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Policy and Literature Review on the Effect Millennials Have on Vehicle Miles Traveled, Greenhouse Gas Emissions, and the Built Environment

A Research Report from the University of California Institute of Transportation Studies

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16. Abstract

Vehicle travel has reduced substantially across all demographics in the 2000's, but millennials or young adults born from 1985-2000 stand out as the group that has reduced vehicle travel the most. This reduction of travel among millennials is known as the millennial effect. This policy and literature review discusses insights from recent policy reports and literature regarding the millennial effect and identifies the prominent themes and gaps in our knowledge. The first section reviews existing research on the millennial effect on vehicle miles traveled (VMT). The second section discusses the influence of the built environment on the travel and activities of the millennial generation. The third section highlights scenarios describing the millennials effect's potential magnitude and identifies topics for consideration in future scenario planning efforts. The final section discusses the uncertainty that exists regarding the future behavior of millennials and their influence on VMT and greenhouse gas emissions.

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Disclaimer

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Executive Summary

Vehicle travel has reduced substantially across all demographics in the 2000's, but millennials or young adults born from 1985-2000 stand out as the group that has reduced vehicle travel the most. This reduction of travel among millennials is known as the millennial effect. With a population approximately reaching 10 million in California (Circella, Tiedeman, Handy, Alemi, & Mokhtarian, 2016) and 83 million nationwide (Census, 2015), the decisions millennials make regarding where they choose to live and how they choose to travel have an important influence on the future of policy changes to the built environment and services provided in urban areas. Previous research has called attention to factors influencing the millennial effect including the most recent recession, socioeconomic trends, the urban form, and improved technology. However, while several studies have examined the relationship between vehicle miles traveled (VMT) and the millennial effect, an important question remains: Will this millennial effect last?

This policy and literature review discusses insights from recent policy reports and literature regarding the millennial effect and identifies the prominent themes and gaps in our knowledge. Literature highlighting the relationship between millennials and transportation, public transit, the built environment, and travel behavior were reviewed. Policy reports examined included information regarding trends in millennial behavior in comparison to older generations and long-term trends in VMT. Few studies, however, have examined the impact of the millennial effect on greenhouse gas (GHG) emissions. Most studies use VMT as a proxy for understanding impacts on GHG emissions (Spears, Boarnet, Handy, & Rodier, 2014). This review also discusses efforts to use scenario planning to estimate the magnitude of the millennial effect.

The first section reviews existing research on the millennial effect on VMT. The second section discusses the influence of the built environment on the travel and activities of the millennial generation. The third section highlights scenarios describing the millennials effect's potential magnitude and identifies topics for consideration in future scenario planning efforts. The final section discusses the uncertainty that exists regarding the future behavior of millennials and their influence on VMT and GHG.

The Effects of Millennial Driving Behavior on VMT

In the US, from 2004 to 2013 VMT per capita decreased (Circella, Tiedeman, et al., 2016). This reduction in VMT can largely be attributed to millennials, the largest age cohort, and their changes in travel behavior due to their significant differences in perspective and way of living as compared to older generations. Compared to Generation X or those born from 1961-1981, millennials are driving less at the same stage of life (Circella, Tiedeman, et al., 2016). While some concede that the change in VMT in the 2000's can be attributed to strictly the economy (Garikapati, Pendyala, Morris, Mokhtarian, & McDonald, 2016), behaviors and attitudes of millennials merit attention for future planning. There are two prominent theories that explain for the millennial effect or the influence of millennials on decreasing VMT. One theory attributes the decline in VMT to a shift in the attitude of millennials, that is their preference to drive less and live in more urban environments that accommodate alternative travel options and connectivity. The other theory attributes the decrease in VMT to demographic and economic factors and suggests that the difference in the lifestyle between millennials and older generations is due to their economic situation (McDonald, 2015). This review provides insights based on both theoretical assumptions.

