

# NCHRP 08-36, Task 132

## UNDERSTANDING CHANGES IN YOUTH MOBILITY

### Requested by:

American Association of State Highway and  
Transportation Officials (AASHTO)  
Standing Committee on Planning

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# CHAPTER ONE: EXECUTIVE SUMMARY OF THE RESEARCH AND ITS IMPLICATIONS FOR THE PRACTITIONER

*The overall objective of this research is to understand the extent to which the changes in travel behavior by the Millennial Generation do, and do not, represent a major issue for the leaders of the transportation sector. The core of our approach is to better understand travel behavior of Millennial Generation in terms of their attitudes, beliefs, and preferences towards basic transportation decisions. Central to this is the need to understand what the Millennial Generation believes about trip making and related factors such as their approach to the urban/suburban dichotomy, environmental stewardship, and the importance of car ownership. It is only by understanding the specific preferences and needs of this age group that transportation managers will be able to make changes in the products and services offered in the transportation system more generally. The results of this study should allow state, regional and local practitioners to improve the process of planning, programming, and project development consistent with the needs and preferences of the younger generations.*

*Statement of Objectives from the Amplified Work Plan*

## Introduction: Why is this research important?

This Executive Summary presents the highlights from a two-year project undertaken within the National Cooperative Highway Research Program to help transportation planners and managers understand the implications of profound changes in the nature of travel demand patterns in the United States, and in other western countries. A seemingly unchangeable pattern of auto travel growth was broken in the first decade of the new century<sup>1</sup>, as shown for the United States in Figure 1. All over the western world, separate researchers reported similar results in the first decade of this century, in which *the amount of auto travel taken by the younger generation decreased at a rate faster than for other groups.*<sup>2</sup>

At one level, this discovery unleashed an exceptional body of literature from many countries that helps the transportation practitioner understand a global phenomenon. At a different level, many elements of the popular press engaged in speculation about the attitudes and behaviors of the Millennial Generation, based on little or no actual fact.

For the transportation planner, this may seem like a small, and perhaps irrelevant issue – or not! When the public believes that Millennials no longer drive in cars, no longer buy cars, and only wish to share cars, this implies that auto travel might suddenly grow out of favor. When the public believes that Millennials do not want to live in the suburbs, and would not drive further to get a larger house, this implies that travel forecasts used in the planning and environmental analyses of new transportation investments are all wrong, and thus invalid.

The research project presents a neutral review of what exactly did happen in these two decades of change in travel behavior, and analyzes how much of this change is attributable to knowable, traditionally documented factors. This, then, builds the case for exploring how attitudinal and cultural changes might explain the rest of the change in travel behavior.

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<sup>1</sup> Garceau, T., C. Atkinson-Palombo and N. Garrick (2014). "Peak Travel and the Decoupling of Vehicle Travel from the Economy: A Synthesis of the Literature." *Transportation Research Record: Journal of the Transportation Research Board.*

<sup>2</sup> Kuhnimhof, T., D. Zumkeller and B. Chlond (2013). "Who Made Peak Car, and How? A Breakdown of Trends over Four Decades in Four Countries." *Transport Reviews.*

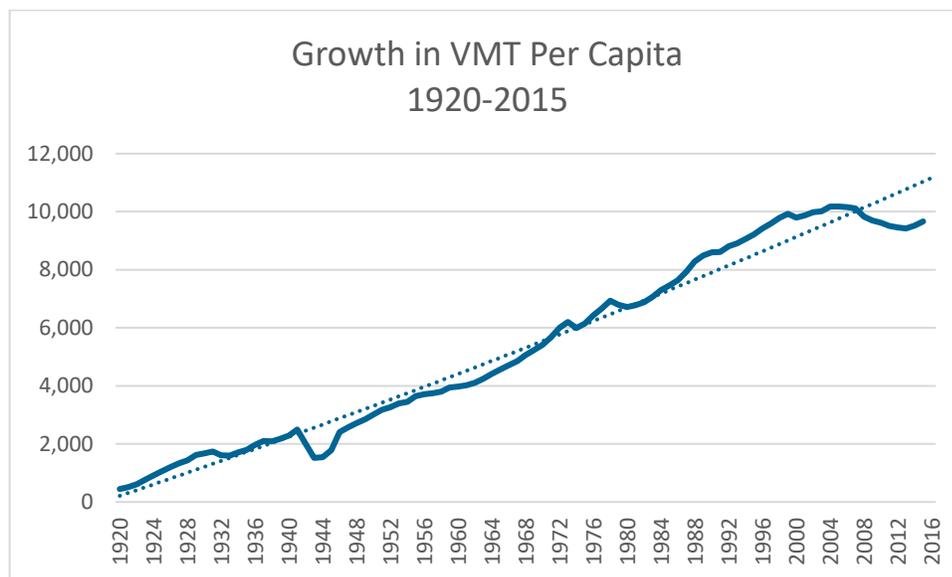


Figure 1 An 80-year pattern of nearly linear growth in VMT/capita ended in the first decade of the 21st century. Source, FHWA

A key theme of this research: *what we can explain and what we cannot*

It will be clear by the end of Chapter Two of this report that something important did indeed happen in a two-decade context (1995-2015) and in a shorter context (2001- 2009). The patterns of all auto drivers changed, but the patterns of those under 35 (“the Millennials”) changed far more dramatically. The published literature can be classified as having two separate hypotheses: 1) that everything important can be explained by the changes in the economic situation over time<sup>3</sup>; 2) that significant cultural changes have taken place, with results that will not disappear with economic recovery.<sup>4</sup> A third explanation would combine aspects of the first two. Accepting that economic explanations are important, there is still a significant shift in travel behavior that cannot be explained by these factors alone: thus, the analysis of what is changing requires a better understanding of the way in which the values and attitudes of the Millennial generation differ from those of their older counterparts.

This report will show that a full analysis of what happened (most specifically between 2001 and 2009) leads the analyst to conclude that the traditional set of causal factors alone *cannot* explain the change, and that new categories of values, attitudes and norms must now be brought into play. Chapter Four of this report contains a new analysis (undertaken by the Research Team) that builds directly on a method used in the published literature<sup>5</sup>, and concludes decisively that a rigorous analysis of a wide range of traditional causal factors cannot alone explain the change in travel behavior. This conclusion suggests that further analysis should be undertaken to further integrate into this analysis the results of Chapter Three, which documents the many ways in which the values and attitudes of the Millennial Generation do, in fact, differ from those of older groups.

<sup>3</sup> "It's the Economy, Stupid: Increasing Fuel Price is Enough to Explain Peak Car in Sweden," Bastian and Börjesson

<sup>4</sup> Dutzik, T., J. Inglis and P. Baxandall (2014). "Millennials in Motion: Changing Travel Habits of Young Americans and the Implications for Public Policy" U.S. PIRG Education Fund, Frontier

<sup>5</sup> McDonald, N. C. (2015). " Are Millennials Really the “Go-Nowhere” Generation?" Journal of the American Planning Association.

From Chapter Three, we learn that the ways in which the Millennials differ are themselves not simple, not linear, and not always as expected. On the one hand, the importance attached to owning a car, being reliant on a car, and gaining happiness from a car *are less valued* by Millennials than by others. On the other hand, the Millennial Generation is more likely than other groups to look forward to a *bigger* house, to be willing to drive further to get that bigger house, and expect to drive more as they age. The majority of Millennials in this project report a preference to live in the suburbs when compared with large cities; ongoing research suggests an interest in either the lower density of smaller cities, or of the suburbs. More challenging for the possible alteration of travel behavior is that Millennials have more concern about traveling with people they do not know, and worry more about safety associated with travel with others, than do the older groups. A careful look at the results of Chapter Three suggest that Millennials are a group that could generate environmentally friendly patterns of travel, but only if the transportation providers understand the details of their preferences.

## What We Learned in this Project

### What did we learn from empirical observation of the change in transport behavior?

Chapter Two presents a brief introduction to the difference between the travel behavior trends for those under 35 years of age (Millennials) and those of older age categories. These differences are explored in the context of historical trends in vehicle miles traveled (VMT) over the last century. The chapter...

- documents the age-based decline in VMT between 2001 and 2009, by location, gender, income, and location.
- explores age-based changes in the use of other modes, including walking and biking during the same period.
- explores what is known about the change in the propensity to obtain a driver's license and the timing of obtaining the license.
- reviews patterns of trip making by Millennials and other groups between 2008 and 2013, examined in terms of the mode used for the Journey to Work.
- includes references from the published literature concerning change in travel behavior.
- reviews known differences by age group in the use of newer modes of transportation.

Highlights of Chapter Two include:

- The fall in auto travel at the turn of the century (roughly 1995 to 2009) was most pronounced in youth, in male youth and in unemployed male youth.
- The decline was stronger for younger urban residents than for younger rural residents; low income rural residents lost more mobility than higher income rural residents.
- VMT decreased far more sharply for young people in the Midwest and South than for young persons in the Northeast.
- The evident pattern of delaying the acquisition of a driver's license largely concerns ages under 20.
- The drop in VMT was not counteracted by an equivalent increase in walking and biking, which did increase moderately.
- Transit trips per capita went up between 2001 and 2009, but not at scale to imply the substitution of transit over auto.
- After 2008, Millennials began to regain their auto travel pattern for their journey to work, with this pattern reported in 49 of 50 states by 2013.
- For the population as a whole, VMT began to rebound in about 2013.

- Millennials are far more likely to have tried Uber or Lyft than the older groups, but only 3% of travelers report using these services on a weekly basis.

### What did we learn about age-based differences in attitudes and values?

Chapter Three is organized around five categories of attitudes and values, with highlights summed briefly here. While the main text is based entirely on RSG's TransitCenter survey, additional information is presented in sidebars from other RSG surveys.

There are wide differences between the attitudes and preferences of Millennials and the older age group concerning the importance of owning, and being dependent upon a private **automobile**: this is true for all neighborhood types and regions.

- Millennials are less dependent on the auto than their parents were, and they like to share cars and bikes more than the older group.
- Millennials have a lower propensity to say that they love the freedom and independence from auto ownership, and to say that they need a car to get where they need to go.
- As they get older, a majority of Millennials expect to drive more than they do now.

On the subject of **urbanism**, the views of the Millennial Generation are complex and not easy to categorize.

- When asked for a preference between cities and suburbs, Millennials report a preference for the latter; ongoing research is also suggesting a strong interest in smaller cities, whose density mimics that of the suburbs.
- Those under 35 would prefer a bigger house more than any other age group.
- Those under 35 would be more likely than the older group to agree to drive more to attain a bigger house.
- As they get older, a majority of Millennials expect that they will like the suburbs more than they do now.
- Of the age groups, those under 35 have the highest propensity to say that an urban setting was ideal.

On the subject of **privacy and personal safety**, the Millennials are far more worried about the conditions of public travel modes than are the older groups: this is true for all neighborhood types and regions, with the least age-difference in the most transit-rich areas.

- Millennials are far more likely to be concerned about traveling with people they do not know than those in age older age categories.
- The Millennials report higher importance for privacy in the trip, and more worry about crime or disturbing behavior on the trip.
- Millennials report feeling safer when riding public transportation than the older group, while the majority of both groups have concern about safety.
- Concerning longer distance travel, the Millennials report feeling less safe than does the older group.

Concerning **environmental issues**, Millennials' attitudes vary by the nature of the question.

- The Millennials are far more likely to say that those important to them would prefer to drive less, and far more likely to say they would change their mode to improve the environment.
- But, they are *more* likely to say environmental issues are overblown, and would be less like to pay to improve those conditions.

Concerning **Information Communications Technologies (ICT)**, the age-differences are strong.

- The Millennials are far more likely to say that their *smart phone* would be the hardest thing in life to live without than the older groups
- Millennials attach greater importance to being connected, and being productive while traveling than do the older age categories.
- The younger groups are far more likely to say that being productive affects their choice of mode in travel.

### What did we learn in interpreting the reasons for the change in travel behavior?

Chapter Four uses both original research and results from the published literature together to explore a series of questions key to interpreting the change in travel. First, empirical evidence was gathered to review commonly hypothesized explanations for the change in travel.

- Was there a strong decrease in auto ownership?
- Were more people living in a zero car households?
- Was it from delayed acquisition of licenses?
- Do issues of race and ethnicity explain the change?
- Did ICT lower the amount of travel?
- Did environmental concern depress travel?
- How did employment interact with gender, and age in the decrease of VMT?
- Was there a boomerang effect?

Chapter Four finds that several candidate explanations were not supported by empirical data:

- *Shift to walk or transit.* The change was in overall trip generation, not just a shift in modes.
- *Shift to taxis or carpools.* Between 2000 and 2010, the rate of carpooling actually declined, while the auto occupancy rate remained stable, growing by about one half of one percent
- *General decrease in auto ownership rate.* In 2001 there were about .81 autos per person, which shifted slightly to .80 during the difficult years around 2009.
- *Rate of no-driver's license.* For those between 25-34, rate of driver's license holding had dropped by about 3%.
- *Concern for the environment.* The international literature was used to review the theory that increased levels of environmental concern would explain the drop in VMT, and no support for this was found.
- *ICT replaces trips.* The hypothesis that increased use of information technology could explain the drop was reviewed in terms of both our available data, and the results of the international literature. In short, increase levels of information technology use are associated with increased levels of travel, not the other way around.

Other factors emerged as potentially more important:

- *Race/ethnicity.* Race did emerge as a powerful variable, with Native Americans and Hispanics falling over 20% in VMT, versus a decrease for whites of 5%.
- *Rate of zero car household.* The portion of survey respondents living in zero-car households did increase from 5.2% to 6.0%. For those between 25-34, the portion living in a zero-car household, was 7.1% in 2009, up significantly from 5.4% in 2001.
- *Expendable income.* By most reports, Americans in general had slightly less real purchasing power in 2009 than in 2001.

### *The complex role of economics and unemployment*

Far more relevant factors were found concerning the economic conditions at play in the base year and the later years. Our examination of the NHTS statistics for 2001 and 2009 revealed an unexpected drop in auto travel of 33% for unemployed males between 18 and 24 over that period, with unemployed males between 25-34 experiencing a 21% drop. Chapter Four concludes that being *unemployed* in the recession of 2008- 2009 was associated with far less car driving than being *unemployed* in the year of 2001. This is true for all male age categories, but with most serious consequences for those under 35 in 2009.

### *A comprehensive modeling approach to interpreting the change in travel behavior*

While the first half of Chapter Four emphasizes the relatively simple-to-understand changes in travel associated with a variety of possibly causal variables, the second half of Chapter Four undertakes a much more comprehensive (and demanding) approach to applying several regression techniques to a wide variety of factors relevant to the explanation of the change in auto travel. The analysis reported by McDonald (2015) has been the most complete multivariate disaggregate analysis of national household travel survey (NHTS) data to date. Through the use of interactions between age group effects and survey year effects, McDonald was able to show strong evidence that Millennials traveled less by auto than in 2009 than what can be explained by a wide variety of other variables that were controlled for in the analysis. In the work reported here, we were able to replicate McDonald's analysis, and then test a number of different ways of extending the analysis.

Chapter Four concludes with a further exploration of NHTS analyses which attempt to calculate the relative level of importance of major categories of explanation for the decline in auto usage among Millennials. Based on the analysis of McDonald, the Millennials who were surveyed in 2009 did travel less by auto compared to the people who had been in that age group in 2001 and 1995, *even after accounting for year specific effects such as the recession*. This study is important in that it uses multivariate disaggregate modeling to confirm trends that have appeared in more aggregate and anecdotal studies discussed earlier in this Executive Summary. It also provides some evidence that the reduced auto use in recent years among Millennials cannot be entirely explained by the lower employment or incomes due to the recession.

To further examine the data with this method, the Research Team added additional explanatory variables, and additional interactions between explanatory variables; we undertook testing other dependent variables, and testing alternative model specifications. Although several of the added variables were significant and helped explain some trends in travel behavior, *the interaction effects between age group and survey year reported by McDonald remained significant over and above the new variables added*. In short, the Research Team was able to confirm the policy-sensitive conclusions reported by McDonald concerning the important role of factors *above and beyond* those normally included in the economic analysis of travel demand.

### **Do We Need to Change the Way We Collect Data about Travel?**

Given the intense demands made on the data in the previous analyses (e.g., comparing the VMT of employed vs unemployed males between 25 and 34 in 2001 vs 2009), Chapter Five presents a summary of the challenges associated with the methods used in national data collections programs. The chapter makes some early suggestions about how the process of data collection for travel demand analysis can be improved. For example, the chapter reviews the issue of sample bias that might stem from reliance on landline telephones, largely to the exclusion of cell phones.

Chapter Five notes that Millennials (and even more so post-Millennials) have grown up using smartphones as their main mode of communication with the world. They expect there to be a good app for everything. This has likely had some major effects on how they have responded to travel surveys over the last 10 years or so.

- Over half of them live in cell-only households, and that number continues to grow. Cell-only households have been missed by Random Digit Dialing (RDD) surveys (and are also somewhat harder to contact even using Address Based Sampling (ABS) since there is no phone number connected to the address). If those in cell-only households travel more than those in landline households, then excluding them will appear in a decrease in travel as the percent of cell-only households grows.
- With growing use of ABS comes lower response rates, so somewhat more potential for self-selection bias in the sample. Particularly for young people, there is some preliminary indication from recent surveys that urban dwellers who are more interested in using alternative modes to the auto are more interested in responding to travel surveys, so the urban samples tend to be skewed somewhat toward those people.
- For the people who agree to participate in the survey, almost all younger people use the internet to report their travel diary data (using a web browser, which could be on any device). Now that the industry is beginning to shift to smartphone data collection, we find the biggest differences in trip rates between smartphone GPS and diary self-reporting methods are for the younger people, particularly age 18-24. They have the highest item non-response bias for diary-based methods, which would show up in analysis as lower mileage traveled by all modes, but it seems likely that it is really because they don't have the patience or inclination to self-report all their trips when they are used to their smartphone already recording everything they do.

Chapter Five reviews some data and analysis that provides preliminary evidence of these patterns, but more analysis of existing data would be very useful, as recommended in the document. Without such analysis, it is uncertain how much of the apparent changes in Millennials' travel behavior are due to changes to survey methods and how they respond to surveys. Considerations in response might include the following:

- It would be desirable to undertake the NHTS on a more frequent cycle and/or to add key transportation-related questions to an existing survey such as the Panel Survey on Income Dynamics (PSID), a semi-annual panel survey of around 10,000 households, administered at the Univ. of Michigan. Alternatively, the American Community Survey of the US Census could include a few more key transportation-related questions.
- For the future, changes in the NHTS might transition to smartphone-based methods that still allows for trend analysis.

## **What are the Implications of this for the Transportation Practitioner?**

### Major Conclusions of this Research

We conclude this Executive Summary of this study of Youth Mobility with several observations put forward in Chapter Six:

- The first decade of 21<sup>st</sup> Century witnessed a drop in the number of vehicle miles of travel taken by the so-called Millennial Generation, generally those under 35 years of age.

- Chapter Two documents in some detail that Millennials in any given age category were generating less VMT than the groups who were in that age category just 8 or 14 years earlier; differences exist among cohorts in how they behave within a given stage in life and age category.
- When analyzing the travel behavior of this group, it is important to note the economic conditions operant at the time period of the travel, such as high unemployment.
- While those economic conditions will be an important input into the amount of travel taken, we have established in this research that there is something *additional* to examine above and beyond the traditional factors known to influence trip making behavior. There must be explanations for the travel behavior change of this group, based in ‘softer,’ more difficult to measure, factors such as preference, attitude and culture.
- Chapter 3 documents in some detail that the Millennial Generation group holds a different set of values, and preferences towards the automobile when compared with older groups.
- The Millennial group has lower need for, love for, and preference for owning a private automobile than older groups have. They have a higher interest in sharing a car or bike with others than older groups have.
- At the same time, Millennials will be proceeding through the life-phases just like everyone else; compared to older groups, they state a *stronger* preference for a bigger house, and a greater wiliness to drive longer to get to it. More Millennials in this study prefer to live in the suburbs than prefer to live in the city, and actively expect to drive more as they get older.
- As they choose a mode of transportation, this younger group has more of a concern and fear of traveling with others, and specifically people who they do not know.

Chapter Six concludes that transportation professionals tasked with creating strategies to reduce congestion, manage demand, and comply with clean air and other environmental mandates will be dealing with a market segment more open than previous generations to owning fewer vehicles, and sharing resources more generally. But, it is our major conclusion that it would be a mistake to take this group for granted. Those practitioners charged with creating new forms of transportation service need to understand the preferences of this group, perhaps dealing directly with the problem of the high value assigned to privacy in travel, for example.

The report notes that young people in pre- and early child rearing phases of life have considerable freedom to live in urban contexts, often with smaller dwelling units spaced closer together – and to be proud of that lifestyle. As they proceed through the life cycle, larger homes, wider spacing will be tempting, or even required for family needs. With greater levels of separation come lower density land use patterns, and long trips<sup>6</sup>. With larger families comes an increase in various forms of ‘chauffeur’ by soccer-moms and soccer-dads, and an increase in VMT. Our research suggests that many young Millennials *are quite aware that their lifestyle will evolve* with increasing age.

Given that this large cohort<sup>7</sup> within the American population does indeed have values, attitudes and preferences that are different from their older fellow citizens, the question turns to how much the influence of those values on behavior will remain through the age-based changes that will come, and how much will be eroded by the geographic and physical constraints to come.

Those tasked with basic transportation planning methods like trip generation forecasting are already involved in re-examining assumptions about a permanent linear growth in VMT per capita. However

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<sup>6</sup> This is consistent with our findings when we added additional residential land use categories (“Claritas” categories) into the chapter 4 regression model.

<sup>7</sup> Currently the largest cohort, having surpassed the Baby Boomers.

slowly, the roles of walking and biking are growing, as noted in Chapter Two. The profession is well prepared to examine the relationship between increase in economic activity and the increase in VMT. But transportation planners may not, at this time, be equipped with the kinds of tools that would be needed to replace traditional, linear forms of forecasting with a process of alternative scenario generation that would make not one forecast of behavior in 30 years, but several different forecasts, based on several different assumptions of the direction of cultures, preferences attitudes and economic settings.

Our research into the details of the mobility of youth leads logically to support the direction taken by many leaders in transportation planning to develop new tools and procedures to take into account various additional factors in the planning and forecasting process. These tools, in turn, must be based solidly in an understanding of the relationships between various values, attitudes and cultures, and actual travel behavior.

We have documented that major roles in transportation demand are played by values, attitudes and preferences—particularly in terms of the youth market under 35. We would recommend that more research be undertaken to understand and document the linkage between those preferences and actual transportation behavior. This could support the development of a scenario-based forecasting process. These new processes, might, in turn require newer and more flexible approaches to data collection, as noted in Chapter Five.

There is no question that the Millennials have a wide variety of values and preferences that could strongly influence the future of American travel; we need to better understand how to deal with what is coming next.

# CHAPTER TWO: EMPIRICAL OBSRVATIONS—HOW THE TRANSPORTATION BEHAVIOR OF THE YOUNGER AGE GROUPS DIFFERS FROM THAT OF OLDER GENERATIONS

## Introduction and Structure

This chapter summarizes the changes which have taken place in the amount of vehicle travel over the past twenty years, with particular attention paid to the role of the youth market in those changes. In this report, the Millennial Generation is defined as those between 16 and 35 at the time of the 2009 NHTS.<sup>8</sup> The chapter:

- will present a brief introduction to the difference between the travel behavior trends for those under 35 years of age compared with all other age categories, including historical trends in vehicle miles traveled (VMT) over the last century.
- uses the measure of VMT per driver to introduce the concept of cohort-effect change and time-effect change.
- documents the age-related decline in VMT between 2001 and 2009, by location, gender, income, and location.
- explores recent patterns in the age at which young people first obtain a driver's license.
- explores age-related changes in the use of other modes, including walking and biking during the same period.
- reviews patterns of trip making by Millennials and other groups between 2008 and 2013, examined in terms of the mode used for the Journey to Work.
- reviews known differences in travel patterns between the youth market and other age categories with other data collected in the present decade, including differences in modal behavior for both metropolitan-scale and long distance modes.

The purpose of this chapter is to present empirical facts about the travel behavior of the youth market, compared and contrasted with older age categories. The interpretation of *why* these behaviors (and differences) take the form they do will be explored in Chapter Four, which will integrate these observations with major results from the literature search, and a new summary interpretation developed by the Research Team.

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<sup>8</sup> In cases where the analysis uses more specific definitions of the Millennial group, it will be noted in the text.

