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Understanding Demographics, Preferences, and Locations Influencing the Future of Public Transportation

MULTIDISCIPLINARY STUDY OF FACTORS THAT AFFECT THE MARKETS FOR TRANSIT

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Above: The Transit Cooperative Research Program explored why different demographic groups respond differently to transportation options.

Although the tools for understanding travel demand, which focus on relative travel times and relative travel costs, provide a sound basis for supporting near-term policy issues, they prove inadequate to support longer-term examination—such as the future of public transportation over the next decade.

When society wants to explore such large and complex issues, simply analyzing the implications of travel times and costs is not enough, because transportation behavior is strongly influenced by a set of underlying factors that cannot be expressed in these terms alone.

Simply put, different demographic groups respond differently to common sets of transportation options. For example, a recent study for the National Cooperative Rail Research Program concluded that, when faced with exactly the same set of services, younger millennial women were three times as likely to choose an intercity curbside bus than were older, postmillennial men (*1*). Again, the times and costs of the competing services were the same for everyone, and it was an individual's demographic category—more than the traditional factors of times and costs—that best explained mode choice (Figure 1, page 44).

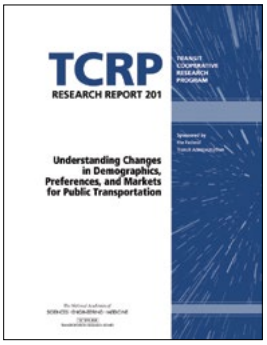
Although variation in demographic category is important in predicting travel behavior, variations in preferences, values, and attitudes also are significant. Some people in society value moving their residence to a more urban setting; some do not value such urban characteristics and defend the suburban settings they have worked hard to attain. As a second-order impact, those with urban preferences are more likely to settle in dense, transit-rich neighborhoods, and populations in such locations will use transit at higher rates.

Challenge of Interdisciplinary Research

When directed to analyze key aspects of the future of public transportation in American

Photo: NACTO

Young millennial women are three times as likely to choose curbside transit as postmillennial men.



addition to relative times and relative costs of the supply side of the equation.

How to incorporate key underlying factors posed a challenge from the very beginning of the study. Researchers in the field of social psychology have accepted methods to relate attitudes and values to choices in behavior, more and more applying Icek Ajzen's theory of planned behavior to transportation (*2*). In parallel, research literature is rich with studies of how characteristics of land use are related to transportation behavior and mode choice. Finally, advanced tools of market segmentation increasingly are used in market research to cluster groupings of travelers by commonality of attitude rather than by traditional demographic categories (*3*). The challenge, then, is how to undertake a truly multidisciplinary research project; that is, using separate tools that may or may not come together in their conclusions.

For the authors of *TCRP Research Report 201*, the answer was to apply a wide variety of the appropriate research techniques; indeed, to develop a new set of methods that attempt to integrate several factors into one mathematical structure.

society, research team managers assembled to produce *TCRP Research Report 201: Understanding Changes in Demographics, Preferences, and Markets for Public Transportation*. The researchers realized that one comprehensive research plan would have to cover values, attitudes, preferences, and location—by demographic category—in

NEW MODELS AND METHODS

The project created a somewhat unusual mix of research methods. For interpretations of how attitudes and values interact to influence travel behavior, a structural equations model was created, incorporating some of the concepts utilized in the theory of planned behavior. Advanced procedures in market research were applied to create several attitude-based market segments, and new multinomial logit travel demand models were created to facilitate a better understanding of classic supply-side factors.

To deal with the effect of location on transit, sample populations from two surveys—one from 2014 with 11,000 respondents and one from 2016 with 3,500 respondents[1]—were assigned to five neighborhood types in terms of the transit orientation of the neighborhood. Formulas developed using the U.S. Environmental Protection Agency's Smart Location Database program allowed the researchers to categorize geographic zones for all 14,500 respondents of the two surveys into the five levels of transit orientation, defined by the ratio of their transit accessibility to jobs divided by highway accessibility to the same jobs.

To better understand how key underlying factors are related to preferences, attitudes, and values, an ambitious analytic framework was created. Using the 3,500-person sample designed for this purpose, researchers examined behaviors, attitudes, and values three times: once in terms of five age categories, once in terms of five neighborhood types, and once in terms of four attitude-based market segments. This format produced a multidisciplinary view both of attitudes and behaviors. For any given proposition, the reader can observe the extent of variation associated with age, location, and market preferences.