Millennials, mostly men, have opted to delay obtaining a driver's license (Blumenberg, Brown, Taylor, & Voulgaris, 2015; Delbosc & Currie, 2013; Kuhnimhof et al., 2012) and are more likely to use public transportation and different modes of active transportation such as walking and biking in comparison to older generations (Blumenberg et al., 2015). Millennials are also more likely to support increases in taxes to fund public transportation. This could be attributed to their unique commitment to protecting the environment and decreasing the negative externalities stemming from transportation (Circella, Tiedeman, et al., 2016). Another aspect setting millennials apart from older generations is their desire to go carless, particularly when they can rely on others for a ride when needed (Schoettle & Sivak, 2013).

A recent study groups young travelers or millennials into four categories: Drivers, Long-distance Trekkers, Multimodals, and the Carless. Drivers make many of their trips by car and rarely use transit. Long-distance Trekkers drive the most miles (and rarely use transit) yet do not make more daily trips than Drivers. Multi-modals use various modes and benefit from high levels of access. The Carless are those who do not own vehicles, thus creating barriers to access and mobility. Though millennials prefer to go carless, it is found that 82% of millennials surveyed are Drivers and Long-Distance Trekkers. Multi-modals only consisted of 4% of millennials and the Carless consisted of 14% of millennials (Blumenberg et al., 2015).

Furthermore, many millennials delay getting married and starting a family, which would contribute to higher per capita VMT since families take more trips with the children and tend to live in suburbs where vehicles are more necessary (Dutzik, Group, Baxandall, & Fund, 2013). Millennials fall in the low per capita VMT category because they delay marriage (Polzin, Chu, & Godfrey, 2014). In comparison to the generation just before them, only 28% of millennials (18-

33 year olds) were married in 2014, while 38% of Generation Xers were married at the same age in 1998 (Pew Research Center, 2014). The delay in marriage and child bearing likely reflects their income and educational attainment since these features also impact VMT. For instance, the median annual income for millennials in California is $21,900 which corresponds to a low mean number of trips made per day (Interrante, 2014; Kiersz & Elkins, 2015). On the other hand, those who earn $70,000 to $74,000 a year drive more (Polzin et al., 2014). With higher incomes, one can afford to travel more to engage in different activities and services. In addition, millennials are more likely to be enrolled in school (Furstenberg, 2010). Millennials with a bachelor's degree are associated with higher levels of VMT per capita and have a daily VMT per capita of 31.5 (Polzin et al., 2014).

Hispanics are a subgroup of the millennials known to incur significantly less VMT, and they make up the largest portion of the millennial population. Using 2009 NHTS data, the daily VMT per capita for 20-39 year old Hispanics/Mexicans is 18.0, the daily VMT per capita for Whites is 28.4, and the daily VMT per capita for African Americans is 25.1 (Polzin et al., 2014). This same data also shows that 16-29 year olds drive more for work-related trips compared to non-work related trips (Dillon, Saphores, & Boarnet, 2015).

The millennial generation is also recognized for its extensive reliance of mobile communications and technology to facilitate their transportation and social connections. Their reliance on mobile technology enables new transportation options such as Uber and Lyft that could decrease the need for a personal vehicle and thus decrease personal VMT. Also, mobile work and e-shopping has to some extent reduced VMT considering there is less of a need to drive to work or stores (Dutzik et al., 2013).

The Influence of the Built Environment on Millennial Travel and Activities

Although research suggests millennials are driving less than older generations, a large portion of millennials still travel exclusively by car. Neighborhood design and built environment factors help explain why many millennials continue to drive even though they may prefer to not drive. In many neighborhoods, few nearby opportunities exist to accommodate those who wish to drive less or go car less. Only 4% of all US neighborhoods provide a viable opportunity for travel by foot and public transit, which is preferred by many millennials (Blumenberg et al., 2015).

Because of their preferences for less driving, many millennials have chosen to live in more compact, dense, and urban communities where public transit, active transportation, or ride sharing apps such as Uber and Lyft are more readily available. Compared to previous generations, millennials are less attracted to the suburban and auto-centric lifestyles. The goal of having a typical home with a big yard and a two-car garage is not as dominant for millennials as they once were for previous generations (Blumenberg et al., 2015).