## What has Happened to National VMT?

### The Historic Pattern of VMT Growth in the United States

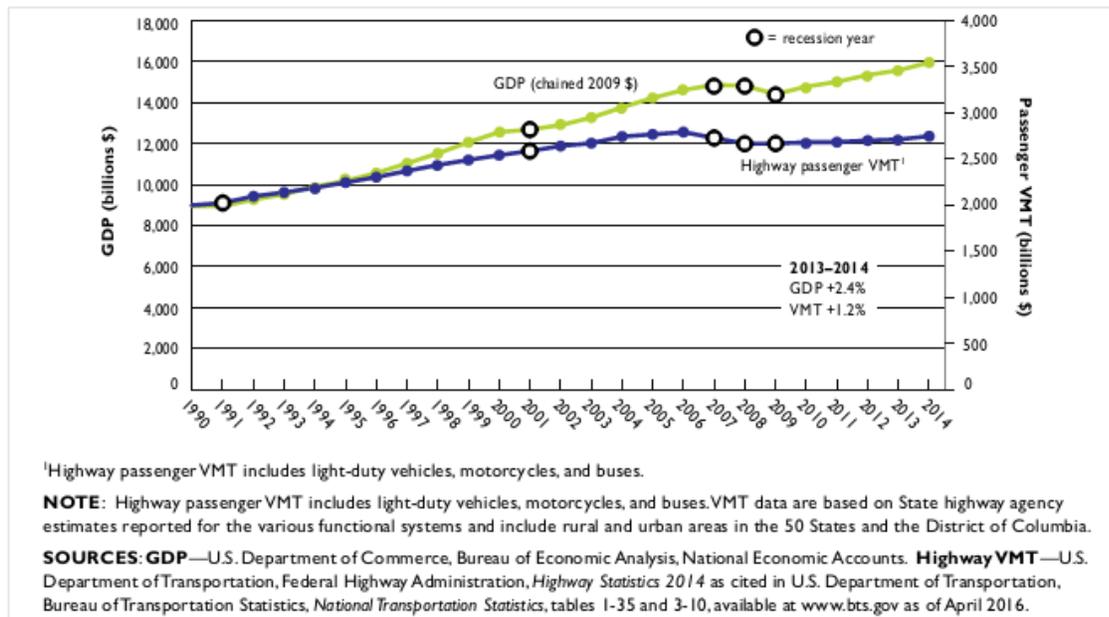


Figure 2. This chart from the Bureau of Transportation Statistics shows the relationship between national VMT and GDP. Source: BTS “Passenger Travel Facts and Figures 2016”

This chapter of the Final Report presents a basic description of changes in American travel behavior over the past two decades, with a goal of improving our understanding of the dynamics of the youth market, generally those drivers under 35 years of age. Our analysis comes at a time of potentially radical change in the production of VMT, in which continuing growth of VMT per person is no longer assumed over time. Before we focus specifically on the last two decades, however, it is worthwhile to set the stage for the analysis to come in the following pages. Figure 1 (included in Chapter One) provided a historical context for the observation of VMT. For example, it shows that in a period roughly between 1968 and 2005, the “average” American doubled her/his amount of yearly driving, following on a remarkably linear growth trajectory stemming back to the recovery from the Great Depression of 1929. It is worth reiterating here that these numbers represent auto use per person, and do not reflect any VMT growth associated with growth of the population itself. The relationship between the growth of national VMT and the national economy (GDP) is revealed in Figure 2. For decades, VMT grew in parallel with GDP; this parallel rise weakens and ends with the end of the century.

Figure 3 provides more detail on the last 20-year period, between 1995 and 2015. This graph shows a “bubble” in VMT per person in the first years of the 21<sup>st</sup> Century, with this pattern ending around 2006, after which a decrease in VMT until 2013, a period which included the economic recovery after the economically traumatic months of the second half of 2008.

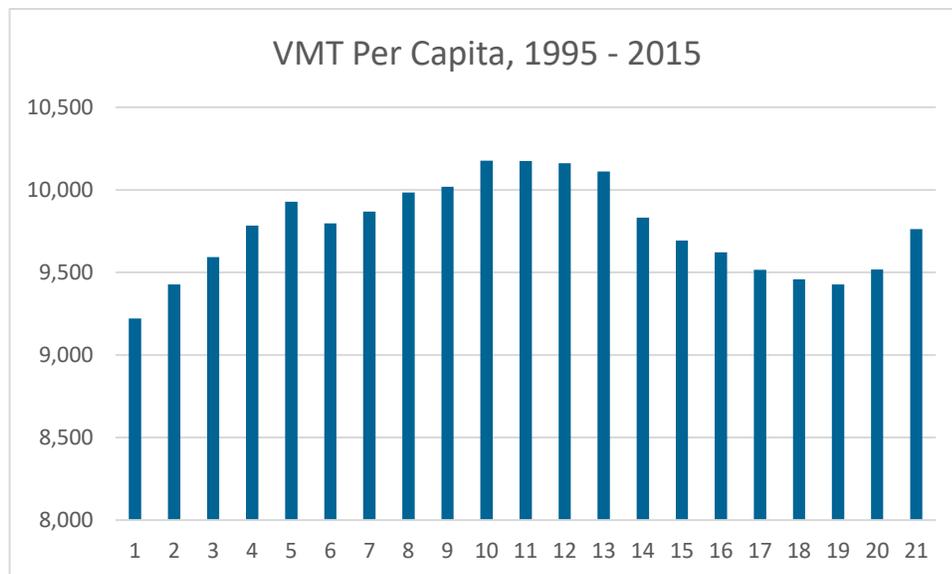


Figure 3 VMT per capita between 1995 and 2015. Sources: FHWA and US Census.

VMT per capita is a very important measure of travel behavior, because the FHWA calculates an estimate of total VMT for every year, using data-sources not linked to surveys, but empirical ground counts, etc.; a straight-forward matching with US Census data for total population creates this easy-to-understand measure of VMT per capita. A weakness of the index is that the denominator of the equation properly includes fluctuations in birth rates (and mortality rates), and other factors that might or might not be good explanatory factors in variation in VMT and travel more generally.

Thus, VMT per capita includes variation in the number of persons logically too young to drive, and variation on the propensity to obtain/have a valid driver's license. The following sections of this chapter will focus on the index of VMT *per driver* as a better analysis metric. This metric allows the analyst to focus on changes in driving behavior by the sub-population that can and does drive.

## Understanding the Setting

Where did the trips go? Just a shift in modes?

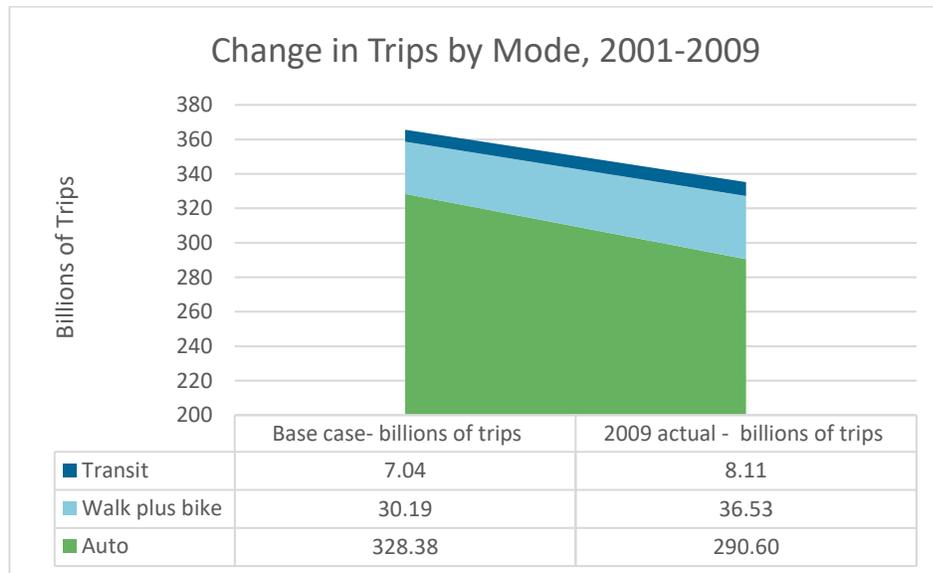


Figure 4 Change in Trips by Mode, 2001-2009. Source: calculated from NHTS Data

The change in transportation behavior between 2001 and 2009 can best be described as a decrease in the total number of trip taken, by all modes, as shown in Figure 4. Within this shrinking total, the *share* of modes captured by walking and biking did increase from about 8.6% to 10.4% and the share of transit increased from 1.6% to 1.9% (which is not statistically significant). However, it is not *primarily* a story of a portion of trips shifting from one mode to another.

Trip making per capita in 2009 was 92% of what it was in 2001, or roughly an 8% drop, with auto trip making per capita down by about 12%. Looking at mode shares of trip-making, auto fell from 90% share of all trips down to about 87% share of all trips. Walk and bike together gained from about 8% to almost 11%, with transit stable at roughly 2%.

To summarize the change, a massive decrease in auto trips was not compensated by a parallel increase in trips by other modes—it was an overall loss of mobility. Figure 4 shows that the roughly 238 million people in 2009 made 37.8 billion fewer trips than if they had traveled at the trip generation rate of 2001. By contrast, a healthy increase in trip-making by walk/bike resulted in some 6 billion more walk/bike trips; with 1 billion more transit trips than would have occurred with a 2001 generation rate. A loss of some 37.8 billion auto trips was compensated by a gain of only 7.4 billion trips by other modes. This was not primarily a transfer from auto modes to greener modes, it was a systemic decrease in travel.

### Was There a Decline in Total Trips between 2001 and 2009?

Figure 5 shows that the number of person trips per day declined because of the dominant decline in the number of private-mode trips. Logically enough, the decline in VMT was paralleled with a decline in the number of trips taken by all modes, including walk and bike. The rate of decline was highest for those 16-20 years old, and lowest for those 36-65 years old.

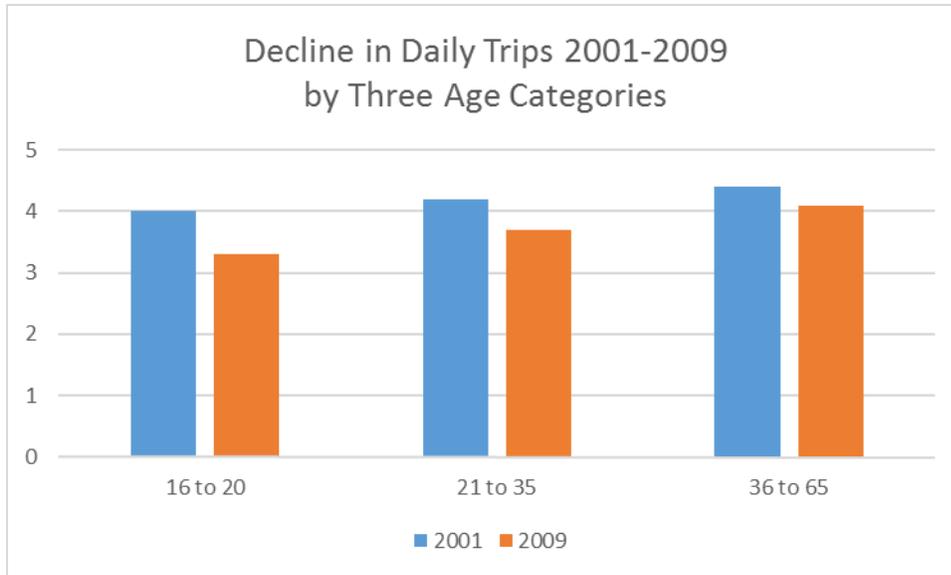


Figure 5 Between 2001 and 2001 the total reported number of trips by all modes decreased for these age categories. Source: NHTS

### How the Youth Market Differs from Other Age Groups

Figure 6 allows the reader to see two very different patterns at once. The overall curve reveals the powerful effect of the *age category* on the generation of VMT per driver. Within each of the separate age categories, three bars are shown representing annual VMT for the age group in 1995, 2001, and 2009. Variation in VMT within the adjacent bars shows the *cohort-effect* of three separate groups of survey respondents. By way of example, the three bars for the first age category represent one cohort born between 1972 and 1975; a second set of three bars shows the cohort born between 1981 and 1984; and the third set of bars shows a cohort born between 1989 and 1993. A comparison of bars *within* the age category reveals changes in VMT over time by separate survey respondents (cohort-effect); meanwhile, a comparison of bars *between* age categories reveals changes in VMT as a function of the time-effect of proceeding through the life cycle and aging process, and other factors not attributable to the characteristics of the cohort group. A quick visual observation from the full graphic is that time-effects *are far more powerful* in the explanation of VMT change than are cohort effects, however relevant they may be to present policy discussions.

### Which Groups Declined in VMT between 2001 and 2009?

From a visual observation of Figure 6 it becomes clear that the pattern of decline in VMT by the younger generation is most pronounced between the 2001 survey and the 2009 survey. To facilitate the rapid observation of many kinds of explanatory variables, four primary age categories have been established for this chapter. Two have been defined for the youth market, and two have been defined for the middle age market. The youngest category includes those between 18 and 24 years of age, focusing on the years after high school. The years 25 to 34 represent a period where many households are formed, and longer term settlement patterns are commenced. The years 35 to 49 represent years often dominated by child rearing, while the years 50 to 64 see the pattern of empty nesters appearing in the travel data. While changes in patterns for those 65 and over are important for society, they will not be the focus of this research about the youth market. Similarly, our work has noted great volatility in the age group 16-17, where most persons are still in high school, and/or the process of setting up independent living arrangements has not commenced; thus, our youngest age category starts at 18.

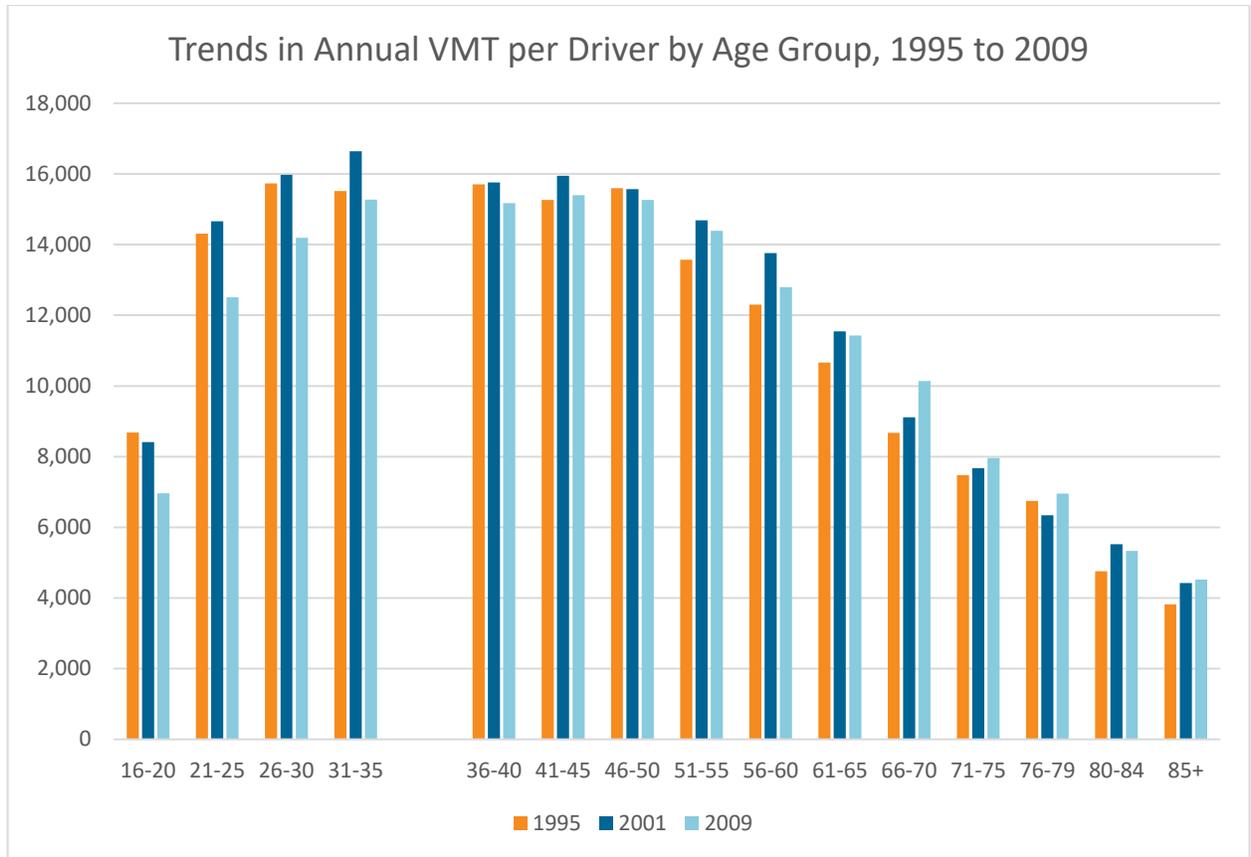


Figure 6 Variation in VMT per driver for age categories over three survey years. Source: data from NHTS, ORNL website.

## Demographic Factors in the Decline in VMT

### Analysis of Age Alone

Figure 7 shows how the VMT per driver rates fell for the younger age categories over the period of most pronounced change, which occurred between the two NHTS surveys, of 2001 and 2009. It shows how the middle age categories saw only modest change in the same period. Whatever volatility did occur was largely experienced by the younger groups, with smaller declines in two other age categories.

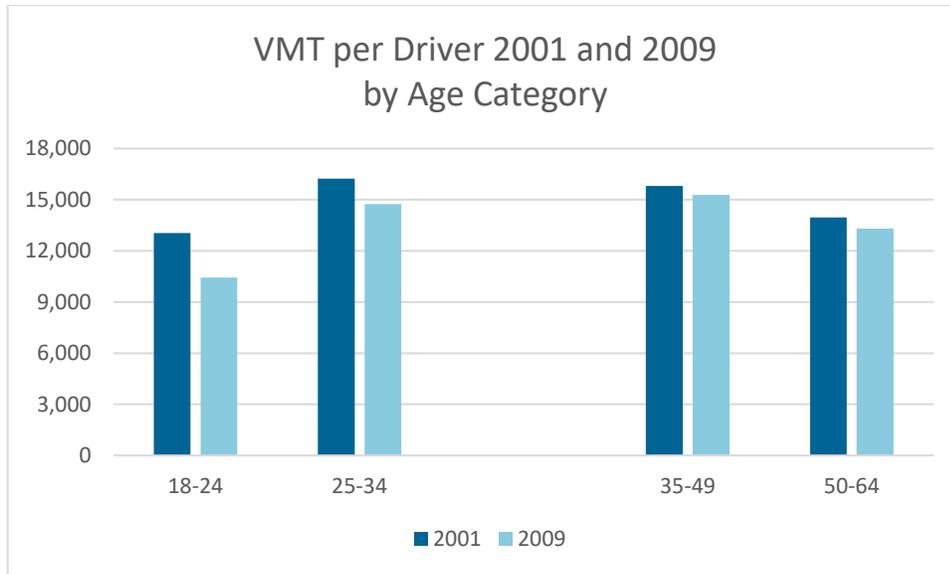


Figure 7 VMT per driver decreased for four age categories between the ages of 18-64. Source: data from NHTS, ORNL website

### Analysis of Age and Gender Together

Gender can also be added to the analysis of the major years of VMT decline, which shows that the two genders have separate patterns of variation in VMT by age category.

The pattern of VMT decrease varies sharply by gender. While the samples for all age groups lumped together fell about 5%, almost all of that decrease was experienced by males (see age category 'all'). The interaction between age category and gender is critical. Figure 8 shows that between the two survey years, VMT decreased by 24% among males 18 and 24 years of age, while females of the same age decreased their VMT by 13%. For those between the 25 and 49, males showed a decrease, while the change for females was statistically insignificant. For females over 50, the increase in VMT was significant.

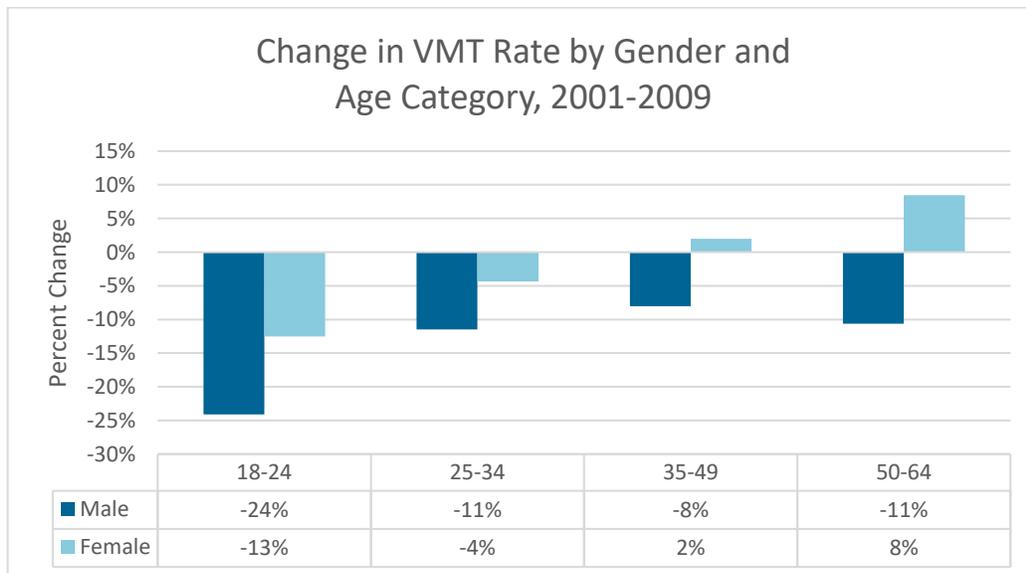


Figure 8 Decrease in VMT per driver was experienced primarily by the males, particularly the young. Source: data from NHTS

## Other experiences with change in travel by age group

The Project Bibliography contains about 70 articles concerning various interpretations of the pattern of decreased auto travel observed generally since 1995. An early article from Le Vine, and Jones (2012), *"On the move: Making sense of car and train travel trends in Britain."* They find through detailed analysis of British National Travel Survey data (1995-2007) that both young men and young women (16–19 years) have experienced a decline in annual car driver mileage. However, the largest changes in mobility patterns have taken place amongst young men: between 1995/7 and 2005/7, car-driving mileage for young men (specifically men in their twenties) fell by nearly 2,000 miles or 30%. They find that around half the average drop in car driving mileage by young men is due to fewer people driving, and half to a reduction in mileage on the part of those who do drive.

As discussed in this chapter, there is no debate that the travel patterns of American youth have changed over the past twenty years. While the number of vehicle miles traveled by American youth tumbled, the same thing happened in other countries at the same time. Kuhnimhof, *et al.* (2011) in *"A New Generation: Travel Trends among Young Germans and Britons."*

...finds decreasing car availability, a significant reduction of automobile mileage, increases in the use of other modes, and growing multimodal behavior of the young, with men reducing their automobile travel more than women. Even though the development is more pronounced in Germany, the similarity of the changes in young people's mobility patterns in the two countries is striking. This similarity suggests that the observed changes in travel behavior are not an idiosyncratic development in one country. Instead, the similarity may indicate a structural change in travel behavior that may be found in other Western countries.

Kuhnimhof, *et al.* (2012) write, in *"Men Shape a Downward Trend in Car Use among Young Adults—Evidence from Six Industrialized Countries:"*

The findings indicate that since the turn of the millennium, access to cars, measured in terms of drivers' licences and household car ownership, has decreased in most study countries, especially for men. Moreover, average daily car travel distance has decreased in most study countries, again especially for men. In France, Japan, and most significantly in the USA, the decrease in car travel has led to a reduction in total everyday travel by young travellers. In Great Britain, the decline in car travel was partly, and in Germany fully, compensated by an increased use of alternative modes of transport.

## Geographic Factors in the Decline in VMT

### *Regional Differences in the Decline of VMT by Age Category*

Having observed that the younger group has experienced the major decrease of auto travel rates, we can quickly review to see if this pattern appears consistently over different regions of the country. Figure 9 shows a high level of similarity in the patterns by region, with the exception of a more pronounced decline in the West experienced by those over 35 years old than in other regions.

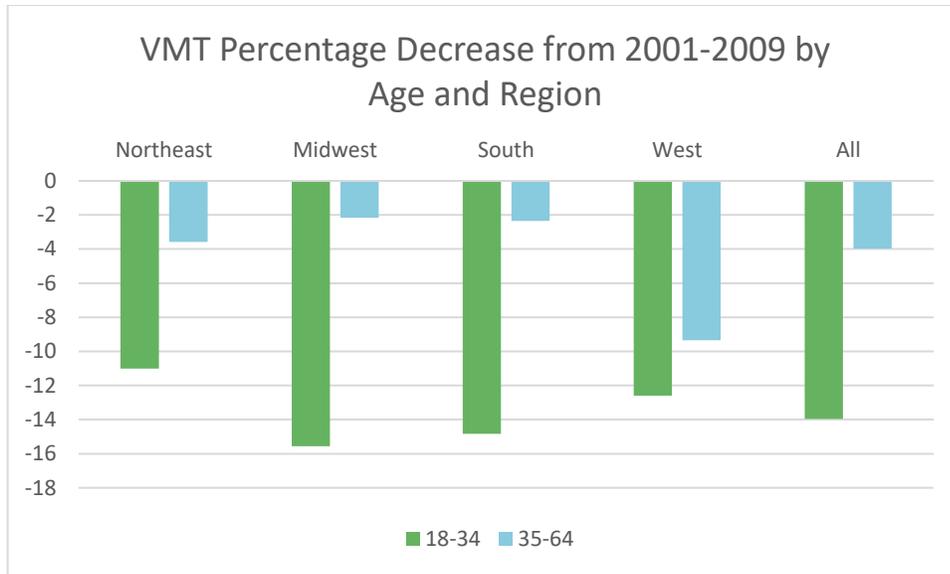


Figure 9. The younger age categories have greater decrease in VMT for all regions. Source: data from NHTS, ORNL website

### Is there More of a Decline for Urban or Rural Residents?

A review of urban vs rural locations explains some of the variation here. During the period between 2001 and 2009, urban residents seem to have decreased their VMT *more* than rural residents, with a 15% decline in VMT for urban residents against only a 9% decrease for rural residents.<sup>9</sup> Again, while urban youth (16-24) reduced 30% of their VMT, the same age rural youth reduced only 8%. The difference is less important for those 25-34, where the urban group was similar in their decrease at 20%, with 18% decrease for the rural group. The rural group over 45 years of age seems to have not experienced any loss within this key time period.

The cities defined in the NHTS process as having “heavy rail” had an overall decrease pattern similar to the country as a whole, with about a 7% decline in VMT/driver between 2001 and 2009. The Millennials suffered most of the loss, with a decline of 20% for those 18-24, and 9% for those 25-34. Consistent with other observations, those above 65 years old in the rail cities saw an increase in their VMT/driver.

