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Proceedings from the

Nationwide Personal Transportation Survey Symposium

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Proceedings from the Nationwide Personal Transportation Survey Symposium

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Foreword

The Nationwide Personal Transportation Survey (NPTS) has been conducted periodically since 1969. Each survey has collected data on the travel by United States households by all modes and all purposes. This travel data coupled with data on the demographic makeup of the household has provided a wealth of information that reflects changing household makeup and the associated changes in travel. The 1995 NPTS is the most recent in the series and was conducted between May 1995 and July 1996. A Symposium was held in Bethesda, Maryland, in October, 1997 to discuss the results in an open forum. Nearly one hundred people attended, representing federal policy offices, state and metropolitan planning agencies, universities, and public interest groups. This report summarizes the results of that symposium.

The symposium showcased the use of the new dataset, and how it could be applied toward policy analysis in a number of transportation arenas. Four papers were presented and discussed topics including: the aging of the baby boomers, residential choices and incentives to move to the central cities; travel behavior of persons in low income households and how programs to move people from welfare to work could benefit from this information; vehicle ownership and usage patterns and the impacts on air quality and other environmental issues; and the relationship of land use and transportation.

Lively discussions ensued during the policy panels which reflected the continuing need to address mobility, economic development, safety and environmental preservation as part of the transportation program.

The workshops developed priorities for research to be conducted using the 1995 NPTS. We hope that the symposium participants will have the opportunity to pursue these topics. The Federal Highway Administration (FHWA) is assessing which of the many priorities are most urgent in addressing national issues and can be made part of the national transportation research program.

Our next conference is scheduled for June 1999. At this conference, the continuum of travel, from the many short daily trips captured by the NPTS to the more infrequent long distance trips captured by the American Travel Survey, will be discussed.

This report is the seventeenth issue of *Searching for Solutions: A Policy Discussion Series.* The series was developed to explore key highway transportation issues such as congestion pricing, public/private partnerships, land use, transportation and air quality. We hope this series will help stimulate a wide-ranging exchange of ideas and opinions on key transportation policy issues.

Dr. Walter Sutton
Associate Administrator for Policy
Federal Highway Adminstration

I.

OPENING SESSION

Welcoming Remarks

Gloria J. Jeff, Deputy Administrator, Federal Highway Administration

Let me welcome you to our Symposium on the 1995 Nationwide Personal Transportation Survey. I am extremely excited about this particular piece of work because it has already begun to prove its worth. Senator Carol Moseley-Braun saw me the other night on C-Span and later told me, "...It was a miracle... I was busy trying to make the case for welfare to work and there you were spouting statistics and information about travel and the impact on communities of color and on women and what their needs are. It was as if God said, 'Carol, you need the information and here's the angel to give it to you.'" So our product has already begun to prove its worth.

The new NPTS is not just a lot of statistical information that sits on pieces of paper and has no life and no vitality, it is becoming usable information for decision makers in a real time fashion. I'm excited that the approach we've taken this year is one that will permit us to look at data that is living, real, and immediately usable.

The NPTS has been conducted since 1969, and the 1995 survey is the fifth in the series. The NPTS is an inventory of daily personal travel, for all kinds of trips, not just the journey-to-work, as is collected in the decennial census. This is a survey of all trip purposes. It includes a broad geographic area and interestingly enough, has advanced the state of data collection by some of the new techniques that have been instituted to advance itself over the period since 1969.

The U.S. Department of Transportation and Federal Highway Administration have established a strategic plan focused around five essential goals, those being mobility, safety, productivity, human and natural environment and national security. I want to talk about some of the elements of the NPTS as they relate to these five goals.

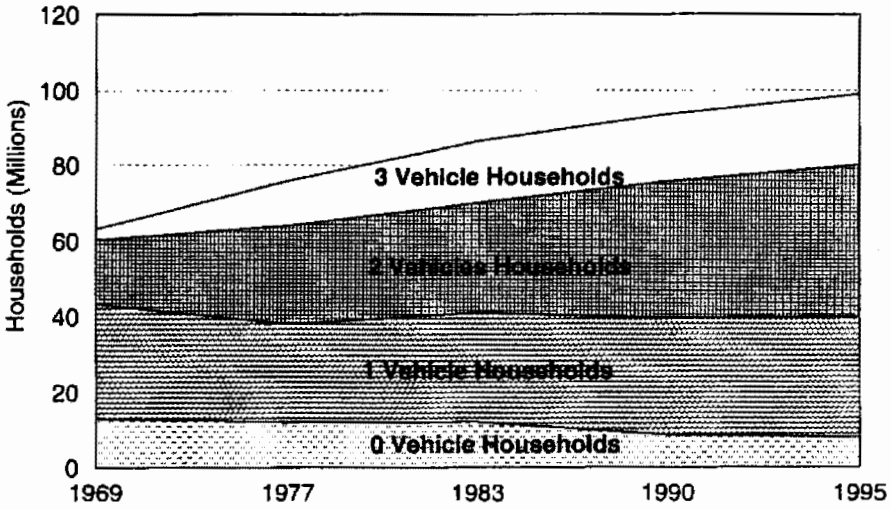
Let me start with mobility. We are trying to focus on the need for the transportation system to provide access to goods and services for people, for other businesses, for information. NPTS provides us with a wealth of fundamental information. It gives us counts of vehicle availability, the number of trips by purposes, by mode, by time of day. We know whether or not folks have access to transit, and whether they are walking or riding a bike.

The NPTS gives us some information of the public's view of whether or not they have access and how well the system is performing. Today, we can tell you what condition the miles of the system are in, we can tell you what the conditions of the buses are and how many folks use it, but the question of how well the system performing is one for which we do not have an intermodal, integrated answer.

When we look at NPTS, we find the beginnings of those kinds of questions and answers. When one looks at vehicle availability, we know that there are more private vehicles than ever.

We have now exceeded more than one vehicle per licensed driver. That makes life really interesting because it means that while some people have no vehicles, other have specialized vehicles amounting to more than 1 car per licensed driver. These can be company cars which have use restrictions, vans for vanpooling, an energy efficient car for SOV commuting, a "show-off" car for the weekend.

Figure 1
Households by Number of Vehicles

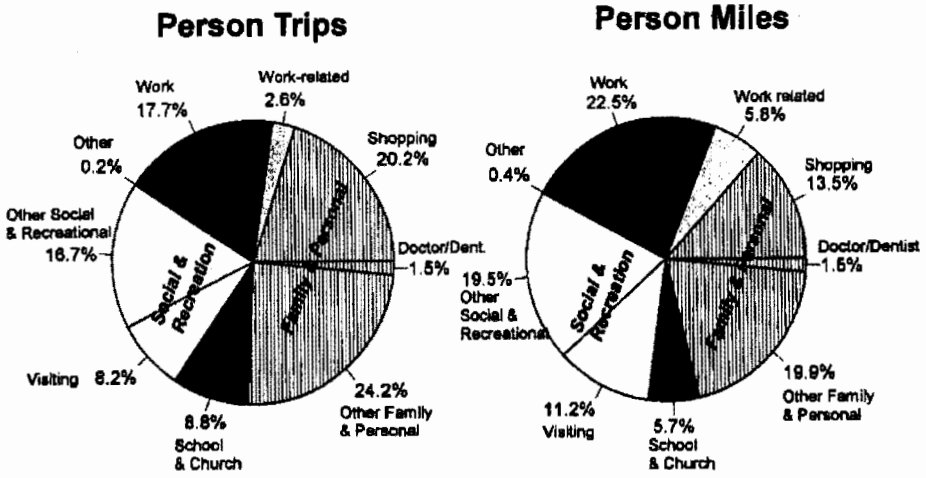


We also have found, while we have an increasing number of households with more than one vehicle per licensed driver, and while there is a declining number of households without automobiles, some subpopulations have very different patterns. When we look at the African American households, 35 percent of these households do not have a vehicle.

The significance of this is very straightforward when you see in Alan Pisarski's first and second editions of "Commuting in America," that a condition of work was possession of an automobile in a household. Where we have a particular subgroup with a significant number of households in which there is not vehicle ownership, it points to some fairly significant policy questions of how do we make these households productive contributors to society. While some of these households may be in New York City where vehicle ownership is not a prerequisite to work, in other parts of the United States where transit alternatives are much less than in New York City, we still have a significant issue. How successful can our intermodal system be when the trends indicate that if you don't have an automobile, you don't have a worker.

So again, looking at the NPTS raises another policy question. Trips destined to work are less than a fifth of all the travel. The data clearly indicates that with only 18 percent of our trips having one end at the workplace, that to find solutions to some of our environmental problems, we have to look beyond the journey to work.

Figure 2
Purpose of Travel by Percent



So have we really made a dent in those policy issues associated with getting people out of the cars? We don't know, but the data clearly says we need to look at that. We need to keep an open mind as we look at this issue. We see that 45 percent of our trips are for taking care of family or personal business and another 25 percent are for social and recreation.

How can we, or should we, coax people out of their automobiles for these 70 percent of our trips that are non-work trips? The vehicle occupancies for these types of trips are about two persons per vehicle. So the question becomes how do we rethink the delivery of a transportation system so that it balances people's ability to meet the kind of travel demand that is out there but do it in new and innovative ways.

Looking now at safety, which is the cornerstone of this Administration, NPTS has a number of ways to provide useful information. The NPTS data are used to measure "exposure" to risk. Owning an automobile is one thing. But if it never goes anywhere, and sits in a garage, the level of safety for the driver of that vehicle is extraordinarily high. But, if someone has a car and doesn't drive it, they may be travelling as a pedestrian, bicyclist, or passenger in other cars. How do we protect people traveling by all these modes?

Clearly, how much time are they spending behind the wheel, how many miles are being traveled by age and by sex, by vehicle type are part of the equation in safety analysis. Looking at national trends can mask important differences. We need to look at subpopulations because their patterns, especially over time, may vary from the general population.

One example is looking at differences by gender in the use of private vehicles. We see that the average American driver is spending about an hour and 13 minutes behind the wheel on a daily basis. Although men make fewer trips than women do on a daily basis, they are traveling greater distances. Women make more trips, but travel fewer miles, and spend less time behind the wheel.

Today, there are also significant differences by age. Among today's elderly, travel by men and women show large differences. But, by the time the baby boomers reach retirement, these differences will largely disappear, older women will be traveling more miles than today's older women, and women still tend to live longer than men! Are we going to need different methods to meet the travel demand of the baby boomers in retirement?

When we look at older Americans, we also begin to see some other things that should give us cause for concern. The proportion of the U.S. population over 65 continues to increase. On average, a person age 65 or over makes about 80 percent of the number of trips of a younger person. But many are making no trips in a day. If our elderly are not getting out, then they are becoming isolated. One of the things we, as a society, need to think about is how is the transportation system providing access to opportunity. So when we look at our older population, these become critical issues.

Table 1
Annual Person Trips for Elderly and Others by Mode

	65+	Under 65
All	1,251	1,615
POV-Driver	830	968
POV-Passenger	284	422
Transit	22	28
Walk	67	87
Other	49	110

Also, NPTS gives us data on walk and bike trips. When we look at those trip purposes associated with walking and biking, they are, interestingly enough, the same kinds of numbers that we see in terms of travel in general. Family and personal and social and recreation are the dominant reasons for travel associated with those modes, which is what we see in the general population as well.

What are accident rates and where those accidents are occurring is also important. The Surface Transportation Policy Project (STPP) has recently released a study on pedestrian safety. We look forward to STPP's use of the new NPTS to help us shape policy at the national level, at the state level, and at the local level on this topic.

Looking next at productivity, how do we relieve congestion, how do we make it more efficient and effective for our systems. That means examining travel times, modes, whether or not carpooling and use of transit. Then finally, what's the public's view of congestion. There we have some very interesting answers.

Table 2
Commute Profile

	1983	1990	1995	'83-'95 %change
Average Work Trip Length (in miles)	8.5	10.6	11.6	36.5
Average Work Travel Time (in minutes)	18.2	19.7	20.7	13.7
Average speed (MPH)	28.0	32.3	33.6	20.0

Between 1983 and 1995, the average speed for work travel increased by about 20 percent. We find that not necessarily surprising when we began to think about why we're seeing this increase in speed. As our metropolitan areas have decentralized, we are seeing more activity centers develop away from the central business district. As a result, the nature of travel has begun to change.

As we have moved from an industrial focus of our society to one of more of information, the sort of stigma of not wanting to live next to those smelly, dirty, polluting manufacturing plants where people worked is not as much an issue as the attractive campus-type settings that we see. For many, information transfer becomes much more attractive, and so proximity between work and residence is not as significant. One, we have moved away from the traditional "nine-to-five" work schedule. We see that via a variety of fairly effective methods, we've expanded the peak period. But by expanding the peak period for work trips, trips for other purposes, such as personal business and shopping, are making up a greater share of peak period trips.

When you think about the growth of women in the workplace and the fact that we ladies still tend to be the principle caregivers in the household, so we're the ones who run all those wonderful errands, which is why we have more trips and less distance than the fellows do. So the question is, if you're going to get me out of my SOV, how are you going to make alternatives to SOV attractive for me?

NPTS isn't going to answer that question, but understanding how people travel today makes all of us at DOT discuss the issue of balancing transportation in a way that the demand for travel gets met, but it's done in a way in which people have better choices in how and when and where they travel.

Vehicle occupancy. I have found this table most interesting, because there's a lot of "conventional wisdom" about the dreaded SOV. When we began to look at the dreaded SOV, we find that for the work trip, average occupancy is indeed very low (1.14 persons), that is, overwhelmingly, people going to work are riding alone. The data continues to support that, but what's interesting when one looks at that as being only 18 percent of the travel, that gives us a very different spin on how we solve this problem of getting people to make better choices.

Table 3
Vehicle Occupancy by Trip Purpose

Trip Purpose	Average Vehicle Occupancy
All Purposes	1.59
Work	1.14
Shopping	1.79
Family/Personal Business	1.82
School/Church	1.65
Visiting	2.08
Social and Recreational	2.17

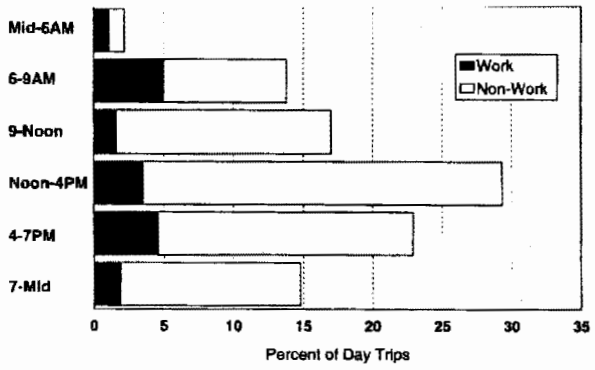
When we look at vehicle occupancy for the dominant trip purposes which included family and personal business and shopping, average vehicle occupancies are close to 1.8. When we look at social and recreational trips, the average is over two individuals per vehicle.

That suggests that maybe we're doing a more intelligent job of sharing the rides, but again, how do we get them into making choices that help them utilize even higher vehicle occupancy in making these other trip purposes, particularly since non-work trips are becoming the dominant reason for travel.

Human and natural environment. This goal for the U.S. Department of Transportation is split in the way that you see it, because we recognize that there is a natural environment that reflects the air, the water, the plants and animals with whom we share this planet. We also recognize that there's a cultural, social and economic environment that is as important and that we've got to do a good job in both. So we view that in our strategic objectives, we have to explicitly address both human and natural environment.

Looking at the natural environment issue, what's the composition of the vehicle fleet? Are vehicles getting older, are we keeping them longer and what's the impact of keeping them longer? This data can be used to count cold starts and hot soaks to estimate air quality impacts, and to forecast the potential for alternate fuel vehicles as we look at some of those operating characteristics with respect to trip length and other related matters.

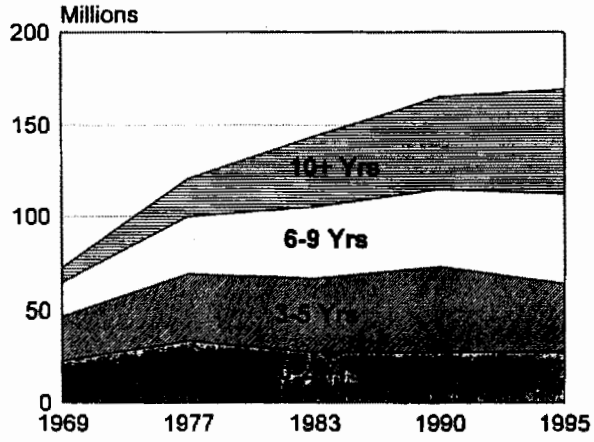
Figure 3
Work/Non-Work Trips
By Time of Day



If we examine trips by time of day, you will see that between noon and 4 p.m. and 4 p.m. to 7 p.m., is when the most trips are occurring but that a very small proportion of it is travel to or from work. Because of that, we increasingly have to look at what are the nature of those non-work trips and how do we do a better job of clarifying them.

Next, drop-off, pick-up trips. There are more pick-up and drop-off trips during the week, but even these kinds of trips made on the weekend are significant. More telling is the difference between men and women. Women make far more of these trips than men.

Figure 4
Distribution of Household
Vehicles by Age



Next is what I call the "ask any parent of a teenager" question. The answer is very simple. It's called "I have an automobile, am I giving the brand new one to my kid?" I have a 17 year old and 21 year old, plus me, and the new car is not theirs. I would like to keep it more than six months. But when we look at the distribution of the fleet, the curve is flat in terms of new cars, but the real growth is in the number of vehicles that are over 10 years of age and over five years of age. These are the cars that are going to the teenagers.

The reason for examining fleet composition and age of the fleet is safety. What is happening is that second and third vehicle in the household is being given to the population which statistically has the highest incidences of safety related problems, of accidents, fatalities, et cetera. So one, we are talking about making vehicles safer. We're looking at air bags, we're looking at increasing the seat belt laws and those mandatory requirements. Yet the vehicles that are either exempted or don't have those features on it are being given to the population at greatest risk.

When we look at the whole phenomenon of preserving air quality, when we look at where the highest number of trip making is taking place, again we're looking at populations that tend to do a very large amount of trip making, and a whole lot of it is non-work related. As you can tell, I am showing my biases as a parent of teenagers.

But we have that additional phenomenon of the fact that if we're going to look at correcting or reducing some of the negatives associated with air quality in these older vehicles, we needed to look at the population. Teenagers seem to have a herd mentality. I very rarely see a vehicle with one teenager in it. So at the very least, there are more persons traveling than just one. We just need to think about what that means for the transportation system.

National security is the final DOT strategic goal. My very fine staff said there are no obvious NPTS relationships. I disagree with them. This is why we have fun. There is no direct relationship between NPTS and the national security issue; NPTS isn't going to be used to predict manmade or natural disasters or military conflicts. What NPTS does have is information on typical travel that can be used to evaluate priorities in restoring service, in terms of what time of day, what kinds of travel. So there are opportunities of using the NPTS with respect to national security.

In closing, this is an exciting opportunity for us. The NPTS is not just for transportation data junkies, it a living, breathing, usable data source for decision makers. We have made the transition from simply collecting individual data points, translating that data into statistics, and then translating that set of statistics into usable information. For NPTS to be on that pathway is exciting, and I hope that all of you will it as exciting.

One of the critical messages from NPTS is that we have to think about delivering transportation differently than we have in the past. It is not simply enough to talk about nationwide vehicle availability. Household composition becomes important, the amount of time spent behind the wheel, the age of the individuals in the household, all of those become important factors as well. We're going to have to rethink our models, we're going to have to rethink the delivery systems.

We've got to do a better job of helping people make more intelligent choices about how and when and where and how they travel. So we begin to look at options, particularly when we get to issues like security and utilization of advanced technologies to give people higher levels of comfort while accomplishing their daily travel.

For this symposium, four fundamental papers will be presented. But as you listen to these four papers, we want your ideas on what areas need more work. I have to tell you that saying the authors took a conservative approach would not be an accurate description. Some of our authors

have taken intentionally provocative positions. We want to know your ideas on what other things we can do to advance the state of data collection, and in moving us forward along those pathways, help us begin to craft the second in the series of our NPTS meetings.

This is not your opportunity to sit and be a bump on a log. If you are here, you are here because you are interested, because you have something to contribute. This is a roll up your sleeve kind of approach, we want to hear what you have to say. There is no thought that is unimportant or that does not make a contribution for each and every one of us. Take that approach, roll up your sleeves, take us on, be controversial, help us make this better. Thank you.

NPTS -- Past, Present and Future

Susan Liss, Office of Highway Information Management,
Federal Highway Administration

Susan Liss discussed the NPTS program, noting that it was developed in 1969 when states began dropping transportation surveys from their budgets. Even at the outset, NPTS was designed to be multi-modal with an aggressive face-to-face interview to collect data. The first surveys were conducted by the U.S. Census Bureau, but as costs rose and sample size decreased, it became increasingly difficult to communicate quickly and effectively with the interview team, the NPTS decided to move into a computer-assisted telephone interview format in 1990. The move resulted in a larger sample, better documentation, and more coordination in editing and collection of data since the interviewers were all located at a single site.

The 1990 NPTS was a great improvement, but the 1995 NPTS had even more advances. A personal travel diary was used to record trips, which resulted in many more trips being reported -- errands, personal and recreational trips, etc. The telephone interviewing software allowed a household roster of trips, which reduced duplication of data when the interviewer talked to a second or third person in the household.

Ms. Liss explained that future plans included a continuous survey process to reduce the "gear-up/gear-down" effort. FHWA hopes to start this process in 1999, to preceed the year 2000 milestone. A longitudinal component of the continuous survey is also planned. Finally, there are efforts to use the 1995 data to test the feasibility of geographic substitution, the ability to model data to create "synthetic" data sets for states and MPO's. It will obviate the need to use old data to make current decision, and it will help agencies that have not completed such transportation surveys locally.

NPTS OVER TIME

YEAR	SAMPLE SIZE-Households	METHOD	CONDUCTED BY	CONTENT NOTES	SURVEY NOTES
1969	15,000	in-home interview	Bureau of Census	-auto only, not all POV, trips collected	-shortest NPTS questionnaire -problems with weighting -cannot add daily trips and long trips -used retired CPS sample
1977	18,000	in-home interview	Bureau of Census	-much detail on long trips -mapping certain daily trips to determine urban/rural split of travel	-part of sample also interviewed for a separate long trip survey, NTS -cannot add daily trips and long trips -used retired CPS sample
1983	6,500	in-home interview	Bureau of Census		-sample so small that interviewers never got proficient -used retired CPS sample
1990	22,300 18,400-national 3,900-add-ons	telephone- CATI	Research Triangle Institute (RTI)	-collected segmented trips -collected minor accident data	-recall method (no advance warning of travel day) -first add-on component -list-assisted, stratified RDD (random digit dialing) sample
1995	42,000 21,000-national 21,000-add-ons	travel diary with telephone retrieval	Research Triangle Institute	-odometer readings on household vehicles -address of residence and workplace - information on incidence of telecommuting and transit use	-large add-on component -first use of incentives -first use of travel diary -household rostering of trips -list-assisted, stratified RDD sample

II.

SOCIETAL TRENDS: THE AGING BABY BOOM AND WOMEN'S INCREASED INDEPENDENCE

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SOCIETAL TRENDS: THE AGING BABY BOOM AND WOMEN'S INCREASED INDEPENDENCE

EXECUTIVE SUMMARY

Introduction

The two most important societal trends today are the aging baby boom and women's increased independence. This paper compares the travel profiles of women aged 40 to 49 (early baby boomers) with women aged 75 and over and with men aged 75 and over (parents of the baby boom) to estimate the impact of an aging population on vehicle ownership rates and Vehicle Miles Traveled. Although current gender differences are likely to persist as the baby boom ages, middle-aged women today probably will travel more like their fathers than like their mothers when they reach their parents' age.

The baby boom has been the demographic engine driving social change in the U.S. for the past fifty years. Within this large cohort, significant numbers of baby boom women earned college degrees, entered the labor force, and began to maintain their own households during the 1980s. Baby boom women also are more likely to have drivers' licenses than women who are elderly. Any of these trends alone has implications for transportation now, but together they raise important questions for the future: What will the transportation profile of baby boom women look like when they reach the oldest ages and when the majority have been employed, and have been drivers, throughout their lives? How will these women maintain the independence to which they have become accustomed?

Data from the 1995 Nationwide Personal Transportation Survey (NPTS) suggest that female baby boomers will be more likely to own cars and will make more trips and drive more miles when they reach ages 75 and over than older women do now. Given the current suburban distribution of population and jobs, women's greater mobility portends additional gridlock and pollution in coming years. Yet appropriate policies might avoid this scenario. More than twenty years of federal highway and housing subsidies unwittingly created the suburbs, and we now have twenty years to implement comparable tax incentives to intentionally encourage central city growth before the baby boom reaches retirement age.

This report analyzes travel behavior by age and sex with reference to licensing status, education, household headship, income, race, and ethnicity. Access to vehicles is examined in addition to four measures of mobility (person trips, person miles, vehicle trips, and vehicle miles per day). Weighted data from the 1995 NPTS person files are based on all trips (weekday and weekend) of 75 miles or less. Capping trips at 75 miles includes 98.8 percent of all cases and eliminates extremes.

Findings

Since baby boom women are more likely than today's older women to be licensed to drive, to be college-educated, to be affluent, and to be heads of households, older women in the future will have higher mobility than older women now. On the other hand, since the older population will be more ethnically and racially diverse in the future, and minorities have lower mobility than whites, collective mobility may decline below that for Americans who are older now. Specifically:

-Persons licensed to drive have higher mobility than those without licenses. If baby boom women who are *licensed* retain men's travel profiles as they age, one-half as many will live in households with no vehicles as women who are 75 and over now. Aging baby boom women who keep their licenses will make more trips per day and drive almost twice as many miles per day as older licensed women do now.

- College graduates have higher mobility than persons with only a high school degree. If *college-educated* baby boom women keep vehicles at the same rate as their fathers have, one-fifth as many will live in households with no vehicles as college-educated women who are 75 and over now. College-educated baby boom women will make more trips and drive more miles per day than college-educated women of their mothers' age do now.

- Higher-income persons have higher mobility than lower-income persons. If *affluent* baby boom women copy their fathers' travel behavior, they will live in households without vehicles less often than older affluent women do now. If affluent baby boom women adopt older affluent men's mobility patterns, they will make more trips and drive more miles per day than older affluent women do now.

- *Hispanics, blacks, and other minorities* are more likely than whites and non-Hispanics to live in households without vehicles. Minorities also make fewer trips and drive fewer miles per day than whites and non-Hispanics. Since the older population of the future will be more diverse than the current older population, the *lower* mobility of older minorities may offset older women's *higher* mobility.

Implications

Since land use and travel behavior are so closely linked, the most effective transportation planning strategy would facilitate central city residence among older Americans so that existing transit and nonmotorized options are more convenient and affordable than cars. As suburbanites age and worry less about the quality of schools and more about their ability to drive, the high density of cities may become more appealing. The baby boom led the first wave of gentrification in the 1970s and it could do so again in the next century given financial incentives and residential options that would enhance their independence by reducing their need to drive.

INTRODUCTION AND OVERVIEW

This report uses data from the 1995 Nationwide Personal Transportation Survey (NPTS) to examine two demographic trends of particular relevance for transportation planning in the twenty-first century: **an aging population and women's increased economic independence.** The baby boom has been the demographic engine driving social change in the U.S. for the past fifty years. Baby boomers were born in post-war suburbia and have put pressure on schools and housing markets as they aged. Now they are beginning to exert demands on health-care programs. Because women of the baby boom generation were the first to go to college like men, join the labor force, head their own households, and be licensed to drive like men, they will carry greater mobility into old age. This trend will produce future strains on transportation similar to those already experienced by schools, the housing market, and health care.

The effects of women's greater independence are already evident in travel statistics. Every year women make more trips and drive more miles. Not only are women commuting more than in the past, they are making increasing numbers of "non-work" trips that result in longer trip-chains. Cars are necessary for most people to travel between suburban homes, jobs, and shopping, and the density in most suburbs is too low to support efficient transit systems (Rosenbloom 1992; Wachs and Crawford 1992). Increased reliance on vehicles, therefore, is the result of land-use decisions made cumulatively over the last fifty years. Future transportation demands of the baby boom epitomize what Alan Pisarski calls the "collision of demography with geography" (Pisarski 1997).

The majority of the elderly now live in suburbs and are more dependent on cars than previous generations, a trend that will intensify as baby boom women age (Rosenbloom 1995b). Encouraging central city residence among the elderly, therefore, could reduce projected increases in gridlock and pollution. This is not as impossible as it seems. During the 1950s and 1960s the federal government promoted suburbanization through 1)urban renewal that depleted the central city housing stock; 2) FHA and VA mortgages for new construction that subsidized the suburban housing industry; and 3) interstate highways that facilitated the decentralization of people and jobs. Private business leveraged public subsidies to speed the exodus. If such a public-private partnership could unwittingly create vast suburbs, a deliberately coordinated attempt to encourage central city residence could have a comparable impact.

As the baby boom has aged, the demographic characteristics of women have changed in ways that will affect their future mobility. A significant number of baby boom women earned college degrees, entered the labor force, and began to maintain their own households during the 1980s. Baby boom women also are more likely to have drivers' licenses than women who are elderly now. Any of these trends alone has implications for transportation now, but together they raise important questions for the future as well: What will the transportation profile of baby boomers look like when they reach the oldest ages and when the majority have been employed, and have been drivers, throughout their lives?

The purpose of this report is to examine the transportation issues associated with an aging baby boom, a generation in which women have become increasingly autonomous. I compare the travel profiles of women aged 40 to 49 (early baby boomers) with women aged 75 and over and with men aged 75 and over (parents of the baby boom). For every measure of travel behavior (licensing, access to vehicles, and number of trips and miles), baby boom women exhibit greater mobility than older men or women do now. It is unlikely, however, that baby boom women will retain all of that mobility once they are beyond childbearing and employment years.

If age alone accounts for mobility limitations among the old, the future transportation profile of baby boom women will resemble that of women now aged 75 and over (their mothers' generation). But if baby boom women's greater independence accompanies them into old age, their future transportation profiles should be closer to those of men now aged 75 and over (their fathers' generation). Since women are the majority of the older population (a group that will constitute almost one-tenth of the population within the next thirty years), older women's needs will become increasingly relevant to transportation planning. While gender differences in travel behavior exist at every age, they are especially pronounced now at the oldest ages. The *narrowing* of these differences among the oldest in the future is the focus of this paper.

Concern about the baby boom's potential impact on transportation is based on three assumptions: 1) reducing dependence on private vehicles is preferable to increasing it (Downs 1992; Holtz 1997); 2) baby boom women will travel more like today's older men than today's older women when they reach their mothers' age, which means they will own more cars and drive more; and 3) if that happens, older women's greater mobility combined with the higher mobility typical of younger cohorts in the family-formation and employment years will result in a significant increase in vehicle use within the next thirty years.

As the population ages, differences *among* the elderly will become as important as differences *between* the elderly and the non-elderly. The "elderly", those aged 65 and over, have become an increasingly diverse group and now consist of the young-old (or "wellderly") aged 65 to 74; the old-old (or "illderly") are aged 75 and over (referred to here as "older"); and those aged 85 and over, the oldest-old (Treas and Torrecilha 1995). The small NPTS sample size for those aged 85 and over prevents separate analyses of the oldest-old. (See Appendix Table 1 for unweighted and weighted sample sizes.)

I analyze travel behavior for three groups of people: middle-aged women (early baby boomers aged 40 to 49); older women aged 75 and over; and older men aged 75 and over (the baby boom's parents). I focus on the old-old, those aged 75 and over, because increasing longevity and the elimination of mandatory retirement laws have delayed many of the characteristics previously associated with turning 65. Further, licensing rates decline gradually for older women, from the 90 percent range for those in their fifties to 65 percent for those in their seventies, but dramatic drops occur once women reach their eighties, so that only one-quarter of women aged 85 and over are still licensed to drive. Men stay mobile much longer.

Almost all men under the age of 65 have a license and they retain them as they age: nearly three-quarters of men aged 85 and over were still licensed in 1995 (U.S. Department of Transportation 1995:Table DL-20).

Because my focus is on the travel profiles of persons aged 75 and over, presence of children in the household and labor force status are excluded from the current analysis. Although children and jobs generate significant amounts of travel, there are too few older Americans with children at home or in the labor force for meaningful analysis.

Methods

This report includes analysis of travel issues by age and sex with reference to licensing status, education, household headship, income, race, and ethnicity as they affect travel behavior. Emphasis is on women aged 75 and over, and men aged 75 and over; data are presented for women aged 40 to 49 (early baby boomers) to illustrate their greater current mobility. (Appendix Table 2 summarizes characteristics for the entire sample.)

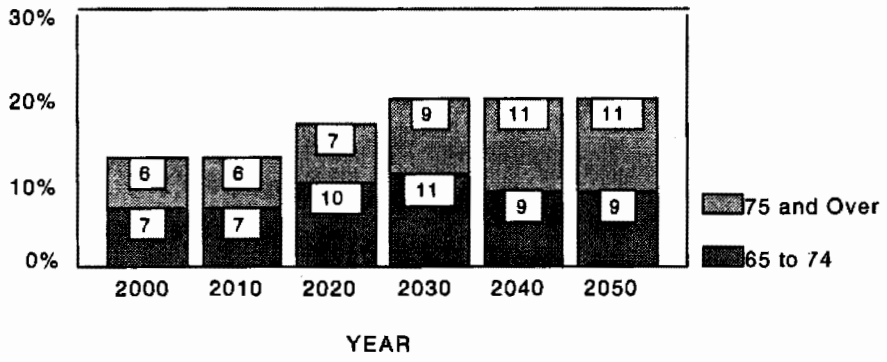
Weighted data from the 1995 NPTS person files are based on all trips (weekday and weekend) of 75 miles or less (see U.S. Department of Transportation 1994). Capping trips at 75 miles includes 98.8 percent of all cases and eliminates extreme outlyers that would skew the results. Unless otherwise noted, data in the Introduction and Overview are taken from Bianchi and Spain (1996) or Spain and Bianchi (1996).

Significant methodological differences between the 1995 NPTS and previous versions prevent direct comparisons with earlier data. Sample size has grown from 6,500 households in 1983 to 22,000 in 1990 and to 42,000 in 1995. More important than sample size, however, are changes in the way data were collected. The method in 1990 and previous surveys consisted of retrospective recall of all travel on the designated day. The 1995 survey asked respondents to keep a diary of their travel day for later reporting to the telephone interviewer. Respondent recall also was enhanced by a trip rostering method in which the interviewer prompted household members about trips other household members had reported taking. Preliminary analysis suggests that travel increased significantly between 1990 and 1995, but as much as two-thirds of that increase is attributed to changes in survey methods (U.S. Department of Transportation 1997).

An Aging Population

The proportion of the population aged 75 and over, now less than 6 percent, is projected to equal 9 percent by 2030. The median age of the American population rose from 28 in 1970 to 34 in 1995; by 2050 the median age is projected to be 38. The proportion of the population aged 65 and over is now approximately 13 percent and is projected to equal 20 percent by 2030. Those aged 85 and over, the "oldest-old", are the fastest-growing group of elderly. The population aged 85 and over is expected to double (to 7 million) by the year 2020 and to equal 5 percent of the population by 2050 (DeVita 1996; Treas and Torrecilha 1995; U.S. Bureau of the Census 1996:Tables 14 & 17).

Figure 1
Age Distribution of the Elderly
Projections to 2050



SOURCE: U.S. Bureau of the Census 1996: 17

An aging population is an issue for transportation planners because older persons experience travel limitations associated with declining health. In 1990, 16 percent of the elderly reported limited mobility outside the home resulting from chronic health problems. Ten percent of Americans aged 65 to 69 and 50 percent of those aged 85 and over report a "functional disability" within the home, or the need for assistance with meals, bathing, dressing, or walking (DeVita 1996). Poor health also can lead to institutionalization if there are no family members or friends available to help with personal care. About five percent of Americans aged 65 and over live in a nursing home or similar facility, and approximately 25 percent of those aged 85 and over live in institutions (Treas and Torrecilha 1995).

The elderly are a strong political force because they are more likely to vote than other age groups. For example, 70 percent of persons aged 65 and over voted in the 1992 presidential election compared with one-third to one-half of younger persons (U.S. Bureau of the Census 1996: Table 456). Public policy debates about tax and health care reforms will undoubtedly be supplemented by debates about appropriate transportation policy for the elderly. The baby boom has been an historically mobile population that is unlikely to settle down after retirement.

It is uncertain, of course, whether characteristics of those who are elderly now will apply to those who are elderly by the middle of the next century. Health care reforms, medical advances, safer workplaces, and healthier lifestyles may reduce the incidence of chronic disabilities for the elderly in the future. The most likely scenario is that people will stay healthy longer, but will eventually succumb to functional limitations at later ages.

Three characteristics of the older population relevant for transportation planning are *increasing longevity, the predominance of women, and growing ethnic and racial heterogeneity.*

Increasing Longevity

Life spans in the U.S. have improved dramatically during the last century. A person born in 1900 was expected to live only 47 years, whereas **an American born in 1994 had a life expectancy of 76 years.** Projections are for continued longevity: Americans born in 2010 are expected to live to age 78 (U.S. Bureau of the Census 1975:55; 1996: 17,88). Life expectancies are averages, so many people live much longer than life tables predict.

Longer life does not necessarily insure a healthy life, however. Because the oldest-old are more frail and disabled than the young-old, they are likely to depend on public and private assistance for daily activities. Since one-quarter of persons aged 85 and over live in a nursing home, growth of this highly dependent population will begin to strain institutional facilities and the health care professions. The role of Medicare and Medicaid in long-term care will become increasingly important in the twenty-first century (Treas and Torrecilha 1995).

The needs of older Americans also will become critical to effective transportation planning. The oldest-old of the future will be more likely than today's elderly to have had a drivers' license, but licensing rates among today's older population begin to decline by age 75 and drop sharply at ages 85 and over. Loss of a drivers' license due to failing health is more than a blow to one's self-esteem; it is also a loss of independence. Unless home delivery of groceries, goods, and medical services is greatly expanded, or unless a substantially larger proportion of the oldest-old are institutionalized, the elderly who are aging in place in the suburbs will need alternatives to the car for many years (Howe et al. 1994; Rosenbloom 1995b).

Predominance of Women

Sixty-four percent of the population aged 75 and over is female. The skewed sex ratio results from women's longer life expectancy (currently 79 years compared with 72 years for men) (U.S. Bureau of the Census 1996: Tables 14 &118). Since women's longevity stabilized during the 1980s while men's improved, demographers Judith Treas and Ramon Torrecilha (1995:62) suggest that the historic excess of older women may be only a temporary shortage of older men. By 2030, 57 percent of the population aged 75 and over is projected to be female (U.S. Bureau of the Census 1996:Table 17).

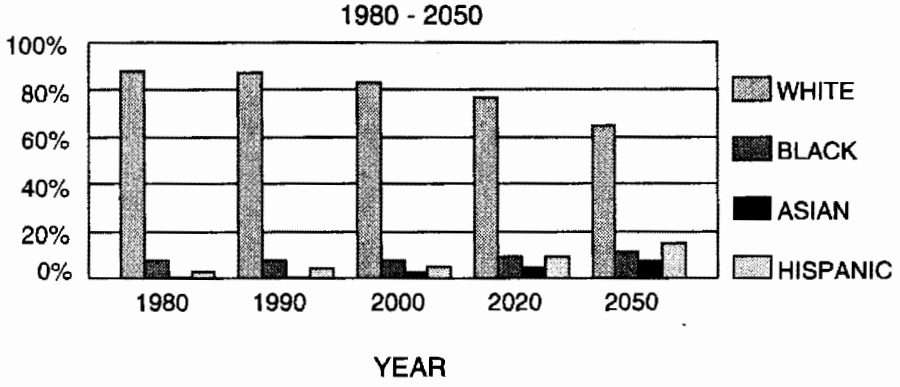
Older women are more likely than older men to be widowed and to live alone. In 1996, for example, almost one-half of elderly women were widowed compared with only 15 percent of elderly men. Although elderly women are more likely than elderly men to live in a nursing home, a significant proportion live alone. **The percentage of women aged 75 and over who live alone rose from 37 to 53 percent between 1970 and 1996** (Bianchi and Spain 1996:13,14).

Feminization of the elderly has several implications for transportation planning. While most older men typically live with a wife, most older widows live alone or with kin. Both scenarios for women suggest dependence on others for transportation as physical health deteriorates. For older married women now, the husband is more likely to drive and the wife to travel as a passenger. If baby boom women keep their licenses, however, there may be an increase in number of vehicles, number of trips, and miles traveled.

Growing Ethnic and Racial Heterogeneity.

The composition of the older population is becoming more diverse. In 1990, 87 percent of the elderly were white; 8 percent black; 4 percent Hispanic; and 1 percent Asian. If current fertility differentials persist and immigration remains the same, projections for the year 2050 are that 65 percent of the elderly will be white; 11 percent black; 15 percent Hispanic; and 8 percent Asian (Treas and Torrecilha 1995).

Figure 2
Composition Of The Elderly Population



NOTE: HISPANICS MAY BE OF ANY RACE

SOURCE: Treas and Torrecilha 1995

The low projected growth rate of the black elderly compared with that of Hispanics and Asians is partially due to lower life expectancy: black men in 1994 had life expectancies of 68 compared with 73 for white men, and black women had life expectancies of 76 compared with 80 for white women (U.S. Bureau of the Census 1996: Table 118).

Minorities report more mobility limitations than elderly whites. In 1990, 21 percent of elderly black men reported difficulty going outside the house compared with 15 percent of Hispanic and 13 percent of elderly white men. Racial and ethnic minorities have been less likely than whites to use institutional care for the elderly, however (Treas and Torrecilha 1995).

Immigrants now make up approximately 10 percent of the elderly population, with the highest proportions of elderly foreign-born living in California, New York, and Florida. Forty-one percent of older immigrants who entered the U.S. during the 1980s speak no English, contributing to a precarious economic status: Nearly one-quarter live in poverty compared with one-half that figure for the total elderly population. The economic well-being of elderly immigrant non-citizens may be further eroded by legislation limiting their ability to collect public assistance (Treas and Torrecilha 1995).

The transportation implications of growing racial and ethnic diversity among the elderly include differential dependence on public transit and differential access to transit due to residential segregation: the white elderly are likely to live in the suburbs and the minority elderly to live in urban enclaves (Massey and Denton 1993). If minorities are more dependent than whites on family members for personal care, they also may be more dependent on kin for transportation needs.

Women's Increased Independence

The baby boom generation came of age in a volatile political climate. The civil rights movement, the women's movement, and the Viet Nam War were all at their peak during the late 1960s and early 1970s. Legalized abortion and oral contraceptives also became available during that period. As women gained the ability to control the timing of their fertility, attitudes about appropriate roles for women became more liberal. It is understandable, then, that women of the baby boom had more options than their mothers.

Three trends contributing to women's expanded economic independence are *educational attainment, labor force participation, and primary responsibility for households and families.*

Educational Attainment

As the proportion of women enrolled in college has risen, so have their graduation rates. Only 8 percent of women aged 25 to 34 obtained a college degree in 1960 compared with 15 percent of young men. In 1980 baby boomers signalled a major change, with 21 percent of young women and 27 percent of young men finishing college. Graduation rates for women have risen only slightly since and have declined slightly for men: in 1994 nearly one-quarter of young women and men had college degrees. In 1990, baby boom women were twice as likely as older men to have college degrees (25 versus 12 percent) (Spain and Bianchi 1996:55).

Racial and ethnic differences among college graduates are pronounced. In 1990 Asian women had the highest college completion rates (32 percent) followed by white women (19 percent), black (12 percent) and Hispanic (8 percent).

The higher the educational *attainment for women, the greater their labor force participation.* In 1990 almost three-quarters of women with a college degree were in the labor force compared with one-half of women with a high school degree, and 40 percent of college-educated women worked full-time compared with 31 percent of high school graduates. (Bianchi and Spain 1996; Spain and Bianchi 1996:54,67-73).

Labor Force Participation

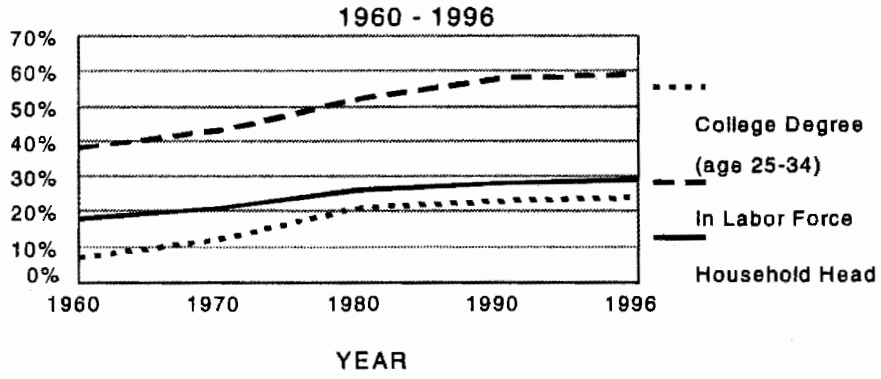
The story of women's labor force participation is fairly straightforward; it has continued to rise, virtually unchecked, since the Depression. **Almost 60 percent of all women aged 16 and over are now employed outside the home. The rate is 76 percent among women in the prime working ages of 25 to 54 (the majority of whom are baby boomers).**

Significant changes in labor force behavior have occurred among *young* women. During the 1950s and 1960s working women typically dropped out of the labor force when they had children. But during the 1970s and 1980s women began working continuously through their childbearing years, and by 1990 there were almost imperceptible differences in women's labor force participation rates by age among those in their primary working years. Labor force participation increased most rapidly for the group with the lowest rates historically – married women with children. Between 1970 and 1996 the proportion of *married mothers* in the labor force increased from one-half to almost three-fourths; those who worked full-time, year-round increased from 16 to 38 percent.

Responsibility for Households and Families

Delayed marriage, high divorce rates, and high out-of-wedlock fertility mean that women are more likely now than in the past to maintain their own households. **Between 1960 and 1995 the proportion of all *households* headed by a woman rose from 18 to 29 percent and the proportion of all *families* headed by a woman rose from 10 to 18 percent.** Women who head a household typically live alone or with dependent children. **The proportion of all women living alone increased from 9 to 14 percent between 1970 and 1996, and the biggest change was among women aged 75 and over, for whom the proportion living alone rose from 37 to 53 percent between 1970 and 1996.**

Figure 3
Indicators Of Women's Independence:



SOURCE: Bianchi and Spain 1996; U.S. Bureau of the Census 1996, 1997

The combined effects of rising educational attainment, women's entry into the labor force, and the growth of households maintained by women have several implications for transportation planning. In terms of education and labor force activity, women are becoming more like men and their journey-to-work patterns may resemble those of men. On the other hand, as the baby boom reaches retirement age, proportionately fewer trips will be commutes to work and proportionately more will be made to take care of personal and family business.

TRAVEL PATTERNS

This section describes travel patterns for the population by age and sex, with emphasis on the baby boom cohort and those currently aged 75 and over (the old-old, also referred to as "older"). Variables include licensing rates, access to vehicles, and four measures of mobility.

Table 2.1
Measures Of Mobility For 1995 NPTS Sample

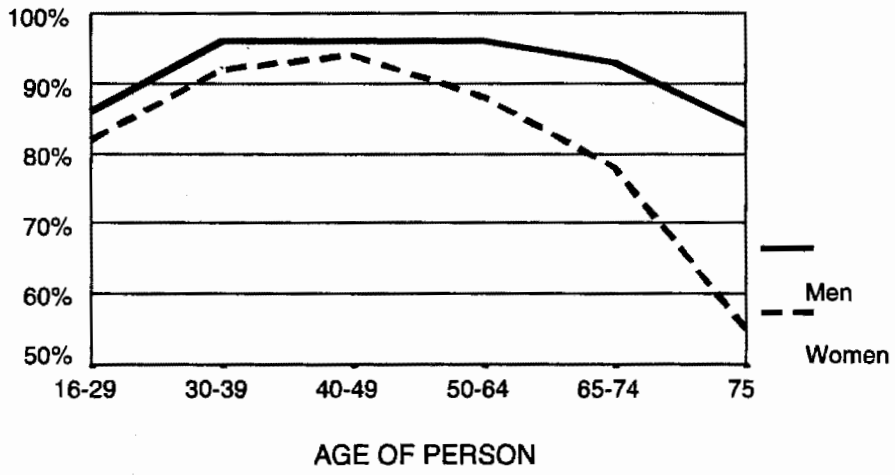
Percent Aged 16+ Licensed to Drive	89%
Percent Living in Household Without a Vehicle	6%
Mean Person Trips per Day	3.88
Mean Person Miles per Day	29.3
Mean Vehicle Trips per Day	2.42
Mean Vehicle Miles per Day	19.3

Source: 1995 NPTS Person File

Licensing Rates

In 1995, 55 percent of women and 84 percent of men aged 75 and over were licensed to drive compared with 94 percent of baby boom women. Licensing rates have risen dramatically for older women over the last several decades. Men, on the other hand, have had historically high licensing rates. Thus licensing differences by gender are still most pronounced at later ages. Baby boomers grew up in an automotive culture. Women of that generation also stayed in school longer and were more likely to enter the labor force than their predecessors. **If baby boom women keep their licenses at the same rate as men do now, 84 percent of women aged 75 and over will be licensed by 2030.**

Figure 4
Percentage Of Americans Licensed To Drive



SOURCE: 1995 NPTS PERSON FILE

More women have licenses now because they need private vehicles to accomplish most tasks. When they become older, baby boom women will no longer be in the labor force and will no longer have young children at home, two factors that produce the most travel now (Al-Kazily 1995; Rosenbloom 1995a; Strathman and Dueker 1995). One way to reduce the projected increase in demand for licenses is to reduce the demand for cars by increasing population density. As admirers of Jane Jacobs (1961) have argued for years, higher densities (and mixed uses) are necessary ingredients for successful cities. Residential proximity to shopping and to health care facilities will become increasingly important, and the potential for both already exists in cities.

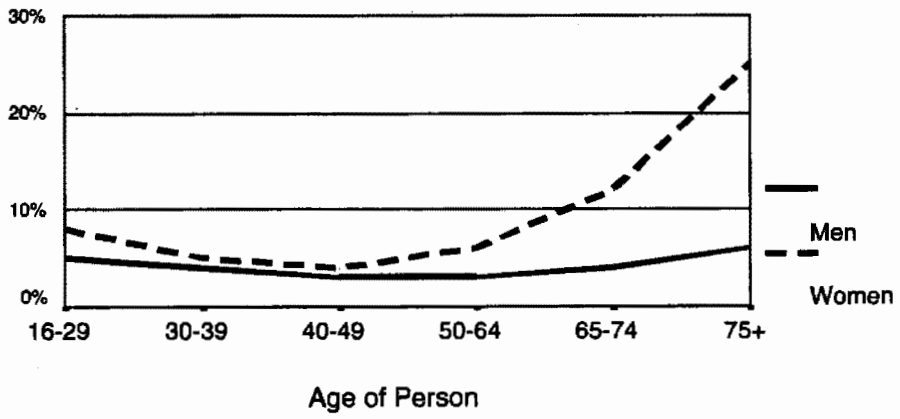
Access to Vehicles

In 1995, 25 percent of older women lived in households without vehicles compared with 6 percent of older men. By comparison, baby boomers have extremely high vehicle ownership rates and differences by sex are practically nonexistent. Only 4 percent of female baby boomers lived in households without a vehicle in 1995 compared with 3 percent of baby boom men. **If baby boom women keep their cars at the same rate as older men have, only 6 percent will live in households without a vehicle when they reach their parents' age.**

Vehicle ownership has become almost as universal as licensing. The proportion of households with no vehicle declined from approximately 21 percent in 1969 to 9 percent in 1990. Since households without vehicles tend to be smaller than average, only 6 percent of *persons* lived in households without vehicles in 1990 (Lave and Crepeau 1994). The 1995 NPTS also reports 6 percent of persons without vehicles.

Older women are less likely than older men to own a car partly because of women's lower licensing rates. In 1995, 25 percent of older women lived in households without a car compared with 6 percent of older men. The typical household without a vehicle has no one in the labor force, has a lower than average income, and lives in a central city. Most of these households are either retired older people or single adults without children, and most are likely to be headed by women (Cutler and Coward 1992; Lave and Crepeau 1994).

Figure 5
Percent Of Americans In Households With No Vehicles



SOURCE: 1995 NPTS PERSON FILE

Mobility

The NPTS measures mobility by the average daily numbers of person trips, person miles, vehicle trips, and vehicle miles driven. A *person trip* is a trip by one person using *any mode of transportation*; person miles are the number of miles traveled by each person on a trip. Thus two people traveling together in one car are counted as two person trips and if they traveled three miles it would count as six person miles (2 persons x 3 miles). A *vehicle trip* is a trip by a single *privately operated vehicle (POV)*, regardless of the number of persons in the vehicle. Vehicle miles of travel (VMT) refers to distance covered in a POV by a driver in the NPTS sample household (U.S. Department of Transportation 1994).

As described in the methods section, this report is limited to averages for all trips (weekday and weekend) of 75 miles or less, a decision that eliminated approximately 1 percent of the sample at the highest extreme. By these criteria, person trips averaged 4.0 per day and person miles averaged 31; vehicle trips averaged 3.0 per day and vehicle miles driven averaged 23 (see Appendix Table 3).

Table 2.2
Average Number Of Person Trips On Trip Day
By Age And Sex

AGE	MALES	FEMALES
16-29	4.13	4.16
30-39	4.21	4.52
40-49	4.29	4.50
50-64	4.05	3.54
65-74	3.91	3.19
75+	2.93	2.11
Column Mean	4.09	3.95
For Entire Population	4.02	

Table 2.3
Average Number Of Person Miles Traveled On Trip Day
By Age And Sex

AGE	MALES	FEMALES
16-29	34.9	30.6
30-39	38.7	33.1
40-49	39.7	32.4
50-64	34.9	24.5
65-74	26.3	19.4
75+	19.0	10.9
Column Mean	35.2	27.8
For Entire Population	31.4	

Older women make the fewest person trips per day (2.1) of any age-sex group (compared with 2.9 for older men), **while baby boom women make the most person trips per day (4.5). Older women are less mobile than older men and are considerably less mobile than baby boom women. Part of this difference is due to baby boom women being in the prime working and family stages of the life-cycle.** Older women travel about one-half as many person miles per day as older men (11 versus 19 miles) **and only one-third as many person miles as baby boom women (32). (Baby boom women still travel fewer miles than baby boom men, who average 40 person miles per day.)**

If baby boom women make as many trips and travel as many miles as older men do now, they will make 2.9 trips per day and travel 19 miles per day when they reach ages 75 and over.

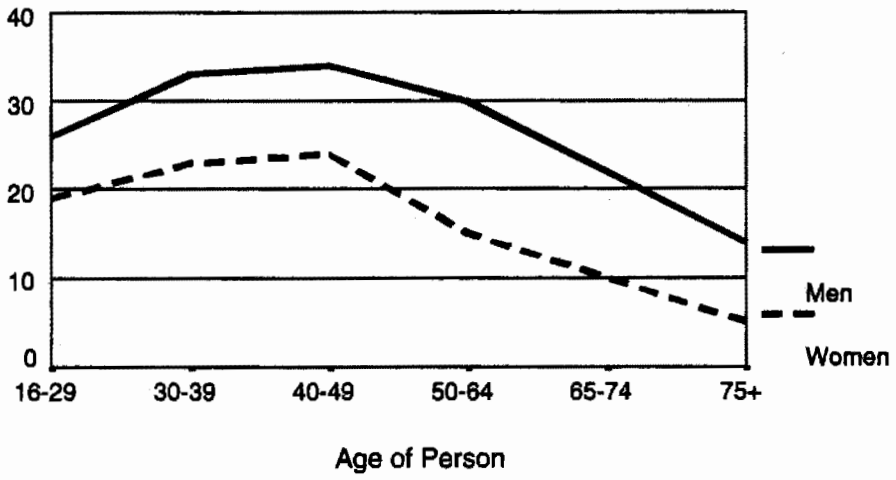
Table 2.4
Average Number Of Vehicle Trips On Trip Day
By Age And Sex

AGE	MALES	FEMALES
16-29	2.89	2.55
30-39	3.45	3.26
40-49	3.63	3.36
50-64	3.41	2.34
65-74	3.20	1.90
75+	2.18	1.07
Column Mean	3.25	2.65
For Entire Population	2.94	

Table 2.5
Average Number Of Vehicle Miles Driven On Trip Day
By Age And Sex

AGE	MALES	FEMALES
16-29	25.9	19.2
30-39	32.9	23.3
40-49	34.5	23.6
50-64	29.7	14.9
65-74	21.6	10.5
75+	13.7	4.9
Column Mean	28.9	18.3
For Entire Population	23.4	

Figure 6
Miles Driven Per Day



SOURCE: 1995 NPTS PERSON FILE

Older women make only 1.1 vehicle trip per day compared with 2.2 for older men and 3.4 for baby boom women. These differences reflect older women's greater use of transit and nonmotorized modes of transportation (Rosenbloom 1995b). **Older women drive only 5 vehicle miles per day compared with 14 for older men** and 24 for baby boom women. If baby boom women use cars as often and drive as many miles per day as older men do now, they will be making 2.2 vehicle trips and driving 14 miles per day when they are 75 and older, increases over current rates of 100 percent and 180 percent, respectively.

Table 2.6
Measures Of Mobility For Baby Boom And Older Cohorts

	Women Aged 40-49	Women Aged 75+	Men Aged 75+
Percent Licensed to Drive	94%	55%	84%
Percent Living in Households Without a Vehicle	4%	25%	6%
Mean Person Trips per Day	4.5	2.1	2.9
Mean Person Miles per Day	32	11	19
Mean Vehicle Trips per Day	3.4	1.1	2.2
Mean Vehicle Miles per Day	24	5	14

Source: 1995 NPTS Person File

Table 2.6 summarizes differences in transportation access and mobility for baby boom women and for women and men of their parents' generation. If baby boom women adopt their father's travel profiles rather than their mothers', older women in the future will be 53 percent more likely to be licensed than older women now (84 versus 55 percent); and four times *less* likely to live in a household without a vehicle (6 versus 25 percent). Older women in the future will make more person trips per day (2.9 versus 2.1), travel almost twice as many person miles (19 versus 11), make twice as many vehicle trips (2.2 versus 1.1), and drive almost three times as many vehicle miles (14 versus 5) as older women do now.

CONTRIBUTING ELEMENTS

A number of factors affect differences in travel behavior among baby boomers and older Americans. For example, trip rates and miles traveled are highest in households with children and employed persons travel more than those not in the labor force (Rosenbloom 1995a). Because so few older Americans are either employed or living in households with children, however, household composition and labor force status are omitted from this analysis.
The elderly are now more likely to live in the suburbs than in central cities, and suburbs typically have residential densities too low to support efficient public transit (Howe et al. 1994; Rosenbloom 1995b). Since baby boomers grew up in the suburbs, they may be even more likely than the contemporary elderly to remain in the suburbs.

On the other hand, baby boomers were the leading edge of gentrification in the 1970s and may be more sympathetic to urban living than their parents' generation when mobility becomes more important than the quality of public schools. This section summarizes the effects of licensing, education, household income, and race and ethnicity on travel patterns.

Licensing

Access to vehicles. The effect of holding a driver's license on travel behavior is predictable: women and men without drivers' licenses are less likely to own vehicles than people with a license.

Even when licensed, older women are less likely than older men to own a vehicle: 4 percent live in households with no vehicles compared with 2 percent of men. In contrast, less than 2 percent of baby boom women with licenses live in households with no vehicles.

Baby boomers with licenses show little difference by gender in their access to private vehicles. Although access to vehicles is affected by more than the legal ability to drive, vehicle ownership will be nearly universal among older Americans in the future if baby boom women keep their licenses as long as older men do now.

Mobility. Older women who are licensed make only 2.8 person trips per day compared with 3.2 for older licensed men and 4.6 for baby boom women. Licensed older women travel fewer person miles (15) than older men (21). Licensed older women also make fewer vehicle trips and drive fewer miles (2.0 trips and 9 miles) than older men (2.6 trips and 16 miles). Licensed baby boom women travel twice as many person miles (34), make more vehicle trips (3.6), and drive more miles (25) than older women or men do now.

Table 3.1
Average Number Of Person Trips On Trip Day
By Age, Sex, And Driver Status

AGE	MALES PERSON IS A DRIVER?		FEMALES PERSON IS A DRIVER?	
	YES	NO	YES	NO
16-29	4.30	2.99	4.43	2.87
30-39	4.28	2.60	4.65	2.92
40-49	4.35	2.81	4.64	2.42
50-64	4.12	2.52	3.75	1.96
65-74	4.07	1.87	3.59	1.76
75+	3.23	1.42	2.80	1.25
Column Mean	4.21	2.62	4.25	2.18
For Entire Population		4.02		

Table 3.2
Average Number Of Person Miles Traveled On Trip Day
By Age, Sex, And Driver Status

	MALES		FEMALES	
	PERSON IS A DRIVER?		PERSON IS A DRIVER?	
AGE	YES	NO	YES	NO
16-29	37.8	16.5	33.9	15.1
30-39	39.7	16.3	34.3	17.2
40-49	40.5	18.7	33.7	12.5
50-64	35.7	17.5	26.5	10.1
65-74	27.6	10.8	22.5	8.4
75+	21.1	8.1	15.2	5.6
Column Mean	36.8	15.5	30.7	11.3
For Entire Population		31.4		

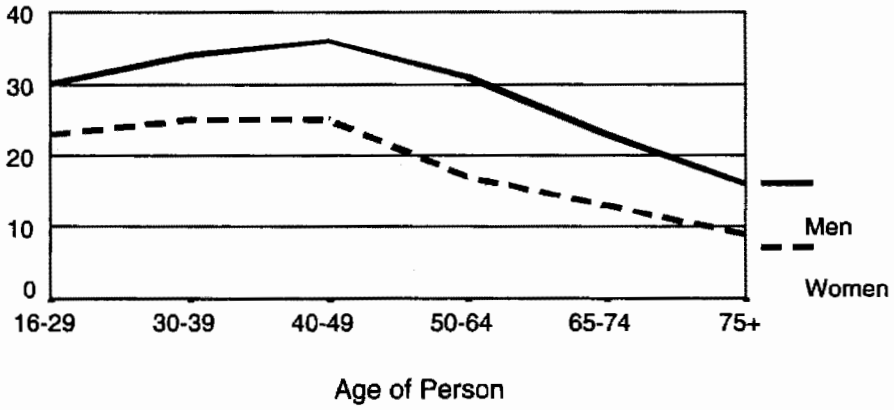
Table 3.3
Average Number Of Vehicle Trips On Trip Day
By Age, Sex, And Driver Status

	MALES		FEMALES	
	PERSON IS A DRIVER?		PERSON IS A DRIVER?	
AGE	YES	NO	YES	NO
16-29	3.33	N.A.	3.08	N.A.
30-39	3.59	N.A.	3.52	N.A.
40-49	3.77	N.A.	3.58	N.A.
50-64	3.56	N.A.	2.65	N.A.
65-74	3.45	N.A.	2.42	N.A.
75+	2.60	N.A.	1.95	N.A.
Column Mean	3.50	N.A.	3.10	N.A.
For Entire Population		2.94		

Table 3.4
Average Number Of Vehicle Miles Driven On Trip Day
By Age, Sex, And Driver Status

	MALES		FEMALES	
	PERSON IS A DRIVER?		PERSON IS A DRIVER?	
AGE	YES	NO	YES	NO
16-29	29.8	N.A.	23.2	N.A.
30-39	34.3	N.A.	25.2	N.A.
40-49	35.8	N.A.	25.1	N.A.
50-64	31.0	N.A.	16.9	N.A.
65-74	23.2	N.A.	13.4	N.A.
75+	16.4	N.A.	8.9	N.A.
Column Mean	31.2	N.A.	21.4	N.A.
For Entire Population		23.4		

Figure 7
Miles Driven Per Day By Licensed Drivers



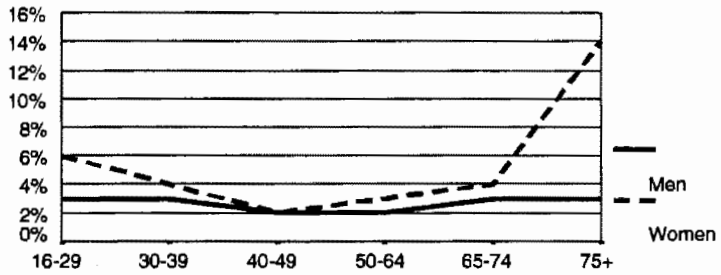
SOURCE: 1995 NPTS PERSON FILE

If baby boom women who are licensed retain men's travel profile as they age, one-half as many will live in households with no vehicles (2 percent) as women who are 75 and over now. Aging baby boom women with licenses also will make 0.4 more person trips per day, travel about 6 more person miles, make 0.6 more vehicle trips, and drive almost twice as many vehicle miles (16) as older women do now.

Educational Attainment

Access to vehicles . The more highly educated the woman, the more likely she is to live in a household with a vehicle. While educational attainment makes little difference in vehicle ownership for *men* until the oldest ages, it is quite important for women across all age groups. In fact, the older the woman, the more pronounced the relationship. **By ages 75 and over, 14 percent of women with a college degree live in households with no vehicle compared with 30 percent of those with high school or less. Among older men, 3 percent with a college degree live in households with no vehicle compared with only 8 percent of those with a high school degree.**

Figure 8
College-Educated Persons In Households With No Vehicles



SOURCE: 1995 NPTS PERSON FILE

Mobility. Higher education is associated with greater mobility. **College-educated older women make 2.7 person trips per day (versus 2.0 for high school graduates) compared with 3.4 per day for older men with college degrees (versus 2.7 for high school graduates).** College-educated baby boom women make 4.9 person trips per day compared with 4.1 for female high school graduates. College-educated baby boom women travel 35 person miles, on average, compared with 28 for high school graduates. Older women with a college degree travel 14 person miles per day compared with 10 per day for high school graduates and 22 person miles per day for older men with a college degree (18 for high school graduates).

Table 3.5
Average Number Of Person Trips On Trip Day
By Age, Sex, And Education

	MALES			FEMALES		
	EDUCATION			EDUCATION		
AGE	H.S. OR LESS	SOME COLLEGE	COLLEGE OR MORE	H.S. OR LESS	SOME COLLEGE	COLLEGE OR MORE
16-29	3.87	4.54	4.35	3.96	4.47	4.27
30-39	3.95	4.41	4.43	4.22	4.81	4.65
40-49	3.91	4.45	4.53	4.09	4.65	4.88
50-64	3.65	4.39	4.47	3.28	3.82	3.93
65-74	3.50	4.43	4.50	2.92	3.52	4.08
75+	2.68	3.64	3.36	1.96	2.50	2.70
Column Mean	3.74	4.44	4.42	3.56	4.33	4.41
For Entire Population			4.02			

Table 3.6
Average Number Of Person Miles Traveled On Trip Day
By Age, Sex, And Education

	MALES			FEMALES		
	EDUCATION			EDUCATION		
AGE	H.S. OR LESS	SOME COLLEGE	COLLEGE OR MORE	H.S. OR LESS	SOME COLLEGE	COLLEGE OR MORE
16-29	31.6	38.7	40.2	26.4	34.7	36.1
30-39	37.0	40.8	39.6	30.6	35.3	34.3
40-49	36.5	41.0	41.8	28.4	34.7	35.2
50-64	31.9	39.2	36.9	23.1	26.5	26.5
65-74	24.1	29.1	29.8	18.3	19.1	26.0
75+	17.8	21.4	21.8	9.8	14.0	13.7
Column Mean	31.9	38.7	38.3	24.1	31.4	32.3
For Entire Population			31.4			

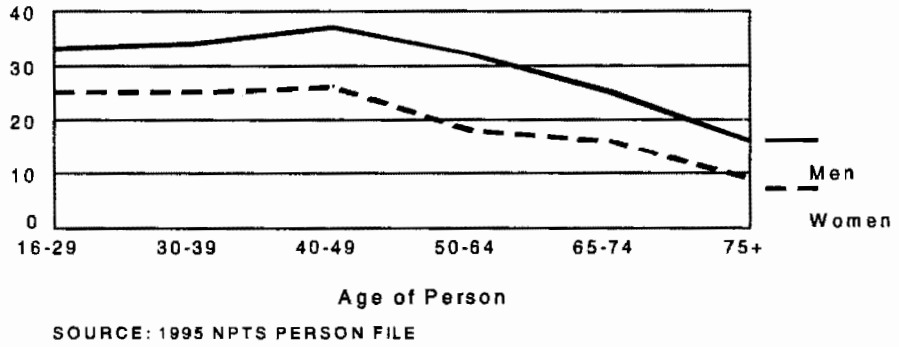
Table 3.7
Average Number Of Vehicle Trips On Trip Day
By Age, Sex, And Education

	MALES EDUCATION			FEMALES EDUCATION		
AGE	H.S. OR LESS	SOME COLLEGE	COLLEGE OR MORE	H.S. OR LESS	SOME COLLEGE	COLLEGE OR MORE
16-29	2.47	3.46	3.41	2.20	3.02	2.83
30-39	3.19	3.68	3.64	2.94	3.54	3.42
40-49	3.23	3.79	3.89	2.93	3.59	3.69
50-64	3.06	3.74	3.77	2.04	2.68	2.77
65-74	2.84	3.79	3.65	1.63	2.20	2.85
75+	1.92	3.04	2.51	0.89	1.55	1.58
Column Mean	2.84	3.64	3.66	2.21	3.06	2.95
For Entire Population			2.95			

Table 3.8
Average Number Of Vehicle Miles Driven On Trip Day
By Age, Sex, And Education

	MALES EDUCATION			FEMALES EDUCATION		
AGE	H.S. OR LESS	SOME COLLEGE	COLLEGE OR MORE	H.S. OR LESS	SOME COLLEGE	COLLEGE OR MORE
16-29	21.3	31.5	32.6	14.6	23.9	25.1
30-39	30.6	35.3	34.4	20.2	25.3	25.4
40-49	31.2	35.7	36.9	19.8	25.9	26.2
50-64	26.6	33.6	31.9	12.8	17.3	17.9
65-74	19.1	25.2	25.0	9.4	11.2	15.6
75+	12.3	17.6	16.3	3.8	7.5	8.8
Column Mean	24.8	32.9	32.9	14.3	21.9	23.1
For Entire Population			23.5			

Figure 9
Miles Driven Per Day By College-Educated Persons



SOURCE: 1995 NPTS PERSON FILE

Older college-educated women make fewer vehicle trips than men with comparable educational attainment and drive fewer vehicle miles: 1.6 vehicle trips and 9 vehicle miles compared with 2.5 vehicle trips and 16 vehicle miles for older men.

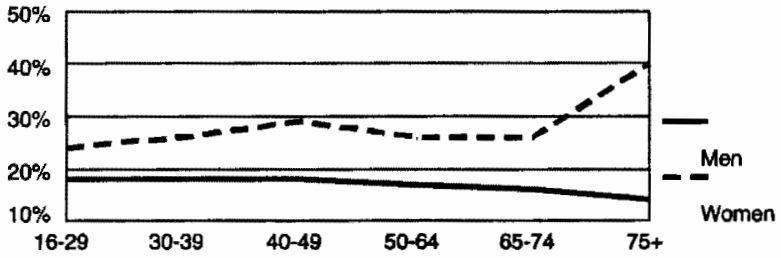
Baby boom women with a college degree make more trips by POV (3.7) and drive more miles (26) than those with high school degrees (who average 2.9 person trips and 20 person miles).

If baby boom women with college degrees resemble older men with college degrees when they reach ages 75 and over, only 3 percent will live in households without vehicles and 10 percent will use transit. When baby boom women are older, they will make 3.4 person trips and 2.5 vehicle trips per day and they will travel 22 person miles and drive 16 vehicle miles per day. Older college-educated women, by 2030, will be nearly five times as likely to own cars and 28 percent less likely to use transit than women of their mothers' age. They will make 0.7 more person trips, travel 8 more person miles, make 0.9 more vehicle trips, and drive 7 more vehicle miles than older women do now.

Household Income

Access to vehicles. Gender differences in access to vehicles by income are large among both the old-old and the baby boom generations. **Women aged 75 and over living in households with incomes less than $15,000 are almost three times as likely (40 percent) as low-income men that age (14 percent) to lack a vehicle**, while 29 percent of low-income baby boom women live in households without vehicles compared with about 18 percent of low-income baby boom men.

Figure 10
Persons In Low Income Households With No Vehicles



NOTE: LOW INCOME = < $15,000

SOURCE: 1995 NPTS PERSON FILE

There are few surprises regarding the relationship between household income and travel behavior: money buys mobility. Affluent households are less likely than middle- and upper-income households to lack a vehicle; they also make more trips and travel more miles than low-income households.

Table 3.9
Average Number Of Person Trips On Trip Day
By Age, Sex, And Household Income

	MALES			FEMALES		
	HOUSEHOLD INCOME			HOUSEHOLD INCOME		
AGE	<$15,000	$15,000-$59,999	$60,000+	<$15,000	$15,000-$59,999	$60,000+
16-29	3.73	4.26	4.40	3.74	4.28	4.64
30-39	3.69	4.33	4.27	4.12	4.67	4.67
40-49	3.63	4.36	4.55	3.64	4.59	4.84
50-64	3.40	4.13	4.42	2.86	3.72	3.84
65-74	2.97	4.20	4.08	2.71	3.56	3.75
75+	2.55	3.17	3.56	1.93	2.60	2.08
Column Mean	3.44	4.23	4.39	3.15	4.19	4.49
For Entire Population			4.02			

Table 3.10
Average Number Of Person Miles Traveled On Trip Day
By Age, Sex, And Household Income

	MALES			FEMALES		
	HOUSEHOLD INCOME			HOUSEHOLD INCOME		
AGE	<$15,000	$15,000-$59,999	$60,000+	<$15,000	$15,000-$59,999	$60,000+
16-29	25.6	37.4	37.8	23.6	32.3	36.7
30-39	26.4	39.7	42.2	25.4	33.6	37.0
40-49	28.9	39.5	43.0	23.9	32.2	37.1
50-64	22.3	36.0	39.0	16.6	25.7	28.5
65-74	18.5	28.3	30.2	15.2	22.2	26.3
75+	15.4	20.4	21.6	8.8	14.4	11.9
Column Mean	23.7	37.7	40.0	18.8	29.7	34.6
For Entire Population			31.4			

Table 3.11
Average Number Of Vehicle Trips On Trip Day
By Age, Sex, And Household Income

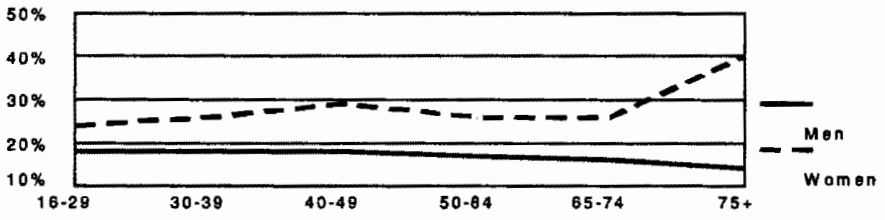
	MALES			FEMALES		
	HOUSEHOLD INCOME			HOUSEHOLD INCOME		
AGE	<$15,000	$15,000-$59,999	$60,000+	<$15,000	$15,000-$59,999	$60,000+
16-29	2.08	3.09	3.21	2.09	2.72	2.88
30-39	2.57	3.60	3.55	2.41	3.43	3.52
40-49	2.49	3.72	3.95	2.20	3.54	3.58
50-64	2.42	3.51	3.88	1.63	2.47	2.63
65-74	2.16	3.50	3.38	1.54	2.12	2.13
75+	1.62	2.44	2.68	0.89	1.41	1.24
Column Mean	2.24	3.42	3.64	1.77	2.89	3.16
For Entire Population			3.03			

Table 3.12
Average Number Of Vehicle Miles Driven On Trip Day
By Age, Sex, And Household Income

	MALES			FEMALES		
	HOUSEHOLD INCOME			HOUSEHOLD INCOME		
AGE	<$15,000	$15,000-$59,999	$60,000+	<$15,000	$15,000-$59,999	$60,000+
16-29	17.1	28.1	29.5	13.8	20.8	23.5
30-39	20.0	33.8	36.9	14.6	24.1	27.4
40-49	21.1	34.7	38.3	15.2	24.6	26.4
50-64	16.9	30.6	34.5	8.7	15.7	18.2
65-74	12.9	23.8	25.6	8.7	11.9	13.7
75+	9.9	15.1	17.6	3.6	7.0	7.3
Column Mean	16.8	30.3	34.5	10.6	20.0	23.9
For Entire Population			24.2			

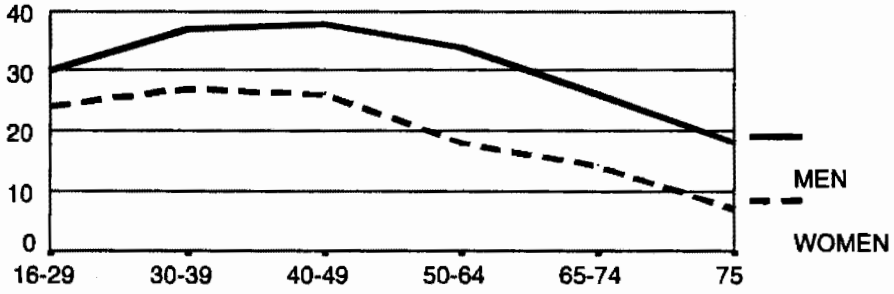
Mobility. Number of person trips made per day, miles traveled, vehicle trips, and miles driven all increase with household income *except for older women.* **Although average number of person trips per day among those aged 75 and over rises with income for men (from 2.6 to 3.6), it is relatively stable for older women (1.9 and 2.1) and is actually highest for middle-income women (2.6). Person miles traveled per day rise with income for older men (from 15 to 22) and for older women (from 9 to 12), but person miles traveled for older women, like person trips, peak for the middle-income (at 14).** Affluent baby boom women make 4.8 person trips per day compared with 2.1 for older women and 3.6 for older men with high incomes.

Figure 11
Persons In Low Income Households With No Vehicles



NOTE: LOW INCOME = < $15,000
SOURCE: 1995 NPTS PERSON FILE

Figure 12
Miles Driven Per Day By Persons In High-Income Households



NOTE: HIGH INCOME = $60,000 +
SOURCE: 1995 NPTS PERSON FILE

The same general relationship holds for use of POVs and miles driven per day. Higher income translates into progressively greater mobility for older men (from 1.6 to 2.7 vehicle trips per day and from 10 to 18 miles driven). Older women with middle incomes make the most vehicle trips per day (1.4), and, along with the wealthiest, drive the most miles per day (7).

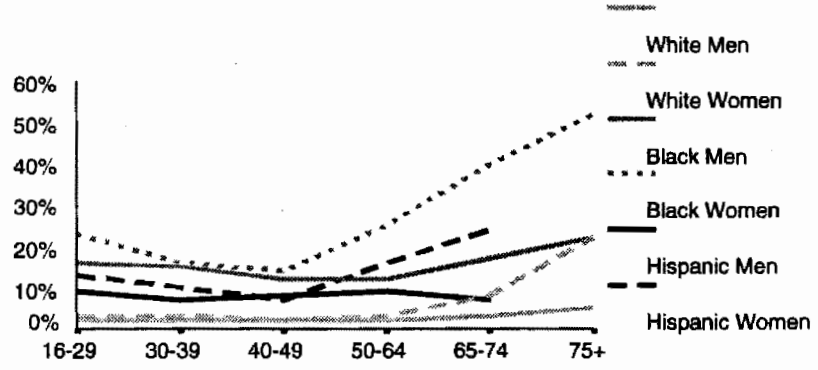
If affluent baby boom women adopt older affluent men's mobility patterns, they will double their car ownership compared with older women now. Affluent older women in the future will take 3.6 person trips, travel 22 person miles, take 2.7 vehicle trips, and drive approximately 18 miles per day when they reach 75. In other words, older wealthy women in the future will make 1.5 more person trips, travel 10 more person miles, make 1.5 more vehicle trips, and drive 11 more miles per day than older women do now if they age like men.

Changes are not as dramatic at the lower end of the income spectrum, but travel among older poor women may still increase over what it is today. Older women with household incomes less than $15,000 in the future will make 0.7 more person trips, travel 6 more person miles, take 0.7 more vehicle trips, and drive 6 more vehicle miles than older poor women do now if they resemble older men's travel profiles.

Race and Ethnicity

Access to vehicles. Blacks and other minorities face transportation inequalities that mirror their lower socio-economic status. Differences between whites and minorities do not necessarily intensify with age, but travel inequalities by race and ethnicity are exacerbated by gender. For example, among white older Americans, 22 percent of women lacked access to a vehicle compared with 5 percent of men. Among black older Americans, one-half of women compared with one-quarter of men lacked vehicles. The pattern is similar for other minorities, and there were too few older Hispanics to make meaningful comparisons.

Figure 13
Persons in Households with no Vehicles by Race and Ethnicity



SOURCE: 1995 NPTS PERSON FILE

Among baby boom women, only 2 percent of white households lack vehicles compared with 14 percent of black households and about 9 percent of Hispanic and other minority households.

Mobility. Since the older population will be more racially and ethnically diverse in the future, their collective mobility may decline below that for Americans who are older now (87 percent of whom are white). Because minority women have lower mobility than white women, average numbers of trips taken and miles traveled should decline because the older population will be proportionately more black, Asian, and Hispanic than it is now.

Table 3.13
Average Number Of Person Trips On Trip Day
By Age, Sex, And Race

	MALES			FEMALES		
	RACE			RACE		
AGE	WHITE	BLACK	OTHER	WHITE	BLACK	OTHER
16-29	4.21	3.79	3.95	4.34	3.81	3.57
30-39	4.23	3.91	4.29	4.60	4.39	4.17
40-49	4.35	3.98	4.08	4.60	4.21	3.96
50-64	4.11	3.38	4.10	3.67	2.83	3.09
65-74	4.05	2.97	3.23	3.40	1.98	2.44
75+	3.01	2.24	2.94	2.19	1.40	2.43
Column Mean	4.15	3.67	4.02	4.05	3.56	3.65
For Entire Population			4.02			

Table 3.14
Average Number Of Person Trips On Trip Day
By Age, Sex, And Hispanic Status

	MALES		FEMALES	
	HISPANIC STATUS		HISPANIC STATUS	
AGE	HISPANIC	NOT HISPANIC	HISPANIC	NOT HISPANIC
16-29	4.24	4.11	3.81	4.21
30-39	4.31	4.20	4.21	4.56
40-49	4.58	4.27	4.41	4.51
50-64	4.02	4.05	2.98	3.59
65-74	3.42	3.92	2.61	3.22
75+	------	------	------	------
Column Mean	4.21	4.08	3.95	3.97
For Entire Population		4.02		

Table 3.15
Average Number Of Person Miles Traveled On Trip Day
By Age, Sex, And Race

	MALES			FEMALES		
	RACE			RACE		
AGE	WHITE	BLACK	OTHER	WHITE	BLACK	OTHER
16-29	36.4	28.4	31.4	33.1	24.4	24.4
30-39	39.8	33.3	35.0	33.9	31.0	30.1
40-49	40.4	38.2	35.8	33.1	30.7	28.3
50-64	35.7	28.3	32.9	25.9	18.0	17.7
65-74	27.8	15.3	21.0	21.0	10.9	13.1
75+	19.9	13.6	13.3	11.6	4.8	10.8
Column Mean	36.2	29.8	32.3	28.9	23.7	24.8
For Entire Population			31.4			

Table 3.16
Average Number Of Person Miles Traveled On Trip Day
By Age, Sex, And Hispanic Status

	MALES		FEMALES	
	HISPANIC STATUS		HISPANIC STATUS	
AGE	HISPANIC	NOT HISPANIC	HISPANIC	NOT HISPANIC
16-29	31.5	35.4	25.3	31.4
30-39	37.1	38.9	27.2	33.8
40-49	45.5	39.3	35.9	32.1
50-64	29.3	35.4	18.2	25.0
65-74	26.8	26.3	15.6	19.6
75+	-------	-------	-------	-------
Column Mean	34.5	35.3	25.4	28.1
For Entire Population		31.4		

Table 3.17
Average Number Of Vehicle Trips On Trip Day
By Age, Sex, And Race

	MALES			FEMALES		
	RACE			RACE		
AGE	WHITE	BLACK	OTHER	WHITE	BLACK	OTHER
16-29	3.06	2.18	2.69	2.78	2.02	1.85
30-39	3.54	2.78	3.36	3.44	2.87	2.54
40-49	3.73	3.12	3.32	3.49	2.94	2.84
50-64	3.50	2.60	3.37	2.48	1.74	1.51
65-74	3.35	2.12	2.64	2.10	0.83	1.18
75+	2.24	1.49	2.34	1.17	0.43	0.78
Column Mean	3.38	2.52	3.05	2.80	2.14	2.09
For Entire Population			2.94			

Table 3.18
Average Number Of Vehicle Trips On Trip Day
By Age, Sex, And Hispanic Status

	MALES		FEMALES	
	HISPANIC STATUS		HISPANIC STATUS	
AGE	HISPANIC	NOT HISPANIC	HISPANIC	NOT HISPANIC
16-29	2.80	2.91	1.96	2.65
30-39	3.33	3.47	2.58	3.35
40-49	3.76	3.63	3.15	3.38
50-64	3.43	3.41	1.66	2.39
65-74	2.68	3.23	1.32	1.93
75+	------	------	------	------
Column Mean	3.17	3.27	2.21	2.70
For Entire Population		2.95		

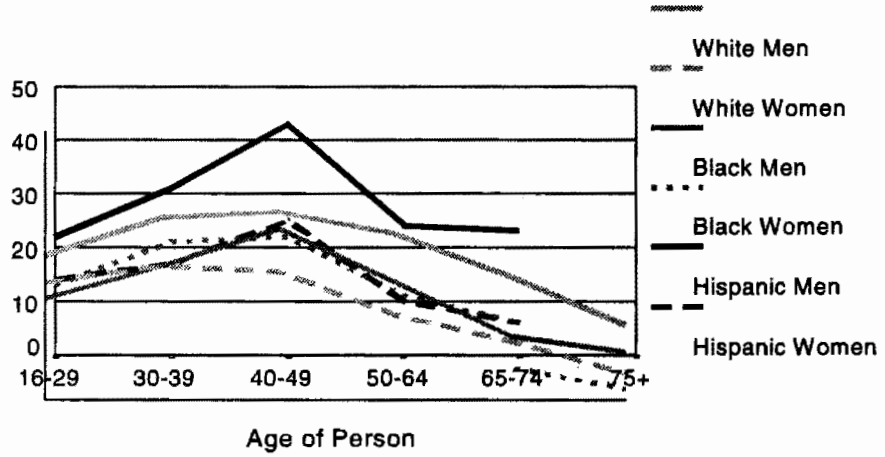
Table 3.19
Average Number Of Vehicle Miles Driven On Trip Day
By Age, Sex, And Race

	MALES			FEMALES		
	RACE			RACE		
AGE	WHITE	BLACK	OTHER	WHITE	BLACK	OTHER
16-29	27.4	19.1	23.7	21.5	13.4	13.6
30-39	34.2	24.9	30.2	24.6	20.7	18.3
40-49	35.3	31.7	31.1	24.3	22.0	20.2
50-64	30.6	22.5	26.5	15.9	11.4	8.6
65-74	22.7	11.5	19.0	11.4	6.0	7.8
75+	14.4	8.7	10.9	5.4	2.0	2.9
Column Mean	30.1	22.2	26.5	18.3	19.3	15.0
For Entire Population			23.4			

Table 3.20
Average Number Of Vehicle Miles Driven On Trip Day
By Age, Sex, And Hispanic Status

	MALES		FEMALES	
	HISPANIC STATUS		HISPANIC STATUS	
AGE	HISPANIC	NOT HISPANIC	HISPANIC	NOT HISPANIC
16-29	22.4	26.4	14.2	20.0
30-39	30.5	33.3	16.8	24.2
40-49	42.6	34.0	24.8	23.5
50-64	24.1	30.2	9.5	15.3
65-74	22.8	21.5	5.7	10.8
75+	-------	-------	-------	-------
Column Mean	27.9	29.1	15.1	18.6
For Entire Population		23.5		

Figure 14
Miles Driven per day by Race and Ethnicity



SOURCE: 1995 NPTS PERSON FILE

Mobility differences in vehicle access and transit use are replicated in person trips, person miles, vehicle trips and vehicle miles driven for older Americans. Black women aged 75 and over make fewer person trips than older black men (1.4 vs. 2.2), travel fewer person miles (5 vs. 14), make fewer vehicle trips (.4 vs. 1.5), and drive fewer miles (2 vs. 9). Whites and other minorities exhibit similar gender differences, with white mobility higher than for blacks and others.

Among baby boom women, blacks and Hispanics make fewer person trips per day than whites and non-Hispanics (4.2 versus 4.6). Baby boom women who are black travel fewer person miles per day than white women (31 versus 33), make fewer vehicle trips (2.9 versus 3.5) and drive fewer vehicle miles (22 versus 24) than white baby boom women. Baby boom Hispanic women travel slightly more person miles, make fewer vehicle trips, and drive slightly fewer vehicle miles than non-Hispanics.

FINDINGS AND CONCLUSIONS

This report has summarized what we know about travel behavior for older Americans (persons aged 75 and over) and for women aged 40 to 49 in order to speculate about the transportation demands that may be generated by the aging baby boom. The working hypothesis is that baby boom women, as they age, are going to exhibit travel behavior closer to those of today's older men than today's older women. The first section described the demographic profile of the nation by age and by indicators of socioeconomic status for women. The second section described travel patterns for the older and baby boom cohorts, and the third section controlled for various factors that influence travel behavior independently of age and sex.

The Demographic Profile

The American population is aging as the baby boom matures. Nine percent of the population will be aged 75 and over by the year 2030, and a majority of these older Americans will be women. An aging baby boom will increase the relative proportions of the elderly and it will also affect the composition of the elderly. Ethnic and racial diversity of the elderly is increasing, so that by 2050 only 65 percent of the elderly will be white compared with 87 percent in 1990. Hispanics and Asians are the most rapidly growing minority groups.

Baby boom women have been decidedly more independent than previous generations of women and that independence may translate into a different travel profile as they age. Specifically, baby boom women were the first generation to approach men's college graduation rates, the first to make employment the norm for women (even mothers), and the first to maintain their own households in significant numbers.

The Transportation Profile

The most important point is that if baby boom women keep their licenses as long as men do now, over 80 percent will still be licensed to drive at ages 75 and over. Whether they continue to drive will depend on their economic ability to afford a vehicle and the absence of physical impairments.

Even when licensed to drive, older women now are more likely than older licensed men to live in a household without a vehicle (25 versus 5 percent). If baby boom women keep their cars as long as men do now, only 5 percent will live in a household with no vehicle when they reach age 75, a 20 percentage point decrease over current rates for older women.

The more highly educated the woman, the more likely she is to live in a household with a vehicle, and the older the woman, the stronger the relationship. This suggests that baby boom women, who are more than twice as likely as their mothers to be college-educated, will have greater access to vehicles than older women now. Not surprisingly, the lower the household income, the less likely the household owns a vehicle.

Among older Americans, low-income women are more than twice as likely as low-income men to live in households without a vehicle. Hispanics, blacks, and other minorities are more likely than whites and non-Hispanics to live in households without vehicles.

Mobility of the population was measured by average number of person trips and person miles traveled per day, and by average number of vehicle trips and vehicle miles driven per day. If baby boom women adopt their father's travel profiles rather than their mothers', older women in the future will make more person trips per day (2.9 versus 2.1), travel almost twice as many person miles (19 versus 11), make twice as many vehicle trips (2.2 versus 1.1), and drive almost three times as many vehicle miles (14 versus 5) as older women do now.

Minority women and men of all ages lead more geographically constricted lives than white and non-Hispanic women and men. Since the older population will be more racially and ethnically diverse in the future than it is now, increases in travel associated with baby boom women's increased independence may be tempered by larger proportions of minorities.

Given an aging population and an increasingly autonomous generation of women, what might transportation planners do to meet the future needs of the baby boom?

Policy Suggestions

Women aged 75 and over in 2030 will be almost universally licensed to drive and few will live in households without vehicles if baby boom women maintain the independent travel profile currently exhibited by older men. Aging baby boom women also will generate more trips and drive more miles than older women now, increases that will be intensified by the size of the cohort.

The most promising transportation policies would facilitate central city residence among older Americans so they can maintain their independence longer by walking and using transit instead of driving. **The first step would be for federal agencies to agree that reducing vehicle dependency by encouraging central city residence is a national goal.** The timing is good because President Clinton has just declared a concerted effort to lower vehicle emissions to their 1990 levels. Reducing vehicle ownership is obviously one avenue toward this goal.

Although no single agency created a plan in the 1950s to implement urban renewal, construct highways, and build affordable homes in the suburbs that would attract business and industry, we know with the clarity of hindsight that these programs reinforced each other to create substantial suburban growth within a few decades. Given that we recognize the power of federal programs to collectively leverage private enterprise and influence personal choice, we can use history to inform current policies encouraging central city residence.

The baby boom might be leveraged as a resource to modify current land-use patterns, given the proper incentives and sufficient lead time. They will be retired from the labor force and will not have children in school, two factors that affect residential location for younger households. Baby boomers also were the leading edge of gentrification in the 1970s and may be more sympathetic to urban living than their parents' generation.

The gentrification movement erroneously dubbed "back-to-the-city" during the 1970s was really a "stay-in-the-city" choice for large numbers of baby boomers. At that time, displacement of the elderly was a central concern among neighborhood activists (Laska and Spain 1978). Strategies devised to help the elderly "age in place" in cities included home equity conversions, property tax abatements, rent control, and expansion of Single Room Occupancy (SRO) hotels (Franck 1990; Myers 1982). Some of those same strategies might be targeted now to suburban seniors of all income levels who will soon be worrying about their ability to drive. Newer strategies include marketing central city housing to suburbanites with cosmopolitan lifestyles, promoting small businesses, and encouraging nontraditional households (Lang et al 1997; Moss 1997).

A package of transportation, housing, and service amenities created by public-private cooperation over the next twenty years could provide the same incentives for central city residence that they did for suburbanization in the 1950s and 1960s. For example, tax credits for the conversion of office space to residential space (similar to the original historic preservation tax credits) could increase the supply of affordable housing, especially in cities with higher than average office vacancy rates. Houston, Los Angeles, New Orleans, and Providence, R.I. all have office vacancy rates approaching 20 percent compared with the national average of 14 percent (U.S. Bureau of the Census 1996:725,726)). Cities have tried to entice businesses (including sports franchises) with tax incentives for over a decade. If the same policies were applied to residential development, some of the housing stock depleted during urban renewal could be restored.

This strategy would be accompanied by rewards for central city residence. Tax credits for households without vehicles would be one. Such tax credits could be supplemented by "Location-efficient" mortgages that reward high-density settlement by expanding the credit available to households with less than one car per worker (currently under consideration by Fannie Mae).

Tax credits for vehicle-free households might prompt private enterprise to develop paratransit alternatives to private cars (Cervero 1997). A public education campaign explaining the net gain after subtracting car, insurance, and personal property tax payments from the household budget might work as effectively as the anti-smoking campaign has reduced cigarette use. Few analysts would have predicted twenty years ago that large numbers of people would give up cigarettes, but information about the risk of cancer changed the climate sufficiently to influence public opinion. Similar health concerns are emerging now about air quality and groundwater pollution resulting from vehicle emissions. If Americans can give up addiction to cigarettes, they can give up addiction to their cars with the proper incentives.

A third component would be to tie Social Security and Medicare benefits (currently *not* place-specific) to location. Since one of the trends fueling suburban and exurban growth has been the mobility of retirement income, directing that income to central cities could help redistribute the baby boom population over the next 30 years. For example, whenever cost of living adjustments to Social Security are made, seniors living in cities would receive more than those living in suburbs. Or seniors seeking medical care would qualify for coverage allowing choice of doctors in cities, while those in suburbs join the rest of the nation's shift to HMOs. Better health insurance and accessible medical care can be powerful incentives attracting seniors to the city.

A national "back to the city" campaign aimed at baby boomers would require the cooperation of several federal agencies. The Department of Transportation could take the lead by creating a team of middle-managers from the Departments of Transportation; Energy; Housing and Urban Development; Health and Human Services, and the NIH Institute on Aging to coordinate efforts to encourage central city residence. Like the Joint Agency Task Force on Fair Housing and Civil Rights formed by President Clinton, a Joint Agency Task Force on Cities for Seniors would be responsible for keeping the big picture in mind: how do decisions made by individual agencies collectively influence the national goal to reduce vehicle ownership by promoting central city residence?

The Task Force on Cities for Seniors could begin by directing Research and Development funds toward reducing vehicle ownership by recognizing the connections between transportation, aging, housing and community development, and energy conservation. Projects addressing these issues comprehensively would be given funding priority. Instead of more research on "smart roads", for example, the goal would be to generate more research on converting vacant buildings into a successful mix of residences and retail districts to encourage "smart cities".

What about safety and what about the economic impact of reducing the importance of the automobile industry? Starting in reverse order, if DOT reduced highway construction and invested in transit for the next 30 years, engineers and laborers who previously worked on highway construction would work on transit construction. Car manufacturers would re-tool for transit and paratransit production just like industries re-tooled for defense production during World War II (WWII).

Instead of targeting the ownership market, the automobile industry could concentrate on the leasing market so households could move in and out of car dependency more easily. When a spouse enters or leaves the labor force, for example, or when a child leaves home, the number of cars could be adjusted to changing household needs. This approach has the added attraction of creating higher turn-over in the vehicle fleet so that older, less fuel-efficient cars cycle out of use more quickly. It might also appeal to banks since leases cost more to finance, and turn over more often, than car loans for owners.

Fear of central city crime will be the most difficult component to address in a Cities for Seniors plan. Jane Jacobs (1961) promoted high density and mixed uses to multiply "eyes on the street" for enhanced safety. But how do you assemble the critical mass of places and people necessary to generate such safety? Relaxing zoning laws to encourage mixed uses would be the first place to start, but then what? Gated communities and more police are *not* the answer to long-term neighborhood stability.

Instead, hospitals, newspaper offices, universities, and other places with round-the-clock activities should be promoted as magnets for high-density residential development. Federal agencies can provide the financial incentives, but private enterprise and individuals would have to implement much of the change. That should not be impossible. If the American Legion could successfully lobby for the G.I. Bill of Rights that provided unemployment, housing, and educational benefits for thousands of soldiers after WWII, the American Association of Retired Persons should be able to effectively mobilize the elderly for a comparable groundswell of social change.

In sum, the same issues that challenge transportation planners now – the relationship between land use and transportation needs – will be exacerbated as the baby boom ages. It will take the same level of public-private cooperation to centralize population in central cities during the next twenty years as it did to decentralize population during the 1950s and 1960s.

A "Cities for Seniors" campaign would meet all of the Department of Transportation's goals. *Mobility* of older Americans would be improved if walking and public transit were viable alternatives to driving, and roads will no doubt be *safer* with fewer older drivers. Reducing non-work trips by car *enhances productivity* for those employed by reducing traffic congestion. Fewer cars per household would also carry significant *environmental benefits*. Finally, to the extent that *national security* is connected to fuel consumption, fewer vehicles translate into less dependence on other nations for oil supplies. We know what the problems will be and we know we have time to address them. All we need now is consensus on the goal.

OTHER RESEARCH

Embedded in discussions of aging and women's greater economic autonomy is the **changing nature of work and its relationship to the home.** Transportation analyses typically differentiate between "work" and "nonwork" trips, but assessment of the categories for trip purpose suggest an underestimation of the actual amount of labor being performed. Shopping for groceries, attending to medical and dental needs, picking up or delivering children, and taking care of "other family or personal business" are reasons for trips that encompass a vast array of work necessary for households to function.

Recognition of this invisible work would make transportation planning more effective by removing such trips from the realm of supposedly discretionary travel. Modifying the analytical categories to reflect *paid versus unpaid labor* would be a step toward recognizing the work performed by all members of a household regardless of age or sex. The importance of journey-to-work trips also will diminish as the baby boom cohort ages into retirement.

The continuum along which work occurs may be expanding. At one end is part-time work and at the other end is the practice of multiple job-holding known as "moonlighting". Both of these alternatives to the forty-hour week are amenable to study with the NPTS. Approximately 20 percent of employed Americans worked part-time (i.e. less than 35 hours per week) in 1995, a proportion that may rise as the baby boom generation retires. The rate at which people work more than one job has increased only slightly since the 1970s, from about 5 to 6 percent, but women's rates now equal those of men's after being significantly lower for two decades. The higher than average rates for both women and men aged 25 to 54 is another indicator of women's greater economic responsibility for families. Moonlighters account for only a small proportion of all those employed, but their travel needs may differ from those of persons with only one job, just as the needs of part-time workers may differ from those of full-time employees. Part-time workers are predominantly female (68 percent) while moonlighters are about evenly divided by sex (46 percent female) (Jacobs 1997: 45-47,69).

The concept of work demands other revisions as we enter the twenty-first century. Telecommuting has captured the public imagination, but is still too rare to qualify as a trend. Approximately one-third of all employed Americans perform some paid work at home (the majority of whom are self-employed), but less than one percent work entirely at home as salaried or wage employees (Deming 1994). The 1995 NPTS corroborates these data from the Bureau of Labor Statistics: less than one percent of respondents chose the category of "telecommuting from home" as a workplace option. Nevertheless, it is useful to begin documenting telecommuting since it may eventually affect travel patterns (Gurstein 1996; Lund and Mokhtarian 1994; Nilles 1994; Pisarski 1992; Yen et al. 1994).

In addition to telecommuting, "edge cities" and "neo-traditional neighborhood design" (NTND) represent recent efforts to realign the jobs-housing balance and reduce automobile dependence. Debate exists, however, about whether these solutions have much effect on the use of cars (Bookout 1992; Crane 1996; Friedman et al 1992; Garreau 1991; Handy 1992; McNally and Ryan 1993).

One category of trip purposes conspicuously missing from the NPTS is volunteer work like delivering Meals on Wheels, attending PTA functions, coaching Little League, or sponsoring Girl Scouts. These are all activities that create a sense of community that typically fall between the private sphere of the family and the public spheres of the polity or workplace (Milroy and Wismer 1994). Neither does the NPTS address the travel implications of job-sharing (Negrey 1993), participation in the underground or informal economy (Hoyman 1987), or recently legislated welfare-to-work programs (Blumenberg and Ong 1997).

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III.

DAILY TRAVEL BY PERSONS WITH LOW INCOME

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DAILY TRAVEL BY PERSONS WITH LOW INCOME

EXECUTIVE SUMMARY

Persons in households with low incomes are much less likely to have a vehicle, largely in part because a greater proportion of their income is spent on shelter and food. About a quarter (26%) of low income households do not have a car, compared to 4% of other households. These low income households often are without regular telephone service because it is an additional expense. Thus, monthly payments for a car or car insurance would be very difficult to meet.

When these households have a car, the car is quite old. The average car is 10 years old in low income households, compared to 7.3 years for other households. However, in low income households, there is on average, only .7 vehicles per adult, compared to over 1 vehicle per adult in other households.

Despite having fewer vehicles, people in low income households still make most of their trips in private vehicles. These trips are much more likely to be made in a vehicle owned by someone else, like a friend or relative (8 percent for low income, compared to 1 percent for other income group).

The biggest difference in travel mode is in the proportion of walking trips. People in low income households are nearly twice as likely to walk as people in other income groups. For example, for work (and work-related) trips, low income households report 5 percent by walk, compared to 3 percent for other income groups. Low income households are also more likely to use transit to work (5 percent compared to 2 percent).

Because so many trips are made by walking, the space in which people in low income households travel is more constricted than for others. About 60 percent of their trips are 3 miles or less, compared to 50 percent for other households. For low income single parent households, about 66 percent of trips are 3 miles or less.

INTRODUCTION

Transportation is a critical element for everyone to accomplish tasks in their daily lives, including getting to work and school, and accessing goods and services. As we focus on moving people from welfare to work, we need to reduce transportation problems as a hindrance by improving accessibility and mobility for this group.

As a first step, we need to understand how people in poverty travel today. We used the 1995 Nationwide Personal Transportation Survey (NPTS) to provide a picture.

The poverty guidelines and poverty definitions used by the Bureau of the Census and Health and Human Services are based on before-tax cash income. Income measures ignore home ownership and other assets that can be important sources of consumption. The official poverty rate does not account for taxes or in-kind transfers such as food stamps or other government-provided medical insurance, which improve living conditions without affecting a family's official poverty status (1). For example, a person making $10,000 a year who receives no public assistance is considered the same as a person making $10,000 a year who received food-stamps and Medicaid benefits. Despite these definitional problems, we also used income as as measure to classify households into two groups: "low income" and "other (not low) income" for purposes of comparing daily travel behavior.

DATA

The 1995 dataset includes 42,633 households. The NPTS does not include extensive questions about income sources or on assets. That is, there is no question specifically on whether the respondent received welfare payments, food stamps, etc. Income is asked only at the household level, not for each person, and is grouped in $5000 increments.

Using the 1990 Census Public Use Microdata Sample (PUMS) and examining the household incomes by persons receiving public assistance, by household size, we categorized the 1995 NPTS households as follows:

Table 1
Definition of "Low Income" Households for 1995 NPTS

Number of persons (regardless of age)	Household Income*
1-2 persons	Under $10,000
3-4 persons	Under $20,000
5+ persons	Under $25,000

Using this definition, 4,721 households in the 1995 NPTS are classified as low income, and 639 households are classified as single parent low income households. Thus, any tables in this paper showing single parent low income households are subject to less accuracy than for the sample of low income households. The NPTS likely underrepresents single parent low income households because it is a telephone survey (2). Although nationwide, only 5 percent of households do not have a telephone, these households are concentrated amongst the poor and the rural areas. Among families receiving welfare, over 30 percent report not having continuous phone service.

The sample includes all ages, and households with and without children (Table 2). About 53 percent of the low income households have no chidren, and 47 percent have children. About 26 percent of the sample has a reference person age 65 and over, with no children present. For households headed by someone between age 21-29, 77 percent had 1 or more children; and for households headed by someone between 30-64, 61 percent had 1 or more children.

In the total sample (n = 42,033), African American households account for 11 percent, and Hispanic households account for 7.8 percent of the sample. For low income households, the proportion of African Americans is 23 percent, and for Hispanics, 14 percent. For the 639 households in the single parent low income group, about 32 percent are African American, and 20 percent are Hispanic, for a total of 52 percent in these two groups. Nearly 90 percent are with a female head. (Table 3a)

The low income population is much more likely to live in the traditional urban centers and in the "second cities", which are often areas that were early suburbs of the central city. In contrast, the suburban areas are much less likely to include the low income population (12 percent of the low income population compared to 24 percent for the total population). (Table 3b).

Table 2
Low Income Households
1995 NPTS

By Age of Reference Person and Number of Children

		0	1	2+	Total
Under 21	*sample*	*79*	*25*	*21*	*125*
	weighted	204,973	54,004	71,549	330,526
21-29	*sample*	*205*	*221*	*356*	*782*
	weighted	459,539	482,993	1,059,775	2,002,307
30-64	*sample*	*983*	*497*	*1,075*	*2,555*
	weighted	2,737,956	1,273,387	2,953,260	6,964,603
65+	*sample*	*1,186*	*46*	*26*	*1,258*
	weighted	3,435,884	137,991	78,603	3,652,478
Total	*sample*	*2,453*	*789*	*1,479*	*4,721*
	weighted	6,838,351	1,948,376	4,164,229	12,950,956

Table 3a
Race and Hispanic Origin of NPTS Reference Person (in percent)
1995 NPTS

Race	ALL	Low Income	Low Income Single Parent
Black, non-Hispanic	11.4	22.5	32.0
Hispanic	7.8	14.2	20.2
Asian	1.8	1.5	.9
Other	79.0	61.8	46.8
Total	100.0	100.0	100.0

Table 3b
Neighborhood Type of NPTS Households (in percent)
1995 NPTS

Race	ALL	Low Income	Low Income Single Parent
Urban	16.7	23.1	25.8
Second City	17.9	20.6	24.1
Suburban	24.4	11.8	14.7
Town	21.3	19.3	18.1
Rural	19.7	25.1	17.2
TOTAL	100.0	100.0	100.0

In this paper, we will examine three basic characteristics:

1. Vehicle Availability,
2. Travel Mode and Vehicle Occupancy, and
3. Total trips and miles of travel.

VEHICLE AVAILABILITY

Probably, the most critical item that affects the mobility of low income persons is access to a car. The 1995 NPTS shows 26 percent of low income households did not have a car, compared to 4 percent of other households (Figure 1). When a low income household has a car, it is likely to be quite old. The average car is nearly 11 years old for low income households, compared to 8 years for other households. Not only are the vehicles older, but also, there are fewer vehicles available per adult: .7 vehicle per adult in low income households, compared to over 1 vehicle per adult in other households.

Figure 1
Households without Vehicles

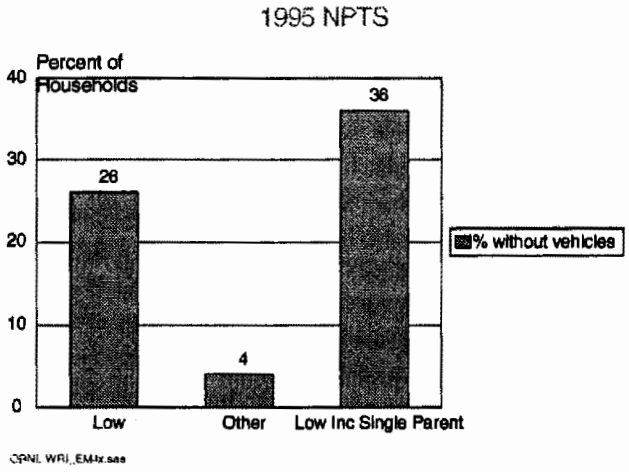


Table 4
Vehicle Availability
1995 NPTS

Income	TOTAL	Low	Other (not low)	Low Income Single Parent
Avg household size	2.58	2.73	2.57	3.28
Avg Num of Veh	1.78	1.16	1.89	0.72
Avg Veh Age	8.3	10.9	8.1	10.8
% of hhld w/o veh	8%	26%	4%	36%
Vehicles Per hhld	1.78	1.16	1.89	0.72
1 Adult hhld	.98	.66	1.09	0.72
2+ Adult hhld	2.11	1.59	2.18	--

The difference in vehicle availability reflects the lack of discretionary money beyond expenditures for food and shelter. Households receiving public assistance spent $15,304 on average during 1992-93. Nearly 60 percent was allocated to food and shelter. Transportation was the next largest share at 15 percent ($2,296) of the total. Single parent households receiving public assistance spent nearly 70 percent on food and shelter, with only 10 percent for transportation. Households not receiving public assistance allocate 47 percent to food and shelter, and 19 percent to transportation (3).

Table 5
Expenditure by HOUSEHOLDS by receipt of public assistance, presence of working members and family type, first quarter 1992 to first quarter 1994

Percent of expenditures

			Households receiving public assistance by			
	Receive Pub Assist	No Pub Assist	No workers	Some workers	Single parent	Dual parent
Food & Shelter	59.5	46.9	71.7	53.4	69.1	54.0
Transportation	15.3	19.2	9.5	19.1	10.2	19.6

Source: Family Economics and Nutrition Review 1997 Vol 10, No. 1, page 43

For people in poverty, even having a telephone is often a luxury that comes and goes. Among poor families (does not include people who live alone), 23 percent did not have on-going telephone service, compared to 3 percent of non-poor families. These proportions are nearly identical to the proportion of families without vehicles. (4)

Table 6
Percent of Families

	Non poor families	Poor families	Single-parent poor families	Families receiving welfare
Car/truck owner*	97.2	76.8	64.1	65.3
Telephone in home**	97.2	76.7	69.9	67.5

* Survey of Income Program Participation 1992 **American Housing Survey 1993
Source: Monthly Labor Review May 1996, page 8

TRAVEL MODE AND TIME TO TRAVEL

This section covers: (a) Journey to work trips and (b) Other trips.

Journey to Work

Despite a greater likelihood to be without a car, people in low income households are still most likely to travel by private vehicles. For the work trip, 84 percent of trips by workers in low income households, compared to 90 percent in other households, use private vehicles (Figure 2). Average vehicle occupancy is somewhat higher for workers in low income households (1.20 vs. 1.15), but this may not be statistically significant. (Table 7) Average travel times by private vehicle for the journey to work do not vary by income group and average between 18 and 20 minutes.

Figure 2
Earning a Living Person Trips by Mode by Income

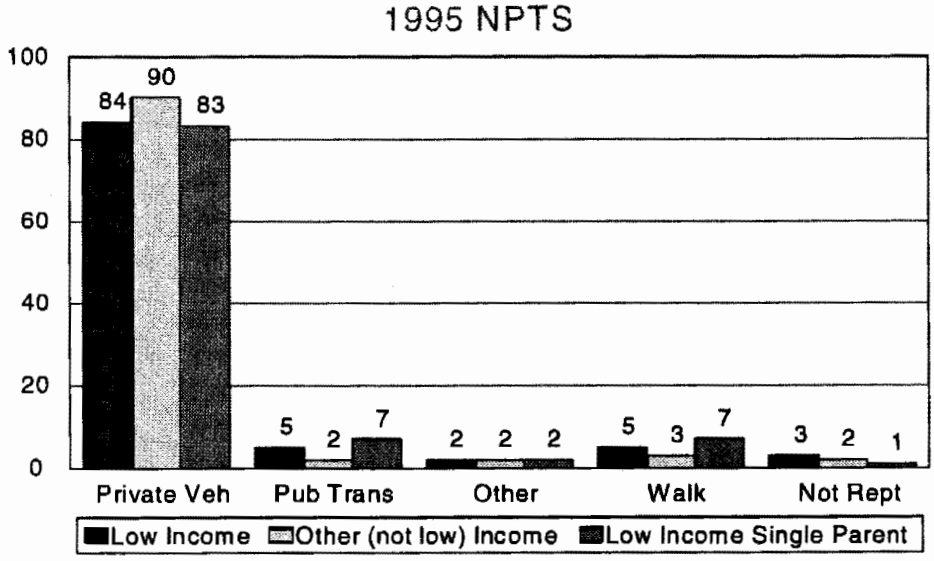


Table 7
Average Vehicle Occupancy for Private Vehicle Trips (Weighted by Miles)
1995 NPTS

	All	Low Income	Other (not low) income
Earning a living	1.16	1.20	1.15
Family & Personal Business	1.77	2.01	1.74
Social & Recreational	2.07	2.48	2.07
TOTAL*	1.59	1.85	1.57

*Not all trip purposes shown

Other differences in the travel mode to work are: a) workers in low income households are much more likely to walk to work (6 percent compared to 3 percent), and b) are more likely to use public transit to get to work (5 percent compared to 2 percent) (Figure 2). The types of public transit trips by the two groups differ. For low income households, the public transit trips are likely to be by bus, and for other income households, more likely to be by train. Thus, the average trip distance for low income households using public transit is 10 miles, compared to 13 miles for other incomes; and the average travel time is 36 minutes for low income, compared to 43 minutes for other incomes.

During the last twenty years, the majority of employment growth has been in suburban areas, and much of the jobs for entry level workers have likewise been in the suburbs. Suburban employment represents an increasing share of metropolitan employment. Case studies in Cleveland, and in Atlanta, have shown the mismatch between the residential location of welfare recipients and new employment locations in the region (5).

Other trips (non-work)

Travel mode for family and personal business, and social/recreation trips show an even greater propensity of low income households to walk. Walking is used for thirteen (13) percent of social and recreational trips and 9 percent of family and personal business for low income households. These proportions are nearly double for other (not low) income households, which report only 7 percent of social and recreational trips and 4 percent of family and personal business trips made by walking (Figures 3 and 4). Social and recreational trips for low income households are significantly shorter (on average) than for other households (Table 8).

Figure 3
Social & Recreation Trips
Person Trips by Mode by Income

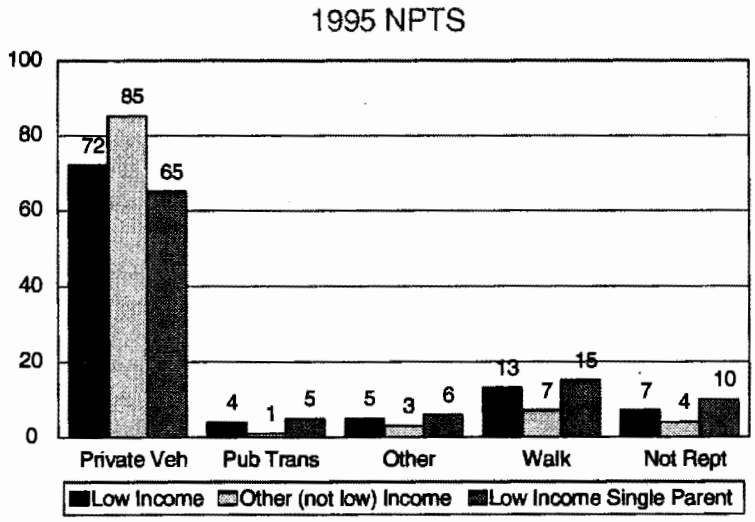


Figure 4
Family & Personal Business
Person Trips by Mode by Income

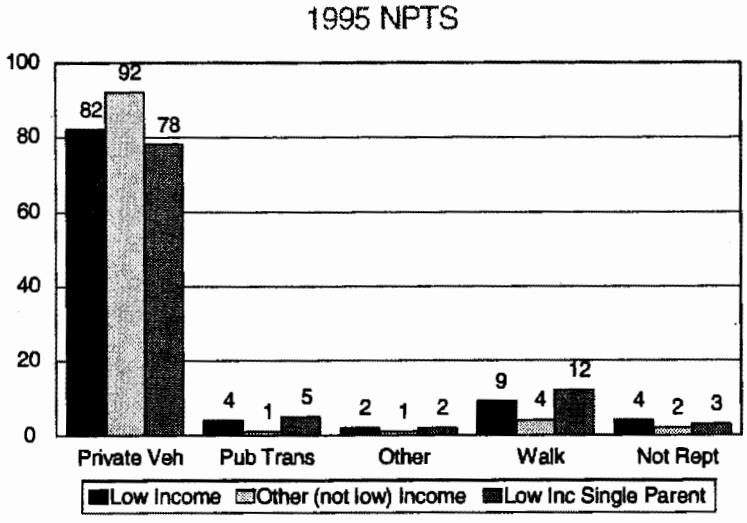


Table 8
Average Trip Length in Miles
1995 NPTS

	ALL	Low Income	Other (not low) income
Family & Personal Business	6.83	5.94	6.86
Social & Recreation	10.70	8.05	11.16

Person trips in low income households are much more likely to be made as passengers in private vehicles, rather than as the driver (Figure 5). Part of this reflects the greater likelihood of children in the household. Trips made in private vehicles are much more likely to be in "non-household" vehicles, that is, in vehicles of friends, neighbors, or relatives. For low income households, nearly 9 percent of private vehicle trips are in "non-household" vehicles, compared to less than 1 percent for other income households. For low income single parent households, the proportion is about 17 percent. (Figure 6)

Figure 5
Person Miles of Travel by Mode
(excluding airplane)

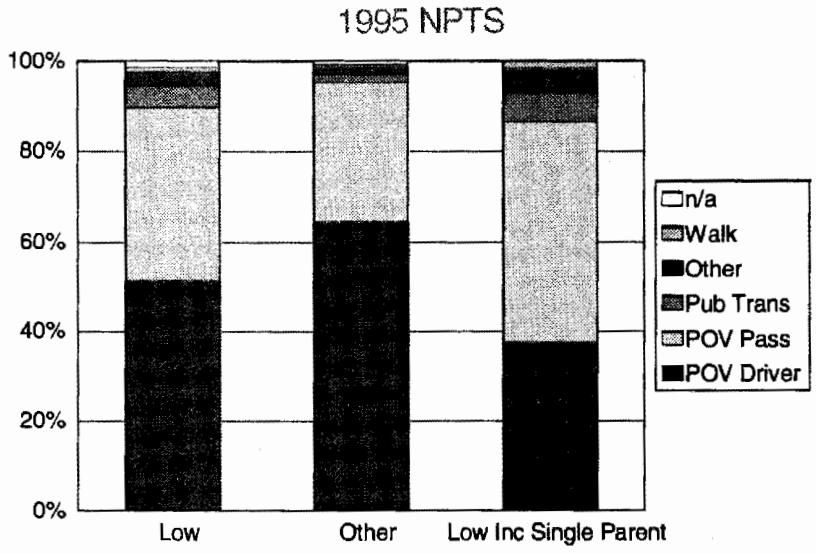
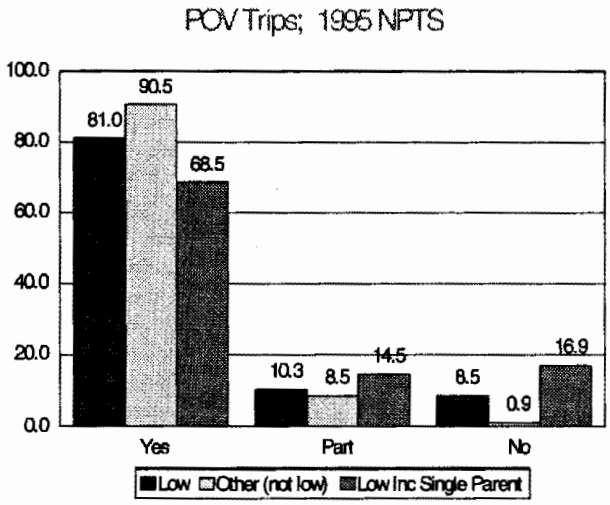


Figure 6
Was a Household Vehicle used on the Trip?



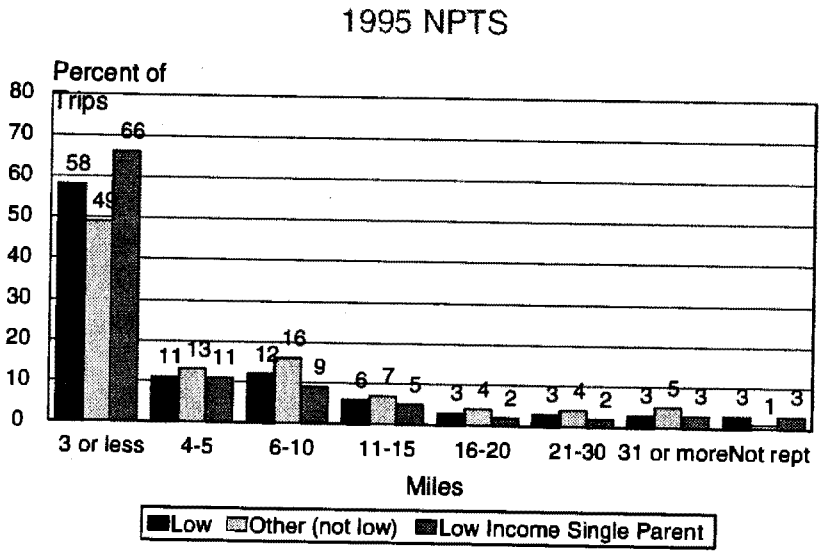
These results corroborate findings from the 1990 NPTS, showing that for persons in households without vehicles, more trips are typically made by private vehicles and by walking, than using public transportation. For example, for African Americans (age 16 and over), in households without a vehicle, 37 percent of trips were made by private vehicles, 37 percent of trips by walking, and 23 percent of trips by public transportation (6)

ANNUAL PERSON TRIPS AND PERSON MILES OF TRAVEL

On a per person basis, people in low income households make about 20 percent fewer trips than people in other households (1,340 person trips compared to 1,648 person trips) (Table 9). However, because so many of these trips are by walking, the difference in person miles of travel is much more striking. People in low income households travel nearly 40 percent fewer miles (9,060 vs. 14,924 person miles). Also, since vehicle availability is also lower, VMT per household is about half that in non-low income households (11,594 miles compared to 23,427 miles).

Because so many trips are made by walking, the space in which people in low income households travel is more constricted than for others. About 60 percent of their trips are 3 miles or less, compared to 50 percent for other households. For low income single parent households, about 66 percent of trips are 3 miles or less (Figure 7).

Figure 7
Trip length distribution—person trips



If we compare a travel radius of 3 miles to a travel radius of 10 miles, the 10 mile radius covers 10 times more area. Within a 3 mile radius of one's home, one has 28 square miles which are accessible. With a 10 mile radius, this area expands to 300 square miles. Given the dispersion of jobs in our large metropolitan areas, the ability to travel beyond 3 miles from our homes is critical to the accessibility of jobs. The ability to travel beyond 3 miles from our homes is also critical to our ability to access goods and services.

Table 9
Overall Travel
1995 NPTS

	TOTAL	LOW	OTHER	SINGLE-PARENT LOW INCOME
Avg hhld size	2.58	2.73	2.55	3.28
Annual Person Trips per Hhld	3,825	3,339	4,011	4,342
Avg Trips per Person	1,567	1,340	1,648	1,491
PMT per Hhld	33,280	22,572	36,330	24,543
PMT per Person	13,632	9,060	14,924	8,927
Vehicle Trips per Hhld	2,321	1,525	2,524	1,314
VMT per Hhld	20,895	11,594	23,437	9,203
POV Driver PMT per Person	8,558	4,654	9,627	3,160
POV Passenger PMT per Person	4,311	3,491	4,590	4,138
Public Tran PMT per Person	300	430	274	547
Walk PMT per Person	45	74	41	118
Other PMT per Person	276	280	282	445

CONCLUSIONS

The Nationwide Personal Transportation Survey (NPTS) can be used to understand the travel patterns of low income households, and other special groups, such as households without cars.

Understanding how people in low income households travel today may assist us in the efforts of transitioning welfare recipients into the labor force. On a short term basis, the quickest way to improve people's accessibility to jobs may be to help them get a car. This could be through car ownership programs via employers, through non-profit groups, or through private/public joint ventures, perhaps involving car dealerships.

Having a car provides the range to travel longer distances and to get to a range of locations that may be inaccessible by bus. Many entry level jobs may require work in the evenings, and some jobs may be shift work. There is usually much less opportunity to use transit at these times, even if the jobs are located in traditional downtown areas.

The NPTS data show that, with a car, people with low incomes not only will drive themselves and their household members, but are also likely to assist friends and neighbors. Having a car provides greater flexibility not only in decisions on travel to work, but to other very important tasks such as child care, medical and dental visits, and household responsibilities such as grocery shopping.

While efforts to return jobs to the central city, to change land use patterns to have employment centers with densities and designs that support transit, bike and walk alternatives, should continue to be long term goals, these approaches may not solve the immediate problems of assisting people who now have a limited time for receiving welfare assistance.

Of course, those with low incomes are not all in the labor force. Many are retired and may have never learned to drive a car. Mobility for the elderly at all income levels is another topic that should be pursued with the 1995 NPTS. Further examination should isolate intervening variables such as the number of children in the household, number of people of working age, as factors that affect the travel of low income households.

Originally presented with 6-month NPTS dataset at
African American Mobility Symposium
Tampa, Florida
April 30-May 2, 1997

REFERENCES

(1) *Monthly Labor Review*, May 1996, p. 3

(2) Note: The full 1995 NPTS includes adjustments that account for low income households that tend to go in-and-out of having telephone service.

(3) *Family and Economics and Nutrition Review* 1997 Vol 10, No. 1, page 42, citing Passero, W.D., *Monthly Labor Review* 119 (4): 21-28.

(4) *Monthly Labor Review*, May 1996, p. 8.

(5) Leete, L. And Bania, N. *The Impact of Welfare Reform on Local Labor Markets*. Center for Urban Poverty and Social Change, Case Western Reserve Univeristy, Cleveland, Ohio. August 1995.

(6) Lave, C. and Crepeau, R. "Travel by Households without Vehicles," in *1990 NPTS Travel Mode Special Reports*. FHWA (FHWA-PL-94-019), Washington, D.C. December 1994.

IV.

TRENDS IN PERSONAL MOTOR VEHICLE OWNERSHIP AND USE: EVIDENCE FROM THE NATIONWIDE PERSONAL TRANSPORTATION SURVEY

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Dear Reader:

Because of the careful research conducted by Dr. Pickrell, the USDOT found an anomaly in the NPTS data set. In short, more people reported traveling zero miles in 1995 than reported traveling zero miles in 1990. Further analysis of the dataset revealed that many of the individuals reporting that they personally drove zero miles in the last twelve months also reported traveling in a car, which was listed as their main vehicle, on the travel day itself. The data were adjusted to alleviate this under-reporting of miles driven in the annual estimate by drivers. These revisions are documented in Appendix B. Please keep this in mind as you read the following analysis.

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TRENDS IN PERSONAL MOTOR VEHICLE OWNERSHIP AND USE

EXECUTIVE SUMMARY

This paper uses information from the Nationwide Personal Transportation Surveys (NPTS) conducted in 1969, 1977, 1983, 1990, and 1995 to explore growth in personal motor vehicle travel, changes in the number, types, and age distribution of household motor vehicles, and the determinants of household vehicle use patterns. After growing rapidly between 1969 and 1990, household vehicle ownership and use have stabilized: vehicle miles traveled (VMT) estimates based on self-reported annual driving and vehicle use each show annual growth under 1% between 1990 and 1995, a markedly slower rate than prevailed during the 1980s. Annual miles driven per licensed driver *decreased* 4.5% over this period, while the number of licensed drivers increased 8.4% The decline in annual VMT per licensed driver occurred among both men and women and among most age groups.

After increasing slowly from 1977 to 1990, the number of vehicles per household showed no change in the 1995 survey. Because the number of household members of license-eligible age declined slightly, the number of vehicles per household member of driving age increased from 0.76 in 1977 to 0.89 during 1990, where it remained in the 1995 survey. At the same time, the average age of vehicles owned by U.S. households increased rapidly from 5.6 years during 1977 to 7.6 years in 1983, showed no change in 1990, but rose sharply to 8.3 years during 1995 (when vehicles 10 or more years old accounted for more than one-third of all household vehicles). The newest vehicles in the household fleet are utilized extremely intensively: those less than five years old are driven approximately 15,000 miles annually, and vehicles from ages five to ten are driven nearly as much, averaging 12,000-13,000 miles annually. Not until approximately age 15 and beyond does average annual utilization drop consistently below the 10,000-mile threshold.

Vehicles classified as light-duty trucks—particularly vans and sport/utility vehicles—increasingly substitute for passenger automobiles. Pickup trucks appear to be a distinct class of vehicles with different ownership and utilization patterns from automobiles and other light trucks. Passenger automobiles represented only about 65% of household vehicles during 1995, a significantly lower share than the more than 71% they represented only five years earlier. Automobiles tend to be driven slightly less than the overall average for all household vehicle types (about 12,000 miles annually), while light-duty trucks are typically used much more intensively: vans average nearly 15,000 miles annually, SUVs almost 14,000, and pickup trucks over 13,000 miles per year.

INTRODUCTION

The size, composition, and use of the U.S. motor vehicle fleet are subjects of major interest to analysts and policy-makers concerned with the environmental impacts of passenger transportation. The release of 1995 Nationwide Personal Transportation Survey (NPTS) provides an opportunity to examine recent trends in motor vehicle ownership and usage. This latest NPTS, which follows similar studies conducted in 1969, 1977, 1983, and 1990, also incorporates several refinements that may make it a more useful data source for understanding the causes and implications of these trends.

This paper addresses three related subject areas. The first is the total volume of personal motor vehicle travel, its recent growth, and the sources of its growth. The second subject concerns vehicle ownership, specifically, the number, types, and age distribution of motor vehicles available to households. The third subject is household vehicle utilization patterns; this section also includes a model of the determinants of household demand for private motor vehicle travel. The paper also explores the implications of changes in vehicle ownership and use for air pollutant emissions and energy consumption.

Like its predecessors, the 1995 NPTS permits a variety of useful analyses that together reveal important insights into the patterns of household motor vehicle ownership and use, as well as into the underlying behavior that produces them. The results presented here should be useful to transportation professionals seeking to understand the patterns and determinants of motor vehicle travel, as well as to planners and policy-makers in their efforts to design and implement strategies that reduce the environmental consequences of growing motor vehicle usage.

ESTIMATES OF TOTAL PERSONAL MOTOR VEHICLE TRAVEL

The 1995 Nationwide Personal Transportation Survey (NPTS) contains three different items that can be used to produce estimates of total vehicle miles traveled (VMT) in personal motor vehicles: (1) the number and usage of household motor vehicles; (2) the number of drivers and the drivers' estimates of annual mileage; and (3) the number and length of household members' trips using personal motor vehicles. This section describes each of these three types of data, explains how each can be used to construct an estimate of total driving, and compares the levels of total household vehicle travel they imply. Total VMT estimates from the different NPTS sources are reported in Table 1 and Figure 1, which also include VMT estimates from the Federal Highway Administration's *Highway Statistics 1995* for comparison.[1]

[1] Federal Highway Administration. *Highway Statistics 1995.* Washington, DC: U.S. Department of Transportation, 1996.

Table 1
VMT Estimates, 1995 NPTS and *Highway Statistics 1995*

#	Source	Universe	Type of Data	Trillion VMT
1	1995 NPTS	personal vehicles	reported by respondent	2.149
2	1995 NPTS	personal vehicles	odometer reading	2.215
3	1995 NPTS	drivers (including commercial driving)	reported by driver	2.217
4	1995 NPTS	travel period & day	trip diary	2.181
5	1995 NPTS	travel period & day & commercial driving	diary + daily commercial driving	2.279
6	*Highway Statistics 1995*	all light duty vehicles (LDVs)	state traffic counts	2.228
7	*Highway Statistics 1995*	all motor vehicles, including heavy duty	state traffic counts	2.423

Notes

1 "About how many miles was this vehicle driven [in the last 12 months/since (month/year bought or received)]? Include mileage driven by all drivers."

2 Based on comparing odometer readings at least 6 weeks apart and annualizing. Outliers removed (776 cases).

3 "About how many miles did you personally drive during the past 12 months in all licensed motorized vehicles? Include miles driven as a part of work."

4 Includes commercial trips if driver made 10 or fewer commercial trips during the travel day.

5 VMT estimate number 4 plus estimate of total miles of commercial driving for the day for those who made more than 10 commercial trips.

6 Unlike NPTS, includes vehicles not garaged at home.

7 Unlike NPTS, includes vehicles not garaged at home.

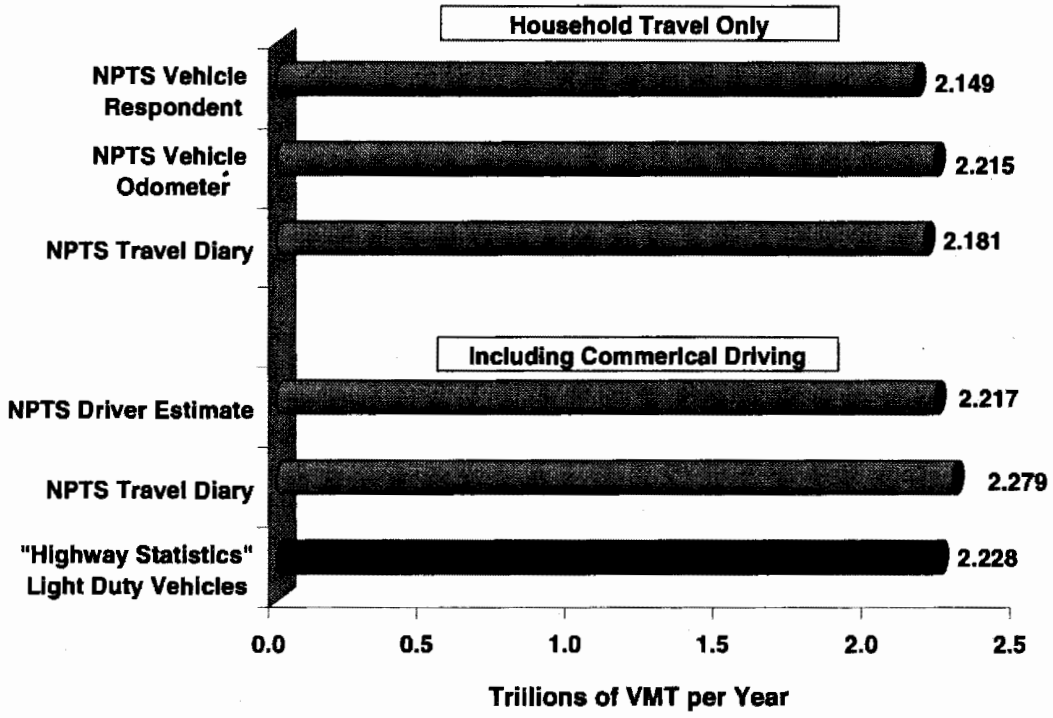
Vehicle-Based VMT Estimates

The first estimate of total VMT is based on the annual mileage driven using all household vehicles that are reported in the survey (defined as "motor vehicles owned or used by the household").[2] In the 1995 NPTS and earlier surveys, respondents were asked to estimate the total number of miles a vehicle was driven in the previous 12 months, including its use by all drivers.[3] The figure was capped at a maximum of 115,000 miles per year. The average of 12,205 miles per vehicle per year in the 1995 survey is multiplied by the 1995 NPTS estimate of the total stock of household motor vehicles (176 million) to produce the owner-reported vehicle-based VMT figure of 2.149 trillion annual VMT reported in Table 1, line 1.

[2] Although the standard errors of statistics reported in this paper were not calculated, they are probably quite small, on the order of 1% or less of the reported means, due to the extremely large sample size of the NPTS (about 40,000 households).

[3] The question asked was, "About how many miles was this vehicle driven [in the last 12 months/since (month/year bought or received)]? Include mileage driven by all drivers." Mileage estimates for vehicles owned less than 12 months were annualized during post-processing of the data.

Figure 1
Estimates of 1995 Household VMT, with and without Commercial Driving



It is likely that the self-reported VMT is measured with error, since total mileage driven by all drivers residing in a household during an arbitrary 12-month period is probably not a figure that most people keep track of. Moreover, the estimate may be biased if people tend to over- or underestimate the amount of their own driving or the amount of driving by other members of the household. The 1995 survey for the first time included paired odometer readings from which annual mileage estimates can be constructed. Odometer readings for each vehicle owned by a household were obtained for the beginning and end of a several-week period and annualized by extrapolating to their 52-week equivalent. Although usable odometer data were obtained for only about half of all household vehicles, these should provide an unbiased estimate of average vehicle use as long as the missing observations are randomly distributed. Any seasonal variation in vehicle use that might make the annualized estimates of *individual* vehicles' usage unreliable should not significantly affect the estimate of *average* annual vehicle mileage, because the survey was administered over approximately a year-long period and thus included roughly equal numbers of mileage measurements recorded during each season of the year.

Like the self-reported data, odometer readings were capped at 115,000 per year per vehicle.[4] On balance, the odometer-based estimate of annual vehicle utilization—the only one in the NPTS based on an instrument rather than respondents' recall—is likely to be more reliable than measures based on survey respondents' recall and approximations. The estimate of annual VMT per vehicle constructed from the odometer data was 12,580, about 3% greater than the self-reported estimate. The total household VMT estimate based on this figure and the previously reported NPTS estimate of 176 million household vehicles is 2.215 trillion annually, reported as line 2 of Table 1. This estimate in principle includes any commercial driving in household vehicles, but not commercial driving involving vehicles not garaged at home.

Driver-Based VMT Estimates

The second source of VMT estimates from the NPTS is derived from asking each driver in the surveyed households to estimate the total number of miles driven (as a driver, not a passenger) in the previous 12 month period.[5] Because respondents were specifically instructed to include commercial driving, i.e., miles driven as a part of work, the total VMT estimate from this source should be higher than the vehicle-based estimates because the question's scope includes *all* commercial driving, not just commercial driving in personal vehicles. The estimate was capped at 200,000 miles annually per driver (only 28 out of 65,718 valid responses exceeded this limit). The 1995 average of 12,540 miles per *driver,* multiplied by the NPTS estimate of 177 million drivers, produces the VMT estimate of 2.217 trillion reported as line 3 of Table 1. This driver-based estimate is probably subject to the same problems of measurement error and possible bias as the self-reported vehicle-based estimate.

Trip-Based VMT Estimates

A third source of VMT estimates can be constructed from the NPTS using the trip-level data recorded in household travel diaries, which are the primary source of NPTS data. The NPTS asked respondents to itemize their trips ending on the previous day (the "travel day") and also trips of 75 miles or more ending in the previous two weeks (the "travel period"). By counting only those trips where the respondent was a driver of a personal motor vehicle, average daily VMT can be estimated. The survey asked respondents who made *more than 10 daily trips* as a part of work (as a truck or taxi driver, for example) to give a separate estimate of their total daily commercial driving. The trips made by commercial drivers who made *10 or fewer trips* on the travel day were included as part of the travel day diary.

[4] This was accomplished by excluding cases where the "FLAGOUT" variable indicated that the observation was an outlier; virtually all of the outliers were cases where the odometer mileage was greater than 115,000.

[5] The question asked was, "About how many miles did you personally drive during the past 12 months in all licensed motorized vehicles? Include miles driven as a part of work."

A comprehensive estimate of total annual VMT includes the sum of all three of these components: travel day VMT, travel period VMT, and daily commercial VMT. (The 2,900 travel day trips in the sample which were recorded in both the travel day and travel period data were eliminated from the travel day VMT estimate to avoid double-counting.) The resulting annual VMT estimates are 2.181 trillion miles from the travel day and period data, and 2.279 trillion including the commercial VMT estimate; these figures are reported as lines 4 and 5 of Table 1.

Table 2 provides a detailed breakdown of the three components of the complete trip-based VMT estimates, and shows the 1990 data for comparison. The 1990 travel day trip mileage estimate reported in Table 2 was adjusted, as described below.

Comparing the NPTS Estimates

All of these VMT estimates—which are derived from completely separate sections of the survey—are surprisingly consistent with one another. As noted previously, the vehicle-based estimates should be somewhat lower than the others in that they exclude driving in non-household (i.e., corporate-owned or fleet) vehicles, some amount of which is incorporated in each of the other estimates. How do the 1995 NPTS VMT figures compare to estimates from other sources? Probably the most widely-cited estimates are those reported by the Federal Highway Administration (FHWA) in its annual *Highway Statistics* publication. The national totals are based on state VMT estimates built up from local traffic counts reported by state sources, and in some cases cross-checked with state-level fuel sales data. The vehicle-based NPTS estimate is closest conceptually to the FHWA estimate for light-duty vehicles (or "LDVs," which includes passenger cars and 4-wheel, 2-axle trucks). However, the latter includes the small amount of VMT represented by light duty vehicles not garaged at a household. The difference between the NPTS odometer reading-based estimate and the FHWA LDV estimate is less than 1%.

The *Highway Statistics* estimate of nationwide VMT for all motor vehicles (both commercial and household) during 1995 was 2.423 trillion, reported as line 7 of Table 1. This figure is approximately 6% higher than the trip-based NPTS estimate that includes commercial driving (2.279 trillion; line 5). It is not surprising that the figures for commercial driving are less closely comparable than the NPTS and FHWA estimates of household and light-duty vehicle use because the NPTS focuses largely on household travel.

Recent Growth in VMT

What is the recent trend in motor vehicle travel as reported by the NPTS? Several changes in the survey between 1990 and 1995 complicate the task of comparing VMT estimates for these two years. The basic survey method (household telephone survey) as well as the self-reported annual driving and vehicle use questions remained unchanged between the two surveys, so VMT estimates using these two sources should be directly comparable for 1990 and 1995. As shown in the total VMT estimates based on these questions each show growth of about 4% over the five-year period, which implies an annual growth rate between 0.7% and 0.9% per year. Unfortunately, it is not possible to derive an estimate of VMT *growth* from the odometer-based VMT estimate, because this method was introduced into the NPTS for the first time in 1995.

Table 2
Complete Trip-Based VMT Estimates, 1990 (adjusted) and 1995

	Travel Day Section Adjusted[1]	Adjusted Travel Day Trips[2]	Travel Period Section	Commercial Driving Section	TOTAL
1990	1,275,792	1,289,826	337,332	302,824	1,929,982
	(133,784)				
VMT/driver	7,826	7,912	2,069		11,839
1995	1,988,141	na	192,998	97,784	2,278,923
	(76,190)				
VMT/driver	11,245		1,092		12,890

[1]The numbers in parentheses are the travel estimated for overlap trips. These estimates are excluded from the travel day estimates to avoid double counting. Travel day estimates without overlap trips are referred to as the "Travel Day Section Adjusted."
[2]This figure comes from a comparison of 1990 and 1995 survey methods in a 1994 NPTS pretest; it is based on motor vehicle total distance traveled.

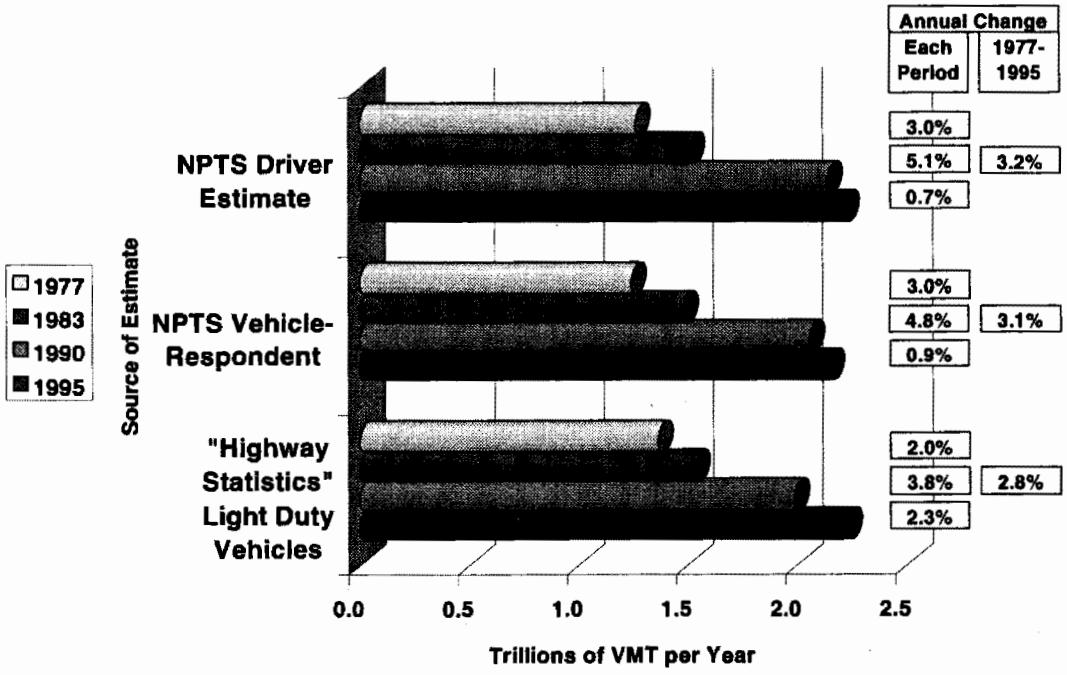
Comparing trip-based VMT estimates from the 1990 and 1995 surveys is complicated by a major change in methodology between the two. While the 1990 survey asked respondents to recall their trips from the previous day, the 1995 survey asked respondents to record all of their trips on a designated "travel day" in travel diaries which were subsequently read to survey collectors. Perhaps not surprisingly, the 1995 method recorded many more trips than the procedure employed in the 1990 and earlier surveys. The new method is likely to have greatly improved the accuracy and completeness of trip recording, since many short trips that were apparently overlooked using the recall method were recorded by the diary method. Comparing the estimate of total household personal motor vehicle travel it implies to that from the 1990 NPTS almost certainly leads to a substantial overestimate of the 1990 to 1995 growth in VMT.

Table 3
Change in VMT, 1990 to 1995: NPTS and Other Sources

Source	Universe	Type of Data	Trillion VMT 1990	Trillion VMT 1995	% change Total	% change Annual
NPTS	drivers (including commercial driving)	reported by driver	2.140	2.217	3.6%	0.7%
NPTS	personal vehicles	reported by respondent	2.058	2.149	4.4%	0.9%
NPTS *	travel period & day & commercial driving	diary + daily commercial driving	1.930	2.279	18.1%	3.4%
Highway Statistics	all light duty vehicles (LDVs)	state traffic counts	1.989	2.228	12.0%	2.3%
Highway Statistics	all motor vehicles, including heavy duty	state traffic counts	2.144	2.423	13.0%	2.5%

*The 1990 statistic was increased to account for undercounting of trips (see previous table).

Figure 2
Annual Growth Rate of VMT, 1977-1995



The 1990 NPTS trip-based estimate of total VMT is thus likely to be an underestimate, and should not be compared to the 1995 figure without adjustment to compensate for under-reporting of trips. For the 1994 pretest of the 1995 NPTS, some surveys were completed with the new method (diary) and some with the old (respondent recall), so that the effects of the change in methodology can be compared directly (a full discussion of this issue is presented in Appendix A). Adjustment factors for trips and miles traveled for all trips, motor vehicle trips (driver and passenger), and vehicle trips (driver only) were calculated based on the pretest data (shown in Appendix A, Table A-1). However, these adjustments do not account for other changes in the survey, such as the treatment of commercial driving; as shown in Table 2, the adjustment was applied only to travel-day trips, not to travel period trips or commercial driving.

The change between the adjusted 1990 trip-based VMT and the 1995 figure (18.1%, or 3.4% per year) is much greater than the driver- and vehicle-based figures reported previously.

It is important to emphasize, however, that even the adjusted 1990 trip-based VMT estimate is not completely comparable to the 1995 figure. In contrast, the questions and methods used in the driver and vehicle estimates of VMT did not change between the 1990 and 1995 administrations of the survey, so the estimates of VMT growth they produce should be more reliable. The annual growth rate implied by the *Highway Statistics* figures—2.3% annually for light-duty vehicles and 2.5% for all vehicles (see Table 2)—falls between the two very different NPTS-derived estimates.

If the driver- and vehicle-based estimates of VMT growth are taken as the more reliable figures, the NPTS data suggest that growth in total travel is slowing compared to the rapid increases recorded during the 1980s.

SOURCES OF GROWTH IN HOUSEHOLD TRAVEL

The estimates of total VMT discussed in the previous section can be divided into several individually meaningful components, in order to gain a more complete understanding of the forces producing changes in motor vehicle travel. This procedure employs a series of "accounting" identities to subdivide the different estimates of VMT into their individual arithmetic components. As an illustration, the driver-based estimate of annual VMT can be thought of as the average number of annual miles driven per licensed driver multiplied by the number of licensed drivers (second line of Figure 3).[6] Each of these two components, miles per driver and number of drivers, can be further broken down: the former into annual driving per household vehicle multiplied by the number of vehicles per driver in the household, as shown in the third line of Figure 3. The number of drivers is equal to the licensing rate (the fraction of the driving-age population actually holding drivers' licenses), multiplied by the product of the share of the population of driving age and the total population itself.

[6] One potential problem in interpreting the vehicle- and driver-based VMT estimates in this way is that the number of household vehicles and the number of licensed drivers vary throughout the year, and some arbitrary date must be chosen to count them. In effect, the NPTS sets this date individually for each surveyed household, but this is likely to be a very minor problem.

Figure 3
Components of Change in VMT, 1990 to 1995

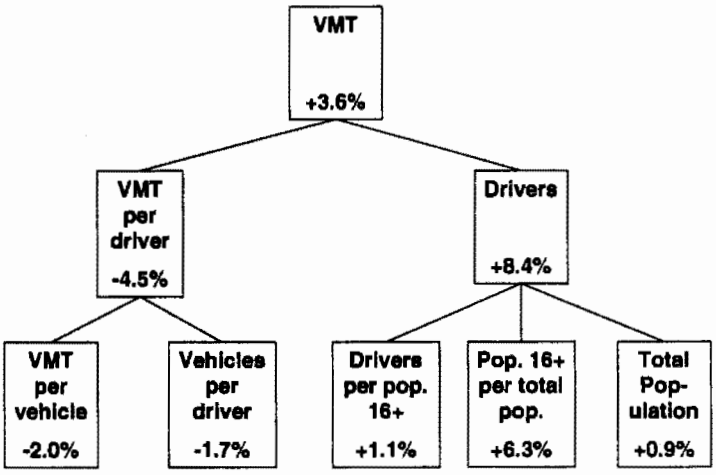


Table 4 shows estimates of each of these components constructed from the 1990 and 1995 NPTSs, as well as their percent changes over the period. Annual miles driven per licensed driver *decreased* 4.5% over this period, while the number of licensed drivers increased 8.4%, resulting in the previously reported total VMT increase of about 4%.

Annual miles driven per licensed driver decreased because each of its two components—annual driving per vehicle and the number of household vehicles owned per licensed driver—decreased, as Table 4 reports.[7] The number of licensed drivers increased because all three of its components grew, although Table 4 suggests that most of the change in the number of drivers was contributed by the increased share of the population of driving age.

Table 4
Components of VMT, 1990 and 1995

component	unit	1990	1995	% change
Population	*millions*	239.4	241.7	0.9%
Population 16+	*millions*	185.1	198.6	7.3%
Vehicles	*millions*	165.2	176.1	6.6%
Drivers	*millions*	163.0	176.8	8.4%
VMT/driver	*miles*	13,125	12,540	-4.5%
VMT/vehicle	*miles*	12,458	12,205	-2.0%
Vehicles/Driver	*miles*	1.01	1.00	-1.7%
Drivers/Pop16+	*na*	0.88	0.89	1.1%
Pop16+/Pop	*na*	0.77	0.82	6.3%

[7] The 2.0% decline in VMT per vehicle shown in Table 4 is taken from the NPTS question concerning miles driven for each household vehicle. An alternative approach, taking the NPTS estimates of VMT per driver and vehicles per driver and solving for VMT per vehicle produces a decrease in use per vehicle of 2.7%.

More detailed analysis reveals that the decline in annual VMT per licensed driver was not the result of demographic changes such as continued aging of the nation's population, since it occurred among both men and women and among most age groups. Table 5 reports that VMT per driver declined for most age and sex categories, with greater declines for the youngest drivers and for men compared to women (with the exception of women 65 and older).

Table 5*
VMT per Driver by Age and Sex

	Male			Female		
Age	1990	1995	% change	1990	1995	% change
16-19	9,543	7,543	-21%	7,387	5,985	-19%
20-34	18,310	16,921	-8%	11,174	11,074	-1%
35-54	18,871	18,029	-4%	10,539	10,637	1%
55-64	15,224	14,951	-2%	7,211	7,049	-2%
65+	9,162	9,830	7%	4,750	4,152	-13%
ALL (1)	16,536	15,685	-5%	9,528	9,257	-3%

(1) Includes drivers with unreported age.
*See Appendix B for revised numbers.

The 1990 and 1995 NPTS results reveal that the use of household vehicles (measured by annual VMT *per driver*) has not contributed to recent growth in VMT but has actually declined, both because household vehicle ownership per licensed driver and the intensity of vehicle use (annual VMT *per vehicle*) fell slightly. Instead, the primary source of the modest growth in total VMT between the two most recent surveys has been the aging of the U.S. population and the resulting increase in the number of persons of driving age. At the same time, slight increases in licensing and total population have each made small contributions to the increased number of drivers and therefore to the growth in total VMT.

Mode of Travel and Vehicle Occupancy

The demand for vehicle miles traveled ultimately derives from the demand for *person* travel. Person travel is the distance traveled regardless of mode and regardless of the number of vehicles used. Translating person miles traveled (PMT) into VMT requires knowing, first, the share of trips that are in motor vehicles, and, second, the average occupancy rate of those motor vehicle trips.

The 1995 NPTS reveals continuing slow growth in the share of trips in personal motor vehicles, considering the travel day data (not including the longer travel period trips). Table 6 shows that the share of trips in personal motor vehicles has grown from an already high 84% in 1977 to 89% in 1995. (The slight dip in the personal motor vehicle share in 1983 may be a result of differences in the definition of "other" mode trips.)

The increase in the motor vehicle share has come at the expense of walking, public transit, and school bus trips. The share of bicycle trips increased noticeably from 1990 to 1995, although starting from a very small base.

Table 6
Person Trips by Mode, 1977-1995 NPTS

	1977	1983	1990	1995	% change, 1990-95
Personal Motor Vehicle	83.9%	82.0%	87.1%	89.3%	3%
Walk	9.3%	8.5%	7.2%	5.5%	-23%
School Bus	2.8%	2.6%	2.4%	1.8%	-25%
Public Transit	2.4%	2.2%	2.0%	1.8%	-10%
Bicycle	0.6%	0.8%	0.7%	0.9%	30%
Other (1)	1.0%	3.9%	0.6%	0.6%	3%
TOTAL	100.0%	100.0%	100.0%	100.0%	

(1) Amtrak, airplane, taxi, and other. It is unclear why the figure for 1983 is higher than that of the other years. Judging from the other survey years, it seems likely that at least 3% of the 3.9% of other trips recorded are actually personal motor vehicle trips.

The person miles accounted for by the nearly 90% of all trips that are personal motor vehicle trips can be translated into VMT by dividing by average trip occupancy. The trends in vehicle occupancy are shown in Table 7. Part A of the table reveals that the number of occupants *per trip* has continued to decline. The number of single occupant trips—which since 1990 have accounted for more than two-thirds of all personal motor vehicle trips—continued to increase, albeit at a slower rate than that found between earlier surveys. The number of trips with two and four or more persons continued to decline, but in a reversal of the prevailing trend, the number of three person trips increased slightly.

Another way of measuring vehicle occupancy is to consider the number of person miles per vehicle mile. This gives an average occupancy rate weighted by trip distance. Part B of Table 7 shows the average occupancy by trip purpose calculated from each NPTS since 1977. The latest survey reveals that the trend toward lower average vehicle occupancy has slowed, but not disappeared. Declining occupancy rates and a higher share of trips in personal vehicles both indicate that more personal motor *vehicle* miles are required to meet the same underlying demand for *person* miles. Viewed another way, these trends imply that person miles have grown at even slower rates than the modest growth in vehicle miles noted previously.

Table 7
Vehicle Occupancy, 1977-1995 NPTS

A. Percent of Vehicle Trips by Number of Occupants

	Number of Occupants				
	1	2	3	4 or more	TOTAL
1977	59.6%	24.7%	8.3%	7.4%	100.0%
1983	65.7%	21.5%	7.4%	5.4%	100.0%
1990	67.1%	21.6%	6.5%	4.8%	100.0%
1995	68.4%	20.2%	6.9%	4.5%	100.0%

B. Vehicle Occupancy by Trip Purpose (Person Miles/Vehicle Mile)

	Trip Purpose					
Survey Year	Work or Work-Related	Family or Personal Business	School or Religious	Social or Recreational	TOTAL (1)	Annual % change
1977	1.32	2.02	1.95	2.44	1.89	
1983	1.32	1.80	2.08	2.12	1.75	-1.3%
1990	1.16	1.78	1.67	2.08	1.64	-0.9%
1995	1.15	1.76	1.68	2.05	1.59	-0.6%

(1) Includes other and unknown purposes.

Trip Length and Trip Frequency

The "travel day" data permit the calculation of trip making rates (trips per capita) and average trip length. The product of these two factors is, of course, total distance traveled. As shown in Part A of Table 8 the travel day data produce a *vehicle* trip rate in 1995 of 2.6 trips per person per day and an average vehicle trip length of 8.99 miles.

For person trips (all modes, including passengers), the rate was 4.4 trips per person per day and the average length was 8.78 miles. Multiplying trips per day by the average trip length gives an estimate of travel distance per person per day.

As a check of the consistency of the data, one can convert vehicle miles traveled (PMT) into person miles traveled (PMT), as shown in Part B of Table 8. Vehicle miles per day are multiplied by average vehicle occupancy to produce person miles in motor vehicles. The result is then divided by the share of mileage in personal motor vehicles to produce an estimate of VMT. The result, about 40 miles per day, is very consistent with the estimate taken directly from the travel day data.

Table 8
Person and Vehicle Trips and Mileage

A. Trip Rates and Trip Length

Type of Trips	Mean Number per Day	Mean Length	Mean Total Miles per Day
Person	4.4	8.99	39.6
Vehicle	2.6	8.78	22.8

B. Converting VMT to PMT

I	Vehicle miles per day	22.8
II	Occupancy (vehicle miles/person miles)	1.54
III	Person miles in motor vehicles (I x II)	35.2
IV	Share of person miles in motor vehicles	88.1%
V	Person miles (III / IV)	39.9

The introduction of the travel diary method in the 1995 survey increased the completeness of trip reporting. However, this change in methods means that trip rates cannot be compared between the 1995 and earlier surveys. Adjustment factors can be estimated from the previously discussed 1994 pretest of the 1995 NPTS (see Appendix). However, these adjustment factors do not appear to fully account for all of the changes in survey methods introduced in 1995. For example, in 1995 commercial travel was included in the travel day count if the respondent made fewer than 10 commercial trips per day, while the 1990 figures exclude commercial driving. Because of the lack of data comparability, the trends in trip rates and trip distance are not discussed here, and, in fact, cannot adequately be measured using the 1995 NPTS.

HOUSEHOLD VEHICLE OWNERSHIP

The 1995 NPTS also reveals continuing changes in the number and types of vehicles owned by U.S. households. Two major developments identified by the survey—both of which have been visible for at least two decades—are the trend toward nearly ubiquitous vehicle ownership among U.S. households, and the increasing number of households owning multiple vehicles.

A more recent development highlighted by the 1995 NPTS is the increasing substitution of vehicles classified as light-duty trucks—pickup trucks, vans, and sport/utility vehicles (SUVs)—for automobiles in providing household transportation, although the substitution of pickup trucks for automobiles both significantly predates that of other types of light trucks and displays a markedly different geographic pattern.

Changing Vehicle Ownership Levels

Table 9 reports changes in the distribution of U.S. households among vehicle ownership categories as reported by the 1977, 1983, 1990, and 1995 NPTSs. It also reports changes in the average number of vehicles owned by all households and in the average number of household members of drivers' license-eligible age (16 and older).[8] As the table indicates, the fraction of households owning no vehicles declined sharply over this period, while the proportion of households owning only one vehicle fell slightly; in contrast, the percentages of households owning two and three or more vehicles rose significantly. Thus during 1977, the number of carless households almost exactly equaled the number owning three or more vehicles, yet by 1995 the number of three-plus vehicle households was more than *twice* as large as the number without vehicles.

Table 9
Household Motor Vehicle Ownership

Statistic	1977	1983	1990	1995
% of households owning:				
0 vehicles	15.3%	13.5%	9.2%	8.1%
1 vehicles	34.6%	33.7%	32.8%	32.4%
2 vehicles	34.4%	33.5%	38.4%	40.4%
3+ vehicles	15.7%	19.2%	19.5%	19.1%
Average number of vehicles owned per household	1.59	1.68	1.77	1.78
Average number of household members 16 years or older	2.10	2.06	1.98	2.01
Vehicles per household member 16 years or older	0.76	0.82	0.89	0.89

Interestingly, these seemingly large changes in the distribution of households among vehicle ownership categories were translated into only modest growth in average household vehicle ownership. As Table 9 reports, the average number of vehicles per household rose from 1.59 during 1977 to 1.78 in 1995, an increase of only about 12% over a period spanning nearly two decades.

[8] The number of license-eligible household members is used in this analysis because the number of licensed drivers per household is so closely related to the average number of household vehicles. This suggests that the decision by a household member to obtain a driver's license is not separable from the household's decision to acquire an additional vehicle.

At the same time, however, the average number of household members of license-eligible age fell by about 4%, as the effect of continuing declines in household size offset that of the aging of the "baby-boom" generation. Thus as Table 9 also shows, the number of vehicles per household member of driving age increased from 0.76 in 1977 to 0.89 (or by 17%) during 1990, where it remained in the 1995 survey.

The Increasing Role of Light Trucks

As indicated previously, a major change in the composition of the household vehicle fleet has been the increasing substitution of light-duty trucks for automobiles Table 10 reports the distribution of household vehicles by type.[9] As it indicates, passenger automobiles represented only about 65% of household vehicles during 1995, a significantly lower share than the more than 71% they represented only five years earlier.

Table 10
Household Vehicles by Vehicle Type, 1990 and 1995 NPTS

	1990		1995		% change
Vehicle Type	**Frequency**	**Percent**	**Frequency**	**Percent**	**1990-95**
Passenger Car	117,521,164	71.2%	113,284,291	65.2%	-4%
Sport/Utility (1)	5,853,590	3.5%	12,154,709	7.0%	108%
Van	8,978,441	5.4%	13,810,102	7.9%	54%
Pickup	28,373,539	17.2%	31,110,105	17.9%	10%
Other Truck	965,717	0.6%	695,829	0.4%	-28%
RV	871,478	0.5%	924,122	0.5%	6%
Motorcycle	2,188,659	1.3%	1,658,514	1.0%	-24%
Other	350,958	0.2%	148,884	0.1%	-58%
Total, Type Known	165,103,546	100.0%	173,786,555	100.0%	5%
Unknown (2)	117,280		2,280,102		
TOTAL VEHICLES	165,220,826		176,066,657		7%
Total Light Trucks	44,171,288	26.7%	57,770,744	32.8%	31%

(1) 1990 NPTS retabulated using 1995 definition of sport/utility vehicles (SUV).

(2) "Don't know" and "refused."

In contrast, SUVs represented 7% of household vehicles in 1995, exactly double their representation among household vehicles during 1990, reflecting the particularly rapid growth in SUV purchases during recent years. The role of passenger vans also increased during this period, as the table shows, while that of pickup trucks—the earliest light truck models to be purchased on a widespread basis for passenger transportation—remained approximately stable.

[9] Unlike the 1995 NPTS, the 1990 version did not include a category for sport/utility vehicles (SUVs) in its vehicle type classification. The SUV category was recreated for this paper by using the SUV vehicle make and model codes from the 1995 survey to identify SUVs in the 1990 sample.

Because the nation's household vehicle fleet grew during the period covered by Table 10 these relatively modest changes in the *proportions* of vans, SUVs, and pickup trucks obscured significant increases in their absolute *numbers*. The number of vans owned by households increased by nearly 5 million over the five-year period between administrations of the NPTS, the number of SUVs by more than 6 million, and the number of pickups by nearly 3 million. In contrast, the number of passenger cars actually *declined* during this period, suggesting that households were replacing older automobiles with new SUVs and vans. Thus in total, the number of light trucks owned by households grew by a third from 1990 to 1995.

Growth in the newest styles of light trucks—SUVs and minivans—was considerably greater than that of pickups, but even the latter was more rapid than that of passenger cars. These differential growth rates meant that light duty trucks accounted for more than one-third of the fleet for the first time in 1995. Recent sales figures suggest that the effect of this shift from conventional automobiles to trucks on the composition of the household vehicle fleet may not yet have peaked, since trucks represent almost 45% of all light-duty vehicles being sold as of this writing. Among the various classes of light trucks, sport-utilities have recently exhibited the strongest sales growth: compared to a year earlier, September 1997 sales were *down* 2.5% for pickups, but up 1.3% for vans and 13.7% for sport/utility vehicles.[10] However, some of the new SUV buyers are former truck owners rather than former car owners, implying that the substitution of trucks for cars may be slowing.

Geographic Patterns of Vehicle Ownership

Differences in household vehicle ownership patterns by Census Bureau regions (shown in Figure 4) and by metropolitan area size reveals some variation in the relative importance of these different vehicle types. As Part A of Table 11 reports, automobiles represent more than 70% of household vehicles in the Northeast, but only about 61% in the West, with the figures for the North Central and South between these extremes but closer to the lower West value.

[10] Figures from Automotive News Data Center, reported in John Couretas, "Sport-Ute Stampede." *Automotive News*. 10/13/97, p. 1i.

Table 11
Type of Vehicle by Census Region and MSA Size

A. Percent Distribution of Fleet by Census Region

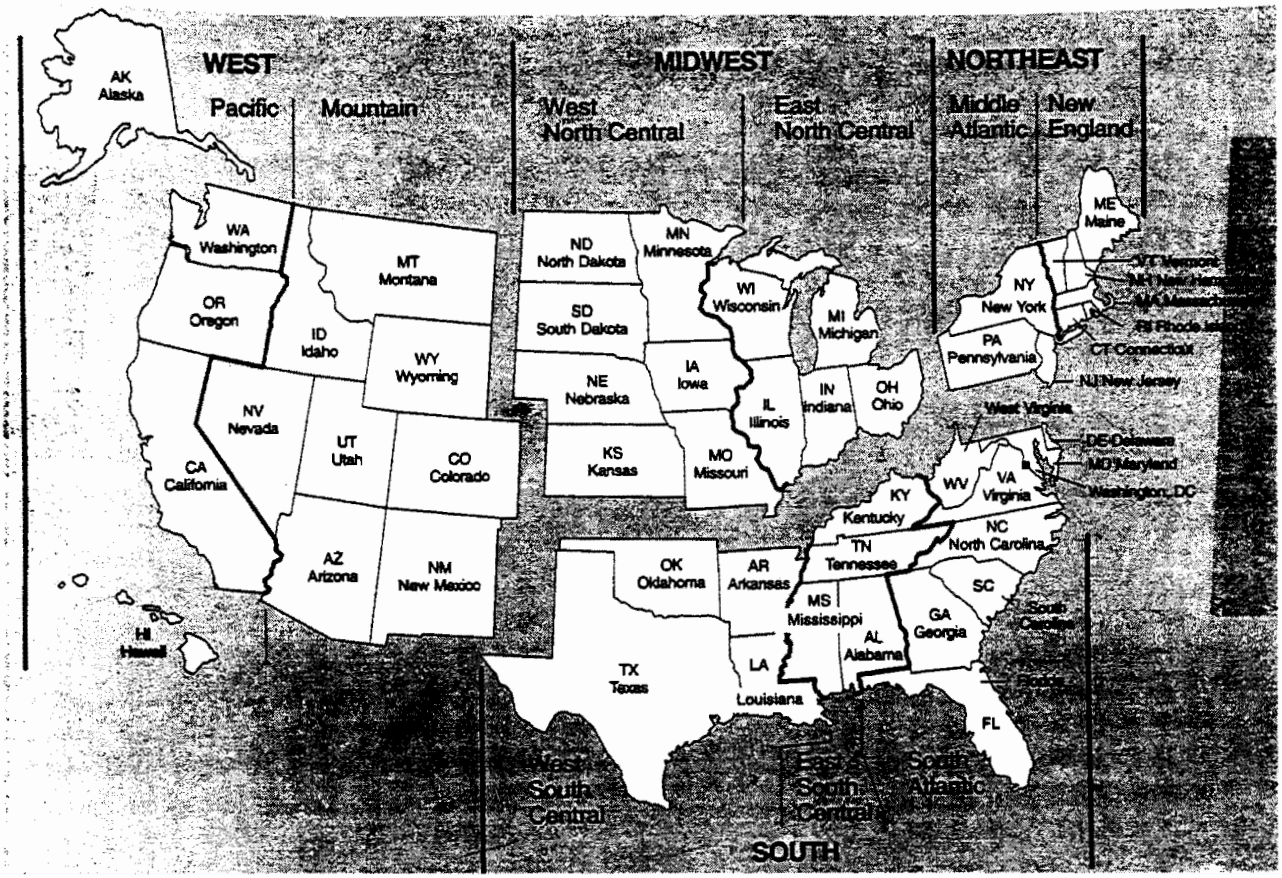
	Northeast	North Central	South	West	USA
Auto	70.8	64.8	62.8	61.3	64.3
Van	7.6	9.1	7.6	7.0	7.8
Sport Utility	7.6	5.9	6.6	8.0	6.9
Pickup	11.2	16.9	20.2	19.5	17.7
Other*	2.8	3.3	2.8	4.2	3.3
TOTAL	100.0	100.0	100.0	100.0	100.0

B. Percent Distribution of Fleet by MSA Size

	Not in MSA	<0.25 mil	.25 -.50 mil	.5 - 1 mil	1-3 mil	3 mil +	USA
Auto	54.8	61.4	62.7	65.6	66.2	70.0	64.3
Van	6.9	7.3	8.5	8.1	8.1	8.2	7.8
Sport Utility	6.6	6.9	7.0	6.8	6.9	7.1	6.9
Pickup	27.9	21.5	18.4	16.8	15.6	11.6	17.7
Other*	3.8	2.9	3.4	2.7	3.2	3.1	3.3
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*Includes other trucks, motorcycles, RVs, and other.

Figure 4
U.S. Census Divisions and Regions



The mix of other vehicle types owned by households varies in a relatively complex pattern among regions: the proportion of household vehicles that are passenger vans varies significantly from its national figure (7.8%) only in the North Central region (where it exceeds 9%), while the fraction of SUVs exceeds its national norm (although only modestly) in both the Northeast and West. In contrast, the role of pickup trucks in household vehicle holdings varies substantially among regions: pickups represent slightly more than one in ten household vehicles in the Northeast, but account for one in six vehicles in the North Central region and as many as one in *five* vehicles in both the South and West.

As Part B of Table 11 reveals, the distribution of household vehicle types varies far more among city sizes and between urban and rural areas than among geographic regions. In fact, it seems likely that much of the regional variation shown in Part A of the table is "explained" by different degrees of urbanization and varying city size distributions among the nation's different regions. As is the case among regions, however, most of the variation in different vehicle types' representation reflects substitution between automobiles and pickup trucks, since there is relatively little variation in the shares of vans and SUVs about their national proportion among urban area sizes and between urban and non-urbanized areas.

Part B shows that in the nation's largest metropolitan areas, automobiles represent 70% of household vehicles, with pickups accounting for less than 12%, and the remainder divided roughly equally between vans and SUVs. In small urban areas (those under 250,000 population), however, the automobile share falls to about 61%, while that of pickups rises to more than 21%.

This pattern continues outside metropolitan areas, where automobiles decline to only about 55% of household vehicles, and where the van and SUV shares also decline slightly compared to even the smallest urban areas. In non-urban areas, pickups increase to nearly 28% of household vehicles, presumably reflecting their adaptability to the various non-passenger transportation functions that household vehicles are more commonly required to perform in rural areas.

AGING OF THE VEHICLE FLEET

The 1995 NPTS reveals a pronounced acceleration of the aging of the household vehicle fleet that first became apparent with the 1983 NPTS.[11] As Table 12 reports, the average age of all vehicles owned by U.S. households increased sharply—from 5.6 to 7.6 years—between the 1977 and 1983 surveys but remained nearly constant (rising only to 7.7 years) until 1990, before rising to 8.3 years by 1995. Not surprisingly, the pattern was similar for automobiles (since they represent the bulk of household vehicles): their average age increased markedly between 1977 and 1983, only slightly between 1983 and 1990, and again rapidly through 1995. The average age of household light-duty trucks showed a slightly different pattern, declining significantly between 1983 and 1990 before increasing again by 1995.

[11] There is no unambiguously "correct" way to translate the distribution of vehicle model years recorded by the NPTS into a fleet average vehicle age. The NPTS surveys households over a period of several months which typically includes more than one calendar year. Because of the difference between calendar year and model year, it is not obvious how to code vehicle ages. This paper uses the average ages shown in the *1990 NPTS Databook, Volume 1*, p. 3-40 (US DOT, Federal Highway Administration, 1993) for the 1977 to 1990 data. The 1995 figures were calculated in a manner consistent with the 1990 data. The most recent model year vehicles (1996, and a very few 1997 vehicles) were assigned an age of 1. One-year old vehicles (model year 1995) were also coded with an age of 1. Model year 1994 vehicles were given an age of 2, model year 1993 vehicles were given an age of 3, and so forth.

Table 12
Vehicle Age by Type

	1977	1983	1990	1995	% change, 1977-1995
Passenger Car	5.5	7.2	7.66	8.23	50%
Truck/Van (1)	6.4	8.8	7.95	8.33	30%
Van	na	na	5.88	6.68	
Sport Utility	na	na	6.42	6.58	
Pickup	na	na	8.41	9.62	
Total Fleet (2)	5.6	7.6	7.70	8.32	49%

Annual Percentage Change

	1977-1983	1983-1990	1990-1995
Passenger Car	4.6%	0.9%	1.4%
Truck/Van (1)	5.5%	-1.4%	0.9%
Total Fleet (2)	5.2%	0.2%	1.6%

(1) Van, SUV, pickup, and other trucks available to the household.

(2) Includes recreational vehicles.

While average ages for individual light truck classes (vans, SUVs, and pickups) are not available for the 1977 and 1983 surveys, their aging patterns seem likely to differ markedly over the period covered by Table 12. Pickups probably showed continuing increases in average age from 1977 through 1990, while vans—which increased rapidly in popularity during the late 1980s—were probably slightly "newer" on average during 1990 than 1983, but have aged slightly since then. SUVs, which were first introduced in the late 1970s but became widely popular only during the 1990s, probably aged the least rapidly during this period. These differing patterns of variation in average age among vehicle classes appear to reflect the increasing substitution of first mini-vans and subsequently SUVs for conventional passenger automobiles.

Changes in the Age Distribution of Household Vehicles

The aging of the fleet is more readily apparent in Figure 5, which displays the age distribution of the nation's household vehicle fleet for each of the four NPTS years. As it shows, the number of new vehicles (those up to two years old) owned by U.S. households during 1995—approximately 28.5 million—was only slightly greater than the comparable figures for 1983 and 1990, and sharply *below* its number during 1977, despite continued expansion of the total household vehicle fleet throughout this period. The number of 3-5 year-old vehicles declined significantly in the 1995 survey, after rising steadily from 1977 through 1990.

At the other end of the age distribution, the number of 6-9 year-old vehicles—which had declined for the first time during the 1990 survey—increased significantly by 1995, while the size of the oldest vehicle age cohort (those 10 or more years old) continued the rapid growth revealed by previous surveys. Thus by 1995, vehicles that were 10 or more years old accounted for more than one-third of all household vehicles.

Figure 5
U.S. Household Vehicle Fleet by Age Category, 1977-1995

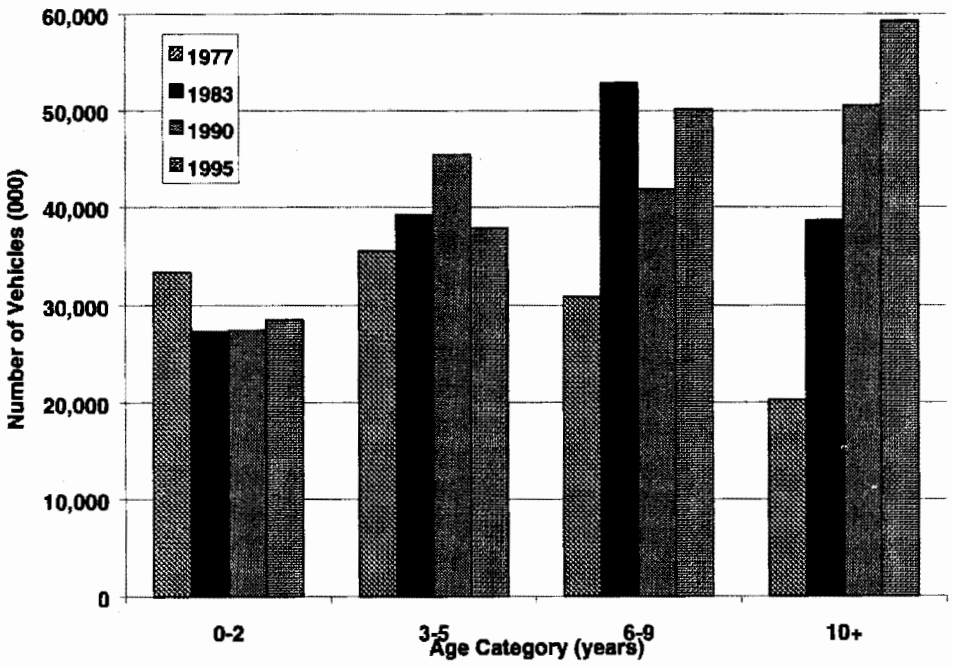
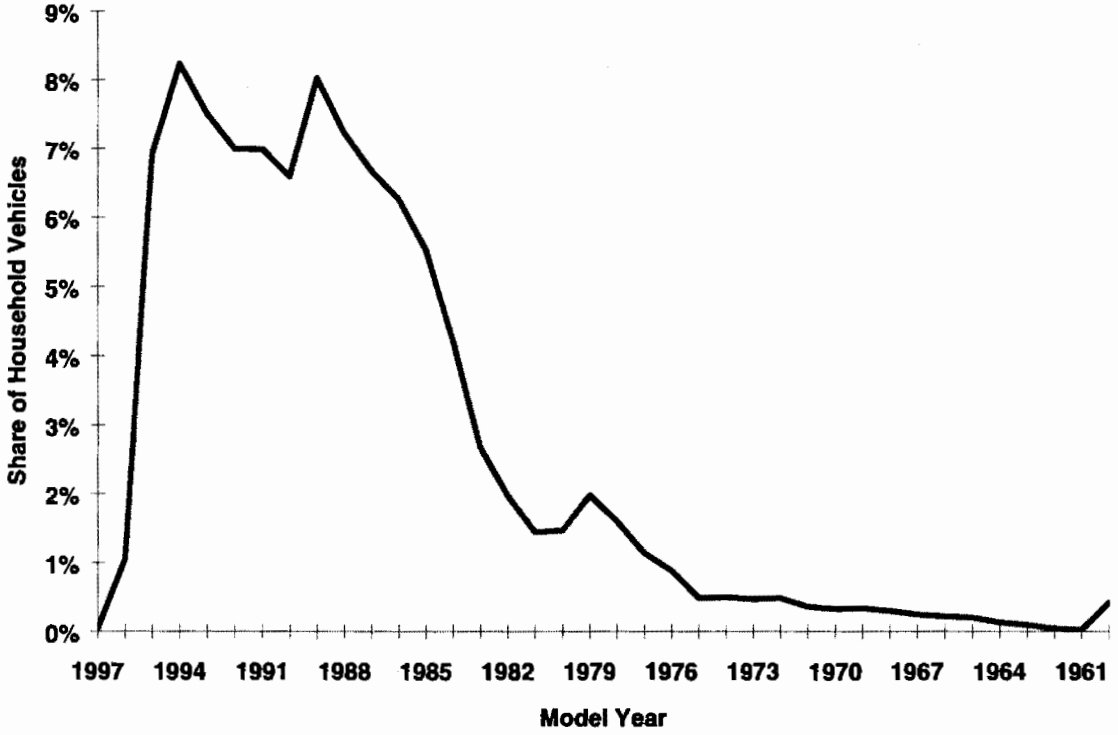


Figure 6 displays the distribution of household vehicles by model year derived from the 1995 NPTS. At the time of the survey, some model-year 1996 (and a very few model-year 1997) vehicles had already entered the fleet, reflecting manufacturers' custom of offering vehicles of a given model-year designation for sale during the latter months of the previous calendar year, while the 1995 model year was probably not yet fully absorbed into the fleet. The irregularities in Figure 6 show the effects of variation in new-vehicle sales patterns during the recessions of 1980-82 and 1990-92 and the ensuing economic recoveries.

Figure 6
Distribution of Household Vehicles by Model Year



However, these relatively minor variations are superimposed on a pattern composed of approximately equal representation—between 6% and 8% of total household vehicles—of the ten most recent model years, followed by rapidly declining presence of preceding model years. The few vehicles remaining in the fleet at age twenty—at the time of the 1995 survey, those manufactured in model years 1976 and earlier—appear to remain in the fleet and be retired only very slowly, as the extremely long "tail" of the model year distribution in Figure 6 shows.

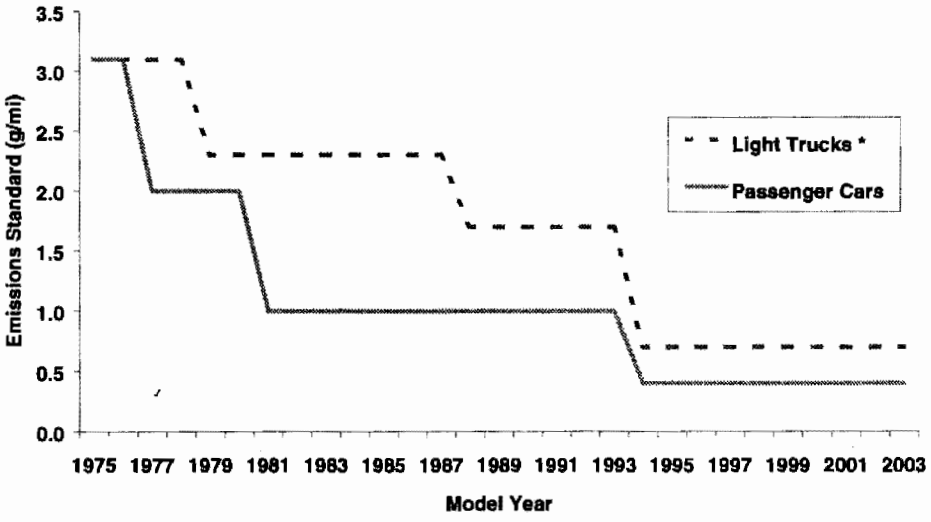
The Underlying Causes of Fleet Aging

The continued aging of household vehicles is undoubtedly a complex phenomenon, but a few of its contributing factors seem readily apparent. The most commonly emphasized of these is the increasing durability of new vehicles manufactured in more recent model years, which has raised the "life expectancy" of vehicles recently entering the household fleet and improved the quality of transportation services they provide when older.

Less frequently noted, but perhaps more important, has been the combined effect of rising household demand for personal motor vehicle travel—itself a product of factors including rising incomes, declining household sizes, increasing participation in the labor force by women, and continuing decentralization of metropolitan areas—with sharply increasing prices for new vehicles relative to those for used models.

This combination of factors has led households to expand their vehicle ownership levels, as revealed previously by Table 9 but increasingly to do so by retaining older vehicles as a substitute for purchasing newer ones. As a result, the progressively tighter safety, fuel economy, and emissions standards that passenger vehicles are required to meet have—by raising prices for new vehicles—slowed "turnover" of households' vehicle holdings and thus been incorporated into the nation's vehicle fleet more slowly than originally anticipated. Since these standards have typically been more stringent for automobiles than for light trucks, this mechanism may also have contributed to the increasing substitution of vans and SUVs for conventional automobiles in households' vehicle-purchasing decisions.

Figure 7
EPA NOx Emissions Standards for Passenger Cars and Light Trucks



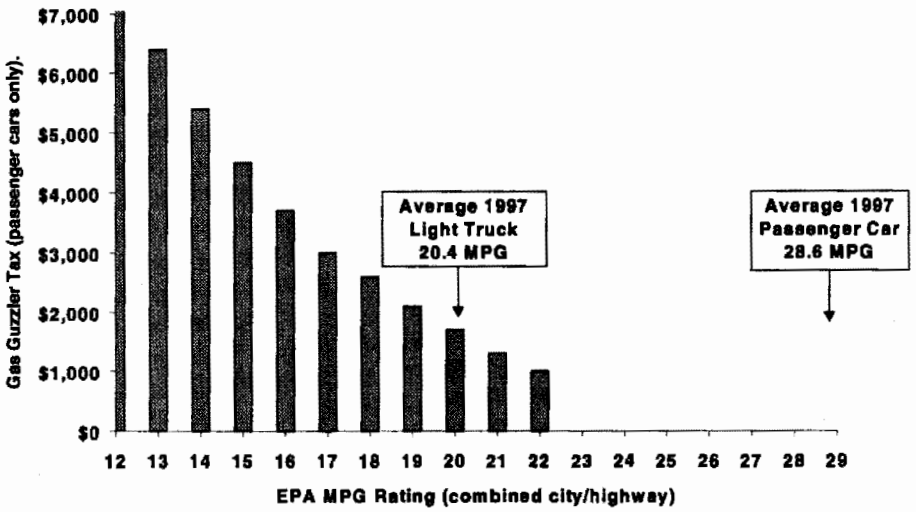
*From 1994 onwards, standards shown are for best-selling weight class of light trucks.

Only the smallest of the four categories of light trucks is now required to meet the same air pollutant emission standards as are automobiles, with larger light trucks subject to progressively less stringent standards. Prior to the 1994 model year, permissible emissions rates for NOx, for example, were consistently higher for light trucks than for passenger cars, and are still more lenient for the best-selling categories of light trucks (see Figure 7. In a similar vein, vehicle manufacturers are required to meet Corporate Average Fuel Economy (CAFE) standards of 27.5 MPG for automobiles, but only 20.7 MPG for their light truck models. Light trucks are also exempt from the federal "gas guzzler" tax imposed on automobiles that fail to meet minimum fuel efficiency levels.

The actual sales-weighted fleet average fuel efficiency for passenger cars and light trucks of the 1997 model year are shown in Figure 8 This figure also shows the schedule of gas guzzler taxes. The average 1997 light truck would owe a gas guzzler tax of $1,700 if it were considered a passenger car.

These differences in regulatory standards allow manufacturers to meet vehicle buyers' demands for comfort and performance at lower costs for light trucks than for automobiles, while restricting their ability to offer automobiles with interior volumes and carrying capacities comparable to light truck models. Thus the more lenient regulatory treatment of light trucks may itself have contributed to their growing popularity as automobile substitutes.

Figure 8
Gas Guzzler Tax Schedule and Fleet Average MPG for Passenger Cars and Light Trucks



Ownership of Pre-1981 Vehicles

Because federal standards for air pollutant emissions by automobiles were tightened dramatically over the 1980 and 1981 vehicle model years, the number of pre-1981 vehicles remaining in the nation's fleet has important implications for efforts to comply with federal air quality standards. Policies that seek to reduce the number of pre-1981 vehicles in service or to curtail their use may have beneficial air quality impacts. However, there is concern over the potential impact of such policies on low-income households, who are more likely to own older vehicles. The 1995 NPTS indicates that approximately 8.6% of household vehicles—or some 6.7 million vehicles in total—were manufactured before model year 1981. As Table 13 reports, households with annual incomes under $25,000 own nearly a third of the remaining pre-1981 vehicles, while those with moderate incomes (between $25,000 and $50,000 annually) own another 37% of model year 1981 and older vehicles.

Table 13
Pre-1981 Vehicles and Household Income

Household Income	% of Pre-1981 Vehicles Owned by Income Class	% of Vehicles Owned by Income Class that are Pre-1981
< $25,000	32.2%	15.1%
$25,000 to $50,000	37.3%	9.0%
$50,000 to $75,000	12.4%	6.1%
$75,000 and more	5.9%	3.6%
refused	12.2%	7.2%
TOTAL	100.0%	8.6%

However, Table 13 reveals that pre-1981 vehicles represent only 15% of all vehicles owned even among households in the lowest income category. This proportion declines to 9% in the moderate-income category, and to only 4-6% for households with annual incomes above $50,000. Thus while older vehicles may play a critical role in meeting the transportation demands of some *individual* households, their overall importance in the vehicle ownership patterns of even the nation's lowest-income households is limited. Since nearly 85% of vehicles owned by low-income households are from 1981 or more recent model years, measures aimed at retiring or limiting the use of pre-1981 vehicles may thus have an impact on fewer low-income households than is commonly supposed.

PATTERNS OF VEHICLE UTILIZATION

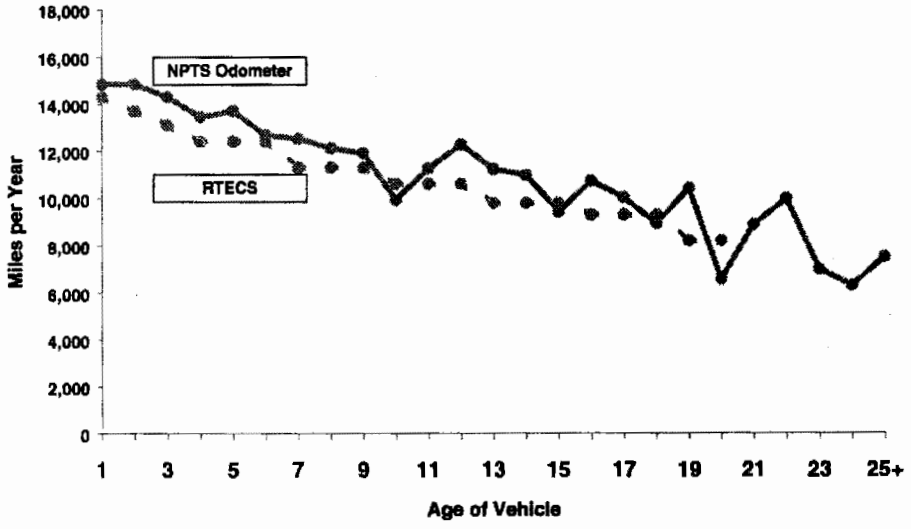
The implications of continued aging of the household vehicle fleet for transportation safety, urban air pollution, and energy consumption depend not only on its age distribution, but also on the pattern of households' utilization of vehicles of different ages. Specifically, if utilization declines rapidly with vehicle age, then the effects of progressively tighter safety, emissions, and fuel efficiency standards for new vehicles will be felt rapidly, while if older vehicles are used nearly as intensively as newer ones, the effects of these measures will require many more years after they are adopted to be felt. The gradual retirement of vehicles of each model year entering the fleet as they age and the changing rates at which vehicles accumulate mileage with increasing age interact to determine the distribution of total household VMT across vehicles of different ages, and the 1995 NPTS—like its predecessors—reveals important information about each of these effects.[12]

[12] Lave has suggested that the customary "model" of individual vehicles' gradually declining utilization with increasing age that is suggested by cross-sectional analysis of the vehicle age distribution and mileage accumulation rates may be misleading, or at least incomplete (see Charles A. Lave, "State and National VMT Estimates: It Ain't Necessarily So," unpublished paper, Department of Economics, University of California, Irvine, January 1994). He argues that an entirely different process may be at work, wherein households with high travel demands purchase new vehicles frequently and "wear them out" quickly, while households with low travel demands satisfy them by purchasing new vehicles infrequently and retaining them for longer periods. Assuming some distribution of household travel demands, this process would produce exactly the same fleet age and mileage accumulation patterns revealed by the 1995 NPTS and its predecessors. In fact, both of these models are probably at work within the household vehicle fleet simultaneously, although their relative contributions to the patterns revealed in the data are

Annual Utilization by Vehicle Age

Figure 9 shows the pattern of estimated annual usage of household vehicles of different vintages derived from the 1995 NPTS, calculated from the sub-sample of vehicles for which odometer readings were obtained. Similar figures from the U.S. Department of Energy's Residential Transportation Energy Consumption Survey (RTECS), last conducted in 1994, are shown in the figure for comparison purposes.[13] As it reveals, the four newest model years (1992-95 at the time of the 1995 NPTS) in the household vehicle fleet are utilized extremely intensively, averaging approximately 15,000 miles annually. Surprisingly, vehicles from ages five to ten years (model years 1991-1986 in the 1995 NPTS) are driven nearly as much, averaging 12,000-13,000 miles annually, and it is not until approximately age 15 and beyond (model years 1981 and previous) that annual utilization drops consistently below the 10,000-mile annual threshold.

Figure 9
Annual Utilization by Age from the 1995 NPTS and the 1994 RTECS



While the small samples of vehicles older than 15 years from which odometer readings were obtained produces considerable variation in the average utilization of individual age cohorts, it appears that annual usage reaches a "floor" of approximately 8,000 miles annually even among the oldest vehicles remaining in the household fleet. The 1994 RTECS data show slightly lower travel overall, but in a pattern that is very consistent with the 1995 NPTS figures.

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difficult to assess. In any case, they have similar implications for the effects of fleet turnover on the age distribution of VMT and on problems such as safety, air pollution, and energy consumption.

[13] The data are from the Energy Information Administration, U.S. Department of Energy. *Household Vehicles Energy Consumption 1994*. US DOE, August 1997. DOE/EIA-0464(94).

The distribution in Figure 5 implies an average annual utilization of slightly less than 12,600 miles for household vehicles of all ages and types, a figure generally consistent with those reported by other sources.[14]

The Distribution of Household VMT by Vehicle Age

Figure 10 combines the age distribution of household vehicles (Figure 5) with the pattern of usage by vehicle age (Figure 9) to produce the distribution of total household VMT driven by vehicles of different model years (and thus ages) during 1995. As it indicates, the effect of declining average utilization with increasing vehicle age accentuates the "newness" of the fleet age distribution—that is, the tendency for the newest model years account for the bulk of household vehicles—thereby causing an even larger share of total VMT to be driven in new vehicles than their representation in the fleet would suggest. Thus nearly 50% of all household VMT during 1995 and 1996[15] was driven by vehicles manufactured during model years 1990 to 1996 (described as vehicles of ages 0 to 6), with the remainder accounted for by vehicles of model years 1989 and earlier.

NPTS Compared to MOBILE

State and local transportation and air quality agencies are required to use the U.S. Environmental Protection Agency's MOBILE5.1 vehicle emissions model in estimating the effectiveness of locally-adopted measures to reduce motor vehicles' air pollutant emissions. Since vehicles manufactured during different model years were required to meet different emission standards, one of the critical assumptions affecting MOBILE's estimates of average emissions per vehicle-mile is the relationship of average annual utilization to vehicle age. Figure 9 shows that according to the 1995 NPTS, a significantly larger fraction of light-duty VMT is accounted for by older vehicles (particularly those manufactured before model year 1981) than MOBILE assumes.[16] This difference arises primarily because the "mileage accumulation" curve suggested by the 1995 NPTS (Figure 9) is considerably "flatter" than that employed by MOBILE5.1, which assumes that average annual utilization of light-duty vehicles declines to less than 5,000 miles by the time they reach age 10.

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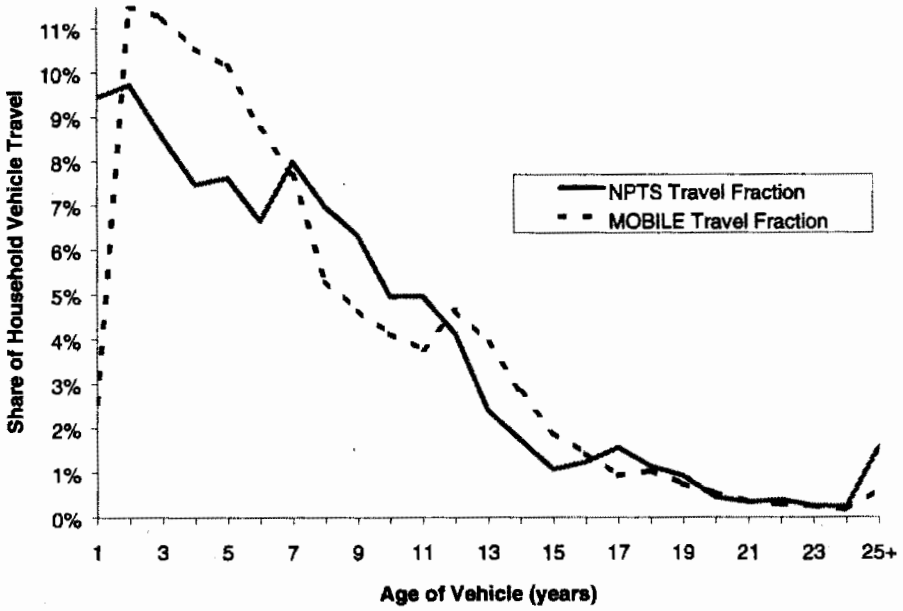
[14] For example, FHWA's *Highway Statistics 1995* reports average annual mileage of 11,489 for automobiles plus two-axle, four tire trucks, a group that corresponds roughly to the definition of household vehicles employed in the NPTS; see Table VM-1, p. V-92. However, this estimate is based on total VMT divided by the size of the vehicle fleet. The latter tends to be overestimated in the state registration data used by FHWA because it double-counts vehicles that are sold or moved between states and thus registered twice during the same year. Compared with survey data produced by R.L. Polk, the FHWA vehicle stock estimate appears to be too large by approximately 10%. Adjusting VMT per vehicle by this amount produces an estimate – 12,638 miles per vehicle during 1995 – which is extremely close to the 1995 NPTS estimate reported here.

[15] The survey was administered between May of 1995 and July of 1996.

[16] MOBILE's data on vehicle utilization by age are based on the 1984 National Vehicle Purchase Diary, updated to reflect changes in average vehicle utilization between 1984 and 1990 reported in FHWA's Highway Statistics.

Figure 10
NPTS and MOBILE Travel Fractions Compared



As a result, using the model may be leading transportation and air quality planners to overestimate the effectiveness of measures that reduce new vehicles' per-mile emissions rates, while underestimating the effectiveness of strategies designed to reduce those of the entire in-use fleet or of older vehicles in particular.[17] Since the MOBILE-based estimates of such measures' effectiveness are used both to select emissions control measures and to assess' localities progress in meeting the emission reduction targets that are necessary for them to comply with federal air quality standards, this difference may have important policy implications. EPA is currently revising the MOBILE model. The new version will incorporate more recent data on the composition and usage of the vehicle fleet.

Annual Utilization by Vehicle Type

Table 14 compares average annual vehicle-miles driven in different types of household vehicles, again computed from the sub-sample of household vehicles from which odometer readings were obtained as part of the 1995 NPTS. As it indicates, automobiles tend to be driven slightly less than the overall average for all household vehicle types—about 12,000 miles annually, or roughly 5% less than the 12,600 figure for all vehicle types. In contrast, light-duty trucks are typically driven considerably more than the conventional automobiles for which they increasingly substitute, as Table 14 shows: vans average nearly 15,000 miles annually, SUVs almost 14,000, and pickup trucks over 13,000 miles per year.

[17] For a detailed analysis of one such measure, see Elizabeth Deysher and Don Pickrell, "Estimating Emissions Reductions from Vehicle Retirement Programs," *Transportation Research Record*, forthcoming.

Table 14
Mean Vehicle Age and Mean VMT by Vehicle Type

Vehicle Type	Age	Annual VMT*	Predicted VMT**
Auto	8.23	11,994	12,121
Van	6.68	14,934	12,519
Sport/Utility	6.58	13,927	12,519
Pickup	9.62	13,154	9,934
Total Fleet* **	8.32	12,580	12,121

*Based on odometer readings.

**Based on average age of vehicle (rounded to nearest whole year).

***Includes other trucks, motorcycles, RVs, and other.

Some—although apparently only a small part—of the more intensive utilization of light trucks appears to result simply from the fact that vans and SUVs are newer on average than automobiles (as Table 12 showed previously). This can be seen by comparing the actual utilization of the individual vehicles types to the "predicted" utilization of household vehicles with the same average age, drawn from the relationship of usage to vehicle age shown previously in Figure 9. As these comparisons reveal, part of the more intensive utilization of both vans and SUVs—although only about 4% for vans and 7% for SUVs—is "explained" by the fact that they are newer on average than the household vehicle fleet as a whole. The higher average age of pickup trucks compared to the household fleet as a whole would be expected to lead to their less intensive use, but Table 14 shows that they are driven about 5% *more* than the fleet-wide average.

Vehicle Use Model

These comparisons suggest that light-duty trucks tend to substitute for automobiles in the vehicle holdings of households with above-average travel demands, probably including many that employ household-based vehicles to serve a combination of personal and work- or business-related travel demands (vanpool operators or small business owners, for example). Tables 15 and 16 present the results of an analysis designed to explore this hypothesis further; Table 15 reports the definitions of the variables used in the analysis, while Table 16 reports the results of regressions of annual utilization on household and vehicle characteristics.[18]

[18] As indicated in Table 15, the gasoline price variable is the average of monthly prices (including all taxes) for the fifteen-month survey period (5/95 to 7/96) in the state where the household or vehicle is located. While it might seem desirable to use gasoline price data for the exact month in which the household was surveyed, the effect of seasonal fluctuations in gasoline demand is to cause significant seasonal variation in its price. As a result, using monthly gasoline prices does not allow movements along the demand curve in response to gasoline price changes—which are the response of interest—to be separated from the effects of seasonal shifts in the gasoline demand curve itself. In the absence of a structural model of gasoline supply to be estimated simultaneously with the models of vehicle usage and household travel demand, the resulting "identification problem" can be minimized by using average gasoline prices over the entire survey period, since these can more properly be considered exogenous from the standpoint of

Table 15
Variable Names and Descriptions

Variable	Description
age	Age of vehicle (MY1996 and MY1997 =1)
hhvehcnt	Number of vehicles per household.
numadlt	Number of adults in the household.
numchild	Number of children in the household.
linc	Natural log of household income.
lpgas	Natural log of gasoline price (1).
van	Indicator: vehicle is a van.
suv	Indicator: vehicle is a sport-utility vehicle.
pickup	Indicator: vehicle is a pickup truck.
truck	Indicator: vehicle is another kind of truck.
rv	Indicator: vehicle is a recreational vehicle.
lbgden	Natural log of block group population density.
age*van	Interaction: age and van.
age*suv	Interaction: age and suv.
age*pickup	Interaction: age and pickup
age*truck	Interaction: age and other truck.
age*rv	Interaction: age and rv.
notinMSA	Indicator: household not in a metropolitan statistical area.
bus	Indicator: transit bus stop within 1/2 mile of residence.
Sunday	Indicator: travel day of week.
Monday	Indicator: travel day of week.
Tuesday	Indicator: travel day of week.
Thursday	Indicator: travel day of week.
Friday	Indicator: travel day of week.
Saturday	Indicator: travel day of week.

(1) Average state price, including all taxes, during the survey period (5/95 to 7/96), adjusted for inflation using the CPI-U.

The regression results show that much of the higher average utilization of vans is explained by the less steep decline in their usage with age in comparison to that for all household vehicles shown earlier in Figure 9. (This is evidenced by the positive coefficient on the age*van variable in the regression results, which reduces the magnitude of the negative value of the age variable itself.) However, this result may be partly a product of the different transportation functions served by older passenger vans—which often serve commercial purposes as well as household travel, and are thus used particularly intensively—and the more recently-produced mini-vans, which more clearly substitute for automobiles and thus tend to serve more limited travel purposes. The higher average utilization of both SUVs and pickups (as shown by the positive coefficients on the suv and pickup variables in Table 13) appears to be largely accounted for by their ownership by households with unusually high travel demands, as evidenced by their higher annual usage even after controlling for household size, income, and other obvious influences on travel demand. This result may reflect the common use of these vehicles for recreational travel, joint household and business use, and various non-passenger transportation uses.

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households' travel demands and vehicle utilization decisions.

The decline in usage of both SUVs and pickups with increasing age actually appears to be slightly more pronounced than for conventional automobiles (as shown by the negative coefficients on the age*suv and age*pickup variables, which accentuate the negative value of the age coefficient), although the reliability of this finding is not extremely high for SUVs.

Thus the newer average age of SUVs may explain somewhat more of their increased utilization than the rough calculation accompanying Table 14 above suggested, but this conclusion is again somewhat uncertain. Since the average age of pickups is significantly higher than other vehicle types, their more intensive utilization is even more difficult to explain in light of the regression model results, although it may simply mean that they are more heavily used by households to serve various commercial and non-passenger household transportation functions than are other vehicle types.

Table 16
Vehicle Usage Model, Regression Results

Dependent Variable: Natural Log of Annualized Vehicle Miles
derived from Vehicle Odometer Readings (mean=8.96)

	Estimated Coefficients and T-Statistics							
independent	Model 1		Model 2		Model 3		Model 4	
variable	β	t	β	t	β	t	β	t
constant	9.75	22.09	8.94	21.12	9.72	22.03	8.90	20.03
age	-0.07	-52.42	-0.07	-52.42	-0.06	-41.32	-0.06	-41.12
hhvehcnt	-0.06	-6.51	-0.08	-8.75	-0.06	-6.51	-0.08	-8.77
numadlt	0.14	12.22	0.15	13.19	0.14	12.22	0.15	13.20
numchild	0.13	20.06	0.12	19.52	0.13	20.13	0.12	19.59
linc	0.05	4.85	0.07	6.44	0.05	4.98	0.07	6.59
lpgas	-0.24	-2.57	-0.03	-0.35	-0.24	-2.56	-0.03	-0.32
van	0.14	5.71	0.13	5.54	0.07	1.80	0.07	1.70
suv	0.12	4.55	0.10	4.01	0.17	4.24	0.16	4.02
pickup	0.06	3.27	0.02	1.12	0.13	4.28	0.09	3.25
truck	0.14	0.94	0.13	0.85	0.08	0.26	0.04	0.15
rv	-0.87	-7.51	-0.86	-7.41	-2.22	-8.67	-2.20	-8.64
lbgden			-0.05	-13.17			-0.05	-13.28
age*van					0.012	2.31	0.012	2.31
age*suv					-0.009	-1.74	-0.010	-1.89
age*pickup					-0.008	-2.84	-0.009	-3.19
age*truck					0.004	0.21	0.005	0.28
age*rv					0.099	5.85	0.099	5.86
Adj. R sq.	0.134		0.139		0.136		0.141	

THE DETERMINANTS OF HOUSEHOLD TRAVEL DEMAND

In addition to producing much revealing information about patterns of household travel and vehicle ownership, the 1995 NPTS—again like its predecessors—enables analyses that can provide important insights into the underlying determinants of household travel demand and their individual influences on travel behavior. This section presents the results of a regression analysis of vehicle miles reported by individual households for the NPTS "travel day" based on a simplified model of travel behavior. The model hypothesizes that the household is the appropriate decision-making unit for travel demand analysis, and that the variables influencing motor vehicle travel demand include household demographics and income, gasoline prices, and characteristics of the neighborhood and urban area where the household resides.[19]

While these variables collectively explain only 15% of the total variation in daily household motor vehicle travel, their individual effects on travel demand can be estimated quite reliably from the large sample of households included in the analysis (Table 17). Not surprisingly, the regression results show that the number of members in a household has a significant effect on the level of motor vehicle travel it generates. The relative magnitude of the coefficients on the **numadlt** and **numchild** variables in all of the model specifications tested consistently suggest that the effect of an additional adult household member on travel day VMT is three times as large as that of an additional child.

[19] For a detailed discussion of the theoretical influence of household demographic, economic, and locational characteristics on the demand for private motor vehicle travel, as well as of alternative modeling structures for identifying the empirical importance of these determinants, see Paul Schimek, "Household Motor Vehicle Ownership and Use: How Much Does Residential Density Matter?" *Transportation Research Record*, Number 1552 (1996), pp. 120-125.

Table 17
Household VMT Model, Regression Results

Dependent Variable: Natural Log of Vehicle Miles per Travel Day per Household (mean=3.57)

	Estimated Coefficients and T-Statistics											
independent	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
variable	β	t	β	t	β	t	β	t	β	t	β	t
constant	3.25	7.52	1.32	3.07	1.49	3.46	0.72	1.64	0.87	1.98	1.17	2.73
numadlt	0.31	32.40	0.30	31.54	0.30	31.53	0.30	31.33	0.30	31.31	0.30	31.79
numchild	0.11	17.20	0.10	15.89	0.10	15.90	0.10	15.77	0.10	15.77	0.10	15.95
linc	0.35	37.89	0.37	40.04	0.36	38.69	0.36	39.62	0.35	38.08	0.37	40.35
lpgas	-0.85	-9.40	-0.32	-3.59	-0.32	-3.58	-0.20	-2.19	-0.19	-2.07	-0.31	-3.41
lbgden			-0.10	-29.37	-0.11	-28.42	-0.08	-21.11	-0.09	-21.96	-0.10	-29.44
notinMSA					-0.10	-5.60			-0.12	-6.43		
bus							-0.13	-8.02	-0.14	-8.62		
Sunday											-0.17	-6.87
Monday											0.03	1.08
Tuesday											0.10	4.17
Thursday											0.08	3.37
Friday											0.11	4.41
Saturday											0.19	7.90
Adj. R sq.	0.121		0.147		0.148		0.149		0.150		0.154	

The Influence of Economic Factors

Turning to the effect of economic characteristics on household demand for motor vehicle travel, the estimated income elasticity of daily VMT in the several models reported Table 17 ranges from 0.35 to 0.37; thus for example a 10% increase in household income increases daily VMT by 3.5-3.7%. As the regression results also show, the elasticity of household VMT with respect to gasoline prices ranges from -0.19 to -0.32 (so that for example, a 10% increase in gasoline prices reduces gasoline consumption by 1.9-3.2%) once neighborhood density is properly accounted for. Because these results are based on a cross-sectional analysis of household behavior, they theoretically capture the long-run responses of travel demand to income and gasoline price variation; both results are in close agreement with previous studies of long-run income and gasoline price elasticities.

Location Characteristics and Travel Behavior

Characteristics of households' residential locations also exert important influences on their demands for private motor vehicle travel, according to the results summarized in Table 17. Greater neighborhood residential density is associated with lower household vehicle travel, although this effect seems to be smaller than some other studies have claimed once the roles of income and household size are properly accounted for (the estimated elasticity of daily VMT with respect to residential density in models 2-6 ranges from -0.08 to -0.11).[20]

Households located outside metropolitan areas travel 10-12% less by private motor vehicles than those with identical demographic and economic characteristics residing within urban areas, as shown by the magnitude of the coefficient on the variable **notinMSA** in models 3 and 5.

This result seems at first to contrast with the widespread hypothesis that the longer separations between trip origins and destinations that result from the low development densities of rural areas lead to higher household VMT. Because density is already controlled for in the models that produce this result, however, this result reflects the effect of non-urban locations *per se* on household travel and may not contradict the conventional hypothesis. Finally, the availability of public bus transit service within a half-mile distance reduces a household's daily travel by 13-14% compared to that of identical households located farther from a bus route, as shown by the coefficients on the **bus** variable included in models 4 and 6.

Daily Variation in Household Vehicle Travel

The regression results indicate that there is considerable variation in household VMT by day of the week, even after controlling for households' demographic and economic characteristics and for residential location factors. Mondays and Wednesdays (the "reserved" case not included in Model 6) appear to represent "typical" travel days, in comparison to which travel by otherwise identical households ranges from 8% (Thursdays) to 11% (Fridays) higher on other weekdays. Not surprisingly, Saturday travel is considerably higher (19%) than during the mid-week, while average household VMT recorded on Sundays is lower than its typical mid-week value by an almost equal percentage (-17%).

[20] Using the census-tract-level density measure instead of the variable calculated at the block group level produced substantially the same results.

CONCLUDING REMARKS

This analysis of the 1995 Nationwide Personal Transportation Survey shows that the several separate estimates of personal motor vehicle travel it can be used to produce are remarkably consistent (resulting in an estimate of some 2.2 trillion miles per year). However, the growth rate in motor vehicle travel since 1990 is less certain, in part because of changes in survey methods since the previous NPTS. The most directly comparable estimates that can be constructed from the 1990 and 1995 surveys, those derived from asking respondents about their driving and the use of their vehicles during the previous 12 month period, imply very modest growth in vehicle travel. For the first time since the original NPTS was conducted in 1969, the 1995 survey showed a *decline* in driving per licensed driver. The modest increase in total driving between 1990 and 1995 was thus completely explained by the increase in the number of drivers, which in turn was accounted for by an increasing number of people of driving age (rather than by an increase in their licensing rate).

Again for the first time since the survey has been conducted, the level of vehicle ownership (vehicles per driver) remained constant between the 1990 and 1995 surveys. This result suggests that vehicle ownership may have reached the long-anticipated "saturation" level. Nevertheless, the share of carless households continued to decline through 1995.

Person travel grew even more slowly than vehicle travel because a higher percentage of person travel demand was accommodated in motor vehicle trips, and because the average occupancy of those trips declined. The decline in occupancy rate continued a trend that has been apparent with each subsequent NPTS. However, the decline in occupancy slowed markedly in the most recent period, suggesting that occupancy may be approaching a floor which parallels the ceiling in auto ownership and use levels previously suggested.

The composition and age of the vehicle fleet has implications for air quality and fuel consumption. The aging of household motor vehicles accelerated dramatically between 1990 and 1995, compared to the relatively slow aging that occurred in the period between previous surveys. Pre-1981 cars, which have considerably elevated air pollutant emissions rates compared to newer models, remain a small but significant portion of the fleet. Moreover, the NPTS estimate of annual use of these and other vehicles above approximately five years of age is considerably greater than that assumed in EPA's emissions model, so the contribution of older vehicles to current light-duty vehicle fleet emissions may be significantly understated.

The 1995 NPTS clearly documents the increasing proportion of the household vehicle fleet comprised of light-duty trucks. Vans and sport/utility vehicles seem to be directly substituting for automobiles, particularly for households that prefer newer vehicles and have higher than average driving demands. Pickup trucks, on the other hand, seem to be a distinct class of vehicles with different ownership and utilization patterns from automobiles and other light trucks.

Pickups tend to be older than other vehicles on average, and tend to be found in lower-income households, in rural areas, and in the southern and western parts of the Nation.

Multivariate regression models of average vehicle usage and total household VMT using the 1995 NPTS suggest that household size and income are the primary determinants of vehicle use per vehicle and total driving, moderated by fuel price and by neighborhood characteristics. Significant portions of both average vehicle and total household vehicle travel are not explained by the available explanatory variables, but this is not surprising given the degree of random fluctuation of individual travel behavior. Fuel price also has a significant effect on household vehicle use in the long run. In addition, neighborhood characteristics such as population density and the presence of transit service have smaller but statistically significant effects on household travel demand, as does location of the household within versus outside an urbanized area.

APPENDIX A: Comparing Survey Methods using the 1994 NPTS Pretest

The 1995 NPTS uses a different survey method than earlier editions of the survey, making comparisons with earlier NPTS statistics difficult. The 1994 pretest of the NPTS used both the 1990 survey method (retrospective recall) and the 1995 survey method (a diary mailed in advance of the travel day).[21] Households were randomly selected with respect to the survey method. The difference in average measures from each of the two survey methods in the pretest approximate the difference due to the sampling technique alone.

Table A-1
Trips, Trip Length, and Travel by Survey Method, 1995 NPTS Pretest

	Retrospective Method			Diary Method			% Difference by Method		
Statistic	Length	Trips	Travel	Length	Trips	Travel	Length	Trips	Travel
All Person Trips (1)	7.77	8.04E+10	6.25E+11	7.89	9.17E+10	7.23E+11	1.5%	14.05%	15.81%
Person Trips in Motor Vehicles	8.51	6.99E+10	5.95E+11	8.75	7.97E+10	6.98E+11	2.8%	14.04%	17.26%
Motor Vehicle Trips (drivers only)	8.65	4.86E+10	4.20E+11	7.97	5.33E+10	4.25E+11	-7.9%	9.76%	1.13%

(1) Excluding airplane trips.

Table A-1 shows average trip length, the number of trips, and their product (total travel) by survey method (retrospective or diary). These three statistics are shown for all person trips (excluding airplane trips), personal motor vehicle trips (driver and passenger), and motor vehicle trips (using the trip data for drivers only). This third statistic produces an estimate of vehicle miles traveled (VMT). For motor vehicle trips, the diary method recorded more short trips, with the result that the number of vehicle trips was nearly 10% higher using this method but the average trip length was nearly 8% *shorter*. The net result is that the diary method revealed only 1.1% more VMT than the retrospective method.

Many more *person* trips were recorded when the diary method was used, and these trips were *longer* on average than those already counted using the retrospective method. About 14% more trips in total were counted under the diary method, and these trips were 1.5% longer. Thus in terms of person miles traveled (PMT), the retrospective method appears to understate travel by nearly 16%. These differences due to survey method for PMT, VMT, and their components were used in this paper to adjust the 1990 NPTS data to make them more comparable with the 1995 data. However, other inconsistencies between the two survey methods were not accounted for, such as the treatment of commercial driving.

[21] The 1994 pretest also used a third technique, a memory jogger, which is essentially a simpler form of the diary. Since this method was not chosen, it is not discussed here.

APPENDIX B: Revised VMT per Driver by Age and Sex

Table 5
Average Annual Miles Driven per Driver by Age and Sex
Office of Highway Information Management, FHWA
Revised February, 1999

Age	Male			Female		
	1990	1995	%change	1990	1995	%change
16-19	9,543	8,206	-14.0%	7,387	6,873	-7.0%
20-34	18,310	17,976	-1.8%	11,174	12,004	+7.4%
35-54	18,871	18,858	0.0%	10,539	11,464	+8.8%
55-64	15,224	15,859	+4.1%	7,211	7,780	+8.1%
65+	9,162	10,304	+12.6%	4,750	4,785	+0.1%
ALL (1)	16,536	16,550	0.0%	9,528	10,142	+6.45%

Why the revision?

Numerous data users had questioned the earlier annual average miles driven (reported by Dr. Pickrell and others) because there were declines in per driver VMT between 1990 and 1995 in virtually all age/gender categories other than men 65 or older. This seemed incongruous, given the overall strong increase in travel during this time. Upon checking, US DOT staff found that in 1990 only 2 percent of the drivers reported driving no miles during the year, while 9 percent of drivers reported driving no miles in 1995. Of the 9 percent, a significant number indicated that they actually did drive, either on their assigned Travel Day or as the primary driver of one of the household vehicles. Therefore the report of 'no miles' is determined to be in error for these drivers, the zero-values were changed to 'miles not reported.' After this edit, only about one and a half percent of all drivers remained in the "no miles category."

What the revised data means

The revised data show modest increases of generally less than 10% for most age/gender groups. The big exception is the 16-19 year-old group, where miles declined between 1990 and 1995. This is probably the result of changes in the survey weighting process between 1990 and 1995, which resulted in a large increase in the number of persons age 16-19. With more individuals in this teenage group in 1995, the average miles per driver would decline. Other factors at work here may also include enactment of laws that increase the age of driver licensing and increase in auto insurance premiums for young drivers.

V.

LAND USE TRANSPORTATION INTERACTION: AN EXAMINATION OF THE 1995 NPTS DATA

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LAND USE TRANSPORTATION INTERACTION: AN EXAMINATION OF THE 1995 NPTS DATA

EXECUTIVE SUMMARY

There is currently a great deal of discussion about the interaction between land use and transportation. The 1995 NPTS provides some ability to investigate this question through the inclusion of variables that measure the interaction of land use and travel behavior. Population density is the primary quantifiable land use descriptor variable. Population density has been further manipulated to isolate area types (urban, second city, suburban, town and rural). Other variables that attempt to quantify land use include residential density and work tract employment density. Characteristics of the population or built environment such as race, age, income, and retail employment further identify land use impacts across different population groups.

Greater population density is associated with decreasing annual miles driven, greater bus availability, decreased dependency on single occupancy vehicles and increased use of transit. The private automobile is still the dominant mode of travel although African Americans, Asians and Hispanics are slightly more likely to use other modes of transportation.

Increasing population density is associated with fewer person trips, fewer person miles traveled, and fewer person miles per trip. Residents of densely populated areas report the fewest vehicle trips, vehicle miles traveled, and vehicle miles per trip. Less densely populated areas tend to have more drivers per adult and more vehicles per adult.

Second cities tend to follow national averages with regard to several transportation parameters, for example, drivers per adult, vehicles per adult, percent of persons working from home, and auto-dependency. Approximately 20% of second city residents go to work by a mode other than the private automobile. Residents of second cities report the highest number of person trips of any area type. Persons in suburban areas make the next highest number of person trips. A surprisingly high number of low-income residents live in second cities, which have limited transit availability.

Results of the 1995 NPTS identify the locational preferences of specific segments of the population. High-income households generally tended to locate in suburban areas while middle-income households are most often found in rural areas. Low-income households are generally found in urban or rural areas.

Distance to work and travel time to work decrease as the percentage of retail trade in an area increases. Urban areas have the smallest percentage of residents working in census tracts with over 25% participation in retail trade. Second cities have the highest percentage with 28.8% of residents working where more than 25% of jobs are in retail trade. Retail employment and employment density at the work census tract have some measurable correlations to travel behavior.

At the home block group, increasing housing density is associated with greater transit availability and closer proximity to transit. Bicycle and walk trips increase as residential density increases. Increasing residential density is also associated with increasing employment density. At residential densities between 100 and 1,499 housing units per square mile, people are less likely to work at jobs with no fixed workplace. Low residential density areas have the largest percentage of people working at home.

Residential density, retail employment, income, area type, and population density all provide important descriptors for transportation behavior and policy implementation. This National Personal Transportation Special Report carefully examines these and other aspects of people, places and employment that may link land use to transportation choices and behavior. Questions underlaying this analysis of that link include:

- What is the relationship between vehicle availability and urban sprawl?
- How do people travel in edge cities?
- How do population density, employment, access to goods and services, and transit availability affect household travel behavior?
- What land use characteristics at the residence and/or workplace end seem to be the best predictors of travel behavior?
- What impact does urban sprawl or dispersion have on travel behavior and transportation investment costs?
- What is the impact of edge cities on travel behavior?
- Have urban areas developed in ways that require us to travel in private vehicles and necessitate long vehicle trips (and vehicle emissions)?
- Do higher residential densities offer some chance of reducing vehicle trips and emissions?
- Does transit accessibility change people's travel behavior for all trips or only the work trip (peak period transit service vs. off-peak service)?

INTRODUCTION AND OVERVIEW

Transportation professionals increasingly look to land use as a possible explanatory factor of transportation behavior. The Federal Highway Administration (FHWA) designed the 1995 National Personal Transportation Survey to include several variables representing land use. The resulting data provides a basis to quantitatively explore land use and transportation interaction.

Summary of Literature

The following is a survey of current literature concerning the effect of land use on transportation. Studies that explore this relationship can help further our understanding of travel patterns and travel behavior now and in the future.
Pushkarev and Zupan's (1977) study on optimum density for transit types found that both high residential density and the high density and relative size of the trip-end destination (workplace) are major determinants of public transportation use. The study also concluded that clustering nonresidential floor-space in central business districts and placing moderate to high density residences (7 to 15 dwellings per acre) close to those clusters was the most effective in promoting transit use.

The reality of development through the latter part of this century is quite the opposite of that pattern. Low density and a doughnut hole of population and employment density in city centers increasingly characterize modern cities. Policies such as the Federal Highway Acts and the Standard Zoning Enabling Acts have drastically affected land use, expanding housing and employment into suburban areas. Instead of the Central Business District (CBD) containing the vast majority of a region's office floor-space, many new clusters of office buildings have sprung up in suburban areas (Pivo, 1990). Instead of dense clusters of buildings, as were found in the street grid of the traditional downtown, these suburban office complexes are spaced far apart with vast expanses of parking acreage in between. Often, the new complexes offer more real space for cars than for the people who drive them, and mass transit is atypical in these areas (Leinberger and Lockwood, 1986). This transit and pedestrian unfriendly environment, coupled with the fact that these complexes were designed as single-use centers, means shopping, dining, and other day-to-day activities tend to be accessible by auto.

In addition, recent years have brought an increasing awareness of the trend of American cities to form nodes of urban activity in the midst of suburbs surrounding central cities. These nodes have transferred travel activity from radial activity focused on the concentrated central core of a city to tangential movement between the outer nodes. Joel Garreau's definitive book, *Edge City: Life on the New Frontier*, characterizes these nodes as edge cities and explains this growing phenomenon.

According to research conducted in the 1980's, the migration of white-collar office and service job centers to the suburbs resulted in an increase rather than a decrease in travel time and distance to work. Robert Cervero (1989) contends this is an outgrowth of "jobs-housing spatial imbalance" brought on by factors beyond the simple lack of land-use planning.

Possible causes include fiscal and exclusionary zoning, two wage-earner households tending to locate close to one workplace and not the other, and the fast pace of job-turnover coupled with an unwillingness to relocate close to a new job (Cervero, 1989).

In contrast, Gordon and Richardson emphasized in the *1990 NPTS Special Report* "Geographic Factors Explaining Worktrip Length Changes" that average work trip duration either fell slightly or grew by much smaller percentages than distances. The suburbanization of jobs and residences has allowed people to live away from activity centers and use roads with less congestion than city streets. With longer distances but less congestion, travel time has not suffered from sprawl[i].

Another study of five communities in the San Francisco Bay area did not focus explicitly on trip length but looked instead at the number of trips by mode. A primary finding was that land use characteristics of the neighborhoods (where person trips were generated) were not associated with number of person trips made, but were associated with transit and non-motorized trips (Kitamura et al, 1997). High density was found to be associated with lower fractions of auto trips, and higher percentages of non-motorized trips. a community was found to be statistically correlated with an increase in non-motorized trips. Eight attitudinal factors were entered into the analysis. The factors included pro-environment, pro-transit, automotive mobility, time pressure, and urban form and added increasing explanatory power to the models used to predict travel mobility. This led researchers to conclude that "attitudes are at least more strongly, and perhaps more directly associated with travel than are land use characteristics." (Kitamura et al, p. 154).

Many studies have shown similar findings with regard to density and its correlation to transit usage versus auto usage and also identified other elements which contribute to transportation mode choice. In addition to low densities and ample free parking, suburban business areas are characterized by a single dominant land use: office space. It is believed that mixed-used developments, combining offices, shops, restaurants, banks and other activities may be important to relieving automobile congestion by reducing the number of trips. In pedestrian-friendly mixed-use suburban activity centers, it is hypothesized that walking can take the place of noon- or peak-hour auto trips to conduct errands.

In her review of density/travel pattern literature, Ruth Steiner identifies assumptions that underlie the views of the proponents of high-density, mixed-used land use patterns (Steiner, 1994).

These assumptions include:
· People are willing to move into high density developments
· Travel patterns will change once people locate in a high density development
· People in high density developments will make fewer and shorter auto trips
· People in high density developments will walk and use transit more frequently

Another study attempting to account for both density and socioeconomic makeup came to the conclusion that "population density, employment density, and land-use mix are related to mode choice [even] when non-urban-form [socioeconomic] factors are controlled" (Frank and Pivo, 1994). The study went on to test the hypothesis that the relationship of population density, employment density and mode choice is non-linear, enabling the identification of thresholds of density where shifts from one mode (auto) to others (transit or walking) occur.

Significant shifts from auto use to walking or transit occur at certain employment density levels (20-75 employees per acre, and at > 125 employees per acre). For shopping trips, population densities need to exceed 13 persons per acre before a significant shift from auto use to walking or transit occurs (Frank and Pivo, 1994).

Key Terms and Definitions

Several conventions were developed to facilitate research with the 1995 NPTS data. These conventions include the following definitions and explanations.

Edge City, Second City, and Area Type

Joel Garreau defined five factors that determine and edge city:

- "Has five million square feet or more of leasable office space--the workplace of the Information Age,
- "Has 600,000 square feet or more of leasable retail space,
- "Has more jobs than bedrooms,
- "Is perceived by the population as one place,
- "Was nothing like 'city' as recently as thirty years ago[ii]."

People often know where these edge cities exist in their own states, but quantitatively defining an edge city for the purposes of the NPTS poses a challenge. NPTS variables deal primarily with people, rather than spaces; hence, population, household, and employment densities can be used to explain these urban phenomena, rather than floor space and community perceptions.

David R. Miller and Ken Hodges of Claritas, Inc. established a standard for defining urbanization categories using relational population densities[iii]. Under this system, Claritas defines a grid system across the United States based on 1/30th of a degree latitude and longitude, which amounts to roughly 900,000 cells of about four square miles each. The total population of a given cell and its eight surrounding cells (a 3x3 grid) divided by the total area of all nine cells determines the given cell's grid density. Claritas then ranks all of the grid cell densities for the nation into one hundred equal groups (a scale of 0 to 99).

The highest grid cell density in a 5-mile radius (5x5 grid, excluding the corners) determines the local density maximum in an area. Population centers emerge where grid cell densities only decrease moving away from a local maximum and no other local maximum with a greater density appears in closer proximity.

Area type classifications depend on the calculated grid cell densities and population center densities. Simple grid cell densities define rural areas (grid cell densities less than or equal to 19) and small towns (grid cell densities greater than or equal to 20 and less than or equal to 39). This classification results in groupings similar to the groups created by the Urbanized Area definition of 1,000 persons per square mile minimum. Claritas associates population center densities greater than 79 with urban areas; second cities comprise remaining population center densities. Areas around second city and urban areas form suburban areas. Lines of different slopes distinguish suburban areas around the population centers of second cities and urban areas.

Area Type Determination Calculations

Area Type	Determination Calculation
Rural Area	GCD 19
Town	20 GCD 39
Urban Area	PCD 79 (urban population center) and GCD 40 (not town or rural) and GCD 0.80 PCD +9.8
Second City	PCD < 79 (not an urban population center) and GCD 40 (not town or rural) and GCD 1.7368 PCD - 64.208
Suburban Area	GCD 40 and Area Urban Area and Area Second City
GCD = Grid Cell Density PCD = Population Center Density	Source: "A Population Density Approach to Incorporating an Urban-Rural Dimension into Small Area Lifestyle Clusters" by Miller and Hodges

Second cities differ from Garreau's edge cities in that second cities can be quantitatively defined and rely entirely on contextual population densities; whereas, edge cities receive their classifications from community perceptions and measurements of space.

Existing political definitions of local borders do not affect the NPTS area type classification system.

Transit Availability

Transit availability is defined as bus availability. The 1995 NPTS assumes that the bus is the basic form of transit. Streetcar, subway, and commuter rail are assumed to exist only where a bus system has been established.

Urban Sprawl

Urban sprawl describes the tendency for people who associate themselves with an urban center to live farther and farther away from that urban center. Sprawl is difficult to define quantitatively. The area type coding provided by Claritas offers a good proxy for sprawl. Population density defines the edge of an urban area's impact on population, as opposed to political boundaries which may not indicate the true form of population dynamics. Suburban areas, as defined by Claritas, are assumed to be associated with an urban area or a second city. Suburbs can, therefore, be classified as the sprawled outer edges of the urban area. In this analysis, travel behavior found in suburbs and second cities represent the effects of urban sprawl.

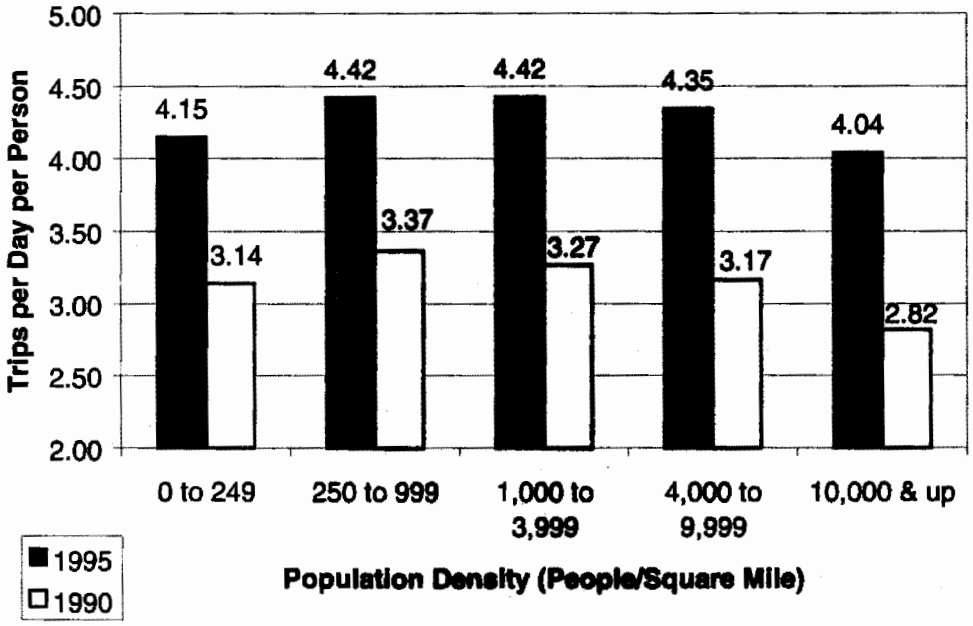
TRENDS

The 1995 Nationwide Personal Transportation Survey provided groundbreaking precedent to provide new ways of exploring the effects of land use on travel. The new land use survey questions, combined with improvements such as travel diaries, establishes a standard for future studies.

Comparison to Historical NPTS Data

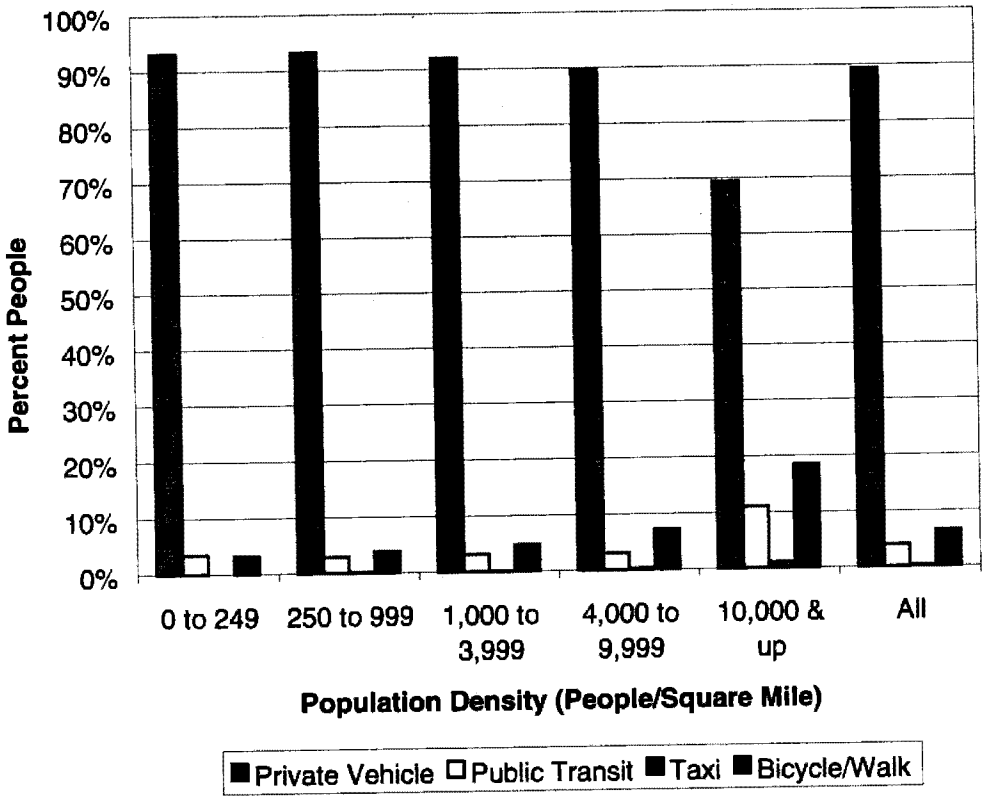
Previous NPTS surveys have provided data on characteristics such as area densities, populations, and differences between central cities and areas outside central cities. Population density provides the greatest comparison between past surveys and the 1995 NPTS

Figure 1
Person Trips By Population Density For 1990 And 1995



In the 1990 NPTS special report "Travel by Households without Vehicles[iv]," Charles Lave and Richard Crepeau found that the number of person trips per day for the total NPTS sample peaked at population densities between 250 and 999 people per square mile. Data values between 1990 and 1995 show an overall increase in the number of trips people took across all population densities. The numbers are difficult to compare, but comparison of person trips to population density remains remarkably similar. In 1995, people tended to make more person trips per day in medium-density areas.

Figure 2
Mode Of Transportation By Population Density



Mode choice trends have also remained consistent in the 1995 NPTS. In the 1990 Special Report "Recent Nationwide Declines in Carpooling[v]," Erik Ferguson found trends of decreasing private vehicle use as population density increases. In addition, transit use increased as population density increased. The data in Figure 2 indicate that these trends remain constant in the 1995 NPTS.

New Variables Available for Land Use Study

Beyond population density, the 1995 NPTS began exploring more aspects of the developed environment than previous surveys. Several census categories can be applied to the NPTS data to offer more information on social characteristics. This report focuses on the following land use and population characteristics:

Measures for People	Measures for Places	Measures for Employment
Population density	Area Type	Employment density
Income	Residential density	Retail employment
Poverty status	Age of Housing	
Race/ethnicity mix	Housing tenure	
Hispanic origin		
Age		
Educational attainment		
Retail employment		

The 1995 NPTS also includes self-reports of transit accessibility, household vehicle availability, and customer evaluations of highway and public transportation.

CONTRIBUTING ELEMENTS

The issues, terms, methodologies, and trends discussed to this point all contribute to the analysis of the 1995 Nationwide Personal Transportation Survey data. The previous section identified historical trends in NPTS data. The literature review has established the current background of intellectual debate regarding land use and transportation. Using these contexts and the concepts of the key terms defined earlier, this report will now employ the new variables available for land use study to analyze the interaction of land use and transportation. This section divides these analyses into categories of measures for people, places, and employment.

Measures for People

Population Density

Traditionally, analysts have used population density and MSA size to measure the effects of land use on different aspects of transportation. Population density provides a good indicator, for instance, of annual miles driven.

Table 1
Miles Driven Last Year By Population Density And Gender

	Annual Miles Driven			
	Male		Female	
People per Mile^2	Mean	Median	Mean	Median
0 to 249	17,991	14,000	10,607	9,000
250 to 999	17,670	15,000	10,288	9,000
1,000 to 3,999	15,415	12,000	8,976	8,000
4,000 to 9,999	14,316	12,000	8,307	6,500
10,000 & up	11,479	9,000	7,276	5,000

The first table shows that high population densities are associated with driving fewer miles annually. Males typically drive 1.5 to nearly 2 times as many miles as females do, but the correlation between density and annual miles driven holds true for both genders at all population densities. Presumably, low population density is associated with increased distance between destinations and greater miles driven each year.

Table 2
Drivers Per Adult By Population Density

	People per Mile^2					
Drivers per Adult	0 to 249	250 to 999	1,000 to 3,999	4,000 to 9,999	10,000 & up	Total
Less than One	10.90%	10.20%	12.60%	15.70%	36.80%	15.80%
One Driver	82.80%	84.80%	82.40%	81.10%	62.20%	79.90%
More than One	6.20%	5.00%	5.00%	3.20%	0.90%	4.30%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Areas of high population density do not follow the same trends in drivers per adult as block groups with lower densities. The most densely populated areas have the highest percentage of residents with less than one driver per adult. In areas with population densities above 10,000 people per square mile, approximately 36.8% of residents have less than one driver per adult. This ratio differs greatly from the average of 15.8% across all density categories. For density levels between 4,000 and 9,999 people per square mile, 15.7% of the people have less than one driver per adult. In contrast, 82.8% of the people have one driver per adult in the 0 to 249 people per square mile density level while only 62.2% have one driver per adult at population densities above 10,000 people per square mile.

Table 3
Vehicles Per Adult By Population Density

	People per Mile^2					
Vehicles per Adult	0 to 249	250 to 999	1,000 to 3,999	4,000 to 9,999	10,000 & up	Total
Less than One	17.10%	17.60%	20.00%	27.10%	53.60%	25.10%
One Vehicle	57.50%	63.30%	64.80%	61.20%	41.50%	59.10%
More than One	25.50%	19.00%	15.20%	11.70%	4.90%	15.80%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

The number of vehicles per adult follows trends similar in most respects to those patterns set by the number of drivers per adult. Population densities of over 10,000 people per square mile have the highest percentage (53.6%) of adults with less than one vehicle. At density levels under 250 people per square mile, only 17.1% of adults have less than one vehicle. Conversely, 25.5% of adults in the lowest-density areas have more than one vehicle, but only 4.9% of adults living in population densities above 10,000 people per square mile own multiple vehicles.

Across all density levels, an average of 15.8% of all adults have more than one vehicle.

Table 4
One-Way Work Trip By Population Density And Gender

People per Mile^2	Distance to Work (Miles)				Time to Work (Minutes)			
	Male		Female		Male		Female	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
0 to 249	17	12	13	10	24	20	20	15
250 to 999	17	10	12	8	24	20	20	15
1,000 to 3,999	14	9	11	7	22	17	19	15
4,000 to 9,999	12	8	9	6	23	20	20	15
10,000 & up	11	7	9	5	26	20	26	20

Table 4 shows that people living in low-density areas generally travel longer distances to work and their commute times are longer than the commute times of their higher population density counterparts. As population density increases, commute times and distances decrease slightly where population densities are less than 10,000 people per square. At densities greater than 10,000 people per square mile, distances continue to decrease, but trip times suddenly increase. This increase likely indicates that short distances cannot alleviate long commute times in densely populated and congested areas. An alternative explanation is that this increase reflects the additional travel time associated with transit use.

At all density levels, women have shorter commute distances and times, indicating that households are located closer to where women work than to where men work. It is not clear whether households locate closer to where women work or if women find jobs closer to home.

Table 5
Transit Availability By Population Density

	Transit Availability		
People per Mile^2	Bus Service Available	No Bus	All
0 to 249	20.1%	79.9%	100.0%
250 to 999	41.0%	59.0%	100.0%
1,000 to 3,999	69.4%	30.6%	100.0%
4,000 to 9,999	88.8%	11.2%	100.0%
10,000 & up	98.0%	2.0%	100.0%
Total	63.4%	36.6%	100.0%

As shown in Table 5, transit (bus) availability increases with increased population densities.

In the least densely populated areas, bus service is available to only 20.1% of the population. This percentage increases over fourfold to 98.0% in areas with population densities of 10,000 people per square mile and greater.

Table 6
Distance To Transit From The Household By Population Density

Distance to Transit	People per Mile^2					
	0 to 249	250 to 999	1,000 to 3,999	4,000 to 9,999	10,000 & up	All
Less than .1 mile	18.5%	20.1%	26.0%	38.4%	57.9%	36.0%
.1 to .24 mile	2.4%	5.6%	13.0%	17.4%	18.3%	14.3%
.25 to .49 mile	3.0%	6.5%	10.4%	13.3%	11.2%	10.8%
.5 to .99 mile	18.7%	29.6%	35.1%	25.2%	11.3%	25.1%
1 mile & up	57.4%	38.2%	15.5%	5.7%	1.3%	13.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

As shown in Table 6, the most densely populated areas have transit located most closely to the household. For areas with population densities of 4,000 people per square mile and greater, the largest share of transit is located within .1 mile of the household. As population density decreases, the distance from transit to the residence increases; this is true except for transit located less than .1 mile from the household.

People living in the least densely populated areas live farthest from transit, with over half of transit located at least .5 mile away from the household.

Table 7
Mode Of Transportation By Population Density

	People per Mile^2					
Mode	**0 to 249**	**250 to 999**	**1,000 to 3,999**	**4,000 to 9,999**	**10,000 & up**	**All**
Private Vehicle	93.1%	93.3%	92.0%	89.6%	69.4%	89.3%
Public Transit	3.5%	2.9%	3.1%	3.0%	11.0%	4.0%
Taxi	0.0%	0.1%	0.1%	0.2%	1.0%	0.2%
Bicycle/Walk	3.3%	3.8%	4.8%	7.2%	18.5%	6.5%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Beyond describing trip characteristics, population density also affects mode choice preferences. As shown in Table 7, the private vehicle dominates as the preferred mode of transportation. Between 4,000 and 9,999 people per square mile, people use private vehicles 89.6% of the time. Above 10,000 people per square mile, private vehicle utilization drops dramatically to 69.4%. Areas with population densities less than 250 people per square mile possess the highest share of private vehicle usage, which may be attributable to the few mode choice options available in low-density areas. In contrast, high population density reduces the private vehicle's popularity.
Usage of alternative modes of transportation drastically increases for population densities over 10,000 people per square mile, while private vehicle utilization drops by roughly 25% to 69.4%. Notably, bicycling and walking (18.5%) outperforms public transit (11.0%) at the highest density. This demonstrated preference merits further exploration of investments for urban pedestrian environments and bicycle right-of-way.

Table 8
Annualized Individual Travel Behavior By Population Density

Population Density	Annualized Individual Travel Behavior					
	Person Trips	Person Miles Traveled (PMT)	Person Miles per Trip	Vehicle Trips	Vehicle Miles Traveled (VMT)	Vehicle Miles per Trip
0 to 249	1,515	16,900	11	958	10,560	11
250 to 999	1,614	15,345	10	1,025	9,762	10
1,000 to 3,999	1,615	14,414	9	1,020	8,458	8
4,000 to 9,999	1,586	12,837	8	968	7,827	8
10,000 & up	1,476	9,029	6	668	4,880	7
Overall	1,568	14,064	9	951	8,523	9

Table 8 summarizes data relating population density, trips and miles traveled. The data reveal a tendency toward fewer person trips in areas with the highest and lowest densities, with some variation in between. The person miles traveled (PMT), however, declines as population density increases, suggesting fewer miles associated with each trip at higher densities.

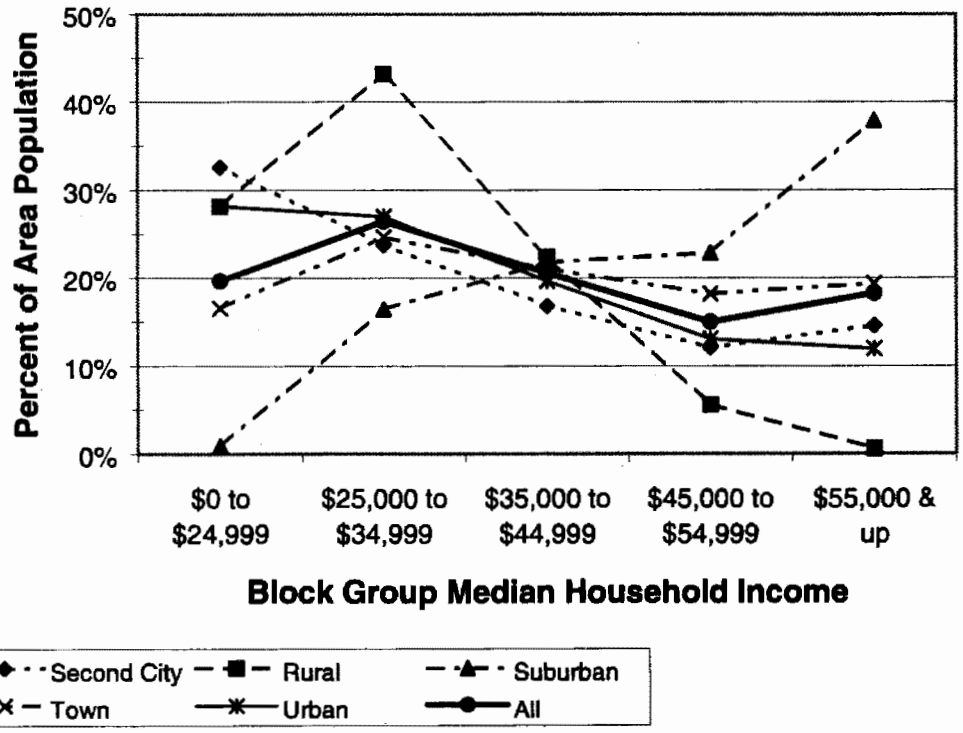
Vehicle trips decrease steadily as population density increases. The vehicle miles traveled (VMT) associated with these trips also decreases. The exception occurs in areas where the population density is 10,000 or higher in which the average number of miles per trip increases slightly to 5.4.

Median Household Income/Poverty

Table 9
Block Group Median Household Income By Area Type

Household Income	Area Type					
	Second City	Rural	Suburban	Town	Urban	All
$0 to $24,999	32.6%	28.2%	0.9%	16.6%	28.2%	19.7%
$25,000 to $34,999	23.8%	43.2%	16.5%	24.7%	27.0%	26.5%
$35,000 to $44,999	16.9%	22.4%	21.8%	21.1%	19.7%	20.6%
$45,000 to $54,999	12.1%	5.6%	22.9%	18.2%	13.1%	15.0%
$55,000 & up	14.6%	0.6%	37.9%	19.4%	12.0%	18.3%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Figure 3
Median Household Income By Area Type



As summarized in Table 9, wealthy households dominate in the suburbs, middle income households prevail in rural areas, and households in the lowest income category are most common in second cities and in urban and rural areas. Suburban areas have the highest percentage of households with a median income of $55,000 and higher; these households comprise 37.9% of all households in suburban areas, twice the overall percentage for this income category. Rural areas have the lowest percentage share of households in the two highest income categories; households with incomes of $45,000 and higher comprise only 6.1% of all households. The middle income categories prevail in rural areas where households with median incomes of $25,000 to $44,999 comprise 65.6% of all households.

In second cities, the percentage of low-income residents (32.6%) is greater than the percentage of low-income residents in both rural areas (28.2%) and urban areas (28.2%). This indicates a growing trend for the poor who have traditionally resided in inner cities to follow the waves of people leaving central cities for outlying areas.

This movement of low-income groups will create significant challenges for meeting transportation needs: second cities must plan for an influx of low-income residents who cannot afford private vehicles and must depend on public transportation for mobility. Because they have been recently developed, second cities do not have the public transportation infrastructure which urban areas have developed over decades. Transit accessibility will become increasingly important.

Table 10
Transit Availability By Block Group Median Household Income

	Transit Availability		
Household Income	**Bus Service Available**	**No Bus**	**Total**
$0 to $24,999	59.4%	40.6%	100.0%
$25,000 to $34,999	56.3%	43.7%	100.0%
$35,000 to $44,999	64.1%	35.9%	100.0%
$45,000 to $54,999	70.6%	29.4%	100.0%
$55,000 & up	72.8%	27.2%	100.0%
Total	63.4%	36.6%	100.0%

As shown in Table 10, transit availability is positively related to median household income: as household income increases, transit availability also increases. This finding merits attention because transit usage is typically associated with the lowest income categories; however, these data indicate that only 60% of households with incomes of $0 to $24,999 have access to bus service. Because low income households are more commonly dependent on transit for mobility, the lack of available public transportation has social and economic implications.

Table 11
Distance To Transit From Household By Poverty Status

	Percent of Block Group Living in Poverty				
Distance to Transit	**Less than 4%**	**4% to 6%**	**7 to 12%**	**13% & up**	**All**
Less than .1 mile	28.6%	31.6%	36.5%	47.6%	36.0%
.1 to .24 mile	12.6%	13.5%	14.4%	17.0%	14.3%
.25 to .49 mile	10.2%	11.4%	11.0%	10.9%	10.8%
.5 to .99 mile	32.0%	27.2%	24.9%	15.7%	25.1%
1 Mile & up	16.7%	16.3%	13.2%	8.9%	13.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Table 11 reveals a tendency for transit accessibility to be greatest for those areas in which the percent of the population living in poverty is the greatest. In those areas where more than 13% of block groups live in poverty, 47.6% live less than .1 mile from transit.

As distance from transit increases the block groups with more than 13% of its residents living in poverty decreases.

However, results also indicate that there are areas having significant numbers living below poverty that are located from .5 to over a mile from transit. For example, 24.9% of block groups that have 7 to 12% living in poverty are located from .5 to .99 of a mile from transit.

Table 12
Annualized Individual Travel Behavior By Household Income

	Annualized Individual Travel Behavior					
Block Group Median Household Income	Person Trips	Person Miles Traveled (PMT)	Person Miles per Trip	Vehicle Trips	Vehicle Miles Traveled (VMT)	Vehicle Miles per Trip
$0 to $24,999	1,482	12,173	8	821	7,026	9
$25,000 to $34,999	1,585	13,594	9	968	8,526	9
$35,000 to $44,999	1,567	14,761	9	984	9,161	9
$45,000 to $54,999	1,592	15,040	9	988	8,896	9
$55,000 & up	1,619	15,199	9	1,001	9,109	9
Overall	1,568	14,064	9	951	8,523	9

As shown in Table 12, both trips and miles of travel are positively associated with income. Person trips and PMT generally increase as household income increases. The average number of miles associated with each trip also increases. Vehicle trips generally increase as household income increases. The VMT associated with these trips also increases.

Race and Hispanic Origin

Table 13
Race By Area Type

	Area Type					
Race	Second City	Rural	Suburban	Town	Urban	All
White	73.5%	88.9%	80.4%	86.5%	53.7%	78.2%
African-American	16.2%	6.5%	9.9%	7.1%	28.3%	12.5%
Asian	1.9%	0.4%	3.6%	1.1%	4.5%	2.2%
Other	8.4%	4.2%	6.1%	5.3%	13.5%	7.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Racial mix varies significantly in different area types. Whites form the majority in all types of areas, but they dominate most in rural areas (88.9%), where all other racial groups combined account for only 11.1% of the population. African-Americans have the most significant presence in urban areas, with one African-American person for every two white persons. African-Americans also have a significant, albeit greatly diminished, presence in second cities. Although second cities have certain population characteristics similar to urban areas, second cities have far less diversity in terms of racial mix when compared to urban areas.

Table 14
Transit Availability By Race Or Hispanic Origin

	Transit Availability		
Race/Hispanic Origin	Bus Service Available	No Bus	Total
White	59.3%	40.7%	100.0%
African-American	80.0%	20.0%	100.0%
Asian	86.5%	13.5%	100.0%
Other	75.8%	24.2%	100.0%
All	63.3%	36.7%	100.0%
Hispanic	76.8%	23.2%	100.0%
Non-Hispanic	62.2%	37.8%	100.0%
All	63.4%	36.6%	100.0%

Table 14 shows that both African-Americans and Asians have higher than average transit availability while the availability of transit for whites is below average. Transit is also available to a greater than average percentage of Hispanics.

Table 15
Mode Of Transportation By Race Or Hispanic Origin

	Race of Household Reference Person				Reference Hispanic Status			
Mode	White	African-American	Asian	Other	All	Hispanic	Non-Hispanic	All
Private Vehicle	91.3%	79.0%	86.1%	84.8%	89.4%	84.8%	89.8%	89.3%
Public Transit	3.0%	10.1%	4.5%	5.2%	4.0%	5.6%	3.9%	4.0%
Taxi	0.1%	0.5%	0.1%	0.3%	0.2%	0.2%	0.2%	0.2%
Bicycle/Walk	5.5%	10.4%	9.2%	9.7%	6.4%	9.4%	6.1%	6.5%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 15 shows that the private vehicle is the dominant mode of transportation for all groups. Whites rely on private vehicles more than any other group and less on public transit than these groups. African-Americans depend on private vehicles less than all other groups and more on public transit and bicycling and walking. Hispanics use private vehicles less than Non-Hispanics and less than the average. As with African-Americans, they are more likely to use public transit and bicycling and walking.

Age

Table 16
Age By Area Type

	Area Type					
Age Group	Second City	Rural	Suburban	Town	Urban	All
5 to 15	16.0%	19.2%	17.9%	19.3%	16.0%	17.8%
16 to 19	5.6%	6.4%	5.8%	6.0%	5.3%	5.8%
20 to 29	18.0%	11.4%	14.5%	12.9%	17.5%	14.6%
30 to 39	17.4%	18.1%	19.7%	19.4%	21.0%	19.1%
40 to 49	14.8%	15.5%	16.6%	16.3%	14.1%	15.6%
50 to 59	9.0%	11.1%	10.2%	9.9%	9.0%	9.9%
60 to 69	8.9%	9.0%	8.0%	8.2%	8.3%	8.0%
70 & up	10.4%	9.3%	7.2%	8.1%	8.7%	8.6%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 17
Family Life Cycle By Area Type

Family Life Cycle	Area Type					
	Second City	Rural	Suburban	Town	Urban	All
Single Adult, No Children	20.1%	12.5%	16.2%	13.6%	24.6%	17.0%
Two or More Adults, No Children	23.4%	23.4%	24.6%	23.2%	23.3%	23.6%
Single Adult, Youngest Child 0-5	1.8%	1.0%	1.0%	1.8%	2.8%	1.6%
Two or More Adults, Youngest Child 0-5	13.1%	14.0%	16.3%	16.5%	13.4%	14.8%
Single Adult, Youngest Child 6-15	2.8%	2.5%	2.5%	2.1%	3.2%	2.6%
Two or More Adults, Youngest Child 6-15	12.1%	17.6%	15.5%	17.0%	10.6%	14.8%
Single Adult, Youngest Child 16-21	1.2%	0.8%	1.1%	1.2%	1.1%	1.1%
Two or More Adults, Youngest Child 16-21	3.4%	5.3%	5.0%	4.9%	2.9%	4.4%
Single Adult Retired	9.9%	8.9%	6.1%	7.1%	8.2%	7.9%
Two or More Adults Retired	12.2%	13.8%	11.7%	12.6%	9.9%	12.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

The 1995 NPTS contains information on age and life cycle patterns, see Tables 16 and 17. As shown in Table 17, cities attract young adults, both single and married, who have no children. These findings indicate a preference by these groups to locate in more densely populated urban settings. Rural areas and towns, in contrast, have lower than average percentages of single, childless adults. Towns and rural and suburban areas are more likely than average to be populated by households with two or more adults and school-age children, indicating a possible educational component in choice of residential location. Rural areas attract a lower percentage of young adults (20-29 years old) than urban areas and second cities.

Table 18
One-Way Work Trip By Age And Gender

Age Group	Distance to Work (Miles)				Time to Work (Minutes)			
	Male		Female		Male		Female	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
16 to 19	7	5	7	4	14	10	15	10
20 to 29	13	8	12	8	22	15	21	15
30 to 39	15	10	12	8	25	20	22	18
40 to 49	16	10	11	8	25	20	21	15
50 to 59	15	10	10	7	25	20	20	15
60 to 69	14	8	7	5	25	15	16	15
70 & up	8	5	7	4	20	15	16	13

Table 18 shows a tendency for younger workers to have shorter work trip distances and trip times. This is true regardless of gender. The trip distance of males increases until the age of 49 when it begins to decrease. However, work trip times for males reaches a peak at age 30 and levels off through age 69, indicating a stable trip time independent of distance. Females have shorter work trip distances and travel times across all age groups. Mean trip distance peaks between the ages of 20 and 40 and begins to decline thereafter. However, work trip times exhibit a slight peak in the 30 to 39 age group category. Not surprisingly, work trip distance and trip times decline significantly for workers in the 70 and up age group category.

Table 19
Transit Availability By Family Life Cycle

Family Life Cycle	Transit Availability		
	Bus Service Available	No Bus	Total
Single Adult, No Children	71.7%	28.3%	100.0%
Two or More Adults, No Children	62.5%	37.5%	100.0%
Single Adult, Youngest Child 0-5	67.7%	32.3%	100.0%
Two or More Adults, Youngest Child 0-5	64.9%	35.1%	100.0%
Single Adult, Youngest Child 6-15	66.0%	34.0%	100.0%
Two or More Adults, Youngest Child 6-15	58.4%	41.6%	100.0%
Single Adult, Youngest Child 16-21	69.4%	30.6%	100.0%
Two or More Adults, Youngest Child 16-21	56.8%	43.2%	100.0%
Single Adult Retired	64.2%	35.8%	100.0%
Two or More Adults Retired	57.5%	42.5%	100.0%
All	63.3%	36.7%	100.0%

Table 19 shows the relationship between family life cycle and availability of transit at the residence. For all life cycle categories, transit service is available to over 55% of households, compared to the overall average of 63.3%.

The data indicate that households with a single adult are more likely to live where transit is available. This tendency is greatest for single adults with no children (71.7%) and holds true for all stages of life. In contrast, households with two or more adults are less likely to live where transit is available, indicating less need or preference to use transit. Households with two or more adults and young children are an exception to this general tendency, with 64.9% reporting transit availability at the residence. According to these data, transit availability at the residence is closely associated with family life cycle.

Table 20
Distance To Transit By Family Life Cycle

Family Life Cycle	Distance to Transit from Household (Miles)					
	Less than .1	.1 to .24	.25 to .49	.5 to .99	1 Mile & up	All
Single Adult, No Children	24.4%	19.9%	18.6%	16.1%	12.2%	19.4%
Two or More Adults, No Children	21.6%	22.6%	23.3%	25.5%	23.7%	23.2%
Single Adult, Youngest Child 0-5	2.6%	1.4%	1.3%	1.1%	1.3%	1.8%
Two or More Adults, Youngest Child 0-5	13.3%	13.5%	12.8%	16.7%	20.1%	15.1%
Single Adult, Youngest Child 6-15	3.4%	2.9%	2.4%	2.6%	1.6%	2.8%
Two or More Adults, Youngest Child 6-15	11.5%	12.7%	11.7%	15.4%	19.7%	13.8%
Single Adult, Youngest Child 16-21	1.3%	1.0%	1.1%	1.2%	1.2%	1.2%
Two or More Adults, Youngest Child 16-21	3.2%	3.7%	3.6%	4.7%	4.9%	3.9%
Single Adult Retired	9.3%	9.8%	10.3%	5.6%	4.6%	7.9%
Two or More Adults Retired	9.5%	12.6%	14.8%	11.1%	10.6%	11.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

As shown in Table 20, transit is most closely located near households with no children and a working-age adult (24.4%). Households with two or more adults and no children are evenly distributed across all transit access categories, with the highest percentage occurring between 5 and .99 miles (25.5%). Families with two or more adults and children under 16 are more likely to live one-half mile from transit or more, indicating less dependence on transit than other family types. Single retirees are more likely than average to live within .5 mile from transit, while families with two or more retired adults are more likely to live from .1 to .99 miles from transit, also indicating less dependence on transit than their single counterparts.

Education

Table 21
Transit Availability By Education

Education of Household Reference Person	Transit Availability: Bus Service Available	No Bus	Total
Less Than HS Graduate	54.0%	46.0%	100.0%
High School Graduate	58.4%	41.6%	100.0%
Some College, No Degree	66.1%	33.9%	100.0%
Associate Degree	62.7%	37.3%	100.0%
Bachelors Degree	70.0%	30.0%	100.0%
Some Grad/Prof School	68.5%	31.5%	100.0%
Grad/Prof School Degree	71.2%	28.8%	100.0%
All	63.1%	36.9%	100.0%

As shown in Table 21, transit availability generally increases as education increases, indicating a positive relationship between the two. On average, transit is available to 63.1% of households. This compares to 54.0% for households in which the reference person has less than a high school education and 58.4% for households in which the reference person has graduated from high school. The percentage for households in which the reference person has attended college exceeds the average, with the exception of the associate degree category. The positive relationship between transit availability and education does not hold true for the category of persons who have some graduate or professional school. The percentage for this category is 68.5%, a decrease of 1.5% compared to households in which the reference person has a bachelors degree (70.0%).

Measures for Places

Area Type

The 1995 NPTS bases urban/rural coding on population densities at a location and in relation to neighboring locations (see Key Terms and Definitions for an explanation).

Table 22
Drivers Per Adult By Area Type

	Area Type					
Drivers per Adult	**Second City**	**Rural**	**Suburban**	**Town**	**Urban**	**Overall**
Less than One	16.7%	11.9%	10.7%	11.5%	32.2%	15.8%
One Driver	80.0%	82.0%	84.6%	83.2%	66.2%	79.9%
More than One	3.3%	6.1%	4.7%	5.3%	1.6%	4.3%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

The majority of all adults in America drive. This ratio of drivers to adults varies, however, with area type. In towns, second cities, suburban, and rural areas, over 80% of the population has a ratio of one driver for every adult.

Rural areas have the largest percentage of ratios above one driver per adult. The NPTS defines adults as persons eighteen years of age or older; whereas, many states allow people to earn driver's licenses at sixteen years of age. Sixteen and seventeen year olds account for ratios above one driver per adult. Rural areas, therefore, have the largest percentage of their young people driving. Rural residents require private transportation for much of daily living, and young people need to attain driving privileges for mobility.

Urban areas have the lowest ratio of drivers per adult. The high percentage (32.2%) of urban populations having less than one driver per adult indicates less dependence on private vehicles. Urban areas offer more options for public transit, and many destinations can be accessed by walking or bicycling.

Table 23
Vehicles Per Adult By Area Type

Vehicles per Adult	Area Type: Second City	Rural	Suburban	Town	Urban	Total
Less than One	27.1%	18.4%	20.1%	18.3%	47.0%	25.1%
One Vehicle	61.6%	56.1%	65.6%	62.4%	46.1%	59.1%
More than One	11.3%	25.4%	14.3%	19.4%	6.9%	15.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Vehicle ownership per adults follows patterns similar to the patterns of drivers per adult. In rural areas, over one quarter of the adults have more than one vehicle, but in urban areas, nearly half of the residents have less than one vehicle for each adult. Over one quarter of the residents of second cities also have less than one vehicle for each adult. In second cities, towns, and suburban areas, over 60% of the population have exactly one vehicle per adult.

The land use of an area can affect the number of vehicles per adult: close access to destinations and plentiful transportation facilities may induce less vehicle ownership in urban areas. The number of vehicles in an area can also affect land use. High levels of vehicle ownership require parking structures, lots, and facilities to accommodate the vehicles. Rural areas have the space necessary to support high vehicle ownership; whereas, land values in urban areas make vehicle ownership expensive.

Table 24
Work Location By Area Type

Work Location	Area Type: Second City	Rural	Suburban	Town	Urban	All
Work from Home	5.2%	8.2%	5.3%	5.8%	5.0%	5.9%
No Fixed Work Place	2.0%	2.6%	2.0%	1.9%	2.6%	2.2%
Work at Work Location	92.8%	89.2%	92.7%	92.3%	92.4%	91.9%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

As shown in Table 24, there is little variation in work location across area type. The percentage of people who work at the work location vastly exceeds the percentages of people who work at home and those who have no fixed work place. The distribution is very similar within the second city, suburban, town and urban categories. The percentage distribution within these categories hovers near the overall percentages for each category. Rural areas vary from this pattern, with more people working from home than average and fewer people working at the work location than average.

Table 25
One-Way Work Trip By Area Type And Gender

	Distance to Work (Miles)				Time to Work (Minutes)			
	Male		Female		Male		Female	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Second City	12	6	9	5	21	15	18	15
Rural	18	12	13	10	24	20	20	15
Suburban	14	10	11	8	24	20	21	17
Town	16	10	12	7	24	20	19	15
Urban	11	7	9	6	26	20	25	20

The impact of area type on the distance to work by gender is reported in Table 25. Across all area types males generally travel greater distances to work and the mean travel time to work for males is also greater. The travel time to work for males and females is roughly equivalent in urban areas and their distance to work in urban areas is different by only two seconds. The distance to work for rural males is 18 miles and for females it is 13 miles. This is the greatest difference in distance to work across all area types.

Table 26
Transit Availability By Area Type

	Transit Availability		
Area Type	Bus Service Available	No Bus	Total
Second City	81.9%	18.1%	100.0%
Rural	14.3%	85.7%	100.0%
Suburban	87.4%	12.6%	100.0%
Town	37.6%	62.4%	100.0%
Urban	98.3%	1.7%	100.0%
All	63.4%	36.6%	100.0%

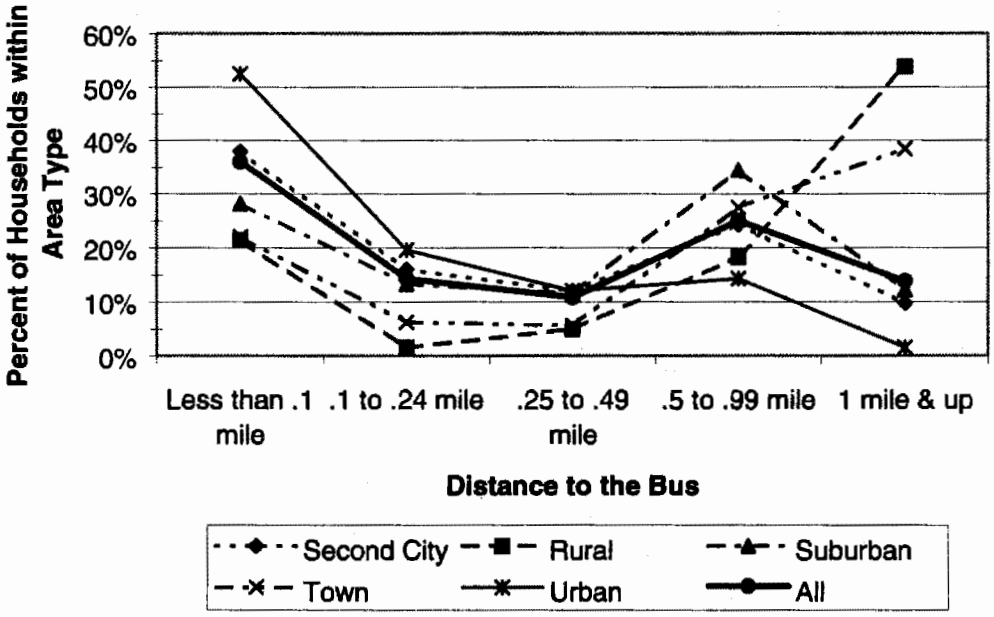
Table 26 summarizes the relationship between area type and transit availability. Urban areas have the highest percentage of available bus service (98.3%), exceeding the overall average of 63.4% by nearly one-third.

Suburban areas (87.4%) and second city areas (81.9%) also exceed the average by a large margin, indicating a tendency for these areas to have transit service available. Rural areas and towns both fall well-below the average with 14.3% and 37.6% service respectively.

Table 27
Distance To Transit From The Household By Area Type

	Area Type					
Distance to Transit from Household	Second City	Rural	Suburban	Town	Urban	All
Less than .1 mile	37.9%	21.4%	28.2%	22.1%	52.5%	36.0%
.1 to .24 mile	16.0%	1.6%	13.4%	6.3%	19.6%	14.3%
.25 to .49 mile	12.0%	4.9%	11.6%	5.7%	12.0%	10.8%
.5 to .99 mile	24.3%	18.3%	34.4%	27.5%	14.3%	25.1%
1 mile & up	9.7%	53.8%	12.3%	38.4%	1.6%	13.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Figure 4
Distance To Transit By Area Type



Approximately 52.5% of persons living in urban areas are less than .1 mile from transit while this is true for only 21.45 of those living in rural areas. When the distance to transit increases to between .1 to .24 mile, 19.6% of urban area residents enjoy this high level of accessibility, but this is true for only 1.6% of those living in rural areas. Residents living in urban areas and in second cities enjoy greater accessibility to transit. Approximately 53.8% of residents of rural areas live at least one mile or further from transit as do 38.4% of persons living in towns. Only 1.6% of urban dwellers are one mile or more from transit. It is clear that residents of rural areas and towns are transit constrained.

Table 28
Automobile Commuting By Area Type

	Area Type					
Commute Auto Usage	Second City	Rural	Suburban	Town	Urban	All
Go to Work by Auto	80.1%	67.3%	83.0%	75.5%	69.4%	75.9%
Do Not Go to Work by Auto	19.9%	32.7%	17.0%	24.5%	30.6%	24.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 28 shows that 75.9% of the population generally travels to work by auto. Second cities and suburban areas exceed this average with 80.1% and 83.0% of workers, respectively, using autos to travel to work. Rural and urban areas both fall below this average with 67.3% and 69.4% respectively. Work-related auto in towns falls at the average. These data indicate a greater dependence in second cities and suburban areas on auto use.

Table 29
Annualized Individual Travel Behavior By Area Type

	Annualized Individual Travel Behavior					
Area Type	Person Trips	Person Miles Traveled (PMT)	Person Miles per Trip	Vehicle Trips	Vehicle Miles Traveled (VMT)	Vehicle Miles per Trip
Second City	1,609	13,445	8	988	7,982	8
Rural	1,549	16,833	11	961	10,432	11
Suburban	1,595	13,790	9	1,009	8,431	8
Town	1,579	15,350	10	1,002	9,563	10
Urban	1,488	9,820	7	731	5,359	7
Overall	1,568	14,064	9	951	8,523	9

With 1,549 person trips, rural residents have the second lowest number of overall trips, and they make the third highest number of vehicle trips at 961. Rural residents are tied much more to their personal vehicles than residents of other areas. They also cover the most distance at 16,833 person miles annually. Townsfolk cover the next highest distance at 15,350 person miles and 9,563 vehicle miles. Urban residents make the fewest number of trips and cover the shortest distance by far with 731 vehicle trips. Part of the reason why the number of trips remains so low for urban residents may have to do with issues of data collection: trips of less than one block or equal to one half mile may be undercounted.

Residential Density

Area types provide a broad look at the geographic landscape. Residential density allows a closer look at land uses where people live and also a link to measures of people. Residential and population densities reflect similar parameters: both indicate the extent of concentration where people live. Population density measures the number of people per square mile; residential density measures the number of living units per square mile. A proportional increase in residential density may correspond with a proportional increase in population density. The two measures diverge in instances where more or fewer people live in a household, compared to the average. Variables such as race or age may impact residential density. Some cultures, for instance, typically live in large households with extended families, while other cultures value independence from family. Similarly, large numbers of single-person households may appear where high concentrations of young adults live.

Table 30
Block Group Residential Density By Area Type

	Area Type					
Block Group Housing Units per Mile^2	Second City	Rural	Suburban	Town	Urban	All
0 to 99	2.7%	81.3%	1.4%	26.8%	0.4%	23.0%
100 to 499	12.1%	12.9%	13.6%	39.5%	0.4%	16.9%
500 to 1,499	32.7%	4.3%	36.2%	22.6%	6.1%	21.6%
1,500 to 2,999	34.3%	1.3%	34.4%	9.8%	23.8%	20.7%
3,000 & up	18.1%	0.2%	14.4%	1.4%	69.2%	17.9%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 30 compares block group residential density to area type and reveals that urban and rural areas are at opposite ends of the spectrum with regard to residential density. Urban areas have the greatest percentage of dense residential areas and the lowest percentage of areas with sparse dwellings. Over 80% of rural areas have residential densities under 100 housing units per square mile. Second cities and suburban areas are comparable to each other with over 65% of block groups having between 500 and 3,000 housing units per square mile.

Table 31
Miles Driven Last Year By Residential Density And Gender

Block Group Housing Units per Mile^2	Annual Miles Driven			
	Male		Female	
	Mean	Median	Mean	Median
0 to 99	17,956	14,000	10,637	9,500
100 to 499	17,523	14,000	10,088	9,000
500 to 1,499	15,382	12,000	8,987	8,000
1,500 to 2,999	14,351	12,000	8,485	7,000
3,000 & up	12,360	10,000	7,387	5,000

The number of miles an individual drives annually consistently decreases as residential density increases. This trend appears in both mean and median measures of central tendency and holds true across gender. The genders diverge, however, in actual numbers of miles driven.

In block groups with over 3,000 housing units per square mile, females drive 7,387 miles annually, which is 4,973 miles fewer per year than males do on average, a 60% difference. In areas with residential densities lower than 100 housing units per square mile, the large difference between the genders increases up to 7,134 miles annually on average, which is also a 60% difference.

Table 32
One-Way Work Trip By Residential Density And Gender

Block Group Housing Units per Mile^2	Distance to Work (Miles)				Time to Work (Minutes)			
	Male		Female		Male		Female	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
0 to 99	17	12	13	10	24	20	20	15
100 to 499	17	10	12	8	25	20	20	15
500 to 1,499	14	9	11	7	22	18	20	15
1,500 to 2,999	13	8	10	6	23	18	20	15
3,000 & up	11	7	9	6	24	20	24	20

For those block groups with 0-99 units per mile, men drive 17 miles while females drive an average of 13 miles one-way for the work trip (Table 32). At the very highest density 3,000 and up males drive 11 miles while females drive 9 miles. The statistics for the time to work corresponds to the pattern observed for distance traveled with males generally traveling greater distances and having correspondingly longer travel times. Males drive for approximately 24 minutes and females for 20 minutes at the lowest density block group and 24 minutes and 24 minutes respectively in the densest block group levels of 3,000 or more housing units. The distance to work decreases for both males and females as housing unit density increases. This is not true for travel time where males living in block groups with 0 to 99 units travel 24 minutes and males living in block groups with more than 3,000 units per mile also travel 24 minutes on average. For females, travel time to work is 20 minutes in low residential density areas and reverses the trend and increases to 24 minutes as density increases. As housing density increases distance to work decreases for males and females.

However, as density increases we do not see a decrease in travel time for males or females. Travel time to work for females is constant at 20 minutes except for an increase in travel time for women living in the most densely populated block groups. There are many possible explanations including congestion associated with densely populated areas as well as the mode of travel or the time of day when the trip occurs.

Table 33
Transit Availability By Residential Density

Block Group Residential Density (Housing Units/ Mile^2)	Transit Availability		Total
	Bus Service Available	No Bus	
0 to 99	20.3%	79.7%	100.0%
100 to 499	44.3%	55.7%	100.0%
500 to 1,499	70.1%	29.9%	100.0%
1,500 to 2,999	85.8%	14.2%	100.0%
3,000 & up	96.4%	3.6%	100.0%
All	63.4%	36.6%	100.0%

As housing density increases the availability of bus service increases from 20.3% for block groups with 0 to 99 units to 96.4% for block groups with 3,000 or more housing units. The general availability of bus service is approximately 63.4% while 36.6% of residents do not have bus service available across all housing density levels (Table 33).

Table 34
Distance To Transit From The Household By Residential Density

Distance to Transit from Household	Block Group Residential Density (Housing Units/ Mile^2)					
	0 to 99	100 to 499	500 to 1,499	1,500 to 2,999	3,000 & up	All
Less than .1 mile	17.8%	19.4%	25.7%	35.1%	54.3%	36.0%
.1 to .24 mile	2.6%	6.0%	13.0%	18.3%	17.2%	14.3%
.25 to .49 mile	3.3%	7.2%	10.5%	13.5%	11.5%	10.8%
.5 to .99 mile	19.1%	31.2%	36.0%	26.9%	14.6%	25.1%
1 Mile & up	57.2%	36.2%	14.8%	6.2%	2.4%	13.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

For those persons having transit available the distance to transit decreases for a larger number of households in the densest block groups (Table 34). At the 0 to 99 level approximately 17.8% of households are less than .1 mile. When residential density increases up to 3,000 units 54.3% of households are less than an .1 mile increase of more than 300%. At the lowest residential density there is a drop at the .1 mile to .49 mile range with a total of 5.9% of households located between those distances.

These numbers change to 19.1 % for households that are located beyond .5 mile of transit. At the 3,000 and up density level only 2.4% of households are located at a distance of one mile or greater from transit. While approximately 57.2% of households are located more than a mile from transit in the lowest density level.

The lack of accessible transit service (within one-quarter mile) in low density residential areas means that persons living in rural areas that are transit dependent have limited or no transit alternative. The distance from the transit station or bus stop is critically important to the decision whether or not to use transit at all.

Table 35
Mode Of Transportation By Residential Density

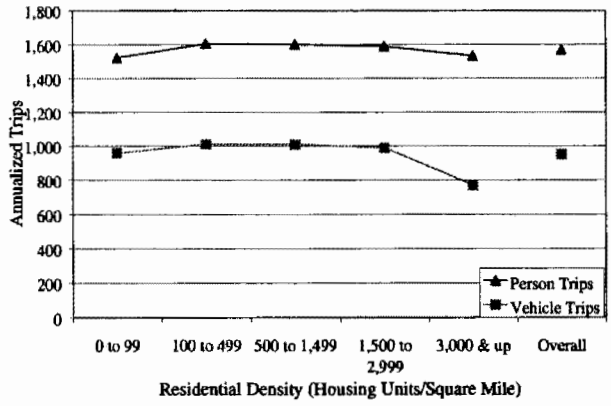
	Block Group Residential Density (Housing Units/ Mile^2)					
Mode of Transportation	0 to 99	100 to 499	500 to 1,499	1,500 to 2,999	3,000 & up	All
Private Vehicle	93.2%	92.8%	92.2%	90.3%	76.0%	89.3%
Public Transit	3.5%	3.1%	3.0%	2.8%	8.4%	4.0%
Taxi	0.0%	0.1%	0.1%	0.1%	0.7%	0.2%
Bicycle/Walk	3.3%	4.1%	4.7%	6.8%	14.9%	6.5%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

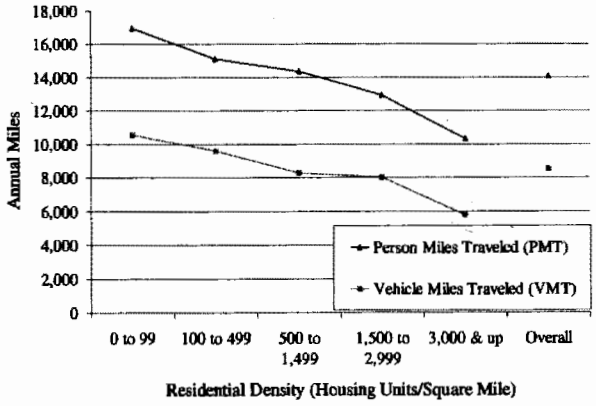
Table 35 reports the results of the primary mode used by respondents. They were asked to identify the mode used for the longest portion of the trip taken. The pre-dominance of the private vehicle is evident across all residential densities. The mode of transportation used by most households in the lowest density areas is the private vehicle used by 93.2% of households. Where residential density is the greatest approximately 76.0% of households use the private vehicle. The densest residential areas display significantly lower dependence on the private vehicle. The availability of transit and other modes explains some of this as well as the existence of large numbers of urban poor that do not own automobiles. Public transit is used by 8.4% of households in the densest residential areas and only 3.5% use it in the lowest density areas. The largest number of bicycle and walk trips are made by households in the densest residential areas and this is probably influenced by the proximity of trip destinations. Overall 89.3 use the private vehicle and 4% use transit.

Table 36
Annualized Individual Travel Behavior By Residential Density

Block Group Residential Density (Housing Units/ Mile^2)	Annualized Individual Travel Behavior					
	Person Trips	Person Miles Traveled (PMT)	Person Miles per Trip	Vehicle Trips	Vehicle Miles Traveled (VMT)	Vehicle Miles per Trip
0 to 99	1,521	16,973	11	959	10,562	11
100 to 499	1,604	15,092	9	1,011	9,590	9
500 to 1,499	1,601	14,366	9	1,010	8,283	8
1,500 to 2,999	1,588	12,923	8	989	8,020	8
3,000 & up	1,532	10,304	7	771	5,764	7
Overall	1,568	14,064	9	951	8,523	9

Figure 5
Annualized Individual Travel Behavior By Residential Density





The impact of residential density on Vehicle Miles Traveled (VMT), Vehicle Trips, and Person Miles Traveled (PMT) is illustrated in Table 36. As residential density increases there is a corresponding decrease in person miles traveled, vehicle trips, and vehicle miles traveled.

From the lowest density residential areas to the densest, the number of person miles traveled decreased by approximately 60.7%, vehicle trips decreased by 58.35% and vehicle miles traveled decreased by 54.31%. So, as residential density increased travel in all three categories experienced a sizable decrease. However, this decrease in travel as density increased was not true for person trips which increased although by only .007%. So residents made slightly more person trips in the densest residential areas but traveled fewer personal miles, made fewer vehicle trips, and reduced the total number of vehicle miles traveled. Increased residential density results in the sizable reduction in specific categories of travel.

Table 37
Work Location By Residential Density

	Block Group Residential Density (Housing Units/ Mile^2)					
Place of Work	**0 to 99**	**100 to 499**	**500 to 1,499**	**1,500 to 2,999**	**3,000 & up**	**All**
Work from Home	7.9%	6.0%	5.1%	5.4%	4.8%	5.9%
No Fixed Work Place	2.5%	1.7%	1.7%	2.5%	2.4%	2.2%
Work at Work Location	89.6%	92.3%	93.2%	92.0%	92.8%	91.9%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 37 reports the impact of residential density on workplace choice. As residential density increases the percentage of persons working from the home decreases from 7.9% to 4.8% while the number of persons working at a work location increases from 89.6% to 92.8%. This increase in employment at a work location may be attributed to a variety of sources for example, greater and more diverse employment opportunities, the availability of transit, wages, and more walk and bicycle trips.

Table 38
Employment Density By Residential Density

Work Tract	Block Group Residential Density (Housing Units/ Mile^2)					
Employment Density (Employees per Mile^2)	**0 to 99**	**100 to 499**	**500 to 1,499**	**1,500 to 2,999**	**3,000 & up**	**Overall**
0 to 174	96.0%	42.2%	6.4%	1.4%	0.5%	36.6%
175 to 799	1.9%	44.8%	40.0%	23.2%	7.9%	21.0%
800 to 1,999	0.6%	7.8%	32.0%	38.1%	24.5%	18.9%
2,000 to 6,499	0.7%	3.6%	17.4%	30.3%	42.3%	16.8%
6,500 & up	0.7%	1.6%	4.2%	6.9%	24.7%	6.7%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

For those people who work at a fixed work location, patterns of employment density follow patterns of residential density. The data in table 38, which come from census data provided by Claritas (as opposed to NPTS data provided by the Federal Highway Administration), show trends where increasing employment density corresponds with increasing residential density. By far, areas with fewer than 100 housing units per square mile have the highest percentage of people working in areas with fewer than 175 jobs per square mile (96.0%). Similarly, areas with over 3,000 housing units per square mile have the highest percentage of people who work in census tracts with over 6,500 employees per square mile (24.7%). Overall, however, the largest percentage of all people work in tracts with fewer than 175 jobs per square mile (36.6%), which could represent a turnaround trend from the days when cities as commercial centers were seen as primary employment centers.

Age of Housing

The age of housing provides another important indicator for residential area land use. New housing in an area implies population growth in that area, and transportation infrastructure must meet the needs of the population where it exists.

Table 39
Age Of Housing By Area Type

% of Block Group	Area Type					
Housing Units Built in the Last Ten Years	Second City	Rural	Suburban	Town	Urban	All
0-20%	80.6%	87.1%	75.2%	70.7%	93.5%	80.6%
21-40%	11.0%	11.5%	13.0%	19.2%	4.8%	12.3%
41-60%	4.8%	1.3%	6.9%	6.2%	1.5%	4.4%
61-80%	2.4%	0.0%	3.3%	2.2%	0.2%	1.7%
81-100%	1.2%	0.1%	1.6%	1.6%	0.1%	1.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

New development has occurred in the last ten years primarily outside of urban and rural areas. Joel Garreau classifies edge cities as areas that were "nothing like 'city' as recently as thirty years ago[vi]." These development configurations started appearing in America much later than traditional urban areas. The similar concept of second city approximates edge city for the NPTS data. Presumably, housing for second cities would be remarkably young; however, the NPTS data do not indicate substantial youth for second cities compared to town and suburban areas. Town and suburban areas have been developed more recently, with only 29.3% and 24.8% of their block groups respectively containing over 20% housing built in the last ten years. This is 19.4% in second cities.

Suburban areas, where 11.8% of the block groups constructed 40% of their housing units in the last ten years, have the highest percentage of very young communities. Existing housing structure in urban and rural areas has maintained a substantially dominant presence with 93.5% and 87.1% of block groups containing less than 20% housing units built in the last ten years (Table 39).

Table 40
Bus Availability For Recent Builds

Bus Availability	% of Block Group Housing Units Built in Last 10 Years					
	0-20%	21-40%	41-60%	61-80%	81-100%	All
Bus Service Available	64.4%	54.8%	65.9%	72.9%	67.1%	63.4%
No Bus	35.6%	45.2%	34.1%	27.1%	32.9%	36.6%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Public transit infrastructure develops over a multi-year process. Established urban areas implemented sophisticated public transit decades ago. Newer towns experiencing high growth may find themselves facing heavy need for transit before infrastructure can be developed. Urban and rural areas have the highest percentages of block groups with less than 20% housing built in the last ten years. Urban areas have well-established transit systems with 98.3% of the population served by transit; with just 14.3% of rural residents claiming transit availability, rural areas have little transit infrastructure.

Transit infrastructure appears to meet new demand. All block groups with over 40% housing units built in the last ten years surpass the overall average of 63.4% of the people served by transit. Areas with between 61 and 80% new housing units achieve the highest level of transit availability with 72.9% of the population of these areas served (Table 40).

Table 41
Percentage Of Renter-Occupied Housing By Area Type

Renter-Occupied Housing in the Block Group	Area Type					
	Second City	Rural	Suburban	Town	Urban	All
0-9%	9.7%	4.9%	25.4%	15.9%	4.9%	13.1%
10-19%	15.1%	45.1%	22.0%	29.4%	9.3%	24.7%
20-29%	15.3%	30.5%	15.8%	21.1%	9.7%	18.7%
30-49%	25.3%	17.4%	18.6%	23.0%	18.6%	20.6%
50-100%	34.6%	2.1%	18.2%	10.5%	57.5%	23.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

As shown in Table 41, area type appears to influence the amount of renter-occupied housing. Urban areas have high rental capacity. Second cities have more rental housing than less densely populated areas but less rental housing than urban areas provide. The largest concentration of rental units in rural areas, 45.1%, occurs in block groups containing between 10 and 19% of rental units. Rural areas match urban areas with only 4.9% of block groups containing less than 10% rental housing. More than 75% of all rural block groups contain between 10 and 29% rental units.

Towns also show a peak at 10 to 19%, but towns have a more even spread that includes 33.5% of block groups with 30 to 100% renter-occupied housing.

Table 42
Transit Availability By Housing Tenure

Housing Tenure	Transit Availability: Bus Service Available	Transit Availability: No Bus	Total
Owned	57.9%	42.1%	100.0%
Rented	77.2%	22.8%	100.0%
Provided By Job or Military	50.7%	49.3%	100.0%
Other	64.7%	35.3%	100.0%
All	63.3%	36.7%	100.0%

As shown in Table 42, public transit serves 50% or more of all housing types. Transit is most closely associated with rental communities, where 77.2% of renters have access to bus service. Rental communities typically include more people without personally owned vehicles compared to communities where home ownership is more common. Approximately 58% of communities have available bus service in areas where home ownership prevails.

Table 43
Distance To Transit By Housing Tenure

Distance to Transit from Household	Housing Tenure: Owned	Rented	Provided By Job or Military	Other	All
Less than .1 mile	29.0%	49.2%	30.3%	65.4%	36.0%
.1 to .24 mile	14.2%	14.5%	6.7%	12.0%	14.3%
.25 to .49 mile	11.6%	9.4%	1.8%	0.0%	10.8%
.5 to .99 mile	28.0%	19.6%	48.9%	17.2%	25.1%
1 Mile & up	17.2%	7.3%	12.4%	5.4%	13.7%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Renters live closer to transit than owners. Of the 77.2% of renters reporting bus service available to them, 49.2% live within one-tenth of a mile of bus service. Only 29% of served owners report that proximity to transit, but even 82.8% of owners with bus service available to them live within one mile of transit. The typically dense nature of rental housing may explain why renters receive better service from public transit: one bus route can easily provide transportation for a large number of renters located in a small area (Table 43).

With only half of the community living in homes provided by employers or the military receiving transit service, 48.9% of this segment of the community lives between one half and one mile away from bus service. Another 30.3% of this community lives less than one-tenth of a mile away from transit. These figures resemble transit availabilities for owner more than for renters. Military personnel may live on bases which provide self-contained communities without need for extensive transportation to non-military locations.

Measures for Employment

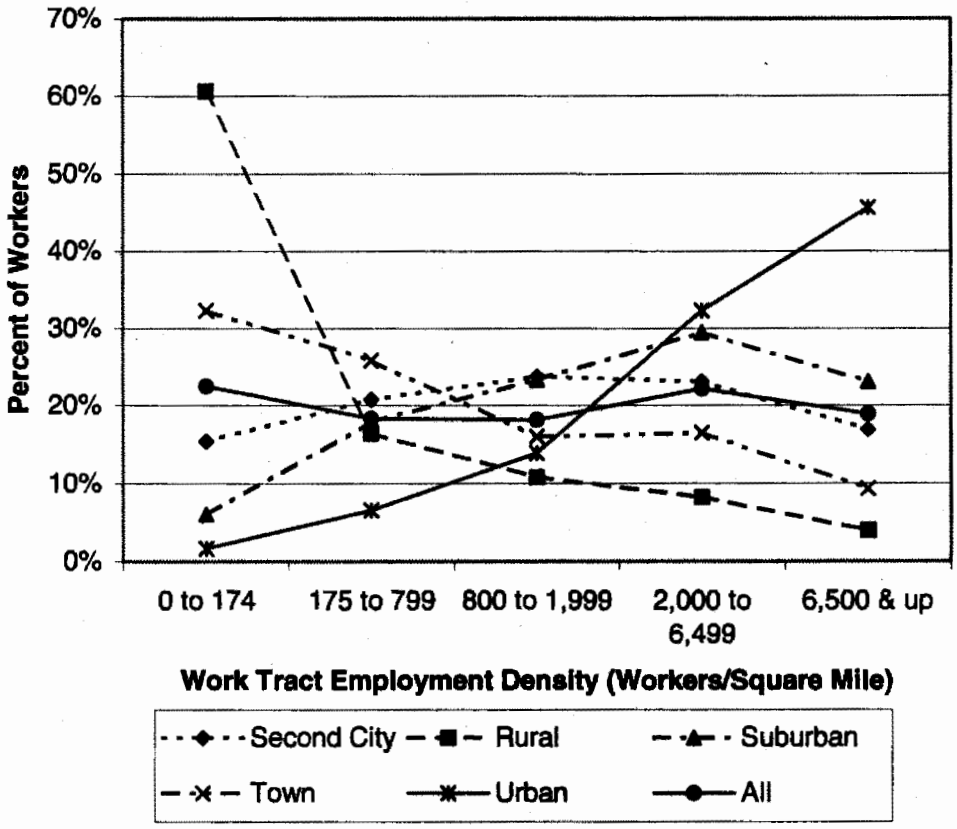
Employment Density

The NPTS data indicate that employment density patterns and population density patterns typically mirror one another. People living in rural areas tend to work in areas of low employment density. People living in urban areas tend to work in areas of high employment density. A graph of work tract employment densities shows striking difference in trend lines according to area type. The trend line for urban areas sweeps up as work tract employment density increases, while the trend line for rural areas turns downward. The trend line for town residents decreases with a downward slope not as steep as the slope for the rural trend line.

Table 44
Work Tract Employment Density By Home Block Group Area Type

Work Tract	Area Type					
Employment Density (Workers per Mile^2)	Second City	Rural	Suburban	Town	Urban	All
0 to 174	15.4%	60.7%	6.0%	32.3%	1.7%	22.5%
175 to 799	20.8%	16.4%	17.9%	25.9%	6.5%	18.3%
800 to 1,999	23.8%	10.8%	23.4%	16.0%	13.9%	18.2%
2,000 to 6,499	23.1%	8.2%	29.5%	16.5%	32.3%	22.2%
6,500 & up	16.9%	3.9%	23.1%	9.3%	45.6%	18.9%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Figure 6
Work Tract Employment Density By Home Block Group Area Type



Trend lines for residents of suburbia and second cities display employment location decisions similar to each other. These trend lines include maximum values. Percentages of second city residents working in tracts with low employment densities increase as employment densities increase, up to a maximum value with 23.8% of second city residents working in census tracts with employment densities from 800 to 1,999 jobs per square mile. A lower percentage of second city residents work in tracts with higher employment densities. Employment density for suburban residents reaches a maximum value with 29.5% of suburban residents working in tracts with employment densities from 2,000 to 6,499 jobs per square mile; fewer suburban residents work in tracts with over 6,500 jobs per square mile.

The graphed trend lines translate easily into indications of density preference. Urban residents live in areas of high population density and, presumably, live near an area of high employment density; therefore, 45.6% of urban residents work in tracts with over 6,500 jobs per square mile. Rural residents live in sparsely developed areas where job densities remain low. Approximately 60.7% of rural residents work in tracts with less than 175 jobs per square mile (Table 44).

Table 45
Miles Driven Last Year By Employment Density And Gender

Work Tract Employment Density (Employees per Mile^2)	Annual Miles Driven			
	Male		Female	
	Mean	Median	Mean	Median
0 to 174	19,367	15,000	11,277	10,000
175 to 799	18,399	15,000	11,144	10,000
800 to 1,999	17,466	15,000	10,956	10,000
2,000 to 6,499	16,537	15,000	10,895	10,000
6,500 & up	14,543	12,000	10,353	10,000

Females do not change their travel behavior as drastically as males do as employment density at the work tract changes. Males working in low employment densities from 0 to 174 employees per square mile annually drive an average of 19,367 miles while females drive 11,277 miles (Table 45).

Table 46
One-Way Work Trip By Employment Density And Gender

Work Tract Employment Density (Employees per Mile^2)	Distance to Work (Miles)				Time to Work (Minutes)			
	Male		Female		Male		Female	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
0 to 174	**12**	**7**	**9**	**6**	**18**	**15**	**15**	**11**
175 to 799	**12**	**8**	**9**	**6**	**20**	**15**	**17**	**15**
800 to 1,999	**13**	**8**	**10**	**7**	**22**	**15**	**19**	**15**
2,000 to 6,499	**13**	**9**	**10**	**7**	**23**	**20**	**21**	**15**
6,500 & up	**15**	**10**	**13**	**9**	**30**	**25**	**28**	**24**

People live farther away from work when the workplace is located in a tract with high employment density than when the workplace is located in a tract with low employment density. The distance from home to the workplace does not vary by much; however, distance consistently increases for both men and women as employment density increases. Men working in work tracts with over 6,500 jobs per square mile commute 15 miles to work on average, which is 3 miles more than men who work in work tracts with under 175 jobs per square mile. Females working in high density work tracts commute 4 miles more on an average one-way trip to work than females working in low-employment density work tracts.

Average commute times for both men and women almost double, going from 18 minutes in a low-employment density area to 30 minutes in a high-employment density area for males and going from 15 minutes in a low-employment density area to 28 minutes in a high-employment density area for females. This strong increase in commute time may be attributable to the increased traffic encountered in areas of high-employment density during peak hours (Table 46).

Retail Employment

Employment density gives indications for travel behavior for all workplaces. Dissecting employment by Standard Industrial Classification (SIC) codes can offer a more refined view of how certain industries affect an area's transportation. This refined view becomes increasingly important when one or two industries dominate an area's employment.

Table 47
Retail Trade By Area Type

Percent of the Work Tract's 16+ Population Working in Retail Trade	Home Block Group Area Type					
	Second City	Rural	Suburban	Town	Urban	All
0 to 9%	28.3%	23.5%	31.4%	26.7%	38.8%	29.5%
10 to 14%	16.8%	23.4%	18.7%	18.5%	19.1%	19.2%
15 to 24%	26.2%	32.1%	25.4%	29.6%	23.8%	27.4%
25% & up	28.8%	21.0%	24.5%	25.2%	18.2%	23.9%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Economists historically started defining American cities with a monocentric model in which all development formed around a central business district. Retail employment has traditionally been associated with urban areas. The metamorphosis of American land use has resulted in malls and retail areas on the outer edges of metropolitan areas and outside cities. The 1995 NPTS shows the plurality of workers living in urban block groups (38.8%) work in census tracts with less than 10% of the population working in retail trade. Urban areas also have the smallest percentage of workers (18.2%) who are employed in tracts with over 25% retail trade participation. Second cities have taken the lead in retail trade where 28.8% of residential block groups have residents who work in tracts with over 25% of their employees working in retail. Rural areas follow closely with where 32.1% of the workforce of rural block groups working where 15 to 24% of jobs are in retail (Table 47).

Table 48
Miles Driven Last Year By Retail Employment And Gender

Percent of the Work Tract's 16+ Population Working in Retail Trade	Annual Miles Driven			
	Male		Female	
	Mean	Median	Mean	Median
0 to 9%	17,184	14,000	10,788	10,000
10 to 14%	18,164	15,000	11,225	10,000
15 to 24%	17,184	15,000	10,797	10,000
25% & up	17,077	15,000	11,044	10,000

The percent of retail employment in one's work census tract does not appear to affect an individual's annual mileage driven. The median annual mileage for females remains constant at 10,000 miles, regardless of work tract retail employment. For males, median miles decrease from 15,000 miles annually to 14,000 miles annually when census tract participation in retail trade falls below 10%. This slight variation does not appear significant since mean mileage is fairly consistent. The results suggest retail employment in the work tract does not affect annual driving distances (Table 48).

Table 49
One-Way Work Trip By Retail Employment And Gender

Percent of the Work Tract's 16+ Population Working in Retail Trade	Distance to Work (Miles)				Time to Work (Minutes)			
	Male		Female		Male		Female	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
0 to 9%	14	10	11	8	25	20	23	20
10 to 14%	13	9	10	7	23	18	21	15
15 to 24%	13	8	10	6	21	15	19	15
25% & up	12	7	10	6	19	15	18	15

Retail employment may, however, provide some effect on work trips. High participation in the retail workforce seems to indicate shortened commutes in terms of both distance and time. Males working in census tracts with over 25% of the jobs in retail trade commute two miles fewer than males working in census tracts with under 10% retail employment. This two-mile reduction in commute distance results in a six-minute reduction in commute time. Females correspondingly reduce their commutes by one mile or five minutes. Retail industries typically begin their workdays after the morning peak period and often end their workdays after evening peak periods. People commuting in areas with a high percentage of retail trade will find the population's commutes spread over a longer period of time than the typical peak period and commuters will encounter fewer delays due to congestion.

FINDINGS AND CONCLUSIONS

Measures for People

Greater population density is associated with a number of travel outcomes including decreasing annual miles driven for both genders for all population densities. This is most certainly affected by the fact that bus availability increases with population density offering other travel choices for urban residents. The existence of transit in more dense populations is associated with fewer miles driven and transit is located most closely to households in the most densely populated areas. Clearly increased density is highly correlated with decreased dependency on the single occupancy vehicle resulting in fewer annual miles driven. People in lower density areas travel longer distances to work and have longer commute times, however recently the most densely populated areas are showing an increase in commute times. To some extent this is attributable to increasing congestion levels in urban areas.

Less densely populated areas tend to have more drivers per adult and more vehicles per adult. The lack of available travel options (modes) explains some of this. The private automobile dominates as the most preferred mode of travel but the use of transit increases as population density increases. Therefore we see greater reliance on the use of the automobile where travelers have few or no alternatives for traveling. Whites are more heavily dependent on the single occupancy vehicle than are other races. African Americans and Hispanics are slightly more likely to use other forms of transportation. Transit availability is below average for whites and above average for African Americans, Asians and Hispanics. Transit availability is generally associated with increases in educational attainment. As educational levels increase these persons tend to locate where they have more access to transit.

Wealthier households are most prevalent in suburban areas, middle income households are most common in rural areas, and households with the lowest incomes are most common in second city, urban and rural areas. Areas with the greatest percent of block groups living in poverty tend to have the greatest accessibility (least distance) to transit.

Households with no children and a working-age adult tend to locate most closely to transit, while families with children under 16 generally live farther from transit. Younger workers tend to have shorter work trip distances and trip times, regardless of gender and females have shorter work trip distances than males across all age groups. Cities attract young adults, both single and married , who have no children; families with children tend to live in suburban areas and towns while the elderly have their greatest presence in second cities.

Increasing density is associated with fewer person trips, person miles traveled (PMT) and person miles per trip. Vehicle trips, vehicle miles traveled (VMT) and vehicle miles per trip are all lowest in the most densely populated areas. Increased densification is one way to reduce miles traveled although the critical question is what level of density would be necessary to cause a significant reduction in miles traveled or a substantial increase in transit usage.

Measures for Places

Area Type

Controlling for area type revealed several correlations between land use and transportation. These new NPTS data which quantify travel characteristics by area type for the first time help identify and verify important trends in the interaction of urban form and travel behavior. Rural, urban and second city areas show noteworthy travel characteristics.

Rural area residents depend heavily on private transportation. They make fewer person trips than almost any other area residents in the country, yet their annual person miles traveled surpass the residents of other areas. Vehicle trips show a similar pattern. Rural areas lead with the highest ratio of young drivers to the adult population, and over one quarter of the residents own more than one vehicle per adult. Rural areas have a lower than average percentage of workers who go to work by private auto, but these areas also have the highest percentage of people who work from home, which indicates either preference or a lack of mobility. Only 14.3% of rural residents have access to transit service, compared to a national average of 63.4%. For over half of those people who do have transit in their rural areas, bus service does not reach closer than one mile from home.

Urban areas can be described at the opposite end of the spectrum. These areas lead with almost a third of the population having less than one driver per adult and less than two percent of the population having more than one driver per adult. Almost half of urban residents share private vehicles or live without them. Urban workers commute across the shortest distances of anyone, but the time length of their work trips slightly exceeds the duration commute trips in other areas.

Urbanites enjoy an array of transportation options, including transit, which is available for 98.3% of the urban population. Over half of these residents have access to transit within one tenth of a mile of their homes. Even with transit options available, 69.4% of urban workers commute to work in an auto. This number represents less auto commuting than the national average of 75.9%, but it also expresses a strong preference for commuters to take an auto to work.

Urban dwellers reported the lowest number of person trips of anyone. Urban residents reported driving just over half as many vehicle miles annually as rural residents. Urbanites cover less distance in vehicles than people from any other area type.

Second cities, here defined as areas of concentrated population density with population centers less dense than the core found in urban areas (see Key Terms and Definitions), have aroused a great deal of interest in recent years. While edge city population and employment clustering has been happening over decades, categorizing this new development phenomena has proven challenging. The 1995 NPTS shows why: second cities display characteristics of several of the other area types.

In some contexts, second cities follow national averages. For 80% of the population of second cities, there is one driver for every adult, and there is one vehicle for each adult for 61.6% of the population, which is slightly higher than the national average. Second cities follow the national average for the percentage of workers working from home and the percentage of workers working at a fixed workplace. Unlike urban and rural areas, where less than 70% of the workers commute to work by auto, second city residents resemble the people of suburban areas in terms of auto dependency for their commutes. Only 20% of second city residents go to work by a mode other than a private automobile.

In other respects, second cities resemble traditional urban areas. Second city workers find employment at distances from work equivalent to the distances that urban workers traverse, but the commute for second city residents takes between five and seven minutes less time (between one fifth and one fourth of the travel time).

Second city residents reported the highest number of person trips of any area type. The next highest number of person trips came from suburban areas. Person miles traveled and vehicle miles traveled by second city residents fell short of the national average. Second city residents make frequent short trips.

In many ways, second cities represent a middle ground between urban and rural areas. Approximately 82% of second city residents have bus service available to them, which is a far higher percentage than for people in towns and rural areas but a lower percentage than for urban and suburban residents. Those second city residents who have transit service available to them typically live close to transit: 37.9% live within one tenth of a mile of transit, which is a far higher percentage than in rural, suburban, and town areas.

Second cities will continue to provide transportation challenges. People living in second cities enjoy the benefits of agglomeration, but they also prefer easy access to open spaces. The conveniences of a thriving small city atmosphere quickly grows into a transportation challenge when attempting to meet the needs of diverse residents. For instance, NPTS data indicate a high percentage of low-income residents already live in second cities.

Without the extensive transit coverage that already exists in urban areas, the growing numbers of people who cannot afford private vehicles will have a difficult time surviving in automobile-dependent second city communities. Traffic congestion in these areas provides another challenge. Finding transportation alternatives for these communities to meet their needs while maintaining the in-between character of second cities poses a creative challenge to all transportation professionals.

Residential Density

As might be expected, high residential densities typically occur in urban areas and low residential densities typically occur in rural areas. About two thirds of second city and suburban people live where residential densities range between 500 and 2,999 housing units.
Travel distances, including annual miles driven, commute trip length, person miles, and vehicle miles, decrease as residential density increases. Interestingly, the distribution of commute time for males is U-shaped, indicating longer trips at the lowest and highest residential densities. Likewise, person trips and vehicle trips for both genders increase to a maximum value and then decrease as residential density increases. People in areas of medium residential density make the highest number of trips and have the longest commutes. Males in these areas have the longest commute times.

Transit availability and residential density share a positive correlation. Increasing housing density is associated with greater transit availability and closer proximity to transit. The availability of alternative transportation facilities reflects itself in mode choice. People living in higher residential densities rely less on private vehicles for trip-making than their counterparts living in lower residential densities do. Bicycle and walk trips increase as residential density increases.

Residential density correlates to some degree with employment, as well. Increasing employment density is associated with increasing residential density. Residential density does not correspond greatly with place of work decisions, but some slight variation exists. At residential densities between 100 and 1,499 housing units per square mile, people are less likely to work at an unfixed workplace. Low residential density areas have the greatest percentage of people who work at home.

Age of Housing

The age of housing provides an indicator for the growth or decline in an area. New housing in an area implies population growth and increased transportation demand. Second cities, which are relatively new phenomena, should be expected to have a high proportion of recent builds. In fact, second cities, towns, and suburban areas have the greatest proportion of housing built in the last ten years. Urban and rural communities established the base of their housing infrastructure prior to the last decade.

Implementing transportation strategies for new communities poses a challenge to keep pace with growth. Data show that new builds are receiving transit service. Approximately, 72.9% of the people who live in block groups comprised of 61-80% housing units built in the last ten years have bus service. The least amount of bus service available (54.8%) occurs in block groups with 21-40% new builds. Transportation planners are generally meeting the demands of growth where development is concentrated.

Housing Tenure

Housing tenure offers an indication of the likelihood of community residents to use transit. Public transit serves over 50% of all housing types, but transit is most closely associated with rental communities, where 77.2% of the residents have transit availability. Rental units, which are typically densely oriented, are easy for transit to serve. Urban areas have the highest percentages of renter-occupied housing compared to other area types. Non-rental units are typically located in suburban areas.

Measures for Employment

Urban residents live in areas with high employment density and rural and town residents work in areas with lower employment densities. Second city and suburban residents work in areas with moderate employment density. However, the annual miles driven decreases for both genders as work tract employment density increases. In addition, distance to work and time to work increase for both men and women as employment density increases. The increased availability of other modes of travel in densely populated areas, including the walk mode, would suggest decreasing travel and commute times but the role of congestion must be considered.

Distance to work and travel time to work decrease as the percentage of retail trade in an area increases. Urban areas have the smallest percentage (18.2%) of block groups with over 25% retail trade, second cities have taken the lead in retail trade with 28.8% of block groups in second cities having over 25% of their population in retail. Rural areas have 32.1% of rural block groups with 15 to 24% of their populations working in retail.

OTHER RESEARCH

The land use special report for the 1995 NPTS provides a starting point for research in several directions. Further work with the 1995 NPTS may include a closer look at the integrated effect of land use and population variables. For instance, do particular races in urban areas have to pay to park more than others? Does a parking fee affect mode choice for urban African Americans? For urban Hispanics?

Other aspects of these data can be broadened. Now that employment density has been established as a standard for land use studies, this variable can be further integrated into descriptions of areas. This report explored the effects of employment density and retail employment on travel behavior. Other areas of employment should also receive attention to determine how to meet the needs of communities based upon their employment centers. The changing Standard Industrial Classification (SIC) system will provide some interesting data in this regard.

Future studies of land use and transportation should refine and expand independent variables. Zoning, for example, will provide another interesting dimension to this exploration. Self-reporting of land use characteristics should provide a good indication. Also, integrating NPTS data with geographic information systems (GIS) in the future will open new areas of exploration.

The issue of how land use interacts with transportation opens more questions than one report can possibly answer. This report endeavored to explore some initial areas of interest and lay a foundation for future research in this area.

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[6] Garreau, ibid.

VI.

DISCUSSION FROM THE PAPER PRESENTATIONS

Discussion after the presentations of Daphne Spain and Elaine Murakami and Jennifer Young's papers

A comment was made that the gap between women and men in the labor force narrowed in the 1970s, not in the 1980s as inferred in Ms. Spain's paper. Currently, 60% of women, and 76% of men are in the labor force. Responding to a comment that suburban mixed use and high density might be as desirable as a move to the central city, Ms. Spain commented that the infrastructure already existed in the central cities, and that the potential for renewal of neighborhoods in the central cities had already been demonstrated. She added that the elderly currently living in the suburbs, who moved there thirty years ago, no longer have the same reasons to live there (e.g. schools, size of housing).

The makeup of current transit users was also discussed. It was noted that in certain areas where minority families have moved into higher income brackets, public transit use remains high. Similarly, immigrants from countries which are highly dependent on public transit may be more likely to continue to use public transit even after they are financially able to acquire cars.

There was considerable discussion about older drivers—whether or not vision and other tests might be imposed to reduce the number of licensed drivers, how important the sense of personal independence is to older divers, and whether there may be substitutes for that sense of independence. There was a suggestion that retailers and health care providers should consider offering a "limo" service, and there should be an effort to enhance the image of using public transit. It was noted that NHTSA was conducting research in the area of older driver profiles. However, it was noted that no matter how glamorous an ad campaign depicts public transportation, the quality of service would be the determinant of actual use.

One way to look at the changing travel patterns of older drivers is to use 1995 NPTS in combination with prior NPTS. Building age cohorts might be a useful way to approach this analysis. Data users were cautioned that because a travel diary was used in 1995, and many more short trips were reported, direct comparisons could be problematic.

Discussion after Pickrell and Schimek, and Ross and Dunning papers.

Pickrell and Schimek found that in comparing the 1995 NPTS to 1990 NPTS, VMT per driver declined, particularly for young male drivers, under 35 years of age. There was discussion about what may have contributed to these surprising figures. Some of the ideas were: it may be a response to slower travel speeds or to driver routing during peak congestion; the 18 to 35 age group was increasingly living in urban areas; there has been a slight increase in use of rail transit in several major cities; perhaps there is a shortening of commute trip length for new entrants into the workforce.

Responding to a question about the precision of the daily household VMT model in their paper, Mr. Pickrell responded that the large sample size of NPTS provided high statistical precision. He acknowledged that if an analyst were to examine specific city size categories, or residential density and household income categories, the data could get more sparse, and therefore less precise.

There was a comment that although the VMT model (discussed above) had double-digit T statistics, it had a low R^2 value. Mr. Pickrell agreed that the low R^2 value suggested that the best explanatory variables had not been identified, but because the sample size is so large, significant factors could be identified with high precision.

Finally, there was a discussion about the MOBILE and MOBILE-6 models from EPA. Mr. Pickrell said that the EPA documentation for MOBILE discouraged users from modifying the mileage accumulation curves, however, his examination of the odometer data from NPTS indicates that the curves in MOBILE need adjustment. Mr. Pickrell noted that although MOBILE-6 used 1990 NPTS data adjusted to 1995, the slope of the curve was not changed. Ms. Liss commented that the 1995 data had been delivered to the EPA office so that perhaps newer versions would be adjusted soon.

VII.

WORKSHOP REPORTS

WORKSHOP ON LAND USE AND TRANSPORTATION INTERACTION

Chair: Peter Stopher, Ph.D., Louisiana State University

The objectives of the workshop were to discuss issues related to the general topic of land use and transportation interactions, to discuss whether NPTS could be used to address the issues, to discuss how these findings will assist policy decision making, to develop short research project descriptions and to recommend who should conduct or sponsor such research. Workshops were asked to address five questions as a means to achieve these objections:

1. What issues were mentioned in the Resource Paper, but need additional consideration or research?
2. What issues were NOT addressed in the Resource Paper, and should be addressed in the next round of reports?
3. For these issues, can NPTS be used to analyze this topic?
4. For these issues, how should the next NPTS be modified or augmented?
5. What are other data resources that could be used to address these topics?

The workshop combined the first two questions and developed a number of research issues that could be addressed by NPTS data, either as collected in 1995, or with augmentation. The workshop also addressed issues of additional analyses that could be performed from the existing NPTS data, suggested other data sources that could be developed or used in combination with NPTS, and proposed a number of ideas on data to collect in the next NPTS. The workshop did not address the questions of who should do the research and who should sponsor the research. The workshop also did not directly address priorities for the research.

An excellent resource paper was provided by Catherine Ross and Anne Dunning. This paper focused on population density as the primary land-use measure from the 1995 NPTS and examined the relationship between a number of transportation measures and population density. The focus of the paper helped the workshop to move ahead in addressing the questions posed to the workshop and to identify issues for further research and analysis.

RECOMMENDATIONS TO IMPROVE NPTS

Quite a bit of the discussion focused on the geographic detail in NPTS, and it was generally observed by the workshop that the lack of detail in the current NPTS makes significant amounts of land use an transportation interaction difficult to explore. There was a general call for providing more geographic specificity, or providing special tabulations that include information from more specific locational and positional data.

Additional Analyses

Under this heading, the workshop suggested two items that could be added to the NPTS data set without damaging confidentiality, which would be instrumental in improving the ability to do land-use analyses. These are:

Distance from the Central Business District (CDB)
Residence and employment locations at the 5-digit zip code level

In considering this aspect of NPTS, it was noted that many analyses involve computing ratios of measures from two different data files. It noted that the method for weighting such ratios is not well understood and that guidance for how to use weights in such computations needs to be provided to potential users.

Existing Data Resources

The following known data resources, or resources believed to exist could be added usefully to the NPTS for research and analysis purposes:

The FTA transit system descriptions, which are believed to be available in a GIS.
Street miles per square mile
CBD employment share

Possible Future Data Resources

The following are data resources that would probably need to be gathered together and standardized into a single national data resource for each listed resource, but which could enhance considerably the potential for research and analysis on transportation and land use interactions:

Housing variability (by square footage, price, or other comparable measure)
Historical growth management policies
Historical traffic impact-land use policies
Parking spaces per employee
Retail proximity
Proximity of community amenities

Each of these data sets should be compiled at block or block group level, and matched to the households in the NPTS to provide these additional data items, similar to those provided in the existing release from Claritas.

The Next NPTS

The workshop acknowledged that there is yet much that can be done with the 1995 NPTS, but when asked to look ahead to the next NPTS, the workshop was able to provide a list of potential changes and additions to the questions.

Questions on the reason for choice of residential location, in order to determine whether transportation or accessibility to community amenities played an important role.
Costs of maintenance of privately-owned vehicles
Square footage of the residence
Transit access at work, identical to current questions asked about transit access for the residence.
Geocoding of ALL trip ends
Determination of the availability of bicycles for use by household members.

Finally, it was recommended that the next NPTS use an activity or time-use diary, in place of the travel diary used in 1995. It was felt that the state of practice in travel surveys has shown the obvious merits of such an approach and that this would also add considerably to the ability to investigate land-use transportation relationships.

RESEARCH RECOMMENDATIONS

The workshop developed a number of research recommendations. No prioritization of research projects was developed, however. They are provided in no particular order here.

Role of Land Use and Density in Solving Transportation and Air Quality Problems

There appear to be many expectations that changes to land use and density can solve transportation and air-quality problems. This includes increased density of residential development to improve transit use, development of mixed-use changes have a cause and effect relationship and will contribute to solving transportation or air-quality problems. Research is needed to establish whether the expectations are founded on fact.

Relationship Between Density, Accessibility and Mode Use

This is related to the proceeding research issue and involves determining to what extent there is a relationship between residential or employment densities or varying levels of accessibility to transit and levels of transit ridership, or other measures of mode choice. This research should also determine if there are thresholds of density that produce different levels of mode use.

Regional Variability in Land-Use Relationships

Relationships involving land use and transportation are not likely to be constant from urban area to urban area, but will likely vary with differences in such environmental aspects as topography and climate. The research should determine how land-use relationships vary with these environmental factors.

Typology of Urban Areas

This research should develop a typology of urban areas with respect to land-use relationships with transportation. The typology may involve such things as relationships of the CBD to overall regional development, levels of maximum and minimum density, locations of employment, etc.

Local GISs and NPTS

It was suggested that many local and state jurisdictions now have significant GIS databases that may contain data of considerable value for analyzing NPTS. This research would determine what is available and how it could be added to NPTS in an effective manner.

Specialized Samples

It was suggested that increasing use should be made in the future of specialized samples or increasing the sample coverage of special population groups – niche sampling and studies. Included in these might be transit, bicycle, walk, and telecommuting trips. The research would determine what niche markets should be covered in more detail and would determine whether sampling within the national sample should be used, or specialized subsamples should be drawn, and how such samples could be achieved.

Appropriate Geography for the NPTS

Much discussion focused on the level of geography of reporting households and trip ends in NPTS. Generally, for land-use studies, the geography in current releases is much too aggregate and the lack of information on trip ends hampers research. It was proposed that this research would determine what compromises can be reached between confidentiality concerns and requirements and the analysts' desires for the most disaggregate data possible. Also, the research could address accommodation of disaggregate needs through the production of special tabulations.

Geographic Biases in NPTS

It was proposed that research be conducted to determine whether the existing sampling procedures and response rates to NPTS produce geographic biases in the data, beyond the known ones with respect to large urban areas and urban area with rail. If bias is determined to exist, as expected, then methods to reduce the bias would develop in this research.

Maximizing Use of Present Land-Use Data

This research would determine how to maximize the use of the land-use data already provided with NPTS. The research would need to address the reliability of the data currently appended to NPTS and determine how best use can be made of it, within the constraints of its reliability.

Attitudinal Data

NPTS contains a significant battery of attitudinal data. This research would investigate the relationships between the NPTS attitudinal measures and quantitative data on transportation systems, to assess the reliability and usefulness of such data. This would also be useful in determining whether future NPTS questionnaires should include additional attitudinal questions, particularly pertaining to land use and accessibility.

WORKSHOP ON ENVIRONMENT AND ECONOMIC IMPACTS

Chair: Deb Niemeier, Ph.D., University of California Davis

The workshop findings and discussion have been organized into three subject areas: issues, data, and research.

ISSUES

In general, workshop participants felt that the Pickrell and Schimek workshop resource paper provided a good first cut of the environment and economic issues that can be explored using the NPTS.

DATA

The workshop participants identified several major data additions that they believed would significantly improve the range of future analyses undertaken with NPTS. These data additions (ranked in order of priority) include:

Perceptions of exposure to environmental impacts

Currently NPTS' use in providing insight related to environmental justice questions is limited. If addition data could be gathered regarding the respondents perceptions of exposure to transportation related environmental impacts (e.g., noise and air pollution), then this data could be combined with the new geographic data to examine such questions as: Are there disproportionate environmental impacts from transportation by race or ethnicity?

Wage estimates by person

Currently household income, as opposed to respondent income, is reported in the NPTS data. With high levels or 2-worker households and increasing trip complexities (that often have gender or occupational clustering attributes), it is becoming more important to understand the dynamics of household interactions as they relate to the allocation of household and family support activities between household members. One key factor that needs to be included in these types of analyses is how individual wages contribute to the total household income.

Were high-occupancy-vehicle (HOV) lanes used during the trip?

Little trip assignment information is available in the NPTS data. Although workshop participants believed that it would be too difficult to record all trip segments by say functional class, many believed that having at least some indication of HOV lane use would help to refine environmental analyses performed using NPTS.

RESEARCH STATEMENTS

Participants defined the following research statements (ranked in order of priority):

Examine travel behavior characteristics driving the changes in vehicle miles of travel.

Estimates of vehicle miles of travel between 1977 and 1995 show about a 3% increase, or approximately 0.2 trillion miles. Although much is known about trip-making activity, greater insight is needed on VMT generation. For example, the latest NPTS suggests that younger male drivers seem to have different travel patterns that noted in previous surveys. This research would focus on examining the factors that might be associate with the observed changes in VMT.

Specifically, such questions as how is VMT going up or down by driver? It was noted that younger male drivers seem to have different travel patterns that previously identified, is this a data artifact or real news? What are the underlying travel behavior characteristics driving changes in VMT? What is the relationship between micro-level (e.g., household) VMT production and the macro-level exogenous factors that can be observed (e.g., densities). What are the travel implications (e.g., non-motorized trips, VMT) of those populations (e.g., no telephone households, group residences, armed service bases, etc.) left out of the NPTS?

What are the behavioral factors driving non-work travel related VMT changes? Can these non-work activity generation factors be associated with certain types of residential or location factors? If we raised densities by twice as much would we just be generating twice as much VMT or trips in a smaller area? Who is making the non-work trips? How is younger driver non-work travel connected to location or activity characteristics? What policies could be defined to reduce the number of non-work trips being made? Is VMT going up too fast to accommodate with changes in the transportation infrastructure? Is it possible that we can implement new transportation projects to accommodate the change in VMT?

Examine vehicle characteristics and use patterns

The choice of vehicle use for the general travel has serious implications in terms of air quality. This research will examine the long-term vehicle choice implications with respect to air quality implications. Such questions as have we reached peak demand for SUV's or any other particular vehicle? What are the fleet ages by ownership characteristics? by region? by MSA? by race or income? What vehicles are being used for commuting? Are different vehicles being used for different trip purposes? How does vehicle specialization occur across race/income/ethnicity?

What are the effects of trip chains on electric vehicle use or the number of cold starts (by vintage). How would alternative definitions of cold starts impact the emissions impacts defined by the NPTS VMT estimates? Workshop participants indicate that this research should include examining if older vehicles that stay "in action" allow more opportunity for automobile purchase by lower income households? The welfare to work concept could provide the policy motivation to investigate the economic and environmental implications of giving an older vehicle to low income households as a part of the welfare to work program.

Examine the environmental implications of changing travel patterns

This research would include examining the impacts of transportation (e.g., noise air quality, etc.) by race and income. This might include defining residential location clusters by race/income and looking at the interactions between equity, environmental, and economic considerations. The workshop participants felt that there might be ways in which to combine the customer-relation questions with the new residential location information to examine environmental perceptions of those making less than $10k relative to the rest of the population.

WORKSHOP ON SOCIETAL TRENDS

Chair: Kim Fisher, Texas Transportation Institute

The following is a summary of the very wide ranging and interesting conversation held in the Societal Trends Workshop. The first section will cover the five general questions asked by the conference sponsor and the workshop participants responses to those questions. The next section contains several general suggestions for the existing and future NPTS databases. The final section contains several research suggestions prepared by the workshop participants. On a final note, both the facilitator and notetaker were impressed by the level of interest and involvement of our workshop participants – the good ides were really flowing.

GENERAL DISCUSSION

What issues were mentioned in the Resource Paper, but need additional consideration or research?

The resource paper, "Transportation Issues for the Aging Baby Boom", by Daphne Spain focused on travel behavior and needs of the elderly and women. As a preliminary analysis of these two populations (preliminary due to availability of the data) this paper covers the trends in travel by these two populations very well. The workshop participants had additional research suggestions for both populations and several of the specific project descriptions at the end of the report describe research for these two groups. One interesting research issue that surfaced was the role of health in mobility for the elderly. The NPTS data set does not contain the necessary information for this analysis, however, the workshop group felt that health was such an important factor in travel behavior that it would be worth collaborating with other surveyors to try to quantify or understand this issue.

What issues were NOT addressed in the Resource Paper, and should be addressed in the next round of reports?

There were many additional topics, not surprising given the broad category of Societal Trends, which the workshop group would like to see explored. Again there are specific project descriptions at the end of this paper, but some general categories included:

Changes in the work place and employment
Substitution of telecommunications for travel (virtual mobility)
Effect of development patterns on travel behavior
Welfare to work issues, and
Additional research on the causes of changes in travel behavior.

NPTS, particularly with the addition of the Claritas data, is well suited to support many of the research topics raised by the workshop. There were some specific additions to the NPTS data set which would aid to an understanding of some trends, these suggestions are highlighted in the project descriptions.

How should the next NPTS be modified or augmented?

One frequently mentioned suggestion was the inclusion of a panel survey as a part of the NPTS survey. This would, of course, be a major change in the design on NPTS the workshop felt it was important to gaining a better understanding of travel in the United States. There were a couple of additional questions suggested, such as passenger characteristic when the passenger was not a household member.

What are other data resources that could be used to address these topics?

The workshop members suggested working with survey experts from other fields, such as health, housing, and retirement groups. They felt that there was much to be gained by learning more about the research done in these areas.

GENERAL SUGGESTIONS ON NPTS DATA COLLECTIONS AND USE

The workshop participants identified many specific project and research efforts using either the NTPS database(s) or an augmented survey, but there were several recurring general suggestions on future data collection and use of NPTS data.

Provide adjustment factors for NPTS variables to account for national and perhaps regional fluctuations in the economy and real cost of fuel.

Increase the use of Geographic Information System (GIS) with NPTS data in order to graphically represent the information available. As an example, one could map travel behavior by region, population group, or transit service to illustrate which regions or populations have greater needs to assure mobility.

Integrate data collection efforts with other transportation, housing, and health surveys. This is particularly important because transportation choices are very influenced by health, housing location, and other population characteristics. Collaboration with other transportation surveys could improve the understanding of long distance travel and welfare to work issues. Other transportation surveys could include CTPP, ATS, etc.

The idea of changing the NPTS either completely or partially into a lonitudinal/panel survey arose in several discussions. This type of survey would be particularly helpful in evaluating the impact of changing demographics, household locations, or employment status on travel. Cross-sectional surveys give a snapshop of effects of these factors but they are more limited in their ability to determine what effect particular changes (such as the birth of a child or a move from the suburbs to the city) versus more intrinsic characteristics (such as education, gender, or race).

PROJECT SUGGESTIONS

Travel with Non-Household Passengers (Informal Ridesharing)

Much of the research, using NPTS travel data, focuses on the specific aspects of trips and the persons making these trips. For motorized non-transit modes (i.e. POVs), a trip-maker may be a driver or a passenger. In the current (and previous) NPTS database(s), for any trip made by a driver who was carrying passenger(s), it is only possible to get demographic characteristics of the passenger(s) if they are members of the driver's household. It is not possible, for example, to determine any characteristics of a passenger that is a friend, co-worker (in the case of car pooling), of relative of the driver. It may be prudent to correct this in the next NPTS. One example mentioned in the work group was the growing necessity of "Baby Boomers" having to transport their aging parents for a variety of trip purposes.

Education as a Societal Trend

Further research into trends in education attainment and how ones level of education affects mode choice and number of vehicles owned. This data could be further considered by gender, race/ethnicity, and age.

Virtual Mobility

Virtual mobility encompasses many types of substitution of communications for travel in several different areas, including: telecommuting or tele-work, tele-shopping, tele-learning, etc. There are several items travel measures which we would be interested in obtaining for all these areas:

What is the frequency of the substitution and what influences the frequency
how many vehicle miles of travel are eliminated due to the substitution
does the use of communication for one purpose result in greater travel in another purpose.

There are also specific questions which arise for each area. Using telecommuting as an example, we would also want to know how regular the practice is, how effectively telecommuting could be used as a response to non-recurring events (such as an Olympics, earthquake damage, etc.), whether specific occupations are more suited for telecommuting, etc.

Exploration of the Mobility of the Elderly

The exploration of how mobility varies by residential location and other variables would be very useful for policy analysis and program development. The work group suggested that the categories of elderly be defined as 55-plus, 65-plus, and 75-plus. These categories were recommended because the health, activity levels, and mobility of these groups of elderly vary greatly.

The group suggested that the following dependent variables be explored:

Number of household vehicles
Proximity to and use of transit
Mode used (particularly the alternatives to SOV)
Number of trips
Person miles traveled and vehicle miles traveled
When travel occurs (time of day that the trip starts)
Trip purpose

Beyond looking at the residential location (central city, second city, suburb, or rural) the work group suggested looking at the effect of gender, race/ethnicity, licensed driver, and employment status. This is one area where collaborating with other fields of research would be particularly helpful, health is believed to have a large effect on mobility and travel needs.

Effect of Development Patterns on Travel

The phenomenon of sprawl or the movement of people, jobs, and resources moving out of the central city to the suburbs or sometimes beyond the suburban area, often mentioned as a cause of traffic congestion. While more people move to the suburbs, not only is there a geographic shift, but a resulting concentrations of poverty in the central city frequently occurs. As mentioned there is a widely held notion that sprawl itself is causing more congestion and reducing mobility. The workshop group suggested using the data in NPTS to investigate this relationship.

Welfare to Work Programs

The spatial mismatch of jobs and employees is a particular impediment to providing work opportunities to those on welfare. With so many jobs, particularly service jobs, found in the suburbs and a large portion of welfare recipients living in either the central city or very rural locations connecting jobs and employees becomes an increasingly difficult problem. The effect of this imbalance is worse for welfare recipients who most often have limited or no access to an automobile. NPTS can be used to quantify the travel behavior of these welfare recipients and can be used to analyze the impact of policy or local transportation decisions.

Personal and Social Attitudes toward Transportation

People make travel choices based on factors beyond travel time, accessibility and ability to pay. Their decisions include their perceptions and attitudes about features of different modes and their relative satisfaction levels for the different options available to them. To understand people's travel behavior more fully, and what you might do to influence travel choices, we need to look at people's social attitudes about transportation. These attitudes include measures like perception of safety and security, comfort, knowledge of the alternatives, etc.

We might start by thinking of these attitudes as both dependent and independent variables. As dependent variables, how are factors like age, income, place of residence, education, etc. related to attitudes? As independent variables, how might these attitudes influence mode choice, number of trips, and overall satisfaction with different transportation options. This would require additional questions to quantify the respondent's perception of their transportation alternatives.

Impact of Tax Policy on Transport Choices

Today's transportation system is largely funded by a consumption-based fuel tax. As we become successful in encouraging the use of alternative modes of transportation, a revised tax structure will become necessary to maintain or improve levels of mobility. The NPTS can elicit opinions of people regarding the extent to which certain taxing or pricing strategies could encourage the use of alternative modes of transportation.

Changing Workplace

Many changes have occurred in the workplace and to what might have been considered the typical worker. The changes include job availability, downsizing, increasing number of service jobs, varied work hours, increased temporary and part-time jobs. These changes result in changing transportation requirements. The workshop participants suggest a study to examine trends in the workplace and the impact of those changes on travel. The data on working age respondents to NPTS should be used in conjunction with other surveys on working and employment to better define the travel behavior and needs of today's workers.

Impact of Life Cycle on Travel

This project would investigate the impacts of life cycles on travel, both cross sectionally and longitudinally. This would require the re-framing of the NPTS survey in, at least partially a panel survey. The project we would propose would compare household and individual travel while in different phases or life cycles. For example, why and how does a four-person family travel and how does that travel evolve? One could postulate that a family with two children less than two years of age would make fewer trips and for different purposes than a family with two teenagers of driving age. Similarly what is the difference in travel between a newly married couple in their twenties, and an "empty-nest" couple in their fifties.

Additional Analysis of the Effects of Demographics on Travel

Research to identify ways to increased incorporation of demographics in the analysis and projection of VMT. This would include age, gender, ethnicity, income, household structure, and employment status. The idea is to anticipate how trends in demographic variables will influence the growth in vehicle travel, number of trips taken, and other driving characteristics, that effect vehicle emissions, greenhouse gases, fuel use, and safety.

Examine the Historical Changes in VMT

The Causes of Growth in VMT Could Handle:
the pent up demand after the second world war
increased availability of the national highway system
increasing number of women in the workforce
changing development patterns (sprawl)
reduced real per mile cost of travel
corporate downsizing coupled with a weak housing market.

Discretionary Travel

Non-work or discretionary travel contributes the greatest portion of personal travel. It is important to understand this travel and how it has changed over time. Quantifying the trip purpose, destination choice, trip start times, trip distance, frequency of trips for each trip purpose and the change in each of these measures over time could begin to quantify the problem. The next step, identifying the underlying reasons for the change could help predict the future trends and how policy makers could influence the trends.

Departure Time Changes Over Time

Traffic count data has revealed a spreading of the travel peak period over the past several years. Since NPTS provides trip start time and trip length, we can examine the trends over time by various demographic groups, trip purpose, and trip mode.

Use of NPTS Data for Regional Transportation Planning

NPTS has historically been used to identify national travel trends and occasionally used to compare travel characteristics of large geographic areas of the United States. An additional resource paper should be prepared to discuss the utilization of NTPS data at lower levels of geography. It could deal with statistical validity, but more importantly it would act as a guide to the non-statistical use on lower level reasonableness criteria. The report should contain the appropriateness and the usefulness for specific data items at lower levels of geography, along with the caveats to their use.

This research would both expand and improve the utilization of NPTS data by transportation decision makers and planners at the state, MPO, and local level.

WORKSHOP ON MOBILITY AND EQUITY

Chair: Elaine Murakami, Federal Highway Administration

GENERAL DISCUSSION

We defined "mobility" to be equitable access to WHERE we go, WHEN we go, and at an AFFORDABLE price. To be equitable, we must meet individual needs, and not presume that each person has the same mobility needs. Some of the aspects to examine in terms of equity in transportation include:

- Physical characteristics of individuals, e.g. disabilities
- Economics - travel time and costs
- Social - Influences of race/ethnicity and racism
- Spatial - Where is new development occurring, where are new jobs, how does transportation system fit (road, transit, bike, pedestrian, etc).
- Infrastructure investments - facility siting (environmental justice), rail vs. bus investments

Equity has not typically been considered when mobility is discussed. If there are more roads, it is believed that everyone has the same opportunity to use them. But the goal of providing transportation alternatives to those without cars has been part of transit investments in the past, and continues today. However, recent investments in rail have come under scrutiny because of arguments that many new rail projects largely benefit white, middle-class households who own vehicles, and provide a greater subsidy (in dollars) per trip, and simultaneously cause declines in bus service to households who are transit dependent without cars.

What do we mean by Mobility and what do we mean by Equity?

Appears that DOT is focused on mobility and not equity
Equity issues have been marginalized - the populations are not a small proportion when you add them up - e.g. elderly, single parents, young people.
Equity does not mean only providing transit service
However, transit should be responsive to needs (evaluate route structures).
Mobility - how much do elderly want to travel? How many are isolated?

What is accessibility?

Accessibility of goods and services
Accessibility for disabled - can you use transit?
Accessibility to jobs - related to welfare to work initiative
Location of new jobs in suburbs
Location of welfare recipients in inner cities
Mixed land use - mix of residential and commercial to improve accessibility?

Population characteristics

elderly
disabled
minority
poor

Mode choice

transit—rail vs. bus
system design in suburbs
transit dependent in inner city
auto – giver cars to people?

NPTS can be used to improve our models of mode choice. The performance of these models is critical for evaluating transportation investments such as new roads, additional lanes to existing roads, and transit investments. Also, particularly with the add-on samples where the trip ends were geocoded to census tracts and blocks, combined with the characteristics of the neighborhood such as residential and employment density, NPTS gives us an opportunity to combine land use characteristics with mode choice.

Mode choice related to density. African Americans and Hispanic Americans are much more likely to use the bus. We can use NPTS data to look at transit trips by land use and race, and see what effect density patterns have.

Need to address equity issues around investments in rail compared to bus. NAACP lawsuit in Los Angeles. Free parking is a big draw for rail – rail transit for people who are "choice" riders, not captive, and use both private vehicle and public transit for commute trips.

Trip purposes

Work – welfare to work
Access to goods and services

Land Use

Access to jobs
Density vs. dispersion related to mode choice

RECOMMENDATIONS FOR ADDITIONS TO NPTS:

NPTS things to add:
Is there a question on disability?
Should there be a special subsample for disabled – what would the cost impacts be?
Need a question on immigration. The face of America is changing.

RECOMMENDATIONS FOR ADDITIONAL NPTS ANALYSIS:

Need to understand how people in inner cities accomplish non-work travel.
Problem with equity – e.g. are there grocery stores? Are there shops? Are there doctors and dentists? Where are the schools?

Look at people who said they had intermittent phone service in 1995 NPTS. What are their characteristics? Do we think they serve as a proxy for households without phones?

Need to link NPTS with income datasets – look at forecasting changes in income and expenditures. When people get a job how do they spend their "extra" money. (Same question as Dowell Myers – how do immigrants determine residential choice and vehicle acquisition?)

RESEARCH TOPICS - GENERAL (NOT SPECIFIC TO NPTS)

Access to Jobs

A longitudinal study on the impacts of giving people a car. With the implementation of welfare reform, DOT has included an access to jobs component in the proposed six-year transportation reauthorization bill. FTA would have programmatic control, however, programs would not necessarily be restricted to fixed route transit, partransit, or vanpool programs. "Welfare to Work" should not be discussed as a "transit program" but a transportation program, of which transit is one alternative. This could be an opportunity to objectively compare the impacts of providing a car to improving transit or paratransit service.

There are problems with some programs, such as "Bridges to Work" because often, new workers, once their work becomes stable, will acquire a car and quit using the vanpool service. So, the success of the vanpool program relies on a continuing supply of new workers and jobs, which may have different locations from the initial supply. However – transportation should not be seen as the panacea for solving the problem of welfare to work.

Improving the measurement of Transportation System Performance

Currently, transportation equity is not a factor in transportation system performance. We now measure miles traveled, congestion, incidents, fatalities, but we don't measure if the system is performing at the same level for all persons. Perhaps comparative travel times across modes could be used. People make many tradeoffs, for example, in housing costs and travel time to work, so defining transportation equity could be very difficult.

We need to know about what kind of mobility people want. How much unmet demand is there? What NPTS gives us is revealed travel data. Is there a minimum level of mobility that should be a goal? Less travel (but not less mobility) may make an improvement in the quality of life, e.g. being able to walk to lunch vs. driving. More travel may mean there are more constraints. Parents who drop off and pick up children at childcare, vs. having child care alternatives at same location at which they work. If all impedances were removed from travel for all people, what would they do? Travel more? Travel less?

Improving the public participation process to improve mobility and equity

We can't expect people without cars, whom work evening and night shifts, can't afford baby sitters, etc. to come to public hearing. They may already feel disenfranchised – why should I participate? What effect will it really have? Use existing community networks/structures, e.g. churches in Black community, neighborhood grocery stores.

Federal role of evaluating community projects and disseminating results. Showcase successful innovative projects. Provide a way to help states learn from each other. This could be done using "peer-to-peer" technical assistance. Have the actual project operator assist others to develop their own projects.

RESEARCH TOPICS – SPECIFIC TO NPTS

Travel by the Elderly - This topic should be a priority for the next set of NPTS reports. The elderly are a large and growing segment of the population. Physical changes as well as changes such as retirement, widowhood, etc. make the elderly at greater risk of losing their mobility. This topic should be included as a continuation of the work completed for the 1990 NPTS.

Informal Ride Giving – transporting family and friends who are not household members. Elaine Murakami's resource paper showed that people in low-income households are much more likely to get rides in private vehicles from non-household members, up to ten percent of all trips. The existing literature may show that this kind of ride giving varies by race and ethnicity. We should see if the NPTS supports this thesis. "Ride giving" at ten percent of al trips is even greater than transit (bus and rail), although not as high as walking. The characteristics of these trips should be examined (trip length, purpose, time of day, etc.).

Mode Choice - Using the NPTS add-on samples where the origins and destinations were geocoded, and to evaluate mode choice with transit accessibility (objective, not subjective). While the 1995 NPTS dataset has many more variables to describe the areas where the respondent lived and worked, it still lacks measures of transit availability on a trip by trip level. The add-on samples where all trip destinations were geocoded to a census tract and block provides an opportunity to objectively measure transit availability on a trip by trip basis. This would involve having the transit and highway network with travel times for the same geographic areas.

VIII.

PUBLIC POLICY PANEL

The Public Policy Panel consisted of individuals from the private sector, state and local governments and academia. Each panel member made a short presentation.

The Public Policy Panel was moderated by Alan Pisarski. Panel members included:

Bunyon Bryant, Natural Resources and Environment, University of Michigan
Sandra Rosenbloom, Drachman Institute, University of Arizona
Sarah Campbell, TransManagement, Washington, D.C.
Ronald Tweedie, New York State Department of Transportation
Viplava Putta, Indian National Council of Governments, Oklahoma

Bunyan Bryant (Natural Resources & Environment, University of Michigan), conceding a limited expertise in transportation issues, made a plea for a more focused effort to understand the impact of transportation on the low income, and especially the African-American low income community. He pointed to studies which show that transportation development often deteriorates the quality of life for these minorities, and that a larger percentage of African Americans and poor live near hazardous waste sites, leaking underground storage tanks and Act 307 sites. He pointed out that in the United States, 4% of the world's population contributes 25% of the emissions that result in the greenhouse effect.

Dr. Bryant suggested that, on a short-term basis, some effort to enable low income households to gain access to vehicles was appropriate, while in the long term, the trends in high density areas of reduced VMT and increased public transit availability was a welcome development. He closed by expressing a belief that the society is more segregated today than it was 25 years ago, and that transportation should include this challenge in its research and development processes.

Sandra Rosenbloom (Drachman Institute, University of Arizona) pointed out that a basic tenant of economics is infinite desire, adding that the "want lists" conveyed by various speakers proves that true of the NPTS survey. She encouraged the audience to look at the benefits of the new 1995 NPTS data rather than to focus too much on what needs to be added in the next round. The 1995 NPTS data is rich in information about density and other factors related to geography, and it should be used now to address current issues.

She noted the calls for more specific local data, and questioned whether there should ever be such specificity. Perhaps the generalized survey results should be an impetus to regional, state and local agencies to conduct studies of their own, to test the general hypotheses raised by the national level research.

Some areas of research that might be fruitful include a look at the commuting patterns of low income individuals (including comparisons of distance to work, the reverse commute and inter-suburban commutes), the impact and importance of trip chaining and informal ride sharing (focusing on the low income segment), and the impact and support that may come from the immigrant population. Her own studies show that 40% of all transit riders are immigrants, a very complex mixture of nationalities with very different living patterns.

Sarah Campbell (Trans Management) agreed that the focus should remain on working with the 1995 NPTS data, since it was unlikely that funds would be allocated for a major expansion of the survey.

The fact that the survey was telephone driven was positive, but there may be a hole in the data because of the proportion of low income and immigrant populations who do not have telephones. There is also a tendency in the general survey process to undercount the urban constituency.

Some research conclusions that were expressed about total travel growth slowing, the possible saturation of vehicles per household, and the characteristics of travel for the elderly and for women, are areas of research that require a closer look. Policies which lead to a denser urban environment seem appropriate to increasing the provision of public transit and reducing the VMT. As a corollary, it reduces the need for what has become exceptionally expensive suburban infrastructure that requires equally expensive maintenance.

Ron Tweedie (New York State Department of Transportation) represented an agency which funded 10,000 additional household samples to the 1995 NPTS. New York State Department of Transportation has an annual budget in excess of $2 billion for transit and highways. New York State has about 7 percent of the U.S. population, 4.8% of the vehicle trips and 6.3% of the person trips. The New York City metropolitan area accounts for 59% of the person trips in the state, but only 46% of the state-wide vehicle trips.

Trip chaining or linking is a question of high interest to New York. About three-quarters of all work trips on the way to work are directly from home, but only half (54%) of the trips from work go directly home. Half of the people who leave work, link a trip to an intermediate destination before returning home, such as to shop, to eat at a restaurant, and so on. More analysis would allow better policy making in this particular area. Since linked trips may be more efficient, there may be ways to encourage such "bundling" of smaller trips into single trips, and the DOT may have a role to play in bringing together the various players in that scenario (shopping malls, businesses, plus improved infrastructure).

The New York DOT is involved in the concept of "Main Street" development, in making the downtown streets more user friendly. An arterial management guidebook is available to urban areas for improving traffic flow and a similar guide for pedestrian and bicycle use might be appropriate. The DOT has also made the Census Transportation Planning Package (CTPP) and other census statistics and maps available to the transit companies to help in route planning and analysis. Finally, there is an Industrial Access program to encourage business and industry to expand and/or locate in the state, and that involves providing better transportation services (which is primarily highway systems, but also includes public transit factors).

Viplava Putta (Indian Nation Council of Governments) explained that the MPO had bought a sample of 976, as an add-on to the 1995 NPTS covering the entire Tulsa MSA. He described the uses of the NPTS data as integrated into overall transportation studies conducted in his area.

Some of the trends peculiar to Tulsa included an increase in vehicle occupancy, an increase in short trips (less than 5 minutes), a dramatic decrease in trips directly to the workplace, and a filling in of traffic patterns that blurs the traditional peaks. Now the peak continues from 6:30 in the morning until about 8:00 in the evening, with an increase in work-related short trips throughout the day. Trip lengths remained constant in both time and distance.

The NPTS data are an excellent source for highway travel forecasting, but because there were so few transit trips in the sample, a supplemental transit survey was conducted in 1995. Also missing was any information about physically challenged or disabled people. The survey costs and the conduct of the survey was quite acceptable.

On a policy level, although there seems to be good communication between agencies at the federal level, that communication has not reached the local and state agencies, and the interaction at the state level could be improved. We do not have an adequate database for understanding public transit trips in Tulsa. State agencies would probably appreciate some policy guidance regarding the increased use of high-emission sport utility vehicles

Discussion:

To a comment made about the New York data, Mr. Tweedie noted that the state has the fourth largest rural population in the United States. He also agreed to make analysis of various aspects of the data available to other DOTs. He added that Massachusetts had also taken a large add-on sample for the NPTS survey.

A comment was made that the survey may have non-response bias when it encountered some respondents in low income and non-English speaking homes, because of cultural differences or a lack of trust is providing the information. Mr. Pisarski commented that, with the increased interest in smaller and smaller demographic strata, the quality of the sample becomes much more critical. It may be necessary to include a face-to-face follow-up when the telephone interview process is inadequate.

Alan Pisarski closed the discussion with the comment that NPTS provides real information on a complex subject and gives us insight into the interaction of social, economic and technological change in society and how it interacts with behavior.

IX.

FEDERAL POLICY PANEL

The Federal Policy Panel was designed to discuss how NPTS could be a resource for public policy issues both at the Department of Transportation and at the other federal agencies.

The Federal Policy Panel was moderated by Gary Maring, Federal Highway Administration. Panel members included:

Gloria J. Jeff, Federal Highway Administration
Bill Passero, Department of Labor
Bob Noland, Environmental Protection Agency
Steve Bartolomei-Hill, Department of Health and Human Services

Gloria Jeff (Federal Highway Administration) pointed out the value of the new NPTS data as a tool for decision and policy makers, especially with current focus of delivery of an integrated transportation system, and not just roads and bridges. It is clear that dominant travel is no longer getting to work and back, but providing for personal and family needs. She reiterated that the needs of individuals moving from public welfare to gainful employment mean more than getting to work and back but included access to day care, the ability to conveniently buy groceries and other goods, and the inclusion of reasonable leisure time and accessible activities.

There are concerns about the aging of the vehicle fleet, including the surprising statistics that a significant number (9%) of vehicles on the road today were built before 1981. Note: For low income households, just over 20% of vehicles are 15 years or older). The aging fleet brings up both safety issues (since most are not equipped with the latest safety features) and high emissions (since most are exempt from regulation).

Ms. Jeff commented that Daphne Spain's paper served a valuable function because it made people wake up and think about new approaches to residential relocation. While we know that America is aging, we have found ourselves in a position where personal freedom is considered a "God-given constitutionally guaranteed right" and means that not only can I live where I want to because I want to, but also that the use of the private vehicle should not be limited. Thus, the concept of moving the aging to the inner cities where transit and walking could replace the automobile is certain to be controversial.

Finally, trying to reduce the number of vehicles or trip frequency by vehicle and any other activity included in the overall "problem" begins to affect personal freedom. The NPTS data should be very helpful in formulating solutions to present and future transportation challenges, including intelligent transportation systems.

Bill Passero (Department of Labor) noted that the conference was his introduction to the NPTS survey and its rich data resources, but as an individual from a statistical part of the government, there were clearly links to other valuable data resources that could be integrated into research and analysis. He listed a series of surveys that should be considered:

The Consumer Expenditure Survey (CES) is a "market basket" price calculation that leads to the Consumer Price Index, but it could be useful in issues concerning access and mobility for low-income households. The CES also reveals spending patterns.

The Survey of Consumer Finances reveals the debts, assets and liabilities of Americans, and the Current Population Survey (CPS) includes information about work experience and income. The Survey of Income and Program Participation (SIPP) looks at all the programs that are available for providing and supplementing income.

Studies of these surveys have shown that, regardless of the source of income, job-related or welfare payments, spending patterns for housing, and transportation are similar. In fact, for low-income individuals, transportation is a high priority and an increase in income often leads to an increase (an upgrade) in transportation expenditures. These kinds of numbers become available through the Department of Labor surveys and could be integrated into a research project related to the NPTS.

There is a challenge in creating a valid poverty threshold definition and the current technique is to combine the cost of several necessities (food, shelter and clothing) and apply a multiplier for all other personal expenses. That multiplier includes factors for both non-work and work related expenses and the definition of those multipliers derives from the Consumer Expenditure Survey. The multiplier includes "non-work related transportation expenses", but this is not defined. Perhaps NPTS, combined with the CES could be used to improve the distribution between work and non-work related transportation expenses.

The current definition of gross domestic product (GDP) includes only market work and does not include household production, e.g. child care. The household production figure could be calculated using either an output-based amount (how much is spent on home business production) or a time use formula that calculates the value of the time spent in home production products and services (child care is an example of a very large segment of commerce).

These issues are somewhat outside the NPTS arena, but are nonetheless issues that could be important in analyzing the NPTS.

Bob Noland (Environmental Protection Agency) underscored the impact of transportation on the environment, in the area of air quality (affected by emissions) and water quality (affected by emissions and surface run-off). There is also the impact of urban sprawl and rapid growth beyond the environment's ability to cope.

The concept of sustainable transportation involves coordinating how the growth occurs, controlling the fiscal impact on maintaining and creating infrastructure (including far more than just transportation's needs), and the cost and waste related to abandoning urban areas. The formula contains three parts -- environment, economics and equity (which relates to the public's reasonable access to all aspects of development and protection from harm in the process).

The EPA has been looking at these issues and has concluded that there must be a balance between technology and behavioral solutions. In the current climate, the latter, including land use decisions, is getting less play and less money.

Considering the NPTS data, it is positive that the VMT per driver is slowing down, but from an environmental standpoint, it is not as positive as it might be since it is still increasing each year. Even an increase of one percent a year contributes to the greenhouse gas problem. Since non-work trips tend to be shorter in distance, and the NPTS shows these trips to be increasing the fastest, there may be promising opportunities to reduce the use of cars to accomplish these trips with mixed land use development. One example may be to use transportation resources to facilitate in-fill development.

The government's role may well be to encourage research (even more than to perform research) with various incentives. The tax structure may be a good place to start. The question must also be asked, is it better to build roads and repair bridges or to spend some of that money to facilitate better development patterns that would result in solutions to some of the current transportation problems? Finally, perhaps the federal establishment involved in transportation should increase technical assistance to local areas, and encourage a "bottom up" approach to develop constituencies and various vested interests to come together in improving the transportation scenario.

Steve Bartolomei-Hill (Department of Health and Human Services), focusing on welfare as it affects DHHS, noted that, before welfare reform, the Department spent about $12 billion on families with children, $350 billion on Social Security and $270 billion on Medicaid and Medicare. As an indication of geographic distribution, the welfare caseload involved families who lived in the urban areas (25%), in the suburbs (50%) and in rural areas (25%).

Related to the transportation issue, only about 6% of families receiving welfare own cars and both federal and state laws put severe restriction on such ownership. The federal law restricted the fair market value of any vehicle owned to less than $1,500. The benefits available also act as a deterrent (the median state welfare payment is $366 a month, which virtually precludes the expense of a car). Under these old laws, about 10% of people receiving welfare worked, but under the new law there should be more than 50% on the job by the year 2002.

There will be a major issue concerning travel to work by that time, involving not only vehicles, but also childcare, which will increase the need for independent transportation even more. At the moment, few DHHS policies have anything to do with transportation, and especially vehicle ownership. In response to the law, state laws are changing regarding vehicle ownership, to make it easier for a welfare recipient in the welfare-to-work process to own a car. It is also very difficult for people in the transition from welfare to work to attend mandatory training programs without having a car.

There is a state planning process in progress, during which states will submit plans and a description of future welfare programs. It would be appropriate to include transportation experts in that process, both at the state and federal level.

A new survey is now being developed. Now is the time to see of questions on transportation issues related to low income households can be included.

Finally, Mr. Bartolomei-Hill announced the upcoming meeting of the Association for Public Policy and Management, inviting interested individuals to attend and participate, and to meet some of the individuals who are involved in the welfare process.

General Discussion

During the discussion, a recommendation was made to investigate a collaboration with the American Housing Survey (AHS) conducted by HUD, which might be able to include questions about travel issues in their annual survey. (Note: Journey to work questions are included in AHS). Also, the Survey of Income and Program Participation includes topical modules, in addition to the standard core questions asked each year. A module about welfare and transportation might well be accepted.

There was an observation that the Consumer Expenditure Survey had asked questions about trip and transit expenditures. Mr. Passero noted that the trips were usually longer trips of 75 miles or more, but the data was available at University of California, Berkeley, through the Internet. He noted there was information on public transportation expenditures to school, work and certain other destinations, and information on the fleet itself (vehicle rental, insurance, maintenance, gas and oil, parking and so on). He added that there are plans to increase the CES sample size by 50 percent in two years. This would allow statewide analysis, rather than analysis by U.S. regions.

Ms. Jeff raised safety and security issues relating to welfare reform. She discussed the fact that people in the transition from welfare-to-work were not likely to find traditional "nine-to-five" jobs, but work at odd shifts, and late nights. Personal security is a real issue when waiting for the bus at 11:00 at night. She also commented that most trips are non-work related, so continuing the focus on reducing work trips may not be our best approach to reducing VMT.

Mr. Noland suggested that living patterns are really determined by underlying subsidies that come from federal, state and local governments, and that a tax structure has a great impact on these same living patterns.

Ms. McGuckin, noted that a disincentive to using public transit is the fact that the cost is a factor of the number of people in the trip. Perhaps group discounts or family fares should be considered to make transit more attractive.

A representative from Bicycle Federation commented that the survey figures for walking had declined slightly and he questioned the validity of the numbers. He lauded the idea of diverting transportation-related tax revenues from highway construction and maintenance to an effort to enhance the planning and policy process. He suggested looking at ways to encourage walking trips as part of the bundled trips related to the work site, for example running errands at lunch or after work.

Ms. Rosenbloom suggested making improvements in the pedestrian and bicycling infrastructure, not for the sake of lowering VMT or reducing greenhouse gasses, but simply for the enhancement to lifestyle and personal independence.

Mr. Noland noted that the EPA was limited in its enforcement to matters affecting air quality, which was the rationale for emphasizing emissions in the policy arena. There was a comment that, in observing NPTS respondents, there appeared to be little guilt related to damaging behavior, like cold starts for very short trips. Another suggested that the lack of sidewalks and safe places to walk probably contributed to that lack of concern.

When asked about how NPTS data might affect policy decisions related to congestion mitigation and air quality, Ms. Jeff noted that it clarifies reality, as in the case of revealing that the work trip is not the dominant trip in the peak congestion period. Concerning the actual policy decisions, she felt that a reduction in travel time was not the objective, but an improvement in the choices people make in how they get from one point to another. Mr. Noland took exception, suggesting that the objective was to improve the quality of life through better access to economic, social and recreational activities, and concomitant reduction in or of travel would be a positive result.

Ms. Liss suggested looking into the ramifications of the claim that 10% of the vehicles cause 60% of the emission problems. She also suggested that trying to change life choices and lifestyles might not be best approach to cleaning up the air.

The next item of discussion was the aging population and the growing problem that many elderly are becoming isolated. Ms. Straight reported that the Administration on Aging collects data from the Area Agencies on Aging, and in 1995, these agencies provided almost 40 million rides (annual) to the elderly. (Note: There were over 31 million persons age 65 and over in America in 1990). Ms. Jeff added that the NPTS data showed a disproportionate number of over-65 who make no daily trips, which means that they did not even walk out of their home to visit a friend. She said this isolation is not a positive outcome.

Concerning changing public response by policy decision, Mr. Pisarski challenged the notion that Washington can make those changes with legislation or any other policy tool.

Ms. Jeff provided another example where policy and choices by Americans may not align. Americans chose to move away from the central city. Racism is not a government policy.

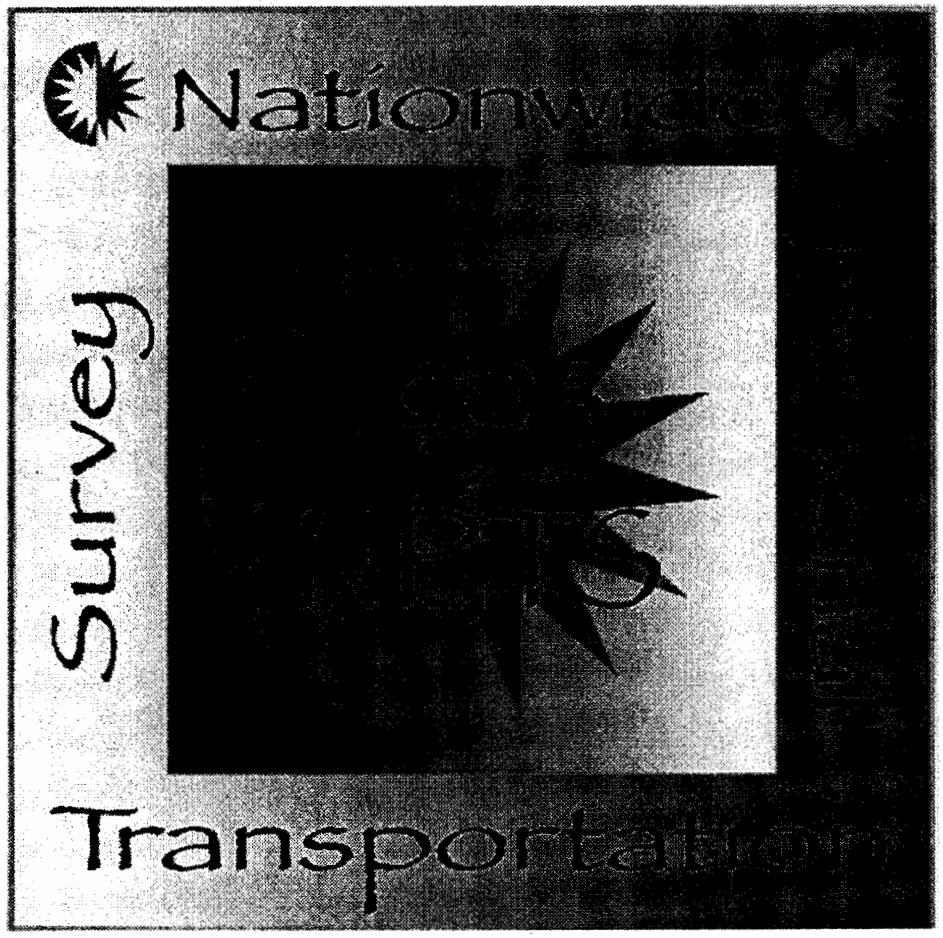
These decisions to move were not a result of a decision to build a transportation facility anywhere. Nor is it a policy that dictates that a cleanup in a low-income community of color will take longer than in a higher income majority neighborhood.

Government should try to educate the public to make better choices, because in the end government will fulfill the wishes of that public.

Mr. Noland commented that pricing transportation must take into consideration such costs as the environmental impact, safety and congestion. All told, the social cost is high and perhaps technology could be a way to lower some of those costs.

Ms. Jeff reminded the group that not only were there costs of transportation, but there were many benefits, benefits to quality of life, economic activity, and choices available to Americans.

Mr. Maring closed the conference, noting that a summary would be placed on the NPTS web page that would allow individuals to leave responses and comments. He urged continued use of the 1995 NPTS data for research and analysis, for its inherent value as rich data.



Symposium

Final Participants' List

October 29–31, 1997
Bethesda, MD

Ashraf Ahmed
Institute for Urban Research
Morgan State University

Winston Allen
Joint Center for Political and Economic Studies

Cazembe Ato
National Highway Traffic Safety Administration

Claude Barnes
NC A&T State University

Steve Bartolomei-Hill
Department of Health and Human Services

Susan Binder
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Bunyan Bryant
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Joann Jackson Stephens
US EPA

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Energy Information Administration

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Volpe National Transportation System Center

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Peter Stopher
Louisiana State University

Audrey Straight
AARP

Kathleen Strub
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Bill Wilkinson
Bicycle Federation of America

Mark Wolcott
EPA

Jennifer Young
Oak Ridge National Lab

Thabet Zakaria
Delaware Valley Regional Planning Commission

Mariia Zimmerman
FTA

Symposium

October 29 – 31, 1997
Bethesda, MD

Federal Highway Administration
U.S. Department of Transportation

NPTS Symposium

October 29-31, 1997

Bethesda, Maryland

The 1995 Nationwide Personal Transportation Survey (NPTS), along with the four previous national surveys, is a valuable resource for understanding changes in travel behavior in the United States. We now own more vehicles, take more trips, and travel more miles than ever before. However, there are serious concerns about traffic congestion and air quality, equity in access to jobs and services, changing demographics, and the impact of mobility on the economic viability of our Nation. These issues have a direct impact on the way we live, commute, and travel both for business and for pleasure.

Four papers commissioned by the Federal Highway Administration will be presented. These papers are written based on the data collected from the 1995 NPTS. This two-day symposium will provide the opportunity for you to learn about the latest research, exchange information and ideas on the implications for transportation policy and planning, and to make recommendations about future transportation research and development. The symposium consists of general sessions, presentations, breakout sessions, demonstrations and networking opportunities. The authors you will hear from are:

Carlos Arce

Mobility & Equity

Carlos Arce is the founder and president of NuStats, a survey research company with extensive experience in conducting household and transit on-board travel surveys during the past 12 years. He and his company have successfully conducted studies in areas with high concentrations of racial/ethnic minorities. His work on Hispanics has included studies on the aspirations, quality of life, use of social and public services, and general consumer behavior. He has conducted comparative studies of Hispanic and African American consumers, with major themes on equity and the assessment of the disadvantaged.

Don Pickrell

Environmental & Economic Impacts: Trends in Personal Motor Vehicle Ownership and Use

Don Pickrell is chief economist of the USDOT's Volpe National Transportation Systems Center and a lecturer in the Department of Civil Engineering at MIT. Prior to joining the Department of Transportation, Don taught economics, transportation planning, and government regulation at Harvard University. He has authored papers and research reports on various topics in transportation planning and policy, including transportation pricing, transit planning and finance, airline marketing and competition, travel demand forecasting, infrastructure investment and finance, and the relationship of travel behavior to air quality and potential climate change.

Catherine Ross

Land Use & Transportation Interaction

Catherine Ross is principal of Catherine Ross & Associates and professor of City Planning at Georgia Institute of Technology. She served as the coordinator and author of two blue ribbon panels convened by the Atlanta Regional Commission (ARC) to upgrade its travel demand forecasting process. She has a unique mix of expertise including the relationship of air pollution and land form, travel patterns and suburban development, citizen participation and urban revitalization, and use of new technology to measure travel behavior.

Daphne Spain

Societal Trends: Transportation Issues for the Aging Baby Boom

Daphne Spain is an associate professor in the School of City Planning at the University of Virginia. She is the author of a recent book, "Gendered Spaces," and co-author with Suzanne M. Bianchi, of "Balancing Act: Motherhood, Marriage, and Employment for American Women." Her recent work has included examination of the changing roles of women in society, especially labor force participation and family obligations, home ownership, and urban neighborhood change (gentrification).

Program

Wednesday, October 29

2:00 p.m. – 7:00 p.m. **Registration (*Versaille Foyer*)**

4:00 p.m. – 5:00 p.m. **Opening Session (*Gallery Room*)**

Welcoming Remarks and Goals and Objectives of Conference
Gloria J. Jeff
Federal Highway Administration

NPTS: Past, Present and Future
Susan Liss
Federal Highway Administration

5:00 p.m. – 6:30 p.m. **Reception (*Washington Room*)**

Thursday, October 30

7:00 a.m. – 3:00 p.m. **Registration (*Versailles Foyer*)**

7:00 a.m. – 8:00 a.m. **Continental Breakfast (*Versailles 3 & 4*)**

8:00 a.m. – 8:30 a.m. **Plenary (*Versailles 3 & 4*)**

Gary Maring
Federal Highway Administration

8:30 a.m. – 10:15 a.m. **Presentation of Papers (*Versailles 3 & 4*)**

Moderator - Introduction of Speakers

- Societal Trends: Transportation Issues for the Aging Baby Boom
  Daphne Spain
  University of Virginia

- Mobility & Equity
  Carlos Acre
  NuStats

10:15a.m. – 10:45 a.m. **Coffee Break**

10:45 a.m. – 12:15 p.m. **Presentation of Papers (*Versailles 3 & 4*)**

Moderator - Introduction of Speakers

- Environmental & Economic Impacts:
  Trends in Personal Motor Vehicle Ownership and Use
  Don Pickrell
  Volpe Transportation Research Center

- Land Use & Transportation Interaction
  Catherine Ross
  Catherine Ross & Associates/Georgia Tech

Website demos on Thursday from 8am to 6pm and Friday from 8am to 4pm – Versaille Foyer

12:30 p.m. – 1:50 p.m. **Luncheon (*Washington Room*)**

NPTS Survey Methodology Issues
R. Paul Moore
Research Triangle Institute

NPTS Website
Pat Hu & Rick Goeltz
Oak Ridge National Laboratory

2:00 p.m. – 5:00 p.m. **Workshops**

Societal Trends (*Gallery Room*), chaired by
Kim Fisher, Texas Transportation Institute
Mobility & Equity (*Versailles 3*), chaired by
Elaine Murakami, Federal Highway Administration
Environmental & Economic Impacts (*Connecticut Room*), chaired by
Deb Niemeier, University of California Davis
Land Use & Transportation Interaction (*Georgia Room*), chaired by
Peter Stopher, Louisiana State University

3:00 p.m. – 3:15 p.m. **Afternoon Break**

Friday, October 31

7:00 a.m. – 12:00 p.m. **Registration (*Versailles Foyer*)**

7:30 a.m. – 8:30 a.m. **Continental Breakfast (*Versailles 3 & 4*)**

8:30 a.m. – 9:45 a.m. **Workshops Resume**

Societal Trends (*Gallery Room*)
Mobility & Equity (*Versailles 3*)
Environmental & Economic Impacts (*Connecticut Room*)
Land Use & Transportation Interaction (*Georgia Room*)

9:45 a.m. – 10:15a.m. **Coffee Break**

10:15 a.m. – 11:00 a.m. **Workshops Report Back to Group (*Versailles 3 & 4*)**

11:00 a.m. – 12:15 p.m. **Policy Panel (*Versailles 3 & 4*)**

Moderator
Alan Pisarski, Consultant

Sandra Rosenbloom
Drachman Institute, University of Arizona

Bunyon Bryant
Natural Resources & Environment, University of Michigan

Sarah Campbell
Trans Management

Ron Tweedie
New York State Department of Transportation

Viplava Putta
Indian Nation Council of Governments

Website demos on Thursday from 8am to 6pm and Friday from 8am to 4pm - Versaille Foyer

12:30 p.m. – 1:45 p.m.	**Luncheon (*Washington Room*)**
1:45 p.m. – 3:30 p.m.	**Federal Policy Panel (*Versailles 3 & 4*)** Moderator *Gary Maring* Federal Highway Administration *Gloria J. Jeff* Federal Highway Administration *John Spencer* Federal Transit Administration *Bill Passero* Department of Labor *David Vandenbroucke* Department of Housing & Urban Development *Bob Noland* Environmental Protection Agency *Steve Bartolomei-Hill* Department of Health & Human Services
3:30 p.m. – 4:00 p.m.	**Summary/Wrap up**
4:00 p.m.	**Adjourn**

Visit the NPTS website at http://www-cta.ornl.gov/npts

Website demos on Thursday from 8am to 6pm and Friday from 8am to 4pm - Versaille Foyer

Your Stay in the Nation's Capital

Lodging

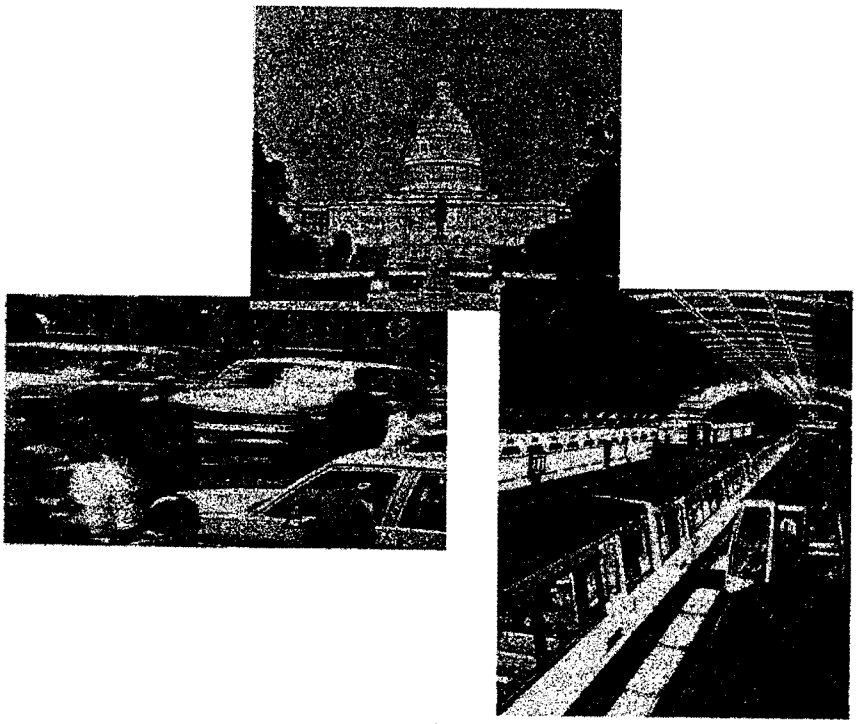
For convenience during your stay, the Holiday Inn Bethesda offers the following:

- Complimentary use of full Health Club facility (Holiday Spa) and in-house exercise room.
- Discount indoor parking for overnight guest ($5) and attendees. ($7)
- Complimentary shuttle to and from Metro (4 blocks). Van leaves every hour and half hour between the hours of 7am - 10pm from the Medical Center Metro, Navy Medical Center and NIH campus.
- Complimentary newspaper (USA Today).
- 10% dinner discount in restaurant for overnight guests.

A complete listing of nearby restaurants is enclosed in your registration packet.

Local Travel

Getting around the Washington Metropolitan area is easy and convenient. The Bethesda Metro station on the red line is about 5 blocks away, the NIH Metro station is on the red line 4 blocks away. Friendship Heights Metro station on the red line is one stop south of the Bethesda station and has additional shopping and dining venues.



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