1990 NPTS

NATIONWIDE PERSONAL TRANSPORTATION SURVEY

DEMOGRAPHIC SPECIAL REPORTS

1990 NPTS Publications Series:

User's Guide for the Public Use Tape
(for tape or diskette users)

Summary of Travel Trends

Travel Behavior Issues in the 90's

1990 NPTS Databook

NPTS Urban Travel Patterns

NPTS Special Subject Reports

U.S. Department of Transportation
Federal Highway Administration

1990 NPTS Report Series

Demographic Special Reports

Based on Data from the
1990 Nationwide Personal Transportation Survey (NPTS)

Prepared for:
Office of Highway Information Management, HPM-40
(202) 366-0160, Fax (202) 366-7742

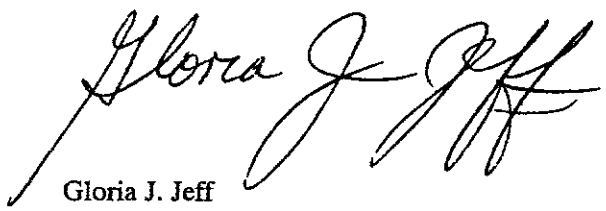
February 1995

Foreword

This series of papers, using data from the Nationwide Personal Transportation Survey (NPTS), has forged new bridges between policy makers, planners, and the academic community. Too often, in the transportation field, we forget that people travel to accomplish activities important to their daily life—to travel to and from work, to take care of their family and themselves, and to enjoy recreational and social activities. NPTS has a specific focus on this personal travel, and allows researchers to examine a multitude of characteristics of persons, households, and vehicles relative to their daily travel.

These papers give us new insights into how people travel today, how this differs from past behavior, and understanding the complexity and variety of travel needs. We need better understanding of how our policy decisions may impact different groups and how our planning processes need to account for these variations.

In 1995, the next NPTS will be collected, adding to the data series started in 1969. This special series of papers has also contributed to improving the design and implementation of the NPTS.



Gloria J. Jeff

Associate Administrator for Policy

Federal Highway Administration

Introduction

The Nature of These Documents

This document is one of three volumes that have been produced as a set, containing topical subject papers from the Nationwide Personal Transportation Survey, NPTS. These volumes represent something of a departure from standard approaches to reporting the NPTS. Traditionally, the survey results have been reported in large volumes with an extensive series of tables, organized around important sections of the survey, or main categories of data, such as Vehicle-miles of travel, or work travel. While such volumes continue to be produced for the 1990 NPTS, they are being supplemented by a different approach as exemplified by these documents.

This new approach examines important emerging travel behavior trends, seeking to understand better key public policy issues on which the survey data can shed light. This approach is an outgrowth of a special study of the NPTS, entitled *Travel Behavior Issues in the 90's*, which provided an early look at the insights the NPTS could provide regarding significant policy-related topics. As a product of that study a series of additional topics were identified for further examination. Individual researchers were selected to intensively examine each subject and to prepare a paper presenting their findings. These papers have been compiled in the three volumes.

Value of This Approach

The goal of this approach is to advance understanding beyond that possible by traditional means. While the large volumes of summary tabulations produced from the survey are of great value, particularly in getting fundamental facts about travel on the record, they represent only one facet of the immense capabilities provided by the NPTS results. These supplemental, interpretive products support the role of the NPTS as an early warning system for emerging travel behavior trends, and as a mechanism for informing public policy officials.

The kind of presentation approach developed for these subjects recognizes the intended audience - primarily public officials, but also researchers, analysts and planners, as well as interested citizens. The extensive use of tables and graphics to make trends and patterns clearer is one attribute of the approach. But the fundamental characteristic that permeates these volumes is the synthesis of large masses of data from the survey into those that are central to understanding what demographic forces are affecting travel behavior.

Why These Subjects?

The subjects selected are something of a "hit parade" of major topics of interest coming from the NPTS. Topics have been selected that:

- are of substantial public interest,
- have bearing on current policy concerns,
- fill-in important questions about the direction and weight of current trends, and
- are sufficiently bounded so that a small individual study can make an incisive contribution to our understanding of travel phenomena.

As the purpose of this undertaking is to mine the rich resources of data from NPTS; it is the 1990 NPTS data set and its predecessor data sets from 1983, 1977, and 1969 that are the predominant, almost exclusive source of data for these studies. Where appropriate, researchers have used other data sets to extend or corrorborate the data.

Selected Studies

The twelve studies have been clustered into three groups based on their general subject matter. These are:

Demographic Special Reports

Chapter 1. An Assessment of the Potential Saturation in Men's Travel, Joel R. Rey, Steven E. Polzin, Ph.D., and Stacey G. Bricka

Chapter 2. Travel by Women, Sandra Rosenbloom, Ph.D.

Chapter 3. Travel by the Elderly, Sandra Rosenbloom, Ph.D.

Chapter 4. Multiworker Household Travel Demand, Siim Sööt, Ph.D., and Ashish Sen, Ph.D.

Chapter 5. Household Structure and Travel Behavior, Joan Al-Kazily, Ph.D., Carol Barnes, Ph.D., and Norman Coontz

Travel Mode Special Reports

Chapter 1. Travel by Households Without Vehicles, Charles Lave, Ph.D., and Richard Crepeau, Ph.D. Cand.

Chapter 2. Recent Nationwide Declines in Carpooling, Erik Ferguson, Ph.D.

Chapter 3. Non-Motorized Transportation, Debbie A. Niemeier, Ph.D. Cand., and G. Scott Rutherford, Ph.D.

Special Reports on Trip and Vehicle Attributes

Chapter 1. Understanding Trip Chaining, James Strathman, Ph.D., and Kenneth Dueker, Ph.D.

Chapter 2. Geographic Factors Explaining Work Trip Length Changes, Peter Gordon, Ph.D., and Harry Richardson, Ph.D.

Chapter 3. The Demography of the U.S. Vehicle Fleet, Alan Pisarski

Chapter 4. Time-of-Day Characteristics of Travel, Ryuichi Kitamura, Ph.D.

There are many other NPTS products already available or underway that go well beyond these subject studies. They are listed on the inside cover of this document.

Broad Findings

It is not feasible to summarize the individual findings of these twelve studies in a brief fashion. Twelve studies cover a broad range of subjects; all address different facets of travel characteristics or travel behavior. However, there are major themes that emerge from the materials. These themes were developed in a two day conference held in Arlington, Va. on April 20 and 21, 1994, in which the researchers presented the findings of their work and invited panelists and other conference participants to discuss the implications of the findings. The themes arose as part of the presentations of the researchers and from the separate workshop discussions that followed.

One of the themes, which has to be expressed with some care, is that researchers have discovered, or re-discovered, how complex is travel behavior and its demographic determinants. It may sound overly simplistic, or even selfserving, to state that travel behavior is increasingly complex but it does appear to be the case. There are several interrelated factors contributing to this trend, but the dominant one is the changing role of women.

This phenomenon is expressed, of course, in the paper addressing the travel characteristics of women, but it also permeates the content of the papers on multi-worker households, household structure, and the topic of trip chaining. The topic of suburbanization and work trip lengths is also affected.

Perhaps the major theme that emerges from the papers is that of issues of equity - equity for women, low income groups, racial and ethnic groups, and the aged. Almost all of the papers make a contribution to this topic, expanding and revealing some of the elements of the key issues surrounding the subject. Even the topic of the aging of the vehicle fleet contains elements of equity concern.

The final major theme links to topics of relevance to environmental concerns. One of these, of course, is the study of the aging of the vehicle fleet. But this, by far, is not the only material of great relevance. Other pertinent papers include the studies of trip time patterns, multi-worker households, walking patterns, geographic factors in trip length, the potential saturation of male travel, and perhaps most significantly, trip chaining characteristics.

There are other themes as well, many of them sub-themes derivative of the major themes. For the most part, the subthemes relate to more technical and organizational aspects of current transportation planning processes. There are three important elements among these technical themes.

- The federal regulatory process, at DOT and other agencies needs to take these patterns and trends into account.
- The state and metropolitan planning processes need to better understand these behavioral patterns and their implications for local travel needs.
- The relationships identified in these studies need to be incorporated better in the current modeling and forecasting systems in use at the state and metropolitan levels.

A final theme that arose again and again concerned the need for better mechanisms to inform the policy process of the character of travel behavior and its changing implications for public policy.

The reader will want to be alert to these themes and to the many others that permeate these reports which the reader may discover.

Alan E. Pisarski

Authors' Biographies

Steven Polzin, Ph.D., P.E., is Deputy Director for Policy Analysis at the Center for Urban Transportation Research (CUTR) at the University of South Florida. CUTR has been working with 1990 NPTS data for two years as well as with prior NPTS data. Its active research program also addresses travel behavior data using attitudinal surveys, on-board transit surveys, and market segment analysis for transportation.

Sandra Rosenbloom, Ph.D., Director of the Drachman Institute at the University of Arizona, is a nationally and internationally recognized expert on issues related to travel behavior of women and the elderly. Her paper, "The Mobility Needs of the Elderly," which presents results from the 1977 and 1983 NPTS surveys, is often quoted and cited regarding national travel trends by the elderly. She has prepared numerous reports on women's travel, most recently, on working mothers and trip chaining, and impacts of mandatory TDM measures on women workers.

Siim Sööt, Ph.D., is Associate Professor in Geography at the University of Illinois at Chicago. **Ashish Sen, Ph.D.,** is Professor of Urban Planning at that university. Drs. Sööt and Sen are regional experts on such topics as spatial employment and economic development, having examined work and home location relative to travel behavior in developing travel forecast models. One specific area of their focus is multiple worker households.

Joan Al-Kazily, Ph.D., is a Professor of Civil Engineering at California State University, Sacramento. Dr. Al-Kazily has participated in a variety of research projects involving alternative modes of transportation for passengers and freight. **Carole Barnes, Ph.D.,** is Professor of Sociology and Director of the Institute for Social Research at California State University, Sacramento. Dr. Barnes' previous work in transportation includes development of a ground transportation master plan for San Francisco International Airport and project plans for Sacramento Transit Authority. **Norman Coontz** is Research Analyst II in the Research Division at the California Air Resources Board, where he conducts applied research on transportation behavior, alternative transportation modes, and land use policies.

Travel Mode Special Reports

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An Assessment of the Potential Saturation in Men's Travel

Joel R. Rey, E.I., Steven E. Polzin, Ph.D., P.E., and Stacey G. Bricka

An Assessment of the Potential Saturation in Men's Travel

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Executive Summary

For planners and decisionmakers to make improvements to the transportation system in the United States, understanding the level of demand from individuals is useful, given their current travel behavior. Previous studies have indicated that the projected levels of future congestion and gridlock based on recent trends may be overstated due to the apparent saturation of demand for automobiles and driver's licenses. According to Nationwide Personal Transportation Survey (NPTS) trend data, both household vehicle availability and the licensing of persons eligible to drive have exhibited growth trends that have stabilized since 1969. However, the effects of saturation in these two elements influence only one half of the travel demand equation: the supply of persons wanting to travel and the number of vehicles at their disposal. Additional analysis is needed to evaluate the other half of the equation, i.e., the individuals' demand for travel.

This study addresses the hypothesis that male travel trends may be approaching or have reached saturation. In analyzing this particular issue, this study examined the overall and gender-based trends in four indicators of travel (vehicle trips, vehicle miles of travel, person trips, and person miles of travel) as well as the trends in related factors (e.g., licensed drivers, household vehicle availability). In addition, the changes in average daily per person travel rates were analyzed for specific segments of the male population as defined by a selection of demographic, economic, and geographic characteristics that contribute to male travel.

Results of this study reveal that total male travel has not indicated signs of stabilization, but has actually increased over time at an accelerated rate. However, analysis of the contributing characteristics shows that various segments of the male population did experience saturation in their average daily travel rates, especially for their person travel measures (trips and miles of travel on all modes). From these findings it can be concluded that total male *vehicle travel* (trips and miles of travel driving a personal vehicle) has not yet exhibited signs of stabilized growth, and its future saturation can only be assumed based on the stability of the trends for licensed driver and household vehicle availability growth. It can also be concluded that the NPTS data did not truly evidence the current saturation in total male *person travel.* However, the stability shown by the various segments of the male population for their average daily person travel rates indicates that the stabilization in total male person travel has already begun and should be more evident in subsequent NPTS data.

Introduction and Overview

Travel behavior has changed significantly over the last several decades. These changes have resulted from changes in the economy, advancements in technology, new social values and norms, and shifts in the locations of households and firms (1). Similarly, changes in travel costs and transportation system performance also have contributed to societal changes. Many of these changes have occurred rapidly, not allowing the transportation infrastructure to keep pace. Accelerated growth in the suburbs, the influx of women into the labor force, and increasing vehicle ownership are a few of the factors that have altered national travel characteristics and commuting patterns (2).

Between 1969 and 1990, the total population in the United States increased more than 21 percent; however, as shown in Table 1, the growth in travel as measured by total vehicle miles of travel (VMT) was nearly four times greater, with an increase of approximately 82 percent during this time. Given these trends, it is easy to see why urban transportation planners are eager to predict the extent to which these increases in demand will continue.

Table 1: COMPARATIVE DEMOGRAPHIC AND TRAVEL DATA 1969, 1977, 1983, and 1990 NPTS

Indicators	1969	1977	1983	1990	% Change 1969-90
Households (000)	62,504	75,412	85,377	93,347	49.4%
Persons, All (000)	197,213	213,141	229,740	239,416	21.4%
Persons, 5 years & older (000)	n/a	198,434	213,228	222,101	11.9%
Vehicle Trips (million)	87,284	108,826	126,911	158,927	82.1%
Vehicle Miles of Travel (million)	775,940	907,603	1,002,519	1,409,574	81.7%
Person Trips (million)	145,146	211,769	224,459	249,562	71.9%
Person Miles of Travel (million)	1,404,137	1,879,215	1,947,481	2,315,273	64.9%

Source: 1977, 1983, and 1990 data tapes; "Summary of Travel Trends: 1990 Nationwide Personal Transportation Survey," FHWA, March 1992.

In trying to understand future travel demand, one question that repeatedly arises concerns the prediction of when per capita travel demand will be saturated. One hypothesis is that men's travel may be becoming saturated. That is, men are close to reaching or have already reached an upper limit on their total travel, given that there is some maximum amount of time available to spend for travel on any given day. According to preliminary analyses of NPTS data, personal travel has increased significantly over the last two decades; however, the rates of increases in travel demand differ significantly by gender. An examination of person trips reveals that average daily trip-making for women has increased approximately 12 percent on a per person (persons five years and older) basis since the 1977 NPTS survey. Comparatively, average daily trip-making for men declined nearly two percent on a per person basis during this period.

While these data seem to indicate that men's travel may indeed be approaching some level of saturation, other data and factors must be considered before this particular hypothesis can be substantiated. For example, what, if any, demographic, geographic, and/or economic characteristics are contributing to a potential saturation of male travel?

As part of this study, gender-based travel trends were analyzed utilizing four basic indicators of travel demand included in the NPTS database: vehicle trips, vehicle miles of travel, person trips, and person miles of travel. Information from the 1977, 1983, and 1990 data tapes were used to construct total and per

person travel trends. The 1983 and 1990 NPTS databases were used for more specific and detailed cross-tabulations.[1]

A literature review is included in this report. Some sources in this literature review discuss a person's daily travel time budget. While the topic of maximum time available for traveling during a given day may be an important consideration in the treatment of the concept of travel saturation, it was beyond the scope of this study. Therefore, it has only been addressed partially and is better left as an issue recommended for additional research.

Ultimately, the value of this research may be in the potential for enhanced capabilities in predicting future travel demand as a function of population growth and demographic characteristics. If, indeed, men's travel is becoming saturated, then it is possible that current travel forecasts that extrapolate historical trends are overestimating future demand and, therefore, producing exaggerated projections of future congestion. It may be the case that the nation's future roadway network will not be as "undersupplied" as was once thought. In addition, analysis of this potentially saturated condition may result in a better understanding of the relationship between demographic and trip-making characteristics.

Previous Studies

A great deal of research has been devoted to the differences in travel behavior attributable to gender. Women's travel patterns generally have been studied in more detail, and with justification, given the significant changes that have occurred over the last several decades. However, noteworthy changes in men's travel behavior also have been taking place, possibly as a result of the rising economic independence of women.

Some of the research reviewed originated in Europe (England, in particular). The use of this reference material is supported by the fact that the United States is experiencing many of the same trends in labor-force participation as many western European nations. For example, data from the mid-1980s indicate that England, France, and the U.S. have had similar female labor-participation rates (with the Netherlands not far behind). These countries also share a number of other trends, including the trend in driver's licensing rates.

An analysis of driver's license-holding rates for men and women over time, indicates evidence that these rates are converging (3, 4, 5, 6). Greene, using NPTS data, notes that the license-holding rates for men have remained virtually the same while those for women have increased substantially. Spielberg, Andrle, Ernst, and Kemp estimate that the share of men holding driver's licenses will actually fall one percent by the year 2000. Kitamura shows that from 1979 to 1983, men's license-holding increased by only 2.9 million, while increasing for women by 6.1 million. Similarly, Bell demonstrates, using data from home interview surveys, that males with licenses increased by 6 percent during the 1970s, while during the same decade women's licensing rates grew 18 percent. These rates show a stabilization in license-holding by males.

Furthermore, Spielberg et al. report that labor force participation rates of men have been declining and are expected to level off and remain constant. They also note that travel by men has fallen from about

[1]It should be noted that for a number of variables within the NPTS database, responses of "not ascertained" or "refused" were indicated in the 1990 data but not in the 1983 data. In these instances, the unknown responses were omitted from the 1990 weighted total data before calculating percentage distributions so that the 1983 and 1990 distributions were directly comparable. Also, in cases where the response cohorts were not identical for 1983 and 1990, cohorts were restructured, if possible, to allow for the most accurate trend comparisons. Notations concerning dissimilar cohorts were provided where applicable.

55 percent of total travel in the early 1960s to 51 percent of total travel by 1973-74. Bell adds that the number of males in the labor force working full time declined during the 1970s, which, in part, explains decreases in work trips by males.

Rosenbloom studies how growing children and their travel needs affect the travel behavior of their parents (7). Utilizing interviews, including 100 surveys of U.S. households, it is noted that men are more likely to link trips to work when their children are very young. Also, when the children in a household are young, little disparity exists between the types of trips men and women make for them. As children grow, fathers make fewer trips for or with them.

Other interesting differences between men's and women's travel are revealed in the literature. Despite any recent changes in travel behavior, it remains clear that men are still commuting much longer distances than women (8, 9, 10, 11). A Transport and Road Research Lab (TRRL) report and Dasgupta's study both determine that men tend to travel almost twice the distance of women. Additionally, Dasgupta completes an examination of men's and women's travel behavior through different life-cycle stages using the results of a travel-to-work survey. Like other researchers, he relates the travel differences between men and women to the different types of jobs each typically hold. A distinct relationship is found between the types of jobs held, the distance traveled, and choice of mode for men and women.

The TRRL study analyzes the travel patterns of economically inactive housewives. The data, from the 1975-76 National Travel Survey, reveal that they have quite low personal mobility. Their mobility is restricted by young children and the lack of an available vehicle, since it appears that, if only one car is available, the husband has priority in its use. This study observes travel patterns of working women as well and found that they are usually drawn to employment that is closer to their homes. Gordon, Kumar, and Richardson's study also notes that women are attracted to more local employment (12). Furthermore, Gordon et al. establish that women generate more non-work trips, while men make more work-related trips.

Wachs addresses reasons why substantial differences persist between men's and women's travel (13). He describes how men secured the domain of the automobile, beginning with its introduction to society. Men were associated with driving to their jobs in central cities from their suburban homes. Women, he explains, were associated with the home in the suburbs. If women became employed, it was limited basically to clerical or service-oriented work that was located in the suburbs. Thus, women worked closer to the home, where they still retained primary responsibility. Referring to a literature review and 1983 NPTS data, Wachs predicts that this tendency will continue. He also cites data that show that lower paid workers make shorter trips to work, again supporting that shorter trips are made by women. Similarly, the premise of Rosenbloom's article attributes the disparity between men's and women's travel patterns to the woman's primary role in child care and other household duties (7). She concludes that this disparity will not significantly lessen until major social changes concerning gender roles in the household occur.

Grieco, Pickup, and Whipp relate how women are "invisible" in transportation issues (14). The authors denounce current decision models that they feel ignore women's issues. Women reportedly suffer significant transportation disadvantages, especially when taking into account personal security issues, and they have much lower mobility than men but have more transportation needs. While women are less likely to be able to afford private means of transportation, they also find it more difficult to use public transit when small children and/or large shopping trips are included. Travel time budgets of women are affected by the changing needs of growing children (14, 11), yet men's time budgets remain relatively constant at a high level until they retire. The authors believe it is time for transportation policy to take serious note of the different travel needs of women.

Other studies investigate travel time budgets as well. Prendergast and Williams analyze the hypothesis that daily travel time budgets have stabilized (15). However, their work shows little support for this theory. At an individual level, the data collected from a National Travel Survey and two surveys from Reading,

England, completed in the 1970s, illustrate very little correlation among daily travel times. However, as mentioned above, along with many other researchers, they find that men travel much longer distances than women, and that married women tend to allocate the least amount of time to travel. Another study by Prendergast and Williams using similar data concludes with similar results (16), but also maintains that households generally trade off the woman's travel in favor of other household responsibilities.

Pas and Koppelman study the day-to-day variabilities in travel behavior using several data sources, including surveys, interviews, and questionnaires (17). They detect little difference in variability between single men and women; however, married women were found to exhibit greater variability than married men. Other characteristics that influence travel variability include education, social status, and employment status. Interestingly, children have an ambiguous effect on the day-to-day variability of their parents' travel patterns.

Many researchers believe that the demand for travel will continue to increase at rates similar to those observed in the past decade or two. This notion is based strongly on informally observed increases in auto ownership and traffic congestion. However, Lave reveals that most estimates of increased travel tend to overlook structural changes such as the impending saturation of automobile demand (18, 19). He evaluates vehicle saturation by measuring the ratio of vehicles to all potential drivers—those who are of driving age.

Data from the 1977 NPTS suggest that saturation in the number of vehicles per person is already occurring, according to Mitchell (20). Similarly, Reno observes saturation levels being reached in vehicle availability for adults, using NPTS data from 1969, 1977, and 1983 (21). This saturation level is reached at less than one vehicle per adult.

Another study determines that, for those who commute by auto, average travel times are remaining the same or declining; thus, the "commuting paradox" between increasing congestion and stabilizing commute times is observed (22). Gordon, Richardson, and Jun conclude that congestion will not substantially worsen, due to the discontinuation of the trends that caused it to rise so remarkably. They see the baby-boomers' contribution to the growth in those of driving age at an end, the numbers of women entering the workforce at their peak, and the ratio of vehicles to the population (of driving age) at its saturation point. Lave (18, 19) and Myers (23) recognize these trends as well.

Myers observes another trend, household size is decreasing as many more people are living without children or a spouse. Kumar and Saccomanno share this conclusion as well in their study to assess major changes in population structure and the implications of these changes. Employing demographic and other travel data from Toronto, Canada, they note that decreasing household size, along with other structural changes in the population, will sizably impact future travel needs (24). The decrease in household size is also noted by Hartgen, who reports that trips per household are subsequently declining (25).

Prevedouros and Schofer believe that many factors—social, economic, technological, and cultural—combine to influence travel behavior, as well as auto ownership and use (1). They also see household characteristics and how they change as important elements. In their work, Hanson and Hanson examine many of the same factors as Prevedouros and Schofer (26). In addition, however, they note the importance of gender role factors in determining individual travel patterns.

Jager and Scheltes recognize that travel behavior is clearly influenced by auto ownership, and that gender has a considerable impact on such ownership (27). The difference in auto ownership between men and women, even among high-income members of both sexes, is extraordinary to Jager and Scheltes. They attribute this to the status of both men and women in the household and the workplace. Almost all of these researchers agree that until this status truly changes, the disparity between travel patterns of men and women will not disappear.

Trends

Prior research on this topic has used vehicle saturation as one indicator of the stabilization of travel demand. Since personal auto use dominates mode choice in the United States (87 percent of all person trips in the United States in 1990 were made in personal vehicles), it is reasonable to believe that a slowdown in the growth of the number of vehicles available per person (or per licensed driver or person eligible for a driver's license) may indeed indicate a similar saturation in the total demand for travel. However, vehicle supply is not the only factor that should be considered; changes over time in personal trip-making characteristics must also be analyzed.

Population and Total Travel

According to the 1990 NPTS data, there were approximately 93.3 million households and 222.1 million persons (age five and older) in the United States. Since 1977, the number of households has increased 24 percent and the population age five and older has increased almost 12 percent. These trends are shown in Figures 1 and 2. The fact that the number of households increased at a rate twice that of population indicates that household size (persons per household) has declined during this time.

The trend lines for population growth by gender are relatively parallel, as exhibited by the dotted and dashed lines in Figure 2. The number of men has increased 11 percent since 1977, and the number of women has increased about 13 percent. Women still comprise approximately 52 percent of the total population in the United States.

Figures 3 through 6 illustrate the trends for the four basic indicators of total travel that are available in the NPTS databases: vehicle trips, vehicle miles of travel, person trips, and person miles of travel. Each

Table 2: PERCENT CHANGES FOR SELECTED DEMOGRAPHIC AND TRAVEL DATA

	Percent Change		
Indicator	1977-83	1983-90	1977-90
Households	13.2%	9.3%	23.8%
Persons, 5 years & older	7.5%	4.2%	11.9%
Male	7.6%	3.2%	11.0%
Female	7.4%	5.0%	12.7%
Vehicle Trips	16.6%	25.2%	46.0%
Male	12.7%	25.7%	41.6%
Female	21.0%	24.7%	50.9%
Vehicle Miles of Travel	10.5%	40.6%	55.3%
Male	7.3%	49.9%	60.8%
Female	14.8%	28.5%	47.6%
Person Trips	6.0%	11.2%	17.8%
Male	1.8%	7.3%	9.3%
Female	10.3%	14.9%	26.7%
Person Miles of Travel	3.6%	18.9%	23.2%
Male	0.5%	17.9%	18.5%
Female	7.4%	20.0%	28.9%

Source: 1977, 1983, and 1990 data tapes; "Summary of Travel Trends: 1990 Nationwide Personal Transportation Survey," FHWA, March 1992.

Figure 1 Households (000)

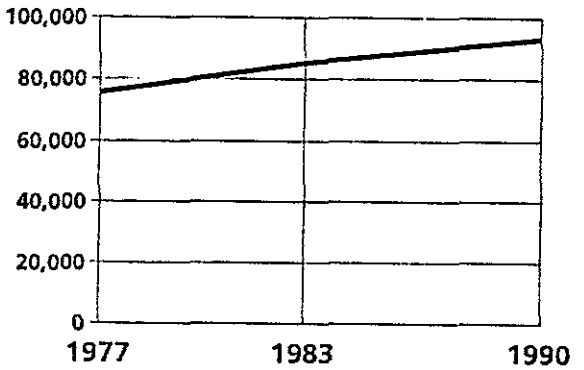


Figure 2 Persons, 5 Years + (000)

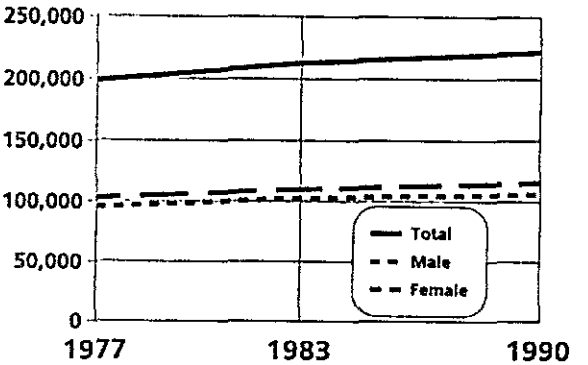


Figure 3 Vehicle Trips (000,000)

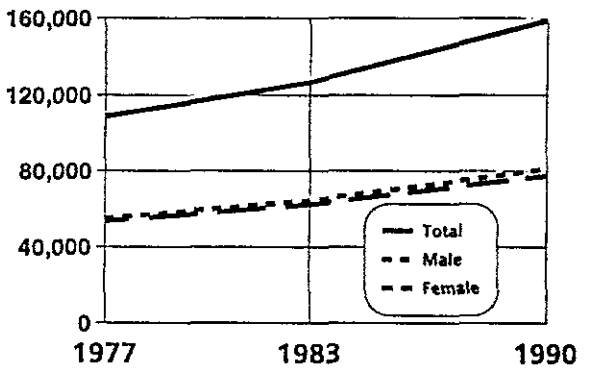


Figure 4 Vehicle Miles of Travel (000,000)

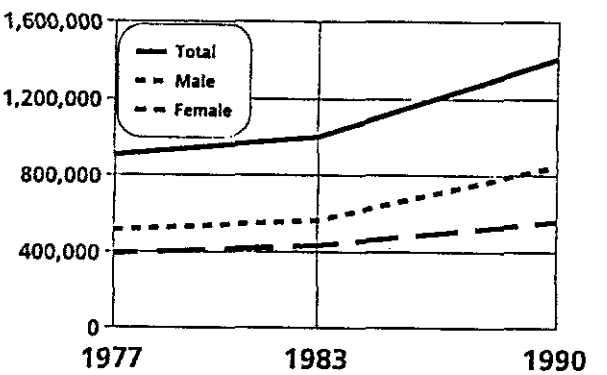


Figure 5 Person Trips (000,000)

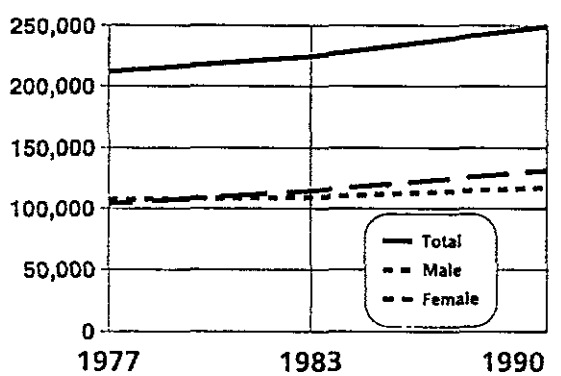
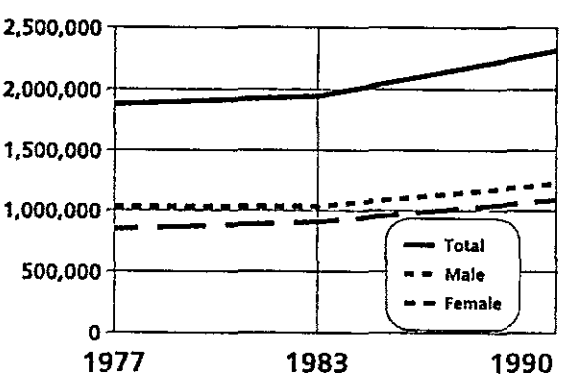


Figure 6 Person Miles of Travel (000,000)



graphic also depicts the gender-based trends for these travel measures. Table 2 presents the percentage rates of change associated with the trends depicted in Figures 1 through 6. From these data, it is possible to determine comparative magnitudes of change between travel measures as well as whether the changes over time are occurring at increasing or decreasing rates.

It is evident that all four travel measures have increased between 1977 and 1990. However, the vehicle-related travel measures (trips and miles made by a personal vehicle regardless of the vehicle's occupancy) have increased more significantly than the person-related travel measures (trips and miles made by a person regardless of the mode of transportation utilized), especially between 1983 and 1990. This finding further evidences the trend of increased use of personal vehicles such as autos, vans, and light trucks for personal travel over the use other modes such as public transportation.

It is interesting to note that all four travel measures have grown at increasing rates, as evidenced by the fact that their growth rates between 1983 and 1990 are greater than those between 1977 and 1983.[2] This is particularly important because this accelerated growth in travel has occurred despite the declining, or decelerating, growth in population and households, as evidenced by their smaller percent growth rates between 1983 and 1990. The "concave downward" shapes of the trend lines in Figures 1 and 2 more clearly illustrate the stabilization in the growth in these two variables.

While there are a number of reasons for overall travel to increase despite stability in the growth of the population, an in-depth discussion is not necessary in the scope of this work. It is important to know, however, that among the more important causal factors are the changing age structure of the population in the United States, specifically the aging of the baby-boom generation; the increase in the number of women entering the labor force; the increase in the availability of the automobile; and the changes in urban development.

Gender-Based Travel

Each of the four travel measures have increased for both men and women. However, women have exhibited greater increases since 1977 in three of the four measures. Only in the number of vehicle miles of travel did men show a larger increase, 61 percent versus 48 percent for women. Despite the significant increases in the measures of women's travel, men still made more vehicle trips and accumulated more miles of travel (both vehicle and person miles) in 1990 in absolute terms.

As was the case for the total travel trends, the growth rates for both male and female travel have also accelerated, especially for men. For example, the number of vehicle trips made by men and women between 1977 and 1990 increased 42 and 51 percent, respectively. Between 1977 and 1983, the percent growth rate for female vehicle trips was 21 percent, while male vehicle trips only increased 13 percent. However, since 1983, female vehicle trips have grown 25 percent and male vehicle trips have increased nearly 26 percent, a rate double that which occurred between 1977 and 1983.

Without accounting for population distribution effects, it would appear from the accelerated growth of the men's total travel data that the possibility of the saturation of men's travel is unlikely. Nevertheless, other variables and data should be considered prior to drawing any conclusions on the matter. In the following section, licensed driver and vehicle availability data are examined.

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[2]The trend lines in the figures display this increasing rate as a "concave upward" shape; conversely, a decreasing rate would be manifested as a "concave downward" shape to a trend line.

Licensed Drivers and Vehicle Availability

The total number of licensed drivers in the United States increased approximately 28 percent between 1977 and 1990, as shown in Table 3. This percentage increase translates into more than 35 million new licensed drivers during this time. Of the new licensed drivers, 60 percent were women, an indication of the need of those women entering the labor force for the travel freedom afforded by the personal vehicle. Also evident from the data presented in the table is that the growth rates for both male and female licensed drivers have decelerated. In fact, the rate of growth between 1983 and 1990 for male licensed drivers was less than half that of the growth in this variable between 1977 and 1983. Similar to the population and household trends examined previously, this trend is interesting since all four travel measures exhibited accelerated growth patterns despite the apparent stabilization in the growth of those persons who travel the most—licensed drivers.

Table 3: LICENSED DRIVERS, ELIGIBLE PERSONS, AND HOUSEHOLD VEHICLES 1977, 1983, and 1990 NPTS

				Percent Change		
Indicators	1977	1983	1990	1977-83	1983-90	1977-90
Licensed Drivers (000)	127,552	147,205	163,025	15.4%	10.8%	27.8%
Male	66,199	75,737	80,289	14.4%	6.0%	21.3%
Female	61,353	71,467	82,707	16.5%	15.7%	34.8%
Eligible Persons[1] (000)	158,263	175,995	185,113	11.2%	5.2%	17.0%
Male	74,542	83,854	87,167	12.5%	4.0%	16.9%
Female	83,721	92,141	97,876	10.1%	6.2%	16.9%
Household Vehs. (000)	120,098	143,714	165,221	19.7%	15.0%	37.6%

[1]*Persons eligible to receive a driver's license, i.e., age 16 and older.*
Source: 1977, 1983, and 1990 data tapes; "Summary of Travel Trends: 1990 Nationwide Personal Transportation Survey," FHWA, March 1992.

The decelerated growth trend for licensed drivers is also evident for those persons eligible to receive a driver's license, i.e., persons age 16 years and older. While both males and females eligible to receive licenses have increased 17 percent since 1977, the majority of these increases have occurred between 1977 and 1983. Overall, the growth in eligible persons is approximately 26.8 million since 1977, a 17 percent increase. Since the increase in total licensed drivers has exceeded that of total eligible persons during this time, it is clear that a greater proportion of eligible persons are now getting licenses. This trend is illustrated in Figure 7, for all eligible persons as well as by gender.

While it is difficult to ascertain the direction of concavity from the trend lines in Figure 7, analysis of the percent changes for the ratios of licensed drivers to eligible persons indicates that the ratios for both men and women have grown at accelerated rates. However, given that the 1990 NPTS data indicate that 92 percent of eligible males and 85 percent of eligible females have already received licenses, it does not appear that a significant amount of additional future growth in licensed drivers will be possible. As such, it would seem that this particular "supply" of potential travelers is approaching a saturated condition.

As for the availability of household (or personal) vehicles, the total number of household vehicles in the United States increased by 45.1 million between 1977 and 1990, an increase of nearly 38 percent. Figure 8 details the trends for the ratios of household vehicle per licensed driver and per person eligible to receive a license. The data in this graphic seem to support the assertions of a number of previous studies that have characterized the saturation of demand for the auto (18, 19, 20, 21). In 1990, an average of one household vehicle was available for each licensed driver in the United States, while persons eligible to receive a driver's license had an average of 0.89 household vehicles available for their use.

Figure 7 Percent of Eligible Persons Licensed to Drive

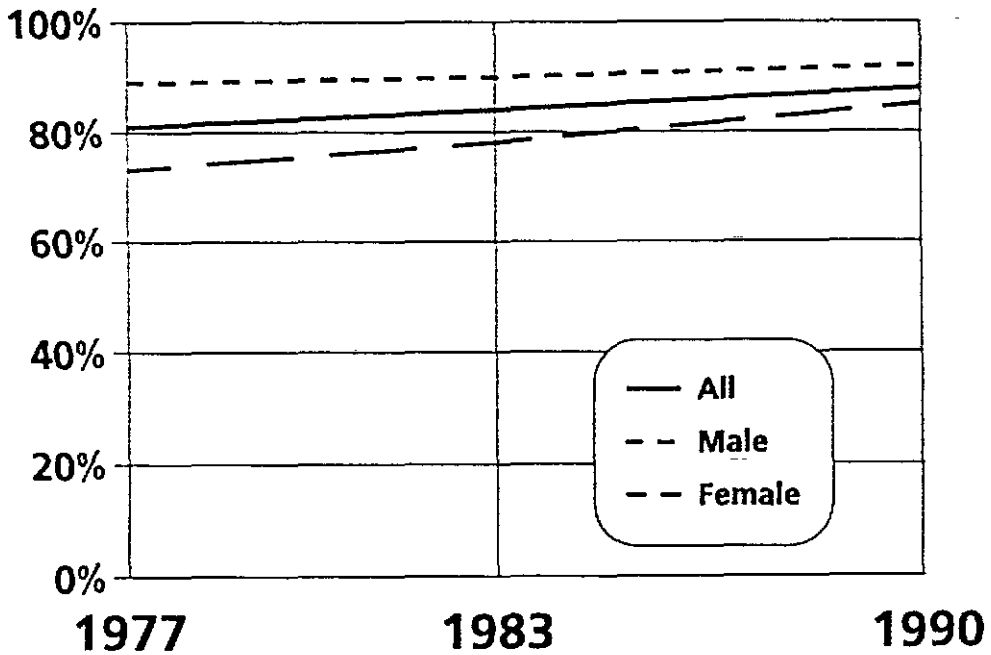
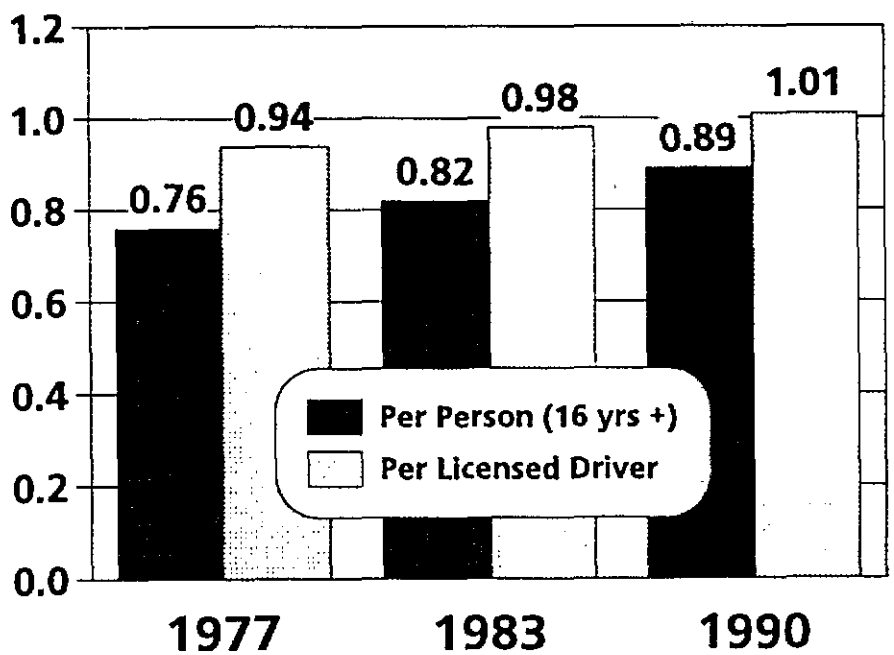


Figure 8 Household Vehicle Availability



Average Daily Travel Characteristics

Thus far, most of the examination of travel trends has centered on total vehicle trips, vehicle miles of travel (VMT), person trips, and person miles of travel (PMT). To account for population distribution effects and analyze travel characteristics on their most basic level, average daily per person travel measures are shown in Table 4. These data provide the best trend lines and rates of change from which to evaluate the potential saturation in men's travel.

Table 4: AVERAGE DAILY PER PERSON TRAVEL MEASURES 1977, 1983, and 1990 NPTS

				Percent Change		
	1977	1983	1990	1977-83	1983-90	1977-90
Daily Vehicle Trips Per Person[1]						
All	1.84	1.98	2.35	7.24%	19.10%	27.72%
Male	1.96	2.11	2.55	7.68%	20.94%	30.23%
Female	1.74	1.86	2.18	6.79%	17.20%	25.36%
Daily Vehicle Miles of Travel Per Person[1]						
All	15.36	15.61	20.87	1.57%	33.73%	35.83%
Male	18.28	18.52	26.70	1.35%	44.16%	46.11%
Female	12.71	12.95	15.67	1.88%	21.01%	23.28%
Daily Person Trips Per Person[2]						
All	2.92	2.88	3.08	-1.36%	6.74%	5.29%
Male	3.08	2.92	3.03	-5.32%	3.98%	-1.56%
Female	2.78	2.85	3.12	2.73%	9.41%	12.39%
Daily Person Miles of Travel Per Person[2]						
All	25.95	25.02	28.56	-3.56%	14.14%	10.08%
Male	29.56	27.63	31.56	-6.54%	14.22%	6.75%
Female	22.58	22.59	25.83	0.06%	14.31%	14.38%

[1]Persons age 16 years and older.
[2]Persons age 5 years and older.
Source: 1977, 1983, and 1990 data tapes; "Summary of Travel Trends: 1990 Nationwide Personal Transportation Survey," FHWA, March 1992.

According to the data in Table 4, average daily vehicle trips and VMT per person (16 years and older) both increased significantly between 1977 and 1990, as would be expected given the growth in total vehicle trips and VMT and the stabilization in population discussed previously. Average daily vehicle trips per person increased 27 percent while average daily VMT increased nearly 36 percent. The fact that average daily VMT increased at a greater rate than did average daily vehicle trips indicates that average vehicle trip lengths (VMT per vehicle trip) have also increased during this time. Additionally, the incremental percent changes for these two travel measures show that their growth rates have increased since 1983. These accelerated trends are illustrated in Figures 9 and 10.

From the trend lines presented in these figures, it is evident that average daily vehicle trips and VMT for both men and women have also increased since 1977, and at accelerated rates.

Figures 11 and 12 present the trend lines for the average daily person trips and PMT per person (5 years and older) travel measures.[3] The data in Table 4 indicate that average daily person trips per person, regardless of gender, increased 5 percent while average daily PMT per person increased 10 percent. The "concave upward" shapes of the trend lines for these measures signify accelerated growth, even though average daily person trips and PMT per person both exhibited slight declines between 1977 and 1983.

Interestingly, the gender-based trends for these two travel measures featured some differences that were not evident in previously discussed trends, especially in average daily person trips per person. For example, this particular measure is the only one in which men's travel actually showed an overall decline, from 3.08 average daily person trips per person in 1977 to 3.03 trips in 1990 (a decrease of less than two percent). Despite this slight overall decline, there was a four percent increase in this measure between 1983 and 1990, indicating a deceleration of the negative trend. Considered alone, the changes in this measure could possibly signify the beginning stabilization in men's average total daily trip-making. However, additional future data would need to be analyzed to determine whether the four percent increase between 1983 and 1990 was an anomaly or an indication of renewed growth.

Another difference indicated by the data was the significant growth in women's average daily person trips per person between 1977 and 1990, which exceeded the increase in this measure for all persons. As a result, women were making more person trips per day in 1990, on average, than men (3.12 trips versus 3.03 trips, respectively). Finally, contrary to what was evident in the average daily person trip and PMT trends for all persons and for men, the trend lines for women did not exhibit declines between 1977 and 1983 in either measure, although the increase in average daily PMT per person was only 0.06 percent during this time.

[3]The y-scale for Figure 11 has been adjusted in order to facilitate analysis of the changes in the trend lines. The trend lines cannot be distinguished from one another when the y-scale begins at zero.

Figure 9 **Average Daily Vehicle Trips Per Person (16+)**

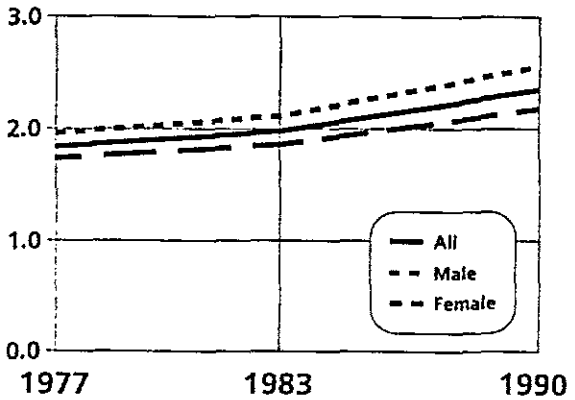


Figure 10 **Average Daily VMT Per Person (16+)**

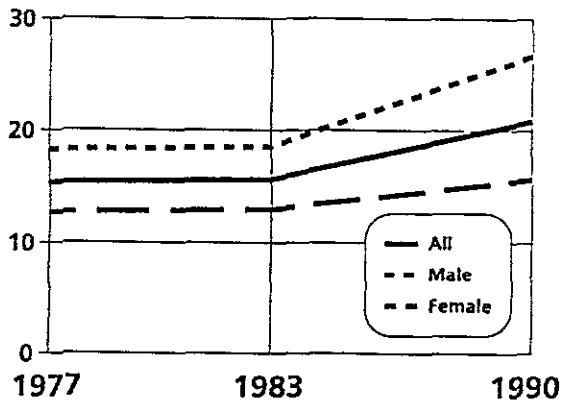


Figure 11 **Average Daily Person Trips Per Person (5+)**

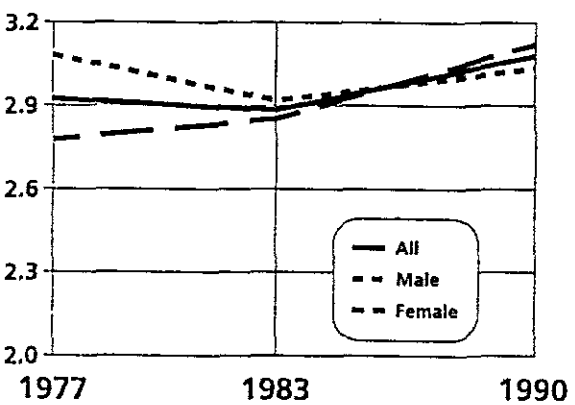
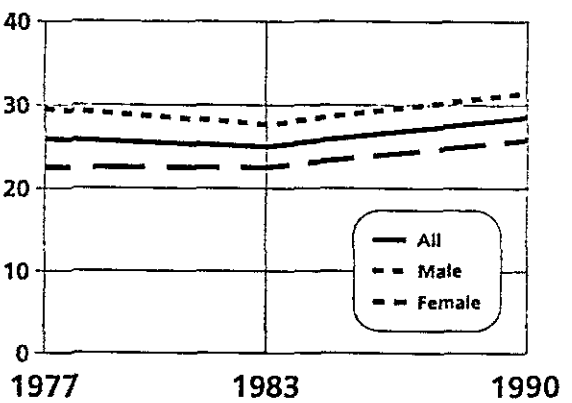


Figure 12 **Average Daily PMT Per Person (5+)**



Travel by Segments of the Male Population

The trends presented thus far suggest that the NPTS data do not evidence saturation in men's travel. In fact, all of the trends that were examined grew at greater rates between 1983 to 1990 than between 1977 to 1983, actually indicating an acceleration in the rates of male travel during this time. Since overall male travel has not exhibited signs of stabilization, several demographic, economic, and geographic variables were examined to determine whether saturation of travel was evident for specific segments of the male population. These characteristics were compared for 1983 and 1990 to document the changes in each segment. In addition, the extent to which specific cohorts of each variable indicated signs of stabilization was also analyzed. For purposes of this study, no change, a decline, or a five percent or less increase between 1983 and 1990 in the male travel measures for any category of a characteristic were used to define stabilization of travel growth within the category.

The characteristics of men that were examined include age, income, race, licensed driver status, worker status, household size, household vehicle availability, life cycle status, household location, mode choice, and trip purpose. Urban area size was also examined, but was not included herein for two reasons: first, the size categories used were not consistent between the 1983 and 1990 surveys; second, there were no significant differences between the impacts of urban size and household location.

It should be noted that the data exhibited in Tables 5 through 13 have been adjusted to reflect the fact that the 1990 data for these characteristics included responses of "not determined." This was necessary due to the lack of a comparable response in the 1983 data. Specifically, the "not determined" responses were re-distributed proportionally among the remaining cohorts.

Age

From 1983 to 1990, the total number of men (5 years and older) in the United States increased approximately 3 percent, from 102.9 million to 106.2 million. As shown in Table 5, the largest change was in the age category of 40-49, which increased by 23 percent. Other significant changes included the 16 percent increases evidenced in both the 30-39 and 65 years and older age categories. The number of men in the 16-19, 50-59, and 60-64 age categories decreased by 12, 4, and 13 percent, respectively.

Table 5: DISTRIBUTION OF MEN (5+) BY AGE

Age	Total Men		% Distribution		% Change
	1983	1990	1983	1990	1983-1990
5-15 years	19,026,299	19,132,048	18.5%	18.0%	0.6%
16-19 years	7,693,294	6,774,768	7.5%	6.4%	-11.9%
20-29 years	20,445,164	18,602,353	19.9%	17.5%	-9.0%
30-39 years	17,239,815	19,962,496	16.8%	18.8%	15.8%
40-49 years	12,314,146	15,141,460	12.0%	14.3%	23.0%
50-59 years	10,905,225	10,473,485	10.6%	9.9%	-4.0%
60-64 years	5,394,748	4,682,109	5.2%	4.4%	-13.2%
65 years & older	9,861,947	11,395,500	9.6%	10.7%	15.6%
Total	102,880,638	106,164,219	100.0%	100.0%	3.2%

Source: 1983 and 1990 data tapes.

Figure 13 Average Daily Vehicle Trips: Men (16+) by Age

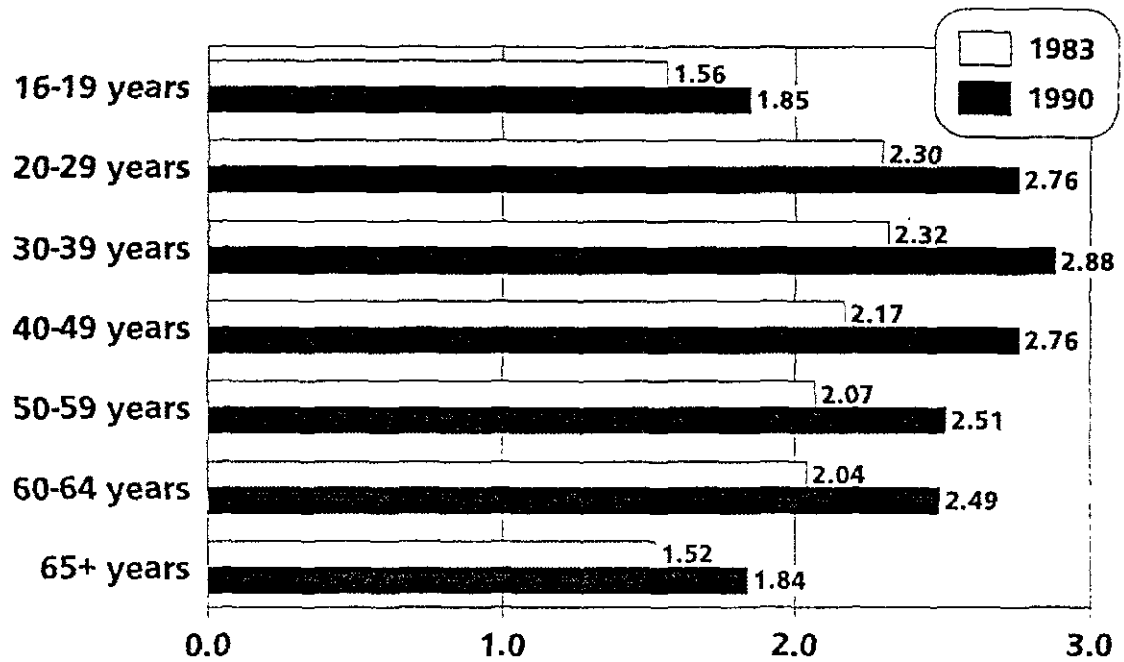


Figure 14 Average Daily Vehicle Miles of Travel: Men (16+) by Age

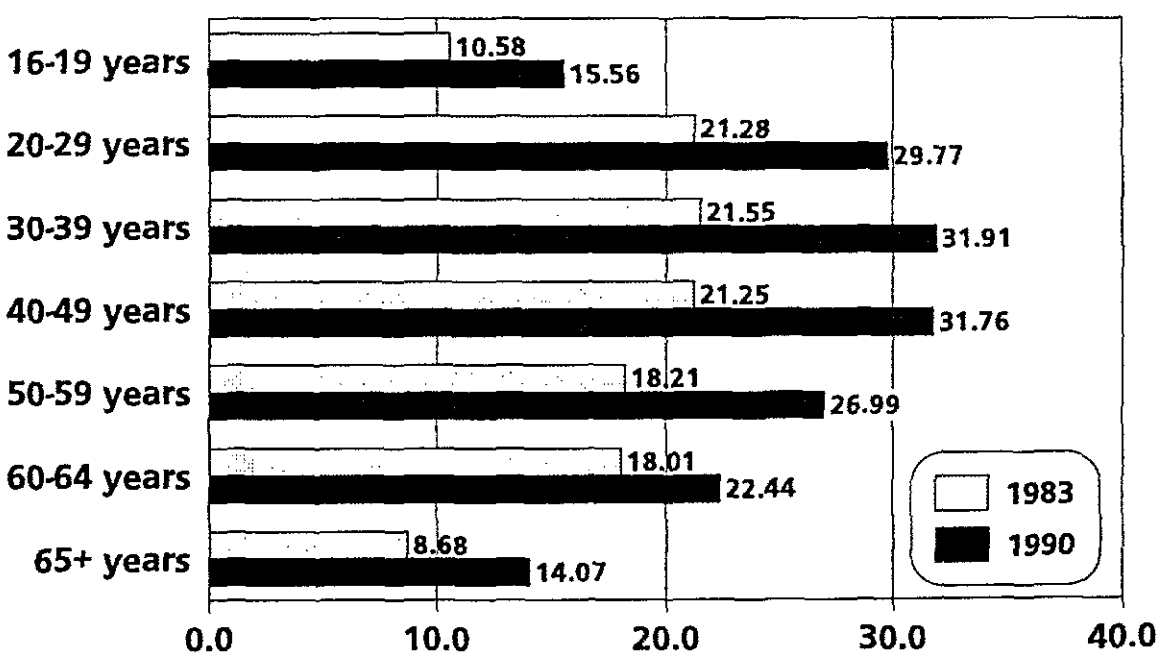


Figure 15 Average Daily Person Trips: Men (5+) by Age

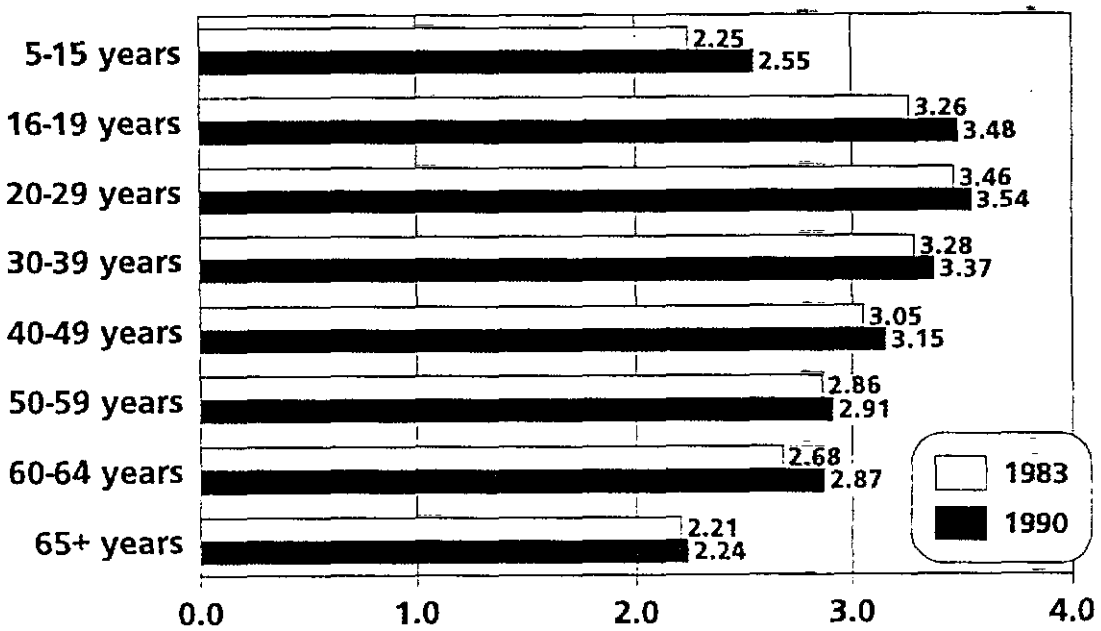
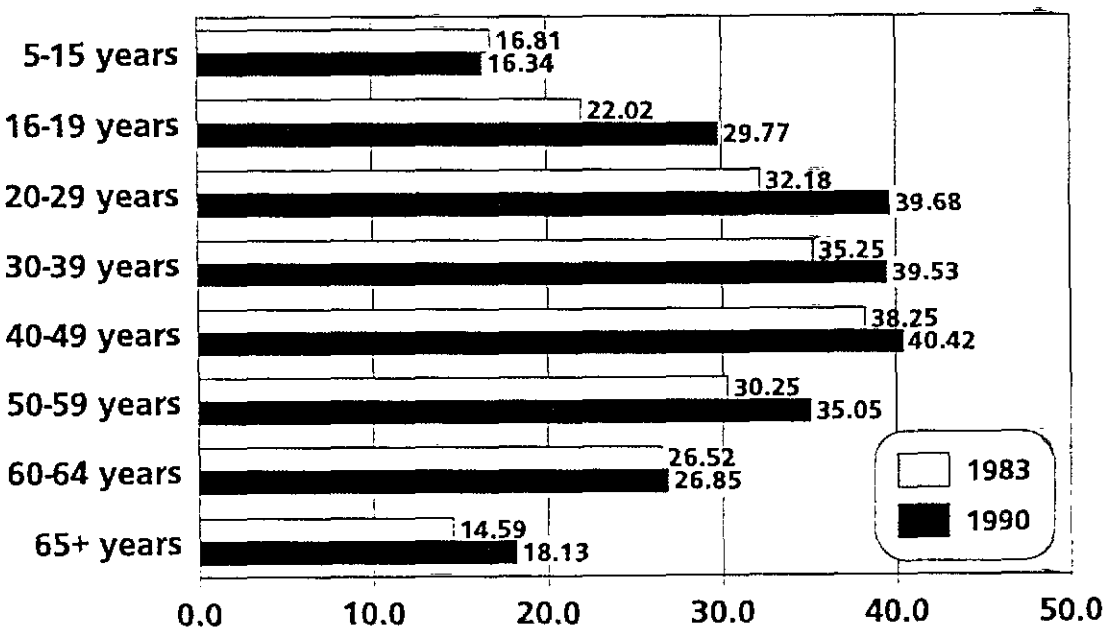


Figure 16 Average Daily Person Miles of Travel: Men (5+) by Age



In 1990, males between the ages of 20 and 49 years were associated with the "baby boom" generation. They comprised more than 50 percent of all men age five and older. According to the data in Figures 13 through 16, men in this age group have the highest average daily travel characteristics. It is also evident that average daily travel declines for men age 50 and older. Therefore, it is possible that, as the baby boomers approach retirement, changes in total male travel may become more stable.

Average daily vehicle trips and vehicle miles of travel increased between 1983 and 1990 for all age categories, as shown in Figures 13 and 14. Average daily person trips exhibited signs of stabilization for men between the ages of 20 and 59, and 65 and older. However, stability in the trends for these age cohorts was not evident for average daily person miles of travel.

For both average daily vehicle trips and VMT per person in 1983 and 1990, men ages 30-39 made the most trips and traveled the most miles. Men in the 65 years and older (65+) age category made the least number of trips and traveled the fewest miles. The most significant change in average daily vehicle trips occurred in the 40-49 age category, which increased 27 percent between 1983 and 1990. The largest change in average daily VMT occurred for men in the 65+ age category, an increase of 62 percent. While none of the age categories have shown declines in either of the two measures, it is evident from the figures that men between the ages of 20 and 49 are the biggest contributors to the increasing total trends of these measures between 1983 and 1990.

The changes from 1983 to 1990 in average daily person trips and PMT per person were not significant, as shown in Figures 15 and 16. Stabilization of growth in average daily person trips was indicated for men between the ages of 20 and 59, and 65 years and older. The largest increase in this person travel measure (13 percent) occurred for men in the 5-15 age group. For average daily PMT per person, the 5-15 and 60-64 age categories showed signs of stabilization.

Household Income

From 1983 to 1990, there appears to have been a shift in total household incomes indicated by men. However, caution should be used in interpreting these changes since the incomes were not adjusted to

Table 6: DISTRIBUTION OF MEN (5+) BY HOUSEHOLD INCOME

Household Income	Total Men 1983	Total Men 1990	% Distribution 1983	% Distribution 1990	% Change 1983-1990
Less than $5,000	6,537,690	2,392,118	6.4%	2.3%	-63.4%
$5,000-9,999	11,131,766	6,548,982	10.8%	6.2%	-41.2%
$10,000-14,999	13,439,512	7,382,079	13.1%	7.0%	-45.1%
$15,000-19,999	12,268,803	9,054,007	11.9%	8.5%	-26.2%
$20,000-24,999	13,111,149	8,567,264	12.7%	8.1%	-34.7%
$25,000-29,999	11,583,090	10,156,497	11.3%	9.6%	-12.3%
$30,000-39,999	15,250,134	19,596,244	14.8%	18.5%	28.5%
$40,000-49,999	9,067,596	13,117,477	8.8%	12.4%	44.7%
$50,000-59,999	4,601,354	11,232,398	4.5%	10.6%	144.1%
$60,000-69,999	2,327,350	6,427,740	2.3%	6.1%	176.2%
$70,000-79,999	1,351,575	3,946,334	1.3%	3.7%	192.0%
$80,000 or more	2,210,618	7,743,077	2.1%	7.3%	250.3%
Total	102,880,637	106,164,217	100.0%	100.0%	3.2%

Source: 1983 and 1990 data tapes.

account for inflation. Given the 1983 U.S. median family income ($24,580) and its value in 1990 dollars ($32,378) as reported by the Bureau of the Census, it would not be unreasonable to expect a 31.7 percent increase in household income between 1983 and 1990.

In 1983, over 80 percent of men lived in households with total incomes of less than $40,000, as shown in Table 6. This decreased to 60 percent in 1990. In addition, from 1983 to 1990, the number of men in households earning at least $50,000 more than doubled. It is interesting to note that these apparent increases in total household incomes have occurred during a time in which average household size has decreased.

The average daily vehicle trip and VMT per person data illustrated in Figures 17 and 18 indicate that the travel measure rates increased as household family income increased. This relationship is also evident for average daily person trips and person miles of travel; however, the changes between 1983 and 1990 for these travel measures were not as significant.

Men with higher household incomes not only made more vehicle trips and traveled more VMT, their income groups also exhibited the largest increases in these measures between 1983 and 1990. In fact, the only income groups that indicated signs of stabilized travel growth for either measure included men in households with incomes of less than $5,000 or between $15,000-19,999. Since these travel measures include only trips made in personal vehicles, it is logical to expect those least able to afford an auto or other personal vehicle to have the most modest travel characteristics.

Men with lower household incomes had the smallest average daily person travel rates, as shown in Figures 19 and 20. Stabilization of both average daily person trips and PMT was evident between 1983 and 1990 for men in households with incomes of $10,000–24,999; $30,000–39,999; and $50,000–59,999. In addition, other income categories indicating possible saturation in these travel measures included the $80,000+ category (three percent decline in average daily person trips) and the less than $5,000 category (17 percent decline in average daily PMT).

Race

As shown in Table 7, 82 percent of all men in the United States were white, non-Hispanic, and 10 percent were black, non-Hispanic in 1983. In 1990, the number of men in the white and black categories remained relatively stable. However, the number of Hispanic males increased by 34 percent during this time. This increase seems reasonable since Census data show that the Hispanic population in the U.S. increased more than 50 percent, from 14.6 million persons in 1980 to 22.3 million in 1990.

It is also possible that this increase may have been influenced by a change in the ethnic origin question on the questionnaire. In 1983, ethnic origin encompassed a broad range of nationalities and was determined via the use of a number of ethnic codes (e.g., German, Irish, Mexican, etc.). Accordingly, assumptions were necessary to determine whether persons were of Hispanic origin. However, in the 1990 survey, the ethnic origin question was changed to ask respondents only whether they were of Hispanic origin (no other nationalities were considered). For purposes of this analysis, the responses to these two questions were combined to create four "race" categories: white, non-Hispanic; black, non-Hispanic; Hispanic (persons of Hispanic origin regardless of indicated race); and other, non-Hispanic.