### Driver’s License Rates and Decline in VMT

This section of the chapter presents an analysis of driver licensing and VMT data for the youth market in the United States. Driver licensing data were obtained from the US Federal Highway Administration<sup>10</sup> (FHWA), and population data were obtained from the US Census Bureau.

<sup>9</sup> Data from the NHTS/ORNL website, as analyzed by the Research Team.

<sup>10</sup> <https://www.fhwa.dot.gov/policyinformation/statistics/2007/pdf/dl20.pdf>

## Trends in Drivers Licensing among American Youth

The percentage of licensed drivers in the United States between the ages of 16 and 30 relative to the total population of each particular age group has decreased over the last two decades (Figure 10). Despite the decrease, a majority of young Americans are still obtaining their licenses, but many are obtaining them at later ages. For example, 43% of persons born in 1978 held licenses by the time they were 16 years old (1994) but only 29% of persons born in 1990 held licenses by the time they were 16 years old (2006). This represents a decrease of 43%. By the time the cohorts reached their 24<sup>th</sup> birthdays the gap was considerably smaller with 88% of those born in 1978 holding driver's licenses and 81% of those born in 1990 holding licenses.

About 85% of Americans between the ages of 25-30 were license holders in 2014. However, this number has decreased as well, from just over 90% between 1994 and 2004, suggesting that there are some cohort effects in decreasing rates of license holding but a focus on the very young (16 to 18) may lead to spurious conclusions.

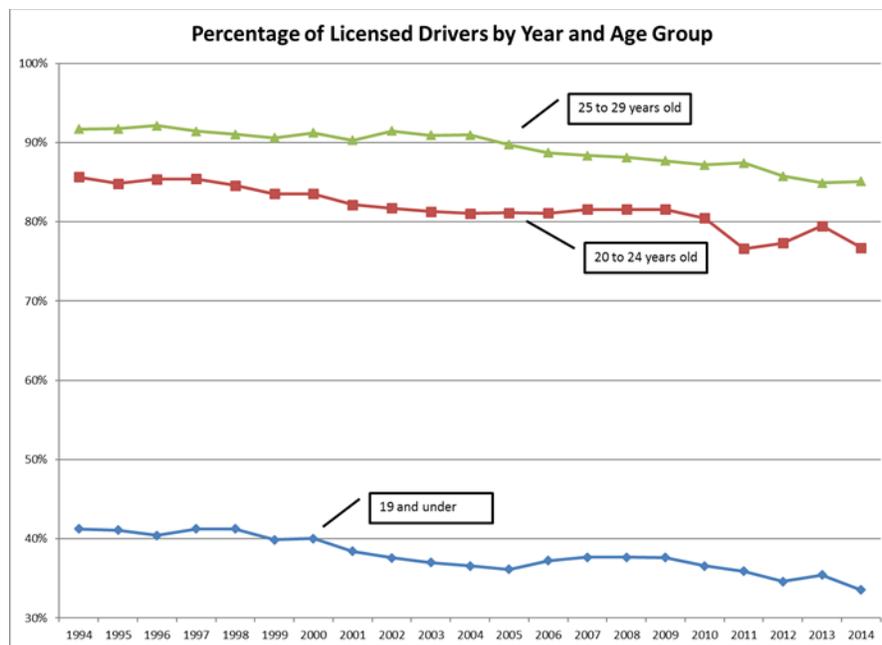


Figure 10. Percentage of licensed drivers in relation to population. Source: FHWA

The decrease has been the most notable for those in the 16-18-year-old age groups whose percentage of license carriers relative to their population appears to have fallen by about sixteen percentage points for both 16 and 17 year olds, and thirteen percentage points for 18 year olds, respectively (Figure 10). However, for each age group between 19 and 24, the decreases were also significant, with each individual age group seeing a percentage of licensed drivers in relation to population reduced by between about eight and ten percentage points over the same time period.

Overall, these reductions equated to a drop of about eight total percentage points of Americans under the age of 19, including 14 and 15 year olds, from just over 41% in 1994 to a third in 2014. For those aged 20-24 the drop proved even more significant, with about a drop of about nine percentage point, from about 86% to about 77% of the total population (Figure 10).

The decline in driver's license acquisitions among 16, 17, and 18 year olds appears to have had minimal effect, though, on a particular cohort's overall ratio of acquisitions over time, particularly once the cohorts are over the age of 19. Instead, it appears that the rate of acquisitions of most

cohorts is simply delayed by about one year. About 41% of 16 year olds had obtained a license in 1994 compared to about 29% of 16 year olds who had obtained a license in 2006. However, by the age of 19 both of these cohorts had licensing rates between 70% and 75%, and have remained within 8 percentage points, and frequently closer, of each other each year since. A similar pattern can be found when comparing most of the cohorts. By the age of 19 all cohorts had a license holding rate within about 5% of each other as their ratios increased (generally) year after year. This pattern continued for each cohort through at least the age of 24.<sup>11</sup>

While American youths do, for whatever reason, appear to be getting licenses somewhat later, *their reasons for doing so are not immediately clear*. There are several factors which may contribute to this phenomenon, including social factors, access to transit, or lifestyle choices. Economic factors are also possible contributors, as evidenced by the fact that all ages, and particularly those between the ages of 19 and 24, dropped *slightly faster between 2009 and 2012*, the worst period of the global recession. The most likely major contributing factor, though, is the change in rules and laws regarding the age young people are allowed to get a driver’s license, and how they can use it once they do.

*Age of License Acquisition by Age Group*

In the TransitCenter survey of 2014, Millennials and Gen X-ers both have *lower* than the average propensity to have obtained their driver’s license while they were 16 years age, with the Baby Boomers and Silent Generations both reporting higher than average rates of obtaining it while 16 years old. Thus, our analysis of rates of licensure concludes that, yes, the exact year in which the license is obtained is being delayed compared to historical patterns, but, the groups seem to be returning to historical levels in their twenties.

The propensity to have a driver’s license did not change substantially between 2001 and 2009, as self-reported by the participants in the two NHTS surveys Table 1. For males, those under 35 had about a 3% lower rate of license holding in 2009 than they did in 2001. Males above 35 years of age dropped by about 1% over the same period. For all age groups together, males went down by 1% and females went up by 1%, confirming that this is not a major explanatory factor in change in VMT between 2001 and 2009, at least as self-reported in the two surveys.

Table 1. Change in self-reported driver status in NHTS, 2009 as a percent of 2001. Source: data from NHTS, ORNL website.

Change in self-reported driver status	18-24	25-34	35-49	50-64	65+
Male (year 2009 rate as percent of year 2001 rate)	97%	97%	99%	99%	99%
Female (year 2009 rate as percent of year 2001 rate)	104%	97%	99%	100%	101%

**Changes in Millennial Travel between 2008 and 2013**

While the travel changes associated with a weak point in the economy at the time of the NHTS 2009 survey have dominated the information presented in this chapter, a certain amount of data is available to continue the study of the relationship between the Millennials and their older counterparts in the marketplace over the next five years.

<sup>11</sup> A more complete discussion of the role of licensing is included in the Technical Appendix to this volume.

The FHWA has created a dataset that follows the changes in the Journey to Work dataset between 2008 and 2013, documenting changes by both the Millennial cohort and the Baby Boomer cohort. In the words of FHWA<sup>12</sup>, the CTPP Generations Profiles have created the 2015 Generations profile sheets...

The CTPP 2015 Generations profile sheets use data from the 2006 to 2008 and the 2011 to 2013 American Community Survey (ACS) Public Use Microdata Sample (PUMS). ... *The Profiles are designed to give planners a handy way to explore how the Millennials and Baby Boomers are different and have changed in the last 5 years.* To better serve this purpose, customized variables were created...

It is important to note that the Journey to Work represents only roughly one-fifth of the nation’s total VMT, but the Census has been tracking these commuting patterns over time, creating a valued and frequently used form of travel reporting.

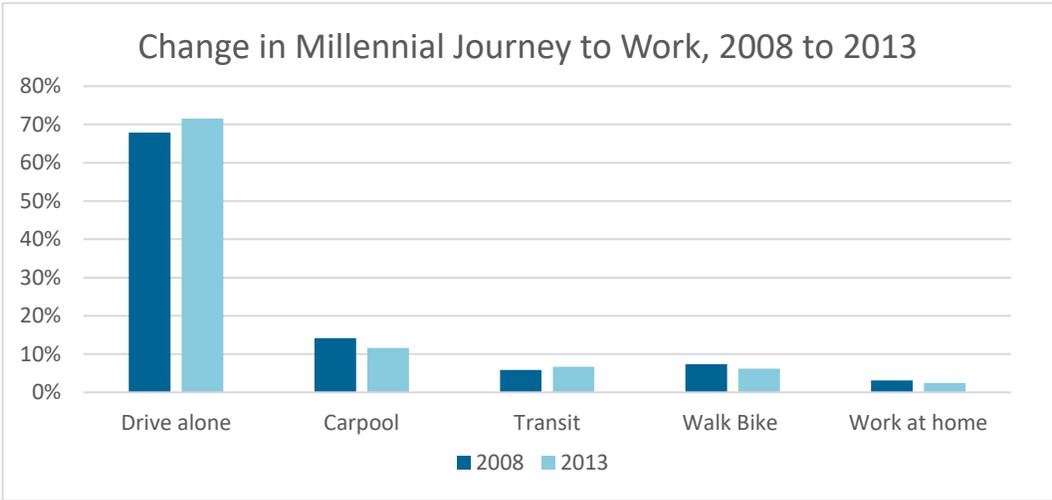


Figure 11. The Millennial group had a slight increase in Drive Alone between 2008 and 2013. Source FHWA CTPP Generations

### Journey to Work Mode, 2008 and 2013: Millennials vs. Baby Boomers

Seen on a national basis, the share of commuting by Millennials in the “drive alone” mode increased between 2008 and 2013. This is not entirely unexpected as the economic conditions of the nation improved considerably over this five-year period. Such a pattern can be compared with Figure 3 of this chapter, which shows rebound in the level of VMT per capita, although the increase in VMT rates occurring in those data started in 2013. Figure 11 shows a small increase in the Drive Alone mode share for Millennials, rising to above 70% share in 2013. That share is still far lower than the Baby Boomers 2013 Drive Alone share of nearly 80%, which had not increased compared with 2008 (not graphed).

Comparative data for other modes do not follow any clear pattern. Anecdotally, this database shows that Millennials do *not* have a higher propensity to work at home than Boomers, nor is that rate increasing over this period. Decreases in both carpool and walk-bike seem to counteract a very small

<sup>12</sup> [https://www.fhwa.dot.gov/planning/census\\_issues/american\\_community\\_survey/products/2015\\_transportation\\_profiles/](https://www.fhwa.dot.gov/planning/census_issues/american_community_survey/products/2015_transportation_profiles/)

increase in the transit share for Millennials over this five-year period. Carpooling is down for both cohort groups.

### Choices of the Millennials: Additional Modes

#### Millennial use of transit and walking

While this NCHRP study on Youth Mobility is focused primarily on trends in overall travel in the United States, (thus, emphasizing the role of auto use), it is worthwhile to note variation in the use of several modes by the Millennials. Figure 4, earlier in this chapter, showed how the overall use of both transit and walking rose in the decade under study. Comparing the young with the older groups, the use of transit tends to decrease over the life span, with the highest levels for the youngest group, and a steady decline as age increases. The influence of age on the propensity to choose transit, by gender, is revealed in Figure 12 from the TransitCenter survey taken in 2014.<sup>13</sup> For both those under 35, and those over 35, males have a higher propensity to choose transit than do females.

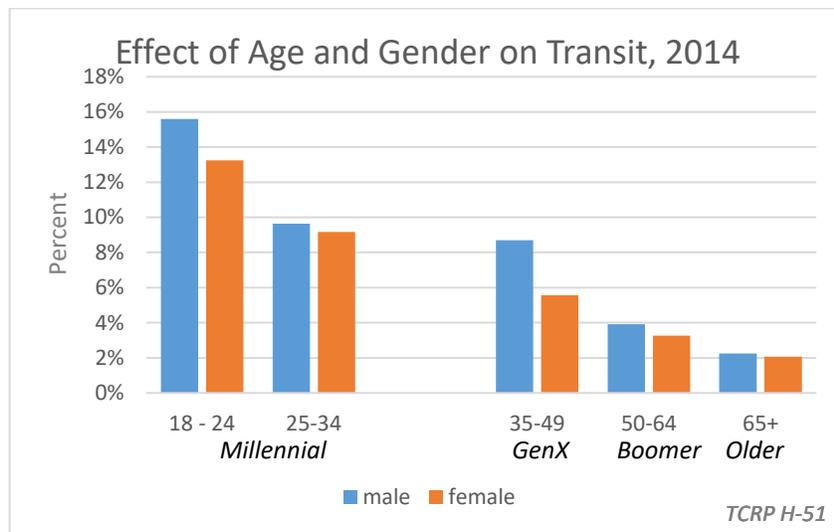


Figure 12 Millennials have higher propensity to choose transit, and lower propensity to choose private vehicles. Source: TCRP H-51

Over the past two decades, the propensity to walk and bike has increased. Figure 13 shows walk/bike rates about three times the share of transit, and that the younger population has consistently higher rates for the environmentally friendly modes, even as the totals for both increase over the 14-year period.

<sup>13</sup> As the TransitCenter survey was taken only in metropolitan areas, the percent of respondents using transit is higher than that reported nationwide in the NHTS surveys.

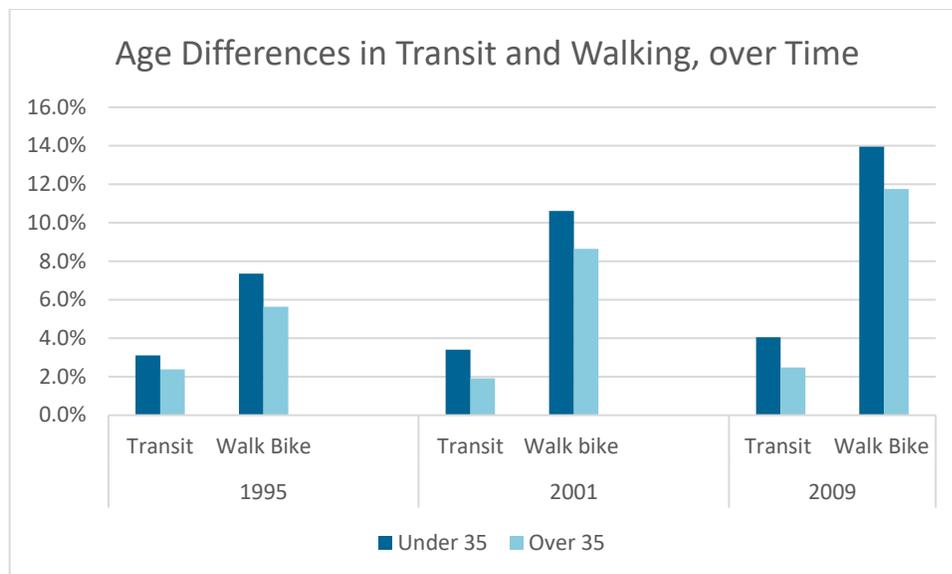


Figure 13 The younger groups show higher use of both transit and walking, with increase over time

### The Role of Age in the Use of Uber and Lyft

A survey by the Pew Research Center<sup>14</sup> in 2015 found a wide disparity between the travel behavior of younger people in the use of 'ride hailing' programs such as Uber or Lyft. While 28% of those under 30 years of age reported using the services, only 19% of those between 30 and 50 do. Only 8% of those between 50 and 64, and only 4% of those 65 and above used the service. Latinos had higher use than blacks or whites, and men had higher rates than women. Those with a college degree had a rate (29%) nearly five times that of those with only high school education (6%). All in all, about 3% of American adults use these services on at least a weekly basis, with 12% using them once a month or less often.

### Long distance modes

For the National Cooperative Rail Research Program Report 4, travelers making intercity trips were surveyed. Figure 14 demonstrates the important interaction of gender and age on mode choice for intercity travel. While Millennials have the same propensity to ride trains as older respondents, at about 11% of this sample, important variations occur in the choice of intercity bus. For this mode, older male participants have a rate of bus use of 5%, while younger female respondents have a bus share of 17%.

<sup>14</sup> Smith, A. (2015). "Shared, Collaborative and On Demand: The New Digital Economy, Pew Research Center

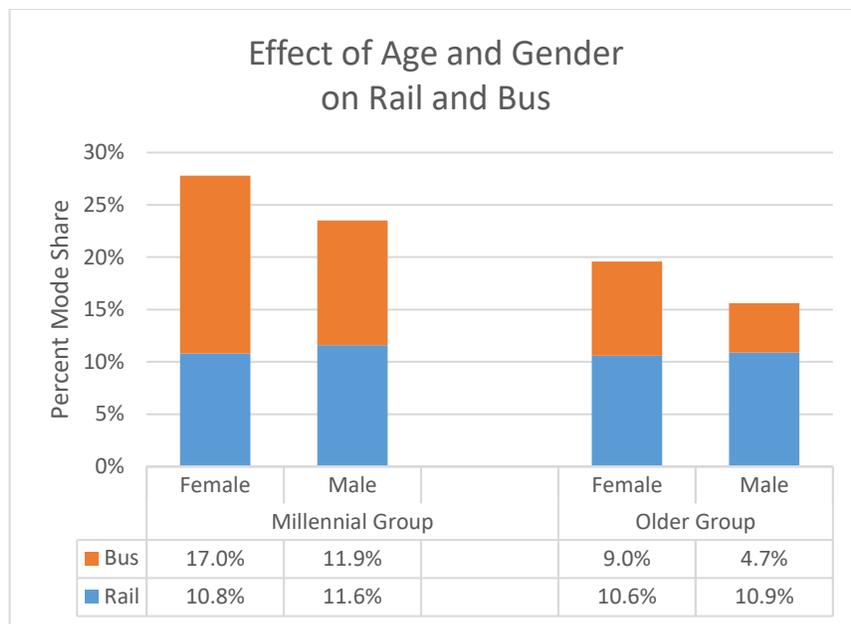


Figure 14. Millennial females take the intercity bus at a rate three times that of older males. Source, NCRRP Report 4

### Recap from Chapter Two: What We Know Happened

- The fall in auto travel at the turn of the century (roughly 1995 to 2009) was most pronounced in youth, in male youth, and in unemployed male youth.
- The decline was stronger for younger urban residents than for younger rural residents; low income rural residents lost more mobility than higher income rural residents.
- VMT decreased far more for young people in the Midwest and South than for young persons in the Northeast.
- Transit trips per capita went up between 2001 and 2009, but not at a scale to counteract the loss in vehicle miles.
- After 2008, Millennials began to regain their auto travel for the journey to work, with this pattern reported in 49 of 50 states by 2013.
- By 2013, VMT began to rebound.
- Younger groups have higher propensity than older groups to choose transit, intercity bus, intercity rail and to walk.
- The Millennials are far more likely to have tried Uber or Lyft than the older groups, but only 3% of travelers report using these services on a weekly basis.

# CHAPTER THREE: AGE-BASED DIFFERENCES IN ATTITUDES, BY REGION AND NEIGHBORHOOD TYPE

## Introduction and Structure

As discussed in Chapter One, the explanation for major changes in American travel behavior can only *partially* be attributed to factors traditionally analyzed in transportation, such as macro and micro-economic forces. This research is based on the concept that changes must also be examined in terms of possible differences in values, attitudes, and preferences of the Millennial Generation compared with those of the rest of the population. Chapter Three now explores differences between the Millennials and older age groups, and how those differences are (and are not) affected by the transportation characteristics of the neighborhood setting, and by the geographic region within the nation.

### Examination by Neighborhood Type, and Regional Classification

Traveler attitudes from five subject areas are examined for the differences in age groups, and for the effect of residential setting and national regions. The data are drawn from the TransitCenter survey, whose sample included more than 11,000 respondents, selected from 46 Metropolitan Statistical Areas. A list of those MSA's is presented in the Technical Appendix.

#### *Five Regional Categories*

For sampling purposes, five “regions” were defined: four of the regions—the South, West/Southwest, West Coast, and Midwest—were defined geographically. A fifth “region” was created to differentiate cities with mature and widely used transit systems—namely, New York City, Boston, Chicago, San Francisco, Philadelphia, and Washington, DC. This ‘region’ is referred to as the “Traditional Cities.”

#### *Four Neighborhood Types*

Four types of neighborhoods were defined based on the output of the Environmental Protection Agency’s Smart Location Database. This source includes an important measure of the transit availability of every location, here organized as ZIP Codes, which reflects the number of job destinations accessible by public transportation. The first category of neighborhood type is defined as having no transit accessibility reported, the sample is then divided into three equal size groups with lowest level of transit accessibility, a middle level, and highest level of transit accessibility. More information on the Smart Location Database is available from the EPA.<sup>15</sup>

#### ***More sources?***

The primary source for data in this NCHRP study of the Youth Market is the TransitCenter dataset, collected by RSG in 2014—it is the only available source of transportation-oriented attitudinal data that covers all the regions of the United States. In addition, we report on the results, by subject area, from several other smaller, more geographically limited surveys. They will be presented within this chapter in the form of sidebars, with highlighted summary material in table format, rather than in a graphical or chart format used for the TransitCenter data.

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<sup>15</sup> [www.epa.gov/sites/production/files/2014-03/documents/sld\\_userguide.pdf](http://www.epa.gov/sites/production/files/2014-03/documents/sld_userguide.pdf)

### *Five Subject Areas for Attitudes and Preferences*

This chapter will present our analysis of five groups of attitudes and preferences, looking for patterns by age group, which is further reviewed for variation by national region and variation in local transit accessibility. These attitudes, preferences, and beliefs concern:

- I. Auto orientation
- II. Urbanism
- III. Privacy and Personal Safety
- IV. Environmental issues
- V. Information Communications Technologies

### **Auto Ownership and Dependence**

Of the five issue areas covered in this chapter, it is the set of attitudes towards *auto ownership and dependence* where Millennials differ most from their older survey respondents; and these young-vs-older differences vary by national region and by neighborhood type. A variety of survey questions allow us to observe the differences between the age groups in this important subject area.

#### *Less Dependent than Parents*

The question of Millennials being less dependent upon the automobile than their parents was subjected to an ANOVA analysis, and the difference between Millennials and the older group was found to be statistically significant, with the Millennials agreeing more with the statement. The difference between men and women was found not to be statistically significant.

Millennials feel that they are less dependent upon the automobile than their parents are or were, and they believe this to be the case far more than the older group<sup>16</sup>. Looking for possible variation by neighborhood type, we can note from Figure 15 that this belief varies quite linearly with increasing level of transit quality of the neighborhood. Thus, for the older group, the level of perception of lower auto dependence in the most transit-rich neighborhoods is more than *twice* the level reported in the “no transit” neighborhoods. The influence of neighborhood type for the Millennials is also strong, resulting in a trend line which is largely similar in slope to that of the older group.

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<sup>16</sup> The survey format allowed 5 levels of response from “strongly disagree to strongly agree.” Agreement in this text is defined by the combination of “agree” and “strongly agree.”

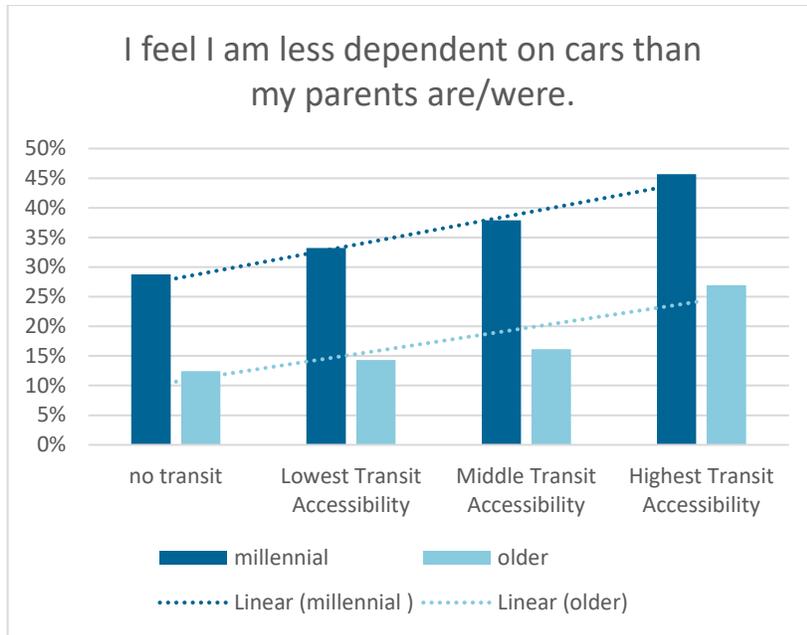


Figure 15. Propensity to report less auto dependence is stronger in the transit-rich areas

### Dependent on Car to Go Where You Need to Go

The Millennial group is less likely to report that they ‘need a car to go where they need to go’ than the older group. This pattern holds true for all four neighborhood types, and all five regional categories. Figure 16 shows that this difference is about 10 percentage points for the No Transit areas, and about 8 points for the most transit-rich neighborhoods. The young-vs.-older difference in the Traditional Cities is 17 points, compared to a difference of about 9 points for the South and Midwest. The statistical validity of the difference between Millennials and older group was confirmed in the ANOVA analysis, which also found no difference by gender.

Exploring the role of neighborhood type, Millennials in the No Transit communities have an agreement rate of 76%, which falls to 59% in the Highest Transit areas. The older group has an agreement rate of 86% which falls to 67% in the Highest Transit areas. Concerning regional variation, agreement with the premise is higher in the South and Midwest, and lowest for the Traditional Cities.

