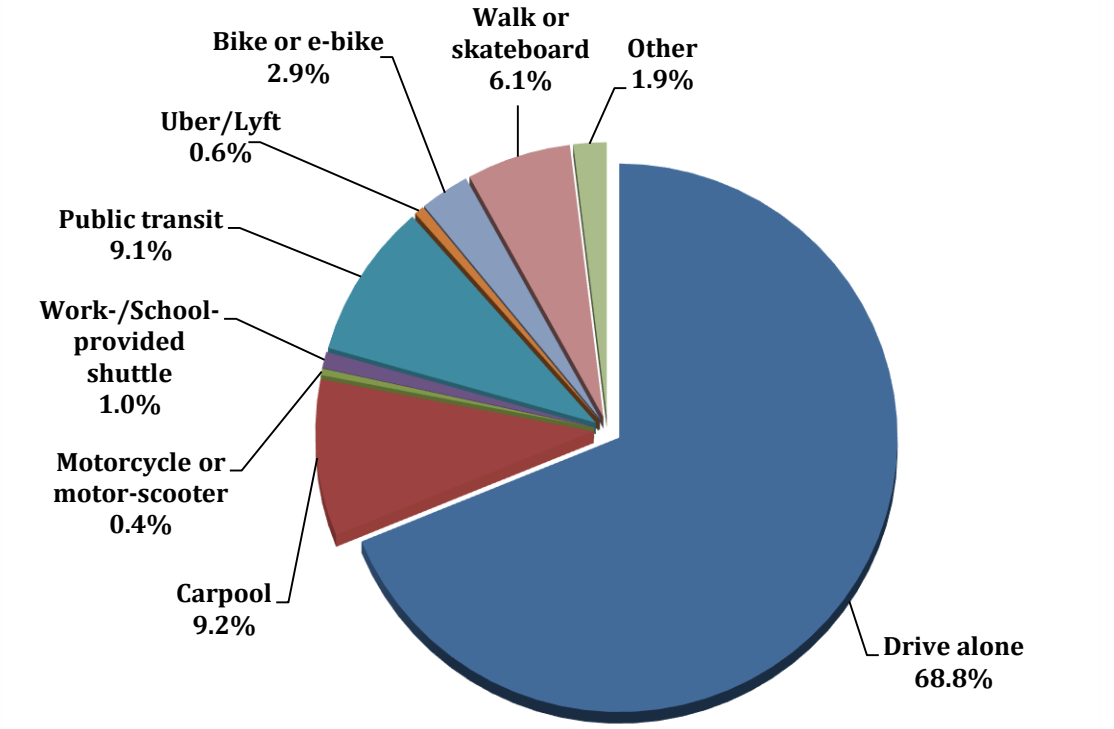


Figure 52. Most recent commute mode: Millennials

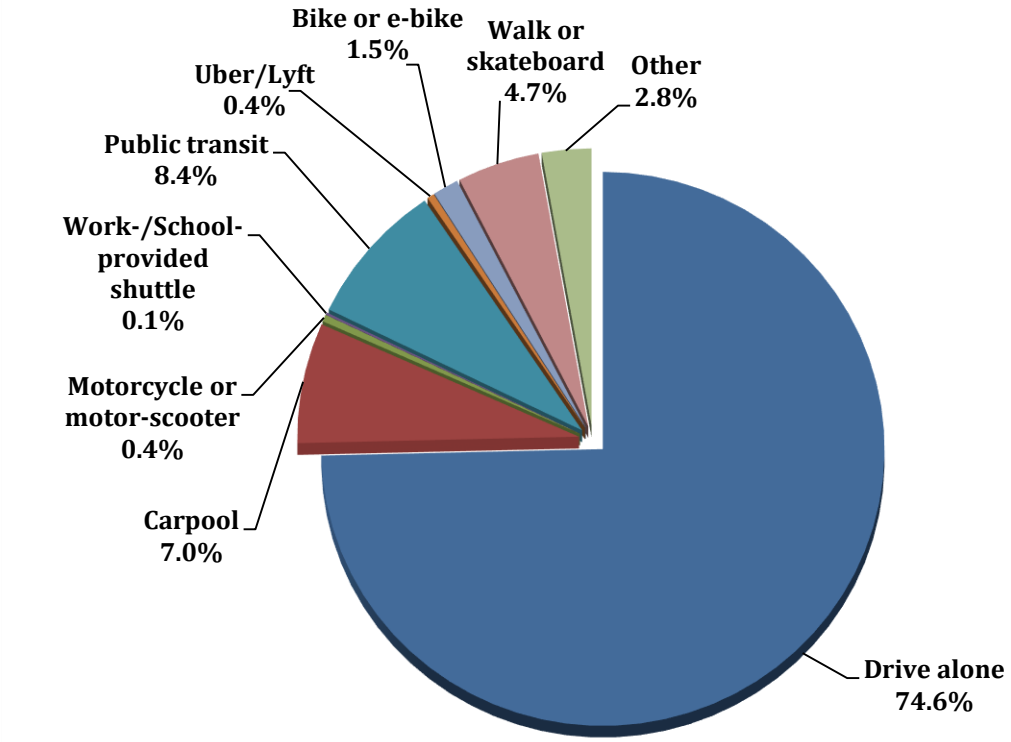


Figure 53. Most recent commute mode: Gen X

Among the individuals that physically commute to work at least one per week, millennials (Figure 54) tend to more frequently engage in *travel multitasking* (i.e. carry out an activity while traveling) during their commute, compared to the Gen X members (Figure 55) in all regions of California. This finding, which appears to correlate with the larger adoption of ICT devices among the millennials generation, deserves additional attention, as it might be associated with a different evaluation of the utility of travel alternatives.

In future stages of the research, we plan to estimate econometric and discrete choice models to investigate the impact of the propensity to engage in, and frequency of adoption of, travel multitasking on frequency of use of the various means of transportation and commute mode choice.

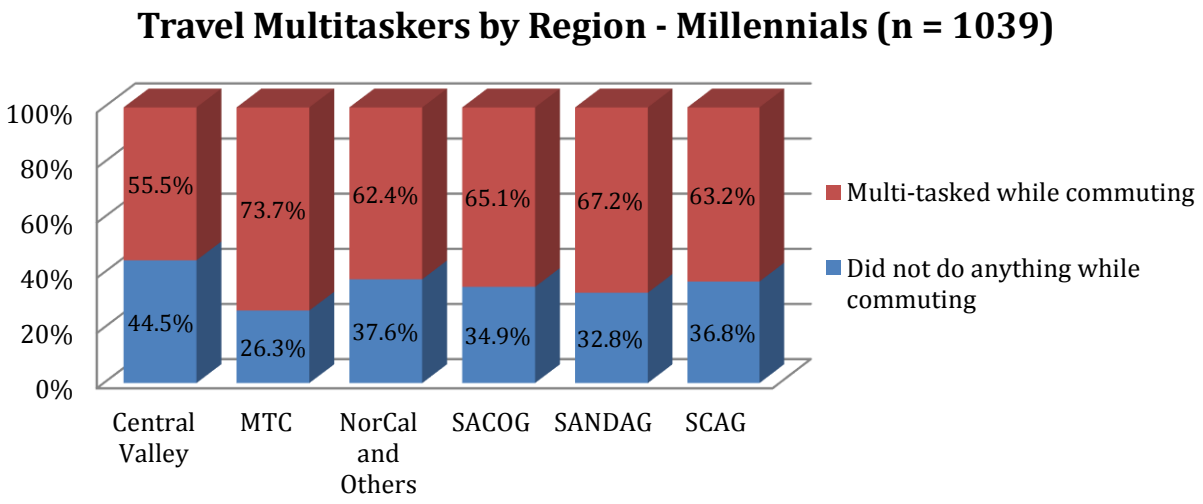


Figure 54. Percentage of millennials that engages in travel multitasking during their commute, by region

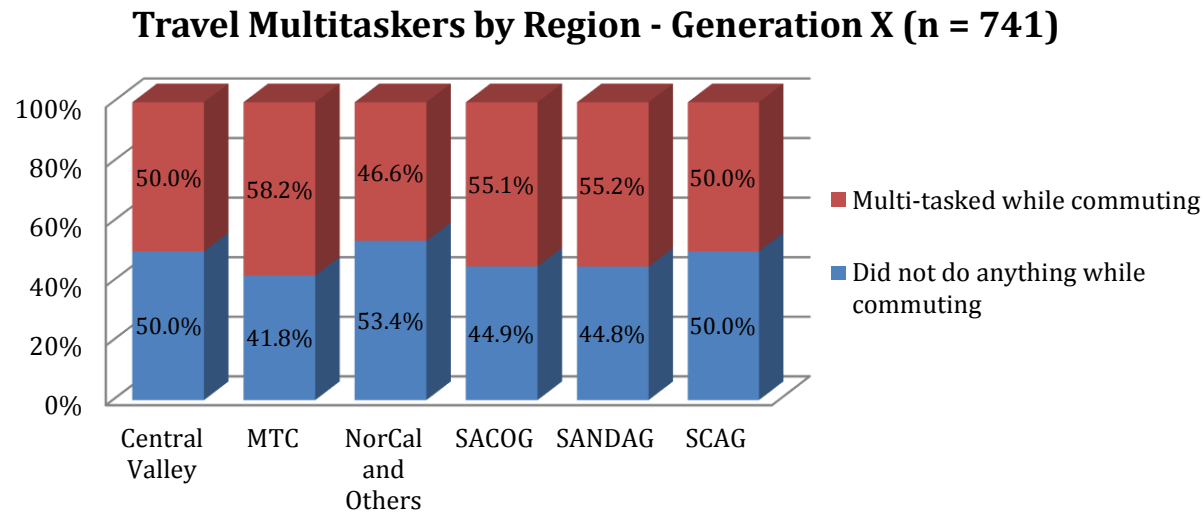


Figure 55. Percentage of Gen X that engages in travel multitasking during their commute, by region

Millennials also report higher preferences, on average, for specific modes of transportation, e.g. riding a bike (see Figure 56), and seem to be less limited by their schedule in the adoption of public transportation (see Figure 57), compared to the members of Generation X.