Millennials are more likely to live in Urban Residential (highly residential areas), Old Urban (highest accessibility, highest density, and high levels of transit service), and Mixed Use (greatest land use diversity, highly residential, and house many renters and movers) areas in comparison to older generations. However, a high proportion of millennials continue to live in New Development areas, with limited public transit and where the majority of residents own cars. Only 12-14% of millennials live in urban areas (Lachman & Brett, 2015), while more than half of millennials live in suburban areas. Nevertheless, a higher percentage of millennials live in urban neighborhoods today compared to previous generations such as the baby boomers or those born between 1946-1964 (Blumenberg et al., 2015). For this reason, millennials are known as the population group that helped catalyze the "back-to-the city movement". It is also important, however, to point out that there are still many millennials who reflect the "out-to-the-suburbs" movement and choose to locate in the suburbs and New Development areas (Blumenberg et al., 2015).

The majority of millennials who live independently, or separate from their parents, choose to live in Old Urban Neighborhoods. Those who live in Old Urban Neighborhoods make fewer trips, travel fewer miles, are less likely to own a car, and are less likely to drive alone if they own a vehicle. They are also more likely to use public transit and delay getting a license compared to millennials in other neighborhood types (Blumenberg et al., 2015).

Urban areas preferred by millennials generally have higher density, more employment opportunities, and have lower daily VMT. Considering more amenities and services are in close proximity, there is less of a need to drive and a higher probability to use other modes of travel (Polzin et al., 2014). Various studies have demonstrated that the built environment, high density, and accessible transportation for employment are associated with less vehicle use (Bento, Cropper, & Mushfiq Mobarak, 2005). Nationally, about 32% of millennials live in urbanized areas (Pew Research Center, 2014). In comparison to the Baby Boomers, when they were in the age group of 18 to 30 years old, 28% lived in urban areas (Polzin et al., 2014). The majority of neighborhoods in the US are New Developments, limiting the number of carless and multimodal opportunities available. Nevertheless, many residents continue to use public transit and active transportation, not by choice, but out of necessity (K. Ralph, Voulgaris, Taylor, Blumenberg, & Brown, 2016).

It has been suggested that millennials will eventually reach a point of desiring "urban burbs" or suburbs with urban like amenities and benefits (Rossenfeld, 2015). As millennials move into their 30's, they will begin to move into behavior that resembles that of previous generations including greater demand for single-family homes (Logan, 2014). In reference to the future the National Association of Home Builders found that two-thirds of millennials want to live in the suburbs, 24% prefer rural areas, and only 10% want to live in urban areas (Hudson, 2015).

Approaches for Estimating the Magnitude of the Millennial Effect on VMT

Although VMT has decreased in large part due to millennials travel behavior, there is uncertainty whether this behavior will continue. Planning scenarios can be developed to estimate future millennial patterns under different assumptions. Scenarios should reflect what can be expected should millennials continue with their current travel behaviors and what can be expected if they change their behavior in response to factors such as the economy and starting a family. Scholars have developed scenarios to help planners estimate the magnitude of the millennial effect under various situations (Case & Schipinski, 2015; Dutzik et al., 2013; McDonald, 2015). Some scholars believe millennials currently may have less of a need for mobility and licensure considering many are students, unemployed, and without children, but that once they acquire employment, wed, and begin to have children their travel demand will then increase. They concede this will occur much later than it did for previous generations (McDonald, 2015). Three studies which examine different scenarios to estimate the magnitude of the millennial effect are described below.

Existing Scenario Planning Approaches

Dutzik and Baxandall (2013) presented three potential millennial scenarios that could occur in the future:

1. Assume a return to what driving was like before the millennial effect: high VMT.
    - As the economy improves and gas decreases, driving will increase.
    - If millennials decided to go back to the past and drive as they once did, VMT could increase by as much as 24% by 2040.
2. Assume a lasting effect.
    - The current travel behavior of millennials will remain the same and millennial preferences will be adopted by future generations.
    - If millennials continue driving less as they age, driving may increase only by 7% by 2040.
3. Assume persistent decline in VMT.
    - Driving will continue to decrease since driving will be less necessary.
    - If the millennial effect continues to decrease driving for twelve more years, VMT could remain below the 2007's peak through 2040 even with an approximate 21% population increase.

McDonald (2015) estimated the millennial effect by assessing the influence of three factors on the decrease of driving among millennials:

1. The overall decrease in driving among all ages attributes to a 40% decrease in driving.

2. With regards to employment, the millennial effect explains 10-25% of the decrease in driving.

3. Attitudes and online shopping explain 35-50% of the decrease in driving, and this is expected to have a lasting effect.