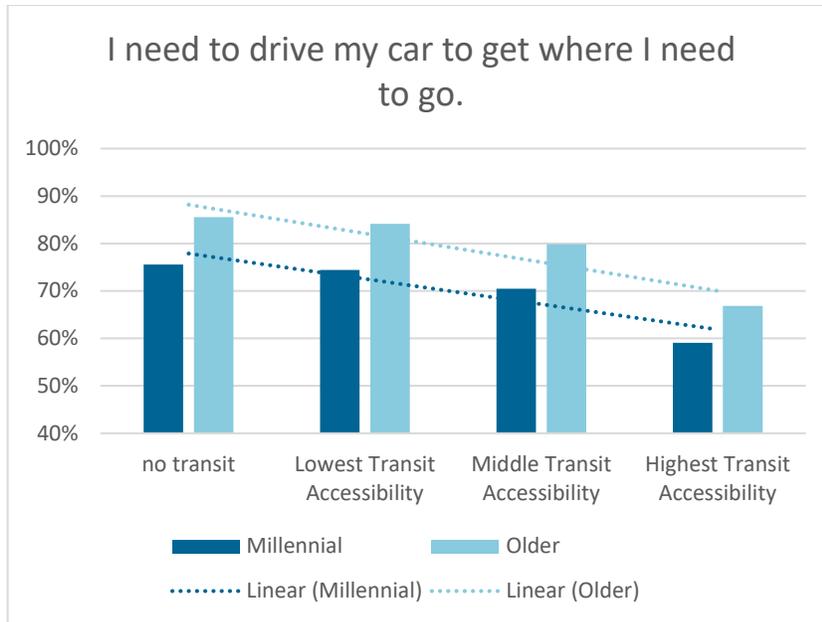


Figure 16. Both age groups in transit-rich areas report less need for the car to get to destinations

### Freedom and Independence

Consistent with the two variables discussed so far, Millennials have a lower propensity than the older group to agree with the statement “I love the freedom and independence I get from owning one or more cars.” This age-based relationship is true for all four neighborhood types, and all five regions. The ANOVA test confirmed the greater level of agreement by the older group than by the Millennials, with no valid difference found by gender.

Variations by regional category are modest (Figure 17). For Millennials, those in the South or Midwest have agreement rates of about 78%, which fall to 71% in the traditional cities. For the older group, those fall from about 87% to 83% in the Traditional cities. Propensity to ‘love’ these auto attributes did not vary in a meaningful manner by neighborhood type.

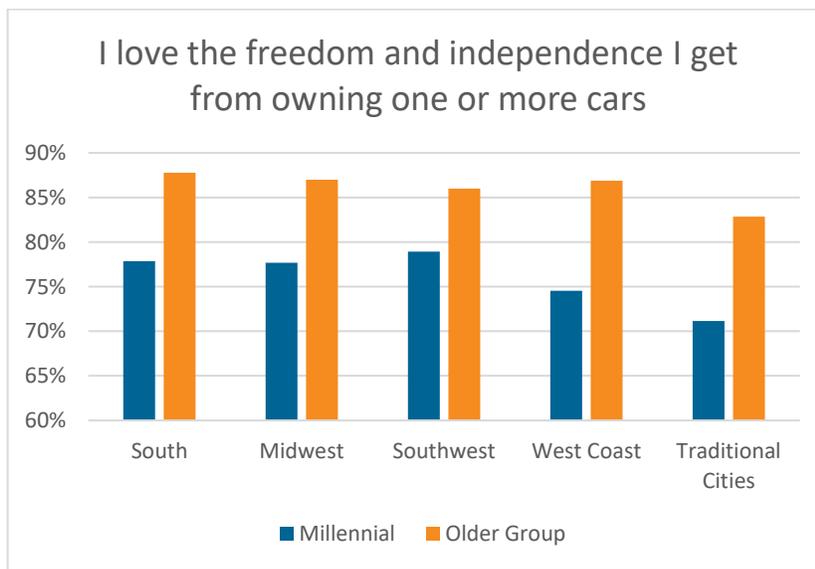


Figure 17. Millennials in the Traditional Cities value the hedonic aspects of car ownership least

### Sharing Cars and Bikes

Millennials are about twice as likely to agree with the sentence “I am a person who likes to participate in programs like carshare or bikeshare” than are members of the older group; this pattern holds true for each of the four neighborhood types, and for all five of our national categories. The statistical validity of the greater level of agreement from the Millennials was confirmed in the ANOVA analysis, which also found no difference by gender.

Looking for variation by neighborhood type, Figure 18 shows the Millennials located in the No Transit area had about 24% agreement, which rises to 31% for the most transit-rich neighborhoods. The older group members located in the No Transit area reported about a 10% agreement rate, with very little variation by type, rising to only 13% in the most transit-rich neighborhoods. Concerning national variation (not graphed), little meaningful variation was found by regional category.

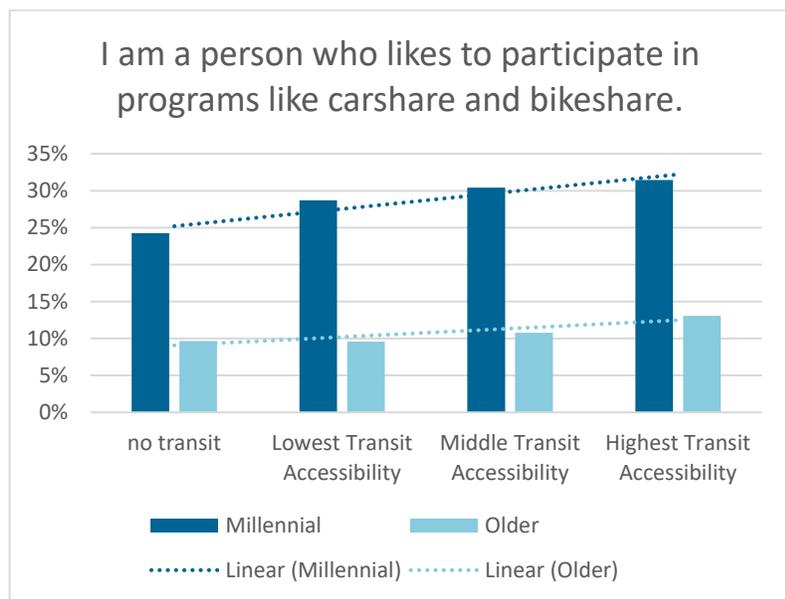


Figure 18. Increasing levels of transit orientation are associated with more ‘sharing’ for the Millennials.

### Driving in the Future

Given that we have established that the Millennials at their present age are less auto oriented than the older groups, it is somewhat reasonable to expect that those with the lowest present use might be most susceptible to increased auto use in the future, approaching more of the cultural average. This seems to be what is happening with the Millennials, with those in the Traditional Cities expecting they will have to increase their driving as they age (Figure 19). About 57% of those in Traditional Cities agree with the statement, while 53% of those in the South and Midwest agree. What is not expected is the remarkably low agreement level from the Southwest to this somewhat nuanced question: more interpretation may be needed before a simple answer can be provided. (This question was not asked of the older group.)

There was little consistent pattern of increase in expectation of increased future driving by neighborhood type. While, as expected, the most transit-rich areas had a higher agreement rate than the no-transit area, there was no consistent pattern in between.

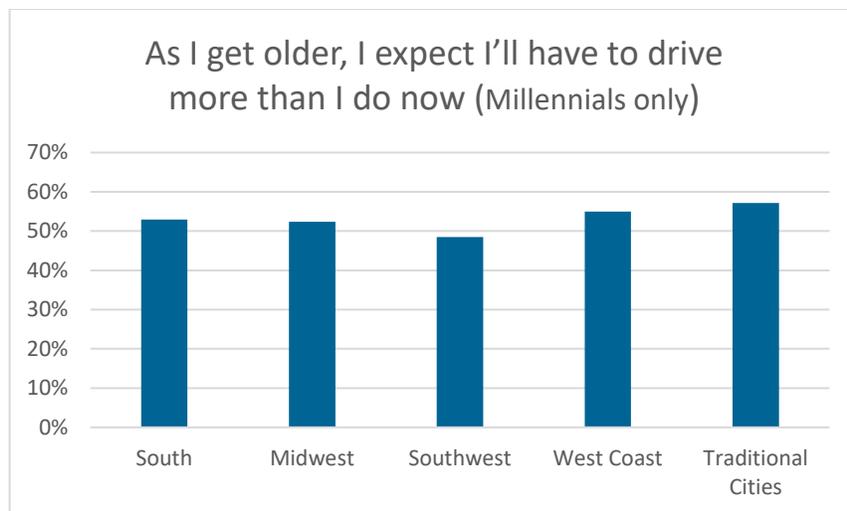


Figure 19. Most Millennials think they will end up driving more than they presently do

## Preferences towards Urbanism

The preferences of the Millennial generation towards urbanism are complex, and reflect contradictions and conflicts perhaps experienced by all age groups. On the one hand, younger persons have a higher evaluation of the urban location than any other age group. At the same time, those under 35 years of age define suburbs as their “ideal” location more than any other location category.<sup>17</sup> Given their present housing size, they would prefer to live in a larger house than their present house to a greater extent than older groups (who are already in larger housing units).

And the younger group is more willing to travel *more* in order to obtain this larger housing unit. While only 20% of the older group stated a willingness to commute longer than 45 minutes to attain a larger house, 43% of the Millennials said they would travel farther to make this critical trade-off. The ANOVA analysis confirmed that the Millennials *were more* willing by a statistically valid difference; it also found men more willing to make the long commute than women. We found virtually no variation by either neighborhood type or national region in the explanation of this age-based difference (not charted).

Millennials would prefer to live in the suburbs over the urban areas by a wide margin, with little preference for rural or small town locations, as shown in Figure 20. At the same time, subsequent survey work by Research Team (unpublished) also reveals an interest by the Millennials in “small cities,” whose density characteristics are similar to the suburban category used in this project.

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<sup>17</sup> The survey gave the respondents the choice of Urban, downtown, with a mix of offices, apartments, and shops; Urban, residential neighborhood; Suburban neighborhood, with a mix of houses, shops, and businesses; Suburban neighborhood, with houses only; Small town, with a mix of houses, shops, and businesses; Small town, with houses only; and Rural Area. We combined Small Town and Rural together for this analysis.

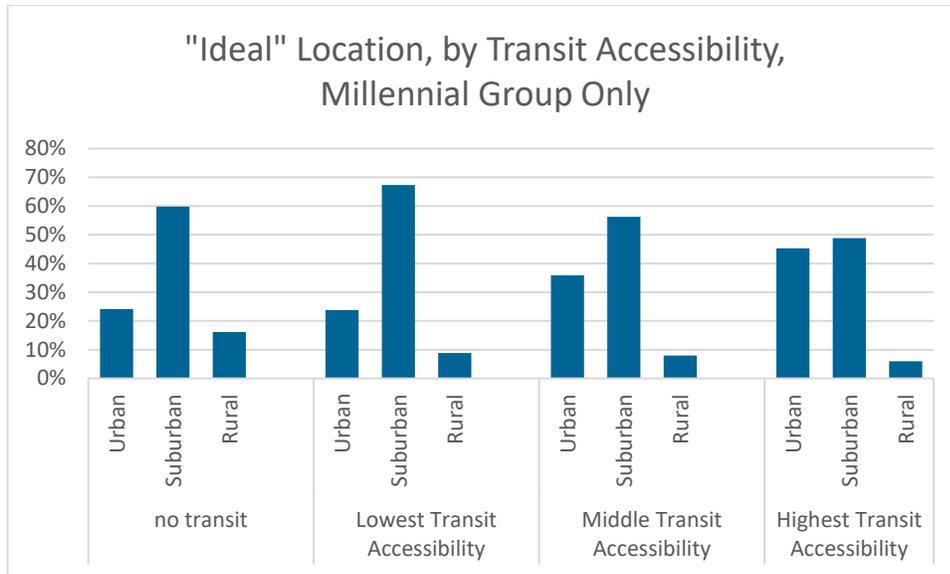


Figure 20. Millennials would prefer to live in the suburbs, with choice of "urban" rising with transit-richness

Concerning the urban context, which group values the urban location more? The answer is that the younger group shows a higher level of preference for the living in the city than do the older groups. This pattern is true for each neighborhood type, and for each national regional category. Concerning variation by neighborhood type, the Millennials are more likely to prefer urban living than the older groups in each type, as shown in Figure 21. The differences between the two groups vary by the level of transit-richness in the neighborhood. For the "No Transit" category of locations, the Millennials have twice the propensity to state that urban is their preference than do the older group, while this pattern of differences is least pronounced in the Highest Transit neighborhood type. The difference between the agreement levels with the urban location being "ideal" were examined with the ANOVA process, which confirmed that the difference is statistically significant; no differences were found between men and women.

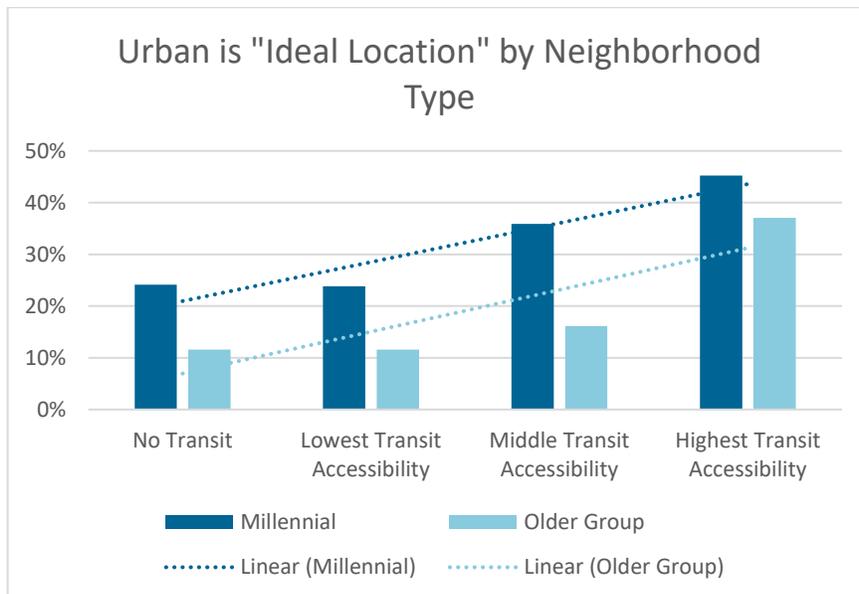


Figure 21. Increasing levels of transit-richness are associated with higher evaluation of urban life

While it is clear from Figure 21 that the location of your residence is associated with your propensity to prefer urbanism, there is less variation by regional categories. While the older group has no variation by regional category, the Millennials in Traditional Cities have a somewhat higher level of urban preference (at 35%) than they do in the South and Midwest (average 29%)

*Community Attributes: Walking Distance*

Millennials report that wanting a community with stores and commercial centers within walking distance was a factor in their choice of residential location to a greater extent than do members of the older group. The Millennials rating of walking distance was found higher than the older group in the ANOVA analysis, which also found women to value it more strongly than men.

The Millennial pattern is true for all four of our neighborhood type categories (Figure 22), and all five of our national region categories.) In the No Transit neighborhoods, 50% of the Millennials reported agreement with this premise, compared to 43% of the older group. In the most transit-rich areas, 69% of the younger group agreed, which is quite similar the 67% agreement rate of the older group.

*Other Survey Results: Ideal Location*

In a survey of 1,675 residents of the Northeast ( NCRRP, 2016), we found that more Millennials consider the suburbs the ideal location than urban areas. We found that Millennials have a higher propensity to choose “Urban” than do Older Groups.

	Millennial	Older
Urban	36%	23%
Suburban	49%	48%

Concerning larger scale variation about the importance of shorter walking distances, Millennials in Traditional Cities were more likely to agree (61%) with the statement than those in the lowest ranking region, the South (at 51%). This difference is similar to that for the older group, who showed agreement of 55% in the highest category, compared to 45% in the lowest region.



Figure 22. Importance of walking distance to stores varies by neighborhood type



Figure 23. Some variation by region is observable for importance of walking distance

### Expected Preferences for the Future?

Consistent with the discussion above about the expected future amount of driving by the Millennials, we can hypothesize that those with the greatest pattern of urbanity today might be most likely to expect those preferences to change with increasing age. This interpretation is largely supported in Figure 24. Agreement with statement “As I get older, I expect to value the suburban setting more than I do now” is higher for the most transit-rich neighborhood category (55%) than for the areas with the lowest transit accessibility (47%). Most of the difference occurs between the No Transit and Lowest Transit categories, with little variation between the agreement levels of the three categories with transit service. (This question was not asked of the older age groups.)

In a similar pattern, those in the Traditional Cities report agreeing with the statement more (56%) than those in the category with the lowest agreement, the South (48%). In both graphs there emerges a pattern in which young adults show geographic variation – the more one adopts a pro-urban residential format, the more one expects to increase his/her appreciation of the suburbs with age (Figure 24). This is a powerful factor in the broader question of whether the Millennials will continue their pro-urban orientation as they get older. *The answers to this survey question imply that many respondents to this survey will not.*

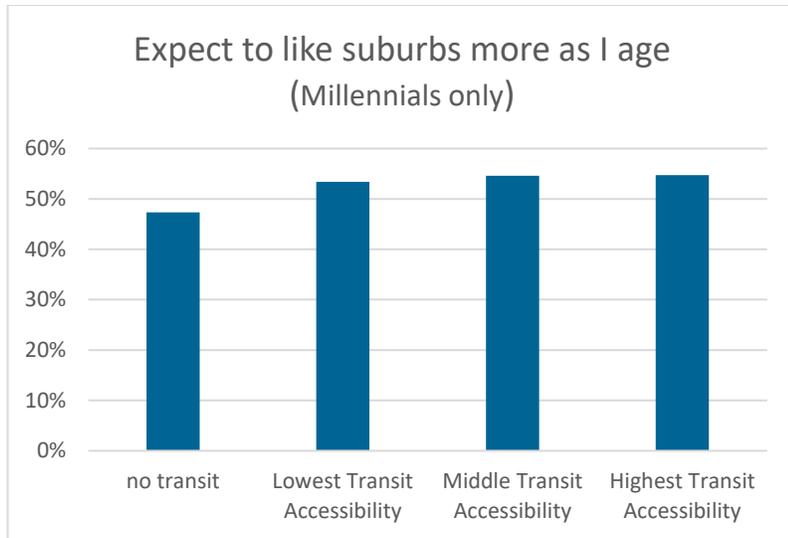


Figure 24. Most Millennials in neighborhoods with transit expect to like the suburbs more as they age

### Preferences towards Privacy and Personal Safety

The Millennial Group is considerably *more* cautious, more worried, and feels more negative about traveling in public with others than do the older group. Their attitudes about feeling safe in the trip will be discussed below, as they vary between long and short distance trip-making.

#### *Traveling with People I Do Not Know*

The scale of the difference between the Millennial group and the older group in the question of being concerned with traveling with others is dramatic (Figure 25).<sup>18</sup> (As expected, the ANOVA analysis confirmed that the difference by age group was significant, with women agreeing more than men.) The powerful explanatory variable here is the age category, and not neighborhood type nor the regional category. The Traditional Cities have essentially the same levels of agreement with the statement as does the South region, with no variation patterns similar to those from other survey questions.

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<sup>18</sup> In a rural survey about commuting (n=2296) we found that Millennials were more worried about traveling with people they did not know in a proposed vanpool project, with 44% of the Millennials stating they did not want to travel with strangers, compared to 31% of the older group.

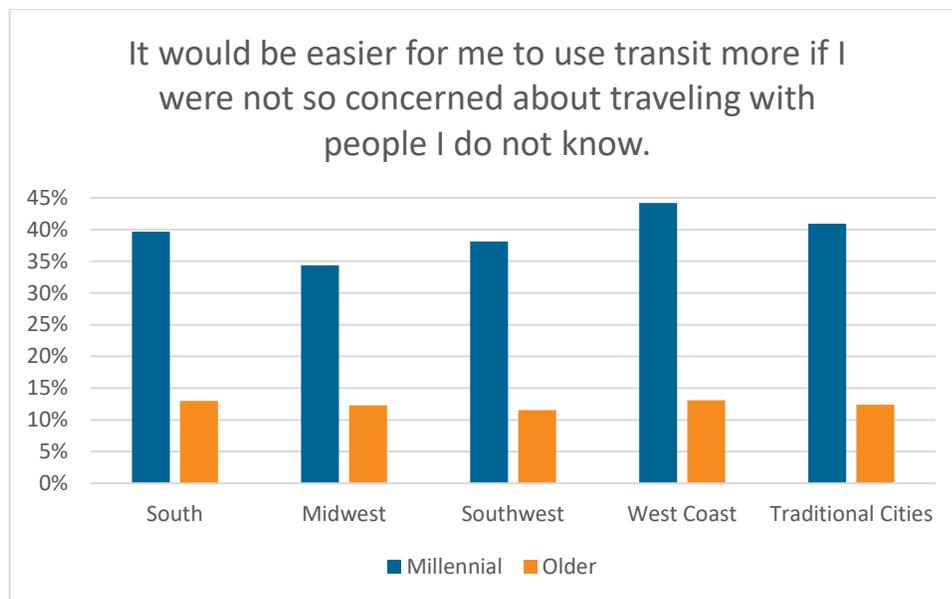


Figure 25. There is little regional variation in the difference between the Millennials and the Older Group

### Other Survey Results: Traveling with Strangers

In the NCRRP survey (n=6,142), Millennials were more likely than the older group to state that they are uncomfortable about being with people they do not know.

In a survey of 2,560 rural residents (2014), undertaken for the University of Vermont Transportation Research Center and the New England Transportation Institute we asked the views about making trips by public modes, in this case for a long-distance trip to New York City. Millennials tended to have more concern about safety, and about traveling with people they do not know than did the Older Groups. (Results of this survey were reported in NCRRP, 2016)

	Millennials	Older
<i>From the NCRRP survey</i>		
I would feel uncomfortable being on the train with strangers	41%	34%
<i>From the rural long distance survey (UVM-NETI)</i>		
I don't like the idea of riding with a lot of people that I don't know on a bus or train.	38%	22%
If I took a bus or train to NYC, I might have to be with people whose behavior I find unpleasant.	69%	48%
The experience at the NYC bus or train station would be so unpleasant that I would try to avoid it.	23%	18%

### Privacy Affects Mode?

Millennials, by a wide margin, are more likely to claim that concern for privacy in travel influenced their choice of mode than are their older colleagues. While the ANOVA test did confirm the validity of this difference by age group, no differences by gender were found. This pattern is true for all four

neighborhood types, and all five regional categories covered in this analysis. Almost no variation by region is shown in Figure 26 for either age group. A similar lack of variation occurred when categorized by neighborhood type (not shown).

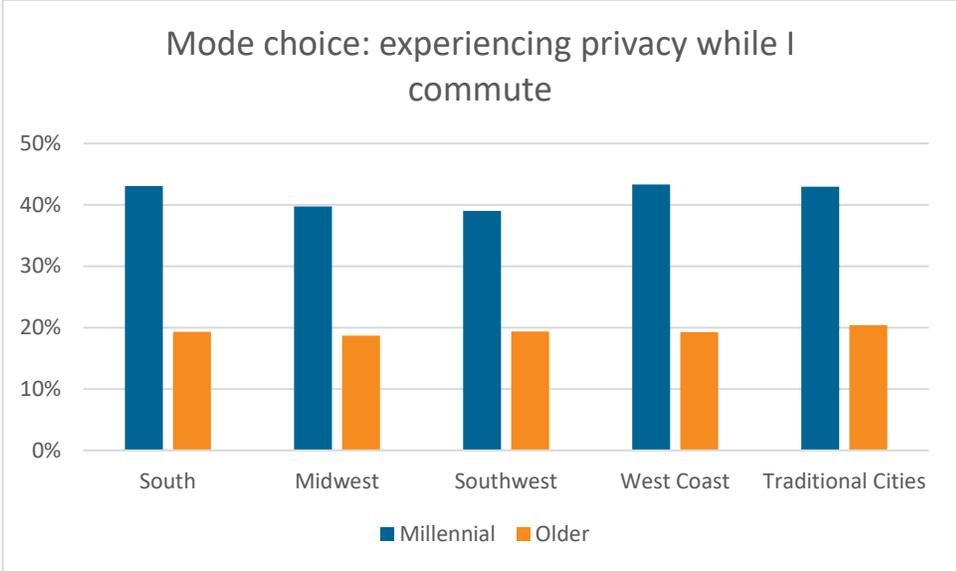


Figure 26. The difference between Millennials and the older group does not vary as a function of region

**Other Survey Results: Personal Safety and Crime**

In both the NCRRP long distance survey, and the rural long distance survey the Millennials are more likely to state their concern about safety in the trip than are the older group. Within the NCRRP survey it was also reported that the Millennials had higher feelings about personal safety on all modes, including air and auto. The precise reason for this pattern is unclear.

From the NCRRP survey	Millennial	Older
Worry about personal safety/disturbing behavior on the train	49%	45%
I would worry about crime or unruly behavior at the train station and on the train	46%	41%
It might be unsafe to make this trip by train	40%	32%

From the rural long distance survey (UVM- NETI)	Millennial	Older
Trip statements - It might be unsafe to make this trip by bus or train.	28%	17%

## Environmental Beliefs

When it comes to issues about the environment, Millennials have stronger propensities to claim that their environmental commitments might make them change their transportation behavior – but maintain a higher level of skepticism toward the legitimacy of environmental dangers, or the need to pay for fixing them.

### *Environmental Optimism*

Looking at a basic statement of environmental optimism, the Millennials are not statistically different from the older group as revealed in the ANOVA exercise. (That analysis did show that women had higher levels of agreement than men.) The belief that, when working together, we can improve the earth has very high agreement rates by all groups included in this study (not graphed). This pattern does not seem to vary directly by neighborhood type, nor by regional category. No consistent pattern emerges from the regional review, as the Millennials have somewhat less agreement with the statement in the Traditional and West Coast categories, but not in the other three.