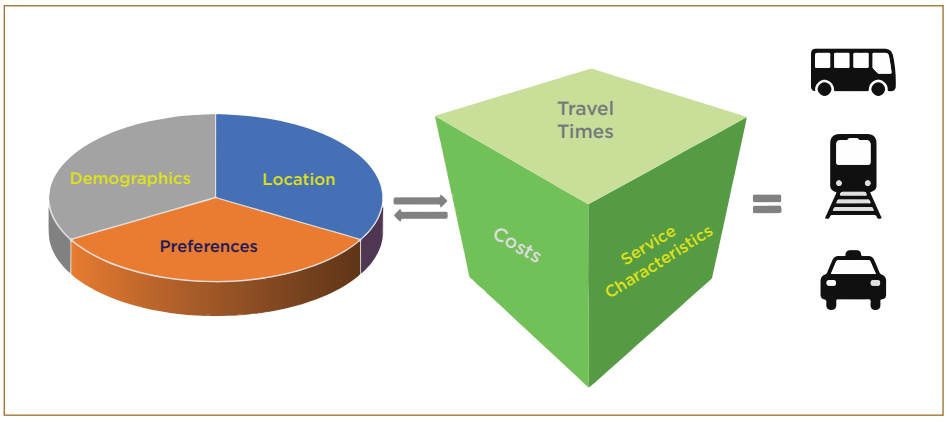


FIGURE 1 Although all the factors noted here affect public transportation ridership levels, the TCRP study focused on the underlying factors illustrated in the pie chart (*left*).

[1] The survey of 11,000 respondents in 2014 was conducted by RSG, Inc., in support of *Who's On Board,* a 2016 TransitCenter, Inc., report.

INTEGRATED CHOICE LATENT VARIABLE

The most ambitious new method created was a single mathematical model that incorporated attitudes and preferences, demographic categories, and locational characteristics to augment travel times and costs. The model, known as an integrated choice latent variable model, combines established procedures used in social psychology with established procedures in travel demand forecasting to facilitate the simultaneous, integrated examination of hard and soft variables when explaining travel behavior.

Results

As part of its research objective to look at future transportation markets, *TCRP Research Report 201* focused strongly on the role of age. A key question concerns how a given cohort group will behave when they are, for example, 10 years older than today, and this leads to an examination of the impact of age on transportation behavior.

To establish the setting, researchers examined the role of age in generating vehicle miles traveled (VMT), a measure of the use of private automobiles (*4*). In Figure 2 (below), which shows the role of age in VMT per driver, the overall amount of car use can be divided into three phases (see arrows). The phase between ages 16 and 30 is characterized by increasing auto use during a period of high level of lifestyle volatility; that is, people tend to change locations, and to form and disband household living arrangements, more frequently in their 20s than later in life (*5*). The number of cars owned increases. Around age 30, people tend to reach their maximum auto use and VMT plateaus. A strong pattern revealed in Figure 2 is the lack of change in transportation patterns between the ages of 30 and 50. Around age 50, some of the travel to far-flung suburban soccer games is transferred to the younger generation, who begin to drive themselves. Later still, retirement patterns reduce VMT in the oldest age categories.

AGE AND TRANSIT USE

According to national aggregate statistics, the life phase between the ages of 16 and 30 includes the prime years for transit use. As shown in Figure 2, the competitive role of the automobile is not firmly established in this time period; by contrast, the intense reliance on cars takes over around age 30. In fact, the TCRP study found that a traveler's age is the one of the most powerful determinants of transit ridership—in general, the older people get, the less they use transit. This pattern can be seen in Figure 3 (page 46), in which the relationship between age and number of transit trips per capita has been averaged using the four most recent National Household Travel Surveys.

Photo: State Farm

The use of automobiles sharply increases—and the use of transit decreases—in the decade between the ages of 20 and 30.

To some extent, the number of transit trips by age group reflects an inverse relationship with the use of its principal competitor, the automobile. The prime auto usage at around 30 years of age generally reflects the same life changes as the decline in transit trips shown in Figure 3. For various reasons, the decade between the approximate ages of 30 and 40 shows a sharp drop in the use of transit per capita.

Researchers found that the distance to the nearest bus stop increases consistently by age group, and the distance to the nearest commercial or village center increases similarly. Additionally, the study's analysis has demonstrated that age is a dominant explanatory factor—not only by acting through the intermediate variable of location. For example, the study's analysis revealed that, for any given level of neighborhood transit accessibility, the younger traveler will choose transit more often than the older traveler.