Case and Schipinski (2015) attribute the decrease in driving to millennials economic circumstances (low-income, inequality, underemployment, etc.). They question whether this travel behavior will persist once millennials are better economically and examine three aspects of the millennial effect:

1. The Period Effect: This effect only lasts for a period of time.

2. The Age Effect: This effect is only associated with one's age.

3. The Generational Effect: This effect stays with a group of people throughout their life.

In addition, Case and Schipinsky (2015) develop a scenario demonstrating what could be the future of VMT with respect to the use of alternative transportation among millennials. In 2010 the baseline use of alternative transportation to work among millennials in the US was 8.2%. They forecasted what alternative transportation in the US would look like once generation Xers retired, leaving millennials to comprise most of the work force. The model took into consideration income, age, urbanized area status, gender, era, MSA Status/Population, and generation. Using 2008/2009 NHTS data, they estimated that alternative transportation use in the US in 2050 could increase to 8.8%.

Considerations for Future Scenario Planning

Though many scenarios have been developed, Metropolitan Planning Organizations (MPO's) need more information to better model the impact the millennial effect will have on regional VMT and GHG emissions in order to meet the goals of Sustainable Communities Strategies (SCS) under SB 375. Travel behavior has typically been measured by assessing factors including the driving age population, household formation, labor force participation, car ownership, gas prices, the association between time use budgets and travel time growth, telecommuting, internet shopping, and delivery of goods and services (Circella, Tiedeman, et al., 2016) and urban (Dillon et al., 2015). When considering scenario planning, it is important to also take note of additional direct and indirect factors that may affect VMT and GHG (Dillon et al., 2015). In addition, rather than ask what are millennials doing, one must ask what do millennials want and what are there housing, family, and mobility goals for the future? And, what are new transportation incentives that millennials may opt for? Thus, several considerations for future scenario planning are discussed below.

Alternative Fuel Vehicles

California has sought to reduce GHG emissions by increasing the number of alternative fuel vehicles (AFV) on the road. Additional initiatives such as HOV lanes, tax deductions, and parking incentives have been implemented to incentivize the use of AFV's. Though they are considered fuel-efficient, AFV's may result in unplanned consequences (Dillon et al., 2015) such as an

increase in VMT and roadway congestion. As the use of AFV's increases, it is important to question who is acquiring these AFV's and whether they are millennials.

A scenario may include millennials increased use of AFV's and thus increasing VMT since ownership of an AFV, compared to owning no car, implies an increase in driving (Dillon, 2016). Considering millennials are more concerned about the environment, and those who are more environmentally conscious are more prone to purchase an AFV (Sangkapichai & Saphores, 2009), millennials could make up a large portion of AFV drivers. However, perhaps only the millennials who live in the suburbs will opt to purchase AFV's since the large portion of AFV drivers are those who commute long distances (Dillon et al., 2015). Another scenario could be that millennials will not purchase AFV's because they cannot afford one or because they live in areas where there is no need for a vehicle. Considering millennials make up a large part of the population, it is important to question how they will react to the development of new AFV's.

Environmental Concerns

Given their growing concern over climate change, will millennials choose to use different modes of transportation such as public transit or AFV's? A scenario depicting the different travel choices millennials could make based on their environmental concerns should be considered. To measure concern for climate change or environmental issues, previous studies have used one's membership in an environmental organization as a proxy for evaluating its influence on AFV ownership (Dillon et al., 2015). Data previously used to account for membership includes the California Ballot Propositions voting data related to environmental issues available through Berkeley's Law School's Statewide Database (http://statewidedatabase.org) (Dillon et al., 2015).

A future scenario could utilize environmental membership levels or voting among millennials to depict their concern over climate change. Should the levels of membership or voting for environmental change be high, the scenario could assume an increase in using other modes of travel. Another scenario could reflect a decrease in membership or voting, possibly contributing to an increase in VMT. Future research is needed to identify the magnitude of expected changes to mode shares and VMT that could be attributed to millennial environmental concerns.