### *Wanting to Drive Less?*

In many ways, the Millennials simply *agree with everyone else* that the environment can be improved. Consistent with this overall optimism, Millennials are far more likely than their older counterparts to report that “people important to them would prefer to drive less.” As shown in Figure 27, there is no significant pattern of variation as a function of neighborhood type/accessibility. What is clear is that the younger groups are far more likely to believe *that people important to them* would prefer to drive less, with no meaningful explanation stemming from either region or richness of transit.

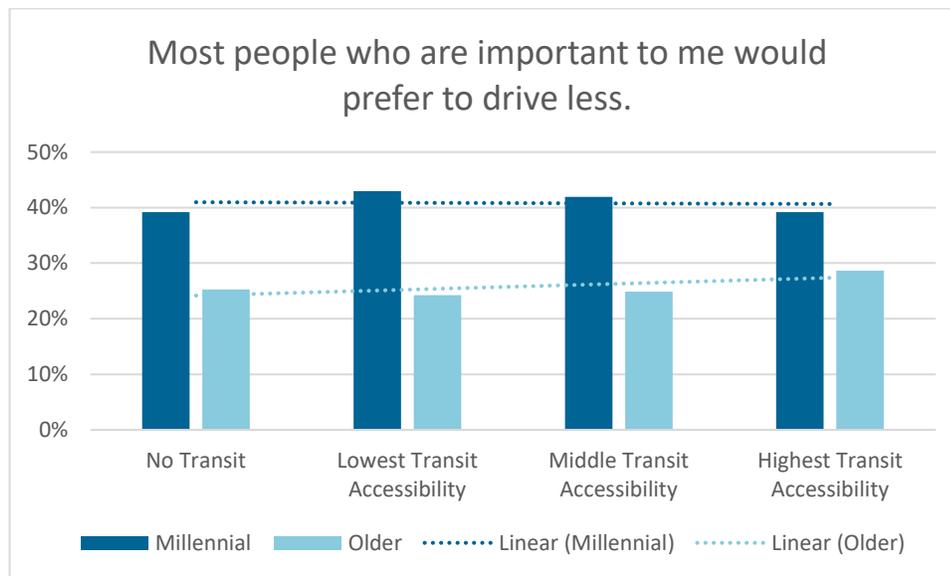


Figure 27. Millennials are far more likely than the older group to report those important to them want to drive less

The differences between the two age groups are dramatic (and significant), with Millennials in Traditional Cities, the West Coast and the Southwest reporting about a 40% rate of agreement, compared with about 25% for the older group. For both age groups, the regional category with the highest level of agreement is the South, representing a ranking order much different that seen for other survey variables.

### Changing Modes to Help the Environment?

The level of agreement with the statement that “I would switch to a different form of transportation if it would improve air quality,” is significantly higher for the Millennials than for the older group, with women scoring higher than men. Figure 28 breaks this down by the five regional areas. The dominant “takeaway” from the graph is the consistently higher levels of agreement from the Millennials—not from regional variation. The Traditional Cities category ranks higher than the others. Pro-environmental positions from the South rank as high as those of the West Coast, while the Midwest emerges as the least pro-environmental area. In many cases, the Millennials have agreement rates around 40%, compared to others at about 25%. The consistently higher levels of agreement from the younger group is the major observation for this environmental question.

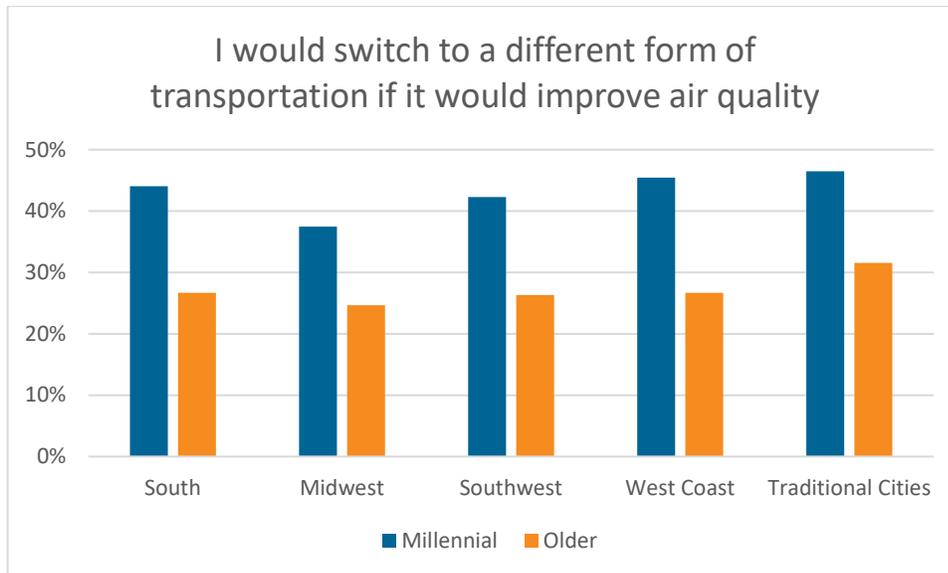


Figure 28. Millennials are more likely to report they would switch modes, with some variation by region.

Another dimension of environmental optimism is explored with the statement that “I like the idea of doing something good for the environment when I ride transit.” Again, the Millennials have significantly higher propensity to agree with the pro-environmental position than do the older groups in every region (Figure 29), as confirmed in the ANOVA test, which also found this statement more supported by women than by men. In terms of the neighborhood type, increasing levels of transit accessibility are associated with increase in the feeling that they are doing something good for the environment by riding transit.

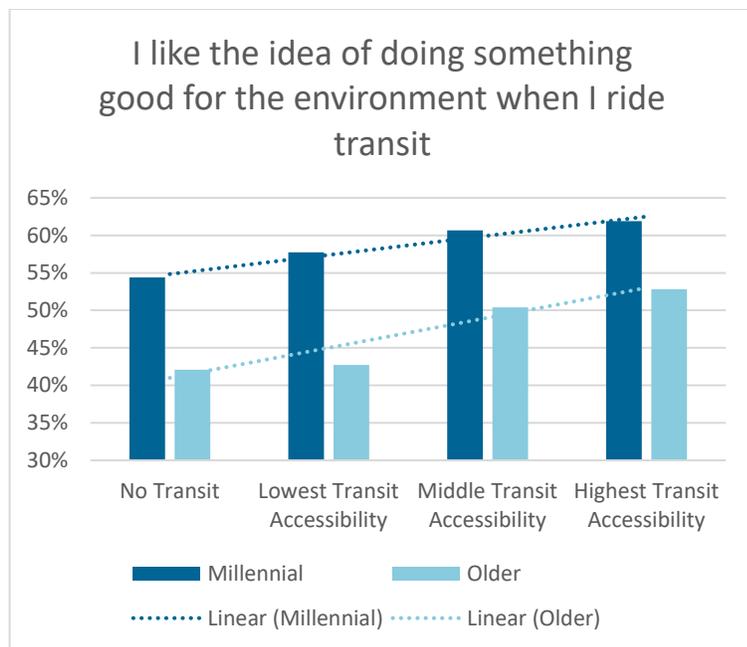


Figure 29. Variations by transit orientation are strong for the idea of doing good

### Levels of Skepticism

While the younger age category is reporting (generally) higher levels of agreement that their transportation behavior could become more pro-environmental in nature, the group under 35 has a higher level of skepticism about the seriousness of the threat to the environment than does the older group, and have less desire to pay for its improvement.

Figure 30 shows quite clearly that the Millennials have a *lower* propensity to agree that the environmental danger is real<sup>19</sup> as confirmed in the ANOVA test, which also found that men have more skepticism here than women. Concerning neighborhood type, very little variation is reported in the agreement levels for the Millennial group. This is in stark contrast to the older group, where those with better transit have higher belief in the reality of the environmental problem. *For the Millennial generation*, increase in the quality of transit provided is *not* correlated with increase in belief that the environmental crisis is real.

Figure 30 reviews the five regional categories. Here the Traditional Cities are associated with higher concurrence that environmental issues are real than for other regional categories – for the older age group, but *not for the Millennials*. Again, for every category explored in the two figures, the Millennials have a higher level of belief that environmental danger is simply “overblown” than their older counterparts. Difference by age category provides the most consistent explanation for this pattern of skepticism.

In response to a different question, Millennials (51%) were somewhat more likely to agree with the statement “Any government effort to reduce environmental pollution should not cost me any money” than were the older group (45%). The ANOVA test confirmed the validity of this difference, while

<sup>19</sup> The original phrasing “Believe that environmental concerns are overblown” has been reversed by using the combination of Disagree and Strongly Agree for these charts. The purpose was to minimize the use of double negatives.

finding no difference between men and women. We found little meaningful variation by our two factors in the explanation of differences (not graphed).

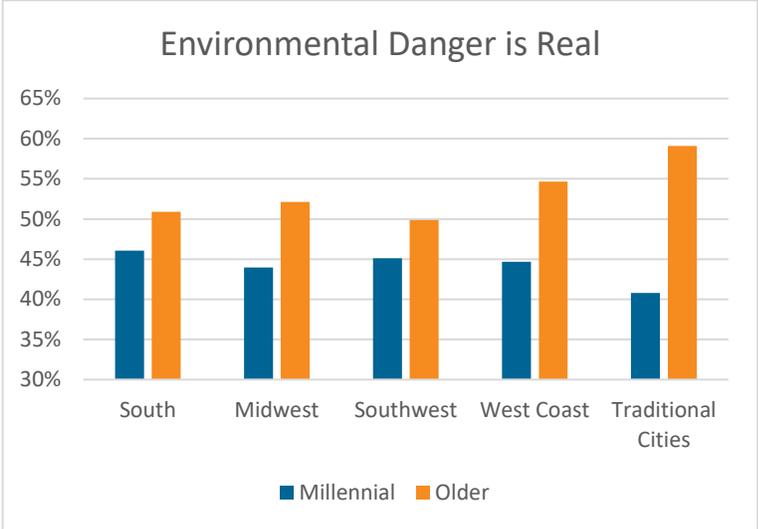


Figure 30. By regional category, Millennials in Traditional Cities have lowest agreement that dangers are real.

### Need for, and Dependence Upon, Information Communications Technology (ICT)

The Millennials are known for their fondness for, and dependence upon, a set of Information Communications Technology (ICT) devices intimately intertwined with their lifestyle. This section of the chapter looks for variation in those patterns by age, by neighborhood type, and by national regional category.

#### Hardest Product to Live Without

The TransitCenter survey includes a question about what devices would be hardest for the respondent to live without. Among the products named as candidate were cellphones (here with and without Wi-Fi combined into one category), other devices such as landline telephones and televisions, and the personal auto. The ANOVA analysis comparing all Millennials with all older groups concludes that, with statistical significance, Millennials were more likely to label the connected devices in this way than the older group, and *women were more likely* than men. Figure 31 looks at just two answers, cell phones (all) and the personal car. The result reveals something of the values of respondents, here presented as four age categories. As the age increases, the naming of the private car increases; as age increases, the selection of the cell phone decreases.

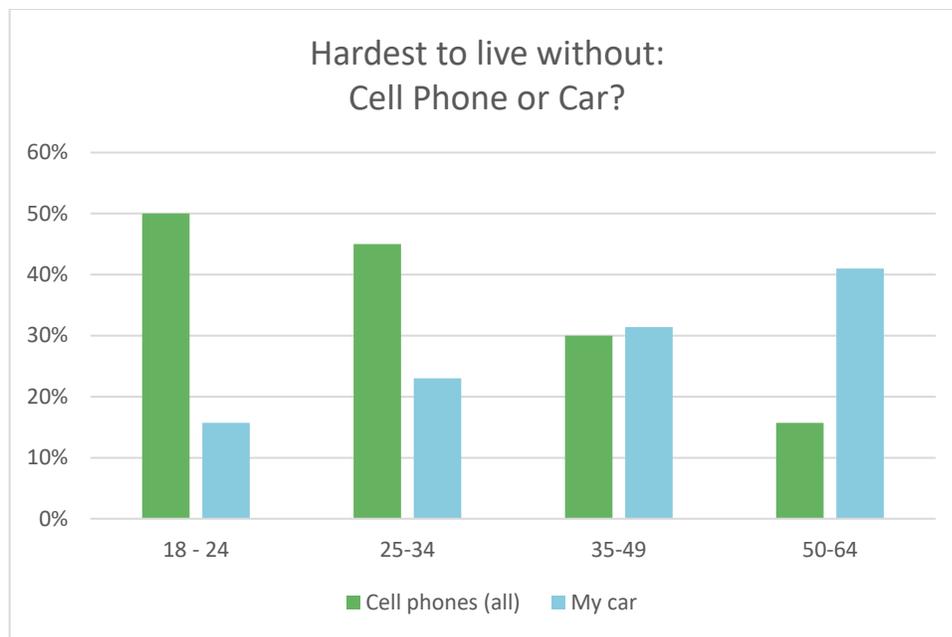


Figure 31. As age increases, the belief that cell phones are hardest to live without decreases, while auto increases

Clearly, for those under 35 years of age, the cell phone trumps the auto, by 50% to 16% for the youngest age category. For those above 50 years of age, the tables are flipped with 16% for the phone, and 41% for the car being the hardest to live without. We found that adding either neighborhood form, or regional location explains virtually nothing about the pattern of variation, which is, of course, a function of age.

### Access and Productivity

Millennials place a high priority on access to ICT devices, and to their use in support of being productive throughout the day, including while traveling. Significantly higher levels were found in the ANOVA exercise for Millennials over the older group, and for women over men. Looking for national regional variation, the results suggest that regions play a relatively small role in the age-based differences. Based on patterns shown throughout this chapter, it might have been hypothesized that the importance of ICT would be most prevalent in the Traditional Cities, but this is not the case. Variation by regional category for the Millennials is minor. Variation by region for the older group is interesting, in that the South has slightly higher (68%) propensity to concur with the statement than the Traditional Cities (63%).

Consistent with this, our analysis of the effect of neighborhood type on this variable found no meaningful pattern of variation. The two analyses together call into question any idea that the persons in the higher density cities have a higher propensity to emphasize the importance of ICT access than persons in other areas, for either age group. Needing to be connected is valued with some consistency across national regions, although always valued higher by the younger persons.

In a similar manner, neither regional category nor neighborhood type had any significant association with variation in the concept that the respondent wants to make productive use of his/her time. Overall, Millennials are more likely to agree with this statement than the older group did, at roughly 70% compared to 60%. The ANOVA analysis confirmed this to be significant, with women giving higher agreement than men. In terms of rank order of regions, Midwest is the lowest for this question.

# CHAPTER 4: INTERPRETATIONS FROM THE LITERATURE AND OTHER SOURCES

## Introduction and Structure

While the previous chapters have presented a wide variety of empirical data describing the general pattern of change in travel behavior by the Youth Market, the task of understanding how it all fits together remains before us. This chapter presents a summary of various explanations for travel behavior change, with an emphasis on those under 35 years of age, generally referred to as the “Millennial Generation.”

This chapter will review known and published interpretations about the reasons for the changes documented in the previous chapters of this Final Report. After a brief recapitulation of those issues, we will review key documents in the literature for their general contribution to explanations about the changes, and propose new explanations from new analysis done within this project.

Following a brief summary of some of the major conclusions from Chapter Two, we review some basic settings underlying all travel behavior before we focus in on the characteristics of the youth market. In this section, we first review the scale of travel change in the last two decades. A comparison is made between the trip generation in 2009 (and its 2009 population) and trips that would have been made if the 2009 population had kept the 2001 rates unchanged. This gives a sense of scale to the issue that is easily understandable.

Several early candidate explanations can be raised and dealt with quickly. Was this primarily a shift in modes, with driving replaced by more environmentally positive modes such as walking, biking and transit? Can we perceive a move towards sharing options such as carpools, or possibly taxis? Given that the number of trips went down, did the vehicle occupancy rates go up? Was the downward shift in trips and vehicle miles of travel explained by a significant decrease in auto ownership rates? We review the role of age and gender, starting with a rich set of contributions from the published international literature. The role of race is reviewed, as is the theory of delayed auto licensing. The logic of change in travel behavior being attributable to environmental commitment is also briefly reviewed.

This chapter focuses on the question of changing travel behavior using two combinations of economic shift and cultural shift. In some of the literature, the reason for the change in the travel behavior of youth is attributable to economic conditions; in other literature, a major cultural shift is suggested to have occurred. We can phrase this as two possible questions:

- To what extent does the change in the travel behavior of youth simply reflect some very difficult economic circumstances that characterized the last year of comprehensive data collection?
- To what extent should the change in behavior be attributable to some form of cultural shift in attitudes and beliefs?

## Recent Interpretative Literature

There exists within the literature several works which treat the decrease in travel as a simple application of economics. In *“It’s the Economy, Stupid: Increasing Fuel Price is Enough to Explain Peak Car in Sweden,”* Bastian and Börjesson write “in this paper we show that economic variables alone can explain the observed car use trends in Sweden 2002-2012.” In the United States, Taylor *et al.* (2013) in *“Who knows about kids these days? Analyzing the determinants of youth and adult mobility between 1990 and 2009,”* find that:

being employed, licensed, having access to cars, and residential area population density all significantly affect PMT regardless of age. By contrast, some socio-economic factors long found to influence adult travel – such as race/ethnicity and household income – are not significant for today’s teens. Finally, with the exception of employment, the effects of societal trends (ICTs, GDLs, and young adults “boomeranging” to live at home with parents) on youth travel are surprisingly muted. When it comes to recent changes in teen, youth, (and adult) travel behavior, the adage “it’s the economy, stupid” appears to hold.

Thus, the contents of the Project Bibliography establish that (1) a marked decrease in auto travel did occur around the turn of the century; and, (2) there is simply no early consensus as to whether this is all attributable to traditional economic explanation, or whether there remained unanswered questions about whether there may be more complex, more cultural changes taking place. Goodwin, (2012), in *“Three views on peak car,”* offers three explanations that:

...trends in car ownership and use in developed economies (a) are still in long-term growth with only temporary interruptions due to economic circumstances; (b) have reached their peak and will show little or no further growth; or (c) have passed a turning point and are now in long-term decline. The evidence is not yet conclusive, but is amenable to properly designed research. The author judges the third view to be a viable possibility with useful policy implications.

Other international observers of travel agree. In *“Peak car use: Understanding the demise of automobile dependence,”* Newman and Kenworthy conclude, “The peak car use phenomenon suggests we may now be witnessing the demise of automobile dependence in cities.” In *Are we reaching peak travel? Trends in passenger transport in eight industrialized countries,* Millard-Ball and Schipper note...

“that total activity growth has halted relative to GDP in recent years in the eight countries examined. If these trends continue, it is possible that accelerated decline in the energy intensity of car travel; stagnation in total travel per capita; some shifts back to rail and bus modes; and at least somewhat less carbon per unit of energy could leave the absolute levels of emissions in 2020 or 2030 lower than today. “

A multi-disciplinary approach to the question of the role of economic factors is offered by Garceau *et al.* (2014) in *“Peak Travel and the Decoupling of Vehicle Travel from the Economy: A Synthesis of the Literature.”*

The complex relationship between the economy (as measured by gross domestic product) and personal vehicle travel appears to be changing, and this change suggests a weakening connection between the two... Although causes such as saturation of demand, aging, decline of young drivers, preference shifts, and time budget constraints all contribute to reduced automobile travel at one time or another, or in one place or another, *none of these factors can explain why peak travel is occurring on multiple scales in a diversity of places.* The authors conclude that although the existing literature explains the recent trend reversal in specific cities or partially explains the global phenomenon, *the fundamental reasons for peak travel are still not understood.*

## Travel Behavior of the Millennials

The second group of articles presented in the Project Bibliography focus more specifically on the behavior of youth, here referred to as those between 18 and 35. The American Public Transportation

Association (APTA) has published a summary of an important TCRP project, in *"Millennials and Mobility: Understanding the Millennial Mindset."* They conclude that:

Millennials, with their relative propensity for urban lifestyle components (whether they live in cities or in suburbs), dexterity with technology, while starting careers during economically constrained times can leave a lasting impact on society. In fact, they are already driving trends. As has been noted in a number of reports, including US PIRG's report, *"A New Direction: Our Changing Relationship with Driving and the Implications for America's Future"*, rates of driving are down in the US, and Millennials are leading the trend.

Blumenberg et al. (2012) in *"What's Youth Got to Do with It? Exploring the Travel Behavior of Teens and Young Adults"* emphasize that, "unemployment rates during the current recession are highest for youth, thereby reducing journey-to-work and work-related travel and limiting the resources teens and young adults have to pay for non-work activities (and associated travel) of all types."

### *Two exceptional contributions in the youth market literature*

Two articles provide particularly meaningful advances in interpreting the travel behavior changes by the youth market. While both represent years of work in two disciplined academic settings, the two use considerably different methods to draw meaning from a common dataset, the U.S. National Household Travel Survey (NHTS)—and they arrive at somewhat different conclusions. As will be discussed later in this Chapter, these two papers<sup>20</sup> were highly influential in the direction taken by the Research Team to understand how all the major factors fit together in the explanation of the change in travel behavior at the turn of the century.

In the first of these two papers, several key factors were emphasized by Ralph (2015) in her PhD Thesis, *"Stalled On The Road To Adulthood? Analyzing the Nature of Recent Travel Changes for Young Adults in America, 1995 to 2009."* She finds that:

...economic constraints, role deferment, and racial/ethnic compositional changes in the population primarily explain the travel trends during this period. The evidence in support of preferences and residential location explanations was substantially more limited. The concluding chapter contextualizes these findings, arguing that a large and growing share of young adults suffer from transportation disadvantage. The most important take-away from this work is that the decline in driving by young people in the 2000's deserves our attention—not as an unmitigated success story, but as an early indication of a problem.

The second paper that influenced our work is that of McDonald, (2015) in *"Are Millennials Really the "Go-Nowhere" Generation?"*, which undertakes an analysis to estimate to the extent to which various theories/factors contribute to the pattern of reduced vehicle use by the young.

Among young adults, lifestyle-related demographic shifts, including decreased employment, explain 10% to 25% of the decrease in driving; Millennial-specific factors such as changing attitudes and use of virtual mobility (online shopping, social media) explain 35% to 50% of the drop in driving; and the general dampening of travel demand that occurred across all age groups accounts for the remaining 40%.

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<sup>20</sup> In this chapter, the two articles will be referred to simply as "Ralph" and "McDonald."

## Decomposing the Decrease in Travel

### Did they go to other modes?

Reviewing basic data first presented in Chapter Two (see Figure 4), the auto trip rate (per capita) fell between 2001 and 2009. This allows us to compare a 2009 population with 2009 auto trip rates, with the same population at 2001 trip rates. With these assumptions, Table 2 shows that the reduced 2009 trip rates would account for a drop of about 37.8 billion auto trips for the population as a whole.

As noted in Chapter Two, we cannot attribute this loss to any major shift in mode. At the same time as nearly 38 billion trips were not taken by car, somewhat more than 7 billion new trips were taken by walk, bike and transit. In short, this leaves to be explained a major decrease in the number of trips made, by all modes.

Table 2. Change in Trip Making Rate, applied to the 2009 population. Data from NHTS and McGuckin

	Trips Per Capita			Change in Trips: 2009 Observed Compared with 2001 Rates
	2001	2009	Change	
Auto	1,378	1,219	-159	-37,775,701,000
Walk+Bike	127	153	+27	+6,346,564,000
Public Transport	30	34	+4	+1,064,379,000

### Did they shift to taxis or carpools?

They did not shift to taxis, which account for less than one-tenth of 1% of journey to work mode in either survey. Uber and Lyft would be competing for this market, but were not relevant at that time. The decrease in auto trip making cannot be attributed to more efficient use of the vehicle, as the rate of carpooling *declined* during each decade since the 1980s, with rates of 12.2% in 2000, vs 9.7% in 2010 – a rather significant decline during the decade in which our two datasets were collected. FHWA reports that auto occupancy did increase from 1.63 persons per vehicle to 1.67 persons per vehicle, or a shift of less than one half of one percent.

### Was there just a general decrease in auto ownership?

Just as it cannot be concluded that all those not traveling by car simply moved to more environmentally friendly modes, we cannot observe a simple pattern of a decrease in auto ownership as a major explanatory factor.

There was not a substantial change in vehicle ownership rates between 2001 and 2009. In 2001, there were about .81 vehicles for every person in the population. In 2009, there were about .80 vehicles for every person. Phrased differently, there were about 1.7 million fewer vehicles registered in 2009 than would have been registered if the rate had stayed constant since 2001. This should be seen in the context of the 246 million vehicles registered in 2009. Thus, the rate of vehicles per person went down by approximately seven-tenths of 1%. Figure 32 shows the following years, from 2009 to 2013, had a very small decrease in the ratio, making it similar in scale with that of 1996.

It is important to note that although the ownership rate was only slightly lower in 2009 than in 2001, the year 2009 was part of a seven-year pattern of trending down (dotted line). Figure 32 shows that

ownership may have peaked at about 2007, falling with the great recession to a lower level which remained until the later period of economic recovery, in this case 2013. The figure shows a slight uptick in 2014 reaching .79 vehicles per person.