Figure 17 Average Daily Vehicle Trips: Men (16+) by Income

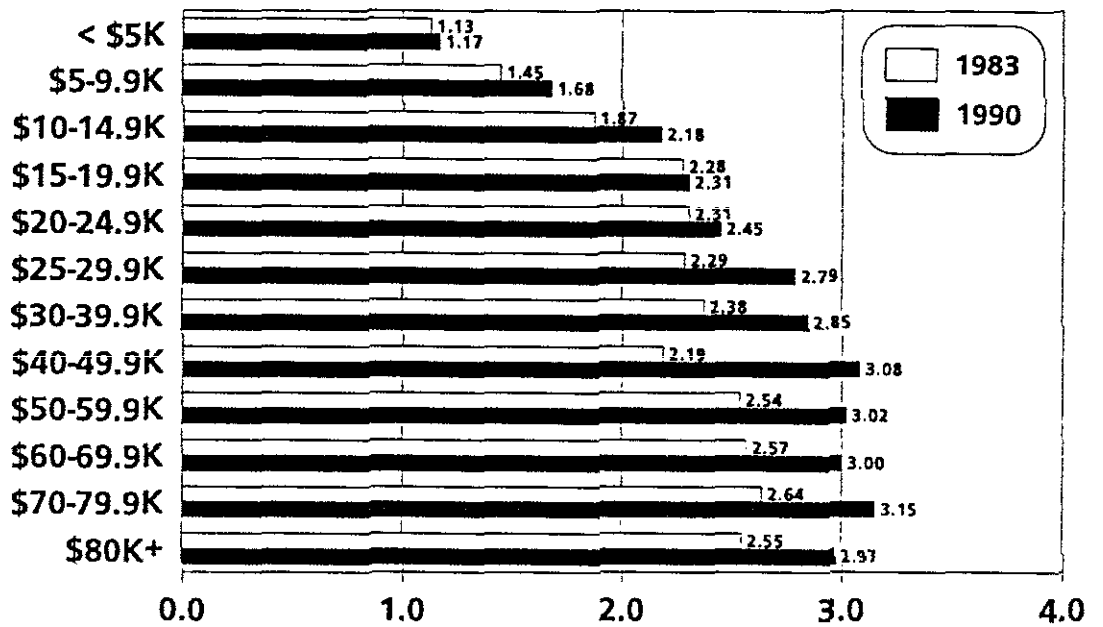


Figure 18 Average Daily Vehicle Miles of Travel: Men (16+) by Income

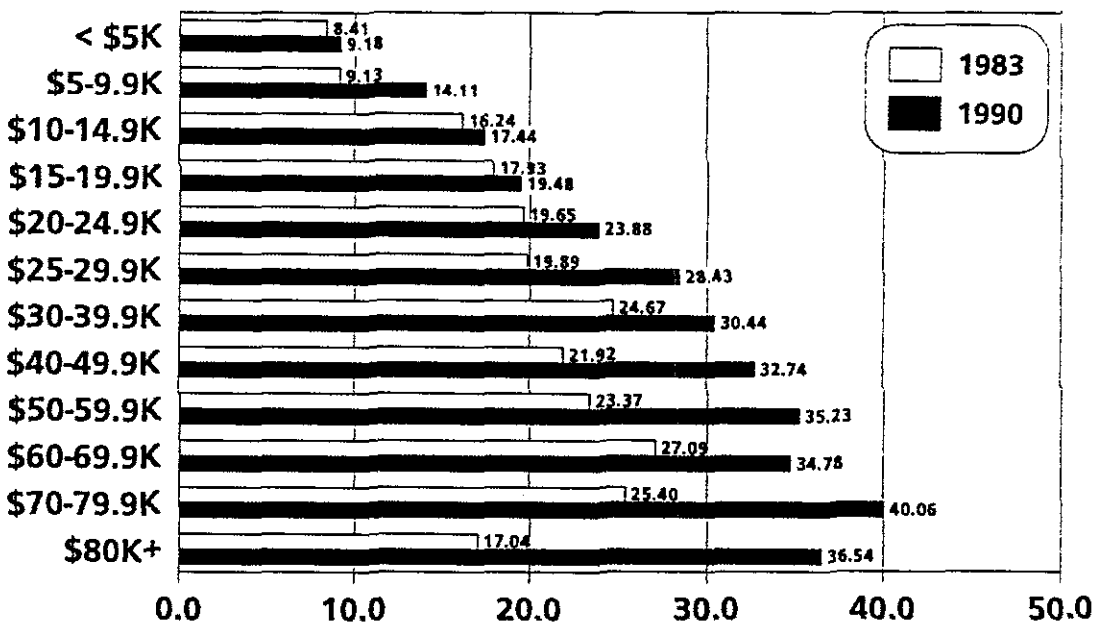


Figure 19 Average Daily Person Trips: Men (5+) by Income

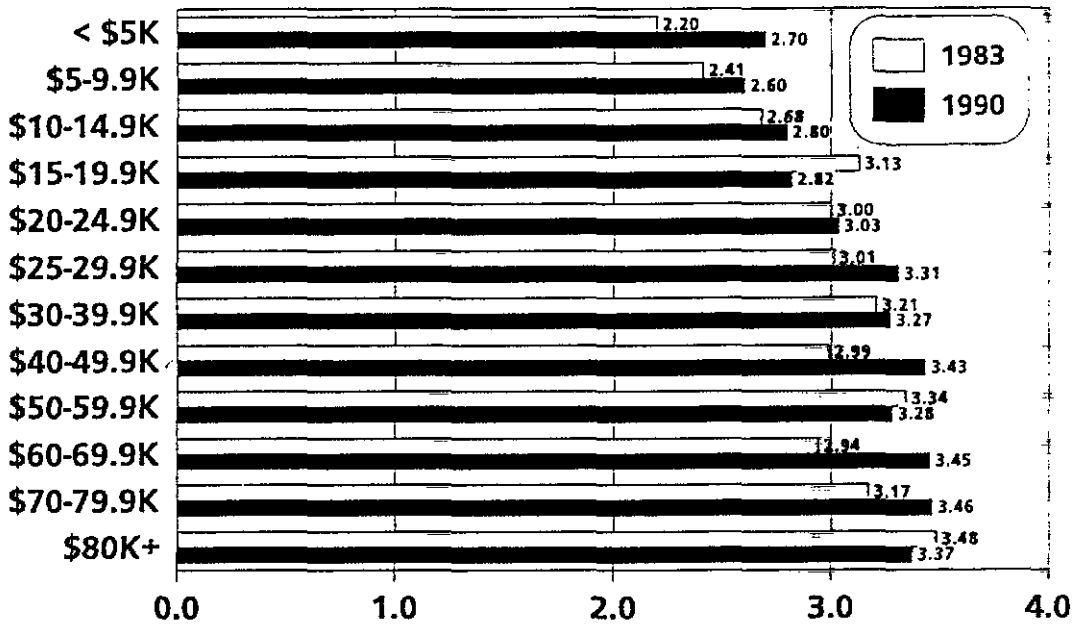


Figure 20 Average Daily Person Miles of Travel: Men (5+) by Income

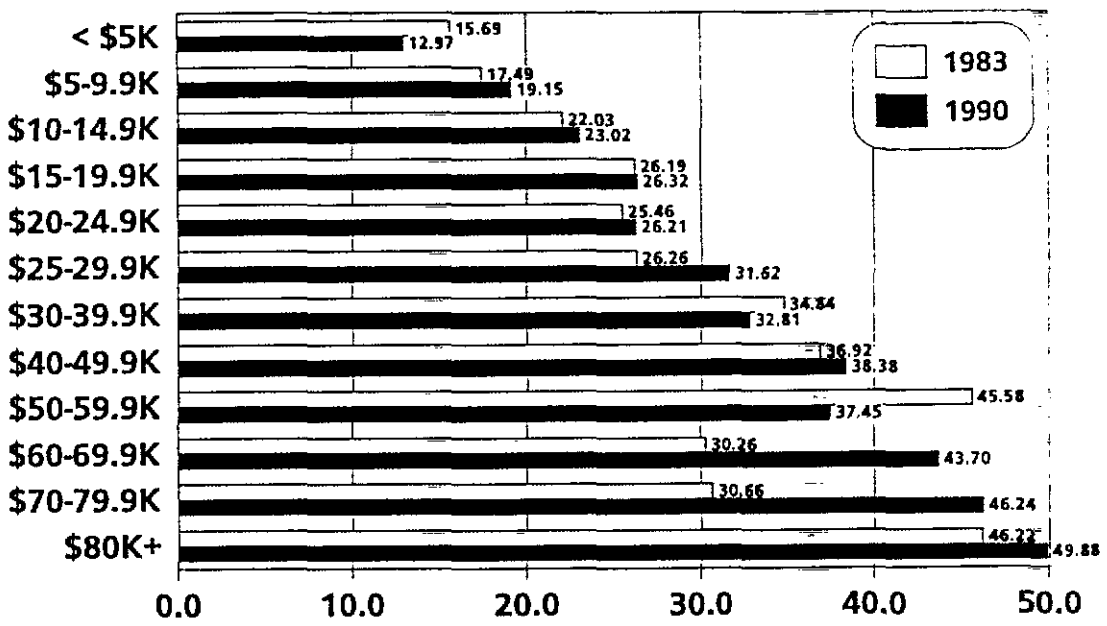


Table 7: DISTRIBUTION OF MEN (5+) BY RACE

Race	Total Men		% Distribution		% Change
	1983	1990	1983	1990	1983-1990
White, Non-Hispanic	83,903,435	83,470,511	81.6%	78.6%	-0.5%
Black, Non-Hispanic	10,369,779	10,747,961	10.1%	10.1%	3.6%
Hispanic	6,137,844	8,247,807	6.0%	7.8%	34.4%
Other, Non-Hispanic	2,469,579	3,697,940	2.4%	3.5%	49.7%
Total	102,880,637	106,164,219	100.0%	100.0%	3.2%

Source: 1983 and 1990 data tapes.

Average daily vehicle trips and vehicle miles of travel by race did not show signs of stabilization between 1983 and 1990. While average daily vehicle travel characteristics increased significantly for all race categories, average daily person trips showed stable trends for men in the white, non-Hispanic and other, non-Hispanic categories.

As shown in Figures 21 and 22, average daily vehicle trips and VMT per person were highest for white, non-Hispanic men in both 1983 and 1990. The most significant growth in these travel measures among the race categories occurred for Hispanic males. *Average daily vehicle trips for Hispanic men* increased 105 percent between 1983 and 1990, and average daily VMT increased 156 percent. Black, non-Hispanic males also experienced significant increases in the vehicle travel measures. As a result, the vehicle travel characteristics of these two race categories in 1990 have approached those of white, non-Hispanic males.

The trends in average daily person trips and PMT per person were quite similar to those for the vehicle travel measures, as evidenced in Figures 23 and 24. White, non-Hispanic men had the highest average daily person trips and PMT of all the race categories in both 1983 and 1990. Additionally, Hispanic men had the most significant increases in these two measures during this time: a 96 percent increase in average daily person trips and a 177 percent increase in average daily PMT. As a result of these changes in the person travel characteristics of Hispanic men, black, non-Hispanic men had the lowest person travel rates of the race categories in 1990. Similar to the average daily vehicle travel measures, the person travel characteristics of black, non-Hispanic and Hispanic men have approached those of the white, non-Hispanic race category.

Licensed Driver Status

In 1983, 91 percent of all men age 16 and older in the United States were licensed drivers. Between 1983 and 1990, the total number of men possessing licenses increased by more than 4.2 million, a percentage increase of more than five percent. By 1990, the percent of total males who were licensed to drive comprised 92 percent of all men age 16 and older. The number of men age 16 and older who did not have driver's licenses declined 11 percent during this time.

Table 8: DISTRIBUTION OF MEN (16+) BY LICENSED DRIVER STATUS

Licensed Status	Total Men		% Distribution		% Change
	1983	1990	1983	1990	1983-1990
Yes	76,206,354	80,389,720	90.9%	92.2%	5.5%
No	7,647,985	6,777,584	9.1%	7.8%	-11.4%
Total	83,854,339	87,167,304	100.0%	100.0%	4.0%

Source: 1983 and 1990 data tapes.

Figure 21 Average Daily Vehicle Trips: Men (16+) by Race

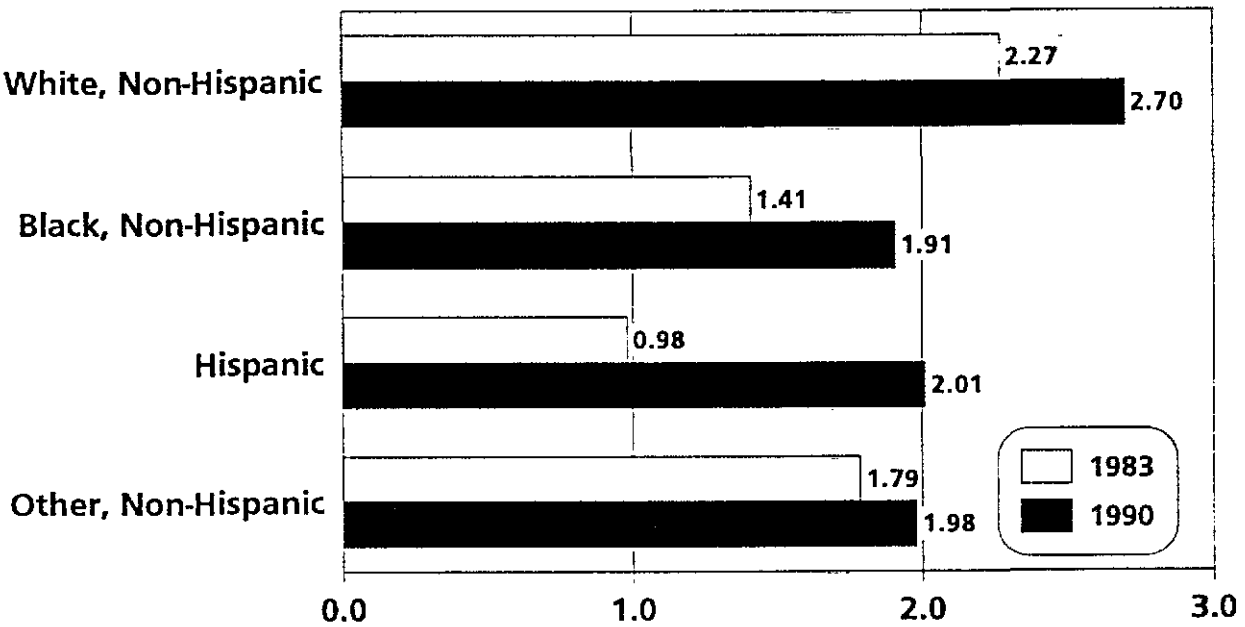


Figure 22 Average Daily Vehicle Miles of Travel: Men (16+) by Race

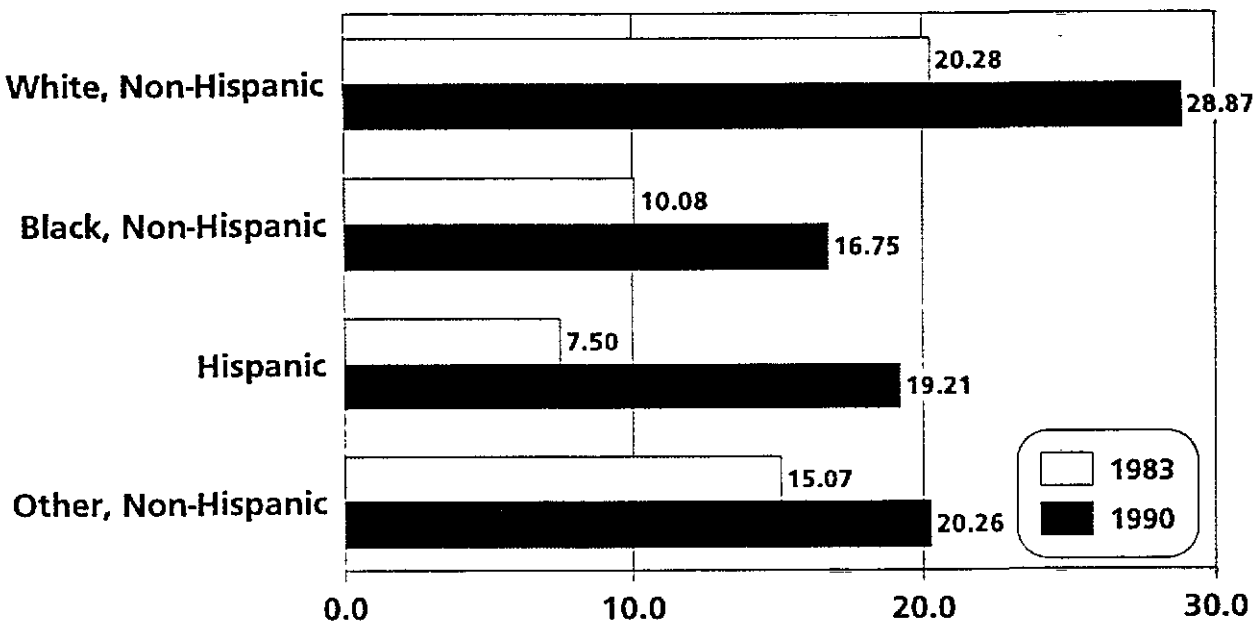


Figure 23 Average Daily Person Trips: Men (5+) by Race

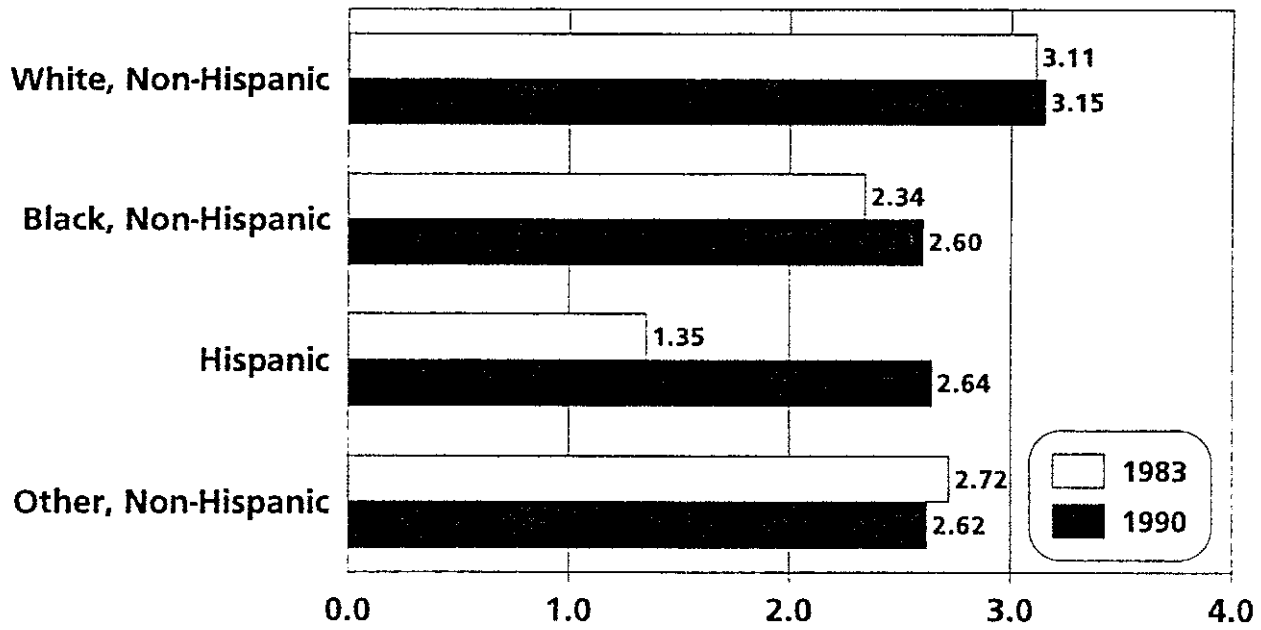
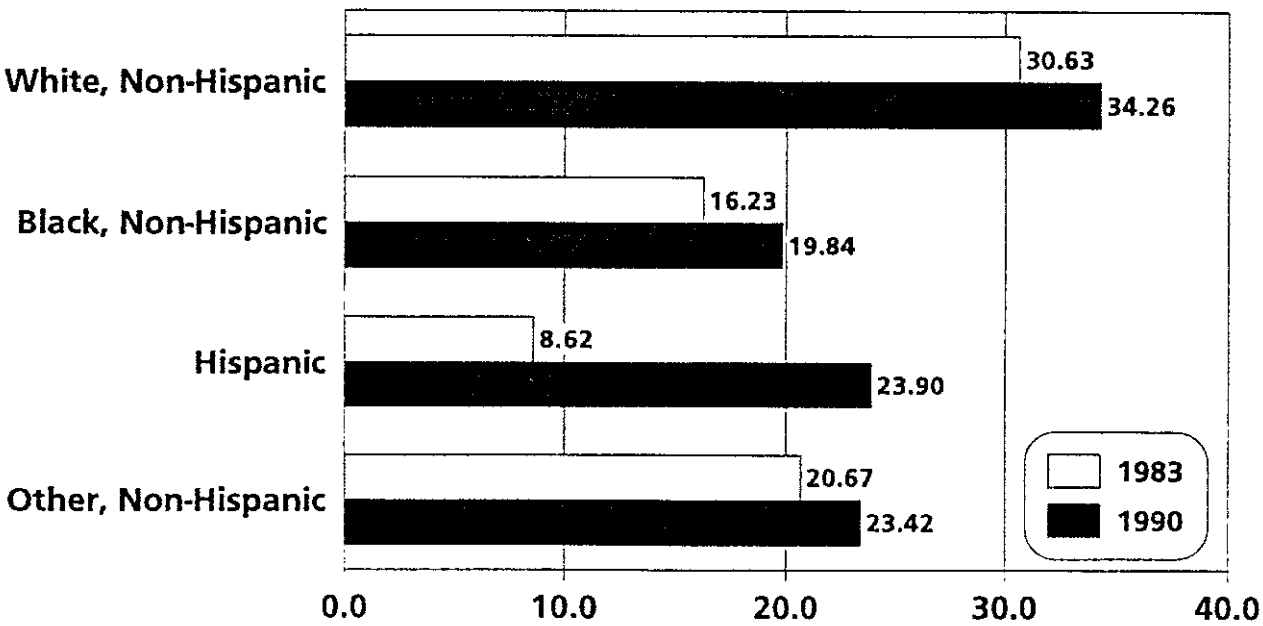


Figure 24 Average Daily Person Miles of Travel: Men (5+) by Race



Since most men age 16 and older are licensed drivers and average daily vehicle trips and VMT per person increased significantly between 1983 and 1990, it would appear that men's travel may not be stabilizing. However, the data for average daily person trips per licensed driver suggests otherwise.

Figures 25 and 26 present the comparative trends for average daily vehicle trips and VMT per licensed driver. Average daily vehicle trips for men with licenses rose 20 percent between 1983 and 1990; average daily VMT for this group also increased significantly, 44 percent. Average daily vehicle trips and VMT for men without driver's licenses were negligible for both 1983 and 1990. Since total vehicle trips and VMT were accumulated only for persons who were indicated as drivers on the trips, it is expected that non-licensed males would not have had an opportunity to accrue vehicle trips and miles.

Despite a 14 percent increase in average daily PMT per person, licensed males exhibited signs of stability in their average daily person trips, which increased less than one percent from 1983 to 1990. The relative changes in these measures indicate that these men were, however, making longer trips in 1990. The data in Figures 27 and 28 also show that average daily person trips and PMT for unlicensed males increased 19 percent and 40 percent, respectively, during this time.

Worker Status

Presented in Table 9 are the male worker status distributions for 1983 and 1990. The data indicate that 70 percent of all men age 16 and older worked during 1983. By 1990, the percent share of men who worked increased to 73 percent of total. This increase in employment may be one reason for the increase in the number of men receiving driver's licenses during this time. With jobs, men who did not drive previously may have found it necessary to begin doing so to facilitate getting to and from work. These two particular trends also may have had a considerable influence on the increasing trend of total male travel discussed previously in this report.

Table 9: DISTRIBUTION OF MEN (16+) BY WORKER STATUS

Worker Status	Total Men		% Distribution		% Change
	1983	1990	1983	1990	1983-1990
Yes	59,011,873	63,996,299	70.4%	73.4%	8.4%
No	24,842,466	23,171,005	29.6%	26.6%	-6.7%
Total	83,854,339	87,167,304	100.0%	100.0%	4.0%

Source: 1983 and 1990 data tapes.

The data in Figures 29 and 30 indicate that there have been significant increases in both average daily vehicle trips and VMT per person regardless of employment status. The increase in average daily person miles of travel for workers was also significant. However, average daily person trips per worker stabilized from 1983 to 1990, as did average daily PMT per person for non-workers.

Working males made more vehicle trips and accumulated more VMT on an average daily basis than did their non-working male counterparts for both 1983 and 1990. This is a logical result, given that workers would not only have additional trips for work purposes (commuting to/from work, work-related business travel), but the income derived from their jobs possibly would provide the means with which they could purchase an auto or other personal vehicle. Regardless of the travel differences between working and non-working men, neither category exhibited any real signs of stabilization in average daily vehicle trips or VMT between 1983 and 1990.

It is evident in Figures 31 and 32 that working males also made more person trips and traveled more PMT on an average daily basis than non-working men during this time. However, the person travel rates

Figure 25 **Average Daily Vehicle Trips: Men (16+) by Licensed Driver Status**

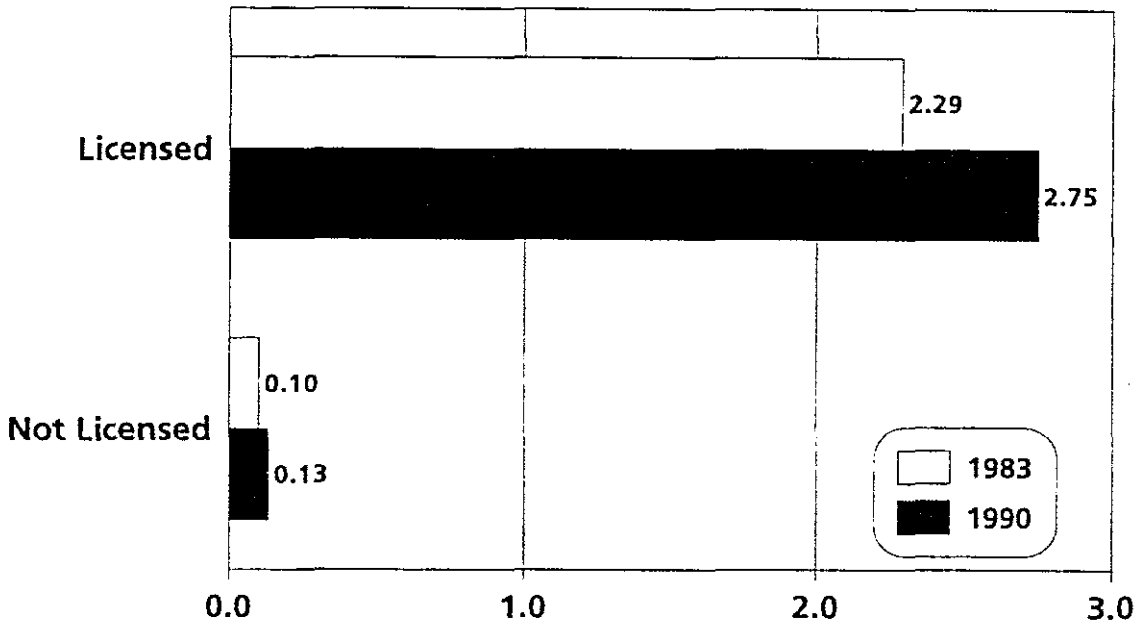


Figure 26 **Average Daily Vehicle Miles of Travel: Men (16+) by Licensed Driver Status**

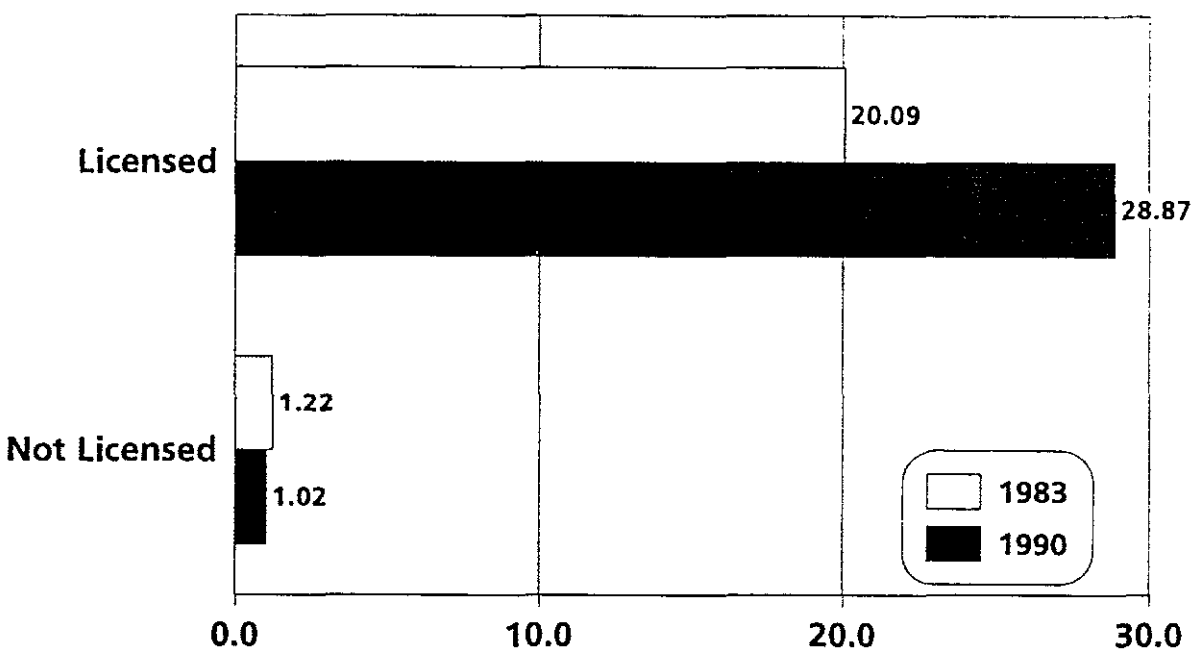


Figure 27 **Average Daily Person Trips: Men (5+) by Licensed Driver Status**

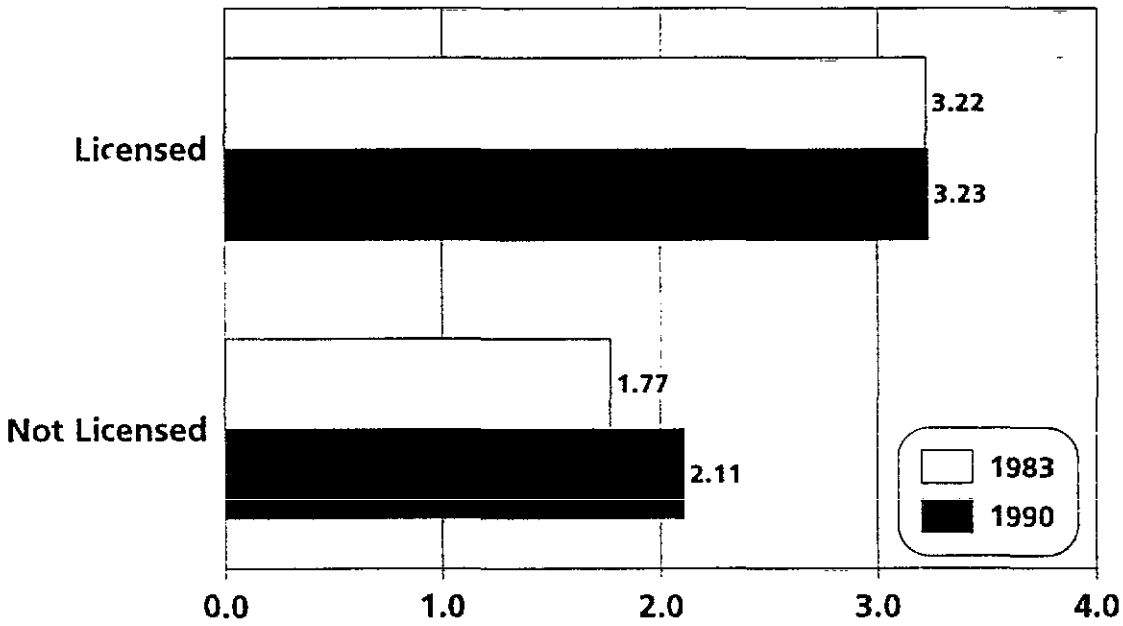


Figure 28 **Average Daily Person Miles of Travel: Men (5+) by Licensed Driver Status**

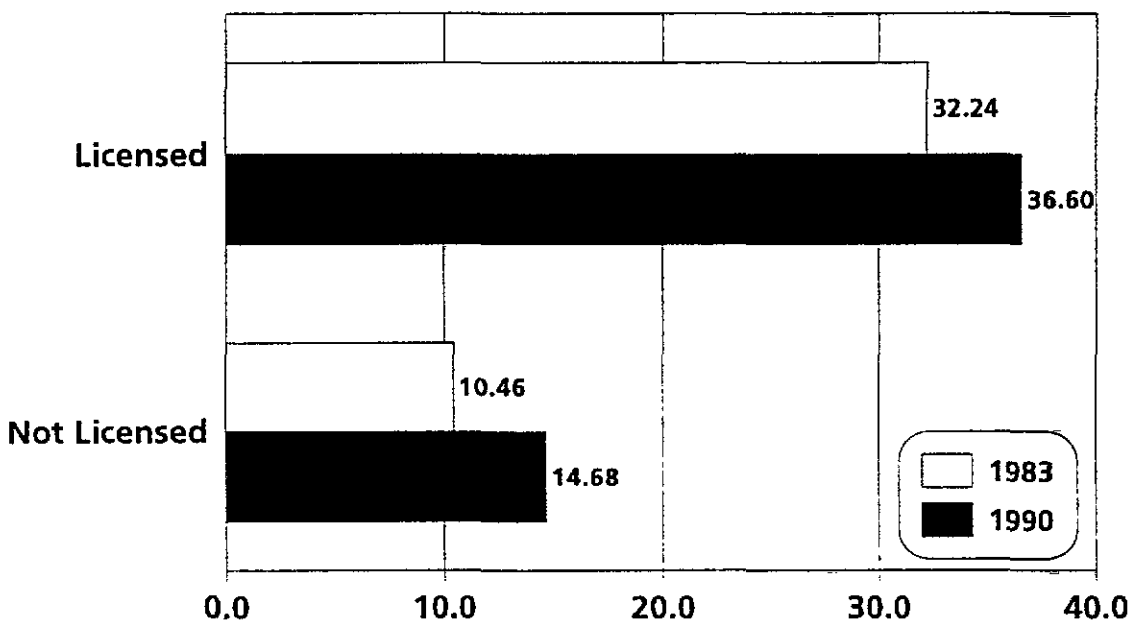


Figure 29 Average Daily Vehicle Trips: Men (16+) by Worker Status

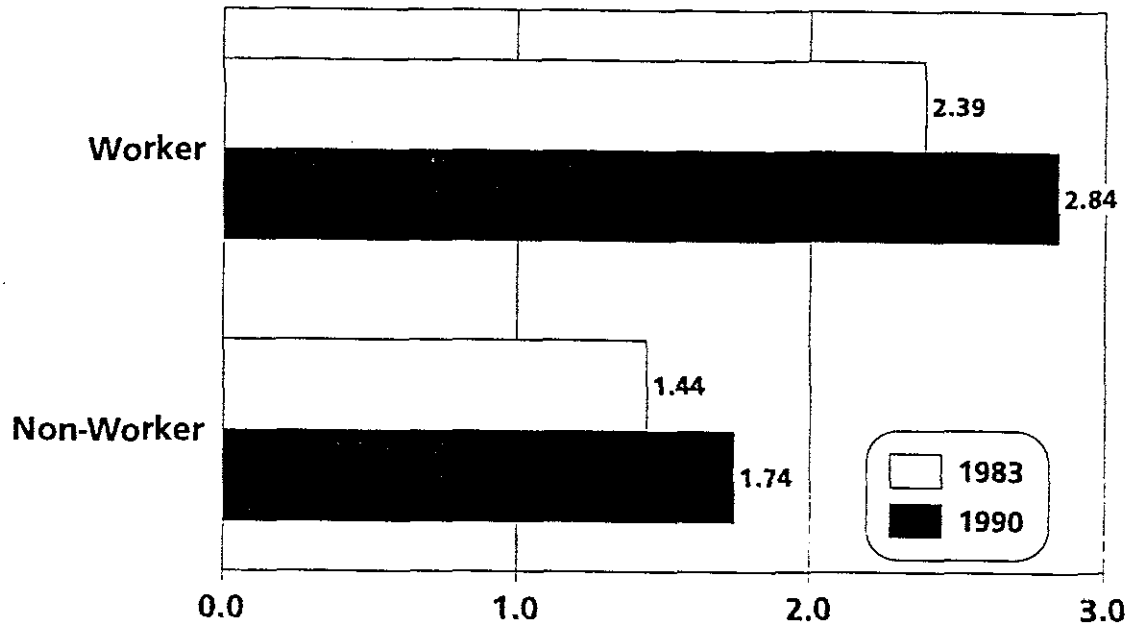


Figure 30 Average Daily Vehicle Miles of Travel: Men (16+) by Worker Status

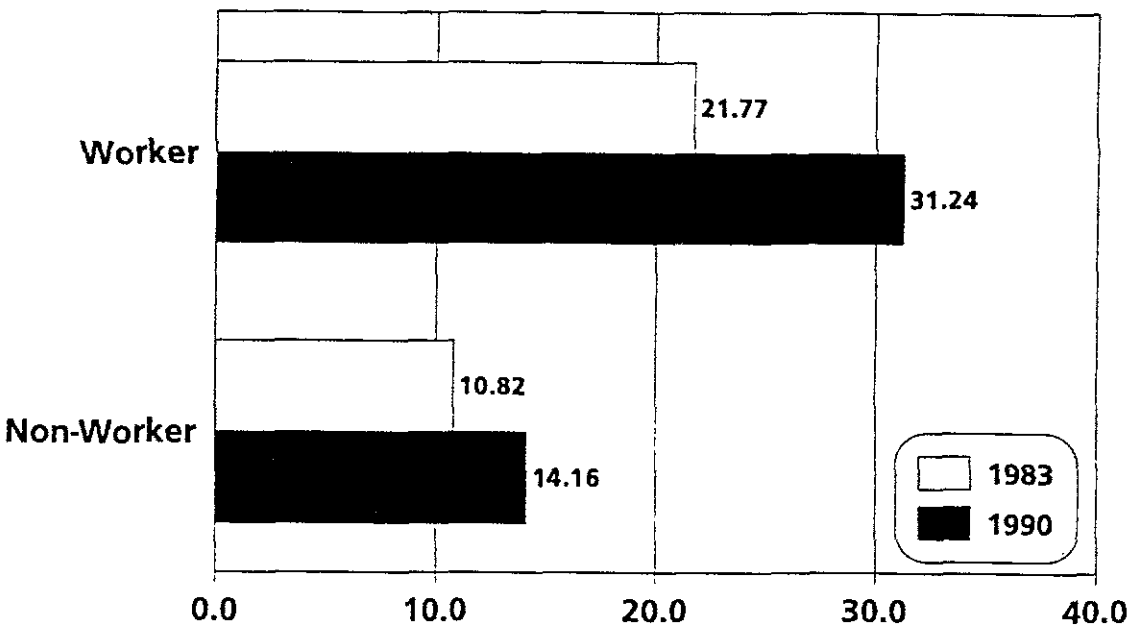


Figure 31 Average Daily Person Trips: Men (5+) by Worker Status

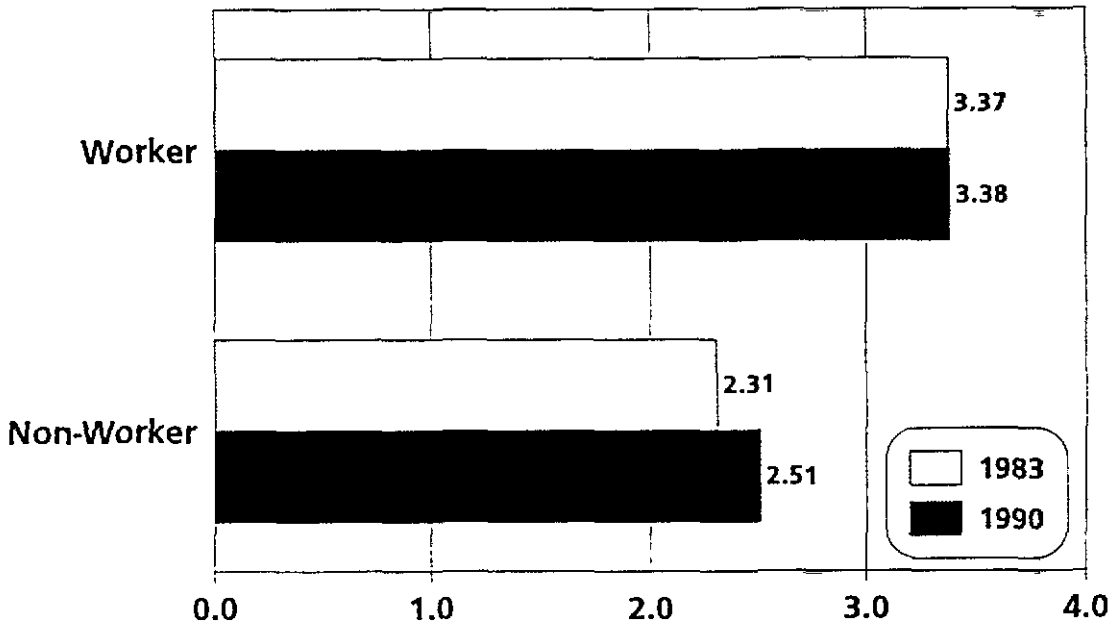
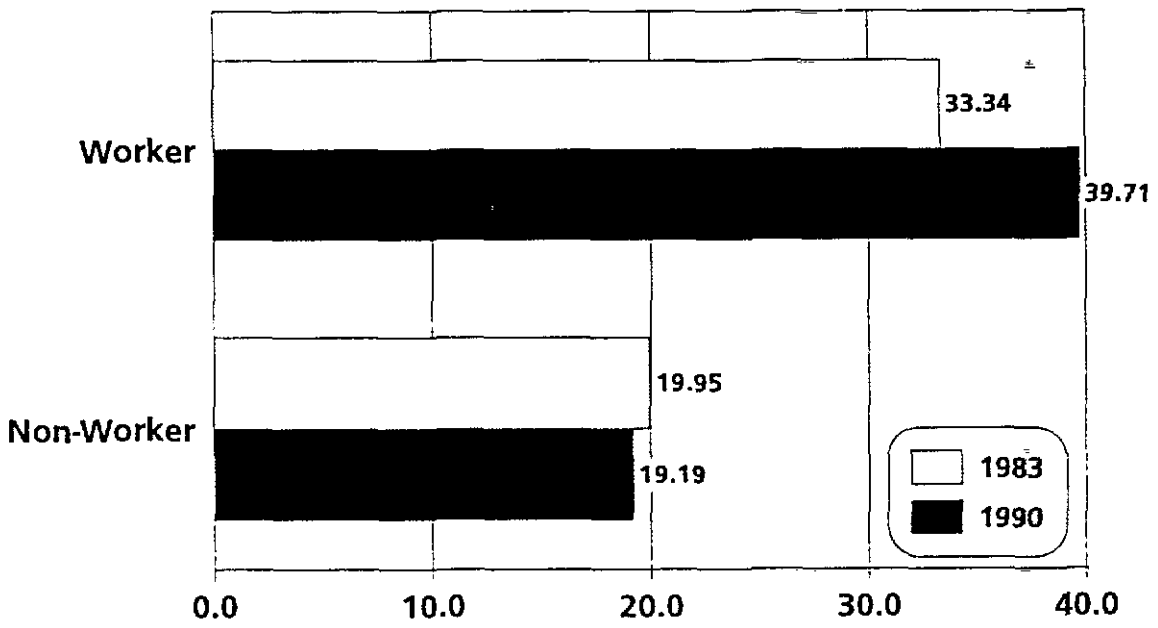


Figure 32 Average Daily Person Miles of Travel: Men (5+) by Worker Status



for the work status categories were not as disparate as were those for the vehicle travel rates. This may be due to the mode choice possibilities assumed for the different travel measures. The vehicle travel measures consider only trips and miles for personal vehicles while the person travel measures include travel on all modes. As a result, non-workers would be expected to have significantly lower vehicle travel rates since they probably have less access to personal vehicles.

Household Size

The distributions of men by household size for 1983 and 1990 are shown in Table 10. The most dramatic increase was in the one-person category, which increased 26 percent between the two years. In contrast, the number of men in household sizes of six or more persons decreased by 21 percent over the same time period. This is not surprising, however, given that average household size has declined for the last several decades, as evidenced by NPTS trend data (3.16 persons per household in 1969; 2.56 in 1990).

Table 10: DISTRIBUTION OF MEN (5+) BY HOUSEHOLD SIZE

Household Size	Total Men		% Distribution		% Change
	1983	1990	1983	1990	1983-1990
1	7,920,844	9,984,799	7.7%	9.4%	26.1%
2	26,181,823	28,637,896	25.4%	27.0%	9.4%
3	19,457,293	20,931,752	18.9%	19.7%	7.6%
4	24,563,263	23,929,298	23.9%	22.5%	-2.6%
5	13,773,943	14,019,426	13.4%	13.2%	1.8%
6 or more	10,983,472	8,661,048	10.7%	8.2%	-21.1%
Total	102,880,638	106,164,219	100.0%	100.0%	3.2%

Source: 1983 and 1990 data tapes.

From 1983 to 1990, average daily vehicle trips and VMT per person increased significantly, regardless of household size. Significant increases were also evident for average daily person trips and PMT per person for a number of household size categories. Only men in two- to four-person households exhibited signs of stabilization in average daily person trips.

The average daily vehicle trip and VMT per person data presented in Figures 33 and 34 indicate that men in three-person and four-person households made the most trips and traveled the most miles on an average daily basis in 1983 and 1990. However, one-person households exhibited the largest increases in the two travel measure rates between 1983 and 1990. It is possible that the overall declining trend in average household size in the United States discussed previously may have contributed to the changes in travel by household size.

Unlike the trends for the vehicle travel measures, the relationship between household size and the average daily person travel measures was not clearly discernable. Figure 35 indicates that men in one-person households had the largest increase in average daily person trips per person from 1983 to 1990. However, as shown in Figure 36, the largest increase in average daily person miles of travel occurred in the two-person household category. The only household size category to show signs of stabilization in average daily person miles of travel per person was the six-person+ category.

Figure 33 Average Daily Vehicle Trips: Men (16+) by Household Size

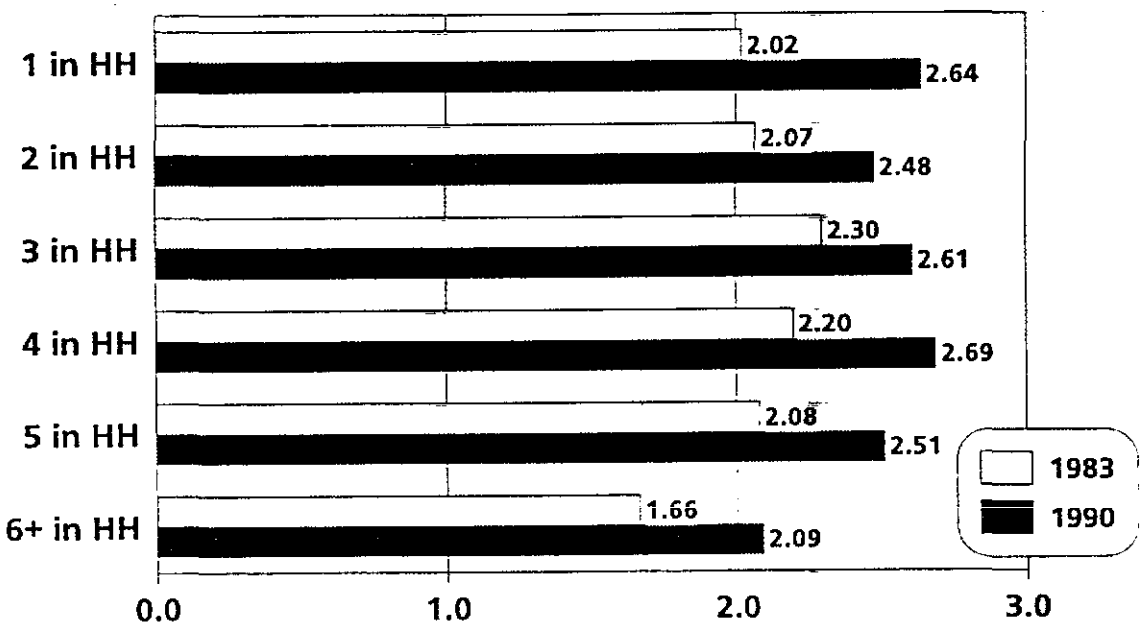


Figure 34 Average Daily Vehicle Miles of Travel: Men (16+) by Household Size

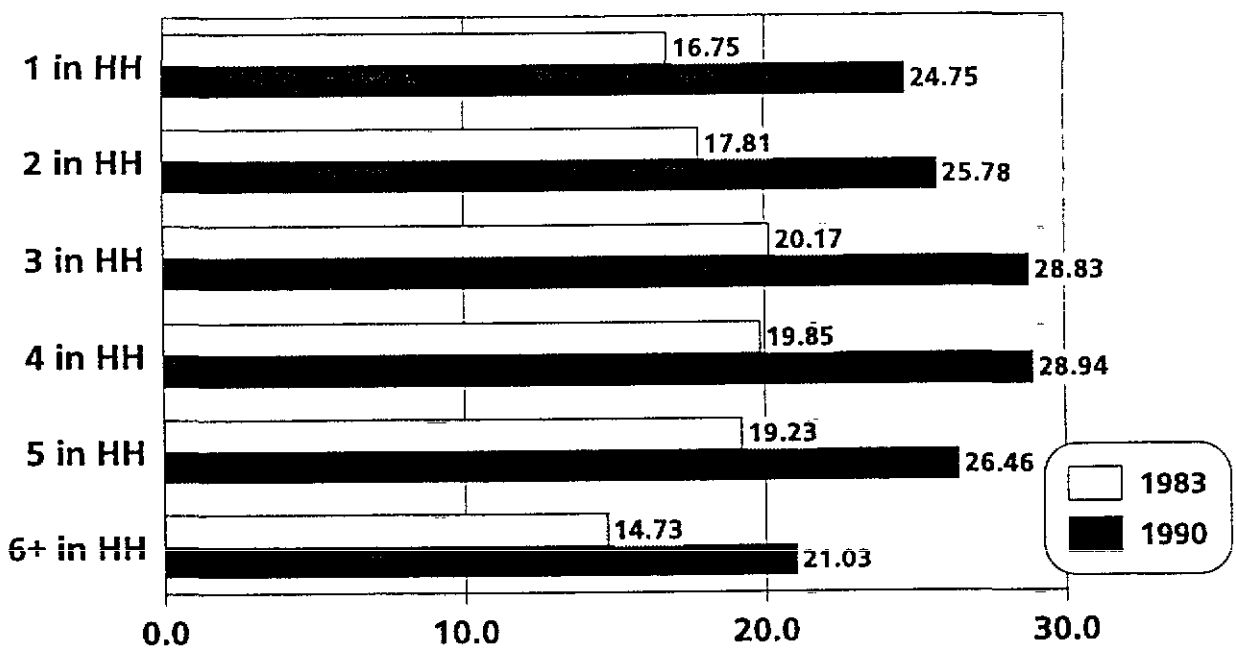


Figure 35 Average Daily Person Trips: Men (5+) by Household Size

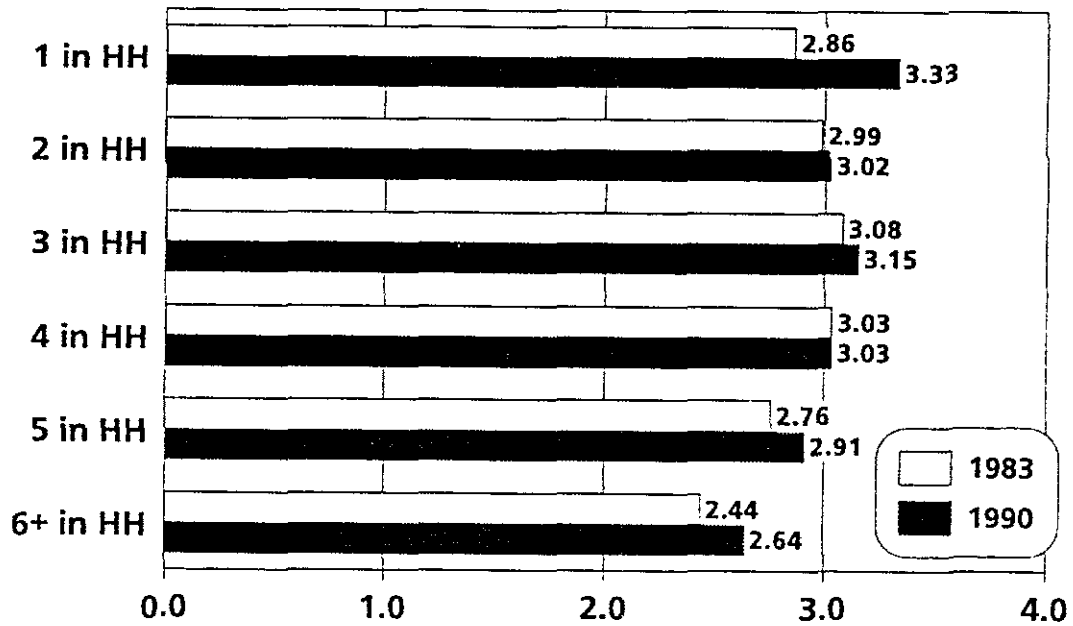
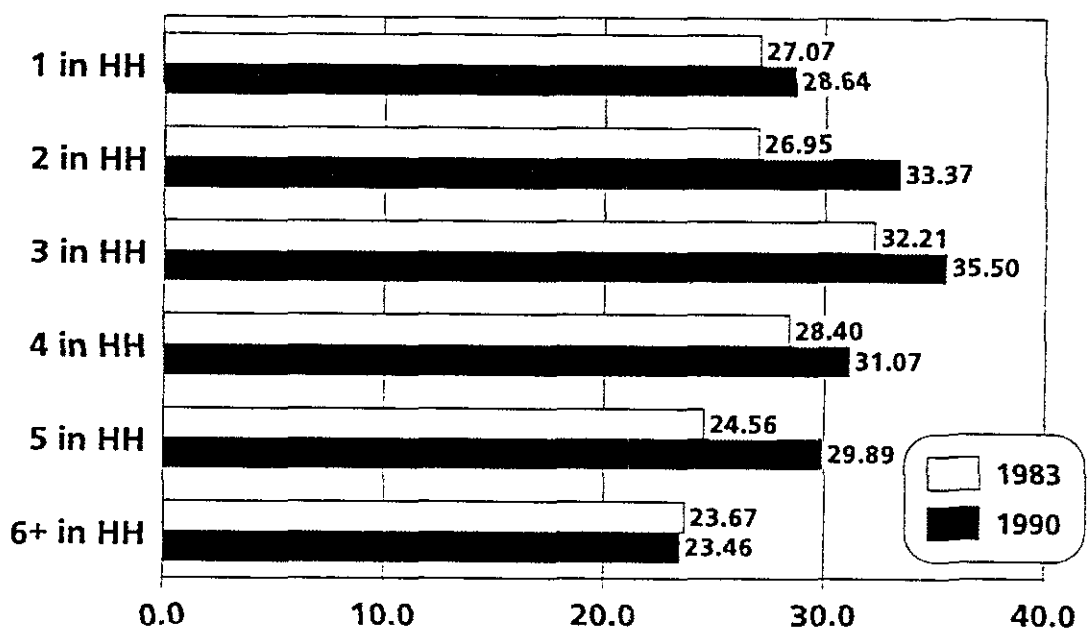


Figure 36 Average Daily Person Miles of Travel: Men (5+) by Household Size



Household Vehicle Availability

From 1983 to 1990, there was a 33 percent decrease in the number of men in households with zero vehicles available. In addition, there was a five percent decline in the number of men in one-vehicle households. However, there was an 18 percent increase in the number of men in two-vehicle households, and an 8 percent increase in men in three-vehicle households. These changes are shown in Table 11. As was the case for the changes in household size, these changes are not surprising. According to NPTS data, the average number of vehicles available per household in the United States has increased 53 percent, from 1.16 to 1.77 vehicles per household, between 1969 and 1990.

Table 11: DISTRIBUTION OF MEN (5+) BY HOUSEHOLD VEHICLE AVAILABILITY

No. of Household Vehicles Available	Total Men 1983	Total Men 1990	% Distribution 1983	% Distribution 1990	% Change 1983-1990
0	7,471,904	5,000,048	7.3%	4.7%	-33.1%
1	25,654,993	24,317,964	24.9%	22.9%	-5.2%
2	39,983,946	47,253,238	38.9%	44.5%	18.2%
3	18,117,591	19,692,012	17.6%	18.5%	8.7%
4	7,255,522	6,650,441	7.1%	6.3%	-8.3%
5 or more	4,396,683	3,250,516	4.3%	3.1%	-26.1%
Total	102,880,639	106,164,219	100.0%	100.0%	3.2%

Source: 1983 and 1990 data tapes.

The average daily vehicle trip and VMT per person data illustrated in Figures 37 and 38 indicate that travel measure rates increased as household vehicle availability increased. This relationship was also evident for average daily person trips and person miles of travel. However, the changes between 1983 and 1990 for these travel measures were less significant.

Men in households with more vehicles not only made more average daily vehicle trips, but their rates of travel also increased more significantly between 1983 and 1990, especially for average daily VMT. Since vehicle trips and VMT are accumulated by the drivers of personal vehicles, it is logical that a larger number of available household vehicles would result in more vehicle trips and VMT. This is also the reason why the travel rates for the zero-vehicle households were negligible. None of the household vehicle availability categories indicated any signs of stabilization for either of these two travel measures.

Several of the vehicle availability categories for average daily person trips and PMT per person exhibited signs of stabilization that were not evident in the vehicle travel measures, as shown in Figures 39 and 40. Specifically, the increases in average daily person trips per person for men in households with at least one vehicle available were relatively small. The largest increase in this travel measure occurred for men in households with zero vehicles available, 28 percent growth between 1983 and 1990. In comparison, the only category to show signs of stabilization in average daily PMT was in households with one vehicle available, which increased three percent between 1983 and 1990.

Life Cycle

Table 12 shows the distribution of men by their appropriate household life cycle category. From 1983 to 1990, the proportion of all life cycle categories of households without children increased. Specifically, the number of single men with no children increased 20 percent and men in two-adult households with no children increased 3 percent. For the one- and two-adult household categories where at least one person

Figure 37 **Average Daily Vehicle Trips: Men (16+) by Household Vehicle Availability**

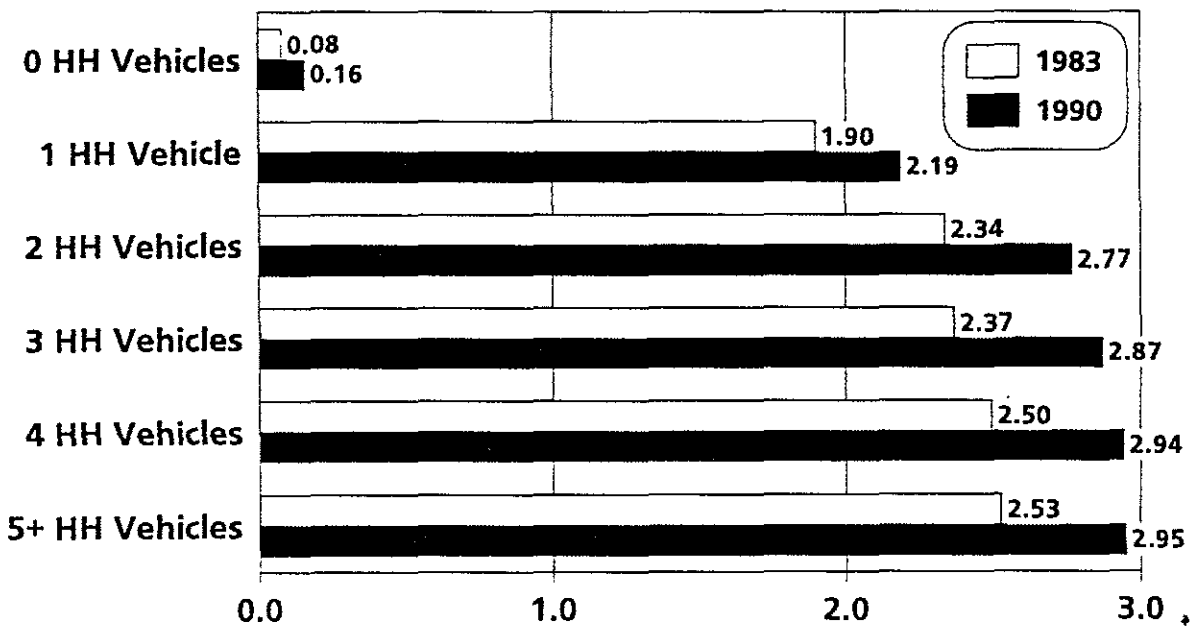


Figure 38 **Average Daily Vehicle Miles of Travel: Men (16+) by Household Vehicle Availability**

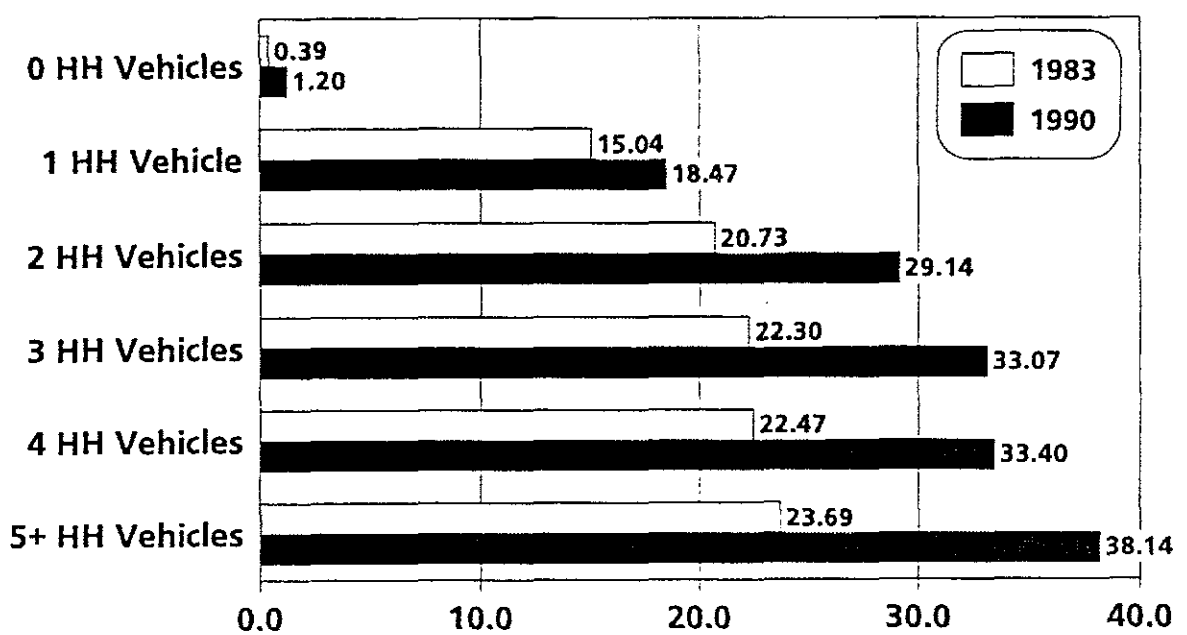


Figure 39 **Average Daily Person Trips: Men (5+) by Household Vehicle Availability**

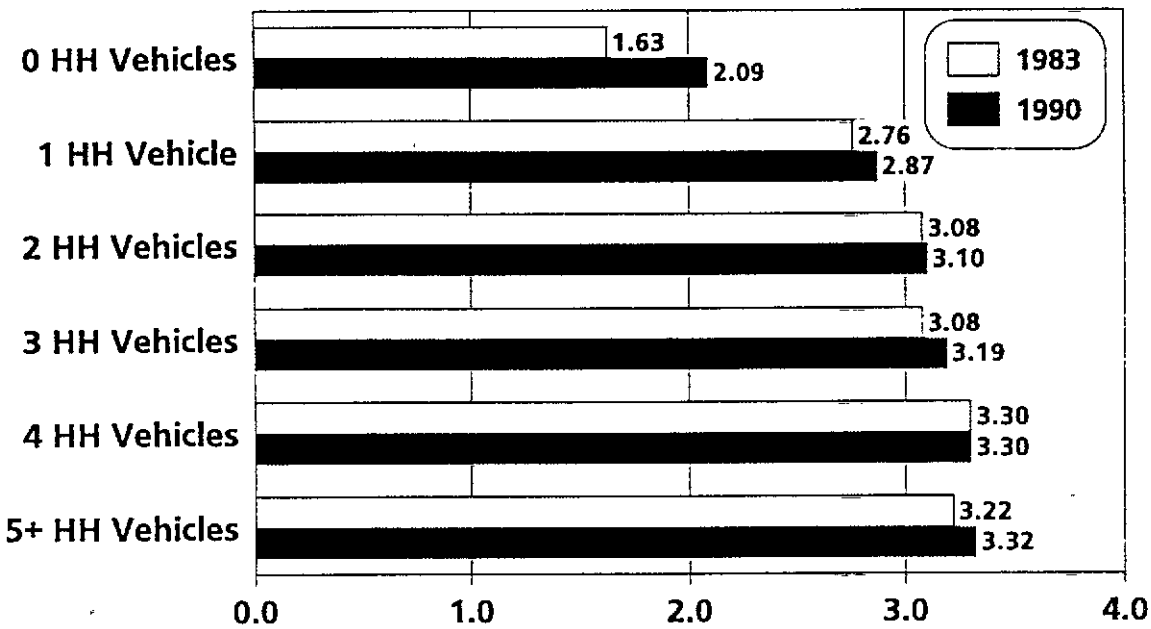
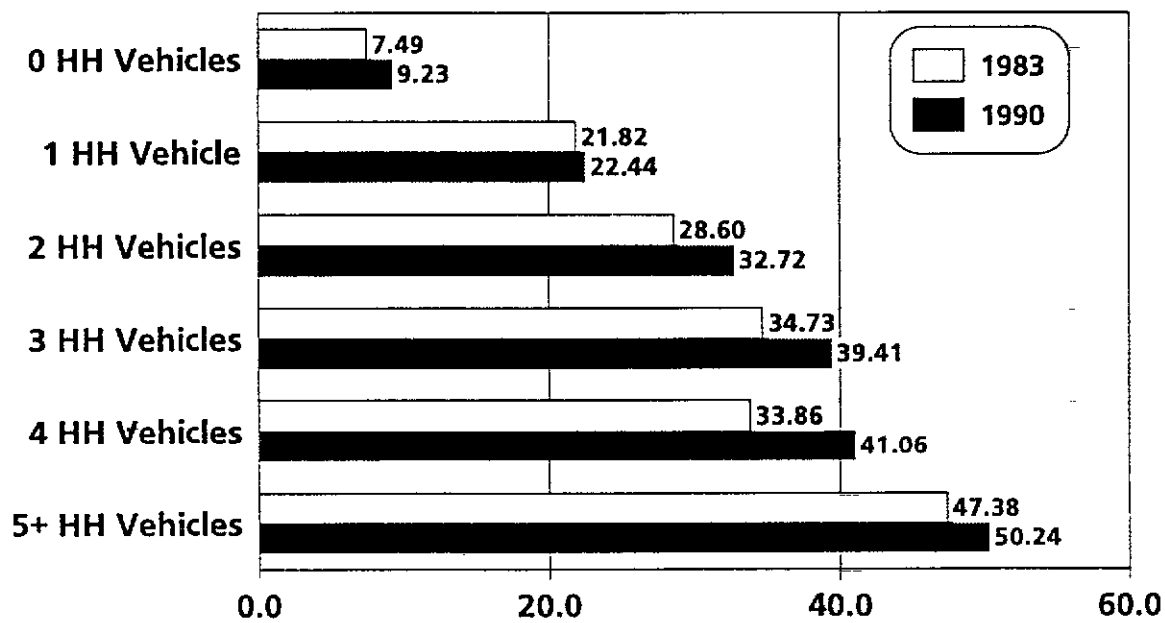


Figure 40 **Average Daily Person Miles of Travel: Men (5+) by Household Vehicle Availability**



was retired, the increases were 89 percent and 54 percent, respectively. Conversely, the proportion of households with children declined during this time.

Table 12: DISTRIBUTION OF MEN (5+) BY LIFE CYCLE

Life Cycle	Total Men 1983	Total Men 1990	% Distribution 1983	% Distribution 1990	% Change 1983-1990
1 adult, 0 kids	6,630,526	7,928,354	6.4%	7.5%	19.6%
2 adults, 0 kids	25,555,771	26,407,367	24.8%	24.9%	3.3%
1 adult, kids 0-5	1,337,969	1,055,130	1.3%	1.0%	-21.1%
2 adults, kids 0-5	21,970,862	21,098,531	21.4%	19.9%	-4.0%
1 adult, kids 6-15	3,703,810	2,548,357	3.6%	2.4%	-31.2%
2 adults, kids 6-15	25,341,202	25,123,603	24.6%	23.7%	-0.9%
1 adult, kids 16-21	838,695	773,381	0.8%	0.7%	-7.8%
2 adults, kids 16-21	8,928,974	7,604,776	8.7%	7.2%	-14.8%
1 adult, ret., 0 kids	1,290,317	2,439,191	1.3%	2.3%	89.0%
2 adults, ret., 0 kids	7,282,512	11,185,529	7.1%	10.5%	53.6%
Total	102,880,638	106,164,219	100.0%	100.0%	3.2%

Source: 1983 and 1990 data tapes.

From 1983 to 1990, there were significant increases in average daily vehicle trips and VMT per person, regardless of life cycle category. This trend is not evident in the data for average daily person trips per person, as most of the household categories with at least two adults showed signs of stabilization. Only one life cycle category indicated a stable trend for average daily PMT per person: households with two or more adults and children age 0-5.

On average for both 1983 and 1990, men in households with two or more adults tended to make more daily vehicle trips and VMT per person than men in one-adult households. According to the data in Figures 41 and 42, men in the "1 adult, retired, 0 kids" and "2+ adults, retired, 0 kids" life cycle categories have continued to accumulate the fewest vehicle trips and VMT on an average daily basis for this period. None of the life cycle categories indicated any signs of stabilization for either measure.

The person travel measure trends are presented in Figures 43 and 44. As with the vehicle travel measures, men in the "1 adult, retired, 0 kids" and "2+ adults, retired, 0 kids" life cycle categories made the fewest person trips and PMT in both 1983 and 1990. However, men in one-adult households with kids age 0-5 also exhibited lower rates of average daily person travel. Despite most of the households with two or more adults showing signs of stabilization in average daily person trips per person, the "2+ adults, kids age 16-21" category indicated an increase in this measure.

Household Location

Three categories were used to describe household location: inside the MSA/SMSA (metropolitan statistical area/standard metropolitan statistical area) within the central city (CC), inside the MSA/SMSA but not in the central city, and not in the MSA/SMSA. The data in Table 13 indicate that there was a 22 percent increase in the number of men living within the MSA/SMSA central city and a 14 percent decline in the number of men living outside the MSA/SMSA. However, from this data it is not possible to determine whether this change is due to an actual shift in the household locations of males; these trends may, in fact, reflect changes in the MSA/SMSA boundaries during this time period.