Hispanic and Immigrant Millennials

Hispanics make up the largest group within the millennial generation (Pew Research Center, 2014) and drive less than other millennials (Dillon, 2016). Furthermore, while many millennials have opted to delay acquiring their license (Tefft C et al., 2013), new avenues to obtain a driver's license for undocumented immigrants were implemented in 2015 through AB 60 (Assembly Bill 60). Given the large population of immigrants and Hispanics in California, some millennials could have obtained driver's license under have AB 60 which could influenced their VMT.

A future scenario could assume that a substantial number of millennials obtained a driver's license in response to AB 60 and have begun to drive. Another scenario could assume this group of millennials continued a multi-modal or carless lifestyle, since they acquired a driver's license primarily for identification purposes. Or third scenario assumption could be that there are few millennials who applied for the AB 60 driver's license because of its high price and the wait associated with acquiring a license. In addition to the built environment and technology, it is important to consider policies such as AB 60 that allow more access for one to drive.

Transportation Network Companies/Ridesharing

With the rise of smartphone dispatch service has also come access to a wider set of travel options including car sharing, ride sharing, and taxi services known as Transportation Network Companies (TNC's). Millennials have a high reliance on these technology services (Dutzik et al., 2013). TNC's can provide increased access to those without cars, help reduce VMT by providing a means to carpool (Anderson, 2014; Wiersig, 1985), and eliminate wasteful driving such as circling to find parking. However, they have also been known to exacerbate the congestion and contamination emitted by cars, especially if the cars being operated are old, and they may take away from other options of travel such as public transit. Thus, these technological changes have altered travel behavior and should be assessed for their influence on VMT (Circella, Tiedeman, et al., 2016) and GHG emissions.

Living Arrangements

Previous research has shown that millennials are less interested in home ownership, but a new study suggests that millennials increasingly desire home ownership (Colton, 2002) which could imply a change in millennial VMT. Future scenarios should consider potential changes in millennial home ownership patterns.

Economic Growth

The economic recession of 2007-2010 is seen as an important factor that resulted in an overall decrease in VMT (Circella, Tiedeman, et al., 2016). Millennials were hit hard by the recession and incurred economic hardships including under-employment, low wages, and increasing inequality (K. M. Ralph, 2015). According to the Census Bureau, millennials (25-34 in 2010) had less average annual income ($31,000) compared to the Baby Boomer generation who in 1980 had a higher annual income ($35,000) when they were in the same age range. There is little evidence indicating how VMT could change once the economic circumstances of millennials improve. Will they choose to have families, own a car, and move to the suburbs when they are better off economically? Planners should develop scenarios incorporating assumptions regarding the age at which millennials could be well off enough economically to invest in a car or home in the suburbs. The same should be incorporated regarding the age at which they marry and start a family (Klein & Smart, 2017) because these events could result in more driving. On the other hand, some millennials may refrain from making such investments despite economic improvements due to student loan debt obligations. Future income growth and its distribution remains a critical factor in determining future travel demand (Polzin et al., 2014).

Public Transit Ridership

Millennials are more likely to use public transit than older generations. However, their use is not expected to last as they grow older. Nevertheless, cities across the US have undergone drastic decreases in their public transit ridership. LA County has lost 10% of its users since 2006 (Elkind, 2016). Are millennials contributing to this decrease? If so, why? Scenario planning should take into account expected changes in millennial public transit ridership considering how the use of public transit could greatly reduce VMT.

Policy Strategies that Could Prolong the Millennial Effect as Millennials Age

Future projects or policies should have the potential to provide benefits under various circumstances that could result under different scenarios (Dutzik et al., 2013). There is a need to plan for uncertainty, support millennials and those who desire to drive less, question plans for freeway expansions, encourage the federal government to take a strategic role in transportation policy, invest in priorities, and invest in research (Dutzik et al., 2013) in order to ensure VMT does not increase again. In addition, the following are recommended:

- Support the development of new apps that facilitate multi-modal transportation and access to these modes of travel.
- Improve infrastructure in neighborhoods to accommodate other forms of travel such as car sharing, transit, pedestrian, and biking that support the carless lifestyle desired by millennials (K. M. Ralph, 2016).
- Develop programs and incentives for employers to provide multimodals with options such as a transit pass for their employees.
- Facilitate online shopping and online personal services to reduce the need to travel by vehicle, and simultaneously reduce VMT and GHG emissions in the delivery sector.
- Permit work from home when possible to reduce VMT.
- Implement policies to support compact developments, mixed use patterns, and transit oriented developments that facilitate an urban lifestyle decreasing VMT (McDonald, 2015).
- Facilitate public transit use to preserve the carless lifestyle which millennials desire by integrating innovative transit apps, efficiency, and safety into the service.
- Public transit should also be kept affordable for millennials in particular due to their economic constraints (low-wage employment, school loans, and housing costs) (Klein & Smart, 2017; Sakaria & Stehfest, 2013).
- Research and prepare to meet the travel demands and behavior of the subsequent generation, Generation Y.

Conclusion

By 2030, millennials will reach the 35-54 age group. What this group will want in the future and what it means for the future of VMT and GHG emissions is uncertain. VMT has decreased in large part due to the distinct driving patterns of millennials. However, it is important to question whether it will decrease, remain static or return to high rates. Understanding the factors influencing VMT among millennials is particularly important for policy makers in both local and state government when proceeding with projects and policies. This policy and literature review highlights the millennial effect on VMT, the relationship of millennial behavior to the built environment, potential scenarios for future study, and possible policy interventions that could continue the millennial effect trends. Nevertheless, the behavior trends of millennials should be continuously analyzed over time (Garikapati et al., 2016) considering they make up a large portion of the population and they begin to change their travel behavior as they engage in actives they had previously delayed such as acquiring a driver's license, buying a home in the suburbs, and starting family. Therefore, their decisions can greatly influence the structure and function of the urban environment in the years ahead (McDonald, 2015).

Appendix 1 Review of Selected Studies Regarding the Millennial Effect

Author(s) (Year)	Question of interest	Data	Methods	Key findings
Brown, Blumenberg, Taylor, Ralph, & Voulgaris (2016)	Is decreased driving among millennials associated with increased use of public transit?	National Household Travel Survey, 2001/2009	Data used to investigate relationship between age and transit use	• There is no assurance in data that transit habits of millennials will endure as they age.
Buehler & Hamre (2015)	What are the trends and determinants associated with multimodal car use in the US in a typical week?	National Household Travel Survey, 2001/2009	Multinomial and logistic regression analyses	• Nearly 2/3 of Americans use a car and take at least one trip by foot, bicycle, or public transit in a week • ¼ of Americans use cars and take at least seven weekly trips by other modes of transportation.
Case & Schipinski (2015)	Considering millennials are open to alternative transport to work, should one plan for an increase in the demand for alternative transport?	National Household Travel Survey, 1983, 1995, & 2008/2009	Regression analysis: • Dependent variable: usage of alternative transportation • Independent variables: era, age, generation, gender, income, MSA status, Urbanized Area status.	• Alternative transportation use is 8.2%. • By 2050, it will be 8.8%.
Circella, G., Tiedeman, K.,	What affects U.S. passenger travel?	Scientific studies and	Review of studies and reports for the	• VMT per capita decreased in the US from 2004-2013.

Author(s) (Year)	Question of interest	Data	Methods	Key findings
Handy, S. Alemi, F., and Mokhtarian, P. (2016)		recent technical reports	contribution of various factors to the use of private vehicles rather than other means of travel, direction of the effects of each factor, future effects, and the degree of certainty for each factor on its influence on the millennial effect.	• The economic recession influenced the decrease in VMT. • Trends in the US: smaller households, delay in starting families, increase in the number of immigrants. • Baby Boomers are retiring and making less trips. • Younger generations typically own less vehicles and are more multimodal. • The future of technologies to support shared ride services is uncertain.
Circella, Fulton, et al., (2016)	What are the relationships between behavioral processes and mobility-related decisions of millennials? How does millennial travel behavior compare to Generation X?	Online survey (n= 2400) of young adults and members of Generation X	Cross-sectional study/survey based in California, consisting Generation X as the control group for comparison, quota sampling method	• Produced the California Millennials Dataset, containing information on personal attitudes, preferences, concerns for the environment, lifestyles, use of social media, living situation, commutes, travel patterns, car ownership, use of shared mobility sources, major life events, propensity to purchase a private car or to use another form of travel, political ideals, and sociodemographic attributes.
Delbosc (2016)	Are young adults abandoning cars or simply delaying the	n/a	Discussion based on socio-technical transition research	• Trends in youth driver licensing have placed pressures on car dominance, inducing innovations that will alter the