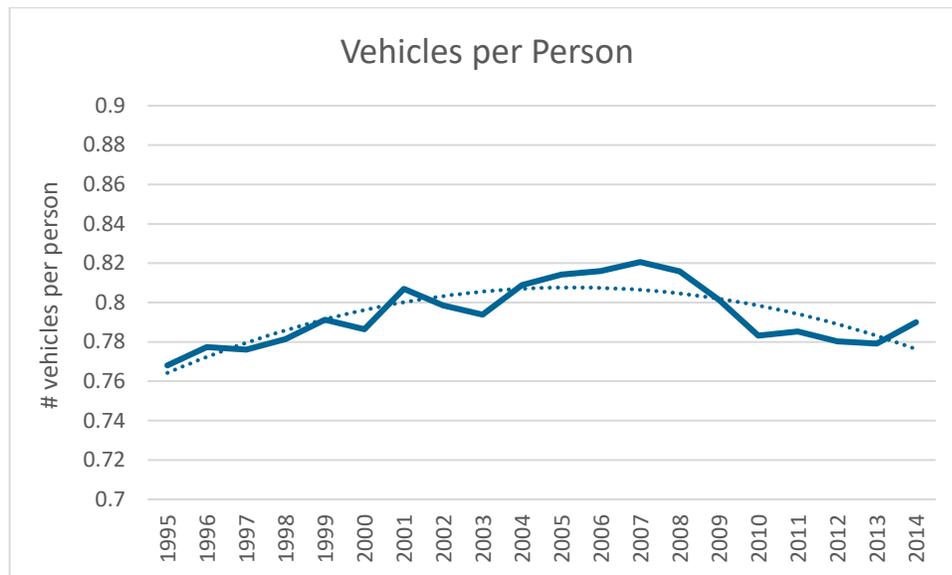


Figure 32. Vehicles per Person 1995 to 2014

### Were more people living in a zero-car household?

NHTS survey respondents in 2009 did have a greater propensity to live in a household without a car. Table 3 shows that, overall, the portion of the sample living in a zero-car household was about 17% higher in 2009 than in 2001. While we will review the role age below, it is interesting that all age groups above 25 years old have a similar pattern, those under 25 years old do not.<sup>21</sup>

Table 3. Rate of Zero Car Households by Age, 2001 to 2009. Source: NHTS, ORNL website

Age	Rate in 2001	Rate in 2009	2009 rate as percent of 2001 rate
18-24	6.3%	5.0%	79%
25-34	5.4%	7.1%	130%
35-49	3.5%	4.7%	134%
50-64	4.1%	5.2%	127%
65+	9.7%	11.6%	119%
<b>All</b>	<b>5.2%</b>	<b>6.0%</b>	<b>117%</b>

These themes of variation in vehicle availability were summarized by Sivak, in his 2013 article, “Has motorization in the US peaked?” He writes,

...the rates of vehicles per person, licensed driver, and household reached their maxima *prior* to the onset of the current economic downturn. Consequently, it is likely that the declines in these rates prior to the current economic downturn (i.e., prior to 2008) reflect other societal changes that influence the need for vehicles (e.g., increases in telecommuting and in the use of

<sup>21</sup> It should be noted that many in this age category are living at home, where the auto is provided by someone else.

public transportation). Therefore, the recent maxima in these rates have better chances of being long-term peaks as well. However, because the changes in the rates from 2008 on *likely reflect both the relevant societal changes and the current economic downturn*, whether the recent maxima in the rates will represent long-term peaks as well will be influenced by the extent to which the relevant societal changes turn out to be permanent. (Emphasis added.)

### Decrease in VMT: Delayed Acquisition of Licenses by Age and Gender

Chapter Two showed that for 24 year olds between 2001 and 2009 there was a fall in the licensing rate from about 88% to about 85%, based on FHWA calculations. Similarly, that section reported that for both males and females those in the 25-34 category at the time of the NHTS, the licensing rate fell by about 3% for the same reporting period. By far the strongest pattern documented was the delay in the attainment of the first driver's license, which occurs more strongly now at 17 or 18 years of age rather than earlier patterns of 16 years of age. The majority of Americans who were born before 1980 finished the license acquisition process at the age of 16; whereas the majority of Americans today attain a license at 17 or 18 years of age. What we are witnessing is a *delay in the licensing process*, not a significant change of longer range transportation behavior.

The VMT implications of delayed driver license acquisitions among American youth are likely to be trivial, particularly among the youngest cohorts. The average VMT of 16-20 year olds over this period has steadily reduced, but only retirement-age Americans drive less on average. However, Cohorts aged 21-25 and 26-30, have remained among the heaviest drivers on average *despite* having also reduced their driving over this time period. Also, as noted above, most cohorts have been shown to "catch up" to license rates of previous cohorts after only a year delay upon reaching the age of 19. Therefore, delayed licensing is likely to produce meaningful effects to the VMT of only 16-18 year olds. However, as this group is among the smallest in terms of licenses held, and overall VMT of any age group, the implications of delayed licensing to VMT are small.

### Decrease in VMT: The Literature on Gender and Age

In the search for an interpretation of what happened to VMT at the turn of the century, we can draw from the literature the role of age and gender in the changes in travel behavior. Several authors have observed that some of the largest changes in mobility patterns in the last 15 to 20 years have taken place among young men (Le Vine and Jones, 2012; Kuhnimhof, 2012).

## Decrease in VMT: The Role of Race/Ethnicity

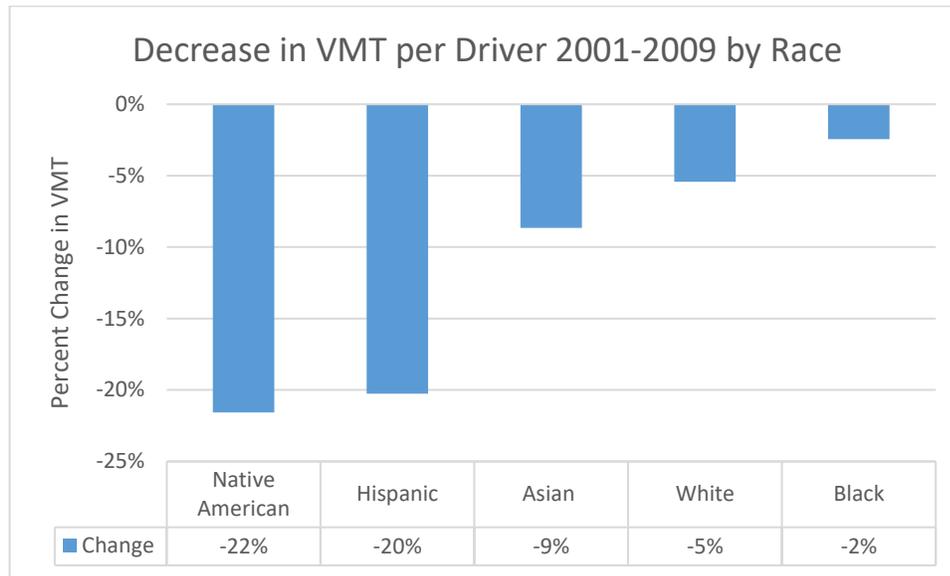


Figure 33. Decrease in VMT by Race/Ethnicity. Source NHTS, from ORNL website

### *The effects of changes in racial composition*

The important role of race can be seen in Figure 33. Ralph cites research from the Pew Research Center, indicating that young people in 2009 were the most racially diverse generation in American history. She observes that white young adults of every age were more likely to be employed and that black young adults of all ages experienced much higher unemployment than other groups, although the gap declined with age, while the gap in employment between whites and Hispanics held steady at around ten percentage points for each age category. Black and Hispanic young adults were disproportionately more likely to live in households with limited income and disproportionately less likely to have high household incomes. Moreover, during the 2001-2009 period, an increasingly larger share of black and Hispanic young adults was in the lowest income quintile (particularly in 2001) and an increasingly larger share of white and Asian young adults was in the highest income quintile. Further, she found that racial-ethnic minority young adults were far more likely than their white peers to live in very large cities (of more than three million people). While three in ten white young adults lived in very large cities, nearly five in ten blacks and Hispanics did and nearly seven in ten Asians did.

McDonald and Ralph also found that non-Hispanic black and Hispanic young people are less likely to make automobile trips than other young people. Ralph found that while just nine percent of white young adults were Car-less in 2009, a quarter of black or Hispanic young adults were Car-less.

In terms of changes over the period, Ralph found that Hispanic young adults experienced the most dramatic reductions in the propensity to be Drivers and an increase in the propensity to be Car-less over time, followed by white young adults (the estimated change in Drivers and Car-less was relatively large for Asian young adults, but there was substantial uncertainty about the estimate). The pattern of change over time differed for black young adults – while the other groups became less likely to be Drivers and more likely to be Car-less, black young adults experienced no such changes.

Ralph estimated that changes in the racial composition of the population accounted for roughly 20 percent of the total decline in Drivers and increase in Car-less young adults. Racial composition changes were incorporated in the lifestyle changes estimated by McDonald.

## Decrease in VMT: Did ICT Lower the Amount of Travel?

### *Information communication technology (ICT)*

Internet technology improved substantially in the period between 1995 and 2009, and therefore it is generally hypothesized that young people growing up in that era are much more likely to be comfortable with ICT. But the relevant question for travel behavior research is whether ICT has served as substitutes or complements to travel. Mokhtarian (2002) concluded, at the time, that, “the empirical evidence for net complementarity is substantial, although not definitive, and the empirical evidence for net substitution appears to be virtually nonexistent.”

### *Travel and Information Communications Technology*

A more contentious debate occurred with the conclusion of Sivak and Schoettle, who noted in “*Recent changes in the age composition of drivers in 15 countries*,” that “the results of the analysis are consistent with the hypothesis that access to virtual contact reduces the need for actual contact among young people.” Later, Le Vine (2014) et al concluded in “*Establishing the links between online activity and car use: Evidence from a combined travel diary and online-activity pseudo-diary data set*,” that “net of other effects, Internet usage is positively associated with car use. The marginal effect of time spent online was, however, found to be negative.”

The concept that information technology was directly replacing physical travel was forcefully challenged in a recent study by the German research arm of BMW, *imfo* and the Imperial College which asked “*Does increasing use of ICT lead to changes in mode choice and car ownership decisions?*” They concluded that “The role of ICT in people’s mode choices (e.g., bus, car, walking) and in car ownership appears to be, at most, secondary. Classical considerations such as prices, travel time, reliability, convenience, and prestige appear to persist as dominant factors in these decisions (Jacek et al, 2015). (See Chapter Four for further discussion of their conclusions.)

In a major study *imfo* collaborated with the Imperial College in London; in “*ICT and Physical Mobility*,” Jacek et al. (2015) concluded:

... that the naïve expectation that ICT is serving to replace physical mobility is unsupported by either theory or the empirical evidence in the public domain. Leading scholars demonstrate that, depending on one’s interpretation, the results are either indeterminate in their conclusions or tend to, on balance, refute this ‘replacement hypothesis’. The exact nature of the relationship typically depends on the specific instance of ICT and the prevailing travel conditions of the physical mobility, contextual factors such as institutional flexibility in employing ICT-based forms of interaction, individual preferences and skills, and the available infrastructure...

Does increasing use of ICT lead to changes in mode choice and car ownership decisions? The role of ICT in people’s mode choices (e.g. bus, car, walking) and in car ownership appears to be, at most, secondary. Classical considerations such as prices, travel time, reliability, convenience, and prestige appear to persist as dominant factors in these decisions.

In “*Explore the relationship between online shopping and shopping trips: An analysis with the 2009 NHTS data*,” Zhou and Wang (2014) found that “online shopping encourages shopping trips while shopping trips tend to suppress the online shopping propensity.” In “*Is the Rise of the E-society Responsible for the Decline in Car Use Among Young Adults? Results from the Netherlands*,” Kroesen and Handy (2015) concluded that, “among the Dutch, the latest trend in the digitalization of society does not play a major role in the currently observed downward trend in automobility.”

Le Vine *et al.*, (2014) in "*Establishing the links between online activity and car use: Evidence from a combined travel diary and online-activity pseudo-diary data set*"... found that, net of other effects, Internet usage is *positively* associated with car use. The marginal effect of time spent online was, however, found to be negative." In a related study, Le Vine (2014) found that "young adults who use the internet are, net of confounding effects, *more* likely to hold a driving license than otherwise identical young adults who do not use the internet."

In a review of the TransitCenter dataset, we looked at the relationship between amount of Internet use and total reported trips by all purposes. The correlation was *positive*, not negative and it was significant. To focus more specifically on Internet use, we undertook a regression exercise that controlled for age, income, employment status, and transit quality (among others); and the relationship was still positive with a standardized coefficient of 0.7. We explored non-work trips, which also resulted in the same coefficient. In short, the greater the number of hours spent on the Internet, the *greater* is the total number of trips taken.

### Environmental Concern and Actual Travel Behavior

Could the decline in auto travel be attributed to a sudden increase in environmental sensitivity? Probably not. The weakness of the link between environmental concern and transportation behavior has been well documented in the available literature. As early as 1995, Grob, in "*A structural model of environmental attitudes and behaviour*" reported

The strongest effect on environmental behaviour stemmed from personal-philosophical values and emotions. *No effects on environmental behaviour stemming from factual knowledge were found.* Thirty-nine per cent of the variance in environmental behaviour was explained by the attitudinal components.

The theory that awareness of environmental implications influences travel behavior has been explored in several articles. Line, *et al.*, (2010) found their sample of young people claimed "that their current environmentally friendly travel behaviors (such as walking or cycling to school) are not influenced by the issue of climate change..." DelBosc and Currie (2013) reported that in their panels of young people in Australia "not one person in the sample spontaneously mentioned that environmental concerns shaped their travel choices; even when prompted these concerns were far removed from travel decisions."

### Unemployment and Economic Factors in the Decline in VMT

The interaction of gender, employment, and age in the decrease of VMT

#### *Unemployment rates in 2001 and 2009*

The year 2009 was a very difficult year to be young and unemployed, and the extent to which this dominated the decline in VMT is still being debated. While the unemployment rate for the country was extreme at 9% (twice that of early 2016), the rate for those between 16 and 24 was historic. The US Census at the time wrote, "The youth unemployment rate (the unemployment rate for 16 to 24 year olds) was 18.5 percent in July 2009, the highest July rate on record for the series, which began in

1948.”<sup>22</sup> For young males it was about 20%. This was a major increase compared with the 2001 youth rate of about 11%, as part of a national rate of 5%.

Table 4 shows that the portion of the sample in the “Worker Status = No” group in the NHTS worsened by 14 percentage points for the age category 18-24 between 2001 and 2009, but actually improved for the age category 35-64 years. It is important to note that the NHTS ‘worker status’ variable is not the same thing as the Unemployment Rate defined by the US Government agencies, and incorporates answers to several survey questions in the development of this joint index. Nonetheless, in general, the variation over time in the scale of survey respondents in the “Worker Status = No” reflects expected patterns by age category.

Table 4. NHTS Worker Status for 2001 and 2009. Source: Data from NHTS, ORNL website.

	Percent of Category with NHTS Worker Status = No			
Survey Year	Age Category			
	18-24	25-34	35-49	50-64
2001	22%	21%	20%	34%
2009	36%	25%	20%	29%
Interpretation/ Scale of Difference	<i>Worse, with 14 point difference</i>	<i>Worse, with 4 point difference</i>	<i>Same</i>	<i>Better, with 5 point difference</i>

### VMT by unemployed males: comparison between 2001 and 2009

Looking at the decrease in VMT per driver in Figure 34, we see that youngest *employed* males in 2009 had a VMT rate 17% less than in 2001; we see that same aged *unemployed* males had a VMT per driver rate 33% lower than in 2001. Although these numbers are difficult to interpret, it would seem *that being unemployed in the great depression of 2008- 2009 was associated with far less car driving than being unemployed in the year of 2001*. This is true for all male age categories, but with most serious consequences for those under 35 in 2009. Looking at females of all ages combined, it seems that all of the loss in this period was experienced by those without employment. Looking only at males, patterns of VMT decrease were far more dramatic for those without employment than for those with employment, this is true for both age categories.

Males in all age groups combined<sup>23</sup> witnessed a VMT decline of 11%; those in the employed category lost 8%, and those in the unemployed category lost 9% of the VMT. For unemployed males, those between 18 and 24 years saw a decrease of 33% with a decrease of 21% for those between 25 and 34 years.

<sup>22</sup> Bureau of Labor Statistics, U.S. Department of Labor, The Economics Daily, Youth unemployment and employment in July 2009 on the Internet at [http://www.bls.gov/opub/ted/2009/ted\\_20090828.htm](http://www.bls.gov/opub/ted/2009/ted_20090828.htm) (visited February 06, 2016)

<sup>23</sup> “All age groups combined” includes all the males in the sample, from 15 years to 93 years. The charts describe participants between 18 and 64 only.

The changes for females were less conclusive, as the change for employed women between 18-49 was statistically insignificant, with an increase for those above 50 years of age. Unemployed women fared worse, with those 18-24 and 35-49 experienced loss, while change in the other categories was statistically insignificant.

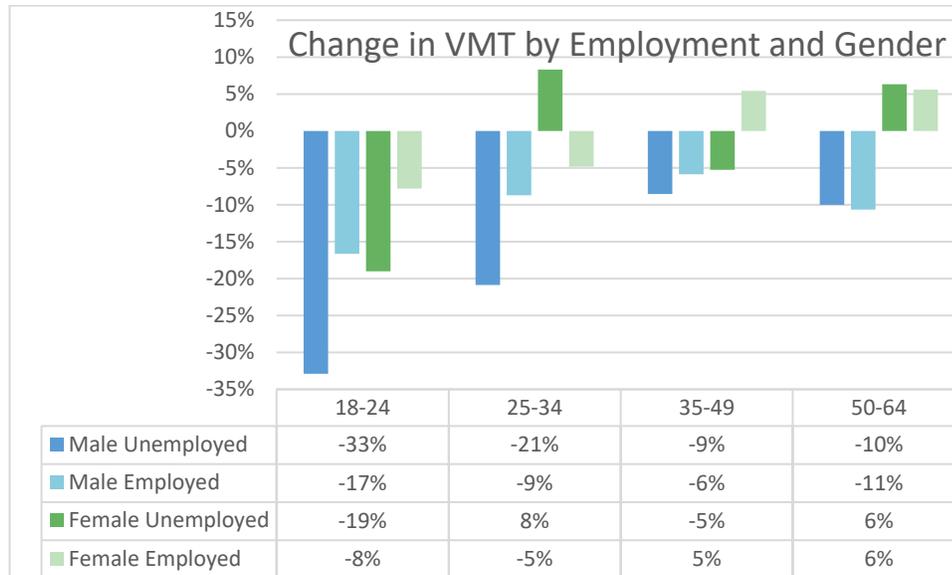


Figure 34. The decrease in VMT by unemployed young males is revealed in these data. Source: Data from NHTS, ORNL website.

Figure 35 presents data for the unemployed males *only* for the two survey years. Together these graphics show that (a) VMT rates were down sharply for those in the unemployed category and (b) such unemployment was particularly acute for those in the younger age categories. In short, bad economic conditions for the young in 2009 were strongly associated with low rates of auto use at that time.

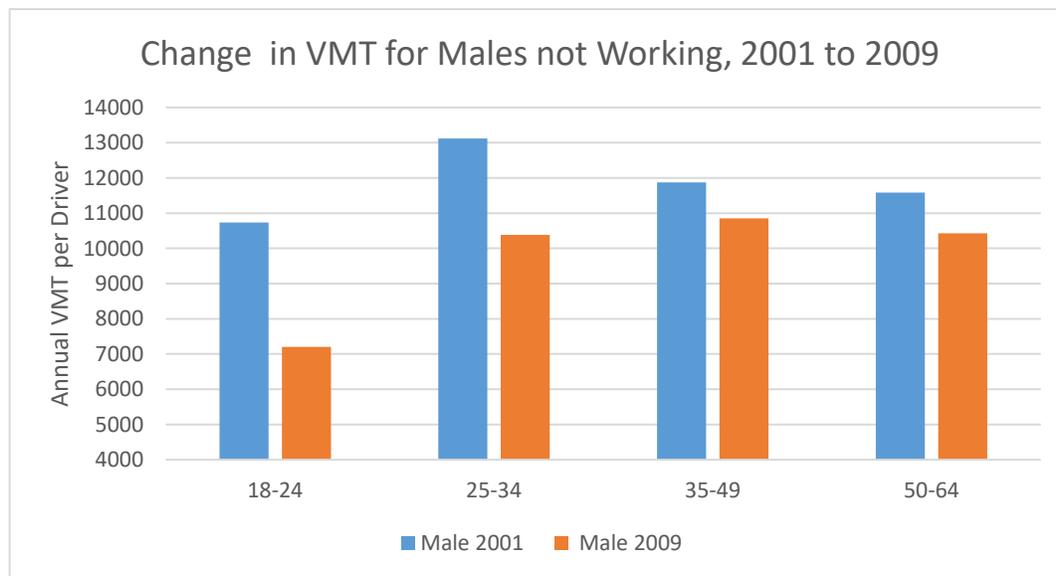


Figure 35. Change in VMT between 2001 and 2009 by males not working by age category. Source: Data from NHTS, ORNL website.

Figure 35 shows a sharp drop in the VMT among those in the “not working” category of the NHTS over the eight-year period. At the same time, the average American had slightly less buying power in 2009 than in 2001, but not on a scale that would explain VMT variation of the magnitude being observed.

The surveyed population between the ages of 25 and 64 had household incomes which were modestly *less* wealthy in 2009 than they were in 2001, when observed in constant (2001) dollars). For the two surveys together (all age categories) about 55% of the groups from each year lived in households with over \$50,000 of income – thus, they experienced no effective increase in spending power over this (near) decade. But, for those between 25 and 64 years of age, a modest decrease in real spending power (of between 1 and 2%) seems to have occurred (NHTS). The demographic data seems to support the general observation that there was there was little meaningful change in real (constant) income to be spend in 2009<sup>24</sup>, but *the changes in these specific categories would not explain the kind of scale of VMT loss discussed in this study.*

### Traditional economic factors, e.g., prices and incomes

The focus here is on the observed effects of traditional economic factors, including changes in the prices for travel and changes in incomes (noting that some of the income effects may also be tied up in employment effects, discussed above).

Neither McDonald (2015) nor Ralph (2015) explicitly quantify the size of economic effects more generally on automobile use for young people. However, on this issue, Ralph observes that “the bulk of the decline in driving occurred for young people with the fewest resources – those without jobs (discussed above), with low incomes and/or limited educational attainment,” suggesting that economic constraints were a key driver in the decline in Drivers and increase in Car-less-ness. She cites research from Carnevale, Hanson et al., (2013) based on analysis of the Current Population Survey that found that earnings fell for the typical young adult (age 21 to 30) between 2000 and 2010 and fell most for those with limited educations; specifically noting that college graduates’ earnings fell by nine percent during the decade, whereas wages for workers without a high school degree fell by more than twice as much. Moreover, she finds that the relationship between resources and traveler type (and travel) strengthened over the time period of analysis—widening the gap in travel between the haves and the have-nots.

Ralph also reports that the costs of owning, operating and insuring a vehicle increased during the survey period. While such effects will influence the population more widely (as in the McDonald analysis), some, such as changes to insurance costs, may have a larger effect on young people.

As we understand, the lifestyle impacts quantified by McDonald also take account of income changes. Other economic changes that impact travelers more generally, including changes in the cost of travel, would be included within drivers that would impact travelers generically (estimated to account for around 40 percent of the reductions in travel).

An analysis in Sweden by Bastian and Borjesson (2014) makes a strong case that fuel price and GDP changes have had significant impacts on car use and mostly explain peak car effects across the whole of the population in Sweden. While this work does not focus on young people, it does indicate that the scale of such impacts could be substantial.

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<sup>24</sup> Data published at [https://en.wikipedia.org/wiki/Median\\_income](https://en.wikipedia.org/wiki/Median_income) shows that the (constant) median income for the years of the ‘2001’ survey and those of the ‘2009’ survey are essentially the same.

## Was there a boomerang effect?

Focusing our attention on the differences in residential characteristics between 2001 and 2009, it does not seem that differences in the propensity to live at home with parents can explain much of the travel behavior differences. In 2001, about 50% of those between 18 and 24 lived with their parents; by 2009, this percentage had grown to about 52%. In 2001, about 10% of Americans 25 -34 lived with their parents; by 2009, this percentage had grown to about 12%. Thus, changes in location with the parents might explain *some* of the decrease in VMT by the younger groups. It is worth noting that over the years *after* the 2009 survey, the pattern of young adults living with their parents did continue to increase – thus the hypothesis might be more relevant today than it was in 2009.

### *Travel behavior of adults who live at home*

The TransitCenter (2014) data suggests that young adults living with their parents (in this case without paying rent) do have somewhat lower rates of travel than do those of the same age out on their own. For example, the total number of trips reported per month by those in the parental house is about 72% of that of those who are out on their own.

Those out on their own have a higher propensity to have some employment than those living at home. While 69% of those under 30 living out on their own report full- or part-time employment, only 41% of those living with their parents report such employment levels. While 56% of those under 30 out on their own report full-time employment, only 21% of those at home report full-time employment.

## Location and land-use effects

Both McDonald (2105) and Ralph (2015) find that young people who live in larger conurbations and who live in more densely populated areas tend to drive less. However, neither find evidence of a “back-to-the-city” movement, which would contribute to reduced car travel. In fact, Ralph reports that relatively more young adults lived at low densities in 2009 compared to 1995 and relatively fewer lived at high densities. She also finds that, over the analysis period, young people residing outside of metropolitan areas or at low densities became more likely to become Car-less – and that those young people almost certainly suffer from transportation disadvantage.<sup>25</sup>

## Treatment of Non-Traditional Factors

### Unexplained Factors

The final category of potential drivers influencing travel of young adults is changing attitudes. Both McDonald and Ralph estimate the influence of attitudes indirectly. In the analysis by McDonald, the estimate of the impact of changing attitudes and use of virtual mobility is based on (negative) model coefficients by age group reflecting observed changes in automobile use changes not taken into account by socio-demographic and lifestyle factors and other generic year constants. McDonald estimates that these could account for between 35 to 50 percent of the observed decrease in auto use of young adults. Ralph is more cautious, suggesting that the evidence points to economic factors as opposed to changes in attitudes as the root cause of the decline in driving. As evidence, she reports that nearly all of the growth in Car-less-ness occurred among people with low incomes and limited

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<sup>25</sup> Ralph, based on research of others, defines transportation disadvantage as having limited access to safe, reliable and convenient transportation.

educational attainment, whereas people with extensive resources, in contrast, did not become more likely to be Car-less over time. However, she does note that the smaller increases in Multimodals and decline in Trekkers<sup>26</sup> were primarily concentrated among high-income young adults and that this finding may provide indirect evidence that preferences were more important than economic constraints for these changes.