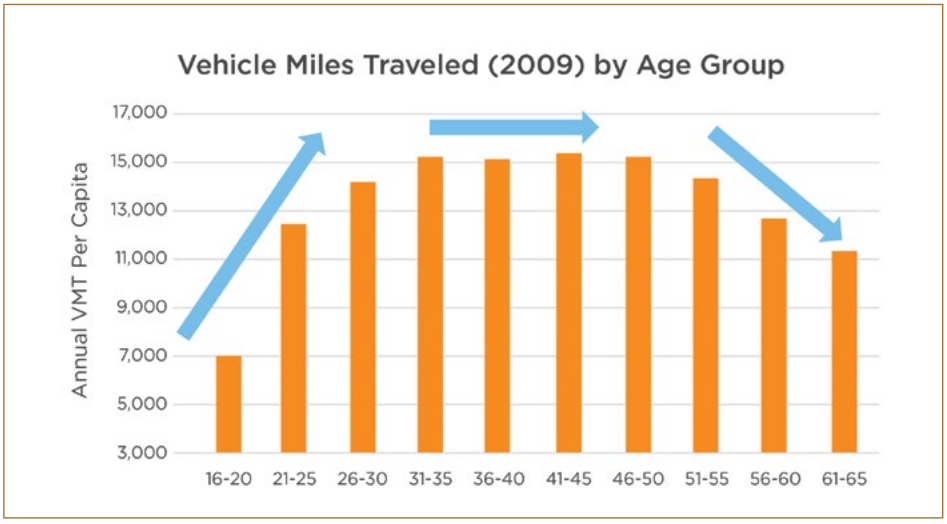


FIGURE 2 The number of VMT per driver can be seen in three phases, denoted by the blue arrows. (Source: National Household Travel Survey of 2009.)

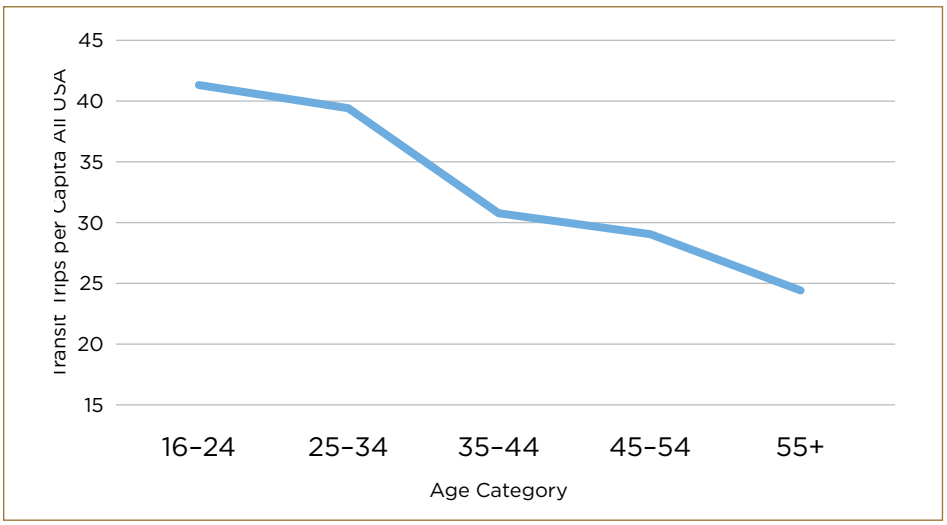


FIGURE 3 Effect of age on number of transit trips per capita. (Source: Nancy McGuckin, Analysis of National Household Travel Surveys of 2017, 2009, 2001, and 1995.)

MILLENNIAL GENERATION

The study concluded that the next decade could see some difficult times for the public transportation market. Using the multidisciplinary techniques noted above, the study merged information about attitudes with information about demographics and location. The results raise some issues of concern.

Recently, the Pew Research Center defined the millennial generation as those between 22 and 37 years of age in 2018 (*6*). If the millennial generation is divided into three cohort groups of 5 years each, the oldest of these groups now is between 32 and 37, and solidly within the age category with the greatest decline in transit, shown in Figure 3. People between the ages of 26 and 31 will move into this older age category in the coming years; importantly, this 5-year cohort currently is the single largest cohort category in U.S. population. The cohort of Americans ages 26–31 is larger than any 5-year segment of the Baby Boomer generation, which previously boasted the largest cohorts in the U.S. population.

The youngest 5-year age cohort—ages 22–26—is somewhat smaller than the middle group, and the following 5-year cohort group is smaller still. This means that the size of the key 20–30 age category for pro-transit behavior is shrinking demonstrably over time when viewed through the lens of national demographic data. At the same time, the largest cohort soon will be passing through the lower-transit-use age category of between 30 and 40.