Author(s) (Year)	Question of interest	Data	Methods	Key findings
	transition to a car-dependent lifestyle?			car centric regime. However, policies and planning are needed to support this trend should it continue.
Dutzik, T., and P. Baxandall. (2013)	What are the changes in transportation trends that should be made clear in order to plan better for the future?	National Household Travel Survey, 2001/2009, Census	Develop scenarios depicting the possible outcomes of the millennial effect. Scenario numbers were developed using linear interpolation.	• Scenarios do not provide predictions for the future • They provide a range of possible outcomes.
Garikapati, Pendyala, Morris, Mokhtarian, & McDonald (2016)	Will differences in the behavior of millennials continue as millennials age?	American Time Use Survey, 2003-2013	Longitudinal analysis	• Millennials delay activity patterns of previous generations • Include delaying completing education, acquiring jobs, and having children • Suggests travel demand will grow in the future
Klein & Smart (2016)	Are travel behavior changes brought on by millennials due to changing preferences or economic factors?	Panel Study of Income Dynamics, American Community Survey, etc.	Assess 8 waves of vehicle ownership among families over time. Tools: Poisson panel regression, fixed-effects models, random-effects model, Hausman Test	• Economically independent individuals own more vehicles than expected, considering their low incomes and wealth.

Author(s) (Year)	Question of interest	Data	Methods	Key findings
KRC Research (2010)	Description of millennials and their driving behavior	Online survey (n= 1,045 adults), 2011	Bar graphs to visualize differences among other age cohorts	• Millennials prefer alternatives to decrease driving due the high car costs, the environment, and social media. • Millennials prefer to save money than spend on a car. • Millennials are more prone to participate in sharing programs like car sharing due to the savings.
McDonald (2015)	Are Millennials Really the "Go-Nowhere" Generation?	National Household Travel Surveys, 1995, 2001, 2009	Descriptive statistics to profile trends and regression models	• Driving decrease is not offset by increase in other travel. • Decreased distance does not explain vehicle use decline. • Lower employment explains 10-25% decrease in driving • Online retail & social media explain 25-50% of decrease
Ralph, K. (2015)	Are millennials who drive less taking transit, walking? How does multimodality look over the course of a week?	National Household Travel Survey, 1995, 2001, 2009	Identify four traveler types using latent profile analysis of travel patterns for a single day and for an extended period.	• Changes that explain travel trends: Economic constraints, role deferent, and racial/ethnic composition • Young adults have a transportation disadvantage.
Ralph (2016)	Are millennials multimodal?	National Household	Latent class (LC) models	• Multi modals are rare and 8/10 millennials used a vehicle for almost

Author(s) (Year)	Question of interest	Data	Methods	Key findings
		Travel Survey, 1995, 2001, 2009		every trip as a Driver or Long-distance Trekker
Sakaria, N. & Stehfest, N. (2016)	What is the millennial lifestyle and decision-making processes? How do millennials make their mobility decisions? What are the barriers, benefits of various mobility options? What are the opportunities?	Data obtained from interviews and surveys	In-depth phone interviews (5 cities) and mobility journaling, quantitative online survey (6 cities)	• Cost, convenience, and exercise are motivations • Many millennials are becoming multimodal due to cost and convenience. • Millennial car owners live in urban areas, are parents, and are using cars as one mode a midst other options. • Millennials are concerned about the environment therefore motivating their transportation mode. • Millennials are multi-taskers. • Local community is important to millennials.
Schoettle, B. & Sivak, M. (2013)	What are the reasons behind the recent decline in young driver licensing in the U.S.?	Online Survey (n= 618)	Questionnaire developed. Only individuals between 18-39 were surveyed and those who did not currently have a driver's license.	• Millennials are too busy to acquire a driver's license. • The cost of maintaining a vehicle is too expensive. • They are able to get rides from others

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