### *Lifestyle-related demographic shifts*

Both Ralph and McDonald find that lifestyle-related demographic shifts, including reductions in employment, delays in independent living and having children have led to substantial reductions in travel by car for young people between 1995 and 2009. The difference between the studies is in the estimates of the size of these impacts. McDonald estimates that such lifestyle-related shifts (including impacts of all demographic changes, including income, changes in racial distribution, etc.) explain 10 to 25% of the decrease in driving. Ralph estimates the size of lifestyle effects including changes in employment, delays in living independently, getting married and having children, but excluding changes in income, racial distribution, etc., account for roughly 30 percent of the aggregate change in the prevalence of Drivers and Trekkers in the population (who account for most of the driving in the population).

While both Ralph and McDonald identify many of the same drivers of changing travel patterns for young people, it is not immediately clear why the sizes of the estimated impacts of lifestyle and attitudinal effects are so different. The approach used by Ralph develops clusters of travelers with similar characteristics and then predicts changes in the sizes of these groups. It may be that this approach is better able to take account of correlations between sociodemographic variables. For example, the Car-less group is characterized by the confluence of lower incomes, lower employment levels, higher living densities and high proportions of black and Hispanic young people, which together may be important in understanding changes in sociodemographic shifts. Another potential difference is that Ralph observes that in some cases the strength of drivers increases over the period, for example, the effect of not being employed increased the propensity to be Car-less over time; whereas, McDonald estimated constant parameters across the period of interest.

Lastly, it may be that some of the attitudinal factors estimated by McDonald reflect other economic effects, for example if insurance costs for young people are higher or have increased at a faster rate than those for the rest of the population, these would be better categorized as economic factors rather than attitudinal effects.

## **A Further Exploration of NHTS Analyses Explaining the Relative Decline in Auto Usage among Millennials**

This concluding section of Chapter Four starts by providing a brief review of the quantitative analysis of McDonald (2015), which provides the clearest evidence of a recent decline in auto usage among Millennials relative to other age groups, based on national travel survey (NHTS) data. It then describes how the research team extended McDonald's research approach in several different directions, in order to confirm her findings and/or possibly find additional variables that would help to explain the differing behavior attributed to Millennials. The final part of this section summarizes our findings and suggests further avenues of research in this direction.

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<sup>26</sup> These are references to names of market segment groups used in Ralph's analysis

## A summary of the regression approach and findings

In *Are Millennials Really the “Go-Nowhere” Generation?* McDonald bases her findings on a multivariate disaggregate analysis of data from the 1995, 2001 and 2009 National Household Travel Survey (NHTS) datasets. These datasets contain data on all trips made during an assigned travel day for each surveyed adult, including the purpose, mode used, and distance of each trip, as well as the socio-demographic characteristics of each household and person (including those people who made no trips at all on the assigned day). McDonald calculated the number of auto miles traveled during the travel day for each person, and used that as the dependent variable in a linear regression model that included a wide variety of explanatory variables, including year of the survey, age group, gender, race/ethnicity, employment status, urban vs. rural areas, population density near the residence, driving license status, autos per driver in the households, presence of children in the household, living at home with parents, and household income, plus a variable to capture the difference between weekend and weekday travel days. Although the focus of the analysis was on the interaction of the survey year and age group variables, it was important to include the other variables in the analysis, because those may be correlated with age group and survey year, so just analyzing those two variables without also controlling for the correlated variables may lead to spurious conclusions.

In addition to the inclusion of several background variables, there are other key aspects to McDonald’s specification of the regression model that allows it to isolate various intertwined effects related to how auto travel has changed across time. Most importantly, the use of longitudinal data from three survey years makes it possible to separate the *effects of the survey year* (e.g., the economy changes from year to year) from the *effects of age group* (e.g., people’s lifestyles tend to change as they age, even after accounting for changes in family composition, income, etc.). As shown in Table 5, McDonald also included *interaction terms between the age group and survey year* effects. For example, was the year-specific effect for car travel in 2009 related to 1995 larger for a specific age group relative to other groups?

McDonald limited the sample for analysis to four age groups of six-year duration – ages 19-24, 25-30, 31-36 and 37-42. Persons under 19 were excluded because they tend to be school students living at home, and also because the phenomenon of delayed driving license acquisition has mainly occurred between the ages of 16 and 18, so will not have a major effect on this analysis. (In other words, the study was designed to provide evidence of declining car use rates among Millennials for reasons *other* than delayed license acquisition.) At the other end of the age spectrum, those aged 43 and over were excluded because it has been established in other research that the lifecycle-related effects of age start to become dominant as people generally begin to travel less as they enter their fifties and beyond (all else equal). In 2016, “Millennials” are typically regarded as those between ages 18 and 34. In 2009, those same people were between the ages of 11 and 27, meaning that only the 19-24 age group and about half of the 25-30 age group consisted of what are currently considered “Millennials”. In 2001, “Millennials” were between the ages of 3 and 19, meaning that they are not represented by any of the age groups used for the 2001 or 1995 data. So, considering “Millennials” specifically, the key variables in Table 5 are the “2009 x 19-34 age interaction” and the “2009 x 25-30 age interaction.”

Table 5. Variables used to capture interaction between period effects and age group effects. Source: Derived from McDonald

YEAR / AGE	Age 37-42	Age 31-36	Age 25-30	Age 19-24
1995	Base for comparison	31-36 age effect	25-30 age effect	19-24 age effect
2001	2001 period effect	2001 period effect + 31-36 age effect + 2001 x 31-36 age interaction	2001 period effect + 25-30 age effect + 2001 x 25-30 age interaction	2001 period effect + 19-24 age effect + 2001 x 19-24 age interaction
2009	2009 period effect	2009 period effect + 31-36 age effect + 2009 x 31-36 age interaction	2009 period effect + 25-30 age effect + 2009 x 25-30 age interaction	2009 period effect + 19-24 age effect + 2009 x 19-34 age interaction

Figure 36 shows the resulting regression estimates from Table A.2 in the McDonald paper, but with the base categories re-specified so that the effects are always negative (fewer miles traveled) with respect to the base. The blue bars (vertical striping) show that the year effect between 1995 and 2001 was not significant, but that the effect between 2001 and 2009 quite substantial, with people traveling about 3 miles per day less by auto in 2009 (a drop of about 8%, on average).

The age group-specific effects (red bars, horizontal striping) show that, after controlling for the effects of income, employment, household composition, etc., people tend to travel fewer auto miles, with a steady downward trend as they age. The difference between the 19-24 and 37-42 age groups is slightly more than 3 miles per day, all else equal.

However, the interaction terms (the mixed color bars) show that this difference between the age groups has become much less since 1995. In 2009, the younger age groups, particularly those in the “Millennial” generation, showed a much larger drop in average auto use compared to 1995 and 2001 than did the older age groups. In particular, after accounting for all other effects, auto travel per day for the 19-24 age group decreased by about 3 miles per day more than it did for the 37-42 age group. In fact, if one combines the red and mixed color bars together and interprets them as year-specific age group effects, then the higher auto use for the 19-24 age group (all else equal) that was found in 1995 and 2001 has disappeared by 2009.

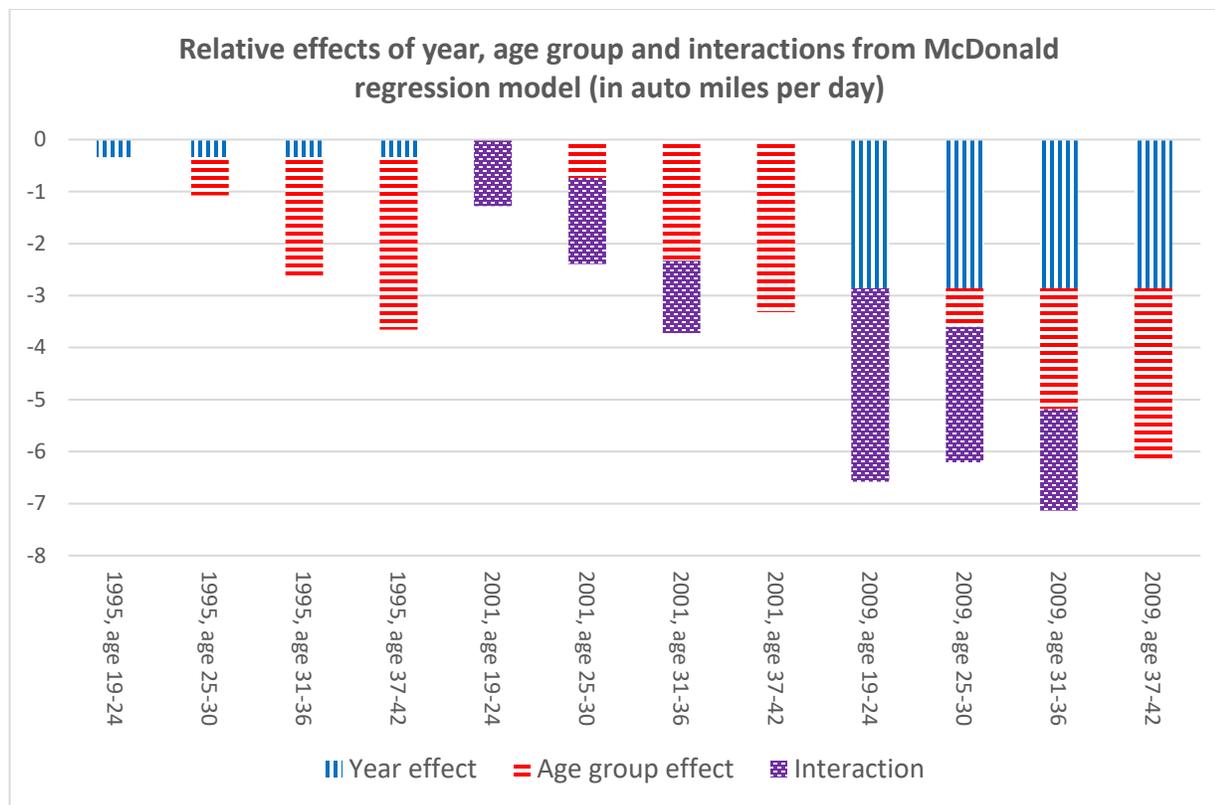


Figure 36. Relative effects of year, age group and interactions from McDonald regression model (in auto miles per day) Source, graph reformatted from McDonald (2015) Table A-2

Although this is not a pure cohort-based analysis because the time period between the surveys (6 and 8 years) was not exactly consistent with the 6-year length of the age groups, it does indicate that the Millennials who were surveyed in 2009 did travel less by auto compared to the people who had been in that age group in 2001 and 1995, even after accounting for year specific effects such as the recession. This study is important in that it uses multivariate disaggregate modeling to confirm trends that have been seen many times in more aggregate and anecdotal studies discussed earlier in this Report. It also provides some evidence that the reduced auto use in recent years among Millennials cannot be entirely explained by the lower employment or incomes due to the recession.

On the other hand, McDonald’s analysis raised a number of questions that our research team felt warranted further exploration. The following section describes the further analyses that were carried out to extend the same research approach, in terms of both methodology and results.

### Extensions of the research approach: description of methods and results

The research team carried out a variety of analyses, starting from the approach used by McDonald. These included combinations of including new explanatory variables, including additional interactions between variables, changing the dependent variable used in the regression, and changing the function form of the regression model itself. In this section, we give a qualitative description of the analysis methods and results, without providing the quantitative model estimation results in detail. (A more detailed description with full model estimation results will be available for inclusion in the Technical Appendix to this document.)

### *Replicating the original analysis*

Our first analysis was to use the description of the survey data processing and model specification provided in the McDonald paper and attempt to replicate the original model and results. This test was successful, as we were able to produce sample statistics and regression model estimation results that were very close to those reported in the paper, with only very minor differences. This test provided strong evidence that there were no major data processing or analysis errors made in either McDonald's analysis or our own, and that our initial models were a reliable basis for further exploration of the data.

### *Adding additional explanatory variables*

One hypothesis is that there may be additional variables in the NHTS data that could help explain why the younger age groups in particular showed the largest drop-off in auto use in 2009 compared to the earlier years. Below is a list of additional explanatory variables that were tested, and a quick summary of implications [shown in brackets].

- Parents with children in different age categories [Child rearing years show more VMT]
- People age 19+ living with their parents [Males living at home travel less, while females more]
- Saturdays versus Sundays [Data collected on Saturday has more VMT than Sunday]
- Households with no cars [Zero car status a more powerful variable than cars per driver]
- More detailed land use categorization [Use of more complete categories reinforces known pattern of urbanized setting having lower VMT]
- People looking for work [Unemployed and looking for work still travel less.]
- Education level and student status [Those with at least some college education travel more auto miles, even after accounting for other related factors]
- Non-linear effects of income [Existing linear relationship confirmed]

Our main reason for testing these additional variables was to see if they would account somewhat for the lower auto miles traveled found for the youngest age groups in 2009. If that were the case, then we would expect the interactions between age and survey year (the checkered, two-color bars in Figure 36) to become smaller and less statistically significant. That was not the case, however. While adding all of the additional variables listed above improved the statistical fit and explanatory power of the models, the *interaction effects between the age groups and survey years remained* at a similar magnitude and significance. At first pass, this finding suggests that the reason for the Millennials' reduced auto use in 2009 (relative to other age groups and time periods) was at least partly due to variables that were not measured in the travel survey data, such as differences in attitudes towards travel and/or differences in lifestyle, possibly related to the use of mobile technology and social media. However, we hypothesized other possible statistical reasons for the estimation results that were due to the way that the regression model was specified. The tests of these further hypotheses are reported below.

### *Adding additional interactions between explanatory variables*

One possible drawback of the way that the original regression model was specified is that only the age group variable was interacted with the survey year. Thus, the implicit assumption is that all of the other demographic variables, such as employment status, income, etc. had the same marginal effects across the different survey years. If, for example, being unemployed had a more significant effect in reducing auto usage in 2009 than it did in 2001, and if more people in the youngest age categories were unemployed in 2009 relative to the older age groups, then that could lead to estimation of a (at least partially) spurious relationship between age and survey year. We tested this hypothesis by

including a number of different interactions between various key explanatory variables and the survey year.

We also tested three-way interactions between age group, survey year and other key variables, essentially replicating the 'year-x-age' interaction variables shown in Table 5 for different demographic groups.

In summary, the tests of interaction effects indicate that *lower auto use* in 2009 compared to the earlier years is *greatest among males, non-employed, and those without a college education*, all else equal, but none of those effects appear to be much different for the younger (Millennial) age group than for the other age groups. In fact, even when all of these additional interaction effects were added to the model specification, the original *interaction effects between age group and survey year remain very close in size and significance to those shown in Figure 36.*

### *Testing other dependent variables*

“Auto usage” from a travel survey can be defined as person-miles traveled (PMT) or vehicle-miles traveled (VMT). PMT includes miles for all trips by auto, whether as a driver or a passenger, while VMT generally includes only miles for car driver trips<sup>27</sup>. Although it is not explicitly stated in the McDonald paper, it appears that PMT was used as the dependent variable, as it also was in our comparative analyses. If, however, car occupancy rates shifted across the different age groups over time, then using VMT as the dependent variable may give different results. This was tested empirically by using the same NHTS data observations and independent variables, but using only auto driver trips rather than all auto trips to calculate one-day VMT as opposed to PMT. The VMT estimation results are quite similar to the analogous model regressed on PMT, with all of the same variables being significant with the same signs and comparable magnitudes. However, the interaction effects between age group and survey year, while remaining statistically significant, *decrease in magnitude by about 50%* compared to those shown in Figure 36. This finding indicates that the “unexplained” drop in auto miles for Millennials in 2009 (as compared to the same age group in earlier survey years) is less pronounced when one considers only car driver trips rather than all auto trips. Another way of interpreting this finding is that *the “unexplained” drop in car miles traveled was greater among Millennial car passengers than among Millennial car drivers.*

### Conclusions from our modeling exercise

The analysis reported by McDonald has been the most complete multivariate disaggregate analysis of national household travel survey (NHTS) data to date. Through the use of interactions between age group effects and survey year effects, McDonald was able to show strong evidence that Millennials traveled less by auto than in 2009 than what can be explained by a wide variety of other variables that were controlled for in the analysis. In the work reported here, we were able to replicate McDonald’s analysis, and then test a several different ways of extending the analysis.

First, several new explanatory variables and interaction effects were added to the model that could potentially help explain why Millennials’ auto use declined in 2009 relative to what would be indicated by the other variables controlled for in the analysis. Although several of these added variables were significant and helped explain some trends in travel behavior, *the interaction effects*

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<sup>27</sup> Alternatively, one could include all trips and divide the miles traveled by auto occupancy, but it is questionable as to whether VMT should be allocated to child passengers for any behavioral analysis. A third option would be to include all trips and divide by the number of adult auto occupants to obtain an estimate of VMT, but that is not a straightforward calculation using NHTS data that does not always identify all passengers

*between age group and survey year reported by McDonald remained significant over and above the new variables added.*

The one change tested that had the largest effect on the model results was to use vehicle-miles travelled (VMT) rather than person-miles traveled (PMT) as the dependent variable. With the model based on VMT, the interaction effects between age group and survey year remained statistically significant, but only about half as large as the same variables in a model based on PMT. This finding indicates that the “unexplained” relative decline in auto miles traveled among Millennials *has been somewhat more pronounced for auto passenger trips than for auto driver trips.*

# CHAPTER FIVE – ARE IMPROVEMENTS NEEDED IN THE WAY WE COLLECT TRAVEL DATA?

## **Recommendations for Data Collection on Millennials' Travel Behavior over Time**

### The Importance of the NHTS

The material presented in preceding Chapters of this report has relied a great deal on household travel survey data collected over time—particularly the data from National Household Travel Survey (NHTS), which has been carried out every six years or so since the 1960's. Although more aggregate data can also be useful, disaggregate data from household travel surveys is the most useful because it allows for multivariate analysis that can isolate the different effects on travel behavior that are related to household characteristics, person characteristics, and land use characteristics near the residence, and separate those from true trend effects from exogenous influences that vary over time. Survey data from multiple years is necessary to separate age-based differences (e.g., people age 70 or older tend to travel less by foot and by bicycle than younger age groups) from cohort-based differences (e.g., people age 70 or older today tend to make more trips than people age 70 or older made in the 1990s). An excellent example of a multivariate analysis that used NHTS data to isolate both trend effects and cohort effects from other effects is McDonald (2015). In Chapter Four, the research team was able to use the same data to replicate McDonald's findings, as well as test a number of further hypotheses. The finding that the Millennial age cohort showed the largest decrease in auto distance traveled in 2009 relative to 1995 and 2001 appears to be very robust based on the data from the NHTS. It will be very interesting to repeat the same analysis when the data from the 2016 NHTS becomes available.

### *Frequency*

While the NHTS is a very valuable resource, it is done at less frequent intervals than the annual or continuous national travel surveys done in several European countries. (See Kuminhof, et al. 2013 or Garceau, et al. 2014 for examples of analyses using such data.) Compared to annual or continuous surveys, data from longer time intervals is less powerful for separating trend effects from cohort-based effects because there are fewer points in time that can be used to identify such differences. For example, in separating the economic effects of the "Great recession" from possible cohort-based trends in car use, it would be useful to have data from a number of different years before, during and after the peak of the recession.

### *How people are contacted-the role of the cell phone*

Another aspect to note is that survey methodologies, as well as the ways in which people respond to travel surveys, are also evolving over time. This fact should be kept in mind when analyzing any survey. For example, the NHTS is designed to measure changes in travel behavior over time. It is possible that different age cohorts have changed in the way that they respond to the surveys over time (independently of changes in their actual travel behavior), and/or that changes in the survey methods used have had an influence on the amount of auto travel reported by different age cohorts in different survey years.

As an example, in the year 2000, fewer than 1% of US households were "cell only", without a landline phone. By 2009, the portion of cell-only households in the US had risen to 24.5% (Hall, et al. 2011).

The percentages in 2009 varied widely by age group. Figure 37 shows that almost 40% of people aged 18-34 lived in cell-only households by 2009, while the shares were only around 15% for those age 35-44, 10% for those age 45-64, and about 5% for those age 65 or older (DeSilver, 2013). The NHTS used random digit dialing (RDD) in 1995, 2001 and 2009. Because RDD samples exclude those in cell-only households, this means that about 40% of US residents age 18-34 (i.e., Millennials) were excluded from the NHTS in 2009, whereas almost all residents in that same age group were included in the earlier survey years, because cell-only households were still quite rare in 2001.

**Percentage of Adults Living in Wireless-Only Households**

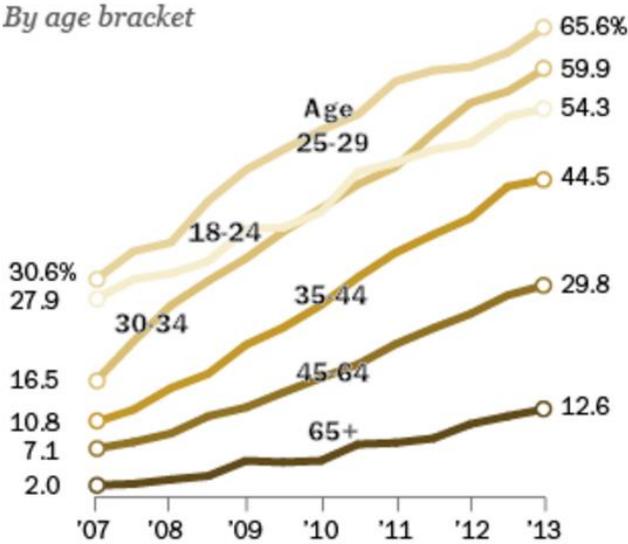


Figure 37 Percent of Adults Living in Wireless-Only Households (source DeSilver 2013)

*Problems with Random Digit Dialing (RDD)*

In terms of analyzing travel behavior, the rise in cell-only households is a problem for RDD surveys only if people in landline households travel very differently than people in cell-only households. For the analysis done by McDonald (2015) and replicated in this project, it would be an issue if people in cell-only households traveled by car significantly more than those in landline households in 2009. In that case, excluding those households from the RDD-based survey would result in an apparent drop in travel for the Millennial cohort, since that cohort had the highest fraction of cell-only households. Preliminary analysis indicates that this bias is not large enough to explain the cohort effect for Millennials found in the NHTS data, but further investigation would be useful.

Many regional-level household travel surveys have been carried out in the US since 2000, with the trend steadily shifting away from using RDD sampling and towards using address-based sampling (ABS), which does include cell-only households in the sample. Address-based sampling is being used for the 2016-17 NHTS.

As the use of ABS has grown in recent years, overall response rates have declined, as people are more difficult to recruit by mail or by telephone. Lower response rates lead to more potential for self-selection bias in the sample. Particularly for young people, there is some preliminary indication from recent surveys that urban dwellers who are more interested in using alternative modes to the auto

are more interested in responding to travel surveys, so the urban samples tend to be skewed somewhat toward those people.

RDD versus ABS sampling/recruitment is only one aspect of household travel surveys that has changed over the last two decades. Another important aspect is the manner in which the travel data has been collected from those who are recruited. While the one-day travel diary has been the typical data structure in US surveys, the way that the diary data has been retrieved has shifted steadily from pencil and paper/mail-back to computer-assisted telephone (CATI) retrieval, and now to internet-based retrieval. In RSG's recent diary-based surveys, almost 80 percent of travel days are reported via the internet versus only about 20 via the telephone. Most of the telephone responses are from older adults, while young adults under 35 use the internet option almost exclusively. NHTS is also offering an internet response option<sup>28</sup> for the first time in 2016-17.

#### *Emergence of the 'smartphone app'*

Over the last year or so, a growing number of US household travel surveys have used a smartphone app as the travel logging and retrieval option for respondents who own smartphones. This method combines the advantages of GPS logging devices—automatic tracking of trip end locations and times—with the advantages of online travel diary reporting—reporting of all trip details (purpose, mode, co-travelers, etc.) within the smartphone app. With the reduced respondent burden compared to other reporting methods, most respondents are also willing to provide multiple days of travel data. With these advantages, it appears likely that smartphone-based data collection will become the most widely-used method for household travel surveys in the coming decade.

RSG has analyzed data from three smartphone-based pilot surveys done in 2015 in the Puget Sound region of Washington (PSRC), the Madison, Indiana region (MCCOG), and in 2016 in the Research Triangle Region of North Carolina. Each of these pilots enabled us to analyze the smartphone-based travel data against diary-based data from the same region and year. In each case, we have found that at least 20% more trips per day were captured using the smartphone-based method as compared to the trips reported using the diary method. As shown in Figure 38, Figure 39 and Figure 40, in all three cases the 18-24 age group has the lowest trip rates of any age group using the diary-based method, and the difference between the diary-based and smartphone-based trips rates is greatest among young adults age 18-24, and next largest among young adults age 25-34. Regression analysis shows that this interaction effect between the survey method and these two age groups is statistically significant. The strong implication is *that non-response bias for diary-based travel surveys is most severe among Millennials (age 18-34)*.