What Will Happen Next?

The research conducted for *TCRP Research Report 201* included extensive consideration of the values, preferences, and attitudes for each relevant age category; this allows additional understanding of what may happen to millennials' transit use as they proceed through the life cycle. An analysis of attitudes shows that this group has positive views of urbanism and are more open-minded about automobile alternatives. As they age, however, millennials may find that loyalty to transit becomes more difficult.

The expected shift away from transit has been flagged not only in terms of demographics, but is reported by millennial survey participants themselves in the TCRP study. Although the study has found that millennials proceed through the stages of the life cycle more slowly than previous generations (getting married and buying homes later), millennial survey respondents reported that they fully expect to move to less-dense locations as their families mature.

Millennials also expect to take transit less often and drive more often in future

Photo: Shawna L. Keyes, U.S. Air Force

More than half of survey participants ages 25–34 responded that they wanted to settle in a house and neighborhood that reminded them of their parents' home.

Photo: Ian Fisher, Flickr

Long-term values—for example, living in a diverse community—influence a preference for urban living and can lead to higher transit use.

years, according to the survey. In addition, in no age group did a majority of respondents report that they wanted to replace auto ownership with various short-term strategies to share, borrow, or rent cars. Of all age groups, it was the 25–34 age group who agreed most strongly that they "love the feeling of freedom and independence that owning several cars provides for my household." Approximately 56% of that key age group also agreed with the following statement: "As I get older, I think I will eventually want to settle in the kind of house and neighborhood that my parents had."

How Does It All Fit Together?

Keeping in mind the goal of integrating preferences and demographics to understand markets better, the research team created an analytical framework separating preferences into two categories: 1) longer-term values that influence location selection and 2) nearer-term attitudes about travel services and options. Preferences about desired residential location influence travel, both directly and through the mediating influence of the choice of residence. Similarly, the details of the environment at any location affect travel directly as well as via the mediating influence of near-term attitudes. Finally, near-term attitudes reflect perceptions of available options, highly influenced by comparative times and costs. As noted by the arrows stemming from the top of the diagram in Figure 4 (below), demographic categories must be taken into consideration at all phases of the process.

Results from the project's structural equation modeling (included in *TCRP Research Report 201* and documented in its technical appendices) show the cumulative importance of many factors. For example, a latent factor is created to reflect value placed on urbanism, derived from responses to such statements as the following: "I would value living in a community with a mix of people with different backgrounds." The model shows the impact of this underlying value on the selection of neighborhood type (e.g., density of intersections per square mile) and reveals the impact of the neighborhood type latent factor on amount of transit taken. The model allows the reader to see the cumulative effects of the longer-term preferences for the urban setting and the indirect influence through subsequent mediating factors. For example, the model shows that a 10% increase in the latent factor "Values Urban" is associated with a 3.5% increase in transit ridership—a strong impact.[2]

> The TCRP study found that a traveler's age is the one of the most powerful determinants of transit ridership.

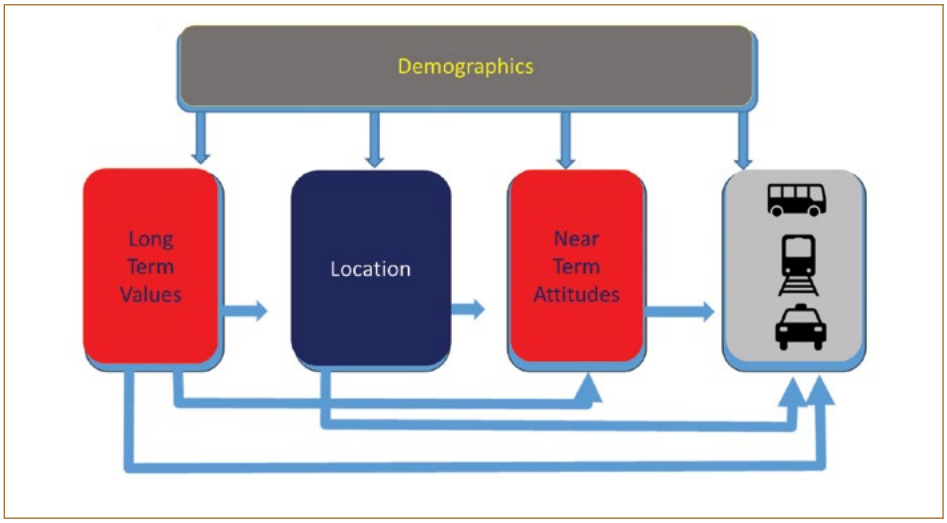


FIGURE 4 The relationship between demographics, long-term values, location, near-term attitudes, and travel behavior.

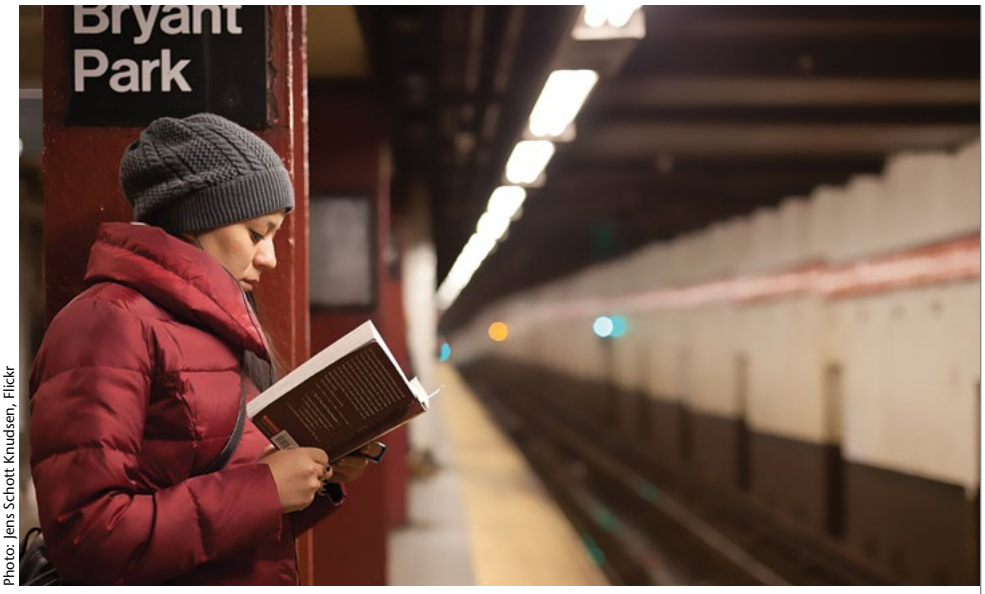


Photo: Jens Schott Knudsen, Flickr

Travelers under the age of 30 and with higher levels of education are more likely to choose transit.

TCRP Research Report 201 also reports the results of the integrated choice latent factor model developed in the project. This innovative effort to incorporate both preferences and service characteristics into one forecasting model showed that, in the hypothetical case in which all age categories adopted the attitudes of those under 30, transit ridership would increase by 5%.

A similar scenario, in which all groups adopted the attitudes of those with the highest levels of education, showed an 8% increase in transit ridership. A combined scenario, in which all participants had the attitudes of both the highest-education and under-30 groups, produced a combined ridership increase of 13%.

The same model then was used in a parametric exercise to explore possible futures assuming improved levels of transit times and costs and worsening times and costs of competing modes. In this exercise, transit ridership increased by 35%.[3] This experience in scenario testing allowed *TCRP Research Report 201* to conclude that the future of transit will be influenced far more by the competitive quality of its services than by cultural changes about attitudes and values. Hypothetical futures with more supportive attitudes toward transit pushed the needle up by 13% and hypothetical futures with more competitive transit travel times and costs are associated with growth of more than 30%.

The future of transit will be influenced far more by the competitive quality of its services than by cultural changes about attitudes and values.

The transit industry must face the challenge, however, of fewer people in the key 20–30 age categories. If this loyal—and large—population cohort reduces its present transit use as they reach the ages of 30–40, a new generation of transit services may be required that attempt to retain key positive market segments even as they migrate out of transit-rich locations into lower-density geographic settings. *TCRP Research Report 201* concludes that, in the meantime, further research is needed to better understand the Generation Z cohort—now firmly in its prime transit-consuming years.

[2] This measure, called "standardized total effect," is documented in detail in the technical appendix to *TCRP Research Report 201*.

[3] In the same set of model runs, a scenario with worsened transit services and improved competing mode services showed transit use to fall by 32%.

Acknowledgments

The study described in this article was the work of large research team, which included Tom Adler, Greg Spitz, Stephane Hess, and Mark Bradley, on travel behavior; Nancy McGuckin on demographics; Rich Kuzmyak on land use; and Karla Karash on transit services. Coogan served as principal investigator. The research team is indebted to the TCRP project panel and TCRP Senior Program Officer Dianne Schwager.

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