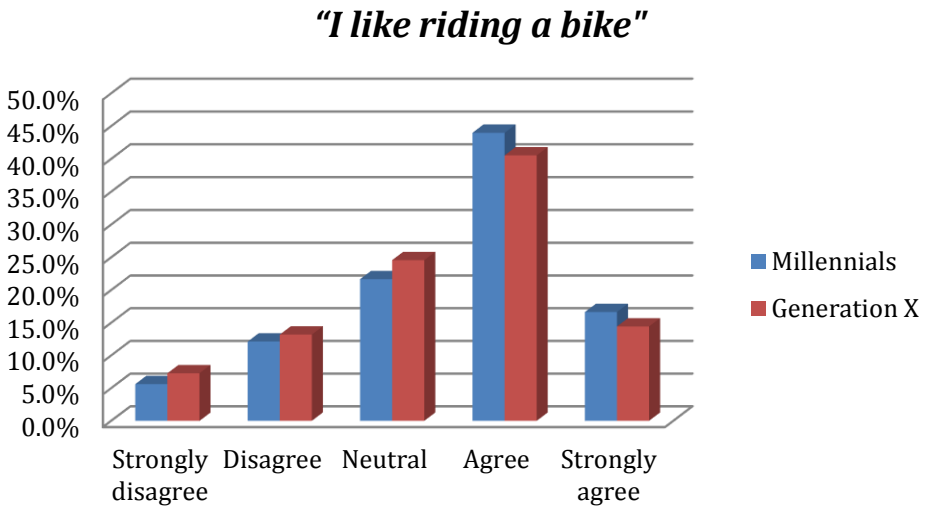


Figure 56. Respondents' agreement, by age group, with the attitudinal statement *"I like riding a bike"*

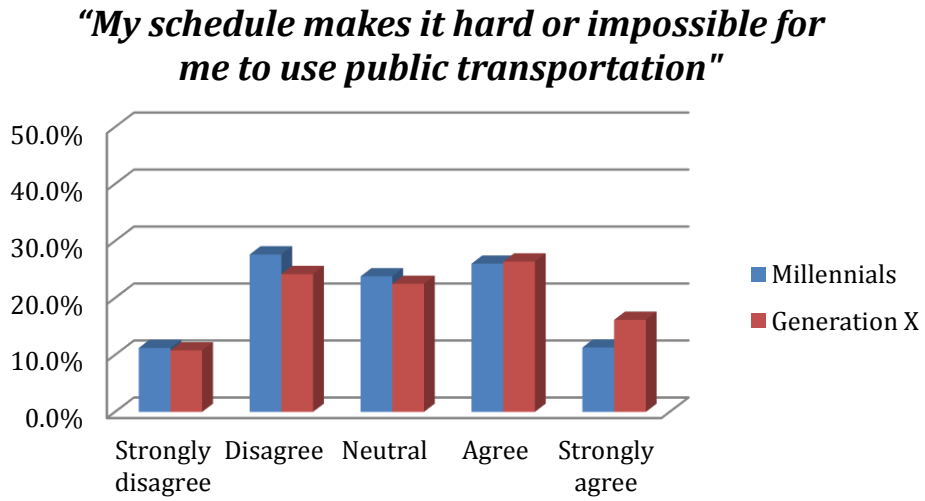


Figure 57. Respondents' agreement, by age group, with the attitudinal statement *"My schedule makes it hard or impossible for me to use public transportation"*

In next stages of the research, we plan to investigate the impact of this type of mode preferences and schedule constraints and characteristics of the work and commute patterns, on the commute mode choice and frequency of use of various means of transportation, through the use of multivariate analysis.

In this study, we also collected several pieces of information related to residential location preferences of the members of the two generations of millennials and members of the Generation X. For example, Figure 58 shows the respondents' level of agreement with a

statement that measures the preference for residential location vs. size of the unit: while most respondents from both age groups tend not to agree with the content of the statement, a larger percentage of millennials seems interested in a residential location closer to public transportation, even at the cost of a smaller residential unit.

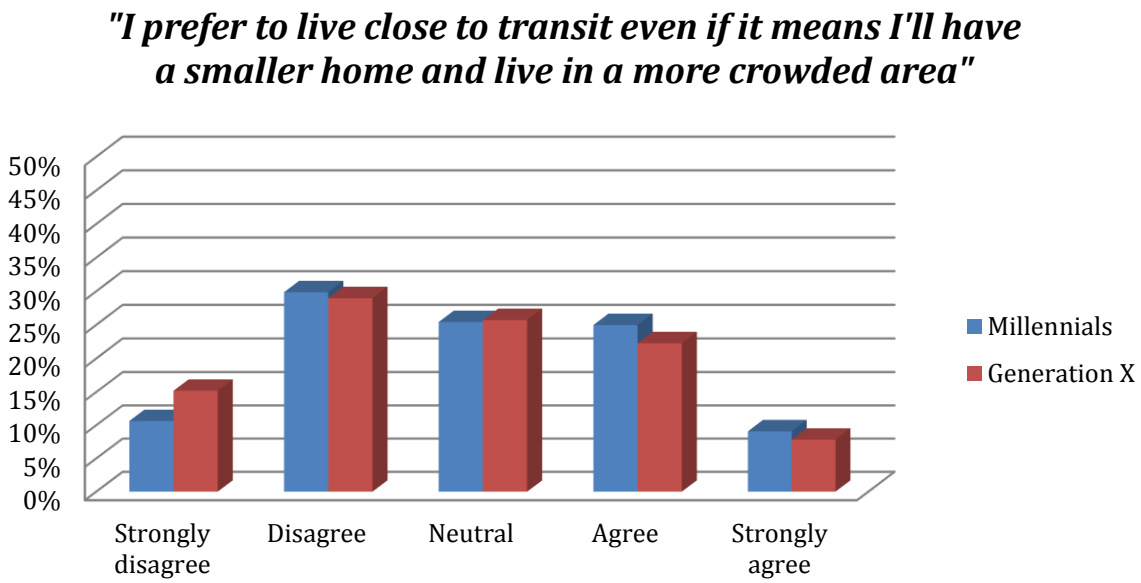


Figure 58. Respondents' agreement, by age group, with the attitudinal statement *"I prefer to live close to transit even if it means I'll have a smaller home and live in a more crowded area"*

During the future stages of the research, we will focus on the analysis of the relationships among personal attitudes and preferences, residential location of the respondents, and travel behavior choices, also through the integration of additional data on the built environment/land use of the neighborhood where each respondents live, as obtained from other sources. This will allow us to evaluate (a) the degree in which residential location preferences of millennials vs. members of Gen X affect match their current residential location (also to verify an eventual *self-selection* of respondents, who tend to locate in neighborhoods and part of a city that match their preferences); and (b) the way in which personal preferences and current residential location affect travel behavior of the individuals belonging to the two analyzed age groups.

Millennials are also often described as idealists and more committed to the environmental cause. In the California Millennials Dataset, a number of questions investigate this type of environmental concerns, and attitudes of the members of the two analyzed age groups. According to the data, a larger percentage of millennials agrees with the principle that "*The government should put restrictions on car travel in order to reduce congestion*" (Figure 59), "*We should raise the price of gasoline to reduce the negative impacts on the environment*" (Figure 60), and "*We should raise the price of gasoline to provide funding for better public transportation*" (Figure 61).

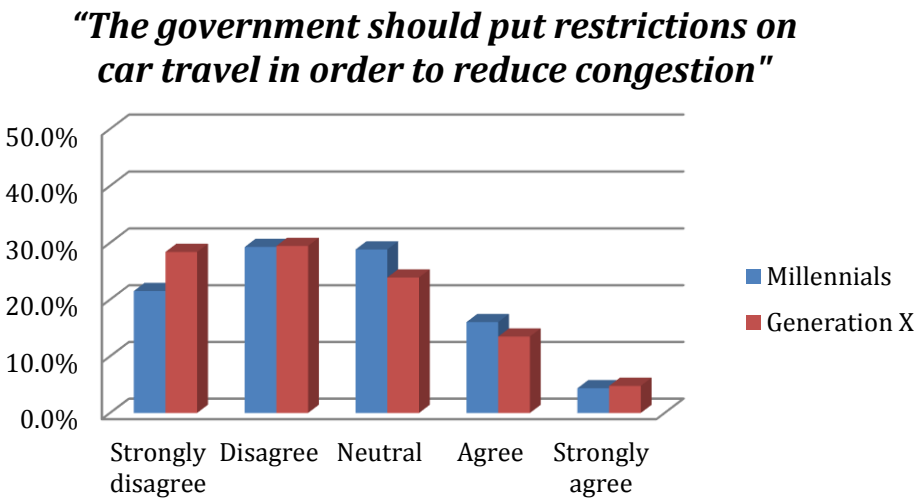


Figure 59. Respondents' agreement, by age group, with the attitudinal statement *"The government should put restrictions on car travel in order to reduce congestion"*

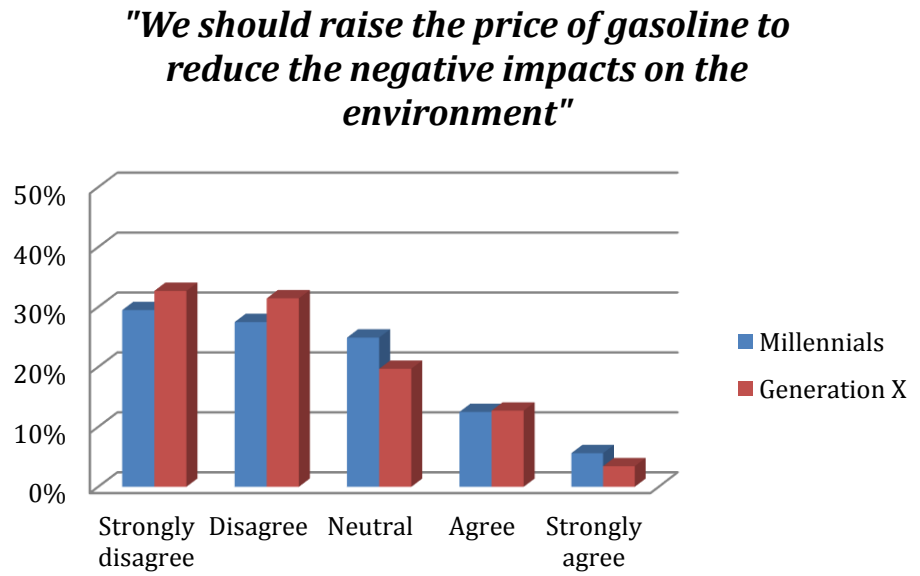


Figure 60. Respondents' agreement, by age group, with the attitudinal statement *"We should raise the price of gasoline to reduce the negative impacts on the environment"*

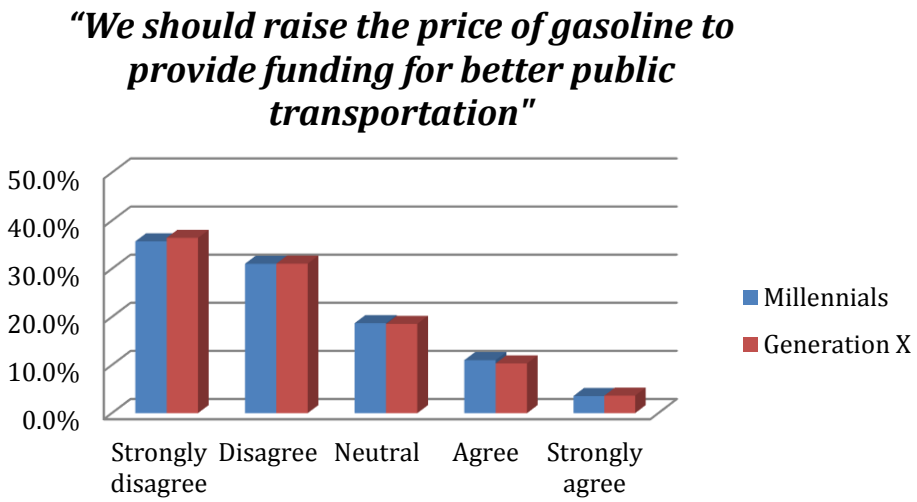


Figure 61. Respondents' agreement, by age group, with the attitudinal statement *"We should raise the price of gasoline to provide funding for better public transportation"*

Finally, Figure 62, 63 and 64 present some information related to the adoption of modern technologies and *shared mobility* services among the members of the millennial generation vs. the members of Generation X. In this study, we collected a vast amount of information related to the awareness, availability and frequency of adoption of a number of shared mobility services in California, including *car-sharing*, *bike-sharing*, *dynamic ridesharing* and *on-demand ride services such as Uber or Lyft*.

Figure 62 reports the awareness and previous use of on-demand ride services such as Uber or Lyft, among the two subsamples of millennials and members of Generation X. While the number of respondents that overall have heard of these services is very similar among the members of the two generations, according to our data the number of millennials that have already used these services, in their hometown/city and/or away from home, is definitely higher than among the members of the Generation X.

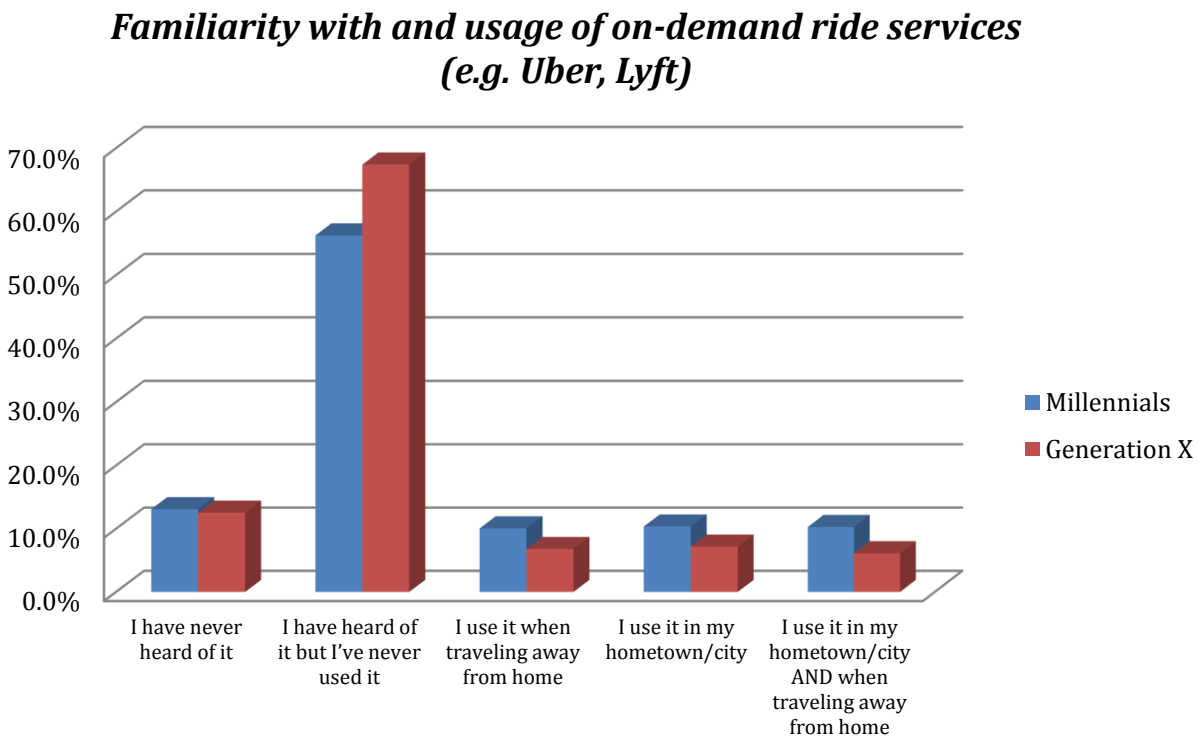


Figure 62. Respondent's familiarity with and usage of on-demand ride services (*e.g.* Uber, Lyft)

In this research, we are also interested in understanding the impact of the adoption of new shared mobility services in terms of potential substitution of other modes. Accordingly, for all respondents that have used any type of on-demand ride services such as Uber or Lyft at least once before, we asked a set of questions related to the last trip that took with these services.

Figure 63 and Figure 64 report the impacts that the last trip made by Uber or Lyft had on the use of other means of travel, as reported respectively by millennials and members of Gen X who live in various neighborhood types in California.

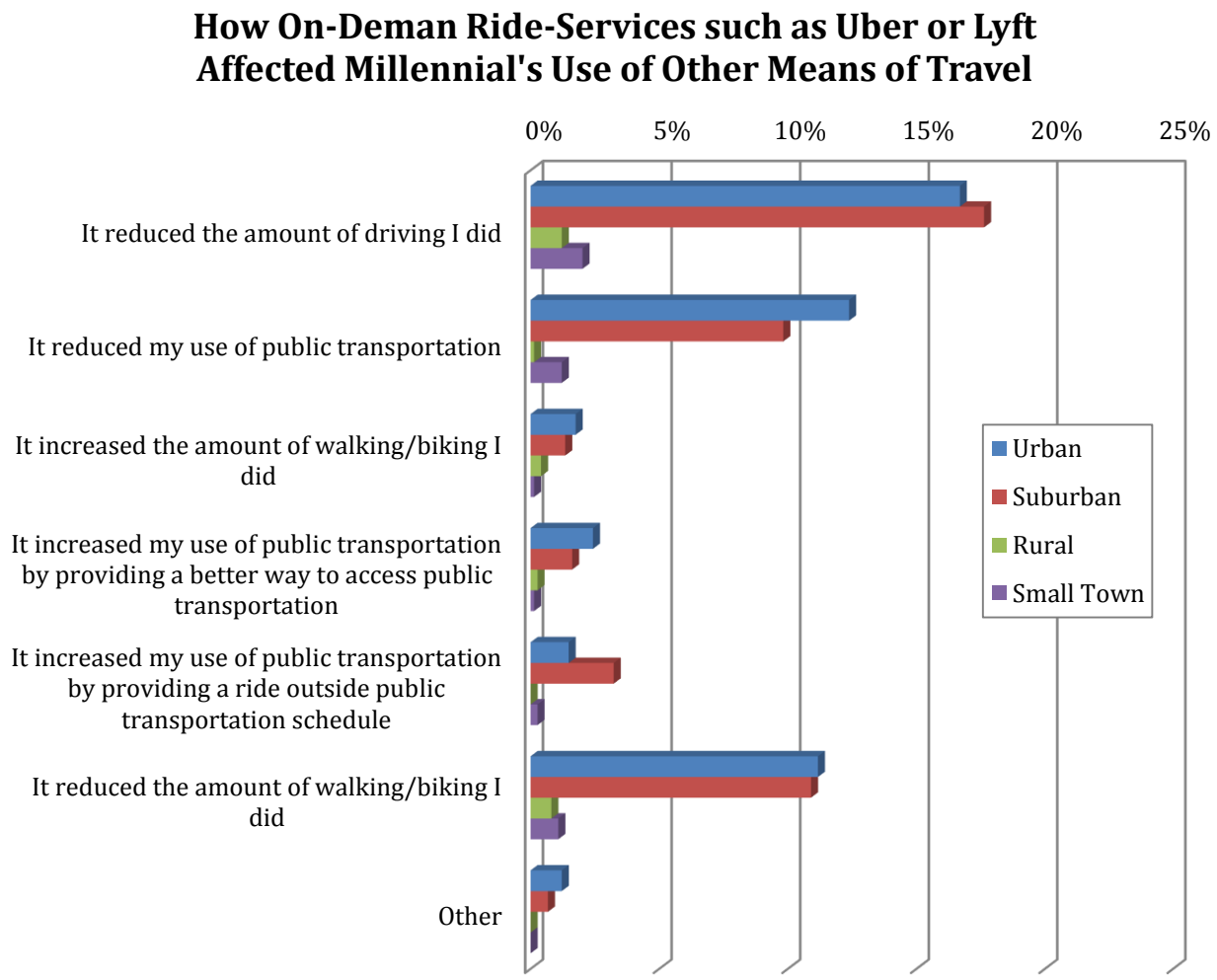


Figure 63. Impact of the last trip made with on-demand ride-services such as Uber or Lyft on millennials' use of other modes

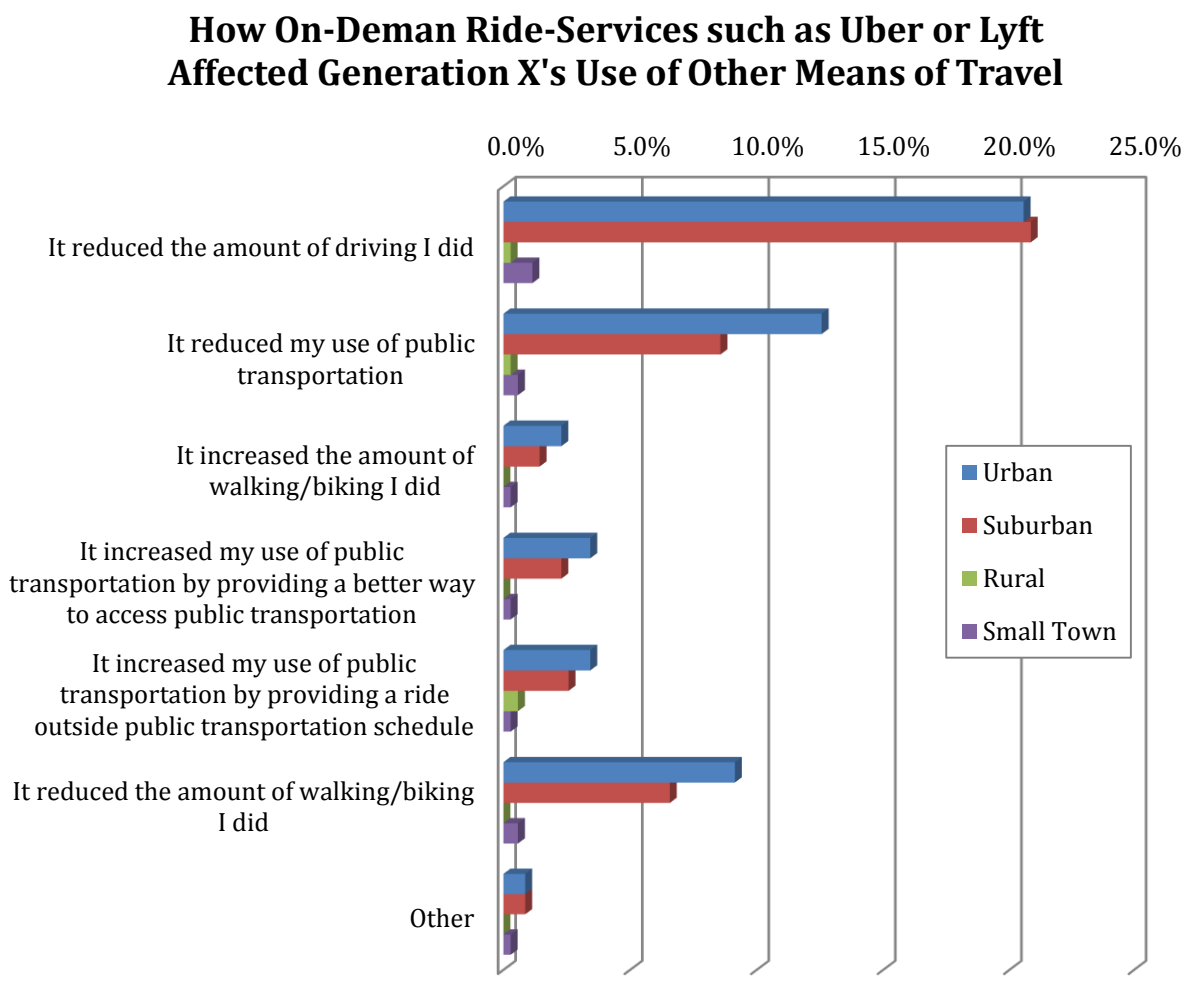


Figure 64. Impact of the last trip made with on-demand ride-services such as Uber or Lyft on millennials' user of other modes

In the study, we also collected information about several additional groups of variables, which have not been reported in this section. The California Millennials Dataset contains detailed information on respondents' personal attitudes and preferences, lifestyles, adoption of online social media and information and communication technology (ICT), residential location, living arrangements, commuting and other travel-related patterns, auto ownership, awareness, adoption and frequency of use of the most common shared mobility services (including car-sharing, bike-sharing, dynamic ridesharing and on-demand ride services such as Uber or Lyft), propensity to purchase and use a private vehicles vs. use other means of travel, major life events from the past three years, environmental concerns, political ideas and sociodemographic traits. The analysis of this large amount of information, and of the relationships existing these groups of variables, will be developed in stages during the next phase of the research.

Conclusions and Next Steps of the Research

Millennials are often described as the new, dynamic generation, whose tastes, lifestyles, consumer and travel behavior differ from those of previous generations at the same stage in life. They often are early adopters of new trends (in culture, as well as lifestyles) that later are adopted by other segments of society. Understanding the dynamics behind millennials' travel behavior and mobility-related decisions is of outmost importance for scientific research as well as for planning processes. Millennials include the future influential leaders of the society and are often in a very important "transitional" stage of their life, in which they are building the basis for their future life, family and work career. They will contribute to create new households and influence future travel patterns in many ways. They are expected to have a growing purchasing power in future years, and might be potential buyers of private vehicles and/or early adopter of new services (e.g. the continuously evolving shared mobility services), and will continue to affect travel demand with their tastes, purchase and everyday travel choices.

Several studies have attempted to investigate millennials' travel behavior, and analyze the impact of several factors on their choices. However, to date, findings from scientific research in this field have been limited, mainly because of limitations in the available data. For example, studies based on the use of NHTS or other statewide of regional survey data are usually limited by the lack of information on specific variables, such as personal attitudes and preferences, or the adoption of new technologies and emerging mobility services, that have been suggested as important factors affecting the mobility of the members of this segment of the population. The results from other studies that are based on the use of non-random samples, such as convenience samples drawn from university students, are of difficult generalization to the entire population of interest.

Additional questions are associated with the differences existing between different groups among the population of millennials. The tech-savvy urbanites are the group of millennials that attracts most of the attention in many market research studies, as well as in the media and in the popular culture, and certainly a common presence in the central neighborhoods of most US cities. At the same time, vast mass of young adults in California as well as in other states certainly have more traditional lifestyles, which are believed to be more similar to those from the previous generational groups. Further, even among the urban group of millennials that is particularly popular in the media, it is not clear yet if any reductions in car travel that might be achieved through modified lifestyles and increased adoption of non-motorized modes are in somehow compensated by an increased number of other trips. These may also include long-distance trips for either work-related or leisure purposes that are increasingly allowed by the growth in air travel, the increased availability of low-cost flights and discounted intercity bus services, and the increased opportunities to travel associated with many innovations that have been introduced in recent years. The easier communications and seamless transactions enabled by modern technological solutions, e.g. last-minute discounted offers for air ticket and hotel fares, online reservations from AirBnb, cheap access to cars through peer-to-peer carsharing

services such as RelayRides, are certainly contributing to reshaping the overall landscape of transportation, but their impact on individuals' travel behavior is still largely unclear.

This study provides an important step in improving the understanding of millennials' mobility-related decisions, and of the factors that affect them, through an unprecedented systematic data collection effort aimed at collecting information on a number of important variables that have been attributed an important role in affecting millennials' behaviors. The California Millennials Dataset, presented in this report, contains information on the respondents' personal attitudes and preferences, lifestyles, adoption of online social media and information and communication technology (ICT), residential location, living arrangements, commuting and other travel-related patterns. It also includes auto ownership, awareness, adoption and frequency of use of the most common shared mobility services (including car-sharing, bike-sharing, dynamic ridesharing and on-demand ride services such as Uber or Lyft), propensity to purchase and use a private vehicles vs. use other means of travel, major life events that have happened in the past three years and that might have influenced the current lifestyles, residential location and travel behavior, environmental concerns, political ideas and sociodemographic traits.

A total of 2530 participants have, to date, completed the online survey that was designed as part of this project. In this report, we present descriptive statistics based on the analysis of the 2391 valid cases contained in the dataset, including both millennials and members of the previous generation X. after we filtered out 370 cases that were contained information that was found to be inconsistent, frivolous, severely incomplete or otherwise problematic. Through the analysis of the data in the dataset, we find that millennials, on average, drive fewer miles by car than the members of the older generation X. This difference in the amount of car travel is confirmed also when accounting for the different neighborhood types in which respondents live: in both suburban and urban settings, millennials are found to travel less, on average, than their older peers. In the future stages of the research, we will investigate the various factors affecting these trends, and the amount to which they explain the differences in behavior of millennials vs. the members of Gen X. We will also develop a set of weights that will be applied to the dataset in order to correct for any deviation in the distribution of respondents from the population of interest, and to make the dataset fully representative of the population of California, correcting for the effects of quota sampling (with the oversampling of individuals that live in some regions of California, e.g. rural areas and less-populated regions).

On average, millennials are found to be more technologically oriented than their older peers: as shown in the analysis presented in this report, millennials seem to have adjusted more easily to the modern technological solutions and to the use of smartphones in particular. They tend to use the internet and/or smartphone apps more often to identify possible destinations (e.g. restaurant, café, etc.), learn how to get to new places, and decide which means of transportation, or combinations of multiple means, to use for a trip. They also report to use their devices more often while they travel: they more likely engage in travel multitasking activities during their commute. Millennials show a stronger commitment to protect the environment, and seem to be less opposed than the members of Generation X to policies that

increase gas taxes in order to provide better funding for public transportation and reduce the environmental externalities of transportation. Finally, the analysis of the data contained in the dataset confirms a higher adoption of emerging transportation services among millennials, than among the members of the previous Generation X. The impact of the adoption of these shared mobility services on the use of other means of travel is not straightforward, and it seems to vary by region. If in most cases, and in particular among the members of the Generation X, the use of on-demand ride services such as Uber or Lyft mainly replaces the use of private cars, in many regions of California millennials report to have reduced their use of public transportation or the amount of walking or biking as the result of the use of Uber/Lyft.

During the next stages of the research will plan to capitalize on this large research effort. During fall 2015, we plan to continue expanding the dataset through the recruitment of additional cases that will allow us to bring the total number of valid cases in the dataset to at least 2400 respondents, including 1400 millennials and 1000 members of the generation X. We also plan to develop an in-depth investigation of the data contained in the dataset and to integrate additional information available from other sources, including built environment and land use data for the neighborhoods where millennials live, and estimate multivariate statistical models of millennials' travel demand, current car ownership and propensity to purchase a vehicle.

This study has allowed establishing a very ambitious research program for the investigation of the mobility of millennials in California. In this report, it was evidently not possible to present exhaustive data analyses for the entire California Millennials Dataset that was established as part of the study. Accordingly, the investigation of many of the research questions related to millennials' mobility will be developed in the following stages of the research. The full analysis of the data contained in this dataset will provide important insights into (1) the key motivations affecting young adults' mobility-related decisions; (2) the extent to which local conditions, including urban form, characteristics of the transportation supply, and the knowledge about the local transportation system, affect these decisions; (3) the impact of personal attitudes and preferences, including environmental concerns and motivations, on younger generations' travel behavior and their use of cars; (4) the role of cultural background (e.g. perception of car driving, role of young people and women in society, etc.) in affecting these processes; (5) the role of peers' influence and social interactions (also through the availability of new technologies, e.g. online social networks) in affecting travel-related decisions and private vehicle ownership; (6) the aspirations of young people regarding future travel patterns and the purchase of private vehicles; and (7) the potential responsiveness of young people to policies designed to increase environmental sustainability in transportation, e.g. through price incentives, local or online advertisement, policies to support the adoption of more efficient or alternative fuel vehicles (AFVs), or the use of public transportation.

Many of these analyses will be developed in the following stages of this research, and in particular during a "Year II" research grant that was funded by Caltrans through the National Center for Sustainable Transportation, starting in October 2015. The research questions that we will explore through the analysis of the data collected in this study include:

1. *What are the relationships among travel behavior, personal preferences, adoption of technology and residential location of millennials?*
   In order to answer this research question, we plan to estimate frequency models for the use of various means of travel, segmented respectively for millennials and members of Gen X, and investigating important factors including the impact of:
   a. millennials' level of education, income and geographic location;
   b. living arrangements vs. personal preferences on mobility related decisions (e.g. mode choice) and travel behavior;
   c. the major factors affecting the adoption of modes alternative to cars;
   d. the adoption of *on-demand* ride services (Uber/Lyft) and other technology-enabled transportation services (and their impact on the use of other modes).

2. *Are the dominant trends of millennials' travel permanent or temporary (e.g. effect of a transition in life stages)?*
   This type of research question cannot be fully answered through the analysis of NHTS or other currently available travel survey data. Using the data collected in this study, we can estimate a VMT model that controls for sociodemographics, personal attitudes, lifestyles, and geographic location, and allows to investigate the impact of:
   a. the stage of life (e.g. being married, presence of children) on the travel behavior of millennials;
   b. personal attitudes and preferences;
   c. the place where individuals grew up;
   d. major life events (new job, relocation to city, moving out of parents' place, moving in with partner, etc.)

3. *How many millennials match the stereotype of urbanite/socialite common in the media?*
   We plan to develop a cluster analysis to analyze different profiles of people (e.g. socialite/urbanite vs. others), investigating the proportion of the millennials (vs. members of Gen X) that fit in the stereotype common in the media:
   a. live in urban areas;
   b. have dynamic lifestyles;
   c. are heavy users of social media;
   d. own zero (or few) cars;
   e. use public transportation
   f. adopt new technologies

   How many millennials vs. members of older generation fit in this profile, and what are the differences with the behavioral patterns observed in *other* segments of the millennial population (e.g. "suburban" millennials)?

Additional research questions that we will be able to investigate through the analysis of this dataset includes exploring issues associated with the self-selection of individuals that want to live in a specific type of neighborhood type. For instance, millennials' travel behavior seems to be greatly affected by residential location, with millennials that live in denser urban areas traveling less by car and using public transportation more often. But is this a direct impact of

urban form on travel behavior, or rather the result of the residential self-selection of young adults, and of the adoption of lifestyles and forms of mobility that match their preferred mobility choices and activity patterns? Will providing more housing units and improved public transportation services in these areas attract other young adults to relocate and adopt more sustainable transportation patterns? What is the role of economic factors (available income, costs of living, gas prices, other transportation costs) and emerging technologies (e.g. the availability of ride-sharing services such as Uber) on these decisions? The models developed in this study will investigate the impact of these and other variables on travel behavior, while controlling for the effect of a number of additional variables (e.g. impact of new transportation options, influence of peers, use of social networks, etc.) not available to other studies.

Future extensions of this multiple-year research program will also expand the study to other states in the United States, and internationally, through the comparison of the information collected in this dataset with the data collected for other regions.

References

American Public Transit Association. 2014. *Public Transportation Ridership Report*.

Axhausen, K.W., Schmid, B., Weis, C., 2015. Predicting response rates updated, Arbeitsberichte Raum- und Verkehrsplanung. IVT, ETH Zurich, Zurich.

Belgiawan, Prawira Fajarindra, Jan-Dirk Schmöcker, Maya Abou-Zeid, Joan Walker, Tzu-Chang Lee, Dick F Ettema, and Satoshi Fujii. 2014. "Car Ownership Motivations among Undergraduate Students in China, Indonesia, Japan, Lebanon, Netherlands, Taiwan, and USA." *Transportation* 41 (6). Springer: 1227–44.

Blumenberg, Evelyn, Brian D Taylor, Michael Smart, Kelcie Ralph, Madeline Wander, and Stephen Brumbagh. 2012. "What's Youth Got to Do with It? Exploring the Travel Behavior of Teens and Young Adults."

Buck, D., Buehler, R., Happ, P., Rawls, B., Chung, P., Borecki, N., 2013. Are Bikeshare Users Different from Regular Cyclists? A First Look at Short-Term Users, 4 Annual Members, and Area Cyclists in the Washington, DC Region. Transportation Research Record: Journal of the Transportation Research Board 2387, 112-119.

Caltrans, 2015. California Transportation Plan 2040: Integrating California's Transportation Future.

Cao, Xinyu, Patricia L Mokhtarian, and Susan L Handy. 2009. "Examining the Impacts of Residential Self-selection on Travel Behaviour: A Focus on Empirical Findings." *Transport Reviews* 29 (3). Taylor & Francis: 359–95.

Cervero, R., Tsai, Y., 2004. City CarShare in San Francisco, California: Second-Year Travel Demand and Car Ownership Impacts. Transportation Research Record: Journal of the Transportation Research Board 1887,117-127.

FHWA, 2011. Next Generation of Travelers Literature Scan: Technology and Transportation Behavior.

Frändberg, Lotta, and Bertil Vilhelmson. 2011. "More or Less Travel: Personal Mobility Trends in the Swedish Population Focusing Gender and Cohort." *Journal of Transport Geography* 19 (6): 1235–44. doi:http://dx.doi.org/10.1016/j.jtrangeo.2011.06.004.

Garikapati, Venu M., Ram M. Pendyala, Eric A. Morris, Patricia L. Mokhtarian, and Noreen C. McDonald. 2016. "Activity Patterns, Time Use, and Travel of the Millennial Generation: What is All the Hype About? " In *Transportation Research Board 95th Annual Meeting*, no. 16-6024.

Goodwin, Phil. 2012. “Peak Travel, Peak Car and the Future of Mobility.” OECD Publishing.

Haustein, Sonja, Christian A Klöckner, and Anke Blöbaum. 2009. “Car Use of Young Adults: The Role of Travel Socialization.” *Transportation Research Part F: Traffic Psychology and Behaviour* 12 (2): 168–78. doi:http://dx.doi.org/10.1016/j.trf.2008.10.003.

Hallock, L., Inglis, J., group, F., 2015. The Innovative Transportation Index: The cities Where New Technologies and Tools Can Reduce Your Need to Own a Car. Frontier Group.

Kalaee, Meead, Mohammad Rezaeian, Mohammad Ahadi, and Gholam Shafabakhsh. 2009. *Evaluating the Factors Affecting Student Travel Mode Choice*.

Kamargianni, M, and A Polydoropoulou. 2014. “Generation’s Y Travel Behavior and Perceptions Towards Walkability Constraints.” In *93rd Annual Meeting of the Transportation Research Board*. Washington, D.C.

Kerr, Alistair, Alexia Lennon, and Barry Watson. 2010. “The Call of the Road: Factors Predicting Students’ Car Travelling Intentions and Behaviour.” *Transportation* 37 (1). Springer US: 1–13. doi:10.1007/s11116-009-9217-9.

Klöckner, Christian A, and Thomas Friedrichsmeier. 2011. “A Multi-Level Approach to Travel Mode Choice – How Person Characteristics and Situation Specific Aspects Determine Car Use in a Student Sample.” *Transportation Research Part F: Traffic Psychology and Behaviour* 14 (4): 261–77. doi:http://dx.doi.org/10.1016/j.trf.2011.01.006.

Kuhnimhof, Tobias, Jimmy Armoogum, Ralph Buehler, Joyce Dargay, Jon Martin Denstadli, and Toshiyuki Yamamoto. 2012. “Men Shape a Downward Trend in Car Use among Young Adults—Evidence from Six Industrialized Countries.” *Transport Reviews* 32 (6). Routledge: 761–79. doi:10.1080/01441647.2012.736426.

Kuhnimhof, Tobias, Dirk Zumkeller, and Bastian Chlond. 2013. “Who Made Peak Car, and How? A Breakdown of Trends over Four Decades in Four Countries.” *Transport Reviews* 33 (3). Taylor & Francis: 325–42.

Limanond, Thirayoot, Tanissara Butsingkorn, and Chutima Chermkhunthod. 2011. “Travel Behavior of University Students Who Live on Campus: A Case Study of a Rural University in Asia.” *Transport Policy* 18 (1): 163–71. doi:http://dx.doi.org/10.1016/j.tranpol.2010.07.006.

Martin, E., Shaheen, S., 2011. The Impact of Carsharing on Public Transit and Non-Motorized Travel: An Exploration of North American Carsharing Survey Data. Energies 4, 2094-2114.

McDonald, Noreen C. 2015. “Are Millennials Really the ‘Go-Nowhere’ Generation?” *Journal of the American Planning Association*. Routledge, 1–14. doi:10.1080/01944363.2015.1057196.

McKenzie, Brian. 2014. “Modes Less Traveled—bicycling and Walking to Work in the United States: 2008–2012.” *US Census Bureau, New York*.

Metz, David. 2012. “Demographic Determinants of Daily Travel Demand.” *Transport Policy* 21. Elsevier: 20–25.

———. 2013. “Peak Car and beyond: The Fourth Era of Travel.” *Transport Reviews* 33 (3). Taylor & Francis: 255–70.

Mustard, Ruth. 2010. *The University of Edinburgh Travel Survey 2010*. Edinburgh, Scotland: The University of Edinburgh.

Newman, Peter, and Jeff Kenworthy. 2011. “‘Peak Car Use’: Understanding the Demise of Automobile Dependence.” *World Transport Policy and Practice* 17: 13.

Polzin, Steven E, Xuehao Chu, and Jodi Godfrey. 2014. “The Impact of Millennials’ Travel Behavior on Future Personal Vehicle Travel.” *Energy Strategy Reviews* 5: 59–65. doi:http://dx.doi.org/10.1016/j.esr.2014.10.003.

Puentes, Robert. 2013. “Have Americans Hit Peak Travel?” *ITF Round Tables Long-Run Trends in Car Use* 152. OECD Publishing: 91.

Puhe, Maike, and Jens Schippl. 2014. “User Perceptions and Attitudes on Sustainable Urban Transport among Young Adults: Findings from Copenhagen, Budapest and Karlsruhe.” *Journal of Environmental Policy & Planning* 16 (3). Routledge: 337–57. doi:10.1080/1523908X.2014.886503.

Raimond, Tim, and Frank Milthorpe. 2010. “Why Are Young People Driving Less? Trends in Licence-Holding and Travel Behaviour.” In *Australasian Transport Research Forum 2010*. Canberra, Australia.

Rainie, L., 2012. Smartphone Ownership Update. Pew Research Center.

Rayle, L., Shaheen, S., Chan, N., Dai, D., Cervero, R., 2014. App-Based, On-Demand Ride Services: Comparing Taxi and Ridesourcing Trips and User Characteristics in San Francisco. Working Paper.

Shaheen, S., Chan, N., Bansal, A., Cohen, A., 2015. Shared Mobility a Sustainablity and Technology Workshop: Definition, Industry Development and Early Understanding. University of California Berkeley.

Shaheen, S., Martin, E., Chan, N., Cohen, A., Pogodziniski, M., 2014. Public Bikesharing in Nort America During a Period of Rapid Expansion:Understanding Business Models, Industry Trends and User Impacts. Mineta Transportation Institute.

Shaheen, S., Martin, E., Cohen, A., Finson, R., 2012. PUBLIC BIKESHARING IN NORTH AMERICA: EARLY OPERATOR AND USER UNDERSTANDING. Mineta Transportation Institute.

Shannon, Tya, Billie Giles-Corti, Terri Pikora, Max Bulsara, Trevor Shilton, and Fiona Bull. 2006. "Active Commuting in a University Setting: Assessing Commuting Habits and Potential for Modal Change." *Transport Policy* 13 (3): 240–53. doi:http://dx.doi.org/10.1016/j.tranpol.2005.11.002.

Simons, Dorien, Peter Clarys, Ilse De Bourdeaudhuij, Bas de Geus, Corneel Vandelanotte, and Benedicte Deforche. 2014. "Why Do Young Adults Choose Different Transport Modes? A Focus Group Study." *Transport Policy* 36 (0): 151–59. doi:http://dx.doi.org/10.1016/j.tranpol.2014.08.009.

Sivak, Michael. 2013. "Has Motorization in the US Peaked? Part 2: Use of Light-Duty Vehicles." University of Michigan, Ann Arbor, Transportation Research Institute.

———. 2014a. "Has Motorization in the US Peaked? Part 5: Update through 2012." University of Michigan, Ann Arbor, Transportation Research Institute.

———. 2014b. "Has Motorization in the US Peaked? Part 4: Households without a Light-Duty Vehicle." *Transport Research Institute, University of Michigan, Ann Arbor*.

Wachs, Martin. 2013. "Turning Cities inside out: Transportation and the Resurgence of Downtowns in North America." *Transportation* 40 (6). Springer US: 1159–72. doi:10.1007/s11116-013-9501-6.

Zhou, Jiangping. 2012. "Sustainable Commute in a Car-Dominant City: Factors Affecting Alternative Mode Choices among University Students." *Transportation Research Part A: Policy and Practice* 46 (7): 1013–29. doi:http://dx.doi.org/10.1016/j.tra.2012.04.001.

Zhu, Charles, Yiliang Zhu, Rongzhu Lu, Ren He, and Zhaolin Xia. 2012. "Perceptions and Aspirations for Car Ownership among Chinese Students Attending Two Universities in the Yangtze Delta, China." *Journal of Transport Geography* 24 (September): 315–23. doi:http://dx.doi.org/10.1016/j.jtrangeo.2012.03.011.

Zipcar, 2013. Millennials & Technology: A Survey Commissioned by Zipcar (Powerpoint), Zipcar's millennial study.

Zmud, Johanna, Liisa Ecola, Peter Phleps, and Irene Feige. 2013. *The Future of Mobility*. RAND Corporation.

List of Acronyms Used in the Document

ACOP	American Consumer Opinion panel
Caltrans	California Department of Transportation
CEC	California Energy Commission
EPA	(United States) Environmental Protection Agency
FHWA	Federal Highway Administration
Gen X	Generation X (Middle-aged adults, 35-50 y.o.)
Gen Y	Generation Y (Young adults, 18-34 y.o.)
GHG	Greenhouse Gas
HH	Household
IATBR	International Association for Travel Behavior Research
ICT	Information and Communication Technology
IPF	Iterative Proportional Fitting
IT	Information Technology
IRB	Institutional Review Board
ITS	Institute of Transportation Studies
LDT	Light Duty Trucks
LTE	Long Term Evolution (a 4G mobile communications standard)
LU	Land Use
MPO	Metropolitan Planning Organizations
MTC	Metropolitan Planning Organization (San Francisco Bay Area)
NCST	National Center for Sustainable Transportation
NHTS	National Household Travel Survey
SACOG	Sacramento Area Council of Governments
SANDAG	San Diego Association of Governments
SCAG	Southern California Council of Governments
STEPS	Sustainable Transportation Energy Pathways
SUV	Sport Utility Vehicle
TDM	Transportation Demand Management
TNC	Transportation Network Company
TRB	Transportation Research Board
UC	University of California
UC Davis	University of California, Davis
UCLA	University of California, Los Angeles
US DOT	United States Department of Transportation
UWA	University of Western Australia
VMT	Vehicle Miles Traveled

Appendix A

Many respondents left comments of appreciation on the content of the survey, and often provided thoughtful comments of potential interest for transportation planning purposes.

As a thank you note for the respondents that invested their time to share their ideas with us, we are reporting below the respondents' comments that have more direct relevance for transportation planning purposes. Please note that the language in some comments is quite colloquial, but was left in the original form it was received, apart from correcting for a few typos. The opinions reported in the comments are those of the survey respondents, and they do not represent the views of the authors of the report (nor do the authors endorse the content of the reported comments).

A lot of my current choices of transportation are affected by the fact that 1 - I have a newborn, and 2 - biking is not really safe where I live. When I've lived in bike safe communities, I bike a lot. There wasn't much of a way to express these things in the survey
As much as I have tried or want to use public transportation, there are so many weird people and scary situations that it has discouraged me from using the buses or trolley in my city. The amount of disparity in the streets and general public is reaching new levels. I only use public transportation when it would be better suited than driving my car, but that is rare because I still fear all of the hatred and racist discrimination I deal with each time I ride public transportation. I pay so much more in gas, insurance, DMV fees etc. than if I just purchased a bus pass, but to feel safe and not have to deal with all the crazies makes owning a car worth it.
California does not need more public transit...most people don't use it. Widen the freeways.
Car2go is useful but a little costly and not good for all day trips or many miles due to short battery life
Climate change and global warming is real.
Emissions of large vehicles are extremely important to reduce in an effort to lessen the climate changes.
Environmentalism is ridiculous. I take my used oil to the drop off, and recycle my batteries and metals. Going beyond that is stupid crap to make yourself feel good. See Portlandia.
governments should deal with large scale polluters and abusers of natural resources (big business) and stop trying to make ordinary people limit their life activities. people often cannot change the need to commute or carry things to and fro but big business can limit or cease its carbon footprint and pollution levels and should be obligated to do so.
Having a physical handicap (SCI), a personal car and the independence it provides is paramount.
Having a young child is difficult when using public transportation but I did use Bart to and from work when I worked a few years back but working in Oakland I did feel unsafe so I decided to drive to work instead.
I am encouraged by the different amounts of transportation available. There is work to be done in the transportation sector to make it more efficient.

I am keeping my car. Stop raising gas taxes.
I am registered to vote but DO NOT. i have many plans for my future as a business owner. I hope to be married to the person Im living with. I am half white and half hispanic. i hope to own my own vehicle no matter the type or fuel consumption. as long as I have a roof over my head and its habitable Im ok.
I consider transportation to be really important to being successful in life and I hope public transportation and private become even more available and convenient for all people
I did realize I am way far from being as environmentally conscious as I thought. I will for sure use that for my and the world's benefit.
I do feel that raising prices for fossil fuel to lower usage would be beneficial, however it would be a sacrifice for myself of course. I want to go electric though they are far to expensive.
I don't like your faux/fake progressive policies. Please be legitimately progressive. It's racist to pretend to be progressive
I enjoy walking. Due to medical conditions I can't take public transportation. I try and rideshare with friends and family. Thanks for the opportunity in allowing my feedback on this issue.
I enjoyed the survey because it was unbiased, you wanted my opinions and info. Usually if I don't support a certain brand they say I don't qualify for the survey. You can't learn anything that way, like why I don't support that brand or drive a car.
I enjoyed this survey and that people are interested in studying more about transportation in Northern California. I hope that this helps to improve public transportation in the area.
I enjoyed this survey because I didn't realize that transportation was as important that people make it seem. It's important to have a source of transportation
I feel the current trend of cities eliminating car lanes for bike lanes is ridiculous. In the city of Los Angeles, they are courting the minorities (bicyclists) and ignoring the needs of the general population. Yes, traffic is getting worse and the environment is too but there are other avenues to explore. Don't punish those of us who can't drive a carpool with a bicycle.
I guess my ideal future for transportation would be alternative fuels. Finding a means of having the flexibility of a personal automobile without the negative political, economic, and environmental repercussions of fossil fuel.
I have lived throughout California throughout my life. I have used public transportation approximately 10 times ever...usually when traveling to big cities for work or leisure. I have never lived in an area with a population larger than 30k people, so public transportation has never been a consideration. Because of that, I am uncomfortable using public transportation (taxi, city bus, etc.) because of my lack of knowledge.
I just want to say what a pleasant experience it was to share my thoughts on such a crucial topic. Not just topic but on the reality considering how much our own personal everyday choices have on the way we live. The air we breathe, the quality of life all goes from basically action and reaction. I see what poor air quality, and pollution does to the way I and my family lives. Sometimes when I walk outside in the middle of the day, I have caught myself literally holding my breath until I'm in my vehicle because the bad air just kind of hits me like a ton of bricks almost when I inhale.

I like San Diego's public trolley system, it is just that it does not reach to our area. I would love to see that expanded but NOT a the cost of maintaining our roads. I am a bit tired of the one or the other approach to this. We need to invest in both forms of transportation and get the politics and militant environmentalist out of it!!
I like traveling the Metrolink when I need it (have used it to get between Riverside and OC and LA a few times), its safe and clean, just a little bit expensive. I am scared to death of riding a bus, it's pretty shady around here, plus it takes forever with all those stops. I would like my next car to be a hybrid because of fuel costs and effect on the environment. I'd probably walk more if where I lived wasn't so far from places i wanted to go.
I live in Los Angeles and am angry that the city is eliminating car lanes for bike lanes. The dirty secret is that there aren't enough cyclists to make that trade off worthwhile. Nor will there ever be. Why is this so in vogue with city planners today? American cities were designed for cars, like it or not. We don't have the density of other parts of the world nor do we want it.
I live too close to work to use public transportation
I lived in Sydney for 3 years. They have a fantastic public transit system. We didn't own a car, at all, and rode the train almost every day. / / Los Angeles has no system the even remotely compares. Everything is spread far apart. (and Uber/Lyft is too expensive for every day travel, not to mention the toddler/car seat issue.) The convenience of not having to lug my child around or wait at train/bus stops is very appealing. My primary car is tiny, and I drive less than 5 miles a day, so I don't feel guilty about it. / My husbands car is a hybrid, so that makes me feel better about that as well.
I love to drive my BMW
I moved to California to be closer to my Partners family and we ended up in a rural area with large commutes to save money on housing. we will be moving after our year lease is up to town with public transportation and where I can ride my bike to work again as I did for most of my life. if there was a system I could take any time of day or night to the larger towns with my bike I would but as of now the bus system her is to limited in hours of operation to use in any job other then maybe customer service.
I really enjoyed this survey! Thank you for caring about the environment! :)
I think an important part of the transportation issue and it's resultant environmental impact is overpopulation. While I commend looking for solutions in this area, I believe that any progress we make is a band-aid unless we curb the birthrate and stop overpopulating the planet. I also believe that to reduce traffic congestion and resultant environmental issues, more companies need to either allow telecommuting or stagger shifts past the "traditional" work hours, allowing people to stagger shifts throughout the day. This would greatly assist with the congestion issues, and (with telecommuting) at least some of the environmental issues. / Thanks for letting me participate in this survey. It was quite interesting.
I think it is great that you are assessing people's opinions on transportation. I am curious to see how your research turns out.
I very much enjoyed taking this survey. The questions seemed interesting and allowed me a chance to consider some of the things going on in my life.

I very much want a lifestyle where I don't need a car! Especially as I get older. I'm considering a bike friendly city that is likely to do well with impending environmental effects of climate change. Look for me in Portland in a few years!
I would absolutely take public transit more if it weren't more expensive than traveling by car (actual upfront prices - not including the value of my time)
I would be willing to use as many transportation options as are possible without the need to carry a smartphone. I don't need or want a tracking device in my pocket everywhere I go. End of story.
I would like to use more public transportation, but I live in a small town that does not offer a reliable alternative. / / Health issues prevent me from biking to work, unfortunately.
I would love to be more environmentally friendly, but having children and not a lot of money doesn't give me the option. Plus, the ability to take my kids (or myself, as i am currently pregnant) to the doctor or hospital in an emergency is essential.
I would love to take BART or some other form of public transportation to/from work on a daily or weekly basis, however it does not go from Davis to the Bay Area. I think BART needs to expand much farther to access and service more customers and reduce driving. There are also inconsistent HOV lanes (stops on 680 N around Walnut Creek) which add to congestion.
I would rather use public transport but not available in southern California
If gas prices go up, being able to afford just to get back and forth to work day after day each week all month long can be harsh. The thing is, in most areas not everyone has a train or subway or even buses. Where does that leave someone who has to drive 20 minutes to and from work. They lose their job. I am all about saving our environment! Its more so our home then then roof over our heads. But gas prices going up in thoughts people would use transit more makes no sense.
If the bus system wasn't so confusing, I'd probably take advantage of it. I guess I'm not that bright because I need everything spelled out. "Which bus goes where? What number? What time of day? How long? Do I need exact change? HOW DO I GET OFF THIS BUS?!"
If you want people to use public transit more, you must make it more available. My husband has a 20min commute everyday. If he was to take the bus it would be 3 HOURS!!. 2 of the connector buses only come once an hour. and when the bus does arrive it is full. If you want him to take the bus the busses should run every 10-15 min. Instead of putting money into a high speed train that no one will use, they should put that money into fuel efficient buses and hiring more bus drivers.
In rural areas if there where more ways to travel would be great as to a train/trolley to near by towns..
Interesting survey I quite enjoyed it.. I hope our society will become better with issues like pollution and drive safety
it was an interesting survey to take that allowed for a lot of self-reflection and introspection
it was great time to survey / I learned about myself more
It was simple and easy to do but I thought you were going to ask about future changes in transportation since they are about to open the metro near where I live and I know that I will definitely using it in the future.

It would be great if environmentally friendly ways of traveling can be increased while still incorporating a reasonably priced way of traveling for those who which to reduce the impact that traveling generally has on our planet.
It would've been nice to have more detailed options, especially when it came to the questions about raising gas prices. I don't think that raising gas prices solves any problems. It only makes things worse an causes more problems for families already struggling to pay for gas to get to their jobs. I'm not for raising prices of gas to better the air quality. I think lowering the cost of fuel efficient or electronic vehicles is a better solution. Making these vehicles affordable for everyone is a great way to start fixing our environment.
Living so close to Davis I understand the reasoning to less driving alone and using public transportation and walking more due to the quality of the air in yolo county and surrounding areas.
Mass transportation can be effective in urban environments. Japan would reflect this type of asphalt jungle but it isn't realistic for suburban cities in the US. Its only going to work in cities over half a million people or more.
My transportation decisions are primarily made around my daughter. I commute to drop her off at school then work and back home to pick her up. Although, I would love to carpool or take public transportation her schedule makes it difficult for me (school, sports, etc.). I believe that is the biggest factor in why I use a vehicle.
on some areas you should allow for disabled circumstances for transportation questions a little more and other activity questions towards exercise create more varied questions like I have psoriatic arthritis which is disabling I would like to be much more active but the disease limits me even though I am on stelara and methotrexate and a narcotic painkiller all day long
Public transportation isn't readily available in my area. Also, in order to walk to the nearest grocery store, it is over 4 miles away, and up very steep hills. Our area isn't hospitable to those without their own vehicle.
Public transportation would be easier if it were more widely available and there were accommodations for disabled children
Raising gas prices is NOT the way to improve congestion. It hurts working families trying to make a living in this very expensive state.
Seems like concern for the environment is an issue still being thought of and I appreciate that
Taking this survey make me think of a lot of things in our daily life that we normally don't think about.
Thank you for reminding me I am not being as sustainable as I would like to be.
That was weird. Are you implying that Generation Y does not travel as much as generations past? Also why is some liberal bullshit like rising gas will solve anything? I work in the field of clean emissions. The ride share stuff always seems like a rip off, for yuppies, who like to get ripped off then complain about it later to their gay friends. bike shares sound legit, if they had themat the local community college, I would most likely go get one every once in a while.
The bus system where I currently live is moderate but could definitely do better. They don't travel as far as I need to go for recreational purposes. The bus system where I grew up is almost non existent.The town is so small that there is not a DMV and the bus they do have

did not occur until after I moved. I appreciate having buses because I don't own a car but I think that they need to be re-evaluated.
The government interferes enough. We do not need laws that control /penalize for driving. I used to be much more liberal in my political aspect of life but I've had enough of this presidency and the way liberals want to continually give hand outs.
The lack of public transit in LA is shameful. I would much prefer a safe/fast public transit system to the congestion of LA traffic. Until I live and work in areas that have access to a train/metro, I will drive my hybrid.
There was a lot of questions referring to air quality that cars produce, I think the solution for that is not necessarily having people drive les by increasing gas prices but by companies pushing the use of electric, hydrogen, or other elemental based vehicles.
THIS SURVERY INSPIRED ME TO TRY TO RIDE MY BIKE AND WALK MORE OFTEN
This survey was educational to me and I really enjoyed completing it.
This survey was even useful to me as analyzing my means of transport myself and what I should do in future
This survey was relevant to me, but in a very limited way. I am permanently disabled, and not able to use a bike or car. I use public transportation In and out of the city where I live. When transit is not available, I drive my power wheelchair on the streets about 500 miles per year. This makes the case that transit can be as diversified as the user.
this survey was way too long and not worth the time invested, a waste of time for the compensation received. My time is important and worth a lot more, the time amount was way underrated, I feel lied to, taken advantage of, used, and mislead. I am not here on this earth to humor you and for you to make money off my time and on my dime.
This was a fun survey, and I hope that whatever study this survey is being administrated for is successful in its assumed use to further the public good.
this was a great survey made me think about a lot of things
This was a nice survey on my use of transportation. Car is still definitely my favorite, although I might consider buying a bike for closer destinations.
This was a very interesting survey. Transportation and its effect on the environment is a critical issue.
This was an interesting survey to complete, and it made me ask myself some interesting questions about the way I get around.
This was an interesting survey. It got me thinking about long term goals, which I haven't done for a while.
This was an interesting survey. It made me think a little more deeply about my commuting and its impact on the environment. I liked the structure overall. However, there were a few questions that were irrelevant (although I believe that it is designed to aggregate the data for various groups to interpret).
this was very interesting, hope it helps with traffic and transportation. thank you.
Very good survey, brings up important subject.
very informational, made me think about maybe checking into other ways to commute
Would like to reduce commute time but alternatives are poor or non-existent

Would like to see government agencies promote telecommuting to reduce travel congestion and environmental impact.