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<sup>28</sup> <http://nhts.ornl.gov/trb/2016/Workshop-Westat.pdf>

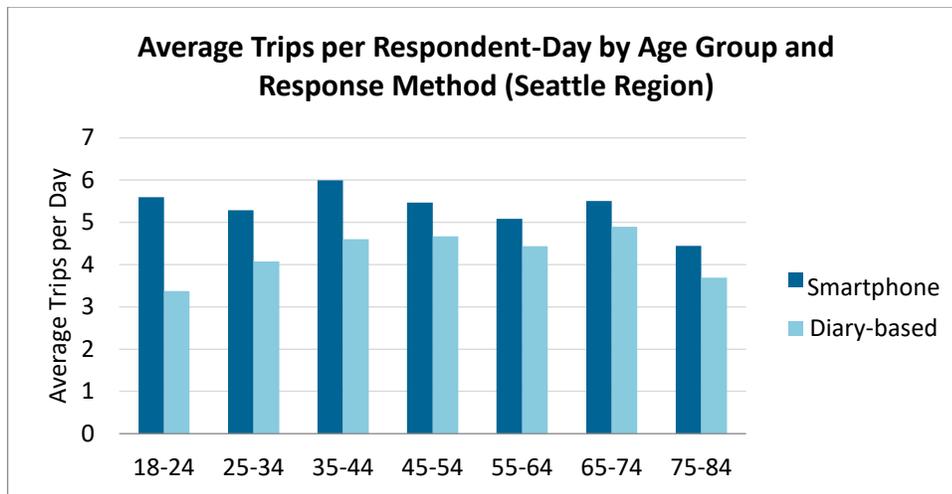


Figure 38 PSRC Data: Average trips per respondent-day by age group

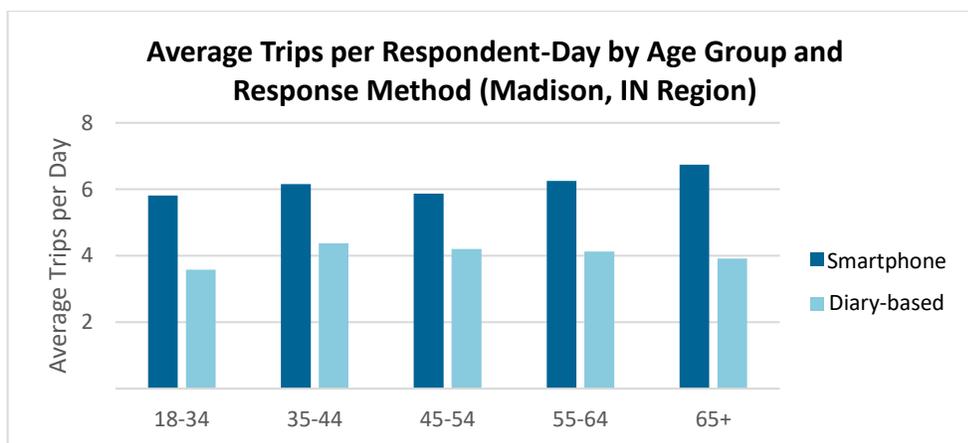


Figure 39 MCCOG Data: Average trips per respondent-day by age group

### Self-selection bias?

A question raised by this finding is whether there is self-selection bias so that young people who agree to participate in diary-based survey are somehow different than the set of young people who agree to participate in a smartphone-based survey. This difference was tested in the North Carolina data (Figure 40), and the diary-based trip rates for young people who do not own smartphones are slightly lower than the diary-based trip rates for young people who own smartphones, but both are much lower than the trip rates obtained from the smartphone-based method. Thus, the non-response bias for young adults appears to be more related to the survey method itself than to self-selection in the sample.

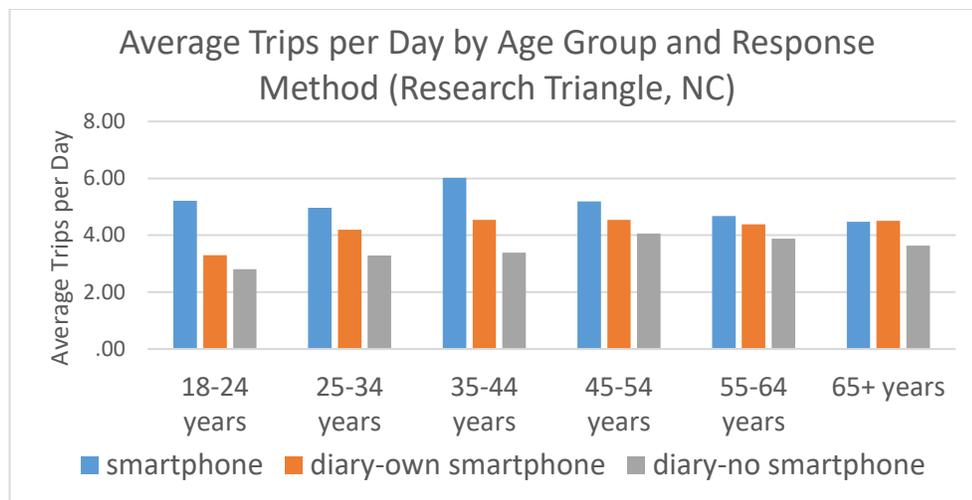


Figure 40 Research Triangle Data: Average trips per respondent-day by age group

Another question raised by this finding is whether or not the non-response bias for diary-based methods among young adults has been growing over time. Perhaps as younger people enter our survey samples who are used to being connected to smart technology all the time, they have less patience for diary-based methods that ask them to provide travel details that they know are already being recorded on their smartphone by Google or Apple.

If travel diary non-response bias among young adults has been growing and/or grows into the future, that will cloud the picture from any trend analyses done using diary-based survey data.

Unfortunately, there is no simple way to know what the underlying bias has been in previous years. As suggested in the following section, meta-analysis of past US household travel surveys that have used both diary-based methods and GPS tracking devices could shed more light on this possibility.

#### Short term research options: targeted analysis of existing household travel survey data

This section suggests research tasks that could be completed in the next year or two to address the research issues and questions raised above.

#### *Adding the 2009 cell-only households to the NHTS multi-year analysis*

In 2009, the designers of the NHTS survey were aware that a growing number of cell-only households would not be included in the RDD sample, and so travel diary data was collected from an additional sample of roughly 2,000 cell-only households. At that time, there was not enough exogenous data regarding cell-only households to weight these households for inclusion in the national public database for 2009, so data from those households were not used in the analyses done by McDonald (2015) or in this project. However, it would be possible to request the data for those 2,000 cell-only households from the group at US DOT that manage the NHTS data. Once the data is obtained, the multivariate regression analysis done for this project can be repeated using those households, with an additional dummy variable applied to cell-only households (and perhaps interaction variables for the combination of cell-only households and people in the Millennial age categories). This could be a reliable way to ensure that the findings regarding decreased auto use by Millennials in the 2009 data are not due to the exclusion of cell-only households from the sample.

### *Merging and analyzing data from many regional and statewide household travel surveys*

Many regional and statewide household travel surveys have been carried out in the US since 1995, with the trend steadily shifting away from using RDD sampling and towards using ABS, and from using paper and pencil (mail-back) and telephone reporting to using online reporting, GPS “black box” tracking units, and now smartphones. It would be very informative to carry out a meta-analysis across many surveys to observe how the average amount of car miles traveled by different age groups has varied, as a function of time and of the sampling methods and data retrieval methods used. There are data publicly available from dozens of surveys:

- The **Metropolitan Travel Survey Archive**<sup>29</sup> contains data from over 50 regional and statewide household travel surveys carried out between 1994 and 2011 (plus some other data from years before 1994 that would not be used for this project). Also, some work has been done to convert the survey documentation and data to common formats to help facilitate merging the data in analysis. The data do not contain detailed addresses or geocodes, but as long as trip mode and distance is included and some type of data on residential Census tract or area type is available, then the data can be used to estimate the desired regression model form.
- The **Transportation Secure Data Center (TSDC)**<sup>30</sup> contains data for another 20 or so surveys collected between 2001 and 2015. Most of the datasets are from later than 2009 and contain at least a subsample for which GPS-based travel data was collected (instead of or in addition to diary-based data). Similar to the Travel Survey Archive mentioned above, the data available to the general public has been anonymized by removing specific addresses and geocodes, but the publicly available data should be sufficient to estimate the desired model forms.

Other household survey data has been collected in recent years that is not (yet) in either of the two survey data repositories listed above. Some of this additional data could be used as necessary to complement the other survey data to fill specific gaps in the analysis. In particular, there is a good deal of recent smartphone-based data, including two major surveys now in the field in San Diego, CA and Columbus, OH. There are also several university student travel diary surveys. This is an important segment of the Millennial population which is typically under-represented in household travel surveys—particularly for students who live on-campus. A firm specializing in household travel surveys could assist with merging together surveys conducted across the country with data from any additional surveys conducted by other firms could be used, either by downloading public data from the agencies’ websites, or by requesting permission to use their (anonymized) data.

It is the intention that merging data from many surveys into a “meta-dataset” will provide the benefits of a national travel survey (data from many regions), while also providing data from many different survey years and survey methodologies. Although each survey may have its own quirks and hidden biases, the expectation is that combining a large number of surveys will allow important trends to emerge without any particular survey having too great an influence on the results.

Each dataset would be processed to include the same set of variables that was used in the 1995-2009 NHTS analysis, so that the analysis can be repeated using the combined “meta-dataset.” The variables include:

- The number of trips and miles traveled during the travel day by each mode;

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<sup>29</sup> <http://www.surveyarchive.org/>

<sup>30</sup> [http://www.nrel.gov/transportation/secure\\_transportation\\_data.html](http://www.nrel.gov/transportation/secure_transportation_data.html)

- Selected characteristics of the household (income, size, number of workers, number of children, auto ownership);
- Selected characteristics of the person (age group, gender, employment status, student status, driving license status, education level); and
- Residence area characteristics (the best available indicator(s) of urban versus non-urban and density).

In addition, new variables would be added to represent aspects of the survey method and survey eligibility such as:

- Number of landlines in the households;
- Personal smartphone ownership;
- Type of sampling used (RDD, ABS, university e-mail list, etc.); and
- How the person's travel data was reported (mail-back, telephone, on-line, smartphone, other GPS device).

Adding this latter set of variables into the analysis could be particularly informative, as it could provide evidence on how changes in survey methodology have influenced reported travel behavior over time, and whether those influences have been different for different age cohorts. Gaining these types of insights will be valuable for interpreting any differences between the 2016-17 NHTS data and NHTS data from past years that may be due to the new address-based sampling and on-line trip reporting option.

#### *Adding the 2016-17 NHTS data into the same analysis, when available*

The data collection for the latest NHTS began in early 2016, and the data is expected to be available to the public in early 2018.<sup>31</sup> The total sample size is expected to be about 140,000 households, which is similar to the sample size in 2009.

In 2018, the NHTS-based multivariate regression analysis carried out on the 1995, 2001 and 2009 NHTS can be repeated, adding in the new NHTS data collected in 2016-17. The updated analysis will test whether the trends in Millennials' car use identified for the years leading up to 2009 has continued past 2009. If the multiple survey merging task described above has also been carried out in the meantime, then the "meta-dataset" can also be merged into the analysis with the NHTS data, to identify how any trends have evolved over intermediate years, and also to help control for changes in the NHTS sampling and data collection methods.

#### Longer term options for travel survey data collection

This chapter concludes with suggestions for household travel survey methods in the coming years to facilitate the analysis of changes in travel behavior over time for different age cohorts.

- There would be advantages to moving the NHTS to a more frequent data collection cycle (even if sample size per year is smaller).
- To facilitate an analysis of how the travel behavior of different age cohorts will evolve over time, it would be ideal to standardize a few key measures that could be collected from each household travel survey done across the states and regions of the US, and to define a methodology for calculating and reporting those measures. The key measures could include

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<sup>31</sup> [https://www.fhwa.dot.gov/policyinformation/presentations/his2015/2016\\_NHTS\\_Santos.pdf](https://www.fhwa.dot.gov/policyinformation/presentations/his2015/2016_NHTS_Santos.pdf) .

average weekday per-capita person trips, vehicle-miles traveled (VMT), person-miles traveled (PMT) by mode. This would greatly facilitate a cross-region, cross-year analysis such as that proposed in the previous section.

- If neither of the two options above proves to be practical or affordable, another option would be to add a small number of key questions to a pre-existing national-level survey that is already carried out annually or semi-annually. An obvious candidate is the American Communities Survey (ACS), which is carried out and reported annually with a sample size of several million households. ACS already includes a few useful transportation-related measures such as auto ownership, work location, and usual mode used to work. Since there is continual pressure to reduce the number of questions asked in the ACS, however, adding a number of new transportation-related questions seems unlikely.

Another candidate survey is the Panel Survey on Income Dynamics (PSID), a semi-annual panel survey of around 10,000 households, which was started in 1968 by the National Science Foundation (NSF) and is administered at the Univ. of Michigan.<sup>32</sup> The survey is mainly focused on tracking trends in income and expenditures, but does periodically add new questions to look at new areas, such as health. Because transportation is a key component of both expenditures and health, and it could also be argued that access to better transportation provides access to more/better sources of income, there could be rationale for adding a limited, carefully designed set of questions on mode usage and travel habits to the PSID.

Finally, if an agency wants to use data from a new household travel survey for trend analysis against data from past household travel surveys, but the survey methodology is changing significantly, then there is an advantage to using a split sample approach. In this approach, a random subsample of respondents is surveyed using the same methods as the previous survey, while the remaining respondents are surveyed with the newer methods. This split-sample approach is easier to carry out and analyze for the changing travel data retrieval methods than for changing sampling methods, and it is also easier when using a more frequent data collection cycle with smaller samples. As an example, Figure 41 shows an example of how the split sample approach can be used to transition from diary-based to smartphone-based methods across years. (Note that a 100% smartphone-based approach is not yet feasible in any case, since not all adults own or are willing to use a smartphone.) In the example, data from the same method across different years is used for trend analysis, while data from the two different methods in the same years is used for bias correction.

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<sup>32</sup> <https://psidonline.isr.umich.edu/>

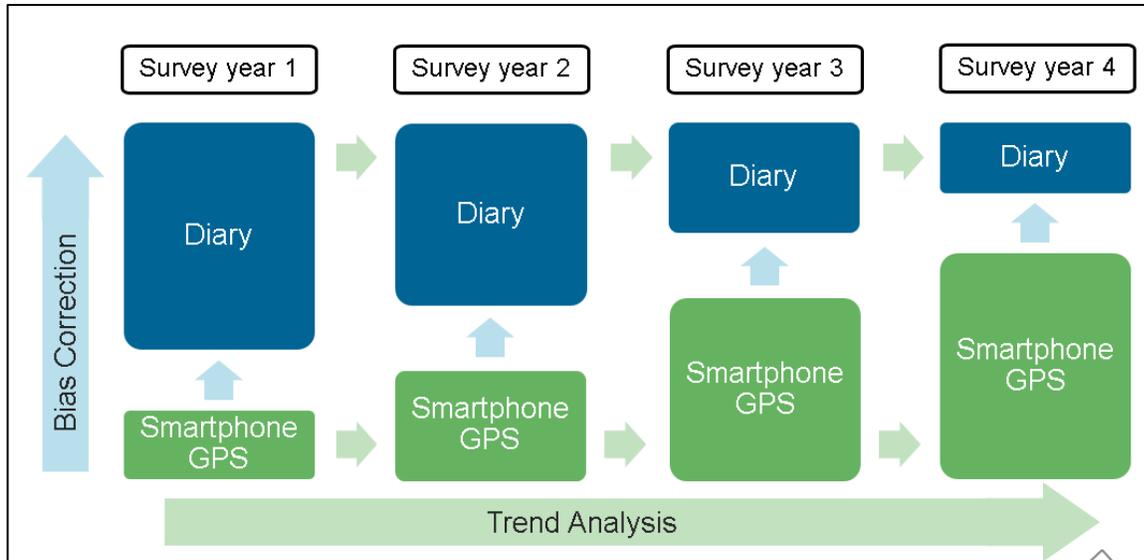


Figure 41 Example of split sample approach to move from diary-based to smartphone-based method

# CHAPTER SIX – RECAP, LESSONS LEARNED AND NEXT STEPS

## What this Report Did

Here is what we set out to do

This report presents a summary of a two-year project undertaken within the National Cooperative Highway Research Program to help transportation planners and managers understand the implications of profound changes in the nature of travel demand patterns in the United States and in other western countries. As documented in this report<sup>33</sup>, throughout the western world, separate researchers reported similar research results in the first decade of this century, in which *the amount of auto travel taken by the younger generation decreased at a rate faster than for other groups*. The present research was based on a core objective: “to understand the extent to which the changes in travel behavior by the Millennial Generation do, and do not, represent a major issue for the leaders of the transportation sector.” At the commencement of the project we noted that, “It is only by understanding the specific preferences and needs of this age group that transportation managers will be able to make changes in the products and services offered in the transportation system more generally.”

Here is how we did it

**First**, the research team undertook an extensive literature search, resulting the creation of a Project Bibliography. A thorough examination of the literature suggests that scholars were deeply divided in the interpretation of the major, well-documented decline in the amount of auto travel taken by the younger generation during the first decade of this century (usually defined with data collected in 2009 compared with 2001). For some researchers, the economic upheaval experienced in the United States after the fall of 2008 explains the sharp decrease in travel and how that decrease was mainly experienced by the young. For others, this experience indicated a potentially profound change in the culture and attitudes of Americans under 35, signifying shift in travel behavior with long-standing impacts. This report has resulted in a third explanation – that there was indeed a solid economic rationale for much of the decrease in these study years, but that traditional economic variables of causality simply cannot explain the entire decrease. In short, this NCHRP report has concluded that both initial explanations have merit, but that a combination of the two is needed to understand fully how American travel behavior has, and has not, changed during this period of time.

**Second**, the research team documented that something important did indeed happen in a two-decade context (1995-2015) and in a shorter context (2001- 2009). The patterns of auto drivers of all age groups changed, but the patterns of those under 35 (“the Millennials”) changed more dramatically.

**Third**, we examined how the values and attitudes of the younger generation differed from those of previous generations. We concluded that the ways in which Millennials differ are themselves not simple—neither linear nor always as expected. On the one hand, the importance attached to owning a car, being reliant on a car, and gaining happiness from a car is less expressed by Millennials than by others. On the other hand, the Millennial Generation is more likely than other groups to look forward to a larger house, to be willing to drive further to get that larger house, and expect to drive more as they age. As they mature, the majority of Millennials prefer to live in the suburbs more than the city; with strong interest expressed for smaller cities also. More challenging for the possible alteration of

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<sup>33</sup> Specific references to the literature are noted in both Chapter One, and Chapter Four

travel behavior is that Millennials have more concern about traveling with people they do not know and worry more about safety associated with travel with others, than do older groups. A careful look at the results of Chapter Three suggests that Millennials are a group that could generate environmentally friendly patterns of travel, but only if the transportation providers understand the detailed characteristics of their preferences.

**Fourth**, we examined the characteristics of the data collection process sponsored by the FHWA, the National Household Travel Survey, for possible changes that may occur in the future, and made some early suggestions for later modification of method.

Here are the primary conclusions from the research

- The first decade of 21st Century witnessed a drop in the number of vehicle miles of travel taken by the so-called Millennial Generation, generally identified as those under 35 years of age. Millennials in each sub-category were generating less VMT than the groups who were in that age category just 8 or 14 years earlier; differences exist among cohorts in how they behave within a given stage in life and age category.
- When analyzing the travel behavior of this group, it is important to note the economic conditions at the time period of the travel, such as high unemployment. While those economic conditions will be an important input into the amount of travel taken, we have established in this research that there is something additional to examine above and beyond the traditional factors known to influence trip-making behavior.
- We have concluded that there must be explanations for the travel behavior change of this group, based in 'softer,' more difficult to measure factors, such as preference, attitude, and culture. The Millennial Generation group holds a different set of values, and preferences towards the automobile when compared with older groups. The Millennial group has lower need for, love for, and preference for owning a private automobile than older groups have. They have a higher interest in sharing the ownership of a car or bike with others than older groups have.
- At the same time, Millennials will be proceeding through the life-phases just like everyone else; compared to older groups, they state a stronger preference for a larger house, and a greater willingness to drive longer to get to it. More Millennials ultimately prefer to live in the suburbs than in the city, and recognize the need to drive more or travel longer distances to work as they get older.
- As they choose a mode of transportation, this younger group expresses a greater level of a concern and fear of traveling in the same vehicle with others, and specifically with people they do not know.

How can this research be used by transportation practitioners?

On the one hand, the results of this research cast doubt on the concept that a major cultural change has occurred, such that all young people want to live in cities like Brooklyn, Cambridge, and San Francisco, and will not follow the pattern of their parents to the less densely settled suburbs. This research clearly demonstrates that highways into and out of suburban areas will be needed for a long time. The report has noted that young people in pre- and early-child rearing phases of life can live in dense urban contexts, often with smaller dwelling units spaced closer together. As they proceed through the life cycle, larger homes, with wider spacing will be tempting, or even required for family needs. As with traditional patterns of growth, with greater levels of separation come lower density land use patterns, and longer trips and higher levels of VMT.

On the other hand, transportation managers involved in implementing congestion management strategies in cities of non-compliance should be aware that this group may be more willing to consider sharing strategies that could lower the number of vehicles owned, whose combined results might result in lower VMT per household. But, practitioners should also be aware that this particular generation of young people may be resistant to sharing space *within* a vehicle, whether that is the city bus or the autonomous auto. Great generalizations are now being made about positive environmental impacts from advanced car-pool-like services that may or may not be based in fact. Simply, we need to understand the market behaviors better before reaching what could be characterized as premature conclusions about acceptance of high-occupancy technologies of the future. At least, what these characteristics imply is a continued need to understand market preferences exhibited by emerging generations in a context of changing technologies and uncertain economic conditions.

Currently, the profession is well prepared to examine the relationship between increase in economic activity and the increase in VMT. But transportation planners may not have the kinds of tools necessary to replace traditional, linear forms of forecasting with a process of alternative scenario generation that would make not one forecast of behavior in 30 years, but several different forecasts based on alternative assumptions of the direction of cultures, preferences and attitudes. This approach would, by its application, expand the exploration of risk and uncertainty as applicable to travel demand forecasts.

### Who is the best audience for its application?

As noted above, those practitioners involved in congestion management and environmental management would probably benefit most from application of a more behaviorally based traffic forecasting process. In a broader context, however, any manager involved with the capital planning process is vulnerable if the public suddenly believes that traditional analysis methods are inadequate. When the public believes that Millennials no longer drive in cars, no longer buy cars, and wish to only share cars, we are then faced with the potential that auto travel might suddenly grow out of favor. When the public believes that Millennials do not want to live in the suburbs, and would not drive further to get a larger house, this implies that travel forecasts used in the planning and environmental analyses of new transportation investments are possibly wrong, and potentially invalid. Such an erosion of trust would affect the entire transportation profession. Applying the newly developed future scenarios could have a profound impact on infrastructure investment strategies.

### What are the Next Steps?

We conclude Task 132 with a better understanding of what has happened to trip-making characteristics over the past few decades. An almost linear path of increased VMT linked to increased GDP was altered at just about the turn of the century, as demonstrated and attributed to the emergence of a younger generation of travelers. These changing conditions lead to a possible next question for the research program: what lies ahead as the population ages, and how are these changes potentially magnified as preferences emerge from yet another group in the youngest categories?

#### *Near term*

It is our recommendation that the NCHRP 08-36 program undertake an analysis of the implications of known, existing data sources concerning the implications on travel demand characteristics of the Youth Market in the future. It would be cost effective to continue the analysis that commenced as described in Chapter Four of this report. That chapter reports that the case is strong that traditional economic factors cannot totally explain the sharp lowering of the driving rate of those in the youth market. Based on the formats already explored and established, additional analysis can now be

undertaken about the specific role of such factors as gender, license status, auto ownership, race/ethnicity, employment status, parent status, income, residential density and urban form in the explanation of change in metropolitan driving patterns.

Other projects within the TRB's Cooperative Research have collected survey data over the past three years, and much of that data could be applied to the question of the future of the present youth market in metropolitan auto tripmaking—a subject not specifically covered in the work undertaken to date in these other programs. In short, many of the questions raised in this report could be examined further in the near future, and in more detail, and without the immediate need to conduct more surveys.

### *Longer term*

We propose that the 2018 NCHRP work program consider a major study of how demand for metropolitan auto travel in the future may vary as a function of the way in which the present younger generation adapts to a variety of changes as they mature. Such a longer-term research program could take the following format. First, undertake a new survey focusing on the relationship between present attitudes/values and present driving behavior, under a variety of economic conditions. In addition, the survey would actively explore the respondents' attitudes and visions about the future, including their future residential settlement pattern, and subsequent changing driving behavior.

The second phase of the longer-term research program could involve the creation of advanced travel demand models specifically designed to incorporate such 'softer' variables as values, attitudes and preferences. There are several formats for models designed to achieve this functionality, and a cost-effective solution would be sought to effectively incorporate the additional factors with the traditional modal characteristics (times, costs, travel party size along with demographics.) An example of such a model structure is the Integrated Choice Latent Variable (ICLV) model developed in the National Cooperative Rail Research Program's Report 4.

The third phase of the research could develop a future scenario testing tool, to allow the cost-effective examination of the relationship between alternative futures for the nation and the travel demand patterns associated with those scenarios. Given the fact that no transportation practitioner can "know" what the future will bring, the creation and testing of alternative scenarios provides a solid base for dealing with such uncertainty, and explaining it within a public, participatory process.

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