Figure 41 Average Daily Vehicle Trips: Men (16+) by Life Cycle

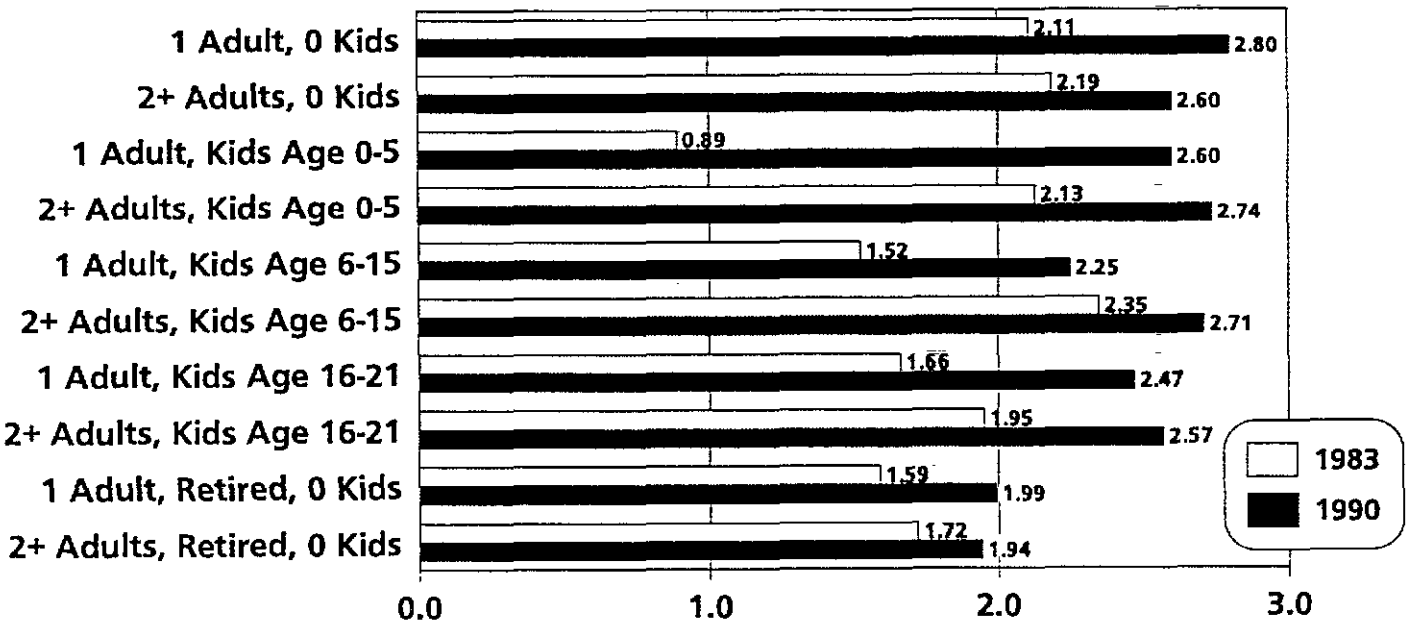


Figure 42 Average Daily Vehicle Miles of Travel: Men (16+) by Life Cycle

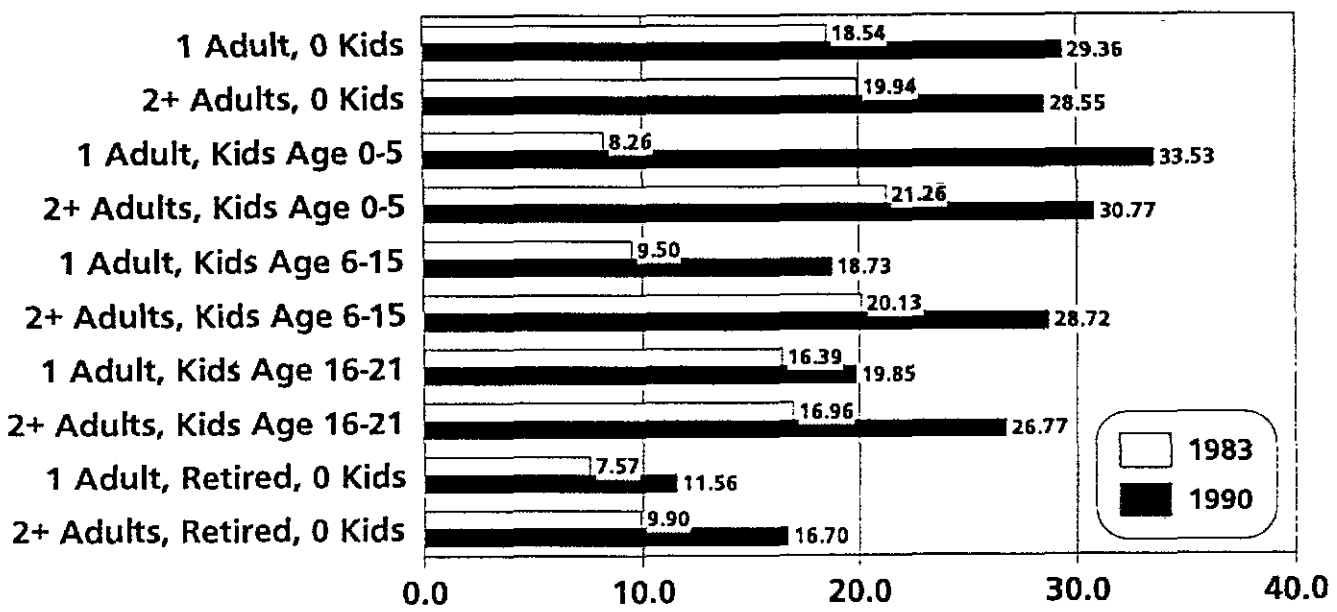


Figure 43 Average Daily Person Trips: Men (5+) by Life Cycle

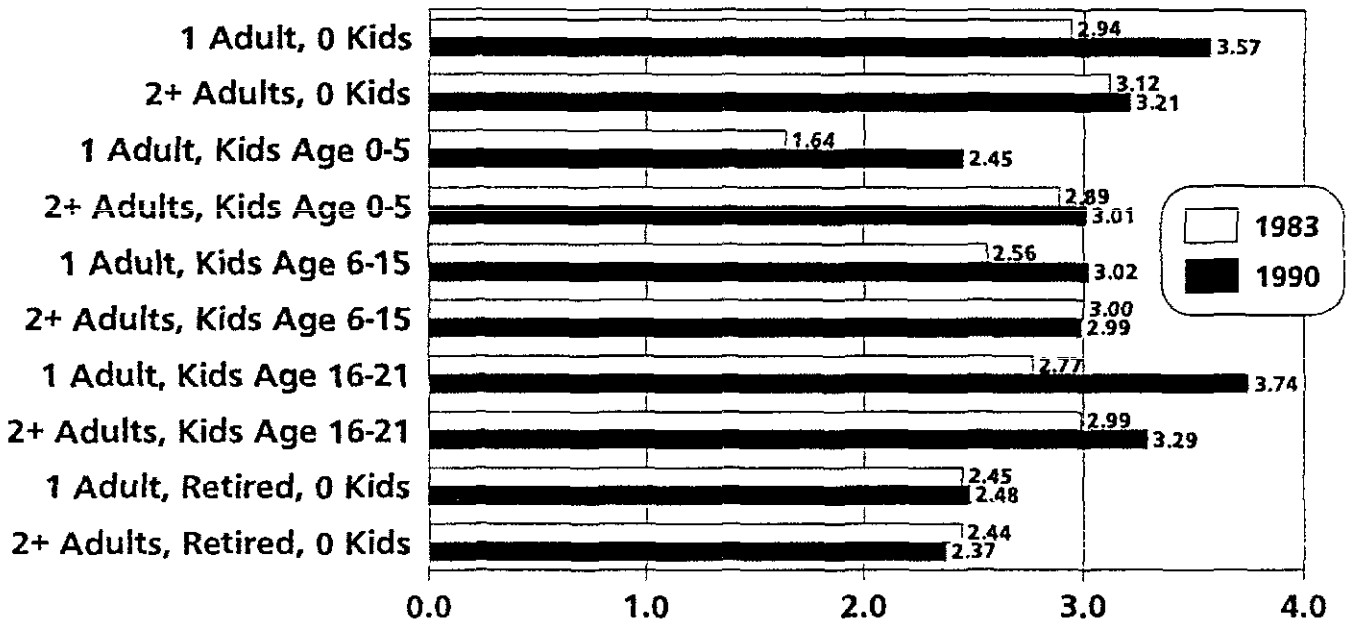
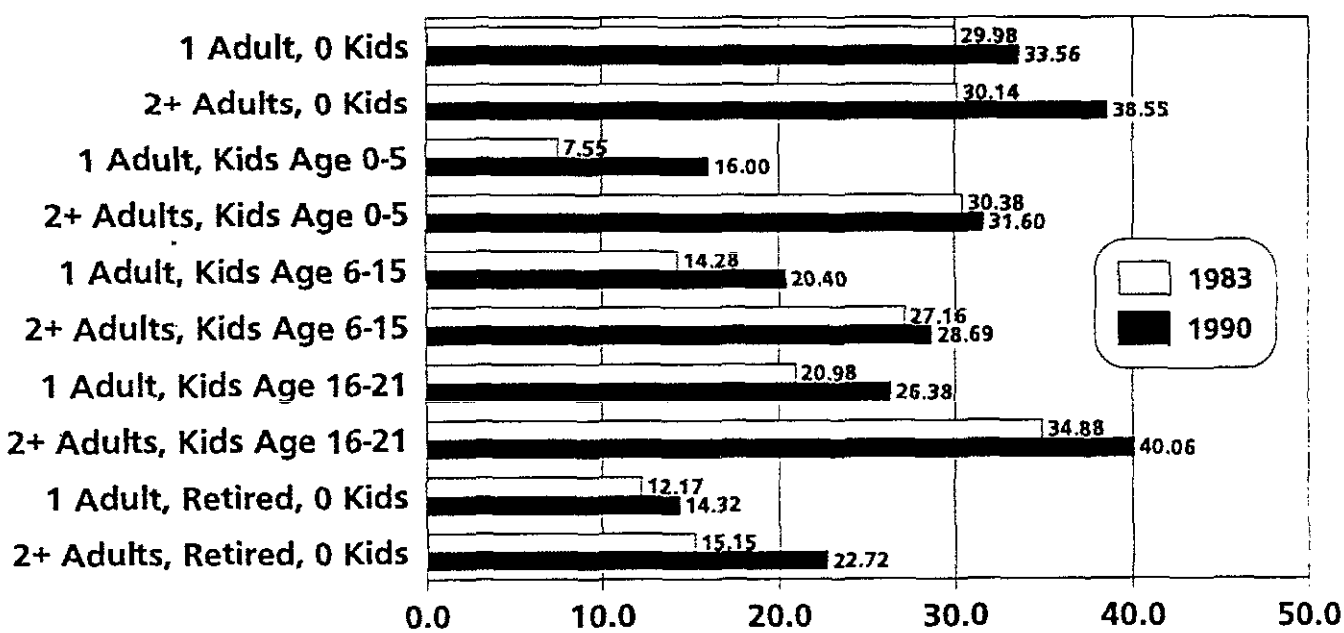


Figure 44 Average Daily Person Miles of Travel: Men (5+) by Life Cycle



According to the Census Bureau, metropolitan areas are redefined after each decennial census, and additional ones may be established between censuses. Through the 1980 Census, SMSA was one of the statistical geographic terms used to designate metropolitan areas. In June 1983, this term was changed to MSA. The 1980 census included 323 SMSAs; however, after the definition change, there were 257 MSAs. As of June 1990, there were 268 MSAs and in June 1993 these areas were redefined again.

Table 13: DISTRIBUTION OF MEN (5+) BY HOUSEHOLD LOCATION

Household Location	Total Men		% Distribution		% Change
	1983	1990	1983	1990	1983-1990
MSA/SMSA, in CC	30,972,633	37,782,214	30.1%	35.6%	22.0%
MSA/SMSA, not CC	44,398,330	44,778,083	43.2%	42.2%	0.9%
Not in MSA/SMSA	27,509,676	23,603,921	26.7%	22.2%	-14.2%
Total	102,880,638	106,164,218	100.0%	100.0%	3.2%

Source: 1983 and 1990 data tapes.

As shown in Figures 45 and 46, average daily vehicle trips and VMT per person increased significantly from 1983 to 1990, regardless of household location. Increases were also evident for average daily PMT per person. However, average daily person trips indicated stable trends for men in two of the household location categories.

The average daily vehicle trip and VMT per person data indicated that men living within a MSA/SMSA but outside its central city had the highest travel rates for these measures in both 1983 and 1990. Nevertheless, it appears from the data that the location of a man's household with respect to a MSA/SMSA and its central city has not influenced his travel rates significantly. The only exception was for men living within the central city, who traveled fewer VMT on an average daily basis than either men living outside the central city or men living outside the MSA/SMSA.

The trends in average daily person trips and PMT per person between 1983 and 1990 also showed the modest influence that the location of a man's household with respect to a MSA/SMSA and its central city has had on his travel, especially for average daily person trips. However, the changes in travel rates during this time for the household location categories were not as significant as was evident for the vehicle travel measures, as shown in Figures 47 and 48. The data indicate that men living within a MSA/SMSA but outside its central city and men living outside a MSA/SMSA showed some stability in their average daily person trips between 1983 and 1990.

Mode Choice and Trip Purpose

The discussion of each of the previous contributing factors focused on the distribution of the total number of men within each factor's categories. However, in the case of mode choice and trip purpose, it is not possible to determine the distribution of all males by mode or purpose since most men utilized more than one mode for their travel needs, which may have encompassed several different purposes. To resolve this problem, total male person trips were used, instead, to analyze changes in mode choice and trip purpose distributions between 1983 and 1990.

The distribution of male person trips by mode choice is shown in Table 14. The data indicate that total male person trips increased approximately 11 percent between 1983 and 1990. Private, or personal, vehicles maintained their status as the dominant mode of choice. In 1983, 85 percent of total male person trips were made in private vehicles. The number of male person trips made using this particular mode increased

Figure 45 Average Daily Vehicle Trips: Men (16+) by Household Location

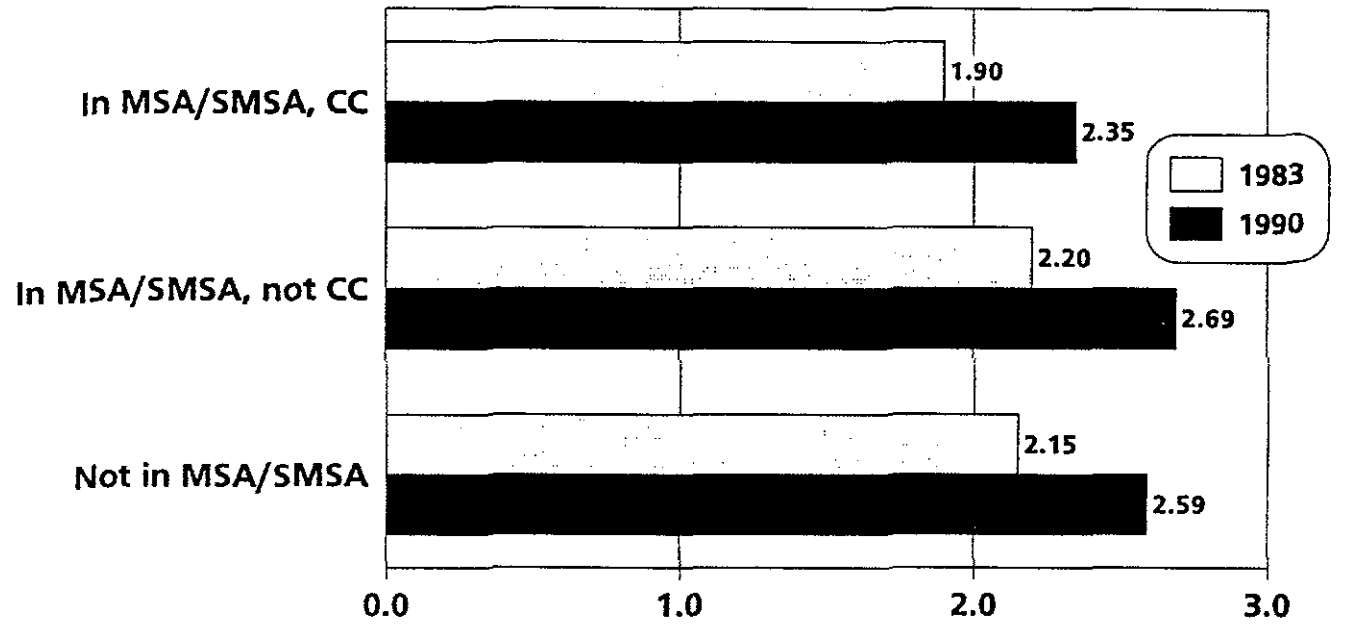


Figure 46 Average Daily Vehicle Miles of Travel: Men (16+) by Household Location

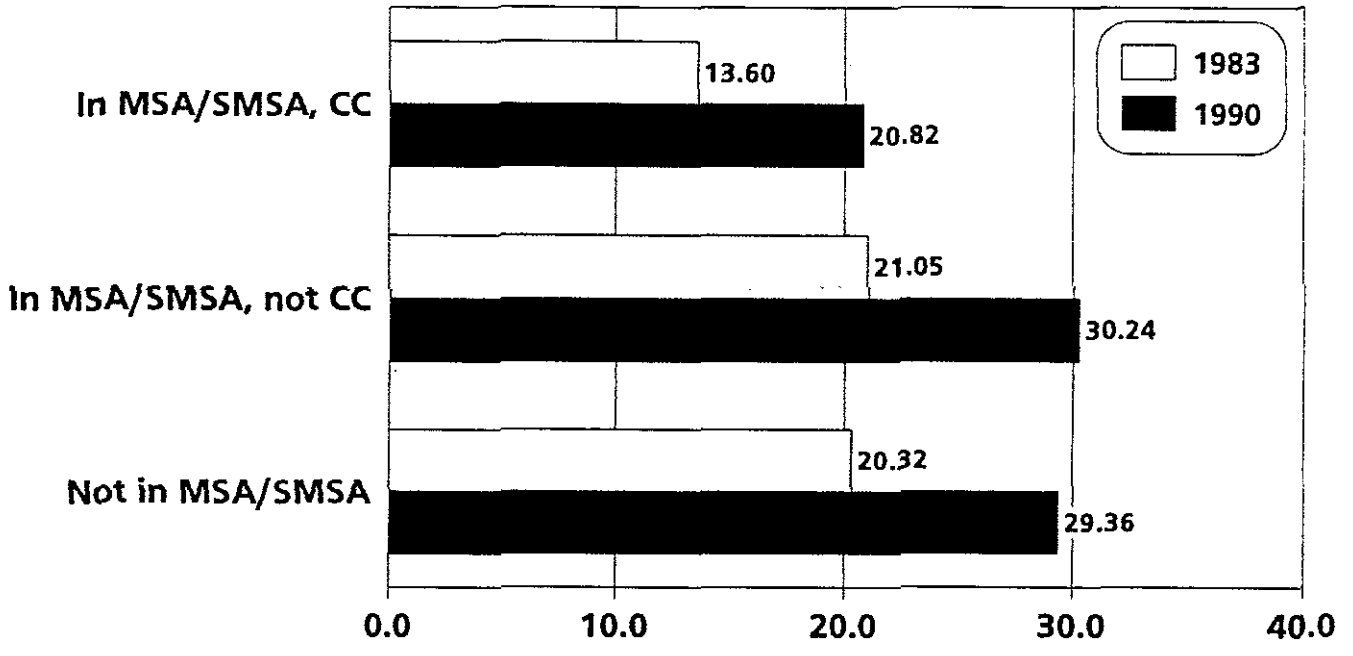


Figure 47 Average Daily Person Trips: Men (5+) by Household Location

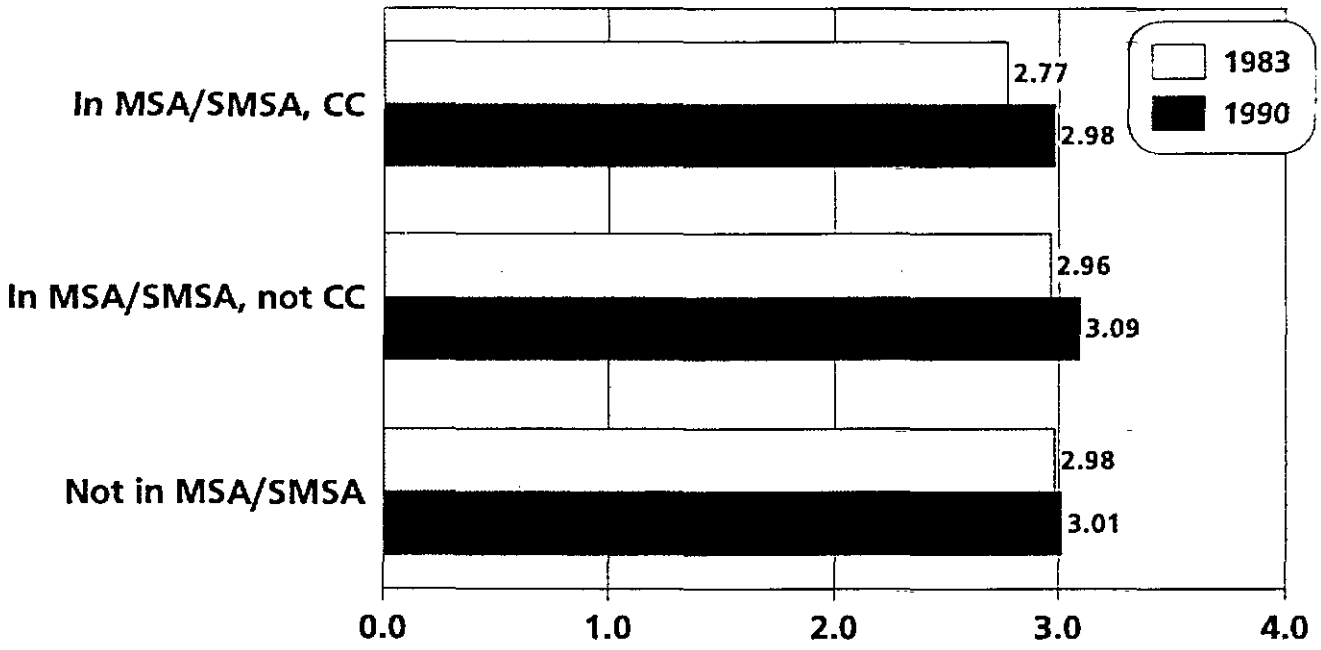
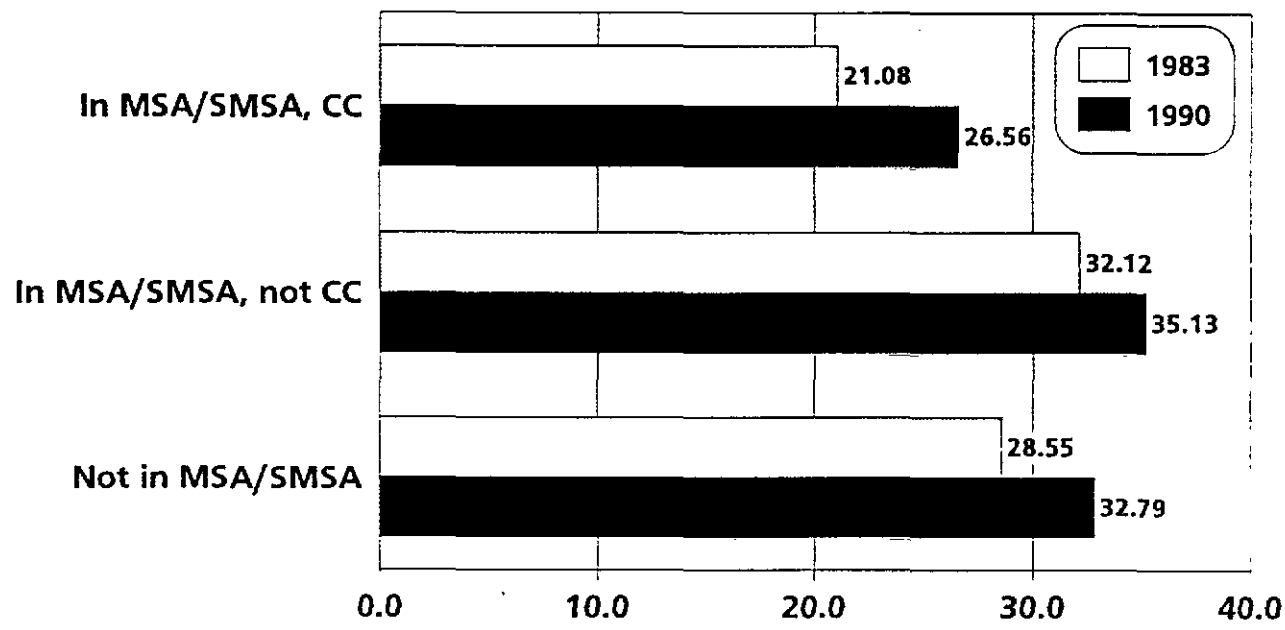


Figure 48 Average Daily Person Miles of Travel: Men (5+) by Household Location



to 87 percent in 1990. Total male person trips by private vehicle increased 13 percent between 1983 and 1990; trips by bicycle exhibited the largest increase, 17 percent. In addition, public transit usage declined approximately 3 percent during this time, and walking declined by 2 percent.

Table 15 presents the distribution of male person trips by trip purpose. For both 1983 and 1990, the to/from work and social/recreational trip purposes comprised approximately 50 percent of all men's person trip travel. The distribution of total male person trips for the other purposes remained relatively stable during this time, as well. The largest change between 1983 and 1990 occurred for family/personal business trips, which increased 39 percent. Male travel for work-related business exhibited the most significant decline during this time, 34 percent, while travel to/from work showed a slight increase.

Table 14: DISTRIBUTION OF MALE (5+) PERSON TRIPS BY MODE CHOICE

Mode Choice	Total Male Person Trips (000)[1] 1983	1990	% Distribution 1983	1990	% Change 1983-1990
Private Vehicle	90,253,802	101,818,645	85.1%	86.7%	12.8%
Public Transit	2,286,889	2,227,298	2.2%	1.9%	-2.6%
Bicycle	1,085,265	1,266,471	1.0%	1.1%	16.7%
Walk	8,627,514	8,445,837	8.1%	7.2%	-2.1%
Other	3,813,433	3,708,422	3.6%	3.2%	-2.8%
Total	106,066,903	117,466,673	100.0%	100.0%	10.7%

[1]Does not include person trips made by an undetermined mode.
Source: 1983 and 1990 data tapes.

Table 15: DISTRIBUTION OF MALE (5+) PERSON TRIPS BY TRIP PURPOSE

Trip Purpose	Total Male Person Trips (000)[1] 1983	1990	% Distribution 1983	1990	% Change 1983-1990
To/From Work	26,891,510	27,474,322	24.5%	23.4%	2.2%
Work-Related	3,376,069	2,215,751	3.1%	1.9%	-34.4%
Shopping	17,284,444	19,458,379	15.8%	16.6%	12.6%
Family/Personal	17,372,465	24,094,515	15.8%	20.5%	38.7%
Civic/Educational	12,112,916	13,072,576	11.1%	11.1%	7.9%
Social/Recreational	30,148,623	30,334,062	27.5%	25.8%	0.6%
Other	2,375,389	870,836	2.2%	0.7%	-63.3%
Total	109,561,416	117,520,441	100.0%	100.0%	7.3%

[1]Does not include person trips made for an undetermined trip purpose.
Source: 1983 and 1990 data tapes.

Figure 49 indicates that most men used private vehicles for their traveling needs in both 1983 and 1990. Possibly as a result of the slight increase in private vehicle use between these years, men's use of public transit declined slightly during this time, as did their number of walking trips. The "other" mode category included person trips made on school buses, airplanes, and taxicabs, among other modes.

In both 1983 and 1990, most male person trips were for social/recreational or commuting to/from work purposes, as shown in Figure 50. These two trip purposes encompassed approximately half of the total male person trips in these years. Other significant changes in men's travel between 1983 and 1990

included declines in the number of trips made for work-related business and other purposes, as well as an increase in the number of trips made for family/personal business.

Findings and Conclusions

Notable among the many theories about travel trends and congestion levels is the contention that current "trend-based" thinking does not take into account the changing demographics of automobile use (18, 19). The effective saturation of automobile ownership is indeed evident in the NPTS total trend data, as is the approaching saturation of licensed drivers (3, 4, 5, 6). However, a number of these analyses have provided insight into only one half of the equation: the trends in the supply of persons able to travel and the number of vehicles at their disposal. Additional analysis is needed to evaluate the equation's other half, i.e., the trends in the individuals' demand for travel.

This study shows that all four measures of total personal travel (vehicle trips, VMT, person trips, and PMT) have increased between 1977 and 1990. Not only have the four travel measures increased, but they have done so at an accelerated rate. These accelerated growth trends are also apparent for the total and gender-based travel measures on an average daily per person basis. The only average daily travel measure to indicate a negative growth trend between 1977 and 1990 was men's average daily person trips per person, which declined less than two percent. Despite the decline, however, this measure did exhibit an increase between 1983 and 1990, indicating the deceleration of the negative growth trend.

Therefore, it would appear that trends in the demand for travel are continuing to increase for both men and women. The lack of evidence indicating the possible future stabilization of these total trends suggests that the saturation in men's travel (or women's travel, for that matter) is not yet evident in the NPTS data. Unfortunately, this means that predictions of increasing congestion and gridlock may not be exaggerated, despite stabilization in the growth of licensed drivers and personal vehicle availability. Persons may be able to drive only one vehicle at a time, but it appears that they want to drive it more often and for longer distances. Perhaps planners and decisionmakers truly are facing a bleak future in the management of traffic in the United States. Fortunately, analysis of the demographic, economic, and geographic characteristics contributing to the overall travel trends indicates otherwise.

While total male travel trends have exhibited increasing growth between 1977 and 1990, analysis of the contributing elements indicates that specific segments of the male population have shown signs of stabilization in their travel measure rates. However, it does not seem reasonable to expect the stabilization of current male travel trends in the near term unless the segments that have indicated stabilized travel rates happen to be major contributors to total male travel.

On an aggregate level, for all characteristics analyzed, the data indicated that men's average daily vehicle trips and VMT per person did not show signs of stabilization. This result may have been due to the definition used for these measures: trips and miles accumulated by persons who were indicated as drivers on trips in personal vehicles. Since the NPTS total trend data indicated increases in both household vehicle availability and male licensed drivers between 1983 and 1990, it is logical to assume that more men were able to drive and actually did so, thereby increasing their vehicle trips and VMT. The only segment of the male population to show stable trends for the vehicle travel measures was men in low income households (less than $5,000; $15,000-19,999). This is a reasonable finding, since lower household incomes would afford these men less of an opportunity to purchase personal vehicles in which to accrue the vehicle trips and miles.

From the analysis of contributing elements it is clear that the majority of the instances in which stabilization of travel was evident occurred for the average daily person travel measures: person trips and PMT. This is fortuitous since these measures included trips and miles for all modes regardless of trip purpose. To truly evaluate the overall travel trends of the various segments of the male population, it would make sense

Figure 49 Distribution of Male Person Trips by Mode Choice

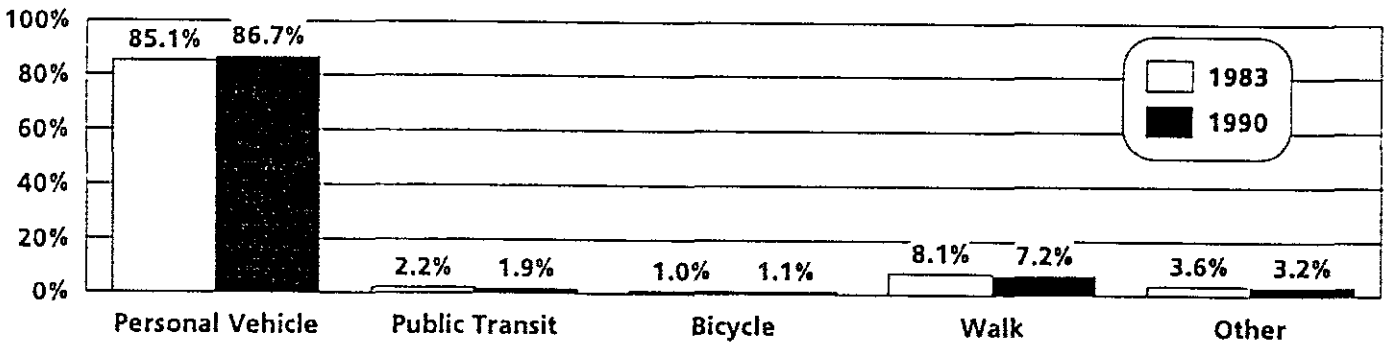
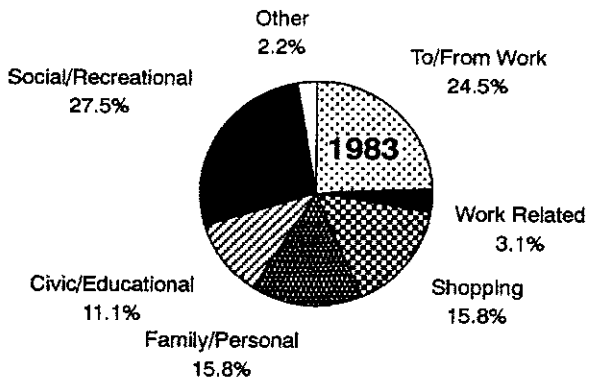
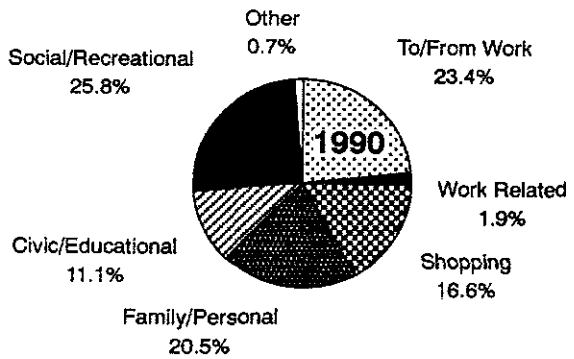


Figure 50 Distribution of Male Person Trips by Trip Purpose





to include all of their travel, and not just trips made in their personal vehicles. Therefore, it is surmised that person travel measures would be the best indicators from which to ultimately determine saturation.

As such, the age distribution data indicated that men between the ages of 20 and 59 and those 65 years and older all showed signs of stability between 1983 and 1990 in their average daily person trip rates. This is significant since the person trips for these age groups accounted for 73 percent of all male person trips in 1990. Two of the age groups that did not exhibit signs of stability in trip-making (5-15, 60-64) did indicate saturation in the number of person miles traveled. Stabilization in male travel was also evident for a number of the household income categories. For example, average daily person trip rates either remained constant or declined for six of the twelve household income categories between 1983 and 1990; these six categories comprised 59 percent of the total person trips made by men whose household incomes were indicated in the NPTS data.

The stabilization of trends in person travel were evident in other important characteristic categories, as well. White, non-Hispanic men, men with driver's licenses, and working men all indicated stable trends for average daily person trip rates between 1983 and 1990. For each of the characteristics, these categories represented the largest portion of total person trips for men. Household size, household vehicle availability, life cycle, and household location all indicated similar findings for male person travel. In most of these cases, the segments of male population that traveled most frequently were the same segments that showed some indications of stabilizing travel trends.

Considered in aggregate, the results of the analysis of the demographic, economic, and geographic characteristics contributing to men's travel trends between 1983 and 1990 seem to conflict with the findings determined from the total travel data presented earlier. Has men's travel really become saturated or not? Well, the answer is not that simple. The differences between the relative changes in vehicle and person travel measures indicate, however, that their trends should be evaluated separately.

The apparent lack of stabilization in average daily vehicle trips and VMT for most of the segments of the male population along with the increases in total male vehicle trips and VMT between 1983 and 1990 seem to indicate that the historical trends of increasing numbers of licensed drivers and household vehicle availability were still having an effect on male travel in 1990. Now that the licensed driver and vehicle availability trends have shown stability in growth, it is expected that the vehicle travel measures as well as total male vehicle trips and VMT will also begin to show declining growth rates. Currently, however, the data do not indicate that men's vehicle travel (i.e., driving personal vehicles) is saturated. Instead, future stabilization can only be assumed based on the stability of the growth rates for the number of eligible persons receiving licenses and for household vehicle availability.

As for total male person trips and PMT, their increases between 1983 and 1990 were significantly smaller than those for the total vehicle travel measures (see Table 2). In fact, total male person trips exhibited the smallest increase during this time of any of the total travel measures. Nevertheless, this increase was greater than that shown for total male person trips between 1977 and 1983, indicating an accelerated growth rate between 1977 and 1990. These trends indicate that men's person travel (i.e., travel on all modes) is not truly saturated, either. However, unlike vehicle travel, the stability shown by the various segments of the male population for average daily person trips and PMT indicate that the stabilization in total male person travel has already begun, and it is anticipated that the effects of this indicator of saturation will be more evident in the results of the 1995 NPTS survey.

While it may be apparent that male travel saturation is looming on the horizon, one must recognize that a number of other factors could influence the extent to which this saturation is evidenced in the future. Real income growth, changes in the relative cost of travel, roadway congestion levels, changes in the male's role regarding household travel responsibilities, and concepts such as telecommuting all may influence the time frame for reaching saturation.

Additional Analyses

In reviewing the findings related to the four measures of male travel utilized in this study, it became evident that for aggregate total travel and per capita data, there was limited evidence of saturation. In an effort to further explore the prospect of saturation in greater detail, some additional analyses were conducted. The two areas that were examined included (1) the extent to which travel may be indicating signs of stabilization for more narrowly-defined groups of the population, and (2) the trends in total daily travel time. The trends in travel for groups that might be characterized as possibly experiencing saturated travel behavior were examined. This analysis included reviewing the tripmaking characteristics for persons and households that have sufficient income, household vehicles, and employment in order to eliminate these traditional constraints to travel.

In Figures 51 and 52, males within specifically-defined segments of the population have been distributed by the number of travel day person trips made. The first segment examined included males 16 years and older (working age) in households earning at least the median income and having at least one vehicle available per adult. As shown in Figure 51, the peak tripmaking for men in this segment was between two and three person trips for the travel day, in both 1983 and 1990. When this segment is redefined to include only single, working males with these characteristics, the peak tripmaking in 1983 was 0-2 person trips for the travel day. By 1990, the peak shifted to 3-5 person trips for the travel day.

The next two figures show the distribution of household travel day person trips, delineated by life cycle category. Figure 53 illustrates the variation in household person trips for men in households with two or more adults, again earning at least the median household income and having at least one household vehicle available per adult, with an additional constraint of all adults in the household being employed. The peak tripmaking for households in this category was 4–6 person trips for both 1983 and 1990. Figure 54 shows the distribution for household person trips for single adult men, with this same criteria. In 1983, the peak tripmaking for these households was between one and three person trips. This increased to 4-6 person trips in 1990.

The data in these figures indicate that there were no signs of stabilization for any of the specific segments examined. Indeed, the trends indicate that from 1983 to 1990, the distributions of travel day person trips have increased, regardless of the segment examined.

Finally, total travel time was examined for both men and women. Total travel time was calculated by summing the reported trip lengths for all trips made by each person on their specified travel day. As a result, the total time spent traveling by an individual is actually an estimate of real travel time based on the individual's perception. Therefore, the distributions indicated in Figures 55 and 56 should be interpreted with this in mind. In both figures, it is apparent that total travel time for both men and women has remained relatively stable between 1983 and 1990. In addition, there appears to be little difference in the total time spent traveling by either gender. The distributions suggest that, at least with respect to travel time, both men and women may be reaching some level of saturation. However, factors such as increased travel speeds, shorter trips, and varied modes, among others, may explain why stability is evident in total travel time but not in the other travel measures analyzed in this study.

Figure 51 **Travel Day Trip Distribution for Men 16-64 Years, Median HH Income+, Vehicle Ratio >/= 1**

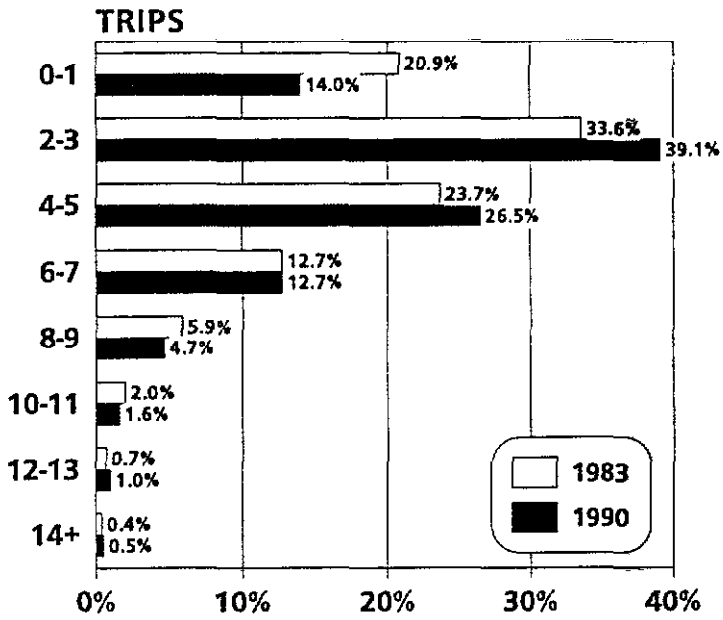


Figure 52 **Travel Day Trip Distribution for Men Single, Employed, Median HH Income+, Vehicle Ratio >/= 1**

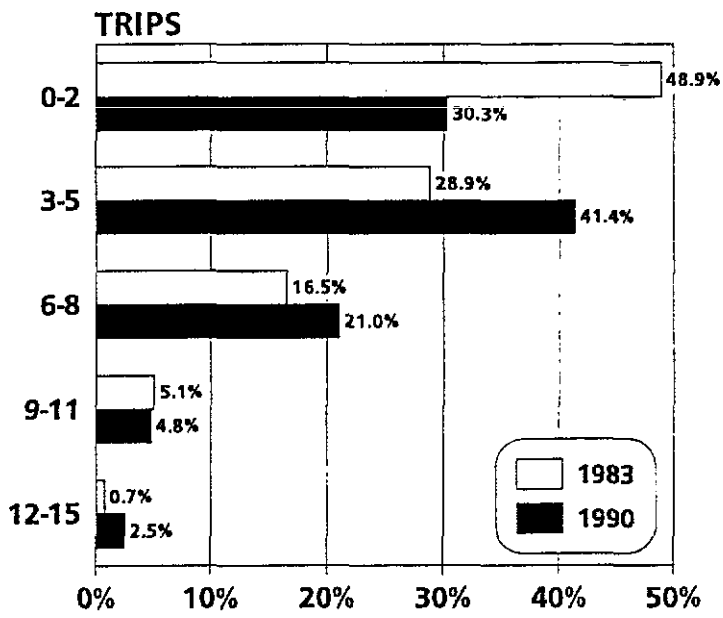


Figure 53 **Travel Day Trip Distribution for Households 2+ Adults, 0 Children, Median HH Income+, Vehicle Ratio >/= 1, Worker Ratio = 1**

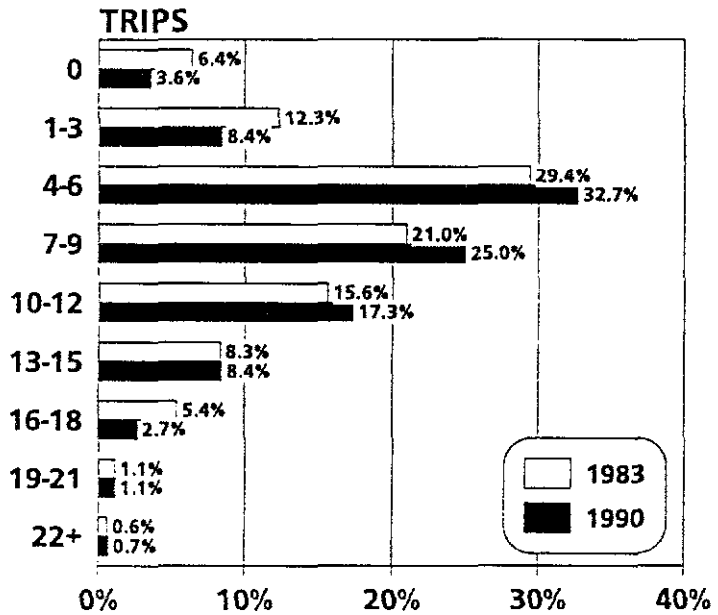


Figure 54 **Travel Day Trip Distribution for Households 1 Adult, 0 Children, Median HH Income+, Vehicle Ratio >/= 1, Worker Ratio = 1**

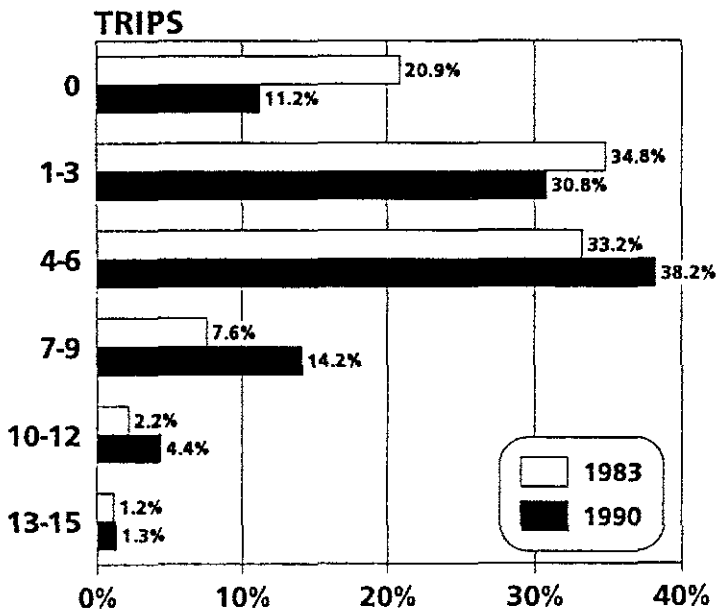


Figure 55 Total Travel Time Distribution for Men

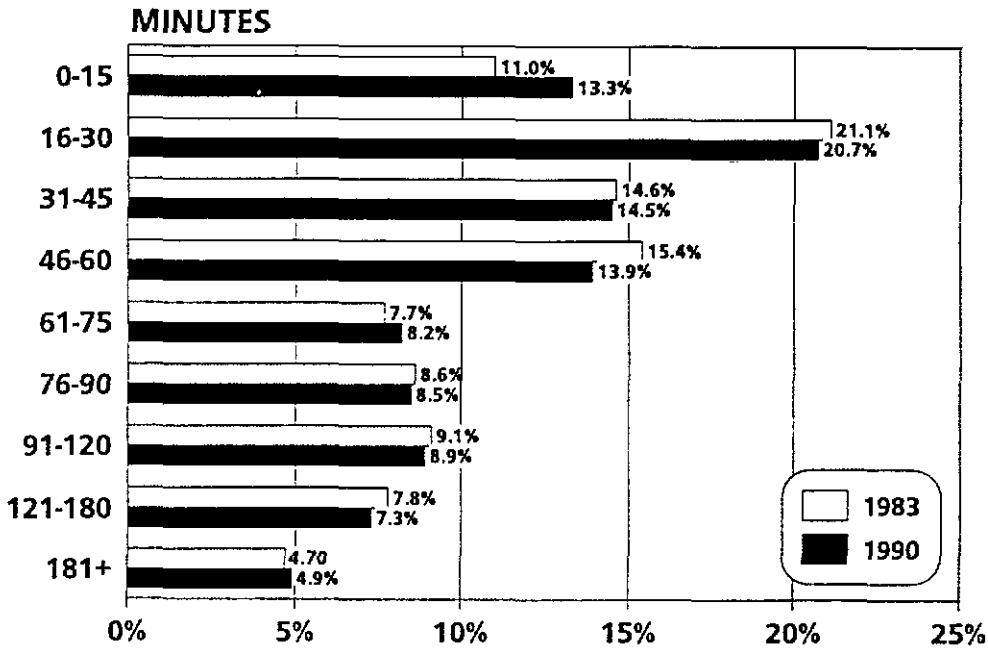
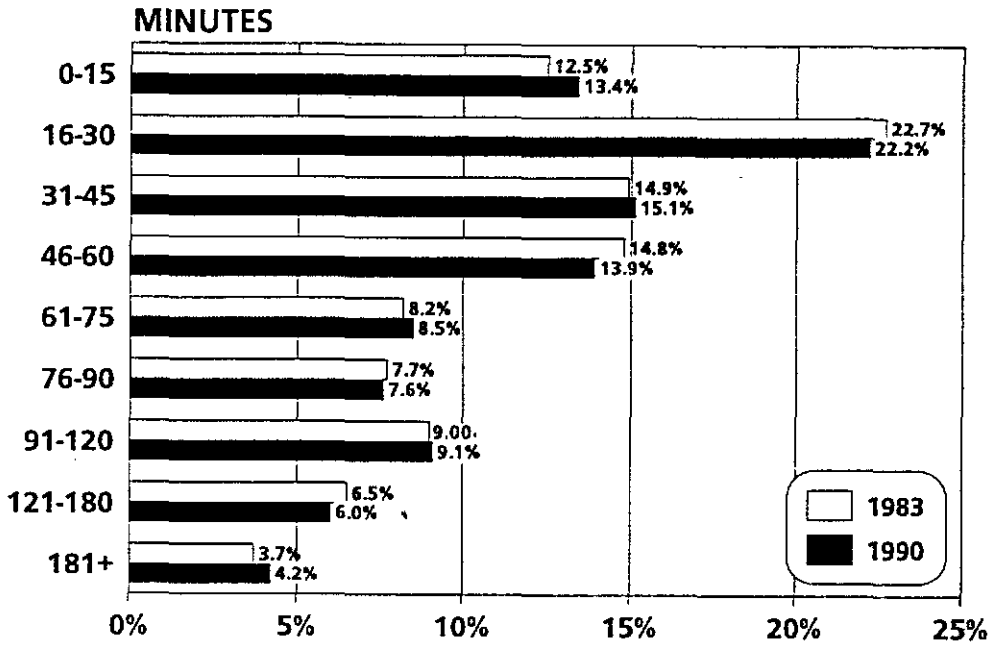


Figure 56 Total Travel Time Distribution for Women



Other Research

According to the results of this study, while saturation is not yet apparent, signs are indeed evident of the beginning stabilization in the average daily travel patterns of men in the United States. By no means, however, have these analyses exhausted the treatment of this particular topic. Other research efforts could help to more fully understand the issue of the potential saturation in men's travel demand. Several areas where additional analysis might further shed light on current travel behavior are presented in this section.

One target area for further study would be to perform analyses similar to those included in this study as additional NPTS data become available in subsequent years, specifically upon conclusion of the 1995 NPTS survey. Like most other studies that utilize historical data to analyze/estimate current and future trends, the evaluation of saturation in men's travel would greatly benefit from additional data points in the trend lines. In addition, greater consistency is expected between the 1990 and 1995 data sampling and collection methodologies, which may result in increased accuracy of the data and an overall improved confidence in the subsequent analyses of the data.

Additional comparisons of travel saturation by trip purpose might also be useful in understanding travel stabilization trends. This effort did not find a manageable way to link trip record data to individuals to analyze trip purpose saturation. However, other efforts might find a way to better analyze and understand whether men's travel saturation is evident for selected trip purpose types. Aggregate data analyzed in this study suggest that dramatic increases have occurred for male travel in the family/personal business category.

Additional investigation into the travel behavior of more narrowly-defined segments of the male population, such as those examined in the previous section, may also be beneficial in the continuing study of saturation in men's travel. For example, is travel saturated for single working males age 20 to 30 who have incomes greater than $70,000? One element that would be advantageous to this sort of additional research is the presence of a larger data sample. It was determined through preliminary analysis that, in some cases, specific segments did not include enough respondents from which to draw statistically-significant conclusions. This was especially apparent in the 1983 NPTS database. Perhaps with a larger sample in 1995, analysis of that database may uncover additional, more specific male segments where a saturation level has been reached.

Another area of travel demand that may require further analysis is the travel behavior of the household unit. Analysis of household travel data might be prove useful in evaluating the extent to which saturation may be occurring at the household level, which in turn may improve understanding of gender-based travel behavior and overall travel demand.

It is also apparent that improved knowledge concerning a number of other behavioral reactions that travelers may have to social, technological, and economic trends might provide further insight into the speculation of travel saturation. A multitude of questions exist whose answers might influence the extent to which we can anticipate a stabilization of travel for particular modes, trip purposes, households, or segments of the population. Examples of these questions for which analysis of current and future NPTS (and other) data may provide answers include:

- Will lower interest rates and stable housing prices enable households to optimize their locations in order to reduce travel, especially for work commute purposes?
- Will retailing trends in both total space and in specialization, as well as the movement to "mega-stores," result in more or fewer, shorter or longer, shopping trips?
- Will telecommuting and/or electronic access to video, information, and retail opportunities reduce overall travel demands?

- Will overall economic conditions and, specifically, the cost of travel impact future overall travel trends?

Finally, it is possible that additional analysis of the distributions of travel by individuals might give further indication of the presence of some maximum probable levels of travel likely within specific segments of the population. From the indicators of stabilized travel for these segments, then, it may be possible to identify the necessary conditions for maximum travel demand by all segments of the population. This information would give planners and decisionmakers the necessary knowledge with which to better provide for future levels of demand for travel.

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In addition to those reports, studies, and papers listed as references for this study, there were a number of other documents collected as part of the literature search process that were reviewed to gain additional insight into such topics as gender-based travel differences, indications of saturation of travel demand, societal changes/trends that have had an influence on travel behavior, travel activity and time budgets, and previous analyses of the NPTS databases. These documents, along with the documents specified in the List of References, are included in the following bibliographical listing.

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Travel by Women

Sandra Rosenbloom, Ph.D.

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Executive Summary

The Background

Our society has undergone profound social and demographic changes in the last thirty years, changes differentially affecting women and their children. Today most women live in low density communities, and most have salaried employment even if they have very young children. The number of families headed by a woman alone has increased substantially and many such families—including some with a parent in the paid labor force—are living in poverty.

As women obtain jobs, increase their income, and acquire licenses they drive longer and use the car for more of their trips, just as men in the paid labor force have traditionally done. However, because their work duties are added to their childcare and domestic responsibilities they also exhibit markedly different patterns than working fathers.

This report analyzes data from the 1990 NPTS data in order to identify and evaluate the differences, if any, in the travel behavior of women in different household and family settings today. The data cannot tell us is if a) these differences will continue into the future and b) if they will not, what women's travel will look like instead. But the analysis is the first step in making our travel estimates more accurate, our planning efforts more responsive, and our policymaking more equitable.

Overall Travel Patterns

The NPTS data show wide differences in the basic travel patterns of men and women. Overall, women 16-64 in both urban and rural areas made more person trips per day than men. However, women made shorter trips; men travelled 27% more person miles than comparable women in urban areas and 16% more in rural areas. Men made more vehicle trips than comparable women and, in both urban and rural areas, covered 60% more vehicle miles.

Overall, traditional travel variables—household income, license-holding, employment—did more to explain the differences among women and among men than they to explain the differences *between* comparable men and women. The higher person trip rates of women persisted through every traditional analysis, as generally did the shorter distances and fewer private vehicle trips. The one major exception: the travel patterns of people from households with low incomes.

Low income people of both sexes in urban areas and low income women in rural areas worked further from home than comparable people from households making more money. At the very lowest income levels women workers travelled further than comparable male workers.

These patterns strongly suggest that women are affected by variables other than, or in addition to, household income or license holding.

The Impact of Children

The NPTS data clearly show that while the presence of children impacts both men and women, having children had profound impact on the trip rates of women and far less impact on the travel patterns of men. The number of trips and the distance travelled by women was much more responsive to both having children and to changes in the age of their children.

Married women made **more** *person trips* than all categories of married men, including those who are not parents; however, they travelled **fewer** *person miles* and made **fewer** *vehicle trips* than comparable men. Married women with children under six made **more** *person trips*, travelled **fewer** *person miles*, and made

the **same** number of *vehicle trips* as single mothers with children under six. However, once their youngest children were school-age, single mothers made **more** *person trips,* travelled **fewer** *person miles,* and made **more** *vehicle trips* than comparable married mothers. In a few categories, single women even made more trips than comparable married men.

Married male parents almost always made fewer trips than comparable female parents regardless of income. Relatively independent of income, married women who were parents travelled less and made fewer vehicle trips than comparable male parents.

Very low income households acted differently; low income mothers travelled further and more often than comparable male parents and more than parents with higher incomes.

Neither marital status nor household income explained the differences between male and female parents. Relatively independent of household income, married women who are parents travel **fewer** *person miles* and make **fewer** *vehicle trips* than comparable male parents. Regardless of household income single mothers travel **fewer** *person miles* but make **more** *vehicle trips* than comparable married mothers. It appears that women who are mothers make more trips because of their family obligations but travel less distance because of their desire to stay closer to home. Single mothers, lacking in-home help with their children, make more trips than married mothers.

The Intersection of Race and Ethnicity

There were sometimes major variations in travel patterns by race and ethnicity; White men travelled more than all other men while White women travelled more than all other women. The gap between Whites and others was so large that occasionally White women travelled more than men in another group. In general men and women in the same group were more similar than were either all men or all women.

White women and men made the longest commute trips; while all men drove more than all comparable women, the gap between the sexes was *largest* among Whites. White women, however, always drove more than women of any other races.

Hispanic women and those from Other Races made fewer trips than comparable men. The differences between Hispanic men and women on all indicators of travel were two to three times greater than the differences between the sexes in any other grouping.

There were large differences in the license status of women. While over 90% of all White women 16-64 were licensed only 71% of Black women and 66% of Hispanic women had a license. Being licensed greatly increased total trip making for all women but the least for Hispanic women. In fact, the gap between Hispanic men and women was consistently larger than that seen in any other group, independent of income, license holding, or employment status.

Although most people drove for the majority of their trips, there were major differences among the groupings. White men and women drove for substantially more of their trips than any other ethnic or racial grouping. However, both White and Black women took more of their trips in a private car than comparable White and Black men.

Implications and Research Needs

These findings raise as many questions as they answer. The first is whether the differences between **comparable** men and women and among women will continue and if they do what variables will be the most important. It would be useful to have both panel studies and longitudinal studies to better understand why women make the travel choices they do (and the employment and childcare decisions that create their travel patterns) and how these choices change over time in response to family events.

Second, the data clearly show that *household income* is a good but flawed indicator of travel behavior, especially when it comes to understanding the dynamics of women's travel. With the growth of two worker households we need a better indicator of the joint impact of personal and total household income on all the major indicators of travel behavior.

Third, in order to make intelligent and equitable transportation investment and financing policies we must know why poor workers are making what may be real sacrifices to travel as they do.

Fourth, it is important to document changes in male parents' travel behavior over time in response to domestic obligations—and the resulting impact on women's travel patterns. It would be useful to see if changes are fast enough or of a magnitude that will lighten the domestic burdens which create such variations in women's travel.

Fifth, it is important to evaluate the policy implications of these findings, in both the short and long term. If we accept that women's travel patterns are different from men's largely or only partly because they are balancing home and work in a way that men do not, we need to consider the impact of pending transportation control programs (to be developed to respond to ISTEA and Clean Air Act Amendment mandates).

Acknowledgments

I would like to thank Marshall Frieman for data management and Gregg Snyder for the graphics.

Introduction and Overview

Converging Societal Trends

American society has experienced a number of major changes in the decades since WWII, changes which may have differentially affected women and ultimately their travel patterns. Among the most significant are the suburbanization of homes and jobs, increasing real incomes, the growing diversity of our population, the almost total automobility of society, the transformation of the structure of the traditional American family, and the increasing involvement of women in the labor force.

All of these changes are inter-related in a complex way and their effects on women are far reaching. Altered household structures and changing family relationships also have profound social and ultimately transportation implications; today most women have salaried employment and many head their own families. In 1990 only one out of five households corresponded to our traditional idea of the family—a working father and a homemaker mother. Instead, over sixty percent of *married* women were in the paid labor force while women alone headed one out of five families. All of these living arrangements and family structures create travel patterns different than those seen just a few years ago.

Moreover most jobs and homes are in the suburbs—a situation arguably caused by, but certainly made possible by, the car. However the low density development which defines the suburbs now requires even low income workers to have a car. Unfortunately, the suburbanization of jobs and the need for a car have disadvantaged certain workers, particularly women, who live in the central city but must commute out to the suburbs for employment.

Allied with the suburbanization of society is the growth in median family income; higher incomes are also clearly associated with greater use of the private car. But increased incomes have not been achieved equally by men and women nor by those of all races and ethnic backgrounds. Certain kinds of households, particularly those headed by a woman alone, have suffered declining real incomes in the last three to five years. Moreover, a greater percentage of single parent households are headed by women from ethnic and racial minorities.

The most salient fact today is that most women, and most women with children, are in the labor force, generally retaining substantial childcare and domestic obligations in addition to their jobs. At the same time, a growing number have also assumed duties for aging parents and in-laws. These compound responsibilities have important transportation implications: they create the need for multiple trips in addition to any work trips, they create the incentive to link trips, and they reduce the ability to use alternative modes, like transit, which are inflexible and time consuming. All of these needs are intensified by the low density suburban development of jobs and homes.

This report uses data from the 1990 NPTS, as well as other sources, to evaluate major questions raised by these trends. What will happen in the future if even more, indeed most, women join the paid labor force? If most employed women have children? If most have very young children? If a significant percent head their own households, or live in poverty, or...?

The NPTS data give us the ability to see the differences, if any, in the travel behavior of women in different settings *today*. They cannot tell us if a) these differences will continue into the future and b) if they will not, what women's travel will look like instead. On the other hand, analyzing NPTS data to highlight the variation in women's travel, and differences between otherwise comparable men and women, is an important first step in making our travel estimates more accurate, our planning efforts more responsive, and our policymaking more equitable.

The report uses largely descriptive analyses and cross-tabulations to address these issues. The approach is dictated by both the data and the policy purposes to which it might be put. While it has limits, it seems appropriate for a first cut at the issues under study.

This, the first major section of the report, will cover each of these issues in greater depth, highlighting the transportation implications for women of the profound demographic and social changes our society has witnessed in the last thirty years. The second section of the report compares and evaluates the travel patterns of men and women in terms of traditional variables: household income, employment status, and license holding. The third major section focuses on the possible impact of less commonly studied variables on women and men's travel behavior. The fourth section summarizes the major findings and the last section briefly describes the research implications of the findings.

Women's Employment Trends and Changes in the American Family

Married Women in the Labor Force

American family life has changed dramatically during the last four decades, but especially since the mid-1970's; overall, the labor force participation rate of married women has increased substantially since the end of the second World War. In 1960 less than one third of married women were in the paid labor force; in 1990 almost 60% of all married women were employed[1]. But the more striking phenomenon is the number of women *with children* who have taken jobs; in 1960 only 27% of married women with children under 18 had salaried employment but that number had grown to 61% by 1986. As a result only 21% of families conform to the traditional family model today: a husband working full time year-round and a wife not in the paid labor force[2].

On the other hand, the percentage of married women without children who are in the labor force has actually declined. In 1970 only 46% of women without children did not have paid employment; in 1990 that figure had increased to over half.[3] In general, the increase is a result of the aging of society; the largest number of those married women not in the labor force are over 50.

In 1990 roughly 28% of all married couples with children under 18 had two full time, year-round workers. In an additional 30% of married couples with children, both spouses worked—the husband full time but the wife either less than full time or not work year-round[4]. There were differences in the employment experience of different kinds of families. In 1990 roughly 74% of women in a married couple with children under 18 were employed; this was roughly comparable for Blacks and White but Hispanic couples (of any race) with children were far less likely to have two workers (only 55% of such couples did).

Within the overall increase in the employment of married mothers is the even more rapid increase in the number of married women with *very young* children who have entered and remained in the labor force. In 1960 only 18% of married women with children under 6 were in the paid labor force; in 1970 only 30% of married women with children under six had salaried jobs. By 1986 over 53% of comparable women were employed[5]. Today almost 60% of married women with young children have salaried employment (while almost three fourths of married women with children from six to seventeen have paid jobs)[6].

Moreover, many of the employed women with children under six had *very* young children. In 1976 only 31% of women 18-44 with children under 12 months of age were in the paid labor force; by 1990 over half of comparable women who had given birth in the previous year were employed and the big jump came between 1980 and 1985[7].

In fact, in 1990 almost half of all mothers of babies under *six months* were in the paid labor force—one in twelve employed women had an infant[8]. A 1990 Department of Labor study found that over 44% of all women return to work before their babies are six months of age, over two-thirds of those on a full-time basis [9]. Thus the child care obligations of working women interact with their home to work travel patterns in a way not seen in previous generations.

Families Headed by Women

Over the last three decades the number of families headed by a woman alone have increased substantially. In 1970 just 11% of all families were maintained by a woman alone; that grew to 15% in 1980, 16% in 1985[10] and almost 20% in 1990. The growth of such families has not been uniform throughout the population; in 1986 13% of White, 44% of Black, 23% of American Indian, and 23% of Hispanic (of any race) families were headed by a woman alone[11].

Another way to look at the impact of this type of family structure is to identify the household situation of children. The proportion of children living with both parents dropped over fifteen percentage points since 1960 while the percentage of children living with just one parent almost tripled; in 1990 3% of children lived only with their father while almost 22% lived with just their mother[12].

While the number of children of all races and ethnic backgrounds who live with both parents has decreased, it has decreased most rapidly for non-Whites. In 1960 over two thirds of Black children lived with both parents; this fell to roughly 38% in 1990. Just under 80% of White children and just under 67% of Hispanic children (of any race) lived with both parents in 1990[13].

Moreover, a substantial and increasing number of children living with one parent live with a *never married* parent—as opposed to one who was widowed or separated or divorced. In 1990 almost 31% of all children in one-parent families lived with a never married parent while over 60% lived with a divorced or separated parent. In contrast, in 1970 less than 7% of children living with one parent had a parent who was never married[14].

Working Women and Their Children

How—and where—working women take care, or arrange for care, of their children while they work has important transportation implications. During the last two decades working women have relied less on relatives to care for their children and more on commercial enterprises; in 1977 over one third of young children with working mothers were cared for in their own homes but by 1988 that number had dropped to 28%. The Census Bureau surmises that this may reflect the growth in labor force participation by women outside the home reducing the number of available relatives.

> The location of childcare activities for full-time working mothers tends to be *outside of the child's home* with nonrelatives, rather than in the child's home with family members[15]. (emphasis added)

Conversely, working mothers are much more likely to use organized child care facilities (such as day or group care centers or nursery or pre-schools). In 1977 an estimated 13% of mothers with children under five used such facilities; by 1988 over 26% of all working mothers were placing their young children in organized child care facilities while they were at work[16]. The use of organized care was much higher among women working full time (when 31% used them) than among those working part time (17% using organized care)[17] and higher among those with incomes above poverty levels.

In 1988 the school-age children of working mothers spent less time in organized care or in school than those under five—roughly 4 hours less per week. The Census Bureau attributes most of this difference to the time associated with "the transportation of the child between home and child care providers,"

> [T]hese discrepancies do not necessarily mean that the child is alone all these hours as some of this time may constitute travel time to school with other children or in the presence of other adults[18].

Census data show that roughly 60% of all women workers have a day shift job (defined as a work schedule where at least one-half of the hours fall between 8:00 AM and 4:00 PM) and the use of organized care was more prevalent among such women. Conversely women with non-day shifts were substantially

less likely to use organized care, probably because these facilities are rarely available during evenings or weekends[19].

The schedules of working women, as well as those of their care providers, interact in ways that have profound transportation impacts. Twenty-three percent of all full time working mothers and almost 60% of those working part time not only don't work the classic 9-to-5 day, they don't even work most of their hours during that traditional period[20]. Working at non-traditional hours may reduce their impact on peak period traffic congestion but may also reduce their ability to join carpools or find appropriately scheduled, let alone safe, transit options, even if their need to transport children didn't require the use of the car.

Not surprisingly, a recent study done for the Department of Labor found that mandatory or inflexible work hour changes created serious problems for working women with children. Only variable work hours which allowed daily fluctuations reduced work/family conflict or increased job satisfaction[21]. Surprisingly, the study concluded that cost was not the most important factor in obtaining child care; much more important were the woman's work schedule, particularly having a day shift, and having supportive managers who allowed some flexibility in work schedules[22].

The relationship between home to work travel patterns and childcare and other domestic responsibilities is also seen in studies of travel reduction programs (which are designed to encourage or force workers to stop driving alone to work or to use transit). Many workers report that their inability to stop driving alone is due entirely or in significant part to their need for their car immediately before and after work, to their child care needs, and to their concern that they might be faced with a family emergency during the middle of the work day[23 24 25 26 27].

Working Women and Eldercare

Many working women also have to care for older relatives[28]. Those currently of working age have been called the "sandwich generation" because they may have responsibilities to both their children and their parents at the same time. This situation arises because many people have delayed the birth of their children while their older parents are living longer. In fact the ratio of those 50-64 to those over 85 has tripled since 1950 and will triple again over the coming sixty years,

> More people will face the concern and expense of caring for their very old, frail relatives since so many people now live long enough to experience multiple chronic illnesses...the oldest old [those over 85] are the most likely to have pressing needs for economic and physical support[29].

The evidence is overwhelming that women—both daughters and daughters-in-law—provide the overwhelming percentage of the care given to older people living in the community, whether or not they are in salaried employment [30 31 32].

The Census found that, in 1988, 15% of working women said that the main reason that they chose their work schedule was to arrange better childcare for their children while an additional 6% said that they did so to arrange for the care of other members of their family. Women working part-time were more likely to report choosing their schedules to accommodate their child or elder care needs[33].

The Transportation Implications of Balancing Home and Work

Research clearly shows that, because they retain child and eldercare responsibilities while working, women have different travel patterns than comparable men. A 1980 Swedish study found that salaried married women made more shopping and domestic trips than their spouses—and fewer social and recreational trips[34]. A 1990 study in four Chicago suburbs found that employed women made *twice* as many trips as comparable men for errands, groceries, shopping, and chauffeuring children[35]. Preliminary 1990 NPTS analyses show that women between 20 and 60 make more trips per day than men of the same age, the largest component of the difference being the trips women take for family and personal business[36].

Comparative work by Rosenbloom in The Netherlands, France, and the United States found that women's travel patterns varied significantly with the age of their youngest child[37]. Perez-Cerezo also found that the age and presence of children more influenced the travel patterns of American women in all types of household[38].

Raux, in a 1983 study in Lyon, France found that working women were the parent in two worker households who arranged their work and travel schedules to fit child care needs[39]. Fagnani has consistently found similar patterns among French families in the Île-de-France (the Paris metropolitan region)—even married women employed full time chose or changed their work schedules to meet the needs of their children while their spouses did not[40]. None of these researchers found that children had comparable (or any) impacts on the travel patterns of married fathers—even those with wives in the *full-time* labor force.

Overall, most research on this issue has found that, to accommodate their children and their household role, employed women adjust their work schedules and job locations[41,42,43,44] and/or their travel patterns [45,46]. Their home to work travel generally becomes shorter as a result of their employment decisions but the impact of these adjustments doesn't stop there. Most working women also make more linked trips to and from work and choose travel modes which allow them the time and flexibility to carry out domestic responsibilities and to respond to children in an "emergency" situation—such as a child becoming ill at school or daycare.

For example, Pickup found that British women in Reading with the greatest child care obligations made the shortest work trips, passing up better jobs with longer commute times. He concluded that women do not travel further because their child care obligations—and not the travel costs—limit them. In support, he found that a significant number of women *without children* were willing to drive considerable distances for even low pay[47].

These findings are supported by a 1988 Census study which found that 4.4% of working women with children under 15 reported losing time in the last month as a result of a failure in their childcare arrangements (including sick children). Strikingly, there were no differences between married and single female parents; the Census Bureau concludes this is "because lost time from work was overwhelmingly the responsibility of the mother" regardless of marital status[48]. No more than 0.7% of men reported losing time from work because of childcare problems.

Rosenbloom's comparative work in Europe and the US found that women were far more likely to link trips to and from work than comparable men; linked trips indicate complicated travel patterns which are not easily served by modes other than the private car. A 1992 survey in Southern California found that 29% of female workers made a stop on the way home compared to 19% of men[49] and that more women made stops on the way to work as well[50]. More than one-fourth of women workers making a stop *to* work were dropping off children, a detour almost always made five or more days per week[51]. When asked which factors they considered when choosing their travel mode to work, women in the Southern California survey were more than twice as likely as men to report both needing a vehicle to take children to daycare and school, and, their concerns about safety[52].

Moreover, working women often retain responsibility for taking children to and from their activities. Rosenbloom found that over 80% of all married American working women reporting "routinely" making trips solely for children, compared to 50% of all men. But the actual incidence of fathers driving children dropped still further when they were questioned about the actual frequency of these "routine" trips. While a majority of women made one or more trips *per week* for each of their children, American fathers with working wives rarely made more than two trips *per month* solely to take their children somewhere. Most American fathers appeared to really provide only a back-up function[53].

When Rosenbloom asked employed parents to describe their children's most frequent travel "mode"[54], both married parents overwhelmingly agreed that the *employed* mother was the most frequent travel "mode" for both young and school-age children. Only 5% of all American working women and 2% of all American

men reported that the father had greater responsibility for children's transportation (and then only for children under six)[55].

The Travel Patterns of Single Female Parents

Research shows that women householders with no spouse have travel patterns that are different from both married parents, in part because of differences in employment and in part because of differences in the way these women organize their domestic and job related responsibilities. Kostyniuk and Kitamura found that, except for the very poorest women who did not drive, single parents in Rochester, NY made *more trips* and *travelled further* for all purposes than comparable married workers. They attribute these patterns to the need to balance employment and domestic responsibilities without the help of a resident partner[56].

Johnston-Anumonwo found that although single women with children in Worcester, Massachusetts were less likely to own cars, they were more likely to make their work trips in cars; she also found that single mothers had *longer work trips* than comparable married women[57]. In later work she concluded that Afro-American single mothers were forced to make longer trips because of spatial imbalances in employment opportunities[58].

Rutherford and Wekerle studied single and married workers in a Toronto suburb and concluded that single mothers spent *more time travelling to work* and that they were less likely to work in the suburb in which they lived than comparable married women[59]. Rosenbloom found that single mothers in Houston and Dallas had very different travel patterns than comparable married women, generally *travelling further* and *using a car more often* than either married worker at all but income levels below $5,000 a year [60].

These findings suggest that single mothers both face more domestic burdens and a different set of employment options than either other women or men. Moreover, they are substantially more likely to have low incomes, even when employed full-time. Clearly all of these factors have transportation implications.

Income Changes and Disparities

Household and Family Income

From 1967 to 1991 median *household*[61] money income, in real dollars, increased in the United States almost 14% while the income of Black households increased almost 16%[62]. However Hispanic households actually made less in 1991 than they had in 1972 in constant dollars and most income groups suffered a decline in real income from 1989 to 1991. For example, the real income of White households declined by 3% between 1990 and 1991 while that of Black households nationally declined only slightly. However, Black household income in the South—where over 54% of such households live—fell over 6%[63]. The income of families maintained by women with no spouse dropped over 5% compared to a 1.4% drop for married-couple families[64].

The impact of the increasing involvement of women in the labor force can be seen in median figures: families with two workers have substantially higher median incomes than other kinds of families. The median income in 1990 for *families* with children who had two full time workers was just over $53,000 while the median income of a family with children in which only the husband worked was just under $34,000[65].

Yet it is striking how little female employment has stabilized household income. Although median family income increased 104% between 1947 and 1973, it only increased 6% between 1973 and 1990[66]. Moreover, families with children were less likely to share in the overall increase in median family income. Between 1969 and 1989 families with children were increasingly more likely to have incomes below the median of all families[67]. In general, the large increase in one-parent families after 1970 tended to hold down the increase in overall median family income. However, even among married-couple families with children, the median income in 1990 was only 11% higher than it had been in 1973.

Women and Poverty

What did increase was the level of poverty among families with two adults; the poverty rates for all married couples and for white couples, for example, were higher in 1990 than they were in 1975. The poverty rate for married Black couples was almost twice that of White couples, and higher in 1990 than it had been in 1978[68].

In 1990 a family headed by a women alone (with no husband) earned 42% less than the families of married couples[69]. Strikingly, among families with children the disparity was even greater, in part because women alone *with* children earned *less* than those without; the median income of female householders with children was $13,092 compared to $41,260 for married couples with children (and $16,939 for female heads of household without children)[70].

There are differences by race and ethnic background, as might be expected. White women heading a household alone earning just under half of what a married couple earned while Black women and those of Hispanic origin (of any race) earned roughly 42% of the amount earned by married couples of similar ethnic or racial backgrounds[71].

In 1990, the median income of all women working full-time, year-round was $20,000 compared to approximately $28,000 for comparable men; in other words men working full-time year round made 40% more than comparable women. However, the gap was much smaller for Blacks and those of Hispanic origin: Black men working full-time year round made 17% more while Hispanic men made 22% more than comparable women[72].

The median earnings of women were significantly lower in every occupational category than those of comparable men. For example, men in professional occupations earned almost 41% more than women in those occupations while men in technical occupations earned greater than 52% more than women.

Conversely, families headed by a woman with no husband have considerably higher poverty rates than any other type of family; over one third of all such families (with and without children) have income below the poverty line. What is really surprising is that the incidence of poverty among such families has been remarkable constant in the long run, although often volatile on a yearly basis. For example, the poverty rate of families headed by a women alone was roughly the same in 1990 as it had been in 1971 and 1976—although it was much higher between 1979 and 1987[73].

Worse, even when the adult in such families worked, they were still likely to be in poverty; poverty rates were higher among the two family types that depended mainly on female workers—two-parent families where only the wife worked and female headed households where the women worked. Over 24% of families with children headed by a *working* women were in poverty—36% of comparable Hispanic and 38% of comparable Black families.

As a result of these high rates of poverty, families headed by a woman alone constituted a substantial portion of *all* poor families: over 50% in 1978 and over 53% in 1990[74]. In order to raise themselves just over the poverty line, the average family headed by a woman alone would require an additional $5,661 per year in 1990 dollars![75]

Many poor female heads of household actually worked; in 1989 roughly 45% of all such women worked some time during the year while just over 8% worked full-time year round[76]. Almost two thirds of those who did not work said the reason was their family responsibilities. Hispanic women heading poor households were substantially less likely to be in the labor force; roughly two thirds of Hispanic compared to just over half of Black and of White women heading families alone did not work at all[77].

Travel Implications of Income Disparities

Much of the (limited) women's travel literature suggests that women's travel patterns are better explained by their household responsibilities than by simple economic factors—although no one argues that

income differentials have no impact[78]. However, a small but growing body of research argues that the intersection of race and income and *not* sex or household responsibilities (at all or alone) influences women's employment choices—and thus the dimensions of their work trip (i.e., length and time).

McLafferty and Preston's analysis of working men and women in New York City found, for example, that commuting times for Black and Hispanic women were *equal to* those of Black and Hispanic men—but far greater than those for either White men or women. The researchers conclude that this proves that simple economic variables do explain travel differences since race, income, and industry of employment are so strongly related[79].

Spalter-Roth and Hartmann found significant differences in wages and work patterns among women that could not be explained by sex or family structure. They concluded that societal changes have had more impact on women's employment and income, and ultimately their travel patterns, than do household structure or implied responsibilities (younger vs. older children)[80]. This study has been widely quoted as showing that single mothers are not disadvantaged by simply being a mother at an early age or lacking a husband; rather that their wage potential is circumscribed by lack of education, failing to receive appropriate credit for work experience, and the shortage of jobs with a future.

In addition there is a growing literature which shows that the jobs open to working women are located in different places in a region than those open to men. Several analysts have concluded that gender segmentation in labor markets has a clear spatial expression and that very localized labor markets exist which have important implications for low skilled women workers[81 82 83]. Hanson and Pratt, for example, have described very small labor catchment areas surrounding suburban firms that hire low skilled women workers; they argue that many employers locate to tap such female labor markets, knowing that these workers will not travel far from home[84].

However even if there are localized labor catchment areas, most employment opportunities are not located close to the homes of most low skilled women workers[85 86 87]. For example, some industries have mixed labor needs and may locate near the source of their skilled workers or they may locate to take advantage of cheaper land, recognizing that higher skilled workers are willing to travel longer for higher wages[88 89]. Therefore, spatial differences in labor markets may force low income women to travel farther to work than comparable men and than higher income workers of either sex.

Certainly the research described above, focusing on single parents, supports this conclusion; Kostyniuk and Kitamura[90], Johnston-Anumonwo[91], and Rosenbloom[92] found that single mothers had very different travel patterns than comparable married women, generally *travelling further* and *using a car more often* than either married worker.

Rosenbloom and Burns found substantial indication that lower income women were forced to travel further regardless of marital status; in a large study in two Arizona cities they found that poor women, whether married or single, were travelling longer to work than comparable men and than women with higher incomes[93].

These findings may well reflect the fact that many families headed by a woman alone have central city residences. Therefore, inner city residents, particularly minority women, may have to travel further to find any clustering of employment opportunities[94] given that almost 70% of jobs are now in suburban areas. In recent work, Johnston-Anumonwo concluded that although both white and black women face a "form of spatial entrapment" the impact on black women is more insidious since they are travelling longer distances for low wage, low status jobs[95].

Women in Our Auto Dependent Society

Women are travelling longer and making more trips—and doing more of that travel in a car.

> Although travel by males still accounts for a majority of total travel, travel by females continues to increase. A significant jump in the share of travel by females was observed in the past twenty years—from 26.8% in 1969 to 35.4% in 1990...travel by females increased across all age groups, except for the 55 to 64 age group[96].

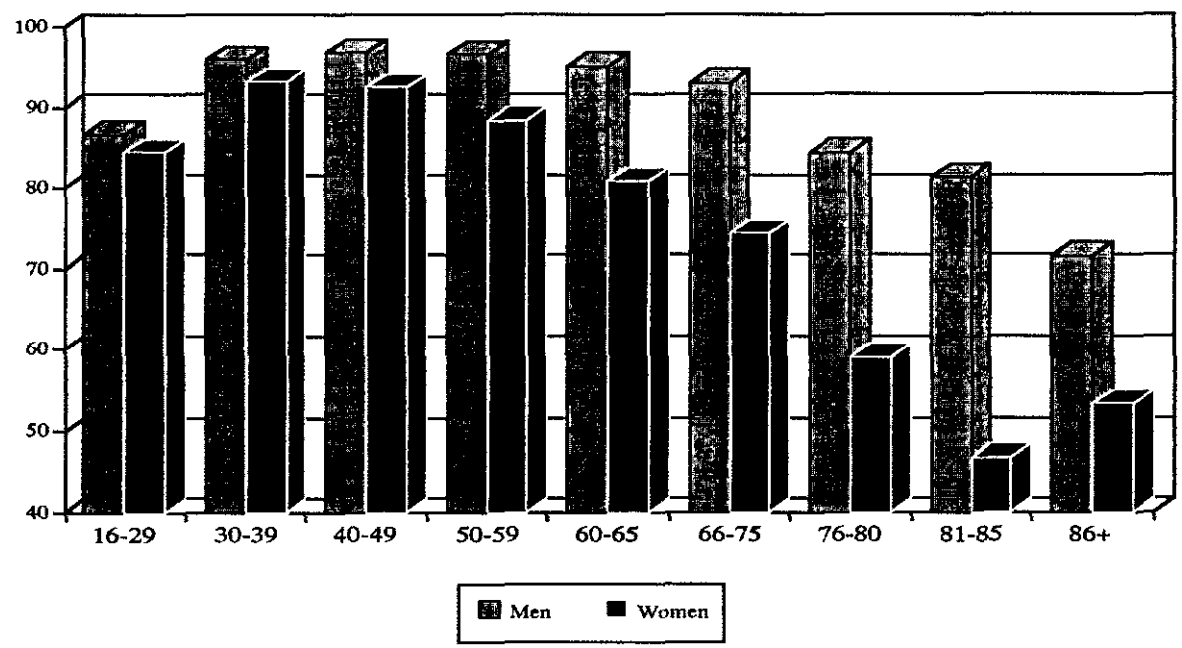
In 1990 urban women (over five) made 86.7% of all trips, and 88.2% of work trips, in a private vehicle; urban males actually made slightly fewer of their total trips by car (85.2%) and only slightly more work trips (89.3%). Women in rural areas were even more dependent on the car than either urban travellers or than rural men: men (over five) made 89.5.7% of all trips and 96% of all work trips by car. However, rural women (over five) made 90.6% of all trips and 96% of work trips by car.

Interestingly, these numbers only reflect a trend already seen in earlier NPTS data. In 1969 all women (five and up) took 90.1% of all trips in an auto, motorcycle or truck, compared to 91.6% of the trips of comparable men. In 1977 women (over five) took 92.7% of all trips in a private vehicle compared to the 93.1% taken by comparable men[97].

As people have come to depend on the car, their use of alternatives have declined—but faster for women than for men. In 1990 urban men 16-64 made 1.9% of all trips and 4.2% of work trips via mass transit; comparable women made 1.5% of all trip and 4.4% of work trips via transit. In contrast, in 1969 women made 4.2% and men made 3.1% of all trips via various mass transit modes; by 1977 women's use of transit had declined to 3.2% of all trips while men's dropped to 2.7%[98].

The increase in travel mirrors the rapidly increasing number of women who have driver's licenses. Figure 1 displays 1990 NPTS data on licensing rates. The figure makes very clear that the gap between men and women has largely closed among younger people. While it appears that the gap between the sexes will

Figure 1 Licensing Rates Among Men and Women, by Age, 1990 NPTS



not totally disappear in the next few decades, a great difference in rates is only seen among those over 65. It too will decrease, however, as younger cohorts of licensed women age.

Other research chronicles women's increasing dependence on the car, regardless of income or occupational status. A recent study by Rosenbloom and Burns for the U.S. Department of Labor, based on very large data sets from Tucson and Phoenix (over 50,000 respondents in each region in each of two years), found that women were as or more dependent on the car as men. Women at all household income levels but the very highest were more likely to drive alone to work than *comparable* men[99].

Rosenbloom and Burns found that women were more likely to work substantially closer to home than comparable men but to take relatively longer to make those commutes, independent of the mode chosen. The researchers concluded that these patterns reflect women's need to combine domestic and employment responsibilities; women work closer to where they live than comparable men because they want to be available to their children and their homes. Moreover women take longer to cover the same distance because they link trips to work with trips to school or child care centers or shopping.

Rosenbloom and Burns also found that the travel differences between men and women held even when controlling for marital status and the presence of children of various ages. Having children had far less impact on the travel patterns of working fathers than on those of working mothers. Women with children were more likely to drive to work at all income levels; the younger their children and the more children they had the more likely women were to drive to work alone.

But the Arizona researchers also determined that women, whether or not married and whether or not a parent, were more likely to drive alone to work than comparable men. That is, unmarried women were more likely to drive alone than unmarried men, female parents were more likely to drive alone than male parents, mothers of small children were more likely to drive alone than fathers of small children. They conclude that women are more dependant on the car because a) even those without children have more domestic responsibilities requiring the flexibility of a car, and b) the car affords women a measure of safety not of the same importance to comparable men.

Travel Trends

Introduction

Society's overall dependance on the car has been driven by higher household incomes and suburban development as well as women's increasing involvement in the paid labor force. All of these variables are, in turn, linked to increased licensing of women. In his preliminary review of 1990 NPTS data, Alan Pisarski concluded that, "...for every 1 percent shift from nondriver to driver in the female population, total travel jumps almost 10 billion miles per year"[100]. Clearly, women's travel patterns are coming to more resemble men's. Yet at the same time, while some patterns are converging—increasing dependance on the auto—others are not—trip lengths to work, for example.

First, the areas of convergence: in spite of very large occupational and earning differences between men and women in 1990 women were roughly as likely to come to work in a car as men. These patterns sharply differ from what we have traditionally known, or thought we knew, about women's travel patterns. In the past men and women had different travel patterns, in part because so many fewer women were in the paid labor force. However, even among salaried workers, men and women had measurably different travel patterns; women worked closer to home, spent less time in travelling to work, and more often used public transit[101] [102].

All three facts seemed related to economic variables;[103] it made sense for those with low incomes to use the cheapest travel mode and not travel far to work. Poor women and poor men were assumed to behave in a similar manner; since there were so many more poor women than men, the aggregate differences simply reflected the far higher proportion of poor women in the overall population. The assumption was that as women continued to enter the labor force and increase their incomes, their travel would become roughly similar to that of comparable men—and we have, indeed, seen some of that convergence.

However, as women have joined the labor force, many of the differences seen in the past have persisted. Clearly some of these differences may be explained by traditional economic variables—but many may not be. Women have continued to work closer to home and spend less time in commuting even as they have become as dependent on the car as men. Since the late 1970's a growing body of research suggests that 1) working women have different travel patterns and needs than *comparable* men because they retain primary child care and domestic responsibilities when they enter the paid labor force, and 2) the location of jobs available to women differs from those available to men. These issues are examined below in the context of the 1990 NPTS data.

Basic Travel Patterns

In 1983 men and women (five and over) made roughly the same number of trips per day; between 1983 and 1990 men increased their number of daily trips by 5% while women increased their trip rate over 9%. In 1990 men made just over 3 trips while women made 3.13 trips per day. However rates of increase were not uniform for women; women between 20 and 50 showed the greatest increase in the number of daily trips, with those 40-49 increasing their trips by over 14%[104]. Pisarski suggests that, while the differences between men and women may be explained by childrearing duties and household activities, the increase in travel by women largely represents a shift from non-driver to driver status. Conversely the increased travel by men represents more travel by men with licenses[105].

Figure 2 illustrates the daily travel patterns of men and women, aged 16-64, in urban and rural areas in 1990. When younger and older travellers are removed from the overall patterns, the average trip rates climb and the differences between the sexes become more marked—and arguably more meaningful;

women in urban areas made 3.5 trips per day compared to 3.3 trips by men. Women in rural areas made even more trips—3.6 per day—but rural men had almost the same trip rate as urban men.

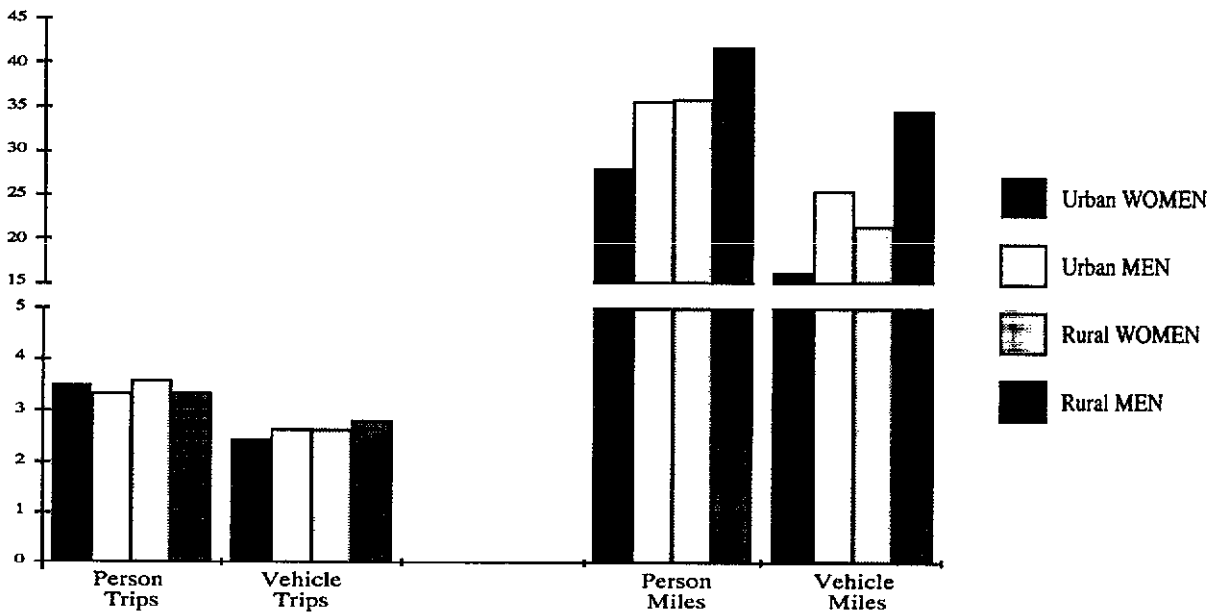
However, in spite of making more trips, women made shorter trips. In urban areas men travelled almost 36 miles per day, or 27% more miles than urban women. In rural areas, both sexes travelled further and the gap between men and women was less; rural men travelled almost 42 miles per day or 16% more than rural women.

One explanation of the mileage differences between the sexes (and between those in rural and urban areas) can be seen in the *vehicle trip rates* shown in Figure 2. Because people make some trips walking (or by other modes) daily vehicle trip rates are always lower than person trip rates. Figure 2 indicates that men made more vehicle trips than comparable women, and rural travellers made more vehicle trips than urban travellers. Since it is possible to travel much further, much faster by car than other mode, people who make more vehicle trips can easily generate more miles in fewer trips—as do both urban and rural men.

These differences are seen even more clearly in the *vehicle mile rates* shown at the far right of Figure 2. Urban men 16-64 travel almost 60% more miles daily than comparable women while rural men travel just over 61% more miles than rural women. Moreover both groups of rural travellers covered more miles than their urban counterparts; for example, rural women—who made only .2 more vehicles trips daily—travelled a third more vehicle miles. These figures clearly indicate the impact of men making more trips in a private vehicle and of rural people doing the same.

Obviously, some travel differences may be caused by differences in work status; Figure 3 illustrates the daily trip rates (person and vehicle) for men and women in urban areas by work status. Since the aggregate of all women take more person trips than men, even though women are less likely to be employed, it isn't surprising that the gap still remains; what is interesting is that gap is greater between the sexes among

Figure 2 Average Daily Travel Parameters, by Sex, People 16-64, 1990



workers than among non-workers. Working women 16-64 in urban areas take 3.8 person trips a day, or 12% more than comparable men, but those who are not paid workers take 2.9 person trips per day, only 1% more than comparable men.

Figure 3 clearly shows that workers make substantially more trips than non-workers but again the gap is greater among women—in other words, having a job more strongly influences the trip rate of women. Urban women 16-64 who work make 31 % more trips than those who do not (3.8 vs. 2.9) while urban men who work make only 25% fewer trips than those who do not work. Both these patterns support the contention that women are more likely to simply add employment trips to most of their existing trips when they enter the labor force (or add additional domestic trips—associated with marriage or children—when already employed).

Figure 3 does show, however, that controlling for employment considerably narrows the gap between men and women in *vehicle trips*. Urban men 16-64 who work make .1 more vehicle trips daily than comparable working women; there is no appreciable difference in the vehicle trip rate of rural workers 16-64. Urban women without paid employment actually make a very small amount more daily vehicle trips than comparable men, but substantially less than urban women who work (2.73 vs. 1.74). In short, the differences in vehicle trip rates seen in Figure 3 appear to be largely explained by the employment status of women—when women work they make almost the same number of daily vehicle trips as men.

Figure 4 shows, however, how little employment explains mileage differences between the sexes. Working men and women travel nowhere near the same person or vehicle miles—although, again, workers of both sexes travel further than those who are not employed. Urban women 15-64 with paid employment travel 31.5 miles daily or 19.1 miles in a vehicle; those numbers are, respectively, 18% and 32% lower than those of comparable men. Rural women with paid employment actually travel more person miles than urban male workers (38.4 vs. 38.3) but 14% less than comparable rural men.

Figure 3 Average Daily Trips, by Sex and Work Status, People 16-64, 1990

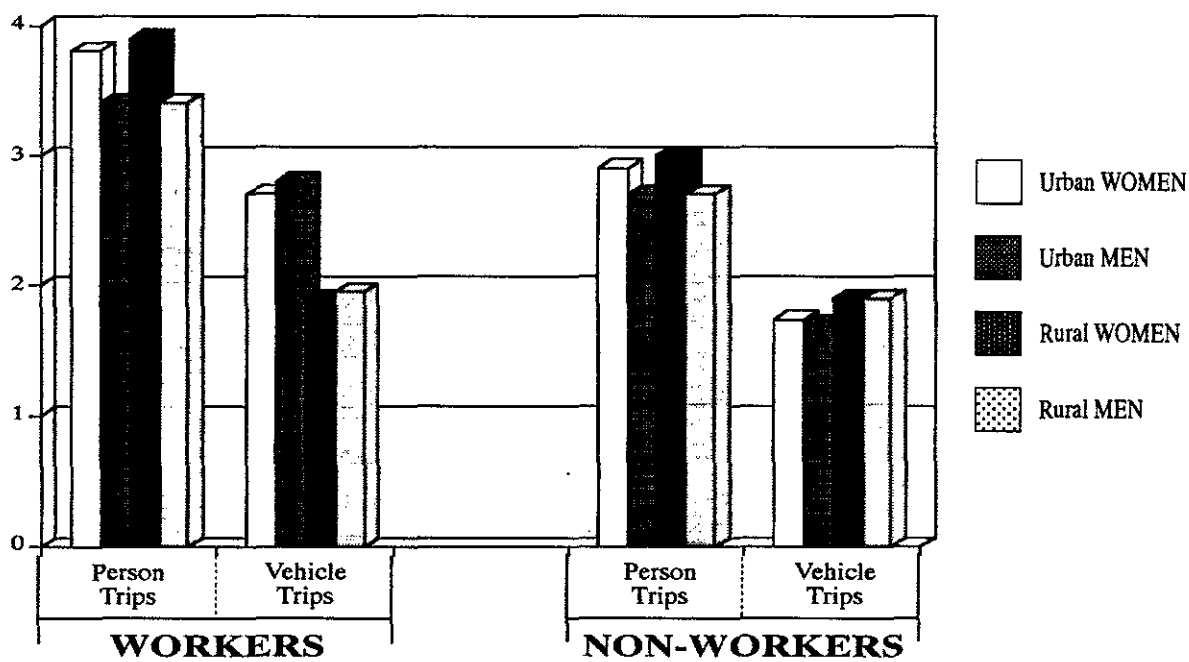
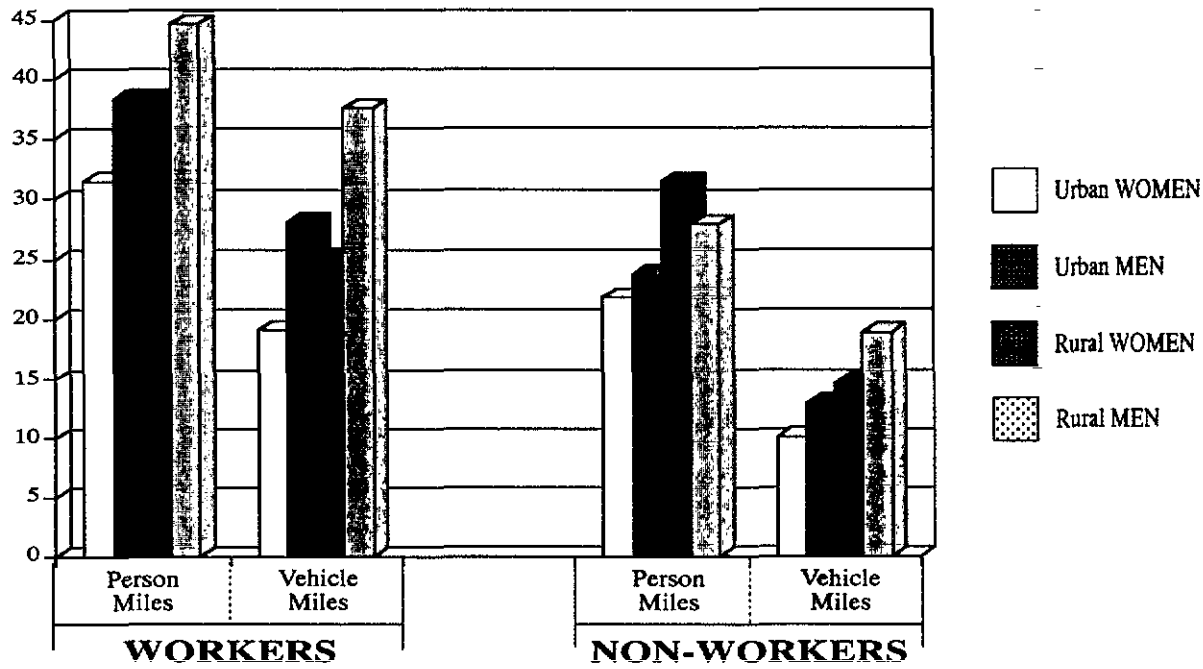


Figure 4 Average Daily Miles, by Sex and Work Status, People 16-64, 1990



Those who do not work travel less distance, but as in the trip rate patterns seen in earlier Figures, the differences between comparable men and women are larger among workers than among non-workers. For example, urban women 16-64 without paid employment travel only 8% fewer person miles than comparable men. In addition, the difference between person miles and vehicle miles is much larger in percentage terms among non-workers; for example rural women without paid employment travel almost 54% fewer vehicle than person miles (23.7 vs. 14.6).

Overall, while Figure 3 shows that employment has more impact on the *number of trips* made by *women,* Figure 4 suggests that employment has considerably more impact on the *total distance* that *men* travel. Both Figures suggest that working is associated with travelling a higher percentage of total miles in a vehicle, although the increase in vehicle trips is much higher for women than for men (over comparable non-workers).

The Impact of Licensing on Travel Behavior

Traditionally women have taken fewer of their trips in a car than men—because they earned less (or had no personal income), had less access to a car, and/or were less likely to be licensed. All of these factors are changing—albeit at different speeds. In 1990 urban women (16-64) made 92.3% of all trips, and 91.0% of work trips, in a private vehicle; urban males actually made slightly fewer of their total trips by car (91.62%) and only slightly more work trips (91.8%). Women in rural areas were even more dependent on the car than either urban travellers or than rural men: men (16-64) made 94.7% of all trips and 96.2% of all work trips by car. However, rural women 16-64 made 95.2% of all trips and 96.8% of work trips by car.

The area most approaching parity between the sexes is licensing rates. Data from FHWA shows that in 1951 90% of men but only 55% of women 30-39 had licenses; by 1984 almost 100% of men of that age and 90% of comparable women were licensed[106]. But in 1992 the gap between the sexes in that age group

had narrowed even further—to just 4% points. Moreover, the gap was even smaller among younger people; 88.9% of men and 85.4% of women aged 20-24 had licenses[107].

Table 1 displays daily travel parameters for men and women 16-64, with and without licenses, in urban and rural areas, in order to gauge the impact of the growing licensing of women—and the table has some interesting messages. First, people of both sexes with licenses travel more, sometimes substantially more, than comparable people without licenses. In fact women without licenses actually make fewer person trips than comparable men in both urban and rural areas; it is only when woman have a license that we see the trip patterns shown in previous figures. More drastic, those without licenses make barely any *vehicle* trips wherever they live. For example, rural women with a license travel almost 23 vehicle miles a day; those without a license travel less than one vehicle mile per day.

Second, having a license has a more profound impact on women; urban women who are licensed make 76% more person trips and travel 191% more person miles than women without. Urban men with licenses make "only" 42% more trips and travel 137% more miles than men without. As a result of having a license, women make more person trips than comparable men; in rural areas, for example, women make 12% more trips than comparable men (3.7 vs. 3.3) although rural men without licenses made more trips than rural women without licenses (2.1 vs. 1.9).

A third message in Table 1 is that, in urban areas, men and women with licenses are more similar than men and women without licenses—that is, that the person mile gap between the sexes is less for licensed people. For example, urban men without licenses travel almost 50% more person miles than comparable women but those with licenses travel only 21% more than comparable licensed women.

But the fourth message of Table 1 is that, even with a license, both urban and rural women still travel fewer person and vehicle miles than their male counterparts. Urban men with a license, for example, cover 50% more vehicle miles than comparable women while rural men with a license cover almost 60% more than comparable women. Since vehicle trips are roughly comparable (at least in urban areas), the table clearly shows that, even with a license and even making the majority of their trips in a car, women simply take shorter trips.

Table 1 Average Daily Travel Parameters, by Sex and License Holding, People 16-64, 1990

LOCATION and License Holding	PERSON TRIPS		PERSON MILES		VEHICLE TRIPS		VEHICLE MILES	
	Women	Men	Women	Men	Women	Men	Women	Men
URBAN With License	3.7	3.4	30.9	37.5	2.8	2.9	18.5	27.7
URBAN Without License	2.1	2.4	10.6	15.8	.1	.1	.4	1.1
RURAL With License	3.7	3.3	37.3	43.0	2.7	2.9	22.7	36.0
RURAL Without License	1.9	2.1	16.0	16.5	.1	.2	.9	1.4

The Impact of Household Income

The keystone of traditional explanations of travel behavior is the impact of household income on mode choice and trip rates; as income rises, people make more trips, travel longer, and make more trips by car. Thus differences in the trip patterns of men and women has been attributed to differences in economic variables at the household level. The 1990 NPTS data suggest that household income, while a powerful factor, does not explain most of the differences between comparable men and women and between married and single mothers.

Figure 5 show that both men and women's mode choice in urban areas are affected by rising household income—but there are some differences worth note. At very low incomes, very high incomes, and those between $10,000 and $25,000 women 16-64 are more likely to make more of their trips by car. The differences are substantial at lower incomes; at household incomes below $5,000 almost 74% of women's trips but only 61% of men's trips are taken in a private vehicle. At incomes between $10-15,000 women make over 84% of their trips by car compared to just under 78% of men's trips.

The differences in urban areas between men and women's *work trip* travel mode are even stronger. For all incomes levels below $25,000—except those under $5,000—women 16-64 are more likely to use a private vehicle to get to work than comparable men. For example, almost 80% of the work trips of women but only 77% of the work trips of men with incomes between $5-10,000 are taken in a private vehicle.

Not surprisingly, mass transit use in urban areas falls as income increases but it moves at different speeds for men and women and there are anomalies at high and low incomes. First, men have higher transit usage than women until household incomes of $15-20,000 per year; for example, 8.1% of all trips of men with incomes of $10-15,000 are taken using transit—compared to 5.2% of the trips of comparable women. After incomes of $20,000 women are slightly more likely to make more of their trips on transit; 1.7% vs. 2.1% at household incomes of $30,000, for example. However, at incomes above $60,000 men again make more of their trips by transit (2.8% vs. 1.6% at incomes above $70,000).

Figure 5 Percentage of Urban Trips Taken in Private Vehicles, People 16-64, by Sex and Income Categories

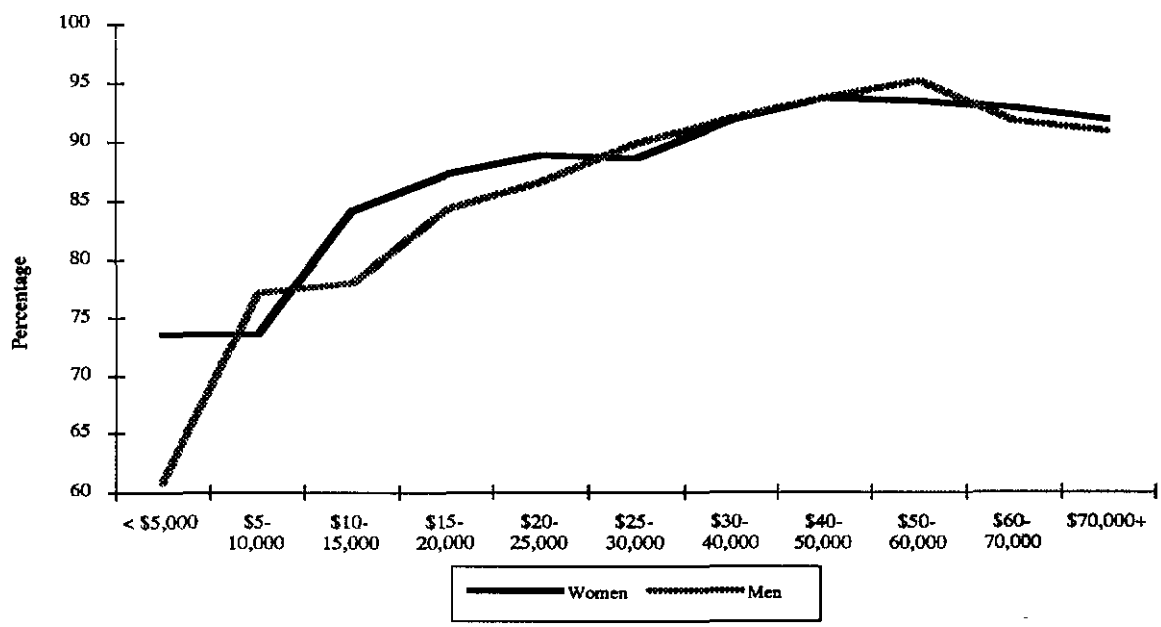


Table 2 focuses specifically on the *work trip* modes of low income urban households. Although the sample sizes are small, it appears that very low income women 16-64 in urban areas rely far more heavily on both walking and transit for their "commute." This confirms some of the research discussed earlier which suggests that some low skilled women only take jobs very close to where they live where/so it is feasible to use these inexpensive modes. The data suggest that men either don't impose such constraints on themselves or they are unable to find work within walking or transit distance.

However, the second very clear message of this table is that at the still low incomes above $5,000, women in urban areas are more dependant on the private car than comparable men even though they still use transit far more than the average of the population.

Private vehicle use data for rural travellers are similar but, as seen in many of the analyses already presented, rural people are generally more dependent on the car. While no urban income group below $30,000 took more than 90% of all trips in a private vehicle, rural households reached the 90% mark at annual incomes of only $10,000. Just as importantly, women at all income levels below $40,000 took more of their trips in a private vehicle than comparable men and the differences were the greatest at the lowest income levels; for example, women in households with incomes $5-10,000 took 91% of all trips in a car—compared to 83% of the trips of comparable men.

Moreover some of the high income anomalies seen in the urban data are seen in rural data: higher income people of both sex made slightly *fewer* of their trips in a car than those with incomes from $30 or 40-60,000 and women from very high income groups made more trips in a car than comparable men. For example, rural women with household incomes between $60-70,000 took over 92% of their trips in a private vehicle compared to just over 90% of comparable men.

Figure 6 illustrates the impact of income on average *work trip* length; like many of the previous analyses it has some challenges for traditional explanations of women's travel behavior. First, at all income levels women work closer to home than comparable men in both urban and rural areas—although the gap is substantially more among rural workers. Second, and just as important, above household incomes of $10,000 distance to work goes up as income rises but it clearly goes up much faster and further for men. Women's lowest urban commute is 5.89 miles and rises to 9.35 miles (at incomes over $70,000) or a 59% increase in distance with an (estimated)1300% rise in income. Men's lowest urban commute is 7.97 miles rising to 14.30 miles at incomes above $70,000—or an 80% increase in distance with an (estimated) 366% increase in income.

Table 2 Work Trip Mode of Selected Low Income Urban Households, by Sex, 1990

	PRIVATE VEHICLE		TRANSIT		WALK	
INCOME	Women	Men	Women	Men	Women	Men
Under $5,000	73.8%	92.5%	11.9%	1.9%	14.3%	5.7%
$5-10,000	79.8	77.2	9.9	11.8	9.2	6.4
$10-15,000	80.2	78.7	14.5	10.6	4.4	9.6
$15-20,000	86.6	84.3	7.8	8.6	5.1	5.2

Source: Trip Files.

Figure 6 also shows the low income anomalies seen in early analyses. Low income urban workers of both sexes and women in rural areas tend to work further from home than workers from households making $25,000 and more. Once again this suggests that the employment opportunities available to low skilled workers, and particularly women workers, are located in different places than those available to workers earning more. For example, urban women from households making $5-10,000 travel further to work than women from households making up to $50-60,000. Just as relevant, urban women workers with very low incomes commute just under 6 miles from home—which helps explain their work trip mode patterns show above in Table 2.

Figure 7 examines the impact of household income on person and vehicle trip patterns in urban areas. Again the table shows that rising income is associated with more trip making but that there are interesting differences between men and women. At all but one income level, women make more *person* trips than comparable men and the gap widens as income goes up; since the trip patterns seen in the aggregate figures hold when they are disaggregated by income, income does not appear to explain why women take more person trips than men. Nor does income help explain why men, in the aggregate, take more vehicle trips. At all but the lowest low income level, women make fewer vehicle trips than comparable men (their vehicle trip making is roughly identical at household incomes of $20-25,000).

Figure 8 illustrates comparable person and vehicle *mile* data in urban areas. While distance increases with income, there are again differences between men and women which are not consistent with traditional thinking. First, the gap in vehicle miles widens as income increases; men from high income households (over $70,000) are travelling a) 221% more miles than men in low income households and b) 66 % more miles than women in with comparable high incomes. However the highest income women are only travelling 61% more miles than the lowest income women; moreover the percentage gap between men and women with incomes between $5-10,000 is only 27 % (10.3 vs. 13.1).

Figure 6 Average Work Trip Length in Urban and Rural Areas, People 16-64, by Sex and Income Categories

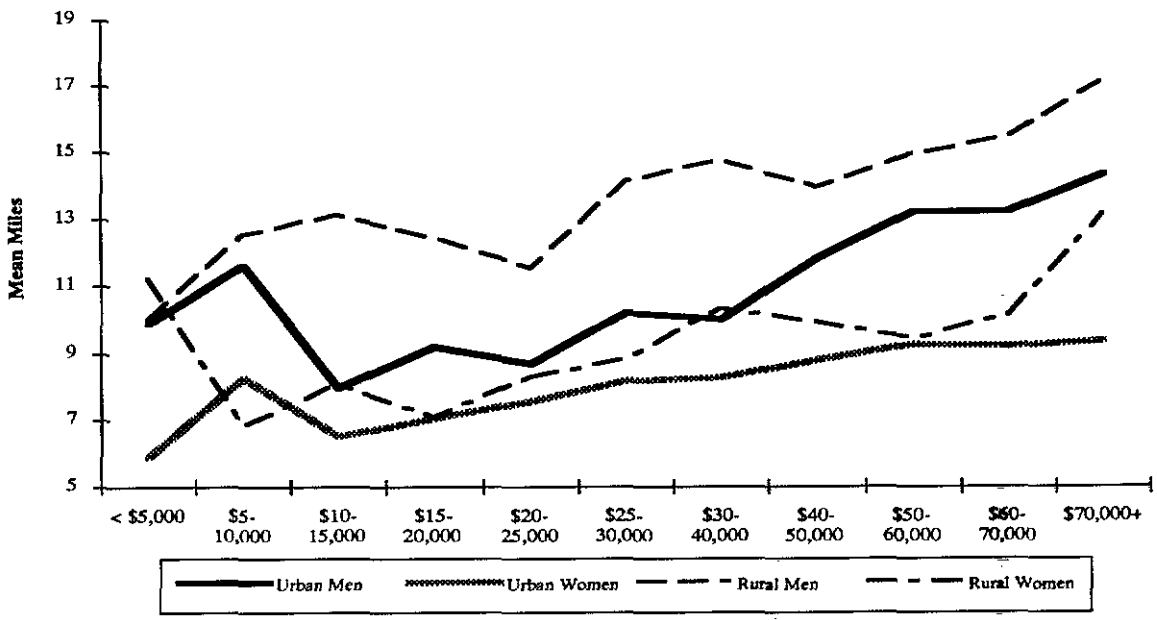


Figure 7 Urban Daily Person and Vehicle Trips, People 16-64, by Sex and Income Categories

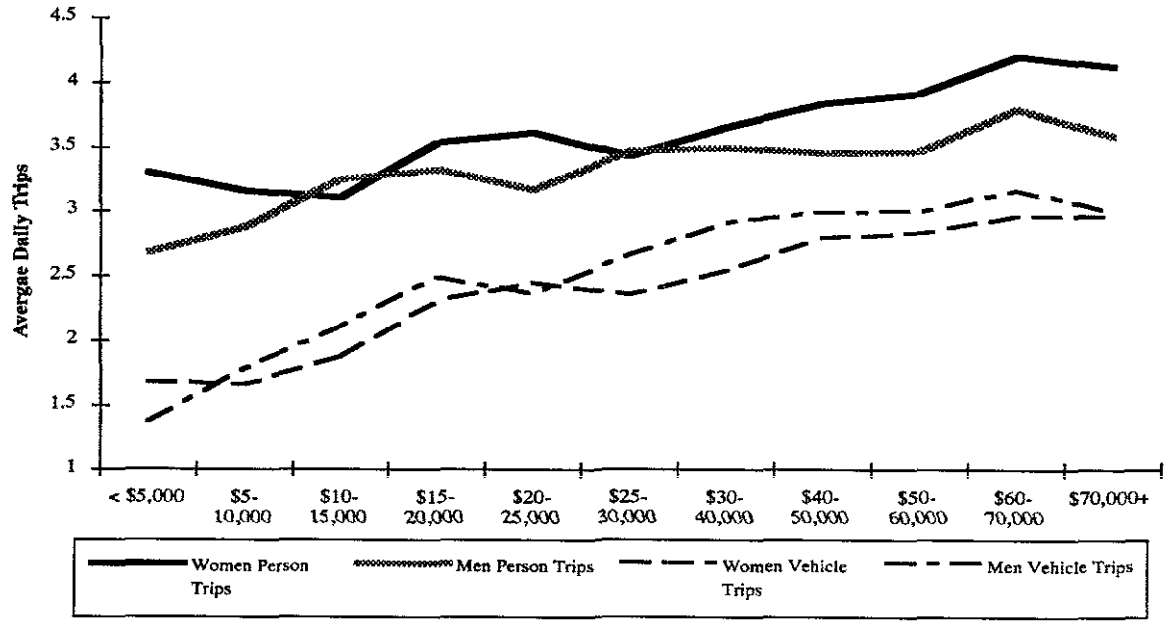
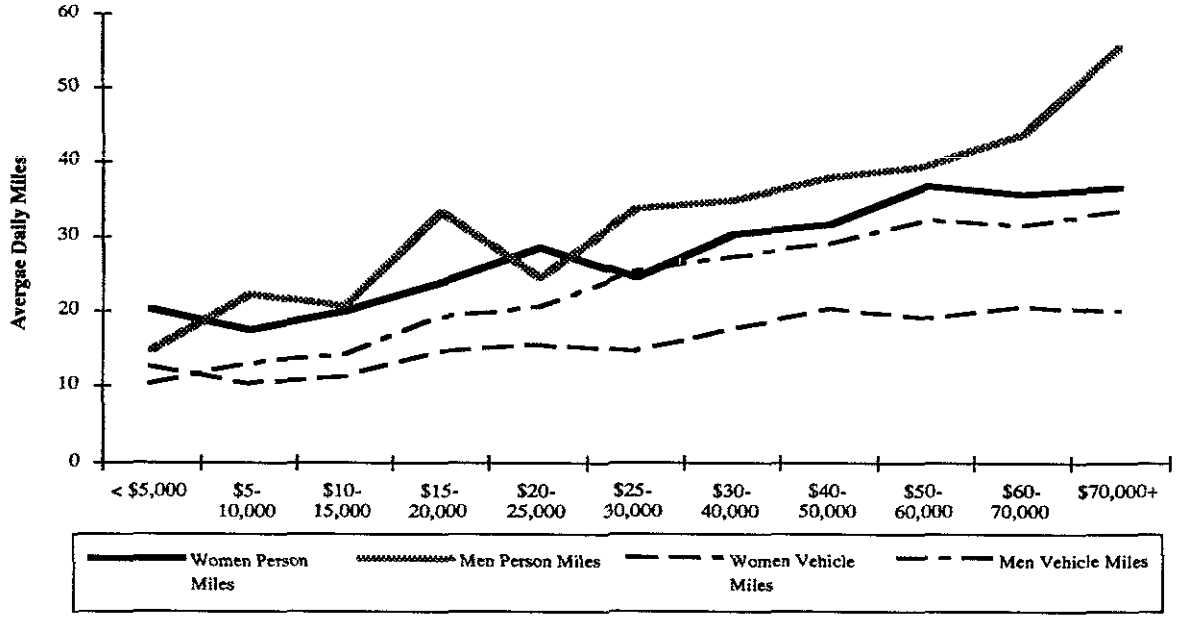


Figure 8 Urban Daily Person and Vehicle Miles, People 16-64, by Sex and Income Categories



While there is more variation in the total person mile category, similar patterns are seen: mileage increases with income but men are almost always travelling further than comparable women (again with the exception of those with very low incomes), and men's distances increase more rapidly with income than do women's. Figure 9 gives comparable data for rural areas showing that rural patterns are roughly similar to urban ones although the distances are greater.

Table 3 combines two powerful determinants of overall travel: income and worker status. Overall Table 3 has a number of messages: in every income category but the very highest women who are workers make substantially more person trips than women who are not. While men make more trips when employed the difference is nowhere near as great—on average working men make 19% more trips than those not working while working women make 33% more than those not working.

A second message is that the increase in *trip* rates accompanying employment is generally greatest among women in the lowest income categories but there is no consistent pattern among men. Third, there is no income category in which male workers make more person trips than employed women. There are, however, several categories where male non-workers make more person trips than women without paid employment.

Fourth, urban workers 16-64 travel more person *miles* in all but the highest income category if they are employed—and generally more miles as income increases. However, the mileage increase associated with having a job is greater for women in each income category than for comparable men; overall women travelled 34% more miles when they had a job while men only travelled 21% further. Women in several income categories increased their mileage over 85% when they had a salaried job but there was only one income category in which men displayed a difference of that magnitude.

Moreover Table 3 indicates that there are two income categories where women workers travel further than male workers—the very lowest and among those having household incomes of $20-25,000 per year. It still is true, however, that mileage among male workers went up far faster as income increased.

Figure 9 Average Daily Rural Person and Vehicle Miles, People 16-64, by Sex and Income Categories

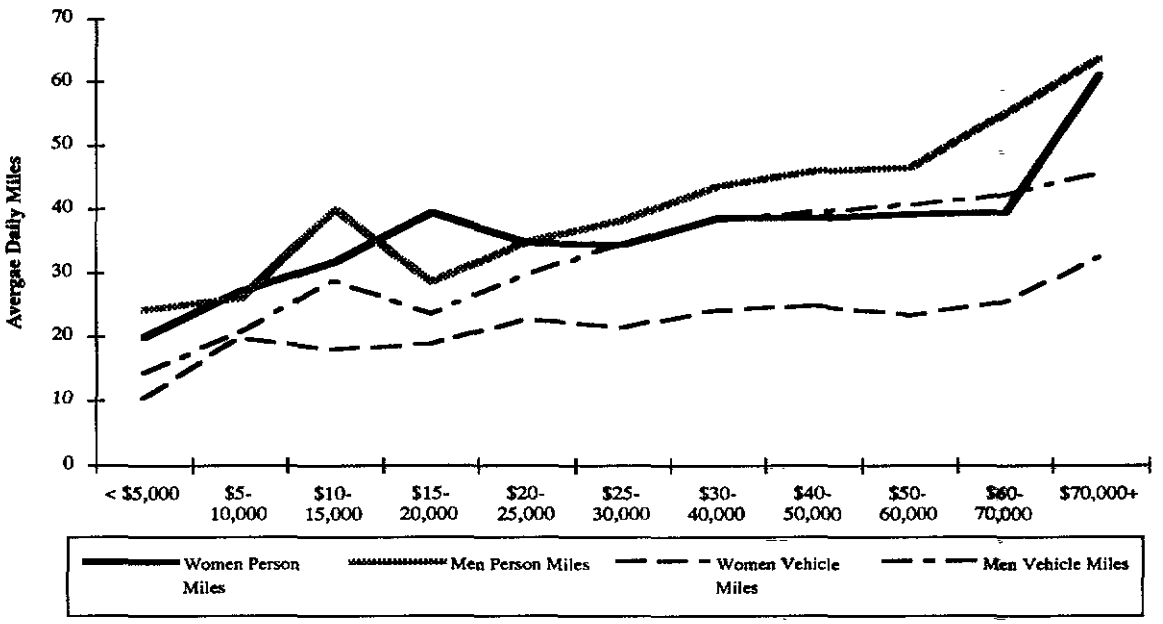


Table 3 **Average Daily Person Trips and Miles in Urban Areas, People 16-64, by Sex, Work Status, and Income Categories**

		WOMEN		MEN	
		WORKER	NON-WORKER	WORKER	NON-WORKER
UNDER $5,000	TRIPS	4.37	2.87	2.42	2.86
	MILES	28.06	16.93	15.02	14.85
$5-10,000	TRIPS	3.80	2.59	3.34	2.32
	MILES	23.09	12.70	25.83	17.86
$10-15,000	TRIPS	3.57	2.57	3.45	2.76
	MILES	21.39	18.43	23.88	13.07
$15-20,000	TRIPS	4.03	2.56	3.55	2.53
	MILES	28.32	14.79	36.59	21.56
$20-25,000	TRIPS	3.96	2.92	3.20	3.03
	MILES	34.97	15.65	26.26	17.05
$25-30,000	TRIPS	3.8	2.61	3.59	2.93
	MILES	28.13	16.57	31.89	42.36
$30-40,000	TRIPS	3.87	3.14	3.50	3.37
	MILES	34.66	19.83	35.84	27.74
$40-50,000	TRIPS	4.02	3.38	3.55	2.88
	MILES	33.31	27.96	40.47	20.54
$50-60,000	TRIPS	4.08	3.49	3.56	2.79
	MILES	33.22	47.11	41.74	22.41
$60-70,000	TRIPS	4.44	3.37	3.86	3.26
	MILES	38.20	27.44	43.60	46.08
$70,000+	TRIPS	4.09	4.24	3.65	2.96
	MILES	36.58	37.43	55.91	53.45

Source: Person Files.

Figure 10 Average Daily Person Miles, People 16-64, by Sex, Income Categories, and License Holding

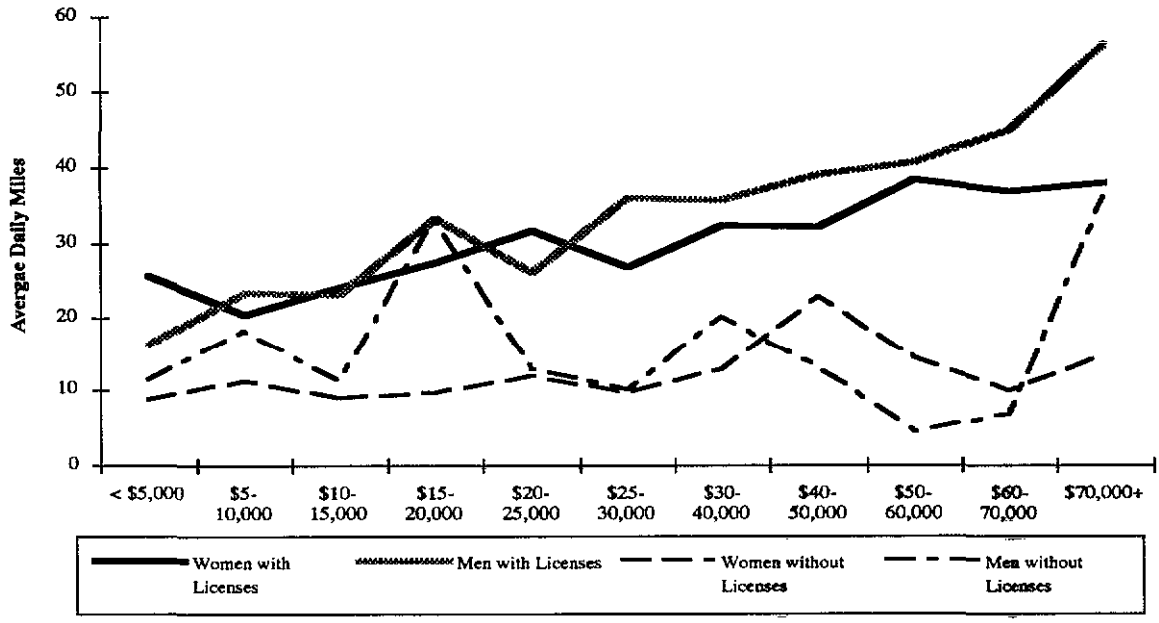


Figure 10 combines two different traditional indicators of travel behavior to examine daily person miles in urban areas among those 16-64: license holding and income. Although the patterns are roughly comparable to those seen in the previous analyses, there are more variations. People with licenses were strongly affected by rising incomes, but people without licenses, particularly women, were far less affected. Women without licenses travelled roughly between 9-10 miles per day until their household incomes reached $25,000; although there were some substantial increases in mileage at higher incomes there was also wide variation; women without licenses in households making $60-70,000 travelled less than those in households making under $20-25,000.

The impact of increasing income on men without licenses was even more variable; men without licenses in urban households making $20-25,000 covered the same number of person miles as comparable men *with* licenses (33.4 miles)—and almost as much as both men and women without licenses in households making over $70,000 per year (36.0 miles).

The Impact of Traditional Variables

Overall, the variables which have been traditionally used to explain travel variations—household income, employment status, licensing rates—clearly explain less of the difference between men and women's travel behavior than has been assumed. Indeed these variables explain far more of the differences *among* women and *among* men and far less of the differences between otherwise comparable people. In short, while income and license holding and employment status aid in understanding travel behavior, they don't go far enough or supply meaningful insight into differences between men and women's travel behavior. The following section of this report attempts to remedy this deficiency.

Contributing Elements

The section above clearly indicates that traditional variables are not adequate to describe or define the travel behavior of most women, and particularly low income women. This section examines the impact of the far less studied factors affecting travel behavior: marital status, the presence and age of children, race and ethnicity—alone, in combination with each other, and in combination with the more traditional variables of employment and income.

Marital Status and the Presence of Children

Much of the literature on women's travel patterns cited in the first section of this report stresses the impact of children on both married and unmarried female parents, although observers have commented that children may also affect the travel patterns of men in ways hidden by aggregate analysis. Table 4, which examines the impact of both marital status and children on urban person trips for people 16-64, 1) confirms the findings of the existing literature on women's travel and 2) suggests that men are *not* very affected by children unless they are a single parent (in fact there are so few single male parents in the NPTS that most of those numbers are suspect).

Table 4 indicates the daily person trip rate for men and women and then indicates percentage differences in rates a) between men and men, and, b) between comparable people of the same sex. The trip rate of married men was almost identical, whether or not they had children, and whatever the age of their youngest child. Married men always travelled significantly less than comparable married women, with the largest gap in households with children 6-15. The larger gap reflects the fact that both married and single women with children 6-15 made more trips than those with children of any other age group; this is consistent with earlier work by Rosenbloom[108 109]. Both sets of women had lower mileage with older children which could mean that older children both take care of themselves and travel more independently.

In addition, Table 4 tends to support the hypothesis that single mothers, lacking the help given by another resident parent, have more obligations affecting their travel patterns; single mothers always make more trips than comparable married women, with the largest gap among women with children over 16. However, overall, the differences between married and single female parents are less than the differences between comparable men and women.

Table 4 **Differences in Average Daily Urban Person Trips, by Sex and Selected Lifecycles, 1990**

Gender and Presence of Children		Two Adult Household	One Adult Household	Difference in Travel Between Comparable Adults in Households*
Children 0-5	Men	3.2	3.1	-3.1%
	Women	3.5	3.6	2.9%
	DIFFERENCE	-8.6%	-13.9%	---
Children 6-15	Men	3.3	3.7	12.1%
	Women	4.0	4.1	2.5%
	DIFFERENCE	-17.5%	-9.8%	---
Children 16-21	Men	3.3	3.8	15.2%
	Women	3.4	3.6	5.9%
	DIFFERENCE	-2.9%	5.6%	---
No Children	Men	3.3	3.6	9.1%
	Women	3.4	3.7	8.2%
	DIFFERENCE	-2.9%	-2.2%	---

*Note: The difference between One and Two Adult Households expressed as a percentage of Two Adult Households. Also note: percentages computed before rounding.

Source: Person Files

Table 5 displays a comparable assessment of differences in urban person miles. Married men travel more miles than married women, but men with children travel roughly the same number of person miles regardless of the age of their children (34-35.6 miles, or a 4.7% from high to low). Married women on the other hand, travelled slightly more miles as the age of the youngest child went up (11% from high to low). Strikingly, the mileage of single women consistently went down as the age of the youngest child went up—again suggesting that the heavier domestic burden carried by working women lightens as children grow up. It is also interesting that, while single mothers always make **more** *trips* than married mothers in each category, they travel **fewer** *miles* after their youngest child is in school, 22% fewer among women with children over 16.

As in Table 4, Table 5 shows that the differences between women with children of comparable age are substantially less than the differences between men and women. However the gaps in *mileage* among the sexes are far greater in percentage terms than are the gaps in *trips*. For example, married men with children 6-15 cover one third more miles than married women (17.5% fewer trips), while single women only travel 8% fewer miles than comparable women (but take 2.5% more trips). Table 5 also shows that both married and single people of either sex *with no children* travel substantially more miles than people with children, although they made roughly the same number of trips.

Table 6 presents a comparable assessment of urban vehicle trip patterns; it is here that we find the most interesting variations. Both married men and women with children make fewer *vehicle trips* than those without children. However women with children older than six actually make more vehicle trips than comparable men. Single women with children 6-15 make a) more vehicle trips than either married parent with comparably aged children, and b) more trips than married parents and single fathers in every category shown on the table, including those without children.

For children over six, the differences between married men and women are, for the first time in this series of analyses, smaller than the differences between comparable women. Married women with children 6-15 made 7% fewer vehicle trips than comparable men but over 14% fewer vehicle trips than comparable single women.

Comparing married parents with children to two adult couples without children shows additional differences between comparable men and women. As previously noted, married men with and without children make roughly the same number of trips; however married men with children actually travel fewer miles and make fewer vehicle trips than those without children. Among married women, however, those with kids make more person and vehicle trips than married women 16-64 without children, although they travel fewer person miles. Again these patterns suggest that having children, particularly children 6-15, strongly influences the travel patterns of married women while having little effect on those of married men.

To summarize, married women make **more** *person trips* than all categories of married men, including those who are not parents; however, they travel **fewer** *person miles* and make **fewer** *vehicle trips* than comparable men. Married women with children under six make **more** *person trips,* travel **fewer** *person miles,* and make the **same** number of *vehicle trips* as single mothers with children under six. However, once their youngest children are school-age, single mothers make **more** *person trips,* travel **fewer** *person miles,* and make **more** *vehicle trips* than comparable married mothers. In a few categories, single women even make more trips than comparable married men.

All of these findings strongly support the contention that women who are mothers make more trips because of their family obligations but travel less distance because of their desire to stay closer to home. Single mothers, lacking in-home help with their children, make more trips than married mothers—but they stay even closer to home (perhaps because they know they are the only back-up their children have). These findings also support previous work which found that the age of the youngest child may make some difference in the travel patterns of male parents but strongly impacts female parents, and single female parents even more so.

Table 5 **Differences in Average Daily Urban Person Miles, by Sex and Selected Lifecycles, 1990**

Gender and Presence of Children		Two Adult Household	One Adult Household	Difference in Travel Between Comparable Adults in Households*
Children 0-5	Men	34.0	8.0	-76.5%
	Women	24.9	25.1	.8%
	DIFFERENCE	36.5%	-68.1%	---
Children 6-15	Men	35.6	38.0	6.7%
	Women	26.7	24.6	-7.9%
	DIFFERENCE	33.3%	54.5%	---
Children 16-21	Men	35.0	28.0	-20.0%
	Women	27.7	21.5	-22.4%
	DIFFERENCE	26.4%	30.2%	---
No Children	Men	40.1	33.3	-17.0%
	Women	31.9	39.1	22.6%
	DIFFERENCE	25.7%	-14.8%	---

*Note: The difference between One and Two Adult Households expressed as a percentage of Two Adult Households. Also note: percentages computed before rounding.

Source: Person Files

Table 6 **Differences in Average Daily Urban Vehicle Trips, by Sex and Selected Lifecycles, 1990**

Gender and Presence of Children		Two Adult Household	One Adult Household	Difference in Travel Between Comparable Adults in Households*
Children 0-5	Men	2.7	2.0	-25.9%
	Women	2.5	2.5	0.0%
	DIFFERENCE	8.0%	-20.0%	---
Children 6-15	Men	2.6	2.0	-23.1%
	Women	2.8	3.2	14.3%
	DIFFERENCE	-7.1%	-37.5%	---
Children 16-21	Men	2.5	2.3	-8.0%
	Women	2.2	2.5	13.6%
	DIFFERENCE	13.6%	-8.0%	---
No Children	Men	2.7	2.8	-1.5%
	Women	2.2	2.8	25.1%
	DIFFERENCE	22.7%	1.4%	---

*Note: The difference between One and Two Adult Households *expressed as a percentage of Two Adult Households. Also note:* percentages computed before rounding.

Source: Person Files

It makes sense to question if some of the differences just seen between married and single parents, or even among married parents are, in fact, income related. Figure 11 adds household income to one of the previous analysis; it examines the person trips rates of all women 16-64 with children as their household income rises. Although there are sample size problems among the single parents, the overall patterns are very clear; at almost every household income level single mothers make more trips than married mothers, sometimes by large margins.

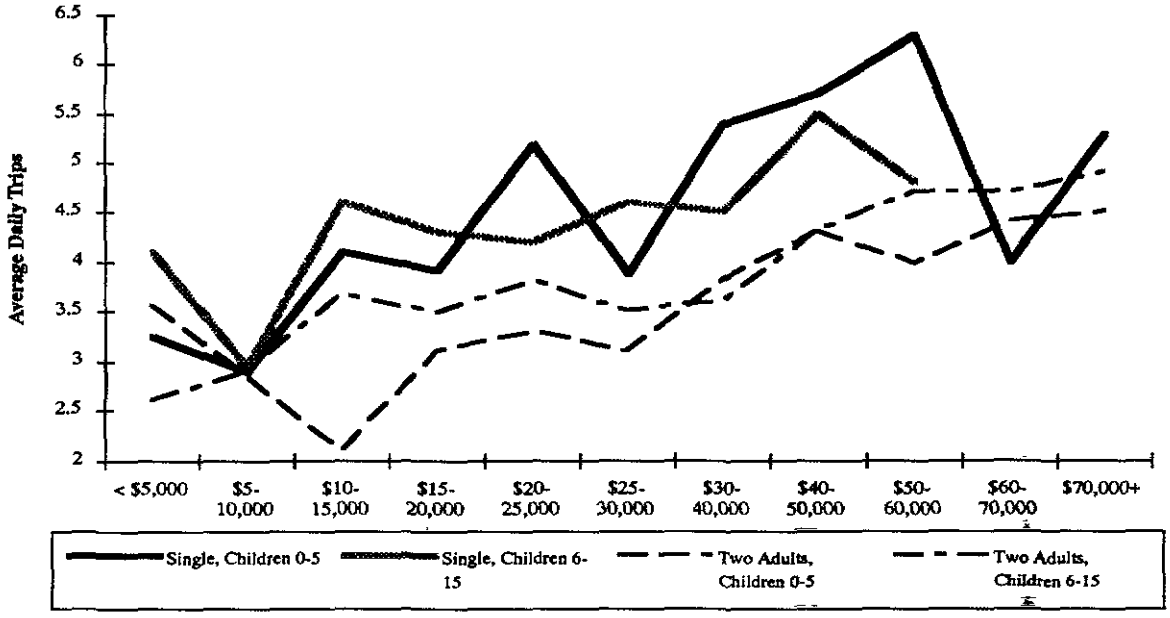
Moreover, Figure 11 shows the low income anomaly seen in previous analyses in this paper; all low income single female parents and low income married mothers with children under six make more trips than those with sometimes substantially higher household incomes.

Additional analyses of NPTS data by income show that married male parents 16-64 with children under six actually make **more** trips than comparable women—but only at incomes between $10-20,000. Married men make fewer trips than comparable female parents at all other income levels, sometimes by considerable margins. For example, at household incomes between $40-50,000 married men with children under six made 3.6 person trips daily while comparable women made 4.3 person trips (or 21% more).

Married men with children 6-15 made **fewer** person trips than comparable women at all but the highest and lowest income levels, although the gap was narrow in some categories. For example, at incomes between $10-15,000 married men made 2.2 person trips, compared to 3.6 by comparable women (or 64% more). Married men with children 6-15 in households earning $30-40,000 made 3.54 while comparable women made 3.63 person trips per day.

Overall, analyzing vehicle trip patterns as well as personal and vehicle miles shows roughly the same thing: household income does not explain well the differences between comparably situated married parents nor between single and married mothers. Relatively independent of household income, married

Figure 11 Average Daily Person Trips of Urban Female Parents, by Income Categories



women who are parents travel **fewer** *person miles* and make **fewer** *vehicle trips* than comparable male parents. Regardless of household income single mothers travel **fewer** *person miles* but make **more** *vehicle trips* than comparable married mothers. Moreover, in every grouping very low income people, but particularly the women, often travel further and more often than people with much higher household incomes. In short, the patterns seen in the initial analyses hold, even when considering income.

Race and Ethnicity

The analysis above has shown that low income people in general, and single mothers in particular, have different travel patterns than higher income and/or married individuals. But households headed by racial and ethnic groups are more likely to be low income or have a single female heads. Moreover, there is growing evidence of lifestyle and residential differences between Blacks, Whites, Asians, and Hispanics[110], some of which can lead to differences in the travel patterns. For example, a recent study in Los Angeles found that Asian commuters there had a higher drive alone and a lower carpool rate than comparable travellers in other ethnic groups[111].

NPTS data previously discussed showed sometimes substantial differences between people of different racial and ethnic backgrounds, and between otherwise comparable men and women, in drivers licensing. Therefore this section evaluates the intersection of race and ethnic background with more traditional travel variables and with the not so traditional life cycle variables just raised.

Table 7 License Holding, People 16-64, by Sex, Race, and Ethnicity, 1990

	URBAN		RURAL	
RACE	Women	Men	Women	Men
HISPANIC (All Races)	65.6%	79.6%	81.7%	88.9%
WHITE	91.3	94.8	94.8	95.9
BLACK	70.8	80.5	77.7	82.0
OTHER	66.9	80.5	79.6	89.2

Basic Travel Parameters

NPTS data show that there is some variation in work trip distance by race or ethnicity in urban areas. Figure 12[112] disaggregates the average trip length of various travellers for three major non-work trip purposes. White men between 16-64 travel 11.9 miles to work compared to the 10.8 mile commute of Hispanic males (of any race) and those of Other (Non-White, Non-Black) races while Black men make the shortest commute:10.1 miles. There is less variation among women: all urban women travel on average shorter distances to work than comparable men and all urban women 16-64 average between 8 and 8.5 miles.

The figure also shows that White men made longer shopping trips in urban areas than comparable women but all other men made shorter trips than comparable women with not much difference in length;

Figure 12 Average Length of Selected Urban Trips, by Sex, Race, and Ethnicity, People 16-64, 1990

the greatest gap between the sexes was among people of Other Races (4.9 vs. 3.9 miles). All men, however, made substantially longer personal business trips than comparable women; White men made the longest personal business trips (10.1 miles) while Black men made the shortest (7.3). While White urban women made the longest personal business trips (7.1 miles) Hispanic women made the shortest (5.1).

There are much greater differences in work trip commutes in *rural* areas; White men 16-64 travel just over 14 miles to work compared to 12.8 miles by Blacks, and 11.9 miles for Hispanics. All women travel less than comparable men but Black rural women travel 12% more than White women (10.8 vs. 9.7 miles); women from Other Races travel the longest (11 miles) and Hispanic women commute the shortest (7.9).

Table 8 analyzes the impact of race and ethnicity on annual miles driven in urban areas by people 16-64. The Table clearly show differences between people of different backgrounds and between otherwise comparable men and women. White men drive the furthest and men from Other Races drive the least; White men drive 10% more miles annually than Hispanic men and 22% more miles annually than Black men. Moreover, all men drive more than all comparable women although there are sometimes major differences among men and among women. The gap between the sexes in miles driven, for example, is greater (in percentage terms) among Whites than among Hispanics or Blacks.

Table 8 also attempts to identify the impact of employment status on annual miles driven. Many of the patterns seen in the aggregate racial breakdowns still hold; White men, whether or not they are workers, drive more than any other men; the same is true of White women. And men in every category drive more than the women in that category. Among male workers, those from Other Races drive the least number of miles while among those not employed Blacks drive the least.

Table 9 is the comparable rural analysis. Most, but not all of the urban patterns are seen in the rural data: White men drive the furthest but it is Hispanic men who drive the least in rural areas, whether or not

Table 8 **Annual Miles Driven by Urban Travellers 16-64, by Sex, Work Status, Race, and Ethnicity, 1990**

	ALL		WORKER		NON-WORKER	
RACE	Women	Men	Women	Men	Women	Men
(All Races) HISPANIC	9,100	15,320	10,679	16,040	5,692	10,003
WHITE	9,790	16,888	10,746	17,676	7,365	11,474
BLACK	8,831	13,799	10,002	15,137	5,220	8,216
OTHER	8,079	13,731	9,647	14,332	4,982	9,812

Source: Person Files.

they are employed. All rural men drive substantially more than all urban travellers and than rural women but the gap between the sexes is far greater in rural areas.

Clearly work status alone does not explain the travel differences between people of different backgrounds (any more than it explained the differences between the sexes in the aggregate data).

Table 10 clearly shows that there are some major differences in the modal choice patterns of men and women with different backgrounds. First, use of the car is not at all uniform; while it accounts for the majority of trips for people from all racial and ethnic backgrounds, and for men and women, there is a substantial difference in the share of trips taken. White people 16-64 in urban areas take over 90% of all trips while Blacks take no more than 78% of all trips in a car. Conversely, while Whites take no more than 2% of their trips using transit, Hispanics take roughly 7% and Blacks roughly 8% of all trips using public transport modes. Interestingly, Blacks are more likely to take trips in a taxi,although the numbers are not high.

There are some surprising gender differences in modal choice data disaggregated by race and ethnic background. Both White and Black women take **more** of their trips in a private car than comparable men; women in the other two groupings take only slightly fewer trips in a private vehicle. The differences between the sexes in each grouping are far less than the differences between the racial and ethnic groupings. White men are more likely to use public transit than comparable women, although women in all other groupings are more often transit users than men. A very interesting finding is the number of women walking for trips; except for White women, women make a greater share of their trips walking than men.

Table 11 applies the same type of analysis to the four major indicators of urban travel. As in Table 10 the differences between the races are often greater than the differences between men and women in the same categories. White men take more person and vehicle trips than any other men and they travel more person and vehicle miles, sometimes by wide margins. For example, White men travel almost 12 miles more per day (or 73% more) than Black men and 11 miles more than those from Other Races (or 64% more).

When travel patterns are disaggregated this way, it becomes clear that not all women make more person trips than men; Hispanic women and those from Other Races make fewer person trips than men in their grouping. In fact the gap on all travel parameters is greatest between Hispanic men and women; Hispanic women make 29% fewer vehicle trips than men (compared to 10% differences for White and Black women) and travel 110% fewer vehicle miles (compared to a 56% difference among Whites and a 46% difference among Blacks).

Table 9 **Annual Miles Driven by Rural Travellers 16-64, by Sex, Work Status, Race, and Ethnicity, 1990**

RACE	ALL		WORKER		NON-WORKER	
	Women	Men	Women	Men	Women	Men
(All Races) HISPANIC	10,179	16,963	11,406	18,363	7,503	8,334
WHITE	11,040	19,839	12,282	21,035	8,497	12,746
BLACK	8,146	18,157	9,495	21,286	5,494	7,442
OTHER	9,777	17,572	10,613	18,919	7,586	7,265

Source: Person Files.

Table 10 **Travel Mode for All Urban Trips, by Sex, Race, and Ethnicity, People 16-64, 1990**

RACE AND SEX		PRIVATE VEHICLE	TRANSIT	WALK	BIKE	TAXI	OTHER
HISPANIC (All Races)	Men	83.6%	6.6%	8.0%	1.2%	.4%	.2
	Women	80.4	7.4	11.5	.1	.2	.4
WHITE	Men	91.6	1.9	4.9	.7	.2	.7
	Women	92.3	1.5	5.2	.3	.2	.5
BLACK	Men	76.3	8.2	12.3	.9	.7	1.6
	Women	78.7	8.5	11.0	---	.6	1.2
OTHER	Men	82.7	6.1	8.9	1.6	.3	.4
	Women	80.0	7.7	11.1	.1	.4	.7

Table 11 Daily Parameters of Urban Travel, by Sex, Race, and Ethnicity, People 16-64, 1990

RACE AND SEX		PERSON TRIPS	PERSON MILES	VEHICLE TRIPS	VEHICLE MILES
HISPANIC (All Races)	Men	2.8	29.5	1.98	18.9
	Women	2.7	17.4	1.41	9.0
WHITE	Men	3.4	38.9	2.8	27.8
	Women	3.7	31.1	2.6	17.8
BLACK	Men	3.0	24.1	2.0	16.1
	Women	3.1	19.7	1.8	11.0
OTHER	Men	2.8	23.5	1.9	16.9
	Women	2.8	16.8	1.5	9.1

Table 12 is the comparable rural analyses; while it shows many of the same patterns seen in urban areas there are some important differences. First the similarities: Whites of either sex take the most person and vehicle trips and cover the most person and vehicle miles. However, all rural women—except those of Other Races—make more person trips than comparable men. Hispanic women 16-64 in rural areas take more vehicle trips and cover more person miles daily than Hispanic men. Black rural women travel a greater percentage of the person miles covered by comparable rural men (30 vs. 26.4) than they did in urban areas while women from Other Races actually travel more personal miles than comparable men.

Table 13 identifies the mode choice patterns for three major types of trips. As in the aggregate figures shown in Table 12 White men and women are the most reliant on the car for all kinds of trips while Blacks are generally the least reliant—although everyone makes the overwhelming majority of their trips in a private vehicle. As would be expected, transit use is highest for the work trip and generally lowest for the family and personal business trip among all travellers, where the car is used by over 85% of people.

Table 13 shows some interesting differences between the sexes; Black women use the car more than comparable men for both the work trip and shopping while White women use the car more than comparable men for shopping and personal business travel. Hispanic women are almost twice as likely to walk for shopping than comparable men and almost twice as likely as all other women. Women from Other Races are more than twice as likely than comparable men or all other travellers to use public transit for personal business trips.

Table 14 evaluates the impact of employment status on the four major types of travel parameters in urban areas while Table 15 describes the complementary rural analyses. The lesson to be learned from this level of disaggregation; when employed all women make more person trips and very close to the same

Table 12 Daily Parameters of Rural Travel, by Sex, Race, and Ethnic[illegible] People 16-64, 1990

RACE AND SEX		PERSON TRIPS	PERSON MILES	VEHICLE TRIPS	VEHICLE MILES
HISPANIC (All Races)	Men	2.8	29.1	2.24	25.9
	Women	3.5	31.8	2.37	19.1
WHITE	Men	3.3	42.8	2.8	35.0
	Women	3.6	35.9	2.6	21.8
BLACK	Men	3.0	30.0	2.3	25.7
	Women	3.1	26.4	2.0	15.3
OTHER	Men	3.1	28.6	2.5	25.0
	Women	2.8+	28.8	1.9	17.5

number of vehicle trips as comparable men. Thus some of the ethnic and racial differences seen in previous analyses all but disappear when we control for employment.

However, the differences between Hispanic men and women tend to be larger than those between any other group. In urban areas, for example, employed Hispanic men travel 48.5% more person miles and make 18.6% more vehicle trips than comparable Hispanic women; Black male workers in urban areas, however only travel 12.5 % more person miles and make only 1% more vehicle trips than comparable women.

These patterns are also seen among non-workers in urban areas. Hispanic men who do not work travel 67% more person miles and make 13% more vehicle trips than comparable female Hispanic workers. Yet White men who do not work travel only 5% more person miles and make 5% *fewer* vehicle trips than comparable women. Clearly, employment does not explain all of the differences between the sexes.

Being in a rural area does reverse some of these trends. As Table 12 forewarned, Hispanic women in rural areas take more trips and travel longer than comparable men, whether or not they are a worker. Hispanic women who do not have paid employment travel over four times the number of person miles of comparable Hispanic men, and make 57% more vehicle trips. For all other travellers being a worker explains more of the differences between men and women in rural areas than does race or ethnicity.

Licensing Rates

License holding is clearly related to increased travel and in 1992 just over 92% of all men and 82% of all women had licenses in 1992. But the 1990 NPTS data show important differences in licensing rates along racial and ethnic lines, differences which may have strong travel implications. Table 7 showed that among Whites in urban areas the licensing gap between men and women 16-64 was only 3.5 percentage points—94.8% of men and 91.3% of White women had licenses.

Table 13 Principal Travel Modes for Selected Urban Trips, by Sex, Race, and Ethnicity, People 16-64, 1990

RACE AND SEX		WORK			SHOPPING			FAMILY/ PERSONAL BUSINESS		
		Private Vehicle	Transit	Walk	Private Vehicle	Transit	Walk	Private Vehicle	Transit	Walk
HISPANIC (All Races)	Men	82.2%	10.5%	5.1%	83.3%	3.5%	12.4%	86.9%	4.6%	6.5%
	Women	80.4	13.9	5.5	78.9	4.6	23.5	85.2	3.9	10.8
WHITE	Men	91.8	4.2	3.0	93.3	.6	5.5	94.3	.7	4.2
	Women	91.0	4.4	3.8	94.0	.5	5.3	94.9	.5	4.2
BLACK	Men	75.7	16.5	12.3	74.6	2.3	21.3	87.7	4.5	6.0
	Women	79.1	14.2	12.5	79.2	4.3	15.8	86.2	4.2	8.9
OTHER	Men	82.2	9.9	5.8	86.4	2.3	10.2	87.3	4.2	6.3
	Women	75.8	16.6	7.3	80.8	5.0	13.5	86.9	10.8	18.9

However the gap between comparable Black men and women was over 10 percentage points—80.5% of urban Black men 16-64 but only 70.8% of comparable Black women had licenses. The contrast was even greater among Hispanics (of any race): in urban areas 80% of Hispanic men but just under 66% of comparable women drove.

There was far less of a gap between the sexes in rural areas for all racial and ethnic groups generally because a much higher percentage of rural women were licensed. Roughly 95% of both White men and women living in rural areas drove; over 77% of rural Black women and almost 82% of rural Hispanic women had licenses.

Licensing rates were also related to household income, although race and ethnicity had greater impact on differences between the sexes. Roughly 70% of all people 16-64 with household incomes below $5,000 had licenses (71% of the men, 68% of the women) while 95.9% of those with incomes over $70,000 drove (96.5% of the men and 95.2% of the women). However, licensing rates for those 16-64 hit 90% at household incomes of only $25,000—where the difference between the sexes was roughly 4 percentage points.

Figure 13 shows that, overall, having a license was associated with 39% more person trips for men in urban areas and 74% more trips for women. However, there were differences along racial and ethnic lines. White women were most affected by having a license—their daily trips increased almost 80%—but both Hispanic women and women form Other Races substantially increased their travel with a license. Figure 14 shows that having a license increases the substantially increases the *trip-making* of women but increases the mileage of men.

Other analyses strongly suggest that having a job explains more of the differences in men's and women's travel patterns than licensing but not all the differences. Moreover, having a job does not have the same impact on the travel patterns of Hispanic women as it does on the patterns of other women. For example

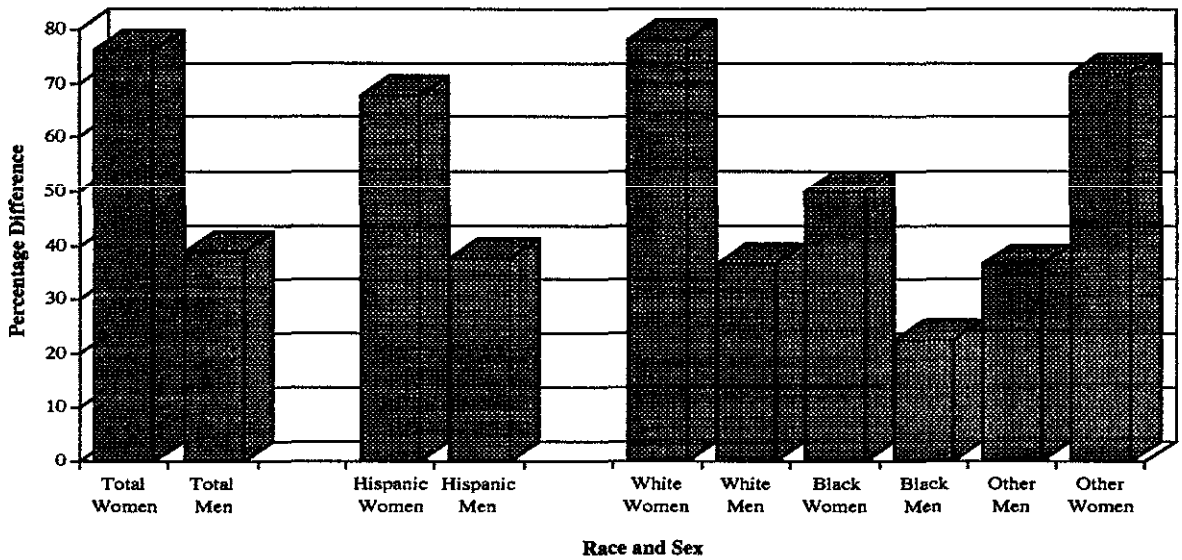
Table 14 **Average Daily Parameters of Urban Travel, by Sex, Work Status, Race, and Ethnicity, People 16-64, 1990**

RACE AND SEX		PERSON TRIPS		PERSON MILES		VEHICLE TRIPS		VEHICLE MILES	
		Worker	Non-Worker	Worker	Non-Worker	Worker	Non-Worker	Worker	Non-Worker
Hispanic (All Races)	Men	3.0	2.0	31.5	21.2	2.2	.9	21.7	37.3
	Women	3.1	2.1	21.2	12.7	1.8	.8	13.1	3.9
White	Men	3.5	2.8	41.0	26.8	2.9	1.9	30.1	15.1
	Women	3.9	3.2	33.7	25.6	2.9	2.0	20.6	12.0
Black	Men	3.2	2.4	27.0	15.8	2.3	1.0	19.4	6.9
	Women	3.4	2.4	24.0	11.7	2.3	.9	14.0	5.5
Other	Men	2.9	2.2	25.4	15.8	2.1	1.0	19.2	7.7
	Women	3.4	2.2	22.2	10.1	2.0	1.0	12.8	4.6

Table 15 **Average Daily Parameters of Rural Travel, by Sex, Work Status, Race, and Ethnicity, People 16-64, 1990**

RACE AND SEX		PERSON TRIPS		PERSON MILES		VEHICLE TRIPS		VEHICLE MILES	
		Worker	Non-Worker	Worker	Non-Worker	Worker	Non-Worker	Worker	Non-Worker
Hispanic (All Races)	Men	2.9	2.1	34.1	5.0	2.2	1.3	30.4	4.1
	Women	3.6	3.3	38.6	22.9	2.7	1.9	25.7	10.6
White	Men	3.5	2.7	41.0	30.0	3.0	2.0	30.2	20.3
	Women	3.9	3.1	33.7	30.6	2.9	1.9	20.6	15.0
Black	Men	3.3	2.4	37.7	12.5	2.7	1.3	32.8	9.4
	Women	3.5	2.4	32.1	18.0	2.4	1.4	17.8	11.3
Other	Men	3.1	2.7	32.9	9.2	2.7	1.1	29.7	3.9
	Women	3.2	2.3	34.4	18.3	2.3	1.2	24.7	6.9

Figure 13 Impact of Driver's License Holding on Person Trips, by Sex, Race, and Ethnicity



Note: % difference in daily person trips between indicated people with and without a driver's license.

while the difference in the vehicle trip rate of Hispanic men and women drops from 40% to 19% when controlling for employment that gap is still more than three times more than that experienced by any other set of workers.

Marital Status and Children

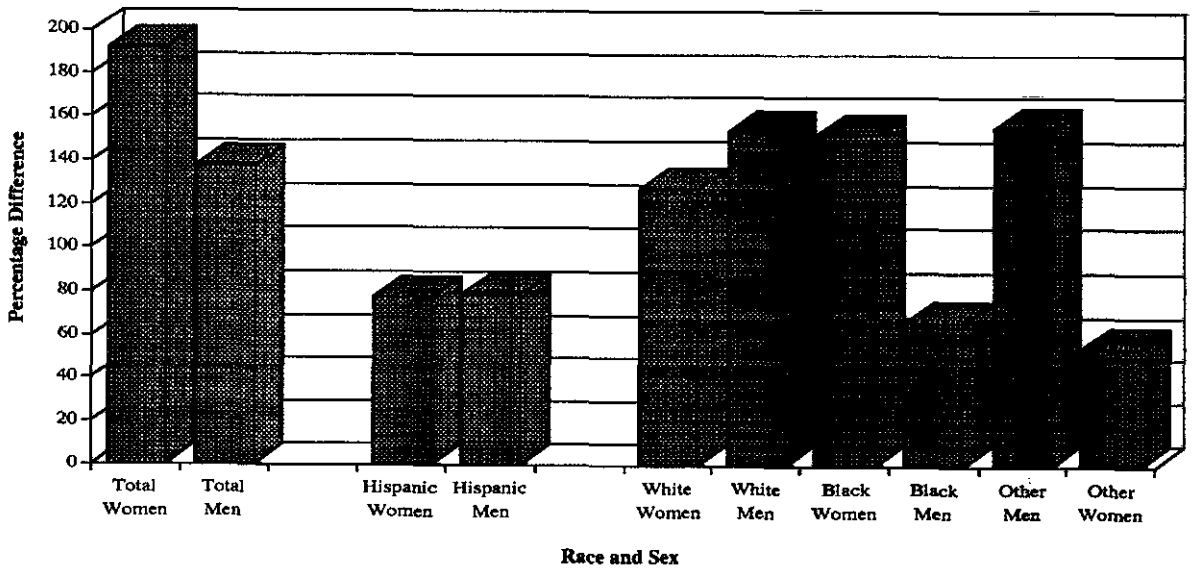
Analyses in a previous section showed that both marital status and the presence and age of children in the household had serious impact on *women's* travel behavior. Here that analysis is disaggregated further by race and ethnicity to see if they add to our understanding of women's travel behavior.

Figure 15 displays the daily trip rate of single female parents 16-64 in urban areas by the age of their children. In the aggregate, as the report showed earlier, those with children 6-15 make more daily person trips than women whose youngest child was younger or older; moreover all of these mothers made in excess of 3.6 person trips per day. However, 1) that pattern is not found among Hispanic single mothers or those of Other Races, and 2) the number of trips taken by Hispanic and non-White single mothers is substantially different than the aggregate or that taken by Whites.

Hispanic single mothers diverge from the overall pattern; they take slightly more trips when they have older children and slightly fewer when their youngest child is 6-15. However, whatever the age of their children, they take fewer trips than Black women and those of Other Races and no more than 60% of the trips of White women. Although Black female parents conform to the overall pattern (the highest trip rate with children 6-15) they make nowhere near the number of trips made by White single parents.

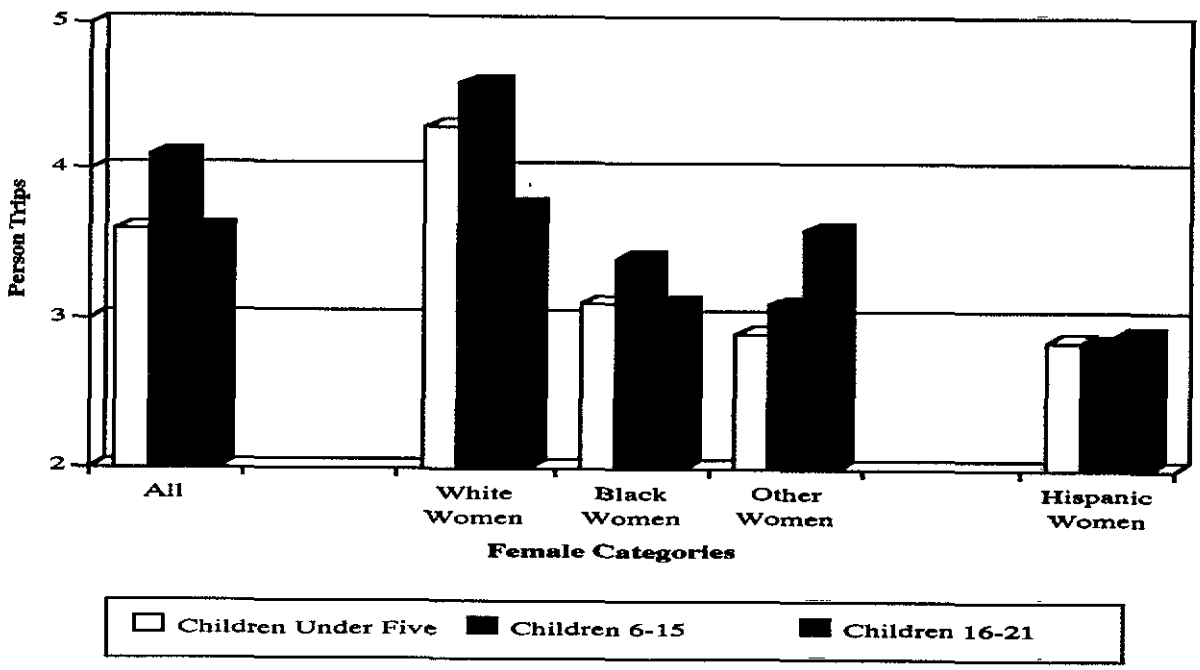
Figure 16 compares the travel patterns of female parents in two adult households in urban areas. The aggregate patterns at the left of the Figure have been seen in earlier analyses; married women take more trips when their youngest child is 6-15 and slightly fewer trips than comparable single female parents. Once again White women have patterns substantially different from other women. Black married women take a

Figure 14 Impact of Driver's License Holding on Person Miles, by Sex, Race, and Ethnicity



Note: % difference in daily person trips between indicated people with and without a driver's license.

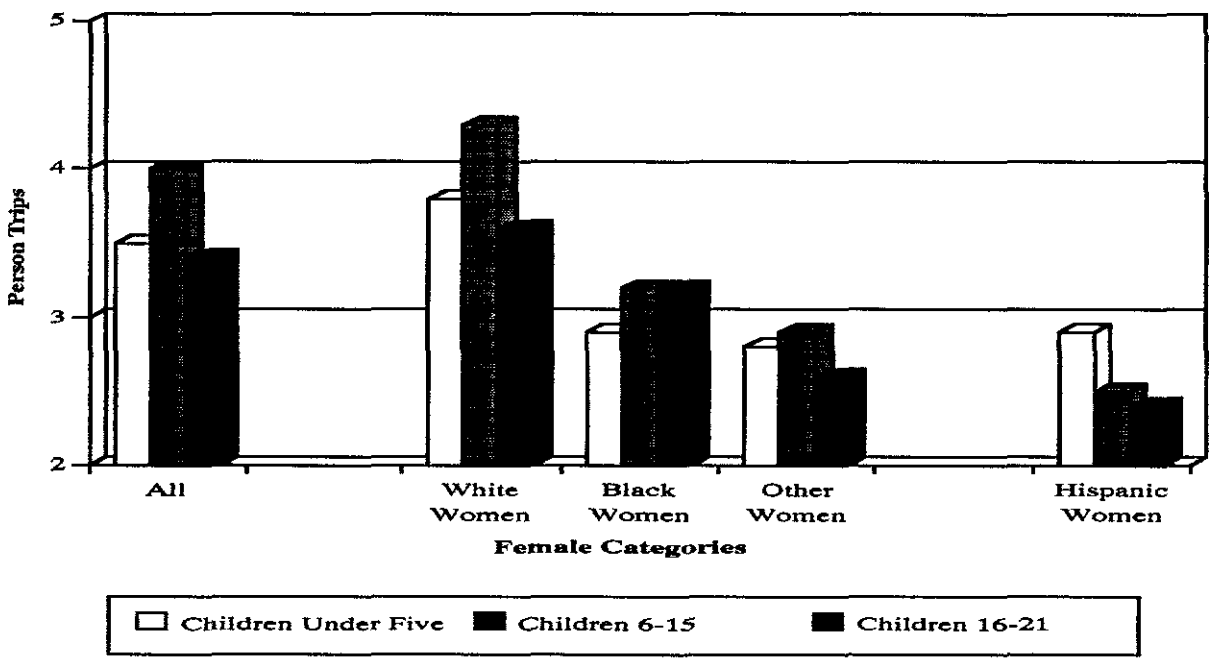
Figure 15 Average Daily Urban Trip Rates of Single Female Parents, by Selected Lifecycles, Race, and Ethnicity, 1990



roughly comparable number of trips for their children over six and substantially fewer trips than women from Other Races.

Again Hispanic women are very different from both the aggregate figures and from non-White women; married Hispanic mothers make more of their trips before their children are school age and fewer as their children get older. Hispanic women actually make fewer trips than any other groups—except for those having very young children, where they make more trips than any other group than Whites.

Figure 16 Average Daily Urban Trip Rates by Female Parents in Two Adult Households, by Selected Lifecycles, Race, and Ethnicity, 1990



Findings and Conclusions

The Societal Backdrop

Our society has undergone profound social and demographic changes in the last thirty years, Census data and a growing body of research show us that many of these changes have differentially affected women and their children and ultimately their travel patterns. Today most women live or work in low density communities. Overall, women account for roughly two thirds of the new entrants into the labor force in the last twenty years and their new trips to work account for a substantial portion of the growth in both travel and auto use. The most drastic increases in auto use in the last 20 years, and the most drastic decreases in transit use, have been among working women.

The majority of married women, and women with children, and women with very young children, are in the labor force, so they must add their job-related duties to their existing childcare and domestic responsibilities. This network of complicated obligations demands multiple and linked trips.

Moreover, the travel patterns of working women are related to where they can find employment and how—and where—they take care, or arrange for care, of their children while they work. Research shows that the jobs open to working women are located in different places in a region than those open to men. Moreover most women cannot have their children cared for in their own homes. Both situations alter and complicate their travel patterns and their mode choices.

The number of families headed by a woman alone has increased substantially and many such families—including some with a parent in the paid labor force—are living in poverty. Many of those heading households by themselves, as well as many of those who are poor, are members of racial or ethnic minorities. Moreover, studies also show that women householders often have travel patterns that are different from both married parents, in part because they are often inner city residents who have to travel further to find any clustering of employment opportunities.

All of these complex situations collide with the escalating dependence of society on a car, which is fueled by increasing real incomes and low density suburban development. As a result, studies show that women are more likely to work very close to home whatever their income, and to link their commute with trips to school or child care centers or shopping, and most importantly, to drive whatever their income. Research indicates that the more complex their childcare obligations, the more likely women are to drive to work alone. Moreover, the car better addresses the security concerns which many women have.

Research indicates that working women with children are particularly dependent on the car because it is the best—and perhaps only—way to balance the child care and domestic responsibilities they retain when they enter the paid labor force given societal constraints—inadequate child and eldercare, limited housing options, segregated labor markets, poor transportation options for children, inaccessible services in the suburban areas in which over 70% of all jobs are located, and unsafe alternative modes.

The literature suggests, that as more women join the labor force, their travel is coming to resemble men's in important ways, while becoming very different in other ways. As women seek jobs outside the home, increase their income, and obtain licenses (and not necessarily in that order) they drive longer and use the car for more of their trips, just as men in the paid labor force have traditionally done. However, because their work responsibilities are added to their childcare and domestic responsibilities they also exhibit markedly different patterns than working fathers. Moreover, their use of the car, while affected by household income, is clearly also strongly related to these complex responsibilities.

Overall Travel Patterns

The NPTS data confirm many of the patterns seen in the literature on women's travel; the data clearly show that the changes in travel have been the greatest among women. In the last two decades our society has seen a significant increase in the role of the auto—coupled with the declining use of transit and carpooling. Between 1969 and 1990 the number of miles travelled by car increased 82% while the number of cars increased 128%[113]. The use of carpools dropped substantially—the average number of people in a car falling 15%—and transit ridership plummeted across the board—for men and women, for Afro-Americans and Hispanics, for the poor as well as for the elderly[114].

From 1969-90, women's share of transit dropped twice as fast as that of men[115]. The number of miles driven by males increased 46% between 1969 and 1990, but those driven by all women increased 76%—and more than doubled among women between 16-34, that is, those entering the labor force[116]. Only among those over 55 did men experience greater increases in miles driven than women.

The NPTS data also show wide differences in the basic travel patterns of men and women. Overall, women 16-64 in both urban and rural areas made more person trips per day than men. However, women made shorter trips; men travelled 27% more person miles than comparable women in urban areas and 16% more in rural areas. Men made more vehicle trips than comparable women and, in both urban and rural areas, covered 60% more vehicle miles.

The NPTS data show that neither having a job nor having a driving license fully explained the differences between the sexes. Both were associated with a) increased travel for men and women and b) reduced differences between the sexes in travel patterns. However most differences between men and women still remained although the gap narrowed. Both men and women with a license and/or a job travelled substantially more than those without but having either or both had a more profound impact on women's travel. Urban women with a license made 76% more person trips and travelled 191% more person miles than women without a license but the difference in men's rates was nowhere near as large.

Household income also had a major impact on travel and helped explain some of the differences between the sexes—but again gaps in travel patterns remained among otherwise comparable men and women. While both men and women's tripmaking increased as household income increased, at all but one income level women made more person trips than men and the gap widened as household income went up. Conversely, at all but the lowest income level men made more vehicle trips than comparable women. The gap in person mile and vehicle mile rates between men and women tended to increase as income increased.

As expected, household income and mode choice were related for both sexes. However, in urban areas, women drove for more of their trips than comparable men at very low incomes, very high incomes, and in some income groupings between—and use of the car was disproportionately greater among women at the *lowest* income levels. Low income women in urban areas were even more dependent than men on the car for the work trip; women were more likely to use a car for their commute than comparable at incomes below $25,000 and the differences in other categories were small.

In rural areas, where dependence on the car is greater, women at income levels under $40,000 took more of their trips in a private vehicle than comparable men and the differences were the greatest at the lowest incomes. For example, rural women 16-64 with incomes under $10,000 took 91% of all trips in a private vehicle compared to 81% of those of comparable men.

Transit use was inversely related to income but the rate of change was different for men and women. Men in urban areas were more likely to use transit for all their trips than comparable women at low incomes and high incomes. However, low income women were more dependent on transit for the work trip.

As expected, distance to work increased as income increased but disproportionately more for men so that the gap between the sexes widened. Women 16-64 in both urban and rural areas worked closer to home than men from households with comparable incomes—although the gap was wider in rural areas.

A combination of worker status and income was linked to travel behavior but, again, differentially for men and women. Working women 16-64 in urban areas made more person trips than comparable men in every income category. Moreover, women who were workers made substantially more person trips than women who were not in all but the highest income category but the differences between working and non-working men were not nearly as great. In addition, the mileage increase associated with having a job was higher for women in each income category.

A combination of license holding and income failed to explain all of the differences in the travel patterns of comparable men and women. Moreover, although increasing income was strongly linked to increasing rates of travel for people *with* licenses, it had far less impact on the trip rates of non-licensed people, and particularly women without licenses.

In summary, traditional travel variables—household income, license-holding, employment—do more to explain the differences among women and among men than they do to explain the differences *between* comparable men and women. The higher person trip rates of women persist through every traditional analysis, as generally does the shorter distances and fewer private vehicle trips. The one major exception: the travel patterns of people from households with low incomes.

The NPTS data repeatedly demonstrate unexpected behavior and choices by low income people, and particularly low income women. Low income people of both sexes in urban areas and low income women in rural areas worked further from home than comparable people from households making more, sometimes substantially more, money. At the very lowest income levels women workers travelled further than comparable male workers. These findings may support the hypothesis that low income people, but mostly women, face employment opportunities which are located in different parts of the metropolitan region.

Overall, these patterns strongly suggest that women are affected by variables other than, or in addition to, household income or license holding. It appears that either these variables do not affect the travel patterns of men or they do so to a far lesser degree.

The Impact of Children

The NPTS data clearly show that the presence of children impacts both men and women but again in different ways. Having children had profound impact on the trip rates of women and almost no impact on the travel patterns of men—unless they were single parents. Married fathers always made fewer trips than comparable married women, with the largest gap when the youngest child was 6-15.

Men with children made *fewer* vehicle trips and travelled *fewer* miles than comparable men without children and the distance they travelled held constant regardless of the age of their youngest child. Conversely, the distance travelled by women was much more responsive to both having children and to changes in the age of their children. Married women with children made more person and vehicle trips than comparable married women without children although they also travelled fewer miles.

These differences were not explained by income. Married male parents almost always made fewer trips than comparable female parents. Nor did household income differences explain differences in mileage or vehicle trips; relatively independent of income, married women who were parents travelled less and made fewer vehicle trips than comparable male parents.

Marital status also had strong impact on the travel patterns of women with children. Single female parents made more trips than comparable married women at almost every income level and travelled more person miles than married mothers with children under six. Moreover, once their youngest children were school-age, single mothers also made more vehicle trips than comparable married mothers.

As in previous analyses, very low income households acted differently; low income parents, but generally the mothers, travelled further and more often than comparable parents and more than with those with higher incomes.

All of these findings strongly support the contention that women who are mothers make more trips because of their family obligations but travel less distance because of their desire to stay closer to home. Single mothers, lacking in-home help with their children, make more trips than married mothers—but they stay even closer to home (perhaps because they know they are the only back-up their children have). These findings also support previous work which found that the age of the youngest child may make some difference in the travel patterns of male parents but strongly impacts female parents, and single female parents even more so.

The Intersection of Race and Ethnicity

There were sometimes major variations in travel patterns by race and ethnicity; in general men and women in the same group were more similar than were either all men or all women. White men travelled more than all other men while White women travelled more than all other women; White men took more person and vehicle trips than other men, travelling 73% longer than Black men and 64% more than men from Other Races (Non-White, Non-Black). The gap between Whites and others was so large that occasionally White women travelled more than men in another group.

White men made the longest commute trip as did White women in both urban and rural areas although the gap among the sexes was even greater in rural areas. White men drove 10% more miles than Hispanic men (of any race) and 22% more miles than Black men; these patterns held true even when controlling for employment status. Interestingly, while all men drove more than all comparable women, the gap between the sexes was *largest* among Whites. White women, however, always drove more than women of any other races.

Although the private vehicle was the mode for the majority of trips of all people, there were major differences among the groupings. White men drove for substantially more of their trips than any other ethnic or racial grouping. White women drove for more of their trips than other women, but the differences between women were not quite as large. However, both White and Black women took more of their trips in a private car than comparable men, a surprising finding.

However, once disaggregated by background, all women did not take more person trips than all men. Hispanic women and those from Other Races made fewer trips than comparable men. The differences between Hispanic men and women on all indicators of travel were two to three times greater than the differences between the sexes in any other grouping.

Having a job explained many of the racial and ethnic differences but some still persisted. Hispanic male workers in urban areas travel substantially more than comparable Hispanic women; however, the situation is reversed in rural areas where Hispanic women travelled more than comparable men.

There were large differences in the license status of women. While over 90% of all White women 16-64 were licensed only 71% of Black women and 66% of Hispanic women were. Having a license substantially increased total trip making for all women but White women were the most impacted and Hispanic women the least. In fact, the gap between Hispanic men and women was consistently larger than that seen in any other group, independent of income, license holding, or employment status.

White single mothers take substantially more trips than comparable mothers and Hispanic single mothers generally take far fewer trips than other type of single parent. Hispanic married women are also different from comparable women; they take fewer trips than other women—except when they have very young children when their trip rate is second only to Whites.

Other Research

These findings raise as many questions as they answer. The first is whether the differences between *comparable* men and women and among women will continue and if they do what variables will be the most important. Clearly licensing and employment impact the travel behavior of woman; as even more women get jobs or licenses we would expect to see more trip making and greater use of the car. However, the other variables driving women's travel behavior are harder to predict; having children seems associated with more person trips but fewer miles than comparable men, perhaps based in an emotional need to stay close to home, or the inability to run a household with time lost to long commutes or trips. Use of the car and trip making goes up as income rises, but income is not a good predictor of the travel behavior of various women.

While more sophisticated quantitative analysis could be done on the data, it is not clear that much would be accomplished. So many of the key variables are highly correlated to begin with; race is highly correlated with income and income with access to a car and single parent status to income, etc. Thus it may be difficult to untangle the skeins with more mathematical exercises. Moreover, there are serious sample size problems when disaggregating the data by multiple variables. Clearly there is a need to conduct quantitative analyses which simultaneously examine the combined impact of various traditional and less than traditional variables, identifying the most influential variable(s) from a host of highly correlated variables.

It would be extremely useful to have both panel studies and longitudinal studies to better understand why women make the travel choices they do (and the employment and childcare decisions that create their travel patterns) and how these choices change over time in response to the birth of children or children entering school or a change in marital status. It is very tempting to use the NPTS data to conclude what happens to, for example, women as they have children, by comparing women who do and do not, but these are, of course, cross-sectional data describing different women.

Second, the data clearly show that *household income* is a good but flawed indicator of travel behavior, especially when it comes to understanding the dynamics of women's travel. With the growth of two worker households we need a better indicator of the joint impact of personal and total household income on all the major indicators of travel behavior, from work trip mode to total miles travelled. Some observers have noted that the failure of household income as a predictor of women's behavior (except in the coarsest sense) only means that we should be using personal income instead—that regardless of total joint resources a working women rationally makes transportation choices based only on the personal income she derives from working (*ie* not driving far for a low paying job regardless of her partner's income).

But using personal income would create substantial problems as well since it's unlikely that families divide resources exactly according to each adult's monetary contribution to the household; for example, a working women may take the one household car in order to meet her childcare and domestic responsibilities even if she has the lower paying job.

While there is some evidence that personal income is a better indicator of women's travel behavior, this seems a researchable question. It seems more likely that women—or their families— make their travel decisions based on *some mixture* of their personal income and their access to family resources. And that may be the most true for married women with children. Moreover, three out of ten women in American today make more than their husbands and it would interesting to see if their decisions are made in the same way as the other 70% of American families.

Third, it would be unconscionable to ignore the very disturbing patterns of those with very low incomes. The NPTS data clearly show that people, and generally women, who earn below a poverty wage are often travelling further or more than those better off—and disproportionately in the most expensive

travel mode, the car. The literature suggests that these patterns may result from differences in specialized labor markets and the need for single parents to handle all family obligations themselves (lacking a resident partner). Unfortunately that is only an educated guess because we can't really tell from these data.

In fact, data describing sub-regional labor markets are scare. There are only limited empirical studies of the spatial implications of fragmented labor markets *at the local level.* Current economic studies of these issues are useless for transportation planners because the spatial focus is at the metropolitan level—which ignores (or assumes away) the fact that people do not have equal access to all jobs or job locations within a metropolitan area (or the ability or inclination to move to do so).

In order to make intelligent and equitable transportation investment and financing policies we ought to know what creates these anomalies among the poor. It would be extremely useful to know why poor workers are making what may be real sacrifices to travel as they do—whether the cause is segregated housing markets preventing them from moving near their jobs,or the need to remain close to family networks (for child and eldercare while working, for example), or the lack of adequate services near the job, or...

Fourth, it is important to document changes in male parents' travel behavior over time in response to domestic obligations—and the resulting impact on women's travel patterns. Critics have often charged that we are not discussing women's travel patterns and needs but *family* patterns and needs; as more men assume a larger role in their children's lives, men's travel may change as well. While most time-budget and other analyses do not find that men have made such major changes in their lives, it would be useful to see if changes are occurring which will lighten the domestic and childcare burden which appears to create such variations in women's travel.

Fifth, it is important to evaluate the policy implications of these findings, in both the short and long term. If we accept that women's travel patterns are different from men's largely or only partly because they are balancing home and work in a way that men do not, we need to consider the impact of pending transportation control programs (to be developed to respond to ISTEA and Clean Air Act Amendment mandates). It is not at all clear that working women, particularly those who are mothers, can easily change their travel patterns or drop their dependence on the car in response to parking controls, road pricing, or heavy taxation.

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Travel by the Elderly

Sandra Rosenbloom, Ph.D.

Travel by the Elderly

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Executive Summary

Introduction

The elderly are the fastest growing component of the U.S population and the very old are the fastest growing component of the elderly. Most elderly people today are drivers and over three fourths live in low density suburban or non-metropolitan places—places where the use of the private car is either encouraged or absolutely necessary. Although a declining *percentage* of the elderly live in rural areas, there is often a high *concentration* of elderly in the rural areas where they do live—areas where they face severe isolation if they lack transportation options.

Moreover, the diversity seen among younger Americans is increasingly being seen among those now elderly and there is little doubt that it will increase in the future. Cultural and ethnic preferences have important transportation implications; people will bring to their senior years the social, personal, and recreational patterns shaped by these preferences—including their traditional travel patterns—which include a very significant dependence on the private vehicle.

This report identifies socio-demographic changes in the older population and then ties the patterns to the travel patterns seen in the 1983 and 1990 Nationwide Personal Transportation Survey (NPTS). The analyses are based on unpublished tape-readable data from the 1990 NPTS as well as unpublished calculations originally made from the 1983 tapes.

Findings

The 1990 NPTS data show an elderly population whose reliance on the car has become more intense since 1983; no cohort of the elderly took less than 75% of all trips in a private vehicle as either a passenger or driver. Conversely, the elderly were even less likely to use public transit for their trips than ever before; no cohort of the elderly used transit for more than 5% of their trips and the average was substantially less. Although walking was the mode of second choice, its importance fell by one-third in urban areas and one-fourth in rural areas since 1983.

Linked to the use of the car is the increasing distance covered by the elderly; the elderly as a group drove 20% more miles than they had in 1983 while those over 70 drove 40% more. Even the very old were driving a substantial number of miles each day. Trip-making dropped substantially as people aged, with the biggest decrease occurring when people hit 85.

The NPTS data also show that there were important differences in the travel patterns of older men and women. Overall, elderly men took 24% more person trips, travelled 19% more miles, and made 94% more vehicle trips than elderly women. In spite of these differences, and even though fewer older women had licenses, women took almost as great a percentage of their trips in a private vehicle.

The data clearly show that having a drivers license is associated with substantial increases in the number of person trips and person and vehicle miles—the trip rates of men with licenses was almost double those of men without. The impact was especially important for the very old—men over 85 with licenses made three times as many trips as comparable men without.

The NPTS data also show that Whites are substantially more dependent on the private car than are Hispanics, Blacks, or other races—although all groups make more of their trips in a car than any other mode. White seniors of both sexes make more vehicle and person trips and travel more miles than any other ethnic or racial grouping. Moreover, white men and women have more similar patterns than the sexes within other groupings; White men make 21% more person trips than comparable females but Black men make almost 100% more trips than Black women.

Implications

The findings raise several major questions. First, we need to know to what extent the differences among the elderly are a function of choice and to what extent necessity. Knowing peoples' preferences will help us make more cost-effective investment and policy decisions. Second, we need to know if current sex, race, and ethnic differences in travel patterns are likely to continue because they reflect important cultural norms and expectations held by younger cohorts of the population. Third, it is important to know if the upward trends among the elderly in all aspects of travel will continue, and if they will continue, what the intensity of growth will be.

Fourth, we must recognize that the growing diversity of the elderly population also includes pockets of much older women living alone, and men and women who are below poverty level, and those who cannot or will not drive, or who cannot or will not obtain rides from others. This should prompt a concern with a more inclusive and comprehensive approach to an aging society. The analyses presented show that there are no easy answers to the problem of the mobility of Older Americans; effective solutions must reflect a comprehensive understanding of how elderly people meet their needs and the environmental constraints and barriers under which they operate.

In the future most elderly will be car drivers—and will hold onto their cars and licenses as long as possible. Until society can offer realistic ways for elderly drivers to meet their mobility needs—and those of their passengers—without driving it is both unreasonable and unfair to expect them to give up their cars. Therefore we must:

- improve the safety of cars and the road network, and,
- assist competent elderly drivers who have financial problems.

At the same time there are pockets of elderly people who cannot drive or afford to maintain a car; to address their needs, and to provide options for those who can chose, we must:

- develop a range of alternative transportation options for those who are non-drivers, or those who wish to decrease the amount of driving they do,
- develop mobility alternatives that are geared to the diversity of the older population, maximizing the choices offered the elderly traveller, and,
- provide more pedestrian friendly neighborhoods—to allow Older Americans to walk to meet some of their needs, or to easily access public transit, or simply for recreational purposes.

Finally in order to develop intelligent and comprehensive solutions to the mobility problems of Older Americans, we must:

- make clear the link between housing and land use choices, on one hand, and transportation needs on the other in all policy discussions.

Acknowledgments

I would like to thank Marshall Frieman for his capable management of the data and Gregg Snyder for the graphics.

Introduction and Overview

The elderly are the fastest growing component of the U.S population; the number of those over 65 grew more than 20% between 1980 and 1990. This phenomenon is characteristic of most developed societies; for example, Germany and Denmark, which expect their total populations to decline in the next thirty years, are projecting an increase in the absolute number and percentage of those over 65. In addition to the overall growth of the elderly, there will be remarkable increase in the number of very old travellers; by the first decade of the Twenty-First Century almost 5% of the entire US population will be over 80.

Among this enlarging group of older people will be a wonderful mix of life styles, cultural and ethnic norms, residential choices, and travel patterns. Moreover, the elderly population will include a complicated mixture of skills and deficiencies, resources and needs, health and illness. An integral part of this mix: most older Americans will have been licensed drivers most of their lives, many of them still driving to meet their needs.

Given the aging of our society, and the large and growing number of very old people, it is important to identify the social, demographic, and cultural changes being experienced by older Americans and to evaluate how those trends affect transportation patterns. As the Bureau of the Census warns,

> Within the coming decades, the United States will have a larger, more diverse older population...As individuals, and as a society, we will face a challenge to anticipate the change in needs and desires of a diverse, aging America.[1]

This report identifies a range of socio-demographic changes in the older population using Census and other data and then attempts to tie these patterns to those seen in the travel data of the 1990 Nationwide Personal Transportation Study (NPTS).

The report largely uses descriptive statistics and simple cross-tabulations to deal with these issues. This approach is dictated by both the limits of the data and the policy and planning uses to which the analyses are likely to be linked. In particular, when the data on older travellers are disaggregated to any interesting extent, the numbers in each group become very small which may limit the meaningful use of more sophisticated techniques. Moreover, while a descriptive approach has its limitations, it produces analyses that are clear and easy to understand.

The travel analyses are based on unpublished tape-readable data from the 1990 NPTS as well as unpublished calculations originally made from the 1983 tapes. These data sources are augmented by other published and unpublished data sources which are identified.

This, the first major section of the report, evaluates demographic and licensing changes among those now elderly and those who will soon be, briefly chronicling their increasing diversity, their growing suburbanization, and their all but universal automobility. The second major section of the report analyzes NPTS data on the trip patterns and travel rates of older Americans; the third major section focuses on some of the gender as well as racial and ethnic differences that underlie the variations in travel seem among the elderly. Finally the fourth major section of the report analyzes the policy and program implications of the trends identified.

Understanding travel data on the elderly is an enterprise fraught with difficulty. Most elderly people travel longer and more often than their counterparts of only a few decades ago; it is both tempting and almost impossible to avoid saying that they these increases represent "greater mobility." In fact, some elders, like those in rural and low density communities, *have to* travel further to access necessary services than did their counterparts of a few decades ago—and they *have to* do so in car, often in the face of declining physical or financial resources, because they lack any other viable option. Being *forced* to travel longer or to drive to reach desired services can hardly be considered better mobility. Unfortunately, when we examine the patterns of any set of travellers we rarely know if we are seeing what they want to do or what they are forced to do by societal constraints and environmental barriers.

A First Look

Table 1 illustrates the growing importance of the older component of the US population. In 1990 those over 65 accounted for almost 13% of the population; over 5% of the entire population of the United States was over 75. The US Census Bureau projects that by the end of the first decade of the next century over 14% of the US population will be over 65, almost half being over 75.

Table 2 further chronicles the growing concentration of much older seniors. Today those over 80 account for a far larger percentage of older Americans than they did just 20 years ago. Tables 1and 2 also show the impact of the aging of the baby boomers: those born after the Second World War will become seniors at the end of the first decade of the 21st Century. This large influence will increase the proportion of younger senior citizens, so that the percentage of all seniors who are over 75 will drop slightly for a decade or so. However, within fifteen years, the proportions will turn again, and the percentage of those over 75, and even over 80, will continue to intensify.

However the very old are not evenly divided among population groups. In 1990 slightly fewer Black and Hispanic seniors were very old; by 2050 the Census estimates that over 38% of whites but only 33% of Blacks and Hispanics over 65 will be over 80. Moreover, a far smaller percentage of the total Black or Hispanic population are over 65; in 1990 only 8% of Blacks and 5% of Hispanics were seniors compared to over 13% of Whites. In spite of these differences, however, the total number of very old people of any race or ethnicity is substantial—in 1990 there were over 6.2 million Americans over 85, a number the Census expects to increase over 400% by 2050.

The Implications of Diversity

The diversity of America is increasingly being reflected in the makeup of the elderly; in 1990 roughly 7% of those over 65 were Black while 5% were of Hispanic origin (of any race). However, the Census

Table 1 Current and Projected Distribution of Population over 65, 1990-2010

YEAR		Percent of U.S. Population	DISTRIBUTION OF POPULATION OVER 65		
			TOTAL	MEN	WOMEN
1990	65-74	7.3%	58.2%	63.6%	54.5%
	75+	5.3	41.8	36.4	45.5
2000	65-74	6.8	52.3	57.7	48.5
	75+	6.2	47.7	42.3	51.5
2010	65-74	7.4	53.5	59.2	49.3
	75+	6.5	46.5	40.8	50.7

Source: Derived From U.S. Bureau of Census, Statistical Abstract of the United States, 1990, Table 18.

Bureau predicts that by the middle of the next Century 12% of older Americans will be Black, almost 9% will be of races other than Black or White, and over 15% will be of Hispanic origin.

Little attention has been paid to racial and cultural differences in *travel patterns* among the elderly and their families[2]—although there is a growing body of literature which shows that these variables are critically linked to travel behavior among younger travellers. Such cultural or ethnic differences may well create variations in the driving patterns of older people as well as in the kind and amount of ride-giving either requested by or provided to them.

Table 2 Distribution of the Elderly Population by Cohort, 1970-1991

TOTALS

AGE COHORTS	1970	1980	1990	1991
65-69	35.0%	34.3%	32.4%	31.6%
70-74	27.3	26.6	25.7	26.0
75-79	19.2	18.8	19.6	19.8
80-84	11.4	11.5	12.6	12.7
85+	7.1	8.8	9.7	10.0

AGE COHORTS	1970 MEN	1970 WOMEN	1980 MEN	1980 WOMEN	1990 MEN	1990 WOMEN	1991 MEN	1991 WOMEN
65-69	37.3	33.4	37.8	31.9	36.1	24.9	35.1	29.2
70-74	27.7	27.0	27.7	25.9	27.2	24.6	27.6	24.8
75-79	18.7	19.6	18.0	19.3	19.1	20.0	19.4	20.0
80-84	10.5	12.1	9.9	12.6	10.9	13.7	11.0	13.9
85+	5.8	7.9	6.6	10.3	6.7	11.7	6.9	12.0

Source: U.S. Statistical Abstract, Table 39.

Martin Wachs and his associates, who conducted the seminal study of the life-styles of the elderly; found that older people in Los Angeles were very heterogenous. While socioeconomic status and car ownership did influence travel, as traditionally thought, Wachs concluded that other variables such as ethnicity, race, and geographic location within a community also significantly affected transportation patterns. He found, for example, that elderly Mexican-American women were significantly less likely to have a drivers license but more likely to make trips in autos than comparably situated Anglos or other minority women.

Another study conducted in Los Angeles for the National Science Foundation (NSF) also found significant differences among Black, Anglo, and Hispanic elderly with comparable socioeconomic status. For example, older Hispanics depended on their families for transportation far more than other racial or ethnic groups. Black and Anglo elderly, conversely, were more likely to drive to meet their travel needs. There were also major ethnic and racial variations in responses to transit cost and fear for personal safety.[3] The NSF study concluded that "differences in cultural orientations and needs of minority groups, [were] not adequately taken into account" in transportation planning.[4]

There is also growing evidence of differences in lifestyle and travel behavior among younger cohorts of people, differences which they bring to their senior years. Analyses of 1980 Census data show that Hispanics are more likely to carpool than comparable workers and less likely to use transit than others in comparable socio-economic groupings.[5] A 1982 study found that Mexican-Americans in Denver used public transit far less than comparably situated Anglos because 1) they preferred to share cars and travel with friends on all trips and 2) they were travelling to different places for activities than other travellers.

Martin Wachs has concluded,

> Just as different communities of younger people are based upon lifestyle variables of culture, ethnicity, and socioeconomic class, these variables will play a larger role than age itself in identifying communities of the elderly during the coming decades[6]. . . it appears that old people will become even more diverse during the coming decades.
>
> Improved health, greater economic resources, and improved education will result in increased varieties of lifestyles among the elderly. These lifestyles will be drawn from the more diverse experiences in younger life as well as from greater freedom of choice in retirement . . .[7]

The Needs of a Diverse Aging Population

Integrally tied to diverse lifestyles among the elderly is the question of family support and caregiving. In the next few decades our society will also experience a situation without historical precedent; a substantial number of middle age *and* younger elderly people will have very old and frail parents. In 1940 only 1 in 3 fifty year old women had a living mother but that figure had doubled to 2 in 3 by 1980.

Studies clearly show that 80-90% of personal care and help with household tasks for the elderly—including transportation—is given by their families, and overwhelmingly the daughters in those families[8,9,10,11]. Overall the level of care required by our rapidly aging population is much more physically and psychologically demanding than that given in 1950, in part because of the increased number of cognitive diseases among the growing number of people older than 80. As a result middle-aged women may actually leave the work force to care for frail older relatives [12,13].

However, there is a literature which shows that there are differences in the care and services, including transportation, that families offer older family members—differences which may be related to ethnic and cultural factors[14,15,16,17,18]. Studies show that both Black and Hispanic families treat their elderly family members differently than Anglo families[19,20]. For example, Keefe, in a study of households in Los Angeles, found that Chicano families were more likely than Anglo families to exchange support services (including transportation)[21].

On the other hand, there is some evidence that *acculturated* Latino households respond differently to the needs of elderly relatives[22]. Although some research suggests that subsequent generations of Latino women become more like the majority culture[23,24,25], other work[26] found that extended families and mutual aid are greatest among *second* and *third* generation Latino families. MacCorquodale, in a 1985 study of families in Southern Arizona, found that salaried Chicanas were more likely to continue giving aid to family members after employment than were comparable Anglo women[27].

The variations in lifestyles that arise out of cultural and ethnic differences will have several important transportation implications for the elderly. First, most people will expect to continue the social, recreational, and personal business patterns shaped by these factors—their *life styles*—as they age. Second, as a part of their life style choices, people will carry into their senior years their traditional *travel* choices and patterns—most people, of course, will be drivers, but they may vary in the degree to which they offer rides to others, accept rides instead of driving, or use alternative transportation options. Third, differences in cultural norms about family support may effect the amount of assistance in carrying out their daily activities which elderly people are offered—or expect—from friends and relatives (reducing the need for travel by bringing goods or services to them or by offering rides when travel is required).

The Impact of Gender Differences

The Tables presented earlier show that there are important differences between older men and women: because women live longer, they outnumber men by 3 to 2 and are overrepresented among the very old (a man 65 in 1989 had an average of 15 more years of life expectancy while a comparable women had almost 19[28]). In 1991 almost 46% of women but only 37% of men over 65 were over 75 while more than one in four older women were over 80 (compared to less than one in five men). The Census Bureau predicts that by 2010 more than half of all women but only 41% of all men will be over 75.

Partially because of the age gap between men and women, older women are substantially more likely to be unmarried or to live alone; in 1990 almost 54% of women but only 19% of men over 65 were widowed or divorced while 16% of men but over 42% of women over 65 were living alone. But the age gap does not explain all the differences between the sexes; among those over 85 more than 57% of women but only 28% of men were living alone; moreover, men over 85 not living alone were almost twice as likely to be living with a spouse or relative than comparable women.

Marital status and living arrangements are significantly related to income and the likelihood of being in poverty—although there are clearly independent sex effects. Older people living alone are 50% more likely to have poverty level incomes than married couples, but women living alone are more likely to have low incomes than comparable men. In 1990, for example, 58% of women over 75 living alone but only 42% of comparable men had incomes under $10,000. In 1990 almost 44% of Afro-American women over 75 but only 34% of comparable men were in poverty; in 1980 40% of women over 85 living alone were poor compared to 27% of comparable men.

Thus while the elderly as a whole are increasingly more affluent, women and people of color have not shared proportionately in these favorable changes. Moreover women comprise the largest component of the very old—those with the most need for services and, because they most often live alone, the most affected by the inability to drive or afford a car.

Changes in Demographic Patterns

Today's elderly show very different living patterns than did their counterparts of a few decades ago. Until 1980 the majority of seniors living in urban places lived in the central city of those places; as Table 3 shows, by 1980 the percentage of seniors living in urban areas had increased slightly and almost 60% were living in the suburbs of those areas. Moreover, the distribution among cohorts of the elderly was more equal; although younger seniors were more likely to live in the suburbs than older elderly, the differ-

Table 3 Geographic Distribution of the Elderly Population, 1980 and 1990

AGE COHORTS	RURAL TOTAL		URBAN TOTAL		CENTRAL CITY		SUBURB*	
	1980	1990	1980	1990	1980	1990	1980	1990
60-64	27.0%	26.6%	73.0%	73.4%	41.0%	40.5%	59.0%	59.5%
65-69	28.9	25.7	71.1	74.3	42.6	40.8	57.4	59.2
70-74	29.5	25.2	70.5	74.8	44.0	40.9	56.0	59.1
75-79	29.0	24.4	70.1	75.6	45.6	41.7	54.4	58.3
80-84	29.0	23.2	71.1	76.8	46.3	42.3	53.7	57.7
85+	29.8	21.5	70.2	78.5	46.2	42.8	53.8	57.2

SOURCE: 1990 General Population Characteristics, Table 12.

* = Urban Fringe

ences were far greater in 1980 than in 1990. For example, there were only two percentage points difference between those 65 and those 85 in 1990 compared to almost four percentage points in 1980.

The Census Bureau notes "most elderly people stay put."[29] Table 3 clearly shows the result of the aging-in-place of the elderly. For over three decades, the residential mobility of older Americans has been dropping; from 1965-70 roughly one in four older people changed their residence compared to only one in five from 1975-80. Moreover most movement is among the very old, leading to speculation that those moves are related to health problems and may reflect relocation to nursing homes and care facilities. For example, almost 30% of the elderly over 85 moved in the five year period from 1975-80, compared to 20% of those in their 70's.

In 1990 23 million seniors lived in urban areas while 8.2 million lived in non-metropolitan, or rural, regions. The rural numbers shown in the Table may be slightly misleading; the drop in the percentage of elderly living in non-metropolitan areas does not reflect movement away from rural areas. Rather it shows that most younger people now live in urban areas, and then continue to live in those places when they become seniors. Moreover, because the rural elderly are also aging in place, the actual *concentration* of rural elders has been increasing substantially. Nationally the rural elderly constitute more than 15% of the population in the areas where they live[30] and there are a number of states and individual counties where they make up over 35% of the rural population. Unhappily, poverty rates were substantially higher among the elderly in nonmetropolitan areas.

These residential patterns are related to both transportation needs and the underlying life style which creates transportation patterns. Wachs found, for example, that older people had more in common with their younger neighbors than with others of their own age living in very different communities. In central Los Angeles seniors were much more likely to use the bus for much of their travel—as did their younger neighbors—but in newer suburban areas seniors rarely used the bus and mostly drove—*like their younger neighbors.*

Interestingly, older Americans are *less* likely to stay in the labor force as they age than their counterparts of a few decades ago. In 1950 45.8% of men and 9.7% of women over 65 were in the civilian labor force; by 1990 the comparable figures had dropped to 16.4% of men and 8.7% of women[31]. Although disaggregated data are not yet available for 1990, the *1980* Census showed that 16.7% of males 75-79 and 10.4% of those 80-84 were in the labor force compared to 6.1% and 3.7% of women in similar age groups. These figures can be contrasted to the 1990 NPTS data in Table 4 which show a still further drop in labor force participation: no more than 10% of men nor 4.2% of women 75-79 or 5% of men or 3% of women 80-84 were in the workforce.

Although labor force participation dropped, incomes increased substantially among all cohorts of the elderly. The median income of those over 65 has more than doubled (in constant 1990 dollars) since 1959 (from $6,609 to $14,183 for elderly men, from $3,447 to $8,044 for elderly women). However, the increases weren't felt equally; the incomes of elderly women living alone increased only 13% in the same period while those of Black women didn't increase at all between 1979 and 198732. In general, those living alone had the lowest median incomes; the majority of those over 75 who lived alone in 1990 had incomes below $10,000.

Although almost four million seniors were poor in 1990, the poverty rate dropped substantially from 1959 when over one-third of all seniors were poor. In 1990 only 12.2% of seniors were living in poverty—a rate roughly half that of the population as a whole. However, although women comprised 58% of those over 65, they accounted for almost three-fourths of the poor elderly.

Table 4 Older People Still in the Work Force, by Sex and Cohort over 60, 1990

AGE COHORTS	MEN		WOMEN	
	Urban	Rural	Urban	Rural
60-64	48.9%	48.8%	32.9%	27.7%
65-69	26.3	21.8	14.6	13.3
70-74	14.9	14.2	19.1	8.2
75-79	8.8	10.0	4.2	3.6
80-84	4.8	2.8	2.8	3.0
85+	1.3	3.6	1.1	.9

Source: Person Files

In addition to other demographic changes, those who will be elderly in the next decades will have substantial higher educational attainment than previous generations. In 1989 only 55% of elderly people had at least a high school education compared to 82% of those 25 to 64; 30 in 100 older people had completed only the eighth grade compared with only 8 in 100 among those 25 to 64. The Census Bureau has commented, "Improvements in educational attainment are likely to make notable differences in the interests of the future elderly, their needs, and abilities."

In fact all of the demographic changes described above will create an elderly population which will differ notably from previous generations in many important ways: they will be wealthier and better educated, substantially more diverse, much more likely to be living in the suburbs, and more likely in their own homes. All of these patterns will create important transportation differences and desires among older Americans in the future.

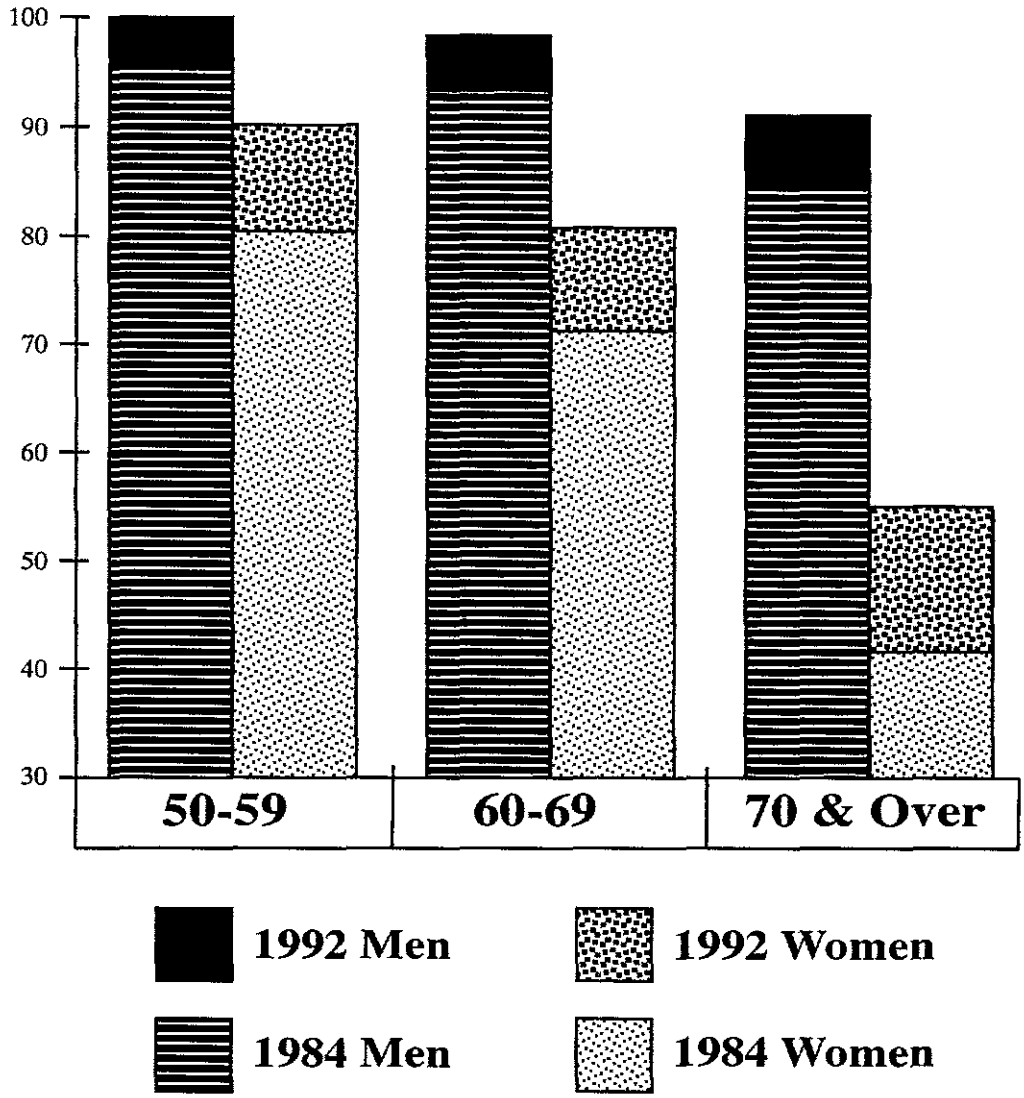
Changes in Licensing Rates

One of the most significant changes of the last three decades has been the increasing use of the private car by both older men and women. Figure 1 shows licensing data from the Federal Highway Administration for men and women over 50 in 1984 and 1992; licensing rates have gone up substantially for every cohort and far faster for women than for men. In 1992 over 98% of men and over 80% of women 60-69 had a driver's license but women's rates had increased 50% faster than men's in the same time period. However the most important message of Figure 1 is that licensing is almost universal among younger cohorts of older women so that a) the traditional gap between the sexes is lessening considerably and b) licensing will be close to universal for all seniors of both sexes by 2010.

The 1992 FHWA data in Figure 1 can be contrasted to 1990 NPTS data which tend to show slightly lower licensing rates among comparable cohorts under 70. However the NPTS data shown in Figure 2 also suggest that NPTS respondents *over 70* were more likely to have (or report having) a driver's license than their national counterparts. For example, the FHWA data indicate that an *average* of 55.3% of women over 70 drive while only one NPTS cohort over 70 shows a rate *that low.*

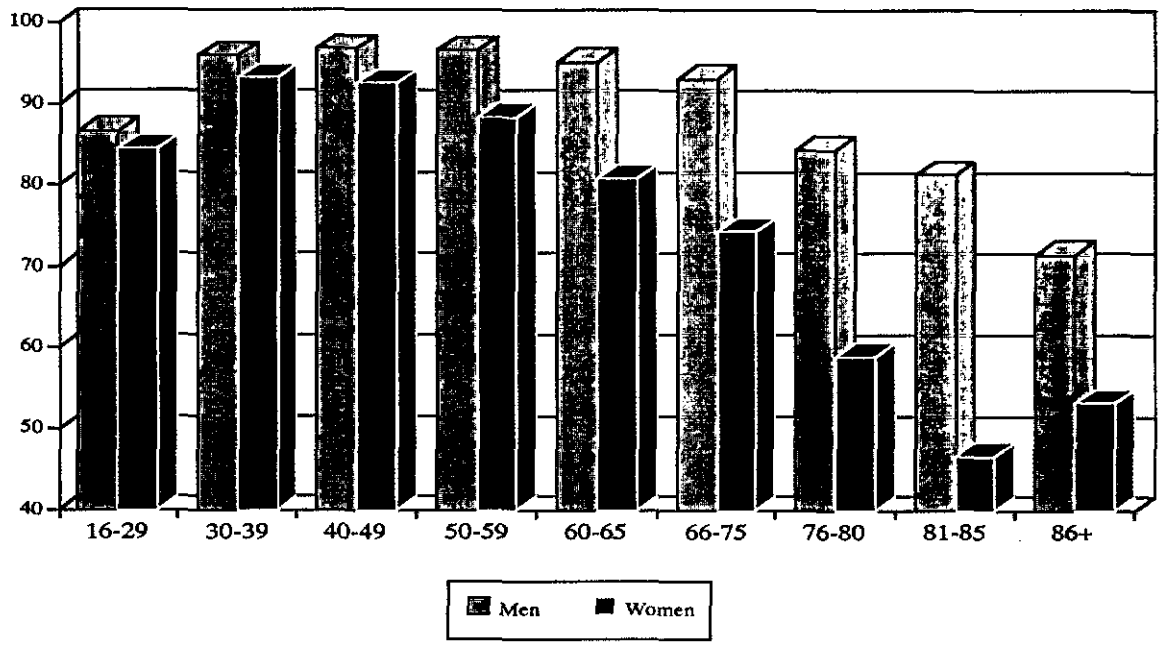
Yet both data sets show the same clear trends: licensing will be very high among both men and women who will be seniors in the next 30-40 years. By 2010 90% of women and almost 100% of men over 65 will be licensed drivers—drivers with over thirty years of driving experience.

Figure 1 **Licensing Rates Among Men and Women over 50, Using FHWA Data, 1984 and 1992**



Sources: FHWA, 1984 Highway Statistics, Table DL, Oct. 1985 and FHWA, Driver's Licenses, 1992, PL-94-006, October 1993, p.8.

Figure 2 Licensing Rates Among Men and Women, by Age, 1990 NPTS



Travel Trends

Most of the travel patterns of the elderly are a direct result of the interaction of the key demographic changes described above. As a group the elderly have more disposable income, are more likely to live in low density places, and are more likely to have a drivers license than their counterparts of just a few decades ago. Higher income, the ability to drive, and the need to use a car in suburban and rural areas where there are no alternatives explain many of the patterns described below.

The following section presents NPTS data on the travel patterns of those over 65 and various individual cohorts of the elderly, and then analyzes differences in those patterns by sex, license-holding, and race and ethnicity.

Dependence on Private Vehicles

Between 1977 and 1983 the dependence of the elderly on the private car, as a passenger or a driver, increased substantially in both urban and rural areas; the 1990 NPTS data indicate that these trends have only strengthened. Table 5 indicates the travel mode for all urban trips while Table 6 illustrates the travel mode for all rural trips. Both Tables clearly show that reliance on the private car has increased since 1983 for all cohorts of the elderly in both urban and rural areas. Given limited alternatives, it is not surprising that auto dependency is even higher in rural areas—where no fewer than 85% of all trips are made in a private vehicle. However, note that there is no cohort of the elderly who use the car for less than three-fourths of all their trips regardless of where they live.

Conversely, transit use fell in urban areas from fairly low levels in 1983 to even lower levels in 1990—no elderly cohort made more than 5% of their urban trips by transit, with the average closer to 2%. In rural areas, however, transit ridership, while minuscule, was recorded for the first time. It may be that rural transit options, particularly those geared at the elderly or those with disabilities, are becoming more available or attractive.

Table 5 Urban Travel Modes for All Trips by Cohort over 60, 1983 and 1990

	60-64		65-69		70-74		75-79		80-84		85+	
MODE	1983	1990	1983	1990	1983	1990	1983	1990	1983	1990	1983	1990
Private Vehicle	87.1%	92.9%	82.2%	89.4%	83.3%	89.7%	81.8%	87.0%	75.7%	82.6%	74.6%	76.5%
Public Transit	2.5	1.7	3.4	2.2	5.4	2.2	1.5	4.5	---	1.0	7.8	2.9
Taxi	.1	.1	.2	.2	.2	.3	1.3	.5	1.4	.8	---	2.9
Walking	8.0	4.6	12.6	7.3	10.1	7.3	12.0	7.8	22.2	13.6	17.6	16.2
All Others	2.3	.7	1.6	.9	1.0	.5	3.4	.2	.7	2.0	0.0	1.5

Source: Trip Files.

Table 6 **Rural Travel Modes for All Trips by Cohort over 60, 1983 and 1990**

	60-64		65-69		70-74		75-79		80-84		85+	
MODE	1983	1990	1983	1990	1983	1990	1983	1990	1983	1990	1983	1990
Private Vehicle	91.6%	95.2%	89.7%	94.7%	87.5%	95.2%	88.7%	93.2%	82.2%	90.5%	80.2%	86.3%
Public Transit	---	.2	---	.3	---	.5	---	.4	---	.6	---	3.4
Taxi	---	---	---	---	---	.4	---	.3	---	2.3	---	1.7
Walking	5.0	4.1	4.9	3.8	11.9	3.5	7.8	4.6	14.9	6.6	5.3	6.8
All Others	3.4	.5	5.4	.2	.6	.5	4.5	1.5	2.9	0.0	14.5	1.8

Source: Trip Files.

Table 7 **Percentage of Urban Shopping Trips Made by Alternative Modes by Cohort, 1983 and 1990**

	Transit		Walking		Taxi	
AGE COHORTS	1983	1990	1983	1990	1983	1990
60-64	2.0%	.7%	8.3%	5.7%	---	---
65-69	1.9	1.2	13.8	6.8	---	.1
70-74	4.9	2.7	12.1	8.7	---	.2
75-79	0.0	3.8	14.8	7.5	---	.6
80-84	0.0	.5	38.8	14.7	---	0.0
85+	16.6	0.0	50.9	9.2	---	1.5

Source: Unpublished data from 1983 NPTS, tape readable format, 1990 Trip Files.

In 1990, as in 1977 and 1983, both urban and rural residents were more likely to walk than to use public transit for trips not made by car—but the use of this mode fell by at least one third for most elderly travellers in urban areas and by one fourth for rural residents. Even though walking as a mode declined in importance, the oldest travellers were more likely to make trips this way than younger seniors in both urban and rural areas.

It is interesting that the use of the taxi was recorded for the first time in rural areas—for those over 70—and increased in importance slightly for some urban travellers. While the numbers are very small—and could be sampling artifacts—the reported use of taxis in rural areas may, in fact, reflect the growing development of rural public transit systems which often contract with taxi providers. The same phenomenon may be occurring in urban areas—where special transit operators often contract with taxi providers as well—or there may be an increased use of the next-best substitute for the private car—the full-fare taxi.

The elderly's dependence on alternative modes, however, was often greater for certain kinds of trips. Strikingly, while most cohorts of the elderly made more of their *medical and dental trips* by private vehicle than their other trips, they used the car *less* in 1990 than they had in 1983 for these kind of trips.

The patterns of urban *shopping* trips are somewhat different; as with medical trips, the overwhelming number of these trips were made by private vehicle but the dependence on the car *went up* for every cohort of the elderly from 1983 to 1990. Table 7 shows that public transit use and walking for shopping trips declined for almost every co-hort of the elderly. On the other hand, the use of the taxi for shopping went up, particularly for the very old—although the numbers are not high.

Overall Trip Patterns

Elderly individuals have become more mobile over time as measured by both trips taken and miles travelled. Between 1969 and 1990, men over 65 increased their miles driven by 55%, or over 2.1% annually, while women over 65 increased their miles driven by over 30%, or 1.2% annually[33]. Although the average elderly person took only 6% more trips in 1990 than in 1983, those trips were 19.4% longer; on average elderly individuals travelled almost 26% farther in 1990 than they had in 1983[34].

This mobility is clearly linked to the growing dependence of the elderly on the car. Table 8 shows the increase in miles driven for all travellers and for selected cohorts of the elderly. In the two decades covered

Table 8 Average Annual Miles Driven, by Driver Age, 1969-1990

	1969	1977	1983	1990
All Ages	8,685	10,006	10,588	13,181
60-64	8,112	8,002	8,568	10,314
65-69	5,850	6,277	6,804	8,347
70+	4,644	4,828	4,348	6,138

by these data, all Americans drove progressively more miles—with a substantial increase between 1983 and 1990. The average American drove almost 25% more miles in 1990 than in 1983; the younger cohorts of elderly drivers also increased their mileage substantially but at a slightly slower rate—a little over 20% in seven years. Remarkably, among those over 70 the increase in mileage was over 40%. (The drop in mileage among those over 70 from 1977 to 1983 is generally considered to be a sample size problem.) NPTS data show that rural seniors generally drove more than urban seniors of the same age-cohort.

Table 9 shows that the distribution of urban trips is remarkably similar for individual cohorts of the elderly—and hasn't changed substantially since 1983 for those under 80. Older seniors take a slightly greater percentage of shopping trips than younger seniors and more medical trips—but even among those over 85 not more than one trip out of fifteen is for medical purposes. Table 10 displays similar data for cohorts of the elderly in rural areas.

Table 11 compares aggregate data for rural seniors to those for urban seniors; note that the general patterns among seniors are roughly the same—over sixty percent of the trips of all cohorts of the elderly are for shopping or social activities. However church-related trips account for a larger percent while medical trips account for an even smaller percent of rural travel.

Table 12 presents data on the annual miles *driven* by age and sex and has several important messages. First, the Table clearly illustrates that rural seniors generally drive more than urban seniors of the same age cohort. Rural male drivers over 65 drive, on average, almost 8% more miles than their urban counterparts while female rural drivers generate almost 17% more miles than their urban counterparts. Except for the very oldest people, the discrepancy between rural and urban drivers actually increased as age increased; rural men 80-84 drove 33% more miles than comparable urban males.

Second, the Table shows that men drive substantially more than women; among all those over 65, urban men drive more than twice as far as urban women while rural men drive 92% more than rural women.

Table 9 Distribution of Urban Non-Work Vehicle Trips, by Cohort over 60, 1983 and 1990

	60-64		65-74		75-79		80-84		85+	
TRIP PURPOSE	1983	1990	1983	1990	1983	1990	1983	1990	1983	1990
Shopping	35.0%	32.9%	32.0%	33.7%	33.0%	32.7%	29.0%	39.5%	19.0%	36.6%
Combined Social	33.0	30.1	31.0	31.1	37.0	29.7	28.0	16.7	56.0	30.1
Family/Business	22.0	26.3	23.0	25.8	15.0	23.6	12.0	11.5	7.0	9.8
School/Church	7.0	6.7	7.0	7.0	7.0	6.7	17.0	5.5	11.0	15.7
Medical	3.0	2.9	3.0	2.5	8.0	5.0	2.0	16.7	7.0	7.8
All Others	---	1.1	.4	.9	0.0	2.3	2.0	3.0	2.0	0.0

Source: Trip Files.

Table 10 **Distribution of Non-Work Person and Vehicle Trips, by Those 65+, 1990**

Trip Purpose	VEHICLE TRIPS		PERSON TRIPS	
	Urban	Rural	Urban	Rural
Shopping	34.1%	29.9%	33.8%	29.4%
Combined Social	29.5	27.2	30.6	29.3
Family/Business	24.6	29.1	23.4	28.7
School/Church	7.5	10.3	7.3	9.9
Medical	3.2	2.6	3.2	2.7
All Others	1.1	.9	1.7	0.0

Source: Trip Files

Table 11 **Distribution of Rural Non-Work Person Trips, by Cohort over 60, 1990**

Trip Purpose	60-64	65-69	70-74	75-79	80-84	85+
Shopping	32.7%	32.6%	36.2%	32.3%	39.5%	32.7%
Combined Social	30.9	31.5	31.2	29.9	25.4	28.1
Family/Business	26.0	25.7	22.5	23.8	16.3	13.6
School/Church	6.4	6.8	6.6	6.5	10.3	17.6
Medical	2.9	2.3	2.7	4.9	5.4	7.0
All Others	1.1	1.1	.8	2.1	3.1	1.0

Source: Trip Files

Even within individual cohorts, there are striking differences; among those 75-79, for example, urban men drove 116% more miles than comparable women.

Perhaps the most striking message of this Table is that very old people drive so far; for example urban seniors *over 85* are driving, on average, over 85 miles per week, a substantial distance considering that they rarely make daily work trips. Even women over 85 are driving a significant distance; rural women over 85 are covering over 160 miles per month.

Suburban vs. Central City Patterns

Although almost three quarters of all elderly live in metropolitan areas, most of them actually live in what can broadly be called *suburbs*; that is, either separate jurisdictions near or adjacent to major urban centers, or, low density neighborhoods within large central cities but at some distance from the traditional core. In the South and Southwest, for example, many large central cities have annexed most of their suburbs; yet in spite of being legally within the central city, older Americans residing in such neighborhoods often live at very low density, miles from downtown, having no alternatives to the car for meeting most of their mobility needs.

Table 12 Average Annual Miles Driven, by Sex and Cohort over 60, 1990

AGE COHORTS	URBAN		RURAL	
	Men	Women	Men	Women
TOTAL 65+	8,951	4,320	9,706	5,046
60-64	12,509	6,046	15,243	7,527
65-69	10,666	4,982	11,169	6,464
70-74	8,742	4,561	10,703	4,665
75-79	7,675	3,554	8,312	3,917
80-84	5,028	2,591	6,680	3,709
85+	4,432	1,624	2,491	1,921

Source: Person Files

Table 13 indicates the impact of residing in (generally) lower density places within metropolitan areas. Overall, those over 65 living in the suburbs are more like their rural counterparts than their central city neighbors: suburban women over 65 drive 6% more than central city women while suburban men drive 14% more than comparable central city men. The patterns are even sharper when the elderly are grouped by cohort; for example, suburban men 75-79 drive 20% more, and those 65-69 7% more, than their central city counterparts.

Moreover, the drop in miles travelled that comes with advancing age, is far greater, absolutely and relatively, for the central city elderly under 80; central city men 75-79 drive 35% fewer miles than comparable central city men between 65-69 while suburban men 75-79 drive 27% fewer miles than men 65-69 in suburban areas. (The reverse tendency among those in the very oldest cohorts may be a sample size problem.)

Table 14 examines the mode choice of elders living in different parts of metropolitan areas. As might be expected, suburban elders are more likely to drive or ride in a car than their city counterparts. While the vast majority of trips taken by all older people is taken in a private vehicle, suburban travellers are far more dependent on the car. Surprisingly, walking is almost as important a travel mode for suburban elders (and more important for all women than for men). Conversely, transit is not a major mode for any of the elderly (who are more than twice as likely to walk as to take transit, even in central cities) but transit use is higher in central city areas than in the suburbs.

Table 13 Annual Miles Driven by People 65+ Residing in Different Locations, by Cohort, 1990

	CENTRAL CITY		SUBURBS		RURAL	
AGE COHORTS	*Women*	*Men*	*Women*	*Men*	*Women*	*Men*
Total 65+	**4,054**	**8,697**	**4,630**	**9,235**	**5,046**	**9,706**
65-69	4,683	10,327	5,311	11,083	6,464	11,169
70-74	4,069	8,417	4,819	8,838	4,665	10,703
75-79	3,485	6,738	3,723	8,093	3,916	8,312
80-84	2,959	5,100	1,843	4,944	3,709	6,680
85+	1,914	4,668	1,650	5,630	1,922	2,491

Table 14 **Percentage of Total Trips by Selected Modes, People over 65 Living in Metropolitan Areas, by Sex, 1990**

	CENTRAL CITY		SUBURBS	
	Men	Women	Men	Women
PRIVATE VEHICLE				
Percentage	88.5%	85.1%	91.5%	89.1%
N	1604	1787	1384	1432
TRANSIT				
Percentage	3.3	3.3	1.3	1.7
N	60	69	19	28
WALKING				
Percentage	7.0	10.2	6.7	8.0
N	126	214	101	128
TAXI				
Percentage	.3	.8	.1	.3
N	6	16	1	4

Contributing Elements

The elderly are not a monolithic group; the section above analyzed differences in travel behavior by cohort and residential location. However, the socio-demographic data presented in the first, introductory, part of this report suggest that sex, race, and ethnicity may create significantly different travel patterns among elderly travellers. The following section evaluates differences in key measures of travel behavior first by sex, then by license holding, and then by sex, race, and ethnicity.

It is important to note that disaggregating the NPTS data to this level sometimes creates cells with a very small number of respondents. Therefore, interesting or even counter-intuitive findings could well reflect a sample size problem.

Differences by Sex

The more aggregate data above have already shown some important differences between male and female seniors. This section focuses more clearly on differences in an array of indicators of travel behavior. First, Table 15 shows that while women and men's travel mode choices are similar, they are not the same. Both men and women depend on the car for the overwhelming percentage of their trips; however women are slightly less dependent—although not as much less as might be expected given licensing (and income) differences. Other NPTS data show that although 10% fewer women 65-69 and 30% fewer of those above 70 had a license, they were almost as likely to take their trips in cars as comparable men, clearly more as a passenger.

Although women were slightly more likely to use public transit and taxis, the largest and most important difference between men and women lies in the use of walking as a purposeful mode—women walked for the trips which they did not take in a private vehicle.

Table 15 Travel Modes for All Trips by Sex for Those over 65, 1990

	URBAN			RURAL		
MODE	ALL	Men	Women	ALL	Men	Women
Private Vehicle	88.3%	89.9%	86.8%	94.0%	95.0%	93.1%
Public Transit	2.5	2.4	2.6	.5	.2	.7
Taxi	.4	.2	.5	.4	.3	.5
Walking	8.1	6.8	9.2	4.1	2.6	5.6
All Others	---	---	---	---	---	---

Source: Trip Files

Table 16 presents data on differences in the *distribution of person and vehicle trips* for men and women in urban areas. Although there are differences, they are not large; the relative importance of the various trips is almost identical. Men make only slightly fewer shopping trips and slightly more social trips while women make slightly more church-related and medical trips. Given how many trips of both sexes are made in a private vehicle, it is not surprising that vehicle and person trip distribution are almost the same.

Table 17 examines three indices of travel behavior: *daily person trips, daily person miles, and daily vehicle trips.* Here the differences between the sexes are far more clear cut. Men over 65 take more person and vehicle trips and cover more miles than comparable women in every cohort of the elderly. Overall, elderly men make 24% more person trips, travel 19% more miles, and make 94% more vehicle trips. The gap between the sexes widens after 75; for example, there is a 12% difference in person trips among those 70-74 but a 67% difference among those over 85. The differences are greatest for vehicle trips; men 80-84 make four times the vehicle trips made by comparable women.

Table 17 also has another clear message; trip making declines substantially as people age, with the biggest decline seen among those over 85. Men 65-69 make more than twice the number of person trips travelling more than three times the number of miles as men over 85. Women 65-69 make almost four times the number of person trips and nine times the number of vehicle trips as women over 85. Interestingly between 65 and 75 men's travel dropped faster than women's on all three indices.

Table 18 presents similar data for rural areas. Although as a group both elderly men and women in rural areas make fewer person trips and roughly the same number of vehicle trips as their urban counterparts, they travel more miles. However, most of the same trends identified above can be seen in rural patterns: travel declines as people age, men's initially declines more than women's, and there are important differences between the sexes in all age-cohorts.

Table 16 Distribution of Urban Vehicle and Person Trips Without Work Trips by People 65+ by Sex, 1990

TRIP PURPOSE	VEHICLE TRIPS			PERSON TRIPS		
	ALL	Men	Women	ALL	Men	Women
Shopping	34.1%	33.6%	34.4%	33.8%	33.0%	34.5%
Combined Social	29.5	30.5	28.6	30.6	31.8	29.6
Family/Business	24.6	26.2	23.1	23.4	25.1	22.0
School/Church	7.5	5.9	8.9	7.3	5.6	8.7
Medical	3.2	2.8	3.6	3.2	2.7	3.7
All Others	1.1	1.0	1.4	1.7	1.8	1.5

Source: Person Files.

However, there are some interesting differences between urban and rural elderly travellers. First, urban men below 70 make more person and vehicle trips than their rural counterparts but the reverse is true after 70. Second, travel declines among women more rapidly with age than it does in urban areas, which may more clearly show the drop caused by stopping work. For example, rural women's person miles dropped almost 33% from 60-64 to 65-69 while urban women 65-69 actually travelled more than slightly younger women!

The Impact of License Holding

Some of the large differences (seen above) between men and women among the older elderly may reflect differences in license holding since less than 60% of female NPTS respondents but over 70% of male respondents over 70 have licenses. Figure 3 shows the travel behavior of urban men and women over 60 by their license holding status. In urban areas, in every age category men with licenses make more person trips than women with licenses and the differences intensify with increasing age. However, the differences between those without licenses in urban areas move in unexpected directions. Women between 65 and 74 and over 80 who do not have licenses travel *more* than comparable men.

Figure 4 shows comparable data for elderly people in rural areas displaying some interesting contrasts to urban data. Men with licenses travel more than women with licenses *but* only until the age of 80 when older women with licenses travel more than comparable men. However, the gap between licensed men and women younger than 80 is greater in rural areas than in urban areas. In short, having a license explains

Table 17 Key Parameters of Urban Travel, by Sex and Cohort over 60, 1990

AGE COHORTS	AVERAGE DAILY PERSON TRIPS		AVERAGE DAILY MILES TRAVELLED		AVERAGE DAILY VEHICLE TRIPS	
	Men	Women	Men	Women	Men	Women
Average 65+	2.23	1.80	16.02	13.48	1.82	.94
60-64	3.00	2.48	28.52	16.46	2.57	1.54
65-69	2.64	2.26	20.01	20.46	2.22	1.21
70-74	2.26	2.01	14.21	14.97	1.86	1.07
75-79	1.99	1.60	14.31	9.33	1.56	.92
80-84	1.56	1.08	14.11	3.57	1.14	.50
85+	1.10	.66	4.11	2.52	.73	.14

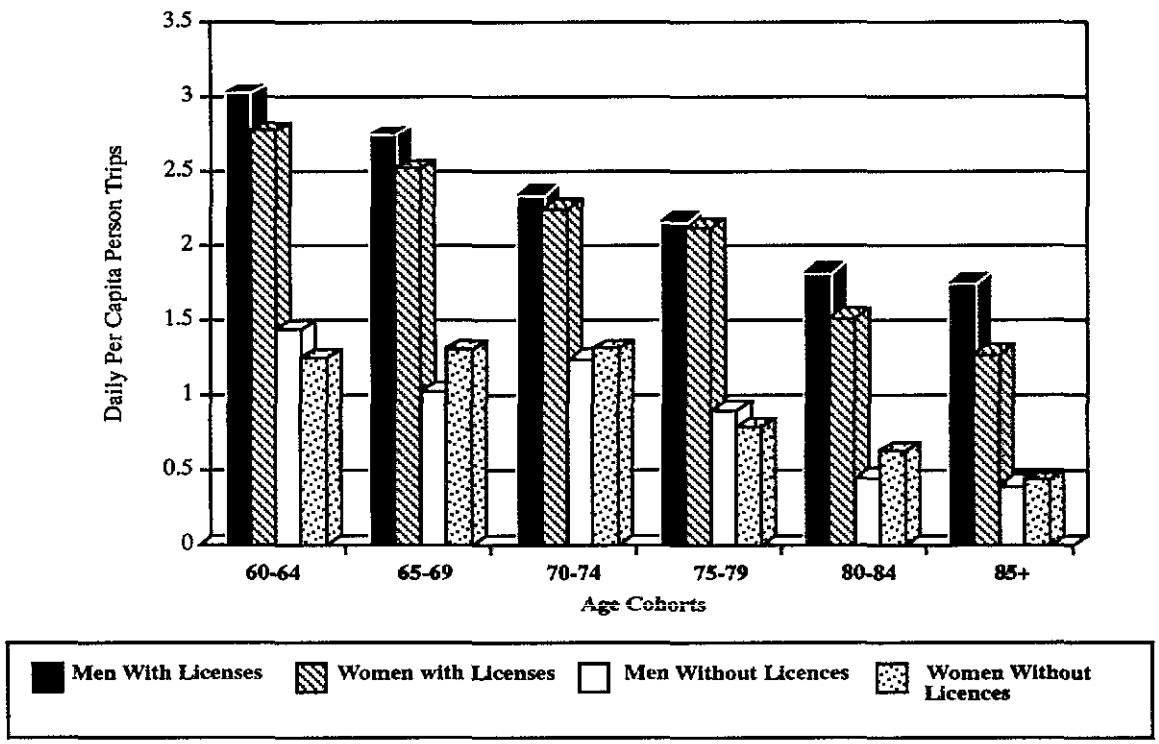
Source: Person Files.

Table 18 **Key Parameters of Rural Travel, by Sex and Cohort over 60, 1990**

AGE COHORTS	AVERAGE DAILY PERSON TRIPS		AVERAGE DAILY MILES TRAVELLED		AVERAGE DAILY VEHICLE TRIPS	
	Men	Women	Men	Women	Men	Women
Average 65+	2.19	1.69	23.88	13.49	1.82	.98
60-64	2.79	2.53	32.25	24.29	2.51	1.57
65-69	2.46	2.10	27.41	18.27	2.11	1.29
70-74	2.47	2.07	23.64	15.59	2.15	1.29
75-79	2.10	1.31	27.57	10.63	1.74	.60
80-84	1.55	1.10	12.36	6.78	1.09	.59
85+	.65	.73	10.73	5.16	.36	.23

Source: Person Files.

Figure 3 **Daily Per Capita Urban Person Trips, by Sex and License Holding**



some but not all of the differences between men and women's travel rates in urban areas and far less of the differences in rural areas.

Table 19 shows the impact of having a license by calculating the increase in trip making that accompanies license holding among urban elderly travellers. Clearly, having a license substantially increases the number of trips and miles travelled. However, it is interesting to note that having a license has more impact on the *trip rate of men* but on the *miles travelled by women.* Overall both the trips and miles of men over 65 almost double when they have a license but the trip rates of women only (!) go up 135%.

The Table does clearly show how much impact the license—or the physical and financial ability to drive and maintain a car—has on much older people: men over 85 with licenses travel three times as much as men without licenses while women over 85 with licenses travel almost ten times more than those without.

Tables 20 and 21 show the actual person trip rates of older men and women who do and do not have licenses; the former presents urban data and the latter presents rural data. The specific data make clear that the most significant drop in travel occurs at the age of 80 for both men and women and in both urban and rural areas (with the exception of rural women over 85).

Figure 4 **Daily Per Capita Rural Person Trips, by Sex and License Holding**

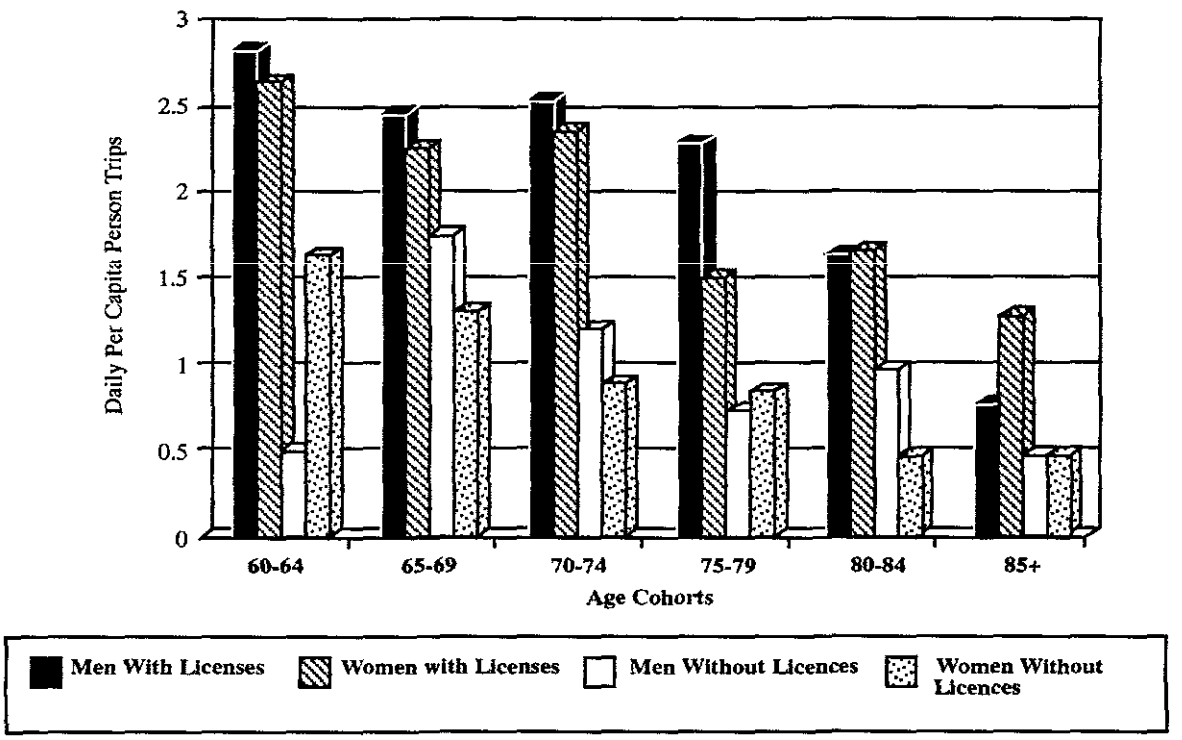


Table 19 Increased Travel by Urban License Holders, by Sex, 1990

AGE COHORTS	MEN		WOMEN	
	Person Trips	Person Miles	Person Trips	Person Miles
TOTAL 65+	185.9%	199.1%	135.5%	216.2%
60-64	108.8	219.3	122.8	105.3
65-69	166.3	55.5	93.2	232.1
70-74	88.8	94.8	72.2	14.3
75-79	135.9	832.4	161.4	303.8
80-84	243.4	293.1	140.6	466.0
85+	288.9	318.3	166.7	909.8

Source: Person Files

Table 20 **Daily Per Capita Person Trips, by Sex and License Holding, Urban**

AGE COHORTS	MEN		WOMEN	
	With	Without License	With	Without License
65+	2.43	.85	2.29	.96
60-64	3.09	1.48	2.83	1.27
65-69	2.77	1.04	2.57	1.33
70-74	2.36	1.25	2.29	1.33
75-79	2.17	.92	2.17	.83
80-84	1.82	.53	1.54	.64
85+	1.75	.45	1.28	.48

Source: Person Files

Table 21 Daily Per Capita Person Trips, by Sex and License Holding, Rural

AGE COHORTS	MEN		WOMEN	
	With	Without License	With	Without License
65+	2.31	.95	2.08	.81
60-64	2.86	.50	2.67	1.64
65-69	2.49	1.77	2.28	1.31
70-74	2.55	1.21	2.39	.89
75-79	2.28	.72	1.53	.84
80-84	1.63	1.00	1.67	.48
85+	.75	.47	1.29	.51

Source: Person Files

Race and Ethnicity

There is growing evidence that younger travellers with different racial and ethnic backgrounds have different travel patterns—patterns which they may well retain as they age. Moreover, a body of work shows that ethnic families behave differently toward their elderly relatives, creating different expectations among seniors about the travel and other assistance they will get from family members. Therefore, this sub-section evaluates the impact of race and ethnicity on travel patterns.

The relevant data in the NPTS are organized to include Hispanics, who can be of any race, and then separately, White, Black, and races Other than White or Black. For purposes of comparison, these data are shown together in the Tables in this section. Note however, that 1) data on Hispanics were originally compiled separately, and 2) that there are Hispanics among both the Black and White data shown in these tables—in other words these are not mutually exclusive categories.

Table 22 first introduces the issue of race and ethnicity. The data clearly show that all ethnicities and races other than whites depend significantly less on the private vehicle—although most trips are still made in a car and all elderly people are more likely to walk than to take transit. Interestingly Hispanics and Blacks are more likely to use a taxi for their trips than whites, but the numbers are still small.

Table 22 Urban Travel Mode for All Trips, Those over 65 by Race and Ethnicity, 1990

MODE	HISPANIC (Any Race)	WHITE	BLACK	OTHER
Private Vehicle	81.4%	89.9%	70.3%	70.4%
Transit	4.0	1.5	13.6	14.0
Walk	11.3	7.6	14.6	13.4
Taxi	.6	.4	.8	---
All Others	2.7	.6	.7	2.2

Source: Trip Files.

Table 23 analyses the travel mode chosen by elders of different races and ethnic backgrounds for two trips which account for almost 70% of non-work travel—shopping and family/personal business. As in the aggregate totals, whites use the car for a greater percentage of these trips and are less likely to walk than those of other racial or ethnic backgrounds. Interestingly, there is some difference in mode choice for the two trips; for example, Blacks make just under 71% of their shopping trips but almost 77% of their family/personal business trips using a private vehicle. In fact, in all cases elderly travellers are more likely to use alternative modes for shopping, usually walking (although seniors of races other than Black or White are more likely to use transit if they don't go in a car).

Table 24 disaggregates these figures further to examine differences between the sexes. As in the Tables above there are major differences between white seniors and those of other racial or ethnic backgrounds but there is far less difference between men and women within each group, with one exception: Hispanic women are significantly less likely to use a private vehicle than are comparable men. Interestingly, women of all backgrounds are more likely to use taxis and generally more likely to use transit than comparable men, with one exception: Black older women use transit for slightly fewer of their trips than Black men.

Table 25 analyzes the travel mode chosen by elderly of different backgrounds for the two major non-work trips—although it should be noted that there are sample size problems in this level of disaggregation. Again, most of the patterns seen in the Tables above are seen here but it is clear that there are important differences between men and women within each group and between types of trips. First, some of the differences between whites and all other seniors are now seen to be as much the differences between the sexes within each group. For example, for personal/family business trips Hispanic women are substantially less likely to travel in a car than are Hispanic men.

Conversely Black senior women are *more* likely to use a car for shopping trips than comparable men. Hispanic older women are much more likely to use a taxi for shopping trips than any other men or women while Black women and those of other races are substantially more likely to use transit for shopping.

Table 23 **Travel Mode for Urban Shopping and Family/Personal Business Trips, Those 65+, by Race and Ethnicity**

	HISPANIC (Any Race)		WHITE		BLACK		OTHER	
MODE	*Shopping*	*Business*	*Shopping*	*Business*	*Shopping*	*Business*	*Shopping*	*Business*
Private Vehicle	80.6%	85.0%	90.6%	91.3%	70.7%	76.7%	70.3%	77.8%
Transit	5.6	3.3	1.1	.5	11.4	13.7	18.9	14.8
Walk	11.1	11.7	7.7	8.2	16.3	9.6	8.1	7.4
Taxi	2.8	—	.2	.3	---	---	—	---
All Others	0.0	0.0	.4	0.0	1.6	0.0	2.7	0.0

Source: Trip Files.

Table 24 **Urban Travel Mode for All Trips, Those over 65, by Sex, Race, and Ethnicity**

	HISPANIC (Any Race)		WHITE		BLACK		OTHER	
MODE	*MEN*	*WOMEN*	*MEN*	*WOMEN*	*MEN*	*WOMEN*	*MEN*	*WOMEN*
Private Vehicle	85.6%	74.2%	91.6%	88.4%	71.0%	69.7%	70.7%	70.0%
Transit	3.6	4.6	1.4	1.7	13.7	13.5	12.1	16.3
Walk	9.0	15.2	6.2	8.7	13.7	15.4	14.1	12.5
Taxi	---	1.5	.2	.5	---	1.4	---	1.2
All Others	1.8	4.5	.6	.7	1.6	0.0	3.1	0.0

Source: Trip Files.

Table 25 Urban Travel Mode for Selected Trips, Those over 65, by Sex, Race, and Ethnicity

Race and Sex		PRIVATE VEHICLE		TRANSIT		WALK		TAXI		OTHER	
		Shop.	Pers. Bus.	Shop.	Pers. Bus.	Shop.	Pers. Bus.	Shop.	Pers. Bus.	Shop.	Pers. Bus.
HISPANIC (All Races)	MEN	81.8%	94.9%	0.0%	5.1%	18.2%	0.0%	---	---	0.0	0.0
	WOMEN	78.6	66.7	14.3	---	---	33.3	7.1	---	0.0	0.0
WHITE	MEN	93.1	96.2	.8	.6	5.6	2.9	.2	---	.3	.3
	WOMEN	88.5	92.3	1.4	2.1	9.5	4.7	.3	.6	.3	.3
BLACK	MEN	76.8	76.3	3.6	15.8	16.1	7.9	---	---	.3	0.0
	WOMEN	65.7	77.1	17.9	11.4	16.4	11.4	---	---	0.0	.1
OTHER	MEN	77.8	79.0	11.1	15.8	11.1	5.3	---	---	0.0	0.0
	WOMEN	63.2	75.0	26.3	12.5	5.3	12.5	---	---	5.2	0.0

Table 26 evaluates whether these racial/ethnic as well as gender differences are seen in other measures of urban travel; the Table summarizes the daily travel patterns of various groups of older men and women. White seniors of both sexes make more vehicle and person trips and travel more miles than other racial and ethnic groups (with the single exception of vehicle trips by men of other races). At the same time, women make fewer trips and travel fewer miles than comparable men in all but one of the groupings. However because white seniors travel so much more than other seniors, white women make more person trips than men in any other group.

The Table also shows that the gap in travel between the sexes is not uniform across racial and ethnic groups; in general white men and women are more similar than are the sexes of other racial and ethnic backgrounds. For example, white senior women travel 86% of the person miles of white men but Black women travel only 50% of the person miles of comparable men. White older men make 21% more daily person trips than comparable women but Hispanic older men make more than twice the person trips of comparable Hispanic women (compared to Black men who make 47% more trips than Black women).

Income Effects

Since we know that there are great income disparities among those over 65—with women and minorities more likely to be poor—it is possible that some or all of the differences seen in the previous sections of this paper actually represent differences in income rather than the impact of sex or racial/ethnic background or residential location. This section evaluates the impact of income on travel differences among those living in urban and rural places, the sexes, and those of different racial and ethnic backgrounds. Unfortunately examining travel differences by income as well as residential location, etc. creates fairly small samples, especially at the extremes of the spectrum. Therefore, it is often difficult to know if variations from overall trends result from sample size problems or represent genuine differences in travel behavior among different groups of older Americans.

Table 26 Key Parameters of Urban Travel by Those 65+, by Sex, Race, and Ethnicity, 1990

	DAILY PERSON TRIPS		PERSON MILES		DAILY VEHICLE TRIPS	
Race	Men	Women	Men	Women	Men	Women
HISPANIC (All Races)	1.88	.92	7.63	4.25	1.31	.46
WHITE	2.29	1.89	16.83	14.58	1.91	1.02
BLACK	1.73	1.18	9.45	4.69	1.17	.41
OTHER	1.65	1.10	8.53	8.50	.98	.38

It is generally thought that as income increases so do a) overall travel and b) use of the car. Table 27 shows that traditional ideas about the effect of income on the travel patterns of older Americans hold in the aggregate, although there are meaningful differences between otherwise comparable rural and urban areas. The Table gives the average annual miles driven by each of 11 income groups; overall both urban and rural travellers drive more with increasing income. Older urban travellers with household incomes over $70,000 drive 233% more miles than those with incomes under $5,000 and 34% more than those with incomes between $25-30,000. In rural areas those with incomes between $25-30,000 drive 3,555 more miles a year than those with incomes between $10-15,000 and 895 fewer miles than rural elders making over $70,000.

Table 28 questions whether income differences explain the travel differences seen earlier between men and women. The Table's data confirm that, *in general,* there is a positive relationship between income and travel use for older Americans of both sexes; as household income rises so do personal trips and personal and vehicle miles for both men and women. However, 1) the increase in travel and auto use is far greater for men than for women, and as a consequence, 2) there are important differences between comparable men and women.

At the very lowest income level women make more trips and travel longer; under $10,000 they produce more person miles as well. But at almost all other income levels men travel much longer and more often in a vehicle; for example, men in households with incomes between $20-25,000 make almost 12% more person trips, travelling 8% more person miles and 182% more vehicle miles (making 115% more vehicle trips) than comparable older women.

It is among households with incomes between $30-60,000 that we see the most interesting differences between men and women. While total average vehicle miles continue to rise substantially with income among men, they actually fall for women. In addition, women don't exhibit as clear a relationship between personal miles and vehicle miles travelled as comparable men; for example older women in households making between $30-40,000 travel almost *five times* (*ie* 500%) as many personal as vehicle miles daily[35]. No income grouping of men over $5,000 travel as much as 50% more personal than vehicle miles.

Table 27 **Average Annual Miles Driven by People over 65 in Urban and Rural Areas, by Income, 1990**

Household Income	URBAN		RURAL	
	N	*Average Miles*	*N*	*Average Miles*
Under $5,000	15	2,986	35	2,434
$5-10,000	186	4,251	153	4,419
$10-15,000	213	4,455	191	6,815
$15-20,000	217	6,543	172	7,015
$20-25,000	166	7,300	112	8,125
$25-30,000	139	7,385	98	10,367
$30-40,000	242	7,368	148	10,394
$40-50,000	117	8,258	61	9,207
$50-60,000	75	7,731	32	8,178
$60-70,000	55	10,107	18	8,444
$70,000+	97	9,932	42	11,262

Table 28 **Key Parameters of Urban Travel by Those over 65, by Sex and Income, 1990**

Household Income	PERSON TRIPS		PERSON MILES		VEHICLE MILES	
	M	*F*	*M*	*F*	*M*	*F*
Under $5,000	.69	1.02	1.58	2.00	.75	.99
$5-10,000	1.88	1.52	6.09	7.93	5.29	3.89
$10-15,000	1.77	1.71	12.77	6.45	10.85	3.16
$15-20,000	1.95	1.88	19.33	21.68	9.62	3.98
$20-25,000	2.51	2.25	17.24	12.84	11.85	4.20
$25-30,000	2.67	2.24	17.71	15.08	12.82	7.24
$30-40,000	2.59	2.52	15.49	28.65	12.92	5.84
$40-50,000	3.10	2.00	14.85	13.45	12.80	5.73
$50-60,000	2.65	2.38	23.67	9.92	17.92	3.90
$60-70,000	2.98	1.72	38.19	28.70	27.68	6.05
$70,000+	2.71	1.76	29.19	36.79	25.87	5.62

Suburban elders are better off financially than those living in the central cities so Table 29 questions whether the aggregate differences seen in previous sections are actually the result of income differences between metropolitan elders. Although there are clearly sample size issues, the Table shows, that as in previous analyses, men and women have different driving patterns and the gap between the sexes is greater at higher household incomes. But the more important point made by this table: in all but the highest and lowest income categories suburban men drive more, often substantially more, than their central city counterparts. For example, suburban men with household incomes between $25-30,000 drive 55% more miles than their suburban counterparts. (The differences at the extremes of the income scale may result from sample size problems).

The Table also shows that suburban women also drive more than comparable central city women in all but three income categories although the gap is not generally as wide as that seen among men. For example, suburban women with household incomes of $40-50,000 drive 44% more miles than comparable central city women; however among those with incomes between $25-30,000, suburban women drive only 7% more than their central city counterparts.

Table 29 Annual Miles Driven by People 65+ Living in Urban Areas, by Sex and Income, 1990

	CENTRAL CITY				SUBURBS			
	WOMEN		MEN		WOMEN		MEN	
	Miles	N	Miles	N	Miles	N	Miles	N
Under $5,000	1,943	7	5,500	2	2,567	3	4,167	3
$5-10,000	3,059	76	4,986	54	4,883	36	5,655	36
$10-15,000	3,901	66	5,714	61	2,300	49	6,223	49
$15-20,000	4,230	59	4,230	60	4,547	40	7,224	40
$20-25,000	3,765	41	9,673	48	4,034	35	10,761	35
$25-30,000	4,077	33	7,055	30	5,585	30	10,955	30
$30-40,000	5,237	66	9,118	57	4,606	55	9,834	55
$40-50,000	4,228	22	9,762	42	6,080	21	10,482	21
$50-60,000	4,433	18	9,175	20	5,465	14	10,436	14
$60-70,000	6,400	11	14,923	13	6,600	12	11,174	12
$70,000 Plus	5,925	20	18,760	26	3,577	22	9,605	22

Table 30 aggregates income groupings in order to look at the impact of income on the racial and ethnic differences seen in earlier sections of this report; because of sample size problems, without such groupings there are very few other-than-White respondents in each income category. The Table shows that there is clear and positive relationship between household income and average annual miles driven by older men and women in most racial and ethnic groups; in general as income rises so do miles driven.

However, there is a substantial difference between White men and all other men; their average milage starts higher and climbs more quickly with income. White men in households making under $20,000 travel 63% more miles than comparable Hispanic men and 36% more than Black men. At household incomes between $20-40,000, White men travel 177% more miles than comparable Hispanic men and 79% more than Black men. Most telling: while White men in households making over $40,000 drive 4,650 (or 64%) more miles than comparable men with incomes below $20,000, the difference among Blacks is only 1,065 miles or 20% more.

The Table also shows that household income does not appear to explain the differences among men and women in the same group nor between groups of older women. In almost all income groupings men drive substantially more than comparable women (with two exceptions); for example, Hispanic older women in households making over $40,000 drive, on average, 64% fewer miles than comparable men. White women from such households drive 56% less than comparable men—but also 57% less than comparable Other women and 17 % less than Hispanic women.

Table 30 Average Annual Miles Driven by People 65+ Living In Urban Areas, by Sex, Race, Ethnicity, and Income, 1990

INCOME	HISPANIC		WHITE		BLACK		OTHER	
	N	Miles	N	Miles	N	Miles	N	Miles
Under $20,000								
Men	27	4,482	669	7,295	57	5,374	29	4,513
Women	35	3,385	1,102	3,920	112	4,633	29	3,950
$20-40,000								
Men	16	3,983	552	11,029	25	6,158	18	3,873
Women	19	4,156	589	5,151	19	667	15	7,400
Over $40,000								
Men	7	17,571	310	11,945	15	6,439	11	14,889
Women	11	6,083	282	5,218	19	3,300	17	8,188

Figure 5 illustrates the average daily person trip rates of women from various backgrounds in the three aggregate income groupings; as expected, travel goes up as income goes up. However, the increased number of daily trips is very small for Hispanic elders (from 1.26 to 1.27) and not much greater for Black elders (from 1.2 to 1.4). It is clear that the daily trip rate for White women is substantially higher than all other ethnic groups, with the largest difference in the $20-40,000 range. However even at household incomes above $40,000 White women make 65% more trips (2.1) than Hispanic women (1.27) and 50% more trips than Black women (1.4).

Figure 6 is the comparable figure for men from various backgrounds; here the pattern is not so clear. It is only among White older men that we see the expected relationship between increasing income and travel; among other-than-White male elders the highest trip rate is at the low-middle income grouping. White men generally have higher trip rates than other men regardless of household income but at incomes between $20-40,000 the gap is much less than that seen among older women. The gap between White and all other men is also slightly less than that experienced by women at incomes above $40,000; in that income group White older men make 3.02 trips per day, 62% more trips than Hispanic (1.86) and 67% more trips than comparable Black men (1.60).

The two Figures taken together also show that, regardless of household income, older women generally travel substantially less than comparable men. At incomes below $20,000 White women make 1.66 trips per day compared to 1.98 trips by White men; at incomes above $40,000 White women make 2.10 trips compared to 3.02 trips made by men. Only at incomes below $20,000 do Hispanic women make more

Figure 5 Average Daily Person Trips, Total, by Women over 65, by Race and Ethnicity, 1990

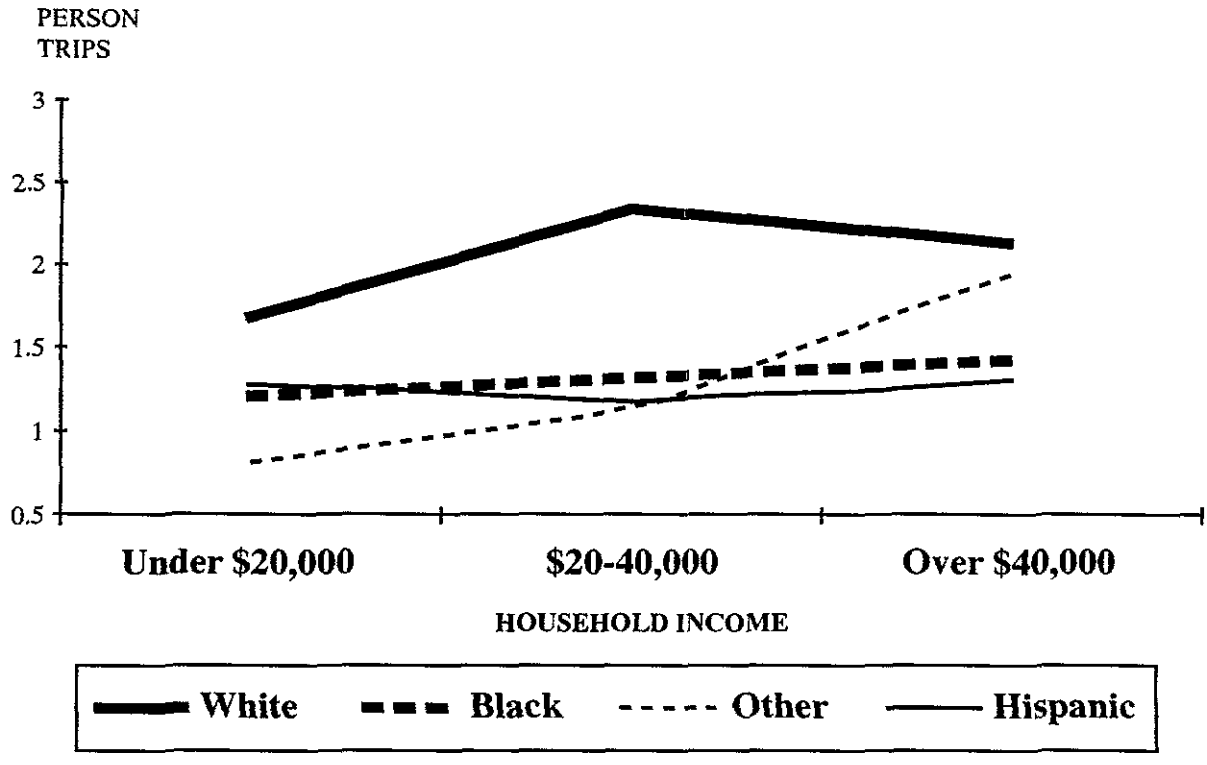
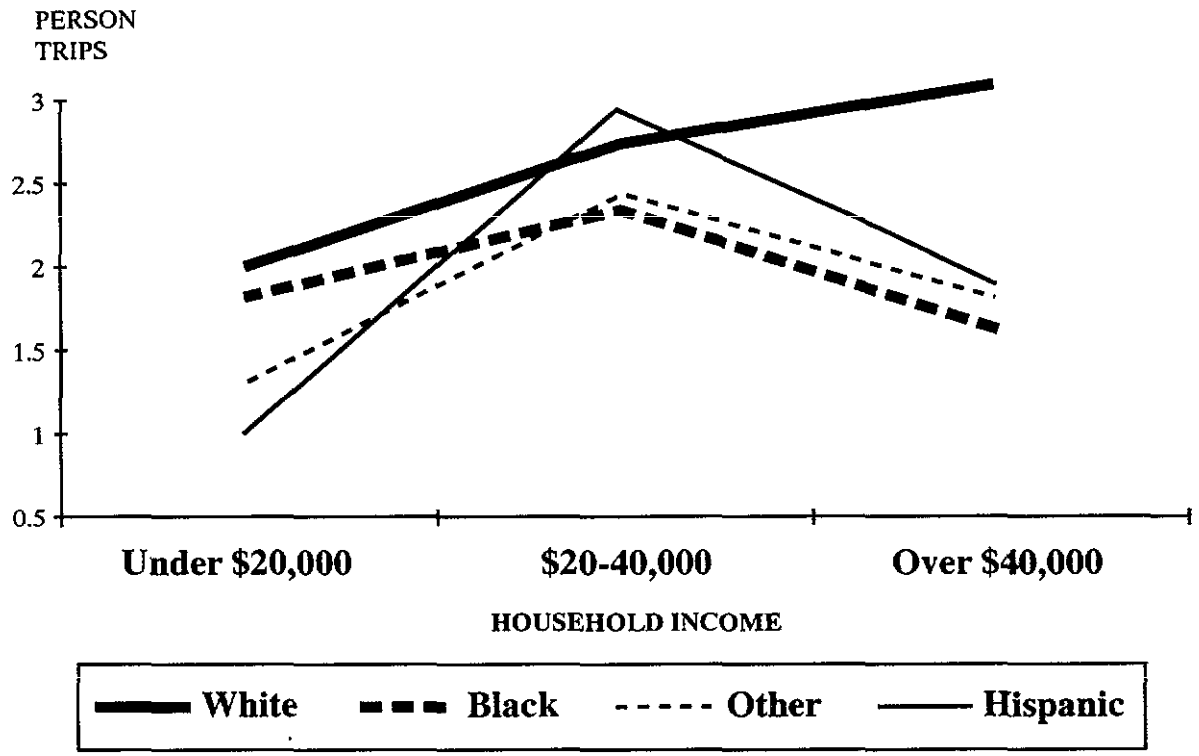


Figure 6 **Average Daily Person Trips, Total, by Men over 65, by Race and Ethnicity, 1990**



trips than Hispanic men; at incomes between $20-40,000 Hispanic women make 1.16 trips compared to 2.90 trips made by Hispanic men.

However the most important message of these figures is that there are racial and ethnic differences in travel among older Americans which are not explained by household income. Income does have some of the postulated effect—travel increases as income does—but other factors also seem to be at work.

However, it must be noted that the aggregations shown in these graphics are very gross; it is possible that certain groups are disproportionately represented in the lower end of each income grouping. Moreover, 1) the numbers of other-than-White elders are relatively small, 2) there is no control for age although we would expect that more of the women are very old (trip-making declines with age regardless of income), and 3) we have not taken account of differences in residential living patterns (ie it is possible that certain groups are more likely to live in denser central cities which would more affect their trip length and choice of mode). Thus the way the data are grouped could, in fact, be "creating" the results rather than demonstrating actual differences among the elderly.

In summary, however, the data in this section suggest that household income does not explain all or even a great deal of the differences described earlier between older men and women, and among elders from different ethnic and racial backgrounds.

Findings and Conclusions

Summary

The elderly are the fastest growing component of the U.S population and the very old are the fastest growing component of the elderly. Most elderly people today are drivers and over three fourths live in low density suburban or non-metropolitan places—places where the use of the private car is either encouraged or absolutely necessary. Although a declining *percentage* of the elderly live in rural areas, there is often a high *concentration* of elderly in the rural areas where they do live—areas where they face severe isolation if they lack transportation options.

The diversity seen among younger Americans is increasingly being seen among those now elderly and there is little doubt that it will increase in the future. Cultural and ethnic preferences have important transportation implications; people will bring to their senior years the social, personal, and recreational patterns shaped by these preferences—including their traditional travel patterns—which include a very significant dependence on the private vehicle.

Over the last three decades the overall physical, educational, and financial status of the elderly has improved markedly but women and people of color have not shared proportionately. Women comprise the largest component of the very old and the largest component of those living in poverty. Elderly women are many times more likely to live alone and rent rather than own their homes. All of these socio-economic factors also have important transportation implications.

The 1990 NPTS data show an elderly population whose reliance on the car has become more intense since 1983; no cohort of the elderly took less than 75% of all trips in a private vehicle as either a passenger or driver. Conversely, the elderly were even less likely to use public transit for their trips than ever before; no cohort of the elderly used transit for more than 5% of their trips and the average was substantially less. Although walking was the mode of second choice, its importance fell by one-third in urban areas and one-fourth in rural areas.

Linked to the use of the car is the increasing mobility of the elderly; the elderly as a group drove 20% more miles than they had in 1983 while those over 70 drove 40% more. Even the very old were driving a substantial number of miles each day. Rural elders were even more mobile than their urban counterparts and the gap tended to increase as both groups aged. On the other hand, it was clear that trip-making dropped substantially as people aged, with the biggest decrease occurring when people hit 85.

The NPTS data also show that there were important travel differences between the travel patterns of older men and women. Overall, elderly men took 24% more person trips, travelled 19% more miles, and made 94% more vehicle trips than elderly women. In spite of these differences, and even though fewer older women had licenses, women took almost as great a percentage of their trips in a private vehicle.

The data clearly show that having a drivers license is associated with substantial increases in the number of person trips and person and vehicle miles—the trip rates of men with licenses was almost double those of men without. The impact was especially important for the very old—men over 85 with licenses made three times as many trips as comparable men without licenses.

The NPTS data also show that Whites are substantially more dependent on the private car than are Hispanics, Blacks, or other races—although all groups make more of their trips in a car than any other mode. White seniors of both sexes make more vehicle and person trips and travel more miles than any other ethnic or racial grouping. Moreover, white men and women have more similar patterns than the sexes within other groupings; White men make 21% more person trips than comparable females but Black men make almost 100% more trips than Black women.

Overall, older Americans exhibit some common transportation patterns—but beneath the aggregate trends are variables either moving more slowly for some groups of the elderly or actually moving in a different direction. Ultimately, the elderly are as diverse in their travel patterns as they are in their lifestyles. It seems clear that different experiences, resources, and expectations have, and will continue to, create wide variations in the transportation patterns and needs of those over 65 in the next century.

Implications of Trends in the Elderly Population

These findings raise several major questions. First, to what extent are the differences among the elderly a function of choice and to what extent necessity? Are older people being forced to drive, or use transit, or to walk for the lack of an alternative that they would find preferable? If we know that people would actually prefer, for example, to *walk* for more of their trips, public investments in sidewalks and other pedestrian facilities, not to mention longer term land use changes, would make more sense than comparable investments in transit service. If we know that older people would prefer to drive for as long as possible, we may make other investment and policy choices. And, if some seniors would prefer to walk while others would prefer to drive, we have still a different set of (difficult) choices.

Second, we need to know if current sex, race, and ethnic differences in travel patterns are an artifact of a different (older) generation or if they are a reflection of important cultural norms and expectations held by younger cohorts of the population. In the future will older women continue to drive less even if they have a license or are the lower travel rates among those now elderly simply "left over" from the days when women didn't travel as much? Are the differences in travel rates between Hispanic men and women part of a cultural preference that is seen among younger Hispanics? Will people of color always rely less on the private vehicle than Whites?

Third, it would be very useful to know if the upward trends among the elderly in all aspects of travel will continue, and if they will continue, what the intensity of growth will be. At some point, the total *rate* of growth must drop, but will trip and vehicle indices continue to rise? And if they do, will the increase be the same for all groups of people in all settings?

Fourth, what is and will happen to older people living in low density places when they can no longer drive? No matter what their race or ethnic background elderly people take the majority of their trips in a car. Those who do not, or chose not, to drive are often given rides by other elderly people; sadly, one senior driver losing a license (or the ability to maintain a car) may create serious mobility problems for several other elderly travellers. What can possibly substitute for the level of mobility provided by the private vehicle?

Table 31 attempts to give some dimension to the problem of seniors losing their ability to drive (or find or ask for rides). The Table shows an analyses which computes how long it would take a senior to make his or her *average* shopping or medical or family business trip by car, by a high level transit system, and as a pedestrian. Although the table obscures some important variables (including the ability to substitute a closer store or doctor when driving skills are lost), the numbers should give us pause. Older Americans could simply not walk to meet any of these important needs—all of the times involved seem beyond the realm of possibility.

The Table shows that fairly high level transit service isn't much help either. The transit column, merely for the purpose of analysis, assumes a ubiquitous route network which comes no farther than one block from where a person lives and one block from where s/he wants to go, and which requires no transfer. Even in the unlikely event that cities could provide that level of service, the transit alternative is a very poor substitute for the car. Almost every trip would take a half hour on the bus but only a few minutes in a car. Moreover, trips for groceries or to the doctor don't seem very amenable to traditional transit use.

Table 31 Estimated Travelling Time for Selected Trip Purposes, by Alternative Modes in Urban Areas, 1990

Trip Purpose By Sex		AVERAGE PERSON MILES	MINUTES CONSUMED BY ALTERNATIVE MODES		
			Car	Ubiquitous Transit	Walking
SHOPPING	Men	3.58	7.2	28.2	71.6
	Women	3.56	7.1	28.1	71.2
PERSONAL/ FAMILY BUSINESS	Men	6.10	12.2	33.2	122.0
	Women	7.17	14.3	35.3	143.4
MEDICAL	Men	6.43	12.9	33.9	128.6
	Women	5.92	11.8	32.8	118.4
CHURCH	Men	4.77	9.5	30.5	95.4
	Women	3.53	7.1	28.1	70.6

Computed based on average Auto speed=30 MPH, average Transit speed=15 MPH + 21 minutes for walking two blocks and waiting 5 minutes, and Walking=3 MPH.

Policy Suggestions

The analyses presented above suggest that the lifestyles among the elderly which reflect ethnic, racial, cultural, and gender experiences and expectations may have important transportation ramifications. Most people will maintain those lifestyles and their traditional *travel* choices and patterns as they age. While most will drive, they may vary in the degree to which they offer rides to others, accept rides instead of driving, or use alternative transportation options. In addition, differences in cultural norms about family support may effect the amount of transportation assistance which elderly people are offered—or expect—from friends and relatives.

The analyses presented above lead to several major policy suggestions. *First,* most elderly will be car drivers—and will hold onto their cars and licenses as long as possible. Unfortunately, they may put themselves, and others, at risk to do so, both directly through traffic accidents, and indirectly, by spending rent or food money to maintain a car. A pragmatic, if not caring, society must respond by finding ways to make it safer for Older Americans to continue driving as long as they wish. Until society can offer realistic ways for elderly drivers to meet their mobility needs—and those of their passengers—without driving it is both unreasonable and unfair to expect them to give up their cars.

To begin, we must spend at least as much time improving the safety of cars and the road network as we do in trying to identify and remove bad drivers from the road. A National Academy of Sciences study concluded,

> The roadway system—broadly construed to include street and highway design and operation, vehicle design and driver licensing—can be better adjusted to the needs and abilities of older drivers. Given the long lead time required to develop and phase in changes in the standards used for the roadway system, however, it is time to begin preparing for the mobility of a society that is already aging[36].

Such changes include identifying and evaluating the type, number, size, and location of traffic signs, the configuration of road networks and traffic devices (*eg* left turn lanes and priority signals) and in-vehicle improvements to compensate for declining visual acuity and other potential physical problems.

In addition, we have to consider assisting competent elderly drivers who have financial problems; the assistance can be direct (e.g., subsidized insurance) or indirect—paying elderly drivers who provide rides to other elderly travellers. The State of Hawaii, for example, has a program which provides limited financial assistance to drivers with low incomes.

Second, we have to develop a range of alternative transportation options for those who cannot drive, or obtain rides from others, or who wish to decrease the amount of driving they do. While traditional transit options don't appear to offer much mobility to many travellers, they are useful in certain kinds of communities. In those cases, transit operators need to consider the needs of older travellers when they make route and service decisions, and they must pay serious attention to the safety and security concerns of these travellers. At the same time, communities must invest in different kinds of transit and paratransit options—smaller, accessible buses routed to the places where Older Americans like to go in a community, subsidized taxi voucher programs, organized non-work carpools, *etc.*

Third, we must develop mobility alternatives which are geared to the diversity of our older population. If some Older Americans, for example, wish to travel with family members, while others do not, we should be able to assist these travellers consistent with those desires. If more women are unable to drive or seek transportation assistance, we should develop solutions which stress the service attributes they seek (for example, security). Above all, we have to maximize the choices we offer the elderly.

Fourth, the link between housing and land use choices, on one hand, and transportation needs on the other must be made explicit in all policy discussions. While some analysts believe that land use policies may change the shape of American communities in ways that reduce the need for car thus benefitting the elderly, major land use changes do not seem likely even if we all agreed that they were desirable. Ironically, however, the elderly may be more willing to make the kind of moves that lead to different neighborhoods if given the choice; in many other developed countries older people are very likely to move when they leave the workforce—moving to communities that meet their new needs (including declining ability or willingness to drive or travel).

Most Older Americans have far less choice. Most can't move to smaller, more appropriate homes in their own neighborhood (because almost everything is the same size and configuration) or to more concentrated neighborhoods. Many of the retirement communities to which some seniors move lack on-site services, assuming that residents will drive to meet most needs—leaving when they cannot. In fact, most moves by older people are probably occasioned by their absolute inability to live alone in their own neighborhood—after years of problems in doing so. It seems likely that providing appropriate housing choices in safe areas with nearby services and businesses as well as adequate transit would address more of the transportation needs of older travellers than providing them with specialized transportation options.

Fifth, we must provide more pedestrian friendly neighborhoods—to allow Older Americans to walk to meet some of their needs, or to easily access public transit, or simply for recreational purposes. It is striking that even in suburban areas elderly travellers make as many as 7% of their trips on foot. Thus neighborhoods need sidewalks, special crossing facilities and traffic signals in areas with a large number of elderly people, and usable sidewalk furniture.

In summary, the growing diversity of the elderly population suggests the need for a more inclusive and comprehensive approach to mobility while the aging of a society so dependent on the automobile raises a host of very serious questions. The analyses presented here suggest that most of the easy answers to the problem of the mobility of Older Americans—more traditional transit, more special transit services—reflect a superficial understanding of how elderly people meet their needs and the constraints and barriers presented by their environment. Moreover, most easy answers assume an understanding of what elderly travellers *want.* Yet it is hard to examine these data and conclude that elderly travellers want anything less than the kind of choices they've had for all their lives, and, that younger travellers still have.

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Multiworker Household Travel Demand

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Executive Summary

The Nationwide Personal Transportation Survey (NPTS) data examined in this study confirm that there are increasing numbers of households with multiple workers and vehicles. The proportion of households with at least two workers rises with household size and with metropolitan area size, and is inversely related to the density within the residential zone and distance to public transportation. These characteristics describe a typical but not universal American dream: owning a home in a low density residential, metropolitan area, with access to jobs, services and urban opportunities, away from the problems of the inner city.

While the NPTS documents a rise in household vehicles and a rise in the number of vehicles per household, there is effectively no change in the number of vehicles per worker (1983-1990). The increase in vehicles can be attributed to the increase in the average number of workers per household (1.21 to 1.27 from 1983-1990) and to the increase in vehicle ownership in zero-worker households (from 0.9 to 1.1).

Multiworker households (MWHs) make longer trips in their daily travels than other households, but it is not because of the length of the work trip. While the work trip is the longest general class of trips, it is the social and recreational trips that increase in length with the number of workers in the household. In seeking low cost, low density settings, households may have increased the distance from their social network. Home-to-shop trips tend to be relatively short; in two-worker households, a subset of MWHs, shopping trips by males outnumber the total for females, while there is still a female bias in shopping trips for zero-, one- and three-or-more worker households.

In several cases there are associations between travel characteristics and the number of workers in the household, but once the household size is introduced into the analysis, the latter sometimes emerges as the dominant factor. Both solo driver work trips and the number of annual miles each vehicle is driven are more strongly correlated with household size than with number of workers, the former negatively, the latter positively.

MWHs are also more likely to take long trips (in excess of 75 miles, one way) but not if expressed in trips per worker. Almost half of these long trips are less than 100 miles from home; the longest trips are found in zero-worker households.

All these relationships are important. MWHs as a group are growing—though the rate of increase has slowed somewhat—and they exhibit travel behavior that is different from that of other households. Too frequently the number of workers per household is not used in transportation modeling, and yet, while all workers need to commute regularly, have the financial resources to purchase vehicles and thus influence peaking and congestion problems, having more than one worker per household changes the length, timing and purpose of trips made. Understanding MWHs' travel patterns could prove valuable to accurate forecasting of future transportation service demands.

A note on the primary data source: Given the paucity of MWH studies, this report uses the 1990 NPTS to study this group's travel behavior. The 1990 NPTS data, however, do not directly provide the number of workers per household; therefore it was necessary to discard about 20% of the household records and recompute household weights so that they would continue to represent the national population. This procedure is explained in the appendix and in the body of the report the data source is consequently the "Adjusted 1990 NPTS."

Introduction and Overview

During the last few decades major changes have occurred in lifestyles and household characteristics which have affected the demand for transportation services. Increasing rates of labor force participation have produced a more affluent population and stimulated the demand for private vehicles. From 1969 to 1990, when the U.S. population grew by 42 million, the NPTS reports that the number of households increased by 31 million, the number of workers by 44 million, licensed drivers by 60 million and the number of vehicles by a remarkable 93 million. Roads and highways across the nation are feeling the ramifications of increased traffic and its environmental effects.

The purpose of this study is to examine the travel behavior and related characteristics of MWHs (defined as households with at least two workers) and how they contribute to the ever-increasing demand for transportation services. On average they have incomes which exceed the national household average and often have multiple automobiles and as households they generate a considerable number of trips. The virtual dearth of previous studies of MWHs makes an overview of their characteristics and their travel behavior necessary.

This study reveals that the number of MWHs has continued to grow as has their use of highways; they are found in disproportionate numbers in low density urban areas distant from public transportation. They also have newer vehicles, and drive each vehicle more miles than other households. As households, MWHs travel more than do other households. However, an individual worker's ability and desire to travel is constrained by time factors, among others, and transportation use by MWHs, when calculated on a per worker basis, is relatively low.

Previous Studies

MWHs have received very little attention in all but the latest studies and their absence from transportation demand models raises questions about the completeness of older models. Boyce admonishes the transportation community for the lack of interest in MWHs and calls it an "embarrassment" to the field of transportation research (1). It should be noted that several planning organizations including, for example, the Chicago Area Transportation Study (2) use the number of workers as a key part of their travel models. There is, in some cases, a reluctance to use the number of workers because of definitional problems: who is a worker? Questions arise about part-time employees, seasonal workers, and temporarily unemployed individuals.

Most of the early literature focuses on two-earner households from the perspective of the gender differences in mode use and trip length. Singell and Lillydahl provide a thorough overview of this perspective and cite a multitude of studies emphasizing gender travel differences (3). Along with Schlesinger they describe the shorter, more public transit emphasis of trips by women, and how this may be derived from the housing location decision and how this relates to the male workplace (4). Many of these studies were conducted in the 1970s and early 1980s, using data generally describing the early 1970s. The NPTS data illustrate how the data on licensed drivers now shows little difference between men and women and, given the phenomenal increase in private vehicle use, the gender differences in mode use have begun to evaporate.

The number of workers per household has increased with the increasing size of the labor force. Prevedouras and Schofer attributes this to three factors: the baby-boom generation entering the labor force, the increased supply of labor from female participation, and the need for more than one income (5). They also point to the increasing number of young adults returning to the family home as a cause of MWHs. Their paper finds that growing suburbs attract large families with young children and concludes that suburban congestion is a product of household structure, with the number of workers a principal element of the latter.

Oster reflects the perspective of the modelling community and he states that the presence of a second worker decreases the number of separate non-work destinations while increasing the number of non-work destinations accessed via workplace related travel (6). Previous traffic models have made the home-to-work trip the main topic of study, but Gordon et al. take issue with this (7). They state that travel behavior can be influenced by the increase in two-worker households and that the growth in peak hour nonwork travel is closely associated with two-worker households. Strathman et al. also indicate that households are most likely to link non-work trips with work trips and that household structure was the most significant variable (8).

Organization of Paper

This paper will first describe general trends in labor force and household composition and will then closely examine MWHs: Where do they live? What are their household financial and vehicle-owning characteristics? What are their travel patterns? These findings will be summarized and finally, certain implications that MWH travel patterns have for transportation planning and policy will be considered.

Trends

There is growing interest in the causes of growing private vehicle use, congestion, and air quality. A correlation exists between these problems and increases in the number of jobs and of MWHs.

Growth of Employment

In 1960 there were approximately 66 million workers in the nation,which was 37% of the population (9). By 1990, 47% of the population was employed, accounting for 115 million workers or a 75% increase. The number of persons not in the labor force increased during the same period by less than 33%.

A large segment of this increase in labor force participation was the increase of women with children entering the job market. In 1960, 19% of women with children under six were in the labor force, but this increased to 60% by 1991 (3). The greatest growth period occurred in the 1970s, but growth continued at a slower pace into the 1980s.

Household and Family Trends

Concurrent with this rapid rise in the size of the labor force there was an increase in household formation, offsetting what may have otherwise been an even larger increase in the number of MWHs. Between 1983 and 1990, the NPTS reports an increase in the multiworker percentage from 34.9 to 38.8 (Table 1). There is an increase in the number of two-worker households, but both the absolute and relative data (number and percent) show a decline in the number of three-or-more worker households, perhaps a consequence of the rapid rate of household formation, households splitting into two smaller units.

Table 1: NUMBER OF WORKERS PER HOUSEHOLD, 1983-1990

Number of Workers	1983 (in millions)	1990 (in millions)	1983 (percent)	1990 (percent)
0	22.6	23.3	26.5%	24.9%
1	33.0	33.9	38.6%	36.3%
2	23.3	30.0	27.3%	32.1%
3+	6.5	6.2	7.6%	6.7%
Total Households	85.3	93.5	100.0%	100.0%
2+ (multiworker)	29.8	36.2	34.9%	38.8%

Source: NPTS 1983, 1990

A long-term comparison with U.S. Census data cannot be made because the Census reports the number of workers by "family," defined as two or more related people living together, rather than by "household." In 1970, families accounted for 80% of all households, but by 1990, accounted for only 70% of all households, largely reflecting the increase in one-person households.

From 1960 to 1990, three of the four "workers per family" categories increased (Table 2); even the percentage of zero-worker families increased from 9% to 13%, a result of an aging population. More dramatic has been the growth of two-worker families,

Table 2: NUMBER OF WORKERS PER FAMILY, 1960 - 1990

Number of Workers	1960	1970	1980	1990
0	9%	12%	13%	13%
1	53%	45%	33%	28%
2	30%	34%	42%	46%
3+	7%	9%	12%	13%
Total	100%	100%	100%	100%
2+ (multiworker)	37%	43%	54%	59%
Number of Families (in millions)	—	50	58	76

Source: U.S. Bureau of the Census

increasing from 30% to 46%, and for three-or-more-worker families, increasing from 7% to 13 % over the 30-year period. The largest change has been the decrease in families with only one worker. In 1960, 53% of families had one worker; in 1990 this fell to 28%!

The increase in MWHs seems to fit the classical S-shaped curve of slow growth in the early period of development, followed by rapid growth, then a condensation period and ultimately, near saturation. From 1960 to 1970 the two-or-more worker families grew by only 6 percentage points, the early period of growth, and then grew by 11 percentage points in the next decade. This growth slowed in the decade from 1980 to 1990, showing a growth of only 5 percentage points for multiworker families. This illustrates the declining rate of growth.

Contributing Elements

A household with more than one worker has different financial and vehicle-owning characteristics than do other types of households. It also has a different set of living requirements, including place of residence. That household's circumstances also engender its own particular traffic patterns. This section examines MWHs and their household structure's relationship to household characteristics, place of residence and travel patterns. Variations in travel demands, especially private vehicle versus public transportation use, can thereby be better understood.

Relationship with Household Characteristics

Partly due to their greater size, MWHs have more vehicles and drivers than other households (Table 3). Their members (especially in two-worker households) are younger and tend to be more educated. Conversely, zero-worker households are the most unique, having an average adult age more than twenty years greater than other households.

Table 3: AVERAGE DEMOGRAPHIC CHARACTERISTICS BY WORKERS PER HOUSEHOLD

Number of Workers	Drivers (per household)	Vehicles (per household)	Age (years) (adult population only)	Some College Education (%) (adult population only)
0	1.12	1.10	65.1	25.0
1	1.50	1.57	43.1	45.4
2	2.09	2.19	38.8	50.8
3+	3.26	3.05	40.8	39.1
All Households	1.75	1.77	45.7	42.7

Source: Adjusted NPTS 1990

Household Income

As may be anticipated, there is a positive relationship between household income and the number of workers in a household. For households with annual incomes less than $10,000, the multiworker percentage is under 10 (Figure 1). Both two-worker and three-or-more-worker household percentages increase with income and peak before the highest category. MWHs households account for 70% of the households in the $75,000 - 79,999 income bracket, even though they account for only 39% of all households (regardless of income). At incomes beyond this level the percentage of multiworker households drops; it is 64% in the highest bracket, $80,000 and over.

Conversely, zero-worker households increase at incomes above $70,000. Over 36% of the households in the top bracket were not multiworker households. This represents a class of affluent individuals or small households who likely have strong travel demands. The size of the affluent non-working population and its travel demands merit closer study than what is feasible here.

Number of Household Vehicles

The association between the rise in the vehicular population and employment can be seen in Figure 2. MWHs households typically have more than one car and in three-or-more worker households almost two thirds have at least three cars. The number of vehicles per household increases with the number of workers, rising from 1.1 for households without workers to 3.1 for three-or-more-worker-households (Table 3). Since the one-worker households have automobile ownership rates of 1.6 per household, the rate per worker declines as the number of workers per household increases. Therefore, the number of workers per household is not the only factor contributing to the number of vehicles in a household.

Similarly, the zero-worker households also have a fair number of vehicles. Remarkably, approximately one-third of the households with zero workers have more than one vehicle and more than one in twenty has at least three vehicles. The vehicular ownership pattern in zero-worker households is atypical. Unlike other households where the number of vehicles is correlated with household size, for zero-worker

Figure 1. Workers by Household Income

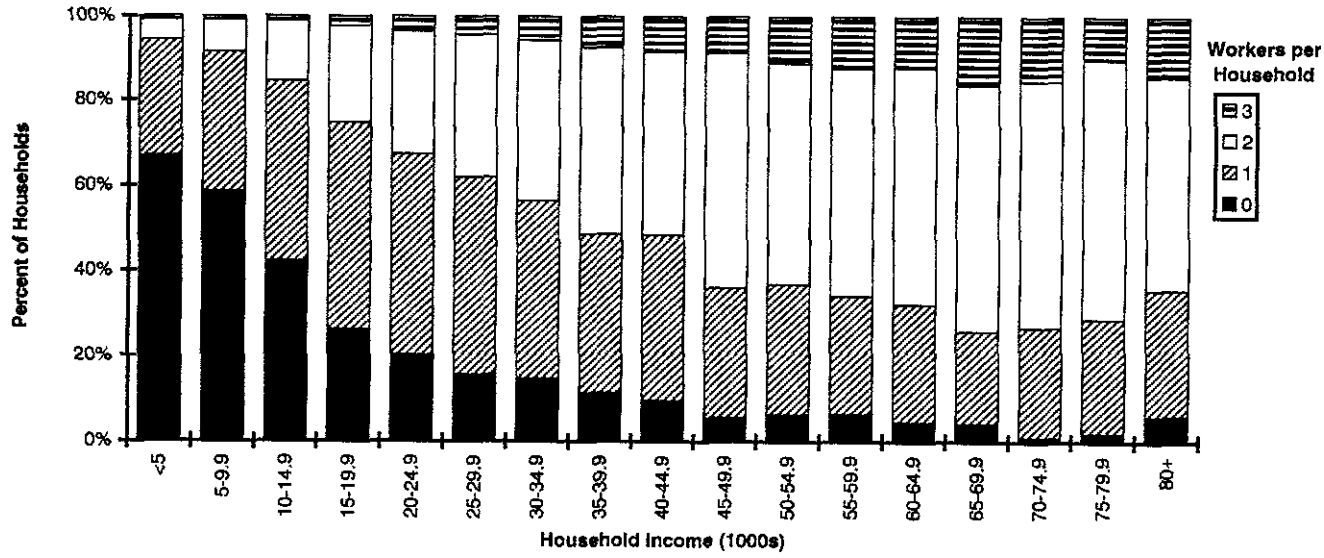
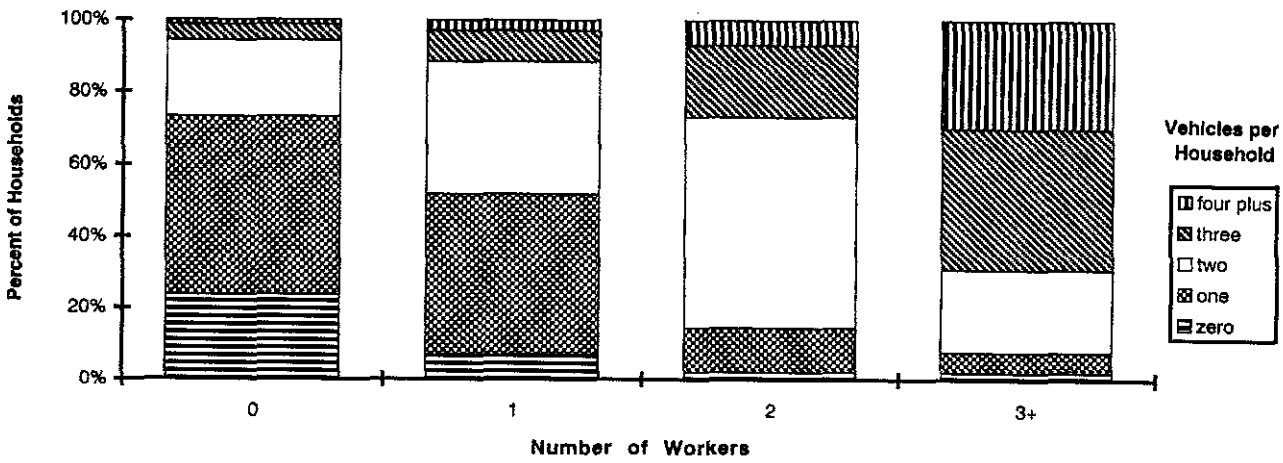


Figure 2. Vehicles by Number of Workers



households vehicular ownership peaks at two-member households (Table 4). Expectedly, large households with small incomes would not be likely to have many vehicles.

Table 4: AVERAGE NUMBER OF VEHICLES IN HOUSEHOLD BY NUMBER OF WORKERS

Number of Workers	Household Size 1	2	3	4+	All
	Number of Vehicles				
0	0.77	1.5	1.29	1.17	1.1
1	1.11	1.7	1.74	1.94	1.57
2	—	2.1	2.21	2.29	2.19
3+	—	—	2.84	3.14	3.05
All Households	0.94	1.8	2.05	2.27	1.75

Source: Adjusted NPTS 1990

This table also indicates that vehicular ownership is related more to the number of workers than to household size. Both clearly contribute to vehicular ownership rates but on average each additional worker contributes about 0.5 vehicles to the household while each additional member contributes considerably less: 0.2 vehicles from two to three and then again, from three to four members in the household (Table 4).

There is also a strong relationship between household income and the number of household vehicles. As the income rises so does automobile ownership, with over a third of the households with incomes over $55,000 having at least three vehicles. The majority of households have at least two vehicles (57%) and this is true for all but the lowest income households, those with annual household incomes of less than $25,000. This has direct implications for vehicles ownership rates; as MWHs increase, so will vehicle ownership, but at a decreasing rate. The growth of vehicles would be even greater if more zero- and one-worker households were formed from larger households, provided that they demonstrate the same propensity to own vehicles as persons in these households do today.

Not surprisingly, the same pattern applies to the average age of vehicles. They get progressively newer with increasing numbers of workers. Averaging the model years from the 1990 study (in which all cars pre-dating 1955 are given a 1955 model year) yields an average model year of 1982.2 for zero worker households and a high of 1983.6 for both two-worker and three-or-more worker households. The zero-worker households may have members who have maintained the same car for many years, thereby increasing the average age of their vehicles.

Table 5: CHANGES IN HOUSEHOLD CHARACTERISTICS, 1983 - 1990

Number of Workers	Average Number of Vehicles per Household and per Worker 1983	1990
0	0.9	1.1
1	1.6	1.6
2	2.2	2.2
3+	3.2	3.1
All Households	1.68	1.77
Vehicles per Worker	1.39	1.40
	Household Characteristics	
Workers per Household	1.21	1.27
Persons per Household	2.69	2.56

Sources: 1983 NPTS, 1990 NPTS and Adjusted 1990 NPTS

While the number of automobiles increased between 1983 and 1990, the increase seems to be partially attributable to zero-worker households. It is the only group that experienced an increase in the number of vehicles per household (Table 5). In households with workers the number of vehicles per worker remained stable, changing only from 1.39 to 1.40 in the seven-year period. But since the number of workers per household has increased from 1.21 to 1.27 during the same

period, the average number of vehicles per household has risen from 1.68 to 1.77. If household size were not declining during this period, perhaps the rate of workers per household would have increased even more. In sum, these data suggest that the number of workers in a household is a major determining factor to the number of vehicles in a household.

Place of Residence

The 1990 NPTS data show that nationally, 32.1% of the households have two workers and another 6.7% have three or more workers (Table 1) but that the country is far from being a homogeneous entity. Given the great diversity of residential areas, it is useful to consider the differences in the frequency of MWHs by place of residence. The discussion here begins with large regional patterns throughout the country and works down the scale to how close households reside to public transportation.

Variations by Census Division and Region

The U.S. Bureau of the Census has divided the country into four regions and nine divisions. An examination of the frequency of MWH rates reveals higher values in the traditional Rust Belt, from New England to the East North Central Divisions (Figure 3). The New England Division has the highest rate of MWHs, but the other two divisions which constitute the Rust Belt, Middle Atlantic and East North Central, have respectively the second and third highest percentages. High rates are also found in the rapidly growing South Atlantic and Mountain Divisions. The lowest rates are located in the traditional South (West and East South Central Divisions), followed by the Pacific Division. The West South Central, dominated by Texas, has the lowest rates.

At the regional level (the four census Regions) the Northeast and the Midwest have the highest multiworker levels at approximately 40% and the other two regions, the South and the West have the lowest, both with 37.5%.

Female participation in the labor force accounts for most of the variation across the nation. Female workers account for over 70% of the female population aged 18 to 64 in the New England Division, where the MWH percentage is the highest (Figure 4). Again the West South Central has the lowest level: 61.9%.

Size of the Metropolitan Area

The 1990 Adjusted NPTS data provide evidence of a relationship between the size of the metropolitan area of residence and the frequency of MWHs; as the metropolitan area increases in size, so does the percentage of MWHs. It increases steadily from 36.2% in non-metropolitan areas to 38.0% in places with less than 250,000 residents to 40.0% in places with over 3 million residents (Table 6). It is plausible that as the metropolitan area increases, housing and transportation costs increase, creating additional pressure for a second or third income. Moreover, as the metropolitan population increases, so does the likelihood of finding a job which could entice workers into the labor force (though there is no data from NPTS to confirm either conjecture). Lastly, since patterns of one-worker households follow MWH trends, there is a strong negative relationship between zero-worker households and metropolitan area size, the only category left.

Density by Zip Code of Residence

The positive relationship with the size of the metropolitan area implies that higher density areas have more MWHs, but the opposite is true when the data are examined at a less aggregate level (Figure 5—equivalent data were not reported in 1983). For those residing in urbanized areas (population densities over 1000 per square mile) the highest multiworker percentages, especially two-worker households, are in low density ZIP-code areas and the lowest percentages are in the highest density zones. There is little variation in multiworker percentages for densities from 2,000 - 7,500 inhabitants per square mile, but with higher densities it declines rapidly (Figure 5). The multiworker percentage drops from 38.5% to 28.3% in these high

Figure 3. Percent Multiworker Households

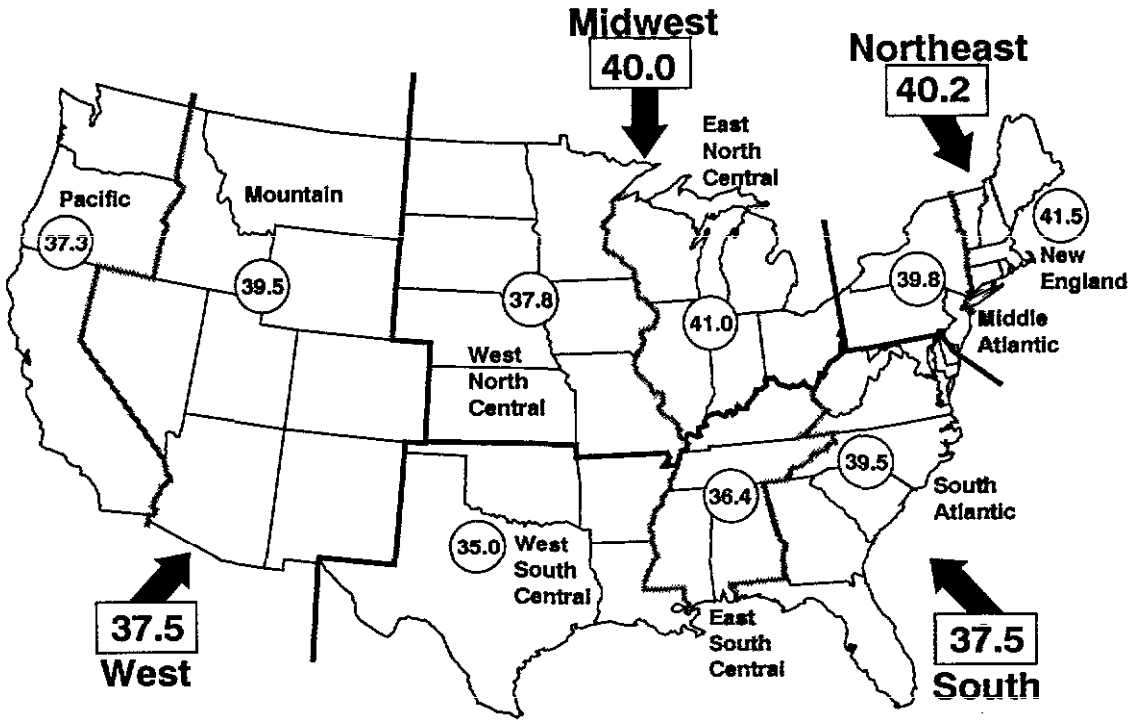


Figure 4. Female Workers as a Percentage of the Female Population Aged 18-64

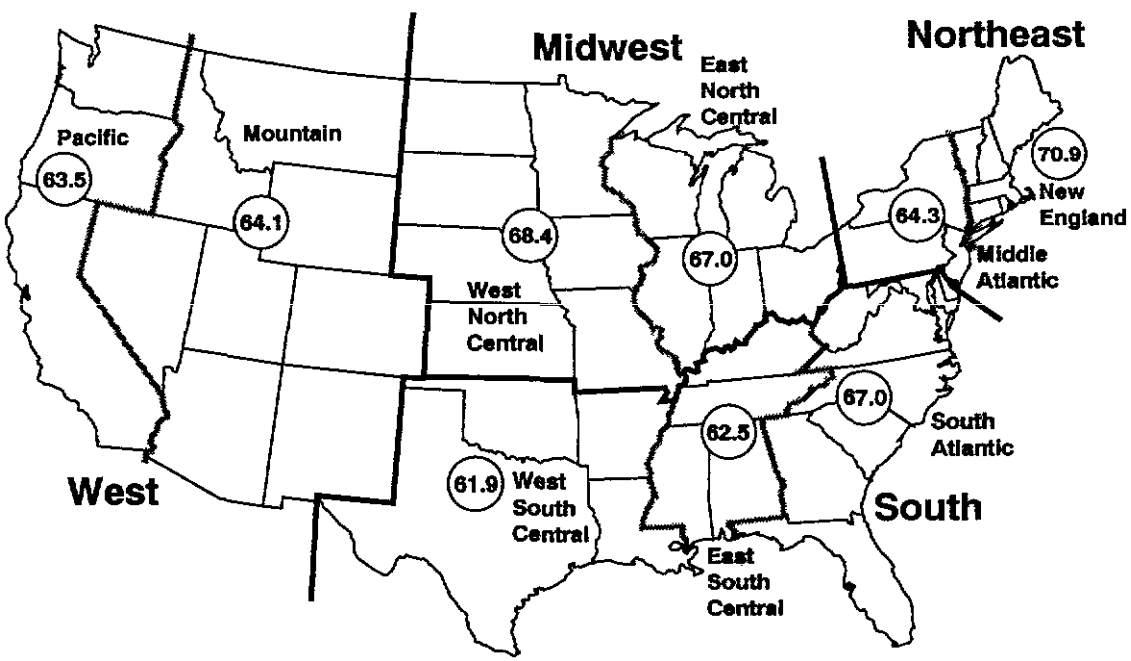


Table 6: HOUSEHOLDS BY METROPOLITAN POPULATION AND WORKERS PER HOUSEHOLD, 1990

Number of Workers	All	Non-Metro	<250 K	250 K-500 K	500 K-1 mil	1 mil-3 mil	3 mil +
		(Percentage by Population Size)					
0	24.9%	30.6%	26.2%	24.9%	24.7%	23.1%	21.0%
1	36.3%	33.2%	35.9%	36.7%	35.9%	37.8%	38.1%
2	32.1%	30.4%	31.8%	33.0%	33.9%	32.3%	32.7%
3+	6.7%	5.8%	6.2%	5.5%	5.5%	6.8%	8.2%
All Households	100%	100%	100%	100%	100%	100%	100%
2+ (multi)	38.8%	36.2%	36.2%	38.4%	39.4%	39.1%	40.0%
Average no. of workers	1.23	1.14	1.20	1.22	1.23	1.24	1.30

Source: Adjusted NPTS 1990

density zones (from 32.2% to 23.7% for two-worker households). In other words, MWHs tend to reside in the suburbs.

The lowest multiworker percentages are in the highest density ZIPs, those with more than 50,000 people per square mile. Since the city of New York has a density of approximately 25,000 per square mile and cities like Chicago, San Francisco and Philadelphia approximate 15,000 per square mile, the highest density category (50,000) is found in only a limited number of places. The most likely areas are in neighborhoods with closely-spaced, high-rise residences, such as Manhattan and the Chicago lakefront. These are areas with considerable public transportation and they attract retired individuals and, since they are generally high rent districts, they also attract young professionals. Many high density areas are also characterized by poverty and unemployment. In short, many small households and households with few workers are found in this exceptionally high density setting.

In non-urbanized areas (densities less than 1000 persons per square mile) there is a positive relationship between density and proportion of households with more than one worker. Small communities (lowest density category) have the highest percentages of zero-worker households; over 30% in places with densities of less than 100 people per square mile. This suggests that there are many rural poor or that many retirees have moved to low density areas where proximity to jobs and other urban opportunities are not a priority. In this setting, however, services are not plentiful and longer distances are typically necessary to satisfy some consumer needs.

Proximity to Public Transportation

Over 40% of the nation's households live where no public transit is available but almost 60% of those that answered the proximity to pubic transit question indicated they were within three blocks of the nearest public transportation. Another 25% lived farther than three blocks but less than a mile (less than 12 blocks) from transit. These two groups represent the first three proximity categories on Figure 6, but unfortunately from a transit perspective, the percentage of multiworker households, especially two-worker households, increases with distance from transit.

Looking at the data from another angle, only 28.7% of the families in the less than three block group have two workers and it rises to 41.2% in the third distance group (1/2 to one mile). For MWHs the corresponding figures are 35% and 50%. As distances greater than one mile increase, the percentage of two-worker and multiworker households declines gradually, but this is of limited importance to transit use.

Figure 5. Workers by Population Density

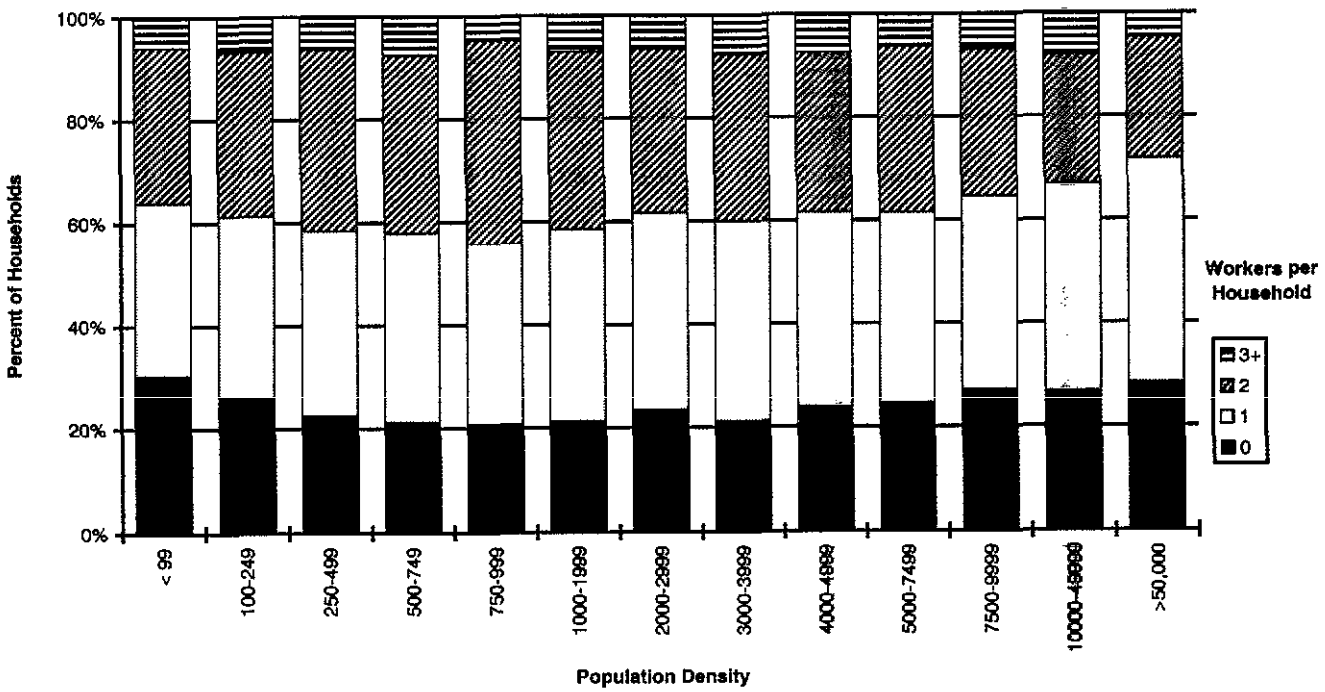
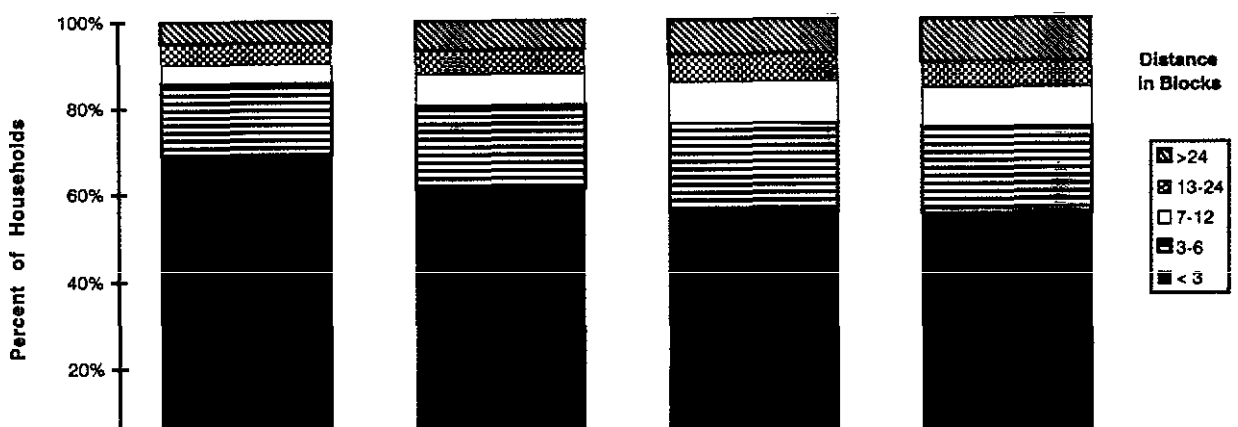


Figure 6. Distance from Public Transit by Workers per Household



The paucity of MWHs close to public transportation places greater emphasis on the use of private vehicles. This spatial pattern also partially explains the declining use of public transportation among women. In the MWH setting, they tend to be distant from public transportation.

The proximity to public transportation has displayed some irregular trends from 1983 to 1990. The proportion of all households—including households with no access to public transit—within three blocks of transit has dropped from 40% to 34%, suggesting either less transit service or a decentralization of the population away from such service. But since the number of households has grown dramatically, there has been an increase in the absolute number of MWHs this close to transit.

Both the 1983 and 1990 data show an increase in MWHs with increasing distance from transit, but in 1983, the multiworker percentage increased even more sharply with distance from transit, rising from 29% in the first distance band to 46% in the third. In this regard, while the 1990 data are not encouraging for transit, they represent a relative improvement from 1983.

Travel Demand

In this section we examine the relationship between the number of workers in a household and travel demand, with an emphasis on trip length.

Miles Per Vehicle

There is a strong positive relationship between the number of workers and number of household vehicles, but the number of vehicles per worker declines with increasing number of workers. This decline in the rate is slightly offset by the rise in annualized miles per vehicle. Partly because work trips are longer than other trips, as the number of workers per household increases, so does the number of annualized vehicle miles. Vehicles in households with no workers log approximately 8,800 miles annually, while vehicles in one-worker households are driven an average of 12,600 miles each year (Table 7). The miles per vehicle statistic is over 13,000 for two-, three- and four-worker households, and it peaks with the latter group (not shown on Table 7).

Table 7: ANNUALIZED MILES PER VEHICLE BY HOUSEHOLD SIZE AND WORKERS PER HOUSEHOLD

	Household Size				
Number of Workers	1	2	3	4+	All Households
0	7,900	8,600	10,100	15,800	8,800
1	12,700	12,100	12,600	13,300	12,600
2	—	13,400	13,000	13,300	13,200
3+	—	—	13,100	13,200	13,100
All Households	10,800	11,900	12,700	13,300	12,400

Source: Adjusted NPTS 1990

Annualized miles also increase with household size, from 10,900 in single person households to 13,300 in four-or-more member households. The increase is, however, not as steep as the jump from zero to one worker households; once someone in the household starts working, mileage per vehicle quite plausibly jumps greatly. Nevertheless, once there is at least one worker in the household, household size affects the annualized miles per vehicle more than the number of workers does.

Adding the number of vehicles in the household to this mix indicates that the most common pattern is for annualized vehicle miles per vehicle to decline with increasing numbers of vehicles in the household (Table 8). In nearly all household size and number of worker categories each vehicle is driven less in three-or-more vehicle households than in single and double vehicle households. The relationship does not hold between one- and two-vehicle households. For Dual Income No-Kids (DINK) households—those households with two workers and two members—the highest mileage levels are for two-vehicle rather than one-vehicle households. This is true for two-person households and for all households as a whole.

Nevertheless, in many household categories, the single-vehicle household is characterized by the highest per vehicle mileage.

Annualized Vehicle Miles Traveled

The ultimate question here may be: "Which households drives more, for example, two one-worker, single-person households or one DINK household"? Table 9 shows that there is no effective difference, about 14,000 miles per person. The difference begins to unfold as the number of members and workers increase. The three-member, three-or-more worker household drives just over 12,000 miles per person.

As in previous examples, the number of workers seems to contribute more to total traffic than does the number of household members. Starting with zero-worker households, each additional worker adds approximately 10,000 miles to the household's total. Regarding additional members, from one to two members the increase is 11,000 but only 5,000 thereafter (Table 9).

Long-Distance Trips (LDTs)

The NPTS also asks about trips with distances over 75 miles during the preceding two-week period. There were 54 million such trips, of which 44% were to destinations less than 100 miles from the place of residence.

Table 8: ANNUALIZED MILES* PER VEHICLE BY NUMBER OF HOUSEHOLD VEHICLES, HOUSEHOLD SIZE AND WORKERS PER HOUSEHOLD

		Household Size				
Number of Workers	Vehicles	1	2	3	4+	All
0	1	7,800	9,100	12,500	15,100	8,700
	2	8,500	8,800	10,600	17,400	9,300
	3+	7,100	7,200	7,900	14,400	8,000
1	1	13,600	13,700	15,200	14,100	13,900
	2	11,300	12,200	12,900	14,200	12,900
	3+	10,000	10,600	10,200	11,400	10,700
2	1	—	12,700	15,000	17,000	14,600
	2	—	14,100	14,200	14,000	14,100
	3+	—	12,200	11,500	12,100	12,000
3+	1	—	—	16,500@	12,100@	14,200@
	2	—	—	14,200	13,100	13,400
	3+	—	—	12,700	13,200	13,100
All Households	1	11,300	11,500	14,800	15,100	12,100
	2	10,400	12,400	13,600	14,100	13,100
	3+	9,100	10,900	11,500	12,400	11,700

Source: Adjusted NPTS 1990

* Rounded to closest 100 miles. @ Less than 300,000 households.

Table 9: TOTAL ANNUALIZED MILES* OF ALL VEHICLES IN THE HOUSEHOLD BY HOUSEHOLD SIZE AND WORKERS PER HOUSEHOLD

	Household Size				
Number of Workers	1	2	3	4+	All Households
0	6,100	12,900	13,100	18,400	9,800
1	14,100	20,600	21,800	25,700	19,800
2	—	28,000	28,700	30,300	29,000
3+	—	—	37,200	41,500	40,100
All Households	10,200	21,300	26,000	30,100	21,700

Source: Adjusted NPTS 1990 * Rounded to closest 100 miles.

As expected, the number of these trips increases with an increasing number of workers, but the trip rate per worker declines with increasing numbers of workers in the household. Two-worker households account for 32.1% of all households but 44.4% of all long trips, thereby being the dominant group (Table 10). One-worker households account for 32.6% of all long trips and they produce relatively fewer trips per household, but they have the highest rate of LDTs per worker.

Quite expectedly, the average trip length is longest for the zero-worker households. Many are retired and have more time; therefore, the average destination distance is 282 miles for this group. The other three groups have lower average destination distances, all ranging from between 207 and 212 miles. Also, the

variation in trip distances (the standard deviation) is considerably higher for zero-worker households.

Table 10: LONG-DISTANCE TRIPS (LDTs) BY NUMBER OF WORKERS PER HOUSEHOLD

Number of Workers	House-holds (mil)	% of HHLDS	LDTs (mil)	% of LDTs	LDTs/ HHLD	LDTs/ Worker
0	23.3	25.0	7.4	12.8	0.32	—
1	33.9	36.3	19.0	32.6	0.56	0.56
2	30.0	32.1	25.6	44.0	0.85	0.43
3+	6.2	6.7	6.2	10.6	1.00	0.31

Source: Adjusted NPTS 1990

Length of Day Trips: Variations by Household Size

From the data discussed up to this point we know that vehicle ownership is largely the result of the number of workers, while the number of miles per vehicle is more related to household size. The length of the average day trip is again related to the number of workers in the household (Table 11). There is a particularly large increase from zero-worker households to all households with workers and a small increase with each additional worker.

Table 11: AVERAGE DAY-TRIP LENGTHS IN MILES AND MINUTES BY HOUSEHOLD SIZE AND WORKERS PER HOUSEHOLD

Number of Workers		Household Size 1	2	3	4+	All Hhlds
0	Miles	6.2	7.4	7.6	7.0	7.0
	Minutes	13.8	14.7	14.8	16.2	14.7
1	Miles	8.5	8.8	7.8	8.2	8.3
	Minutes	15.7	16.2	15.6	14.5	15.4
2	Miles	—	9.4	9.2	7.7	8.6
	Minutes	—	16.3	16.2	14.5	15.5
3+	Miles	—	—	9.4	9.1	9.1
	Minutes	—	—	16.3	16.3	16.3
All Households	Miles	7.8	8.8	8.7	8.1	8.4
	Minutes	15.1	16.0	15.9	14.9	15.4

Source: Adjusted NPTS 1990; Trips over 75 miles in length are not included.

The pattern regarding the household size is irregular. The two- and three- member households have the longest average trip lengths, while the other two categories (larger and smaller households) are clearly lower (Table 11). This latter pattern is particularly noticeable for zero-worker households, where it peaks at three members per household. This may be related to age, since the small zero-worker households are likely to have retirees whose travel destinations are frequently close to home, and as household size increases, young drivers are more likely to be present.

The DINK households are very mobile. Among all households they and the three-member, three-or-more worker counterparts have the longest average daily trip lengths.

Length of Day Trips: Mode Use by Gender

While trip distances increase with the number of workers, there is less difference by gender (Table 12). On average, males make longer trips by private vehicle but the differences are less than one mile for all categories. There is no consistent pattern for average trip lengths by public transit, except that males make longer trips than females in MWHs (measured in both miles and minutes).

In all households females make a higher percentage of all trips by public transit, but in no category does it exceed more than 2.5% (Table 12). For both males and females, the greatest propensity to use public transit is in the zero-worker households, and in both cases it is only marginally greater than the percentages for three-or-more worker households. While it is logical that as the number of workers in a household increases the likelihood of someone using transit also increases, the difference, for example, between one- and three-or-more worker households is less than half a percentage point.

Length of Day Trips: Trip Purpose

We have seen that trip distances increase with the number of workers, and since the work trip is typically the longest trip, one might logically conclude that the work trip contributes to the household differences in trip lengths. Shopping and social trips, however, account for the differences and work trip length actually shows a slight decline with increasing number of workers in the household, especially for trips by private vehicle (Table 13). Conversely, social trip lengths increase markedly with the number of workers in the households.

Table 12: AVERAGE DAY-TRIP LENGTHS IN MILES AND MINUTES BY GENDER, MODE AND WORKERS PER HOUSEHOLD

Number of Workers	Gender		Private Vehicles	Public Transit	All Trips	% by Public Transit
0	Male	Miles	7.4	6.5	7.1	2.2
		Minutes	14.7	29.8	14.9	
	Female	Miles	7.3	8.9	7.0	2.5
		Minutes	14.1	33.1	14.4	
1	Male	Miles	9.0	8.9	8.7	1.7
		Minutes	15.8	31.7	15.8	
	Female	Miles	8.2	9.4	8.0	2.1
		Minutes	14.8	33.2	15.0	
2	Male	Miles	8.9	11.5	8.7	1.1
		Minutes	15.3	36.8	15.5	
	Female	Miles	8.7	10.7	8.5	1.6
		Minutes	15.2	35.4	15.5	
3+	Male	Miles	9.8	11.3	9.5	2.1
		Minutes	16.3	39.6	16.6	
	Female	Miles	9.1	9.6	8.9	2.3
		Minutes	15.5	38.7	15.9	
All Households		Miles	8.7	9.7	8.4	1.7
		Minutes	15.3	34.5	16.4	

Source: Adjusted NPTS 1990; Trips over 75 miles in length are not included.

Table 13: AVERAGE TRIP LENGTHS IN MILES AND MINUTES BY TRIP PURPOSE, MODE AND WORKERS PER HOUSEHOLD

Number of Workers		Home to Work	Home to Shop	Home to Social	Home to Work Private Vehicle	Home to Work Public Transit	All Trips
0	Miles	—	5.7	9.3	—	—	7.0
	Minutes	—	12.3	18.1	—	—	14.7
1	Miles	11.1	6.5	9.2	11.2	12.3	8.3
	Minutes	19.3	12.0	17.2	18.8	37.7	15.4
2	Miles	11.0	6.1	9.6	11.0	14.9	8.6
	Minutes	19.5	11.2	17.2	19.0	42.4	15.5
3+	Miles	10.7	6.9	10.8	10.8	11.4	9.2
	Minutes	18.9	11.7	17.9	18.2	37.8	16.3
All Households	Miles	11.0	6.2	9.7	11.0	13.2	8.4
	Minutes	19.3	11.7	17.4	18.8	39.7	15.4

Source: Adjusted NPTS 1990; Trips over 75 miles in length are not included.

Single-Occupancy Work Trips

As the number of workers in a household increases, so does the seeming potential for increased car pooling to work. Table 14 illustrates that this holds for both increasing number of workers and household members. The likelihood of driving to work alone is more a factor of household size than the number of workers. Just over 90% of the single-person households drive to work alone. This drops ten percentage points to approximately 80% for four-or-more person households. While there is also a statistically significant decline (95% confidence level) in solo driving with increasing numbers of workers in a household, the drop is only about five percentage points (from approximately 83% to approximately 78%).

Females hold a slight margin over males as solo drivers to work but not in all household categories. The most noticeable patterns is with increasing numbers of workers. In one-worker households, the female solo driver percentage is about two percentage points higher than for males, and while they are even in two-worker households, they switch places in three-or-more worker households and males have higher levels by two percentage points.

Table 14: DRIVE ALONE AS A PERCENTAGE OF ALL TRIPS TO AND FROM WORK BY GENDER, HOUSEHOLD SIZE AND WORKERS PER HOUSEHOLD

		Household Size				
Number of Workers	Gender	1	2	3	4+	All Hhlds
1	Male	90.7	76.4	90.1	76.9	82.5
	Female	90.7	81.7	83.8	83.1	84.7
2	Male	—	85.0	80.7	82.8	83.2
	Female	—	87.9	83.1	79.2	83.4
3+	Male	—	—	78.0	80.1	79.5
	Female	—	—	82.4	76.2	77.6
All Households	Male	90.7	82.7	82.1	80.5	82.4
	Female	90.7	86.4	83.1	79.1	82.8

Source: Adjusted NPTS 1990

Work Trips by Public Transit

There is, however, no evidence of increasing propensity to use public transit with increasing numbers of workers in a household nor with increasing household size. In fact as the household size increases public transit use declines (Table 15). There is no evident relationship between number of workers and public transit use.

Table 15: PUBLIC TRANSIT USE AS A PERCENTAGE OF ALL TRIPS TO AND FROM WORK BY GENDER, HOUSEHOLD SIZE AND WORKERS PER HOUSEHOLD

		Household Size				
Number of Workers	Gender	1	2	3	4+	All Hhlds
1	Male	3.6	2.4	2.6	2.0	2.5
	Female	4.2	2.8	4.0	1.8	3.0
2	Male	—	3.0	1.6	1.4	2.0
	Female	—	2.8	2.1	1.9	2.2
3+	Male	—	—	2.3	3.7	3.3
	Female	—	—	1.4	4.6	3.8
All Households	Male	3.6	2.8	2.0	2.1	2.1
	Female	4.2	2.8	2.6	2.5	2.3

Source: Adjusted NPTS 1990

Implications and Conclusions

This report's conclusions may be summarized in the following list:

Trends in Number of Multiworker Households (MWHs)

- MWHs have been increasing as a proportion of all households since 1960.
- The growth in share is continuing but declining in rate.

Household Characteristics

- Both numbers of drivers and numbers of vehicles increase with number of workers in MWHs, but drivers increase more rapidly than vehicles.
- The percentage of MWHs increases with household income up to the $70,000 annual level.

Location of Multiworker Households (MWHs)

- The greatest concentration of multiworker households is in the New England and East North Central (eastern Midwest). The lowest levels are in the South from Texas to Kentucky, where less than 63% of the females aged 18-64 work out of the home.
- The percentage of MWHs increases with size of the metropolitan area.
- The percentage of MWHs increases with declining ZIP-code density.
- The percentage of MWHs increases with distance from public transportation (up to one mile).

Travel Demand

- There is a positive relationship between number of workers in a household and annualized miles per vehicles, but the relationship is stronger between increase in annualized miles and increase in household size.
- There is a positive relationship between number of workers and the number of long-distance (over 75 miles) trips (LDTs), but expressed in LDTs per worker, the relationship is negative.
- The average distance of day trips increases with the number of workers in a household, but not with household size (there is no apparent relationship).
- The average day-trip distances are higher for males in all MWH categories.
- Average distance to work decreases with increasing number of workers in a household, but not for work trips by public transportation.
- Average distance for home to social and recreational activities increases with number of workers in a household.
- There is no apparent relationship between shopping trip distance and number of workers in the household.
- Solo driving to work declines more with household size than with number of workers.
- Females are more likely to be solo drivers in one-worker households and men are likely to be solo drivers in three-or-more worker households.

The emphasis in public policy over the last several decades has been on job creation. Population and job growth has been more rapid in low density suburban areas where public transit service is generally sparse. This contributes to the need for automobile access to the workplace and as a consequence, vehicles per household have increased even with declining household size.

There is little doubt that employment growth has contributed to the number of workers per household, thereby increasing transportation demand. But the increase in MWHs has begun to slow and it seems to be largely confined to two-worker households, which have increased by 25% from 1983 to 1990. The number of three-or-more worker households has begun to decline.

Place of Residence and Household Characteristics

Across the country, there are only subtle regional differences in the proportion of the households with more than one worker. It is higher in the East and lower in the West and South. More significant is the variation by metropolitan area size and the neighborhood population density. As the metropolitan population increases, MWHs increase; however, these households are disproportionately found in low density areas within these metropolitan areas. Therein lies a key to an increasing travel demand scenario. By having the resources that MWHs tend to have, they can opt to live in large living quarters, in low density areas, increasing the dependence on private vehicles for travel.

Trip Length

Long-distance trips (over 75 miles) are also more prevalent in MWHs but if they are expressed in trips per worker, then the production is greatest in single worker households. Effectively, this indicates that workers have less time to make such trips. Zero-worker households make relatively few long trips but their trip-length average is about a third higher than for households with workers.

Day-trip lengths are more a factor of the number of workers in a household than household size, but not only because of the larger number of relatively long work trips. Work trip lengths decline with the increasing number of workers in a household but social trips increase dramatically, thereby accounting for longer total trip lengths. Social trips are more likely to be made by males and most trips by males are longer regardless of purpose, but in both cases the differences are small. In general, there are few notable gender differences in travel behavior.

Principal Conclusion

The principal finding is that the increase in the number of MWHs contributes to a low density urban life style, which relies on the private vehicle to access jobs, stores, and friends. The number of workers, more than household size, contributes to automobile ownership and therefore travel demand. There is little gender difference in travel behavior, although some of the traditional patterns remain, such as slightly shorter trips and marginally more public transit for females. MWHs as a category are different enough in their travel patterns from other household types to warrant the inclusion of household structure as an element in transportation planning studies.

Other Research

Traffic management, congestion and pollution mitigation policies in the past have treated the commute to work as the cause of congestion and pollution. Several studies have indicated that the structure of the household, including the number of workers, affects the makeup, length and duration of the work trip, turning it into a linked, multi-destination, multi-purpose journey (6,7,8). With this in mind, traffic management policies that reduce peak congestion, such as congestion pricing, may increase travel in off-peak hours.

These complex trip chains that are formed by MWHs can, however, be highly resistant to managed attempts at peak spreading. Management policies that try to increase the number of occupants per vehicle have the potential to send two or more drivers out in separate vehicles after the home commute to attend to personal trip requirements. If MWHs do indeed link more trips around the work commute, the extra time that they spend at these stops is time not spent on the highway, thereby lengthening the "peak" hours but reducing the number of cars at any one time.

For these reasons, more analysis of MWHs is needed and future models of congestion and pollution must include this variation from the traditional commuting pattern (home-work-home). The importance of household composition in explaining differences in trip chaining has pollution and congestion management policy and travel demand implications.

MWHs are likely to continue to be part of our social structure. While married couples with children continue to decline as a percent of all households, it is more and more likely that both adults in these households will have jobs outside the home. Job growth in our economy has facilitated what will probably be long-lasting structural changes in our households. Understanding the process of these changes will provide a more fundamental understanding of the changes in the spatial and temporal dimensions of travel demand.

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Adjustment of Weights to Compensate for Deletion of Households with Incomplete Person-level Data

Technical Appendix to

Multiworker Household Travel Demand

Introduction

There are two places in the NPTS data files in which the number of workers per household may be found but in neither place is this a complete count. In the Household File there is a variable, WRKRCNT, which reports the "number of workers in the household." In reality, this is the number of individuals in the household who were interviewed and identified themselves as workers. Those workers in the household who could not be interviewed were not included in this tally and therefore it does not report all workers in the household.

The other file that includes information on number of workers is the Person File. In this file the variable WORKER is coded as a one if the respondent is in the workforce. By summing the number of workers in a household the same tally is achieved as in the Household File. If all eligible individuals in the household (essentially all those over the age of 5) were interviewed, then this would be an accurate tally of the number of workers. Since households in which not all members were interviewed need to be discarded from all data files, the method described in the next section was devised to compensate for the deleted data.

Steps in the Adjustment Process

Step One in the adjustment of the weights included determining whether all eligible persons in the household were interviewed. This was accomplished by comparing the HHELGCNT variable ("# of eligible persons in HH"—page C-2 in the User's Guide for the Public Use Tapes) with the RESP_CNT variable ("Number of respondents in household"—page C-5) in the Household File. If the two variables match then we know that there is information on all eligible individuals and the household record is complete. If the two do not match then some household members were not interviewed, resulting in incomplete household information. These households records were discarded as were all the records which pertain to these households in the other five files, e.g., Travel Day File. This reduced the number of households from 22,317 to 17,690.

Since 4,627 households were discarded, the weights in the household file had to be adjusted upward. This was Step Two and consisted of selecting adjustment variables which we felt would minimize the bias created by discarding households. Based on our experience with the data, the documentation regarding the data, and in consultation with several persons familiar with the data, two variables were selected: household size and household income.

Household size (HHSIZE) was divided into six categories. The first five included one-person to five-person households and the last consisted of households with six or more members. For household income (HHFAMINC), seventeen categories were used plus the two unreported classes (98 = not ascertained and 99 = refused). This yielded a 6 X 19 adjustment matrix with 114 cells; all cells contained at least six households (only five had less than ten households). The list of number of households in these 114 adjustment cells and the adjustment factors is shown in Table 1.

As an illustration there were 244 single-person households in the lowest income category and three of these were discarded because there was no information in the Person File. *Consequently the weights for each of the remaining 241 households (WTHHFIN) were increased by a*

Table 1: NUMBER OF WORKERS PER HOUSEHOLD, 1983-1990

Number of Workers	1983	1990	1983	1990
	(in millions)		(percent)	
0	22.6	23.3	26.5%	24.9%
1	33.0	33.9	38.6%	36.3%
2	23.3	30.0	27.3%	32.1%
3+	6.5	6.2	7.6%	6.7%
Total Households	85.3	93.5	100.0%	100.0%
2+ (multiworker)	29.8	36.2	34.9%	38.8%

Source: NPTS 1983, 1990

factor of 1.01245. Similarly, the two-person households in income category one had their weights increased by a factor of 1.25 (Table 1). Continuing this for all households, the data were adjusted to total 93,347,000 households. This was Step 3. While the total for other variables such as the number of adults should be similar to the original data set, we do not anticipate them to be exactly the same. Step Three yields a file of 17,690 households with new weights (old weights multiplied by the corresponding adjustment factors).

The weighting procedure for the Household File was then completed. These weights also applied to the Vehicle File as was the case with the original weights.

In the original data, the Person File contained a set of weights different from the household weights, because some persons were not interviewed. Since households with these "missing persons" were discarded and new weights were calculated with these deletions in mind, the new household weights were also used for the person file. Applying the new household weights to the Person File was Step Four.

Step Five consisted of applying new weights to the Travel Day File. These were derived by multiplying the new Household (or Person) File weights by 365. In Step Six these same weights were applied to the Segmented Travel File.

Step 7 - the last step - included multiplying the new household weights by 365 (days) and dividing by 14 (days—the duration of the travel period) and applying these to the Travel Period File. This completed the adjustment of the weights for all six files.

Conclusion

It should be noted that a more elaborate design could have been implemented but it was the decision of the research team that this particular procedure was one that could be completed in a timely fashion (since no additional resources were allocated for this task) while accounting for two potentially serious sources of bias. The resulting data now report 114 million workers, closer to the U.S. Bureau of the Census figure of 115 million workers than the original NPTS data. Simple factoring could also have been performed, but given the sizes of the data files, this by itself would not have been a trivial task and surely would have yielded biased data.

Table A.1: HOUSEHOLD FILE ADJUSTMENT FACTORS AND NUMBERS OF HOUSEHOLDS BEFORE AND AFTER DELETION OF INCOMPLETE HOUSEHOLDS

Cell	HHFAMINC	HHSize	Factor	Before	After
1	1	1	1.01245	244	241
2	1	2	1.25	140	112
3	1	3	1.26667	76	60
4	1	4	1.3125	42	32
5	1	5	1.21429	17	14
6	1	6	1.625	13	8
7	2	1	1.01656	614	604
8	2	2	1.16718	377	323
9	2	3	1.25564	167	133
10	2	4	1.25352	89	71
11	2	5	1.29412	44	34
12	2	6	1.36364	30	22
13	3	1	1.01171	432	427
...					
102	17	6	1.56757	58	37
103	98	1	1.16776	355	304
104	98	2	1.35039	686	508
105	98	3	1.69903	525	309
106	98	4	1.72803	413	239
107	98	5	1.7047	254	149
108	98	6	1.69767	146	86
109	99	1	1.05758	900	851
110	99	2	1.38286	1517	1097
111	99	3	1.51096	689	456
112	99	4	1.62162	540	333
113	99	5	1.41401	222	157
114	99	6	1.5	90	60
TOTAL				22317	17690

Household Structure and Travel Behavior

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Household Structure and Travel Behavior

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Executive Summary

This report presents a social structural method for analyzing and understanding personal travel behavior. This method is intended to enhance the understanding of personal travel behavior within the context of household structure and the individual's role within the household.

Household structures are based on the presence or absence of dependents, on the number of independent adults in the household, and on relationships among household members. Similarly, person roles are based on the dependence or independence of the traveler, on the presence or absence of other independent or dependent persons in the household, and on certain relationships among household members. In all, twelve household structures and twelve person roles were developed for this study.

To describe personal travel, innovative measures of travel behavior, called person loops and trip chains, are used in addition to the conventional travel variables of person trip, trip length, and travel distance. A trip is defined as uninterrupted travel from one place to another by any transportation mode. Person loop describes a set of trips which begin and end at home. Trip chains are defined as one or more trips between anchors. Home, work, and school are defined as trip anchors because travel to and from work or school is constrained in time and space, and because travelers generally spend a significant amount of time at these locations. Complex chains are defined as a sequence of trips between different anchors (e.g. home and work), consisting of more than one trip, or between two like anchors (e.g. home and home), consisting of more than two trips.

Profiles of each of the 12 household structures used in this study were drawn from descriptive statistics, including household size, household income, vehicle ownership, gender of household members, person role of household members, and work status of independent persons in the household. The travel behavior of households by household structure was studied to determine differences between household structure groups. The household structure profiles are used to relate household structure and the roles of persons within households to travel behavior.

Results

To evaluate ability to differentiate travel behavior, household structure was compared with household income, number of vehicles in the household, number of persons in the household, age of dependents, and travel mode; person role is compared with gender and work status of the traveler. Both household structure and person role were found to be effective in differentiating values for travel variables. The number of vehicles owned by the household, number of persons in the household, and work status were the only conventional variables which are comparable to household structure and person role in this respect.

Travel Behavior by Household Type

Trip frequency and travel distance per household were found to be highest for households with dependents, and tend to vary with household size.

Trip lengths were found to increase with number of independent adults, but decrease when dependents are present.

Trip frequency and number of person loops increase only slightly with the number of independent adults in a household, but increase substantially when dependents are present.

The effect on daily household travel distance is similar to the effect on trip frequency, increasing more with the presence of dependents than with increasing numbers of independent adults in the household.

One independent adult married households with dependents were found to have lower trip frequencies, trip lengths, and travel distances than two independent married adult households with dependents.

Households consisting of two related adults exhibited very low trip frequency and travel distance in comparison with similar size households consisting of two unrelated adults or a married couple.

Households of unrelated individuals exhibited the highest trip frequencies and travel distances among all two person households without dependents.

Household trips per loop and complex chains per loop generally decrease when dependents are present and as the number of independent adults increases. The tendency to combine trips into complex chains was found to be lowest in the largest household (more than two independent adults with dependents).

Travel Behavior by Person Role

Adults living alone were most likely to form complex chains.

Unrelated adults living in the same household exhibited travel behaviors similar to married adults, while related adults had a low propensity to form complex chains.

Single adults with dependents had a relatively high number of complex chains per loop and a high number of trips per loop, but a low number of loops per day. This suggests that their travel tends to be very complex relative to travel for other roles.

Unrelated independent adults without dependents, single adults with dependents and married adults with dependents exhibited the highest trip frequencies and trip length, and married adults with dependents had longer travel distances. Young adult dependents traveled about the same relatively short distance each day as unrelated adults.

Gender was found to have a different effect on trip frequency for each person role. The effect was most marked for dependent adults over 35 years of age; males made fewer trips than females, who were mostly homemakers. Independent married males with dependents also made fewer trips than their female counterparts. On the other hand, single females without dependents made fewer trips than comparable males. In most role categories, however, trip length and travel distance were longest for males, while females had more trips per loop and more complex chains per loop.

The effect of work status was found to be consistent across all person roles. Students, workers, and student workers had the highest trip frequency and the highest average travel distance. Workers also had the highest average trip length. Retired persons and homemakers were more likely to link trips into complex loops than were workers, while students and student workers had the lowest tendency to do this.

Further Research

The use of household structure and person role as explanatory variables for analyzing travel behavior looks promising. However, this study is limited in several ways that should be addressed in subsequent research.

The findings in this report are limited to person level measures of travel. Further work is needed to analyze the effects of structural variables on vehicle use and the effects of vehicle use on person level measures of travel.

This report uses only group means to quantify personal travel behavior. Future work could include other descriptive statistics, such as modes and quintiles, and should use multivariate techniques to analyze travel behavior by person role. Understanding of the effects of gender, household income, and work status could be significantly enhanced by the use of more advanced statistical techniques.

Time of day of travel and total travel times are important dimensions of travel behavior that should be examined in subsequent research.

The study of trip chaining could also be greatly expanded. Many variables developed in this research and available in the customized data base were not used in this study. Trip purpose could also be introduced to investigate complex trip chains in work or school trips in contrast to complex trip chains formed by trips for other purposes.

Introduction

1.1 Background

This report presents a social structural method for analyzing and understanding personal travel behavior. Rarely engaged in for its own sake, travel typically derives from the need to connect socially structured activities that are dispersed geographically and through time. These activities, defined as events in which individuals and groups interact, are complex behavior because the actions of the individuals engaged in them are structured - tied to and coordinated with the actions of others through relationships. Personal travel reflects this complexity because it is itself a structured activity that links two or more other activities. Consequently, the structure of activities and a person's roles within them can exert a powerful influence over choice of travel destinations, travel times, trip chaining alternatives, and travel mode.

In travel planning and forecasting, trip making is typically aggregated at the person level and at the household level. Individuals have traditionally been described by conventional socio-economic variables such as age and gender. Households are usually described by income level, number of persons in the household, and number of automobiles in the household; less frequently, households are described by lifecycle categories. Thus, in analysis of the Nationwide Personal Transportation Survey (NPTS) data, measures of trip making are correlated with these individual and household characteristics. However, conventional individual and household variables do not accurately specify the structural characteristics of activities important for explaining or predicting travel behavior.

For example, the correlation of trip making with individual trip-maker characteristics does not reflect the relationships that tie the individual trip-makers' travel behavior to their work status or to the travel needs of others within the household. With seventy percent of women in the labor force today, the use of gender without reference to work status and family structure may leave too much variability in travel behavior unexplained. Similarly, household income, size, and vehicle ownership, while important, do not account for the structural characteristics that affect members' travel behavior.

The lifecycle approach is sometimes used to attempt to explain behavioral differences in an individual or group. Lifecycle concepts describe a birth to death developmental process consisting of a sequence of household stages, and assume that individuals progress through a "normal" series of these stages. Lifecycle measures used in the 1990 NPTS are described as follows:

01 Single adult, no children

02 2+ adults, no children

03 Single adult, youngest child 0 -5 years old

04 2+ adults, youngest child 0 -5 years old

05 Single adult, youngest child 6-15 years old

06 2+ adults, youngest child 6-15 years old

07 Single adult, youngest child 16-21 years old

08 2+ adults, youngest child 16-21 years old

09 Single adult, retired, no children

10 2+ adults, retired, no children

However, lifecycle descriptors only loosely correspond to some of the structural influences on trip making. Although lifecycles reveal whether there is more than one adult and whether there are children in

the household, they cannot account for the growing diversity of household types that exist today. For example, households with 2+ adults may consist of married couples, other related adults, or unrelated individuals. The 2+ adult lifecycle thus combines several different types of household structure. For this reason the lifecycle approach also fails to provide a consistent theoretical basis for shifting the level of analysis between households and individuals. At the same time, lifecycle descriptors confound household structural influences with other determinants of travel. For example, separating households by age of youngest child confounds age effects with structural influences; and separating no child households by retired status confounds work status with household structure.

Travel data analysis and travel demand forecasting should also be sensitive to the structured quality of activities when travel behavior is described and quantified. Conventional travel surveys measure travel activity as an aggregation of individual trips. Trips are classified as home-based or non home-based, and each trip has a separate purpose. In this way each trip is disconnected from the other trips that are linked with it to form a chain of activities. Trip measures that abstract trips from their structural contexts can obscure how the timing and linking of trips are critical elements of structured travel strategies. Recognizing this shortcoming, transportation researchers are beginning to develop methods for measuring complex chains of linked trips (Oster, 1978; Hanson, 1979; Oster, 1979; Adler, 1979; Hanson, 1980; Kitamura, 1983; Golob, 1986; Hanson and Huff, 1986; Kondo and Kitamura, 1987; Kondo and Kitamura, 1988; Goulias et al, 1988; Goulias and Kitamura, 1989; Strathman et al, 1992). There is as yet no clear consensus on how best to conceptualize and measure trip chains.

The structural approach presented in this report uses traveler typologies that reflect socially structured differences among households and person roles. Structural measures of trip making are also developed and utilized. The work builds on that of earlier researchers who have adopted an activity-based approach to the analysis of trip making (Neale and Hutchinson, 1981; Hanson and Hanson, 1981; Clark et al, 1981; Damm, 1982; Recker et al, 1987), and on the work of researchers investigating life cycle as a household descriptor (Kostyniuk and Kitamura, 1982; Zimmerman, 1982; Chicone and Boyle, 1994). Other researchers have adopted an approach which is closer to that used in this work. Studies of person-role as a descriptor of traveler (Koppleman 1978), of the travel behavior of non-traditional households (Van Knippenberg et al, 1988), and of the effect of household structure on trip-making behavior (Strathman et al, 1992) all attempt to address the influence of social interaction within the household on travel behavior.

The goal of this report is to develop and evaluate a social structural approach for analyzing travel behavior. Data from the NTPS are used to understand the relationships between complex social characteristics and travel behaviors, not to predict the number of trips, chains or loops in a given population. In this report, simple descriptive statistics (means and standard deviations) are used to describe travel behavior of persons varying in age, income, and gender; of 12 differently structured households; and of individuals in one of 12 person roles. Model-building, seeking which combination of factors best explain the variation in simple and complex chains, loops, and trips, is planned for a later analysis.

This report compares the variation in travel behaviors obtained by conventional definitions of individual travelers with the variation derived from social structural concepts. It is hoped that the results of this work will contribute to improvements in the way travel behaviors are measured and the way individuals and their travel-related relationships are described and understood. It may also improve the precision with which personal travel behaviors are explained and predicted, and, in doing so, may assist planners, public officials, and interest groups in evaluating alternate plans for reducing traffic congestion, supporting energy conservation, and reducing motor vehicle emissions to help to attain ambient air quality standards.

The remaining sections of Chapter One outline the approach used to extract data from the NPTS. Conventional demographic predictors are then discussed in Chapter Two, and household structure and role are introduced as significant predictors of travel strategies with supporting rationales from the social science literature on the behavioral significance of social relationships. Recent developments in the measure-

ment of travel behavior are also reviewed. In Chapter Three the structural descriptors of traveler and travel behavior utilized in this study are presented. The results of the analysis follow in Chapter Four, focusing first on profiles of household structure and person role categories, then on trip making behavior of these categories, and finally assessing the relative strength of structural and conventional measures of travel behaviors and person characteristics. Some implications of our findings are discussed in Chapter Five.

1.2 The Nationwide Personal Transportation Survey Data Base

The 1990 Nationwide Personal Transportation Survey (NPTS) is the fourth such survey conducted in the United States. Of the several files included in the NPTS survey, only three are used here - the "household file", the "person file", and the "travel day file." Hereafter, these files will be referred to as the NPTS files. The file generated in conjunction with these data will be referred to as the CSUS file.

Given that each of the NPTS files describes a different unit of analysis (i.e., persons or households), information was compiled for the smallest unit of measure (persons) and then aggregated for the respective households. Put simply, the newly generated data file (the CSUS file) takes the survey respondent as the unit of analysis and appends the respective household information to the information already compiled for each individual. The variables taken from the NPTS files and the new variables developed for the current study are described in Appendices to this report as follows:

- Variables taken directly from the NPTS person file — Appendix A
- Variables taken directly from the NPTS household file and matched to the appropriate respondent. — Appendix B
- Variables taken directly from the NPTS travel day file (provided for persons) and matched to respondent. — Appendix C
- Computed household variables derived by analysis of information provided in the person file for all persons in the respective household (e.g., age of youngest child) — Appendix D
- Computed household travel variables derived by aggregating personal travel information for all persons in the household. — Appendix E
- Analysis of statistical data on conventional and structural concepts of travelers and travel behavior. — Appendix F

The Appendices are not included in this report, but are available upon request from the FHWA Office of Highway Information Management.

The formulation outlined above implies several instances where cases will be eliminated given that the information provided is not complete. In particular, this is the case when not all of the members of a household were surveyed. In such a case it is not possible to determine whether the missing person is someone's spouse, a relative, a dependent adult, or has some other attribute which describes the role of a person who has been included. In short, the base number of valid cases (persons) in the CSUS file is the same as that presented in the NPTS person file minus persons whose households were not completely surveyed.

Counts of households and associated statistics generated from the CSUS file were derived by selecting one person per household and only for households where all persons were surveyed. The total count of households matches those described in the NPTS household file minus those with incomplete person surveys. In some cases, no person surveys were conducted for persons residing in households described by the NPTS household file.

There are 48,385 persons in the 21,707 households included in the 1990 NPTS sample. However 4,658 persons, 9.6% of the persons in the data base, are excluded from this study because trip data was

either not obtained, or was incomplete for these persons. In Table 1.1 these cases are identified as either missing persons or missing variables. The removal of these individuals eliminated their households since household trip data were then incomplete. This resulted in a loss of 4504 households, or 21% of the households in the data base. It also resulted in a loss of 16% of the sample persons when household level variables were analyzed. In other words, the person level analysis includes some individuals who could not be included when the household data were analyzed.

In NPTS weighting factors (or expansion factors) have been provided to expand the data to the entire population of the United States. Consideration was given to adjusting these weighting factors to compensate for the persons and households excluded from this study. However, since the objective of this study is to better understand the relationships between trip making and household structure and person role, and not to predict trip making measures for the entire population, weighting factors were not utilized. It is noted that the missing data occur more frequently for larger households and for households with higher incomes. Thus smaller households and lower income households are slightly over-represented in the useable data set in comparison with the entire data base.

Table 1.1 CASES EXCLUDED FROM STUDY DUE TO MISSING DATA

	Person Level Analysis	*Household Structure*	
		Households	Persons
Database Total	48,385	21,707	48,385
Person missing	4,197	4,304	7,298
Variable missing	461	200	551
Study Total	43,727	17,203	40,536

Literature Review

2.1 Conventional Demographic Descriptors

A number of economic, demographic, and other factors have been found to influence travel patterns in the United States. Household income is directly related to travel time to work (Wachs, 1987). Using the 1980 Public Use Microdata Sample (PUMS), McLafferty and Preston found that: persons in managerial positions have longer commutes than non-managers; minorities generally face longer commute times than caucasians; and women spend less time commuting than men (McLafferty and Preston, 1991). The reasons for these patterns are less well-established. Commute times for different groups can be influenced by residential choice, the geographic dispersion of jobs and industries, variations in occupational choice, family responsibilities, or transit options in different metropolitan areas. The emphasis on demographic categories (women vs men, minorities vs non-minorities) obscures the increasing diversity in family structure, educational and occupational levels, lifestyles, and economic interdependencies within these groups. Given the possibility of greater diversity within than between these categories, their use in the prediction of other variables, including travel behavior, may result in less precision than utilization of structural variables.

The intersection of economic changes with the alterations in family structure that have taken place primarily in the past twenty years sets the stage for creative new approaches to the analysis of travel behavior. Since 1970, the size of households has decreased 16%, from 3.14 members in 1970 to 2.63 in 1991 (Table 2.1), while the number of household units has increased by almost 50%, from 63.4 million in 1970 to 94.3 million in 1991 (Bureau of the Census, National Data Book, 1992). The increased number of households is due to a number of factors: the coming of age of the baby boom generation; greater longevity, seniors living independently from their children; higher divorce rates; and the postponement of marriage. For example, the proportion of family households headed by women increased from 8.7% in 1970 to 11.9% in 1990, while the proportion of two parent households declined during the same time period from 40% to 26% (Table 2.2).

Table 2.1 AVERAGE HOUSEHOLD SIZE

1960	1970	1980	1990	1991
3.33	3.14	2.94	2.63	2.63

Source: U.S. Bureau of the Census, Current Population Reports, Series P-20, No. 461.

Table 2.2: DISTRIBUTION OF FAMILY AND NON-FAMILY HOUSEHOLDS 1970 - 1991

	1970	1980	1990	1991
Family Households	81.16	73.72	70.80	70.32
Married Couples With Children	40.27	30.90	26.29	25.87
Married Couples Without Children	30.28	29.90	29.76	29.42
Male Without Spouse With Children	0.54	0.76	1.24	1.25
Male Without Spouse Without Children	1.40	1.38	1.85	1.83
Female Without Spouse With Children	4.51	6.74	7.07	7.23
Female Without Spouse Without Children	4.17	4.04	4.60	4.71
Non-Family Households	18.84	26.28	29.20	29.68
Single Persons	17.11	22.65	24.64	25.01
Male Alone	—	8.62	9.70	10.02
Female Alone	—	14.03	14.94	15.00
Other Non-Family Households	—	3.63	4.56	4.67

Source: U.S. Bureau of the Census, Current Population Reports, Series P-20, N. 461.

The structural changes in household composition have occurred in conjunction with significant changes in the participation of women in the labor force, which, in turn, is gradually altering the division of labor within households. Married working females with children in 1990 made up 16.6% of the full-time labor force, compared with 10.2% in 1960 (Table 2.3). Looked at another way, the percentage of women over the age of 25 who were in the labor force has risen considerably between 1960 and 1990, as shown in Table 2.4.

Table 2.3: MARRIED WOMEN WITH CHILDREN AS PERCENT OF TOTAL LABOR FORCE

	1970	1980	1990	1991
Married Women with Children	10.20	13.70	16.50	16.60

Source: Statistical Abstract Table 620 "Women in Labor Force by Marital Status and Presence of Children" based on U.S. Division of Labor Statistics, Bulletin 2307; and unpublished data.

Table 2.4: PROPORTION OF WOMEN IN THE LABOR FORCE BY MARITAL STATUS AND PRESENCE OF CHILDREN

	1960	1970	1980	1990
Married Without Children	30.50	40.80	50.10	58.20
Married With Children	27.60	39.70	54.10	66.30
Single, with & without	44.10	53.00	61.50	66.40
Other	40.00	39.10	44.00	46.80

Source: Statistical Abstract Table 620 "Women in Labor Force by Marital Status and Presence of Children" based on U.S. Division of Labor Statistics, Bulletin 2307; and unpublished data.

In general, studies are finding that working women retain more of the household responsibilities than their husbands (Firestone and Shelton, 1988), leaving less leisure time for working women with children (7% of a day vs. 12% for their male counterparts) (Fox, 1985). The combination of work, household and childcare duties places a premium on commute time. Existing studies do not indicate to what degree the shorter commute times for women (Fox, 1985) are due to the use of proximity as a factor in job choice, the use of job location as a factor in residential choice, or the occupational distribution of women in the work force.

Using data from the 1988 National Survey of Families and Households, Blair and Lichter (1991) found a complex relationship between a woman's employment and earnings relative to that of her spouse or partner and to the degree of gender segregation in household tasks and the relative number of hours men and women devote to housework each week. A woman's education, employment and earnings increase the man's share of total family labor and decrease the gender segregation of household tasks. A woman's hours of participation in the labor force and the relative difference in both education and earnings between partners are significantly related to task segregation and the proportion of housework done by the man. Blair and Lichter found that employed women who equal or exceed their partner in education and income spend less time in household tasks than unemployed women. The presence and number of children were found to exert pressures in the opposite direction.

2.2 Social Trends and Travel Behavior

Social trends identified in this report include: an increase in the percentage of married couple households in which the wife works outside the home; an increase in the percentage of single parent (predominantly female) families; and increases in both single person households and non-family households. All of these changes can be expected to have an impact on the transportation needs and habits of individuals and households.

Some of the effects of these trends on individual and household behavior have been studied by earlier researchers. In particular the impacts relating to and affecting women in the workforce, and women as

single parents, have been the subject of several studies (Carp, 1974; Koppleman et al ,1978; Giuliano, 1979; Bayes et al, 1982; Michelson, 1983.) As pointed out by Michelson, "Role responsibilities (while differing for different women) represent the cornerstone of daily activities and hence of travel." This of course is true *regardless of gender.* However the more varied work status of women (full time, part time, none), and the influence of children in the household (and the ages of the children) on women's responsibilities create a greater variety of role responsibilities for women in comparison with men. The recent changes in work and marital status of women have also led to changes in their role responsibility and hence travel needs.

Women's transportation is, in general, more likely to be influenced by travel of other family members. Michelson (1983) found that (in Toronto, Canada) men were twice as likely to travel alone as were women and 30% more likely to travel without other family members. He also found that women's work and marital status affected the time spent traveling per day but married women spent less time than their husbands in travel and single women who work spent the largest amount of time in travel.

Researchers have also focused on household structure as an explanatory variable for *trip making.* Chicoine and Boyle (1984) used the following four lifecycle stages:

1. Single person households
2. Households of unrelated persons without children
3. Families with children under 16 years old
4. Families with no children, or with youngest child under 18 years old

These household structures were compared for predicting household trip generation rates with the use of the more conventional variable, household size. In both cases vehicle ownership was used as a control variable. This definition of household structure has the advantage of simplicity but does not differentiate between single parent, traditional, and dual income families. Also, for households with two or more members, there is no differentiation of household size.

Chicoine and Boyle concluded that there is evidence to support the use of household structure rather than household size. They concede that there are some difficulties involved in forecasting household structure, but they argue that theoretical considerations support the notion that *the household structure concept* holds the potential to improve the accuracy of the trip generation process.

Zimmerman (1982) used three basic family structures and a lifecycle associated with each. The family structures were:

1. Childless Households : Couples
   Single
   Unrelated individuals
2. Typical Nuclear family
3. Single parent family

Lifecycles for childless households were described by the age of one of the adults in the household, while lifecycles for households with children were described by the age of the oldest child. This definition of household structure does not differentiate between traditional and dual income families and does not include household size as a descriptor.

Zimmerman's work showed higher trip rates for early lifecycles of childless households and higher trip rates for later lifecycles of families with children. The highest trip rates are for typical nuclear families with older children (10 to 11 trips per day) and for households of unrelated individuals under 30 years old (8.33 trips per day.) Zimmerman also found that trips decline steadily with age for childless couples, single person households and households of unrelated individuals. For both one and two parent families, trip

making increased steadily with age of the oldest child. However, two parent families generated roughly 50% more trips than single parent families.

Notwithstanding the attractiveness of the lifecycle approach to trip prediction, Zimmerman points out that divergent views exist on appropriate lifecycle categories for transportation. She calls for "Better theoretical justification for the selection of life-cycle stage in travel research than have been made to date" (p55).

In recent work involving household structure and trip chaining, Strathman et al (1992) have defined household types on the basis of work status, presence and age of children, and age of adults for zero worker households only. These household types are shown with their frequency distribution in Table 2.5.

This comprehensive set of household types leaves out only non-family households (unrelated adults) and unmarried related adult households. And, as with lifecycle, several other variables important for analyzing travel behavior are confounded.

Table 2.5: DISTRIBUTION OF HOUSEHOLDS BY HOUSEHOLD TYPE

Household Type	Percent of Sample
Zero workers, all persons aged 60+	15
Zero workers, some under age 60	14
Single working person	8
Single working person w/child < 6 years	1
Single working person w/child > 5	2
Traditional Couple	16
Traditional Family w/child < 6 years	11
Traditional Family w/child > 5 years	10
Dual income, no children	12
Dual income w/child < 6 years	3
Dual income w/child > 5 years	7
Multiple adult workers	2

Source: Strathman, et al. 1992

2.3 Measuring Travel Behavior

Travel patterns have traditionally been identified in terms of trips that are home-based or non home-based, without regard to relationships between successive trips. However, researchers have found considerable evidence that trip makers frequently chain trips together to accomplish their daily activities. For example, Clark et al (1981) found that 44 to 71 percent of journeys were single stop and the remaining 29 to 56 percent involved some trip chaining.

O'Kelly and Miller (1984) studied the characteristics of multi-stop and multi-purpose non-work travel based on two week travel diaries prepared by residents of Hamilton, Ontario. They compared trip lengths for single stop and multi-stop "tours." Tours were defined as a series of trips starting and ending at home. A single stop tour might be home to grocery shopping to home; a multi stop tour could be home to grocery shopping to grocery shopping (at another location) to home, or home to non-grocery shopping to social/recreational/other to home. They demonstrated that travel times of multi-purpose tours for grocery shopping were typically 40 percent longer than travel times of single stop grocery tours and concluded that "ignoring multi-stop tours will result in serious underestimation of total travel as well as provide a poor conceptual starting point for behavioral modeling efforts."

Kostyniuk and Kitamura (1984) studied urban travel patterns using 1965 and 1980 data from southeast Michigan. They found that travel patterns had changed considerably over this time period but were able to conclude that obligatory and less flexible activities tended to be pursued earlier in the day and before flexible activities. The 1980 data also showed that individuals who made many trips per day were more likely to organize trips into trip chains.

Nishii et al. (1988) looked specifically at trip chaining in the home to work and work to home commute. They hypothesized that the likelihood of undertaking a separate home based trip (or trip chain) to accomplish non-work activities will increase with speed of travel and will decrease with increases in commuting distance, travel cost, and density of opportunities. The analysis was confined to workers who engaged in a single discretionary trip in addition to their work trips. They defined sequences of trips as paths subdivided into multi-chain paths in which the additional activity is pursued in a separate home-based trip chain, and single-chain paths in which the activity is linked to a commuting trip. Data for 1980 from Osaka and Kyoto, Japan, showed that 36.2 percent and 38.7 percent, respectively, of the discretionary trips were attached to the morning or evening commute, 53.5 percent and 42.5 percent were made during work, while 10.3 percent and 18.8 percent were undertaken as a separate home based trip chain. The data used for this study included trips by each household member over five years of age. Commute trip data were not broken down by gender.

In 1989 Goulias et al. developed a method for estimation of trip generation, taking trip chaining into account. Using data from Detroit, they developed regression models in which mandatory trips are a function of income, household structure, and other variables and discretionary trips are a function of mandatory trips and other variables. They found that trip chaining was associated mostly with work, shopping, and personal business trips and very little with school and social/recreational trips.

Using data from an NCHRP project investigating travel characteristics at large scale suburban activity centers in Dallas, Washington, DC and Minneapolis, Chang and Lin (1992) looked for clusters in the travel data. They clustered the data based on the frequency of stops in the commute trip and found that trip chaining on the commute trip is higher in large households with a large number of children and in households with a low number of available vehicles; but a very short or very long commute diminishes the degree to which trips are chained. Small households living very close to work and small suburban households with a short commute exhibited a low propensity for trip chaining on the commute.

Using two week diaries of commuters in Austin, Texas, Hatcher and Mahmassani (1992) investigated the variability in the evening commute. They compared "day-to-day" patterns with patterns which "deviate from normal." They found that about 39 percent of evening commute trips included at least one intermediate stop and 11 percent had two or more stops. Only about 5 percent of commuters made stops in their evening commute every day. At the other extreme, 14 percent did not stop on any of the days in the survey. The researchers separated stops into routine and non routine, defining routine as stops at the same location made at least 3 times per week. Using this definition they found that 15.9 percent of the stops were routine. 9.7 percent of the commuters had at least one routine stop. 62.6 percent of the routine stops were to serve passengers.

In 1992 Strathman et al. conducted a study of the effect of travel conditions and household structure on trip chaining, using data for weekday travel in Portland, Oregon. Trip making was described by simple and complex chains. All chains began and ended at home; data which did not fit into this category were discarded. A simple chain was a home to home circuit with one stop coded by purpose (work, school, shop, social/recreational, personal business, serve passenger, other). A complex chain had two or more stops, each coded by purpose as listed above. The sample of 2718 households consisted of 3443 persons aged 5 and older. In the 24 hour period of the survey, 19112 trips were made, organized into 7,967 chains starting and ending at home. Simple chains made up 76.1 percent of the total and complex chains 23.9 percent. Work chains constituted about one third of all chains; about 80 percent of work chains were simple chains. The number of daily trip chains per household ranged from 0.5 (for single working persons) to 2.5 for persons living in multiple adult worker households.

In their analysis Strathman et al. examined the propensity for trip chaining and the tendency to incorporate non-work trips into the commute trip chain or into separate non-work trip chains. They found that single working adults with preschool children had the highest propensity to form complex commute trip

chains. This group was followed (but not closely) by single persons, single persons with school-age children, dual income couples and dual income couples with preschoolers. At the low end in propensity to form complex commute chains were traditional couples, multiple workers, traditional couples with preschoolers, and dual income families with school age children.

The traditional couple and traditional couple with preschoolers tended to incorporate non- work trips into complex non-work chains, while dual income couples with preschoolers and people living in multiple worker households incorporated more of these trips into complex work commutes. Single persons, single persons with children, and dual income couples incorporated these trips into both complex commute chains and complex non-work chains; however single persons and dual income couples favored the complex commute chain. Dual income couples with school age children incorporated few trips into complex chains.

In addition to the effects of household structure on trip chaining, Strathman et al. investigated the effects of driving alone to work, living in the suburbs, working in the CBD, working in the suburbs, number of vehicles in the household, distance to work, congestion, total number of non-work trips, high income and low income on the tendency to incorporate non-work trips into complex work chains or into complex non-work chains. Driving alone to work was the only variable with effects of the same order of magnitude as household structure and, as expected, this encouraged incorporation of more trips into complex commute chains than into complex non-work chains. The researchers concluded that household structure has an important influence on the formation of complex commute chains and that the rapid growth of households of the type which tend to form complex commute chains has contributed to the high rate of growth of peak period traffic.

2.4 Summary

The literature reviewed above suggests that structural concepts for categorizing travelers and for measuring travel behavior are receiving a lot of attention. Attempts to develop and apply a structural method for analyzing travel behavior have been undertaken for many of the same reasons expressed in this report. However, development of structural concepts and measures are still at an early stage in their development. In particular, categories of traveler are less fully developed and utilized than are measures of travel behavior based on trip chain concepts. Clearly, there is a recognized need to continue this line of research.

Methodology

3.1 Descriptors of Travelers

Travel surveyed in the 1990 NPTS is examined at the household level and at the person level in this report. Household level travel is described for different household structures, and person level travel is described for persons' roles within households. Altogether, travel behavior for 12 household structures and 12 person roles is described.

Several special terms are used in this report. A "reference person" is either the homeowner or the person who pays the rent. One reference person is identified for each household. Other terms include "independent adult" and "dependent." Status as an independent or dependent adult depends on whether a person has a significant degree of economic independence relative to other persons in the household. All persons under 18 years of age were classified as dependents, as were all children of the reference person up to 35 years of age. Most persons classified as independent were those who were reportedly in the labor force (working or looking for work) or retired. All reference persons were also classified as independent, regardless of age. Reference persons may not be working and may derive income from welfare, a working spouse, or some other source. However, the fact that they "pay the rent" suggests that they enjoy some degree of independence within the household. Independent adults were further subdivided by relationship to other household members and presence of dependent persons in the household. Classification of household members into dependent or independent status is shown in Table 3.1.

Table 3.1: CLASSIFICATION OF DEPENDENT AND INDEPENDENT PERSONS

Relationship	Age				
	0-15 years	16-17 years	18-21 years	22-35 years	36 or older
Reference Person	Independent	Independent	Independent	Independent	Independent
Child of Reference Person	Dependent	Dependent	Dependent	Dependent	Mixed*
Spouse of Reference Person	Dependent	Mixed*	Mixed*	Mixed*	Mixed*
Other Relative of Reference Person	Dependent	Mixed*	Mixed*	Mixed*	Mixed*
No Relation to Reference Person	Dependent	Mixed*	Mixed*	Mixed*	Mixed*

* Classified as independent only if main occupation was reported as working, looking for work, or retired.

Household Level

Household structures were defined by the relationship of household members to the reference person and the absence or presence of other independent adults or dependents. The twelve household structure types capture the "traditional" married couple and the traditional nuclear family, as well as household types that have proliferated in recent decades. Other household types include two income married couples, two income families, single person households, single parent families, non family households with two independent adults (with and without children or other dependents), and households with 3 or more independent adults (with and without children or other dependents). Two unmarried independent adult households have been further subdivided into related and unrelated individuals. Households with three or more independent adults may or may not be related, and may or may not include a married couple. (Table 3.2)

Table 3.2: HOUSEHOLD STRUCTURE DEFINITIONS

*Household with no dependent persons***	
Single adult	A single person
Two unrelated adults	Two independent persons*, not related to each other.
Two related adults	Two independent persons, related to each other.
Two independent adult married couple	Two independent persons, married to each other, no other persons in the household
Single independent adult married couple	Two independent persons, married to each other, no other persons in the household
More than two adults	Three or more independent persons irrespective of their relationships.
Households with dependents	
Single adult	A single person with children and/or dependent adult(s)
Two unrelated adults	Two independent adults, not related to each other, with children and/or dependent adults, and no other independent adult(s)
Two related adults	Two independent adults, related to each other, with children and/or dependent adult(s)
Two independent adult married couple	Two independent persons, married to each other, with children and/or dependent adults, and no other independent adult(s).
Single independent adult married couple	Two independent persons, married to each other, with children and/or dependent adults, and no other independent adult(s).
More than two adults	Three or more independent adults irrespective of their relationship and with/without children and/or dependent adult(s)

* "Independent persons" include:
1. All household reference persons regardless of age
2. All adults (not children) unrelated to the reference person
3. Adults *** who answered yes to the worker question or who answered the question what were you doing most of last week by: working; looking for work; retired; or with job but unable to work.

** "Dependent persons" include:
1. Adults*** do not fit the independent status as defined above: i.e. answered no to the worker question and who answered the question what were you doing most of last week by: keeping house, unable to work, going to school
2. Children aged 0 to 17

*** "Adults" are:
1. All persons over 35
2. Persons over 21 who are not the child of the reference person
3. Persons 18 or over who are not related in any way to the reference person

Person Level

Person roles defined for the person level analysis were also deteremined with respect to the relationship of household members to the reference person and the absence or presence of other independent adults or dependents. Role specification was constrained to some degree by the data set. In the data file, a person's relationship to the household reference person is given, but relationships among other members of the household cannot always be inferred from this data. For example, if an independent adult is the spouse, sister, brother, or child of a household member other than the reference person, they are classified as an unrelated adult (see Appendix D). The person roles are defined in Table 3.3.

3.2 Travel Descriptors

Travel descriptors include conventional variables and new variables based on trip chaining concepts. Both conventional and new travel variables are derived from the concept of trip, which is defined as uninterrupted travel from one place to another by any transportation mode. All travel variables are daily mean values. Because of the large number of variables in this study, conventional travel variables are restricted to person trips, person miles of travel, and average person trip distance. Conventional variables used are:

Household Level	*Person Level*
Mean number of household person trips	Mean number of person trips
Mean household travel distance	Mean travel distance per person
Mean distance per person trip	Mean distance per person trip

Trip chains and loops are defined in this report to reflect trip chaining concepts. A trip chain is a sequence of trips which begin and end at a travel anchor. Travel anchors are trip origins or destinations that are relatively fixed in terms of where they are located and when travel between them must be taken. Home, school, and work have been designated as travel anchors; trips to and from school and work are generally constrained to specific days and times of day; home is included as an anchor because daily travel typically begins and ends at home. A loop is defined as a sequence of trips which begin and end at home. Loops may consist of two or more chains. Chains are subdivided into simple and complex chains. A simple chain may contain one or two trips. Simple chains between home and school or work contain one trip; simple chains between home and home, between school and school, or between work and work contain two trips. Complex chains between home and work or school contain two or more trips, complex chains between home and home, school and school, or work and work contain three or more trips. Some examples of loops and chains are:

Loops

Home - work - home

Home - work - shop - home

Home - dinner - shop - home

Home - personal business - lunch - shop - home

Simple Chains

Home - work

School - work

School - home

Home - shop - home

Work - lunch - work

Work - work related business - work

Complex Chains

Home - shop - personal business - home

Home - personal business - school

Home - serve passengers - personal business - work

Work - social - personal business - work

The new travel descriptors used in this study are:

Household Level	*Person Level*
Mean number of household person loops	Mean number of person loops
Mean number of trips per loop	Mean number of trips per loop
Mean number of complex chains per loop	Mean number of complex chains per loop

Analysis of loops and chains was done on a subset of the data used for analysis with conventional trip making variables. The subset consists of 12,982 households and 29,213 persons and includes only those households in which there were no incomplete loops. Further information about the construction of travel pattern descriptor variables can be found in Appendix E.

Table 3.3: PERSON ROLE DEFINITIONS

Dependents

Child 5-15	Any child aged 5-15 (regardless of relationship to reference person).
Child 16-21	Any child aged 16 or 17; a 18 to 21 year old dependent person** or child of reference person.
Adult 22-35	A 22-35 year old dependent person** or child of reference person.
Adult > 35	A dependent person over 35.

Adults with no Dependents

Single	An independent person* living alone.
Unrelated	One or more independent persons in a household where no one is related to the reference person.
Related	One or more independent persons in a household where others are related but not married to the reference person.
Married	An independent married person, living with spouse.

Adults with Dependents

Single	An independent person living with related dependents.
Unrelated	One or more independent persons, in a household with dependents where no independent person is related to the reference person.
Related	One or more independent persons in a household with dependents where other independent persons are related but not married to the reference person.
Married	An independent married person, living with spouse and dependents.

* "Independent persons" include:

1. All household reference persons regardless of age
2. All adults (not children) unrelated to the reference person
3. Adults *** who answered yes to the worker question or who answered the question what were you doing most of last week by: working; looking for work; retired; or with job but unable to work.

** "Dependent persons" include:

1. Adults*** who do not fit the independent status as defined above i.e. those who answered no to the worker question and who answered the question what were you doing most of last week by: keeping house, unable to work, going to school
2. Children aged 0 to 17.

*** "Adults" are:

1. All persons over 35
2. Persons over 21 who are not the child of the reference person
3. Persons 18 or over who are not related in any way to the reference person

Results

Figures and tables in this Section are based on statistical information presented in Appendix F. Complete data are included in Appendix F. In the cross tabulations some cells have very low frequencies. These data have not been used in the analysis. For the household structure and person role groups the lowest frequencies are 144 and 526 respectively and occur for related households with dependents and independent persons living in unrelated households with dependents.

Household structures are identified in figures and tables using the following symbols:

Households with no dependents

- H1 Single independent adult
- H2 Two unrelated independent adults
- H3 Two related independent adults
- H4 Two independent married adults
- H5 One independent adult married couple
- H6 Three or more independent adults

Households with dependents

- H7 Single independent adult
- H8 Two unrelated independent adults
- H9 Two related independent adults
- H10 Two independent married adults
- H11 One independent adult married couple
- H12 Three or more independent adults

Person roles are identified as follows:

Dependents

- D1 Child ages 5 to 15
- D2 Dependent person aged 16 to 21
- D3 Dependent adult aged 22 to 35
- D4 Dependent adult over 35 years of age

Independent adults without dependents

- A1 Single independent adult
- A2 Independent adult living with an unrelated independent adult
- A3 Independent adult living with a related independent adult
- A4 Married Independent adult living with spouse

Independent adults living with dependents

- AD1 Single independent adult
- AD2 Independent adult living with an unrelated independent adult
- AD3 Independent adult living with a related independent adult
- AD4 Married independent adult living with spouse

Some of the persons classified as dependents are working. This occurs in group D2 and D3 because all persons under 18 years and all children of the reference person to age 35 years are classified as dependents, regardless of their work status. Furthermore, some independent adults do not have a "worker," "looking for work," or "retired" work status. This may happen when the reference person, who is always an independent adult, has another work status, such as "student" or "keeping house." For example, a one independent adult married household could contain no "workers" or "homemakers" if the reference person's work status is "student" and the other adult has a dependent status. And a two independent adult married household there might have only one "worker," and there may or may not be a "homemaker" in the household.

4.1 Household Structure and Person Role: Distributions and Profiles

As seen in Table 4.1.1, the single adult household without dependents is the largest category (25% of households), followed by the two independent adult married couple with dependents (23%) and the two independent adult married couple without dependents (19%). The single adult household with dependents is the next largest group (9%), and the one independent adult married couple with dependents is about the same size (8%). The remaining seven household categories each constitute 1% to 5% of the total number of households in the data set.

The distribution of persons in households (Figure 4.1.1) shows that more persons live in two independent adult married couple households with dependents (33% of all persons), followed by persons living in two independent adult married couple households without dependents (16%), persons living in one independent adult married couple households with dependents (12%), single persons without dependents (11%), and persons living in single adult households with dependents (9%). Persons living in each of the remaining 7 household categories make up 1% to 4% of all persons in the data set.

Distribution of persons by person role is presented in Figure 4.1.2. As seen in this figure, 37.6% of persons are dependents, including 19.6% under the age of 16. Of the independent adults, 21.3% are found in married couple households with dependents, and 17% are in married couple households without dependents. Single independent adults with and without dependents constitute 3.4% and 9.8%, respectively, of independent adults. The remaining four independent adult person roles each constitute less than 4% of independent persons.

In the following summaries, key findings are discussed for household structure groups in the following order:

- Single Adult Households without Dependents (H1)
- One and Two Independent Adult Married Households without Dependents (H5 and H4)
- One and Two Independent Adult Married Households with Dependents (H11 and H10)
- Single Adults with Dependents (H7)
- Households with two Related Person, with and without Dependents (H9 and H3)
- Households with two Unrelated Person, with and without Dependents (H8 and H2)
- Households with three or more Independent Adults, with and without Dependents (H12 and H6)

Single Adult Households without Dependents (H1)

For this household category, which constitutes 25% of all households and contains 10.6% of all persons, person role and household structure are synonymous. This group consists mostly of lower income households, as expected for a household size of one. Figure 4.1.3 shows that fifty four percent (54%) of these households have incomes less than $20,000 and only 12.7% have income over $40,000. Automobile

Table 4.1.1: HOUSEHOLD STRUCTURE DISTRIBUTION FOR NPTS SAMPLE

Household Structure	Households (percent)	Persons in Households (percent)	Mean Household Size
Households with no dependents			
Single adult (H1)	25.0	10.6	1.00
Two unrelated adults (H2)	3.2	2.8	2.00
Two related adults (H3)	1.8	1.6	2.00
Two independent married couple (H4)	19.4	16.4	2.00
One independent married couple (H5)	4.7	4.0	2.00
More than two adults (H6)	2.1	2.8	3.15
Households with dependents			
Single adult (H7)	8.6	9.1	2.50
Two unrelated adults (H8)	1.3	1.9	3.31
Two related adults (H9)	1.0	1.6	3.59
Two independent married couple (H10)	22.6	33.1	3.45
One independent married couple (H11)	8.2	12.0	3.47
More than two adults (H12)	2.0	4.2	4.83
	100.0	100.0	2.36
Study Totals	17203	40536	

ownership in these households is low, (Figure 4.1.4) with 22.3% having no vehicle. Not surprisingly, this category had the highest percentage (12.1%) making none of their trips by private vehicle (Table 4.1.2.). As seen in Figure 4.1.5, persons living in this household category are predominantly female (62.2%). Figure 4.1.6 shows that although the largest proportion of persons in this group are working (47.5%), a large proportion are retired (34.6%).

One and Two Independent Adult Married Households without Dependents (H5 & H4)

Married households without dependents consist only of two adults. These household categories make up 4.7% and 19.4% of all households, respectively. Together they account for 20.4% of all persons. Income levels are distributed across the spectrum (but weighted towards the high end for two independent adult married couples). Of these households, 33.1 % and 20.9% have incomes below $20,000, and 32.5% and 43.4% have incomes over $40,000 (Figure 4.1.3). Automobile ownership in these households is high, with 67.3% and 75.0%, respectively, having two or more vehicles (Figure 4.1.4). As seen in Figure 4.1.7, a high percentage (33.9%) of the independent adults in these households are retired, while a very small percentage (less than 1%) are students or student/workers.

Figure 4.1.1 Distribution of Households and Persons

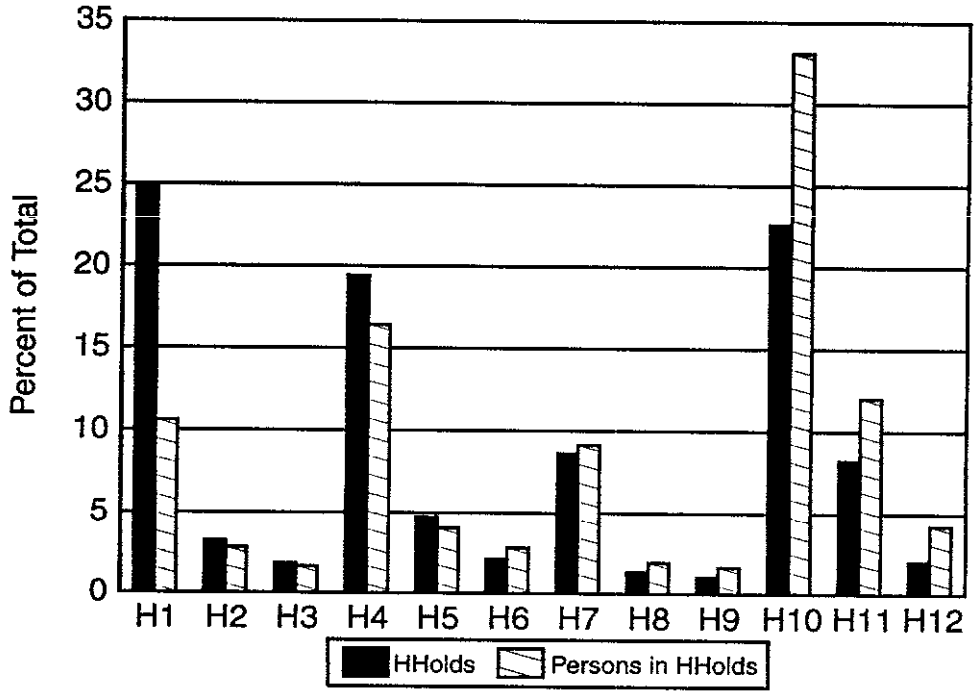


Figure 4.1.2 Distribution of Person Roles

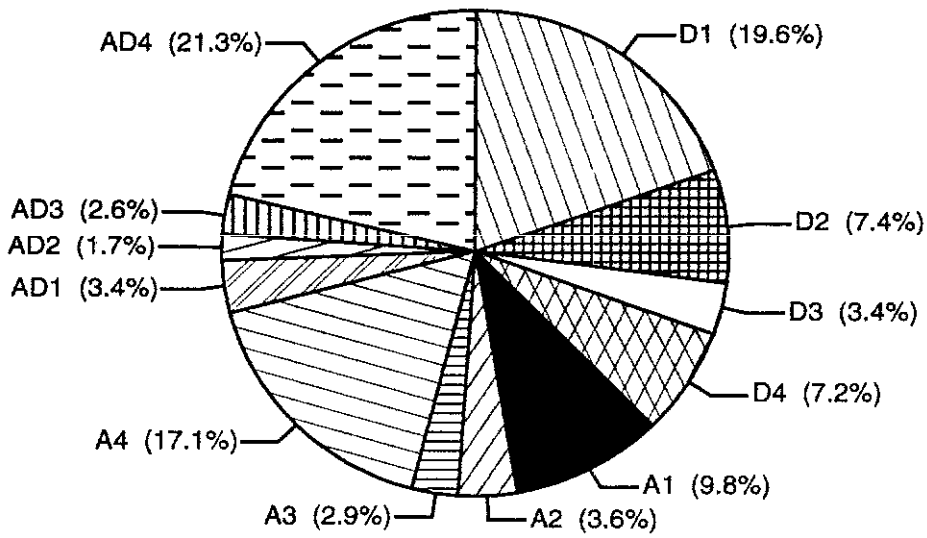


Figure 4.1.3 Distribution of Households by Income

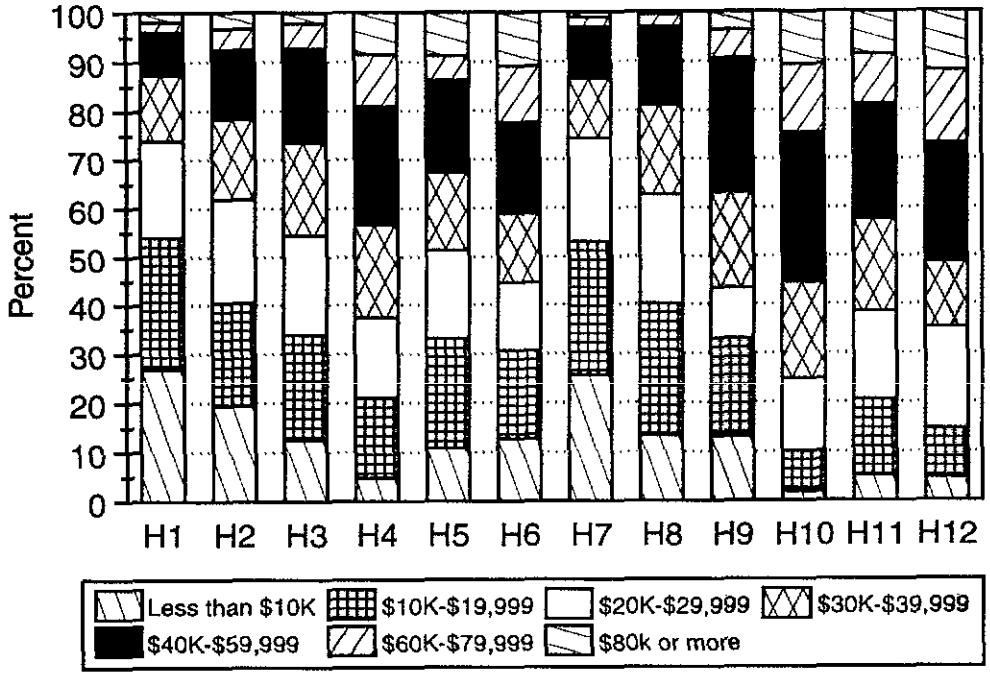


Figure 4.1.4 Distribution of Households by Number of Vehicles Owned

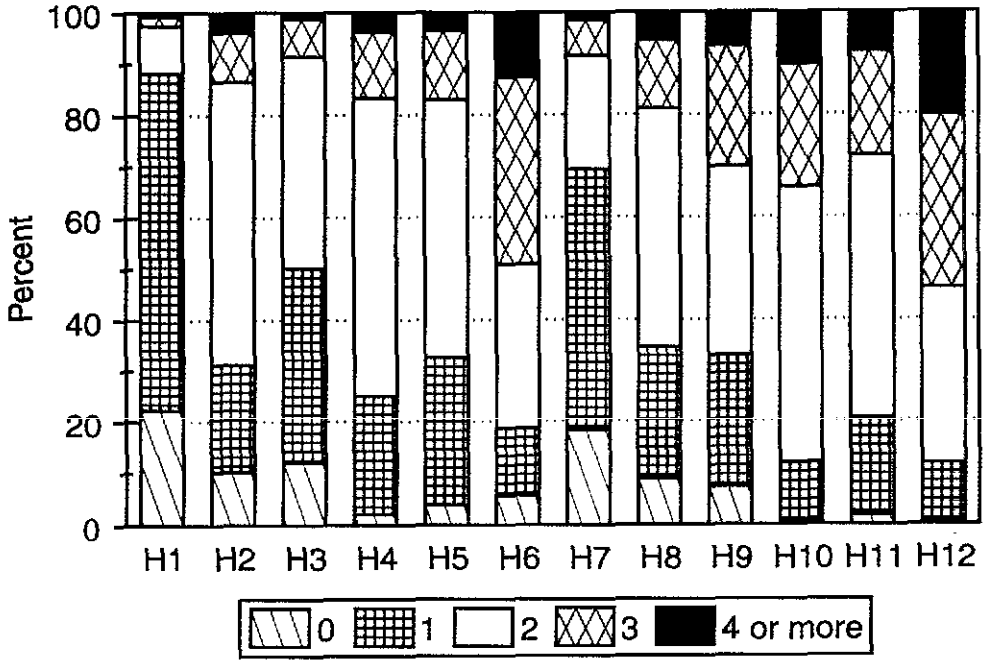


Table 4.1.2: RELIANCE ON PRIVATE VEHICLE MODE BY HOUSEHOLD TYPE

Share of Trips	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12
None	12.1	7.1	8.8	2.4	3.9	4.9	11.0	5.5	12.1	1.4	2.7	2.6
Some	3.8	7.1	5.1	2.1	2.9	6.1	11.6	7.8	8.7	6.2	7.2	10.5
Most	4.5	12.9	7.3	7.6	7.2	16.0	21.7	28.6	22.5	30.6	26.5	34.5
All	79.6	72.9	78.8	87.9	86.0	73.0	55.7	58.1	56.6	61.7	63.6	52.3

One and Two Independent Adult Married Households with Dependents (H11 & H10)

These married households with dependents make up 30.8% of all households (8.2% and 22.6%, respectively), and together account for 45.1% of all persons. These households consist of two adults with dependents of various ages. Average household size is 3.47 and 3.45 persons, respectively (see Table 4.1.1). Income levels are high, with only 20.5% and 10.2% having incomes below $20,000, and 55.4% and 42.4% having incomes over $40,000 (Figure 4.1.3). As seen in Figure 4.1.4, 79.8% and 88.1% of these households have two or more vehicles.

Figure 4.1.17 shows that 71.2% of all persons in the one independent adult household category are dependents (29.4% are non working spouses). In the two independent adult households, 42.1% of persons are dependents (Figure 4.1.18). Respectively, 29.1% and 28.6% of the persons in these households are under 16 years of age. Less than 1% of the dependents are over 35 years of age. Children aged 16 to 21 make up 8.3% and 9.3% of persons, respectively, and dependent adults aged 22 to 35 are only 4.3% and 3.7% of persons in these households.

As seen in Figure 4.1.8, workers make up 87.6% of the independent adults in married households with dependents. Only 3.1% of the independent adults in these households are retired, less than 1% are students or student workers, and 6.2% are homemakers.

Single Adults with Dependents (H7)

This household category makes up 8.6% of all households and accounts for 9.1% of all persons (Figure 4.1.1). As seen in Figure 4.1.3, income is relatively low, with 53.05% of these households having income below $20,000 and only 13.4% having income over $40,000. Of the households in this category, 18.3% do not own a vehicle (Figure 4.1.4). Consequently, 11% of the respondents made none of their trips by private vehicle and only 55.7% of respondents made all their trips by private vehicle, one of the lowest rates for all households (Table 4.1.2). As seen in Figure 4.1.5, independent adults living in these households (role AD1) are predominantly female (84.7%).

Figure 4.1.19 shows that dependents make up 60% of the persons living in these households. Of the persons in these households, 33.1% are under 16 years of age and 3.6% are over 35 years old. Children aged 16 to 21 make up 14.1% of the persons in these households. This group has the largest percentage of young adults, aged 21 to 35, (9.1%).

As seen in Figure 4.1.9, workers make up 68.8% of the independent adults in this category, 5.6% are retired, 3.5% are students or student workers, and 16.5% are homemakers. These homemakers have been classified as independent because they are the household reference persons.

Figure 4.1.5 Gender Distribution by Person Role

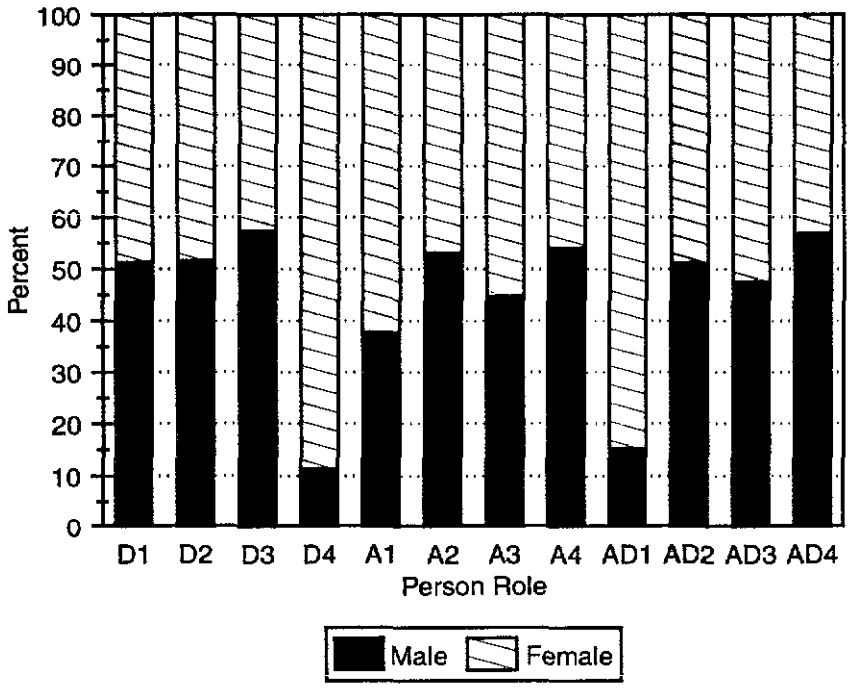
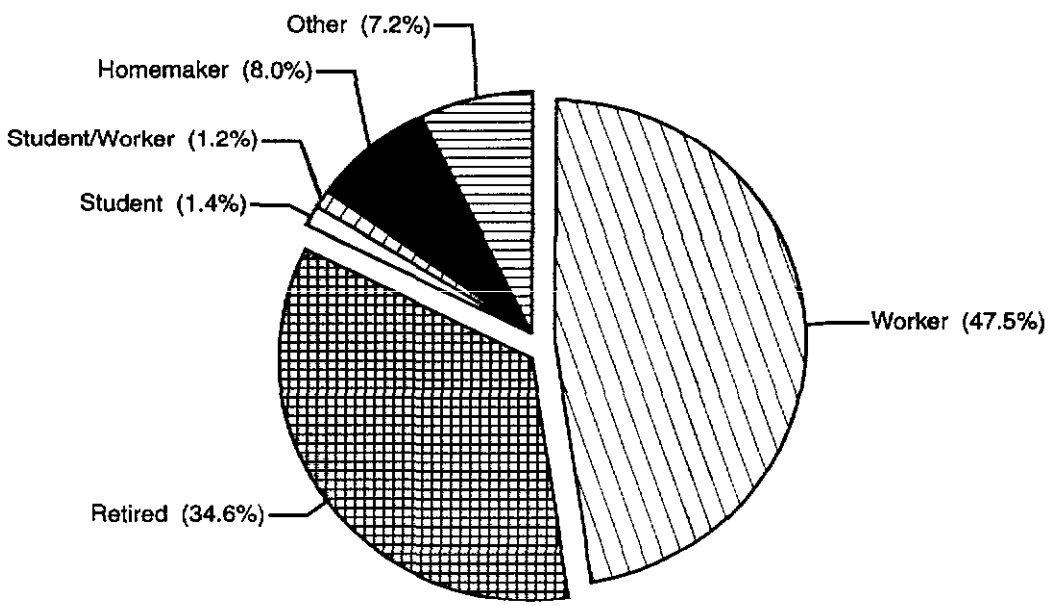


Figure 4.1.6 Work Status of Single Adult Households without Dependents



Households of Two Independent Related Adults, with and without Dependents (H9 & H3)

Related adult households with or without dependents together make up only 3.1% of all households and account for only 3.5% of all persons (Figure 4.1.1). Incomes are distributed across the spectrum with 33.0% and 34.0%, respectively, having household income below $20,000, and 36.9% and 26.5% have incomes greater than $40,000 (Figure 4.1.3). Mean household size is two persons for these households without dependents; for these households with dependents the mean is 3.59, slightly larger than married couple households with dependents (Table 4.1.1). As seen in figure 4.1.5, over 50% of the independent persons in these households (role A3 and AD3) are female (52.5% and 55.2% respectively).

As seen in Figure 4.1.20, 44.2% of persons in related person households with dependents are dependents. This is a little higher than the corresponding percentage for married households. Only 18.2% of persons in these households are 5 to 15 years of age, and 10% (the highest for all household groups) are over 35 years of age. Dependents aged 16 to 21 make up 12% of all persons, and 4% are young adults 22 to 35 years old. Independent adults make up 55.8% of the persons in this household category.

The work status profile for two related adults with dependents (shown in Figure 4.1.10) is unlike that of married couple households with dependents. Of persons in related adult roles, 17.6% are retired, 69.2% are working, 3.8% are students or student workers, and 4.4% are homemakers. Both retirees and students are more highly represented in related adult households than in married households.

Figure 4.1.11 shows work status for independent adults in these households without dependents. The percentage of retirees is large (33.2%) and similar to the percentage of retirees in married person households without dependents. Workers make up 57.1% of persons in this household group. The work status profile is similar to that of married persons without dependents except for larger percentages of students (1.2%) and student/workers (1.4%).

Households of Two Independent Unrelated Adults, with and without Dependents (H8 & H2)

Unrelated adult households collectively make up 4.5% of all households and account for 4.7% of all persons (Figure 4.1.1). Incomes are distributed across the spectrum but weighted toward the lower end. Of these households, 40.2% with dependents and 40.5% without dependents have household income below $20,000 and 18.9% and 21.5%, respectively, have incomes greater than $40,000 (Figure 4.1.3). Mean household size for households without dependents is 2; for these households with dependents mean size is 3.31, which is slightly smaller than households of married couples with dependents (Table 4.1.1). Among independent adults in these households (AD2 and A2), the percentage of females is 48.9% and 46.8% (Figure 4.1.5), respectively, in contrast with percentages above 50% for the comparable related person households.

As seen in Figure 4.1.21, in unrelated person households with dependents, dependents make up 39.6% of persons. Only 1.1% are dependent adults over 35 years, in contrast with 10% for related households with dependents. This household category has a large percentage of persons 5 to 15 years of age (28.6%), and, except for a smaller percentage of dependent adults aged 22 to 35 (1.9%), resembles the comparable two independent adult married couple households.

Figure 4.1.21 shows that 60.3% of the persons in the unrelated adult with dependents household category are independent adults. Of these independent adults, 4.3% are retired, 74.7% are working, 3.3% are students or student workers, and 12.2% are homemakers (Figure 4.1.22). The work status profile for adults in these households is closer to that of married couples with dependents than the households of related adults with dependents.

As seen in Figure 4.1.13, the percentage of retirees in unrelated adult households without dependents is also very small (4.1%), while the percentage of students and student workers is relatively large (15.5%). This gives unrelated households without dependents a work status profile unlike any of the other household categories without dependents.

Households with Three or more Independent Adults, with and without Dependents (H12 & H6)

These households respectively make up 2.0% and 2.1% of all households and account for 4.2% and 2.8% of all persons. The mean household sizes are 4.83 and 3.15 persons (Table 4.1.1). Household incomes are high, with 14.6% and 30.7% below $20,000 and 51.4% and 41.2% above $40,000 (Figure 4.1.3). Respectively, 88.3% and 81.4% of these households own 2 or more vehicles (Figure 4.1.4).

As seen in Figure 4.1.22, dependents make up 38.3% of persons in 3+ independent adult households with dependents. Dependents under 16 years of age make up 17.9% of all persons. Dependents over 35 years are a large group in this household category (7%); another 9.6% are 16 to 21 years old, and 3.7% are dependent adults ages 22 to 35. Of persons in these households with dependents, 61.7% are independent adults (Figure 4.1.19); 44.5% of the persons in these households are related adults, while 17.2% are unrelated adults.

Profile of Dependents

Dependents make up 37.6% of all persons in the data base; the largest group of dependents are those under 16 years of age (Figure 4.1.2). Figure 4.1.5 shows the gender distribution of dependents. Of dependents up to the age of 15, slightly more than 50% are male. Dependents between 16 and 21 years of age are 51.6% males, and 57.4% of dependent adults aged 21 to 35 are males. However, only 11.5% of the dependent adults over 35 are male. Dependent adults over 35 include spouses who are not in the labor force or retired, which significantly increases the percentage of females in this group.

Figures 4.1.14 to 4.1.16 show the work status distribution for dependents 16 to 35 years of age. Persons ages 16 to 35 who were identified as children of the reference person have been classified as dependents regardless of their work status. Thus some of these dependents are workers. For the 16 to 21 year old age group, 36.2% are workers, 32.5% are students, and 16.1% are student workers; a small percentage identified themselves as homemakers (5.9%). Of dependents in the 22 to 35 age group, 75% are workers, 9.1% are students or student/workers, and 6.6% are homemakers. Of the dependent adults over 35 years old, most (76.8%) are homemakers, 4.2% are students, and a large percentage have an unidentified work-status (19%).

Gender Differences

As data in Figure 4.1.5 show, 84.7% of the independent single adults with dependents (AD1) are female, while 62.2% of single adults without dependents (A1) are female. Nearly 90% of the dependents over 35 years of age are female, which is not surprising given the large proportion of homemakers in this role. Closely associated with the disproportionate distribution of females into the D4 role is the distribution 54.1% and 56.9% of males into the independent married adults with and without dependents (A4 and AD4). The respective percentages for related independent adults, with and without dependents (AD3 and A3) are 55.2% and 52.5% female. Unrelated independent adult roles (A2 and AD2) have only slightly more males than females.

Work Status Differences

A high percentage of persons living in households with no dependents were found to be retired persons. As seen earlier, the percentage of retired persons ranged from 33.2% in households of related adults (Figure 4.1.11), to 33.9% for married households (Figure 4.1.7), to 34.6% in single adult households (Figure 4.1.6). However, Figure 4.1.13 shows there is a very small percentage of retired persons (4.1%) in households consisting of unrelated adults. In general, a low percentage of independent adults living in households with dependents were found to be retired persons. For single persons (Figure 4.1.19), unrelated adults (Figure 4.1.21), and married adults with dependents (Figure 4.1.18), the percentage ranges from 3.1% to 5.6%. But in households of related adults with dependents, 17.6% of the independent persons are retired persons (Figure 4.1.10).

Differences in Age of Youngest Child

Data for age of youngest child for households with dependents are found in Table 4.1.3. Married adult households and households with two unrelated adults have the largest percentages for youngest child under 5 years of age (36.2% to 44.4%); two related adult households have the lowest percentage (16.2%). One and two independent married adult households and two unrelated adult households are similar in that 18 to 20% of these households have the youngest dependent aged 16 or more years; and less than 1.5% have youngest dependent over 35. On the other hand, 33.4% of single adult households have the youngest dependent aged 16 or more years and 5.2% have youngest dependent over 35. In two related adult households the corresponding percentages are 48% and 20.1%. Thus a smaller percentage of single adult households and related adult households have children who may be dependent on adults for transportation because of their age.

Table 4.1.3: DISTRIBUTION OF YOUNGEST DEPENDENT BY HOUSEHOLD TYPE

AGE	H7	H8	H9	H10	H11	H12
0-4 yrs	23.9	41.2	16.2	36.2	44.4	27.7
5-15 yrs	42.8	40.8	35.8	43.8	37.3	40.3
16-21 yrs	16.1	13.6	22.3	12.9	10.0	18.0
22-35 yrs	12.1	3.1	5.6	6.6	7.5	8.9
36+ yrs	5.2	1.3	20.1	0.5	0.9	5.1

Figure 4.1.7 Work Status of Married Adult Households without Dependents

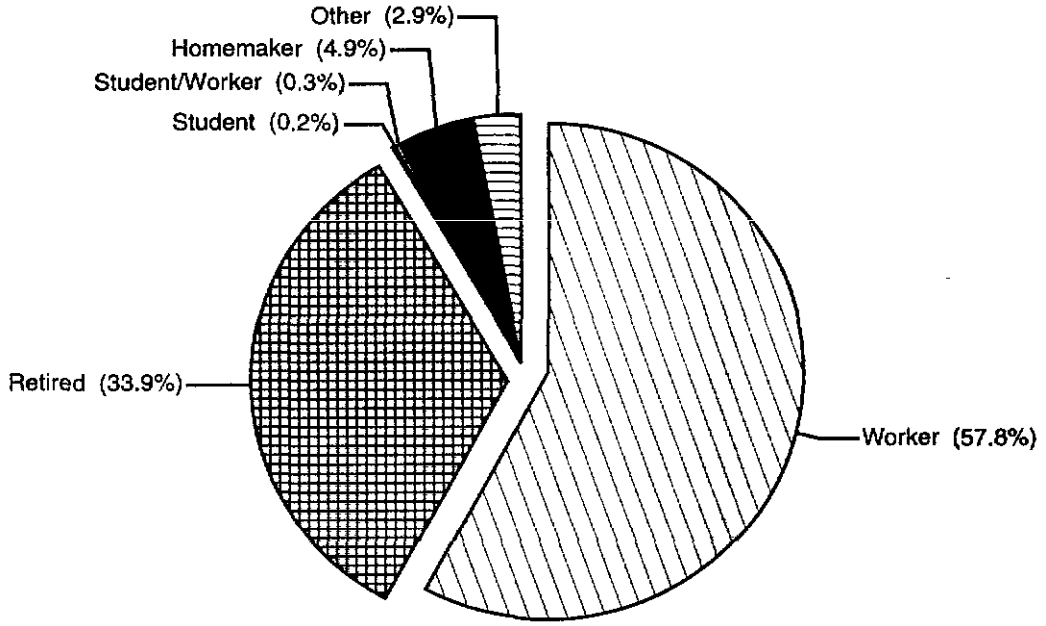


Figure 4.1.8 Work Status of Married Adult Households with Dependents

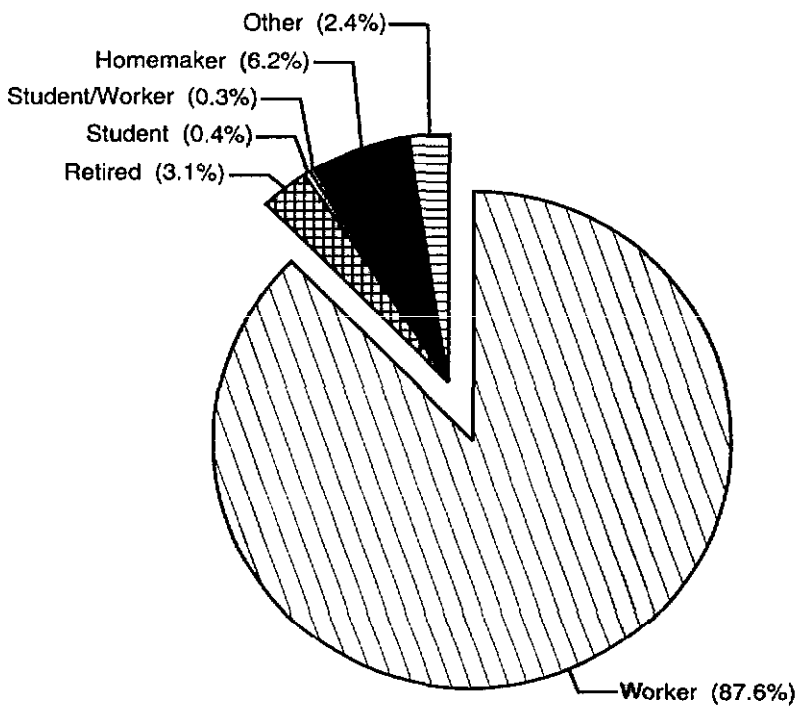


Figure 4.1.9 Work Status of Single Adult Households with Dependents

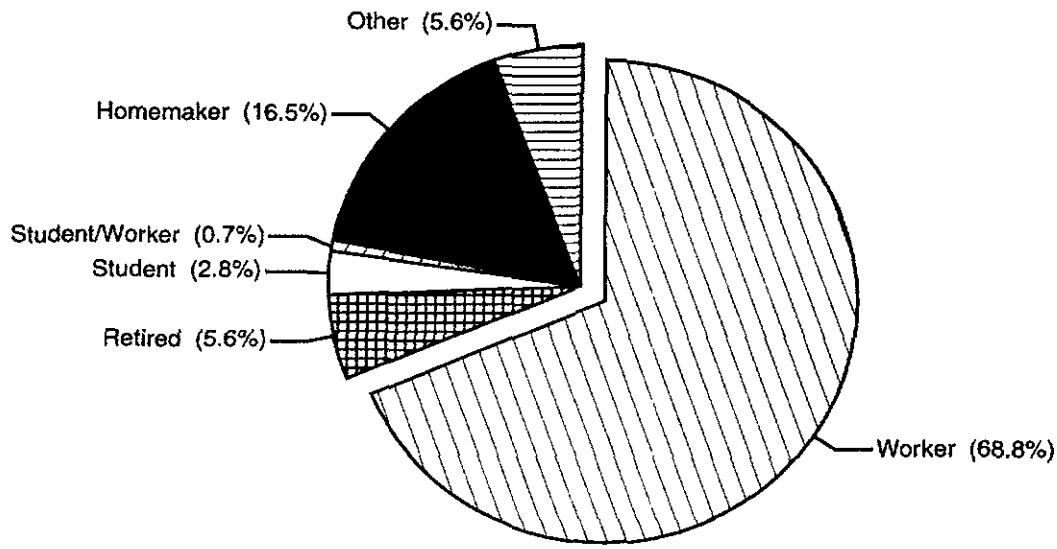


Figure 4.1.10 Work Status of Related Adult Households with Dependents

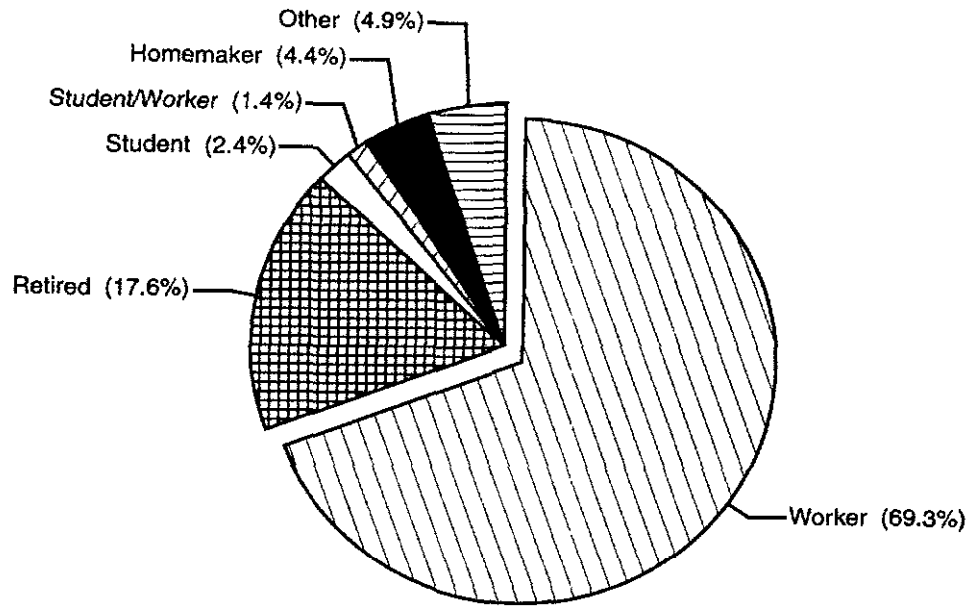


Figure 4.1.11 Work Status of Related Adult Households without Dependents

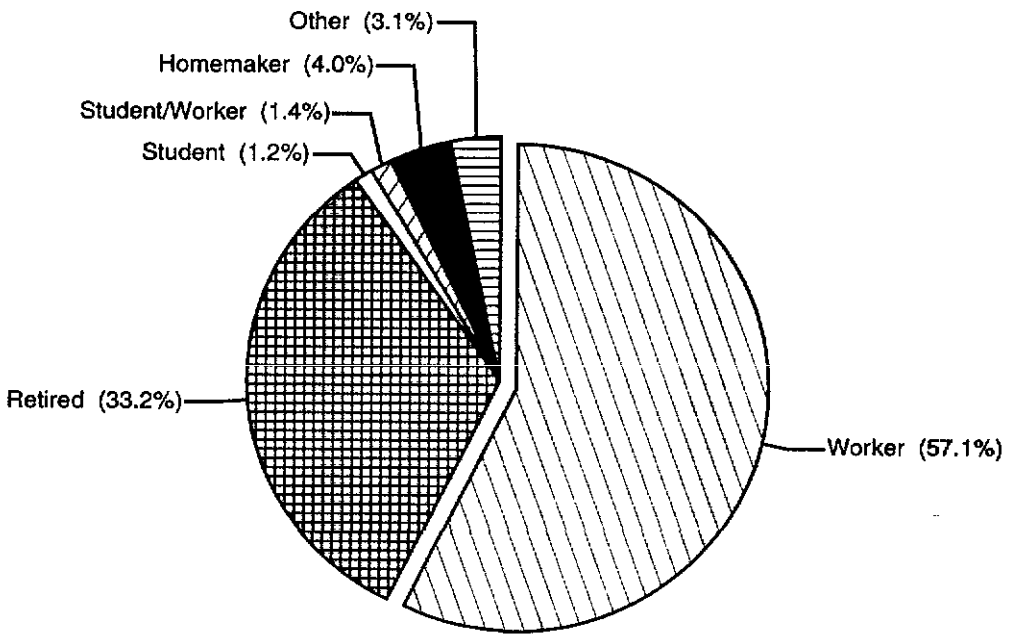


Figure 4.1.12 Work Status of Unrelated Adult Households with Dependents

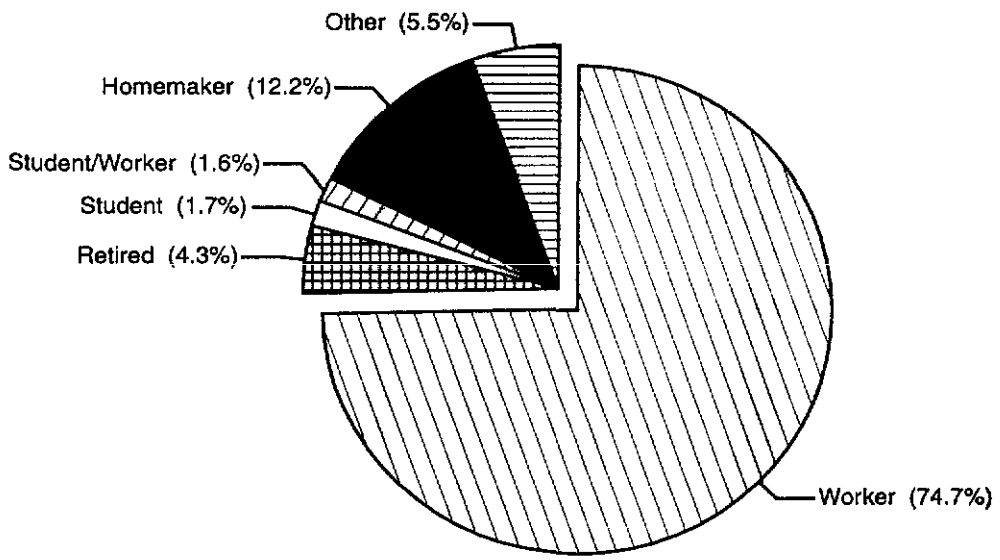


Figure 4.1.13 Work Status of Unrelated Adult Households without Dependents

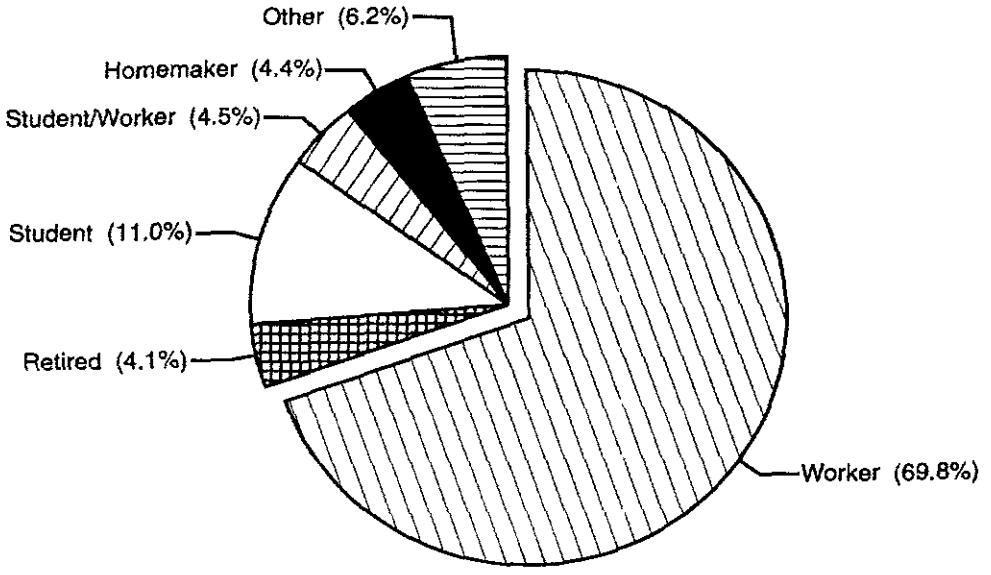


Figure 4.1.14 Work Status of Children Age 16-21

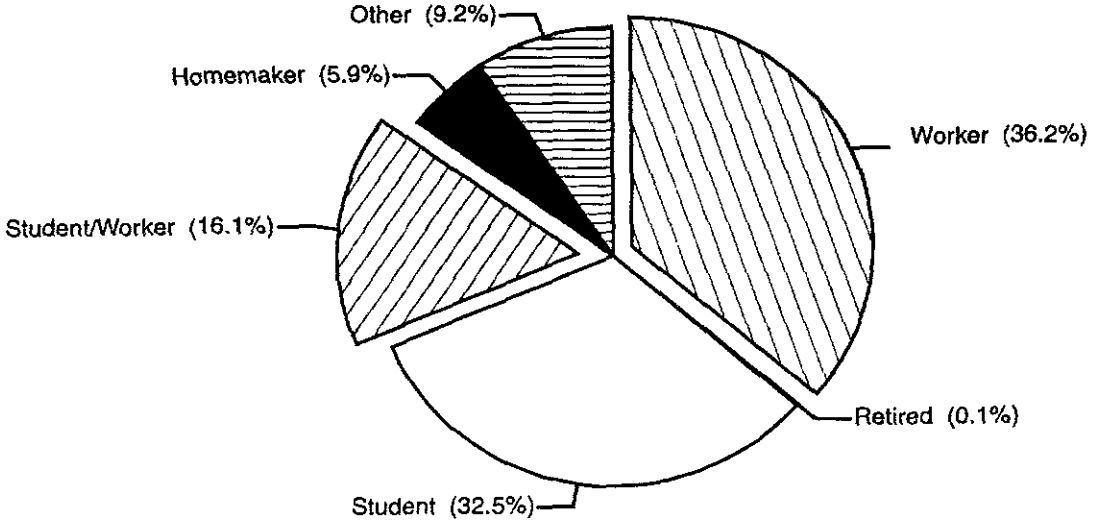


Figure 4.1.15 Work Status of Dependent Adults Age 22-35

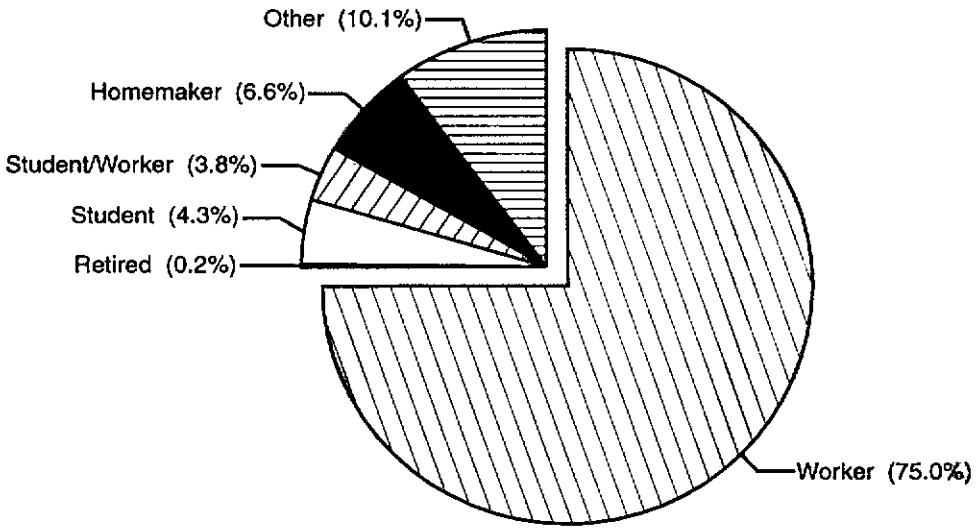


Figure 4.1.16 Work Status of Dependent Adults Over 35 Years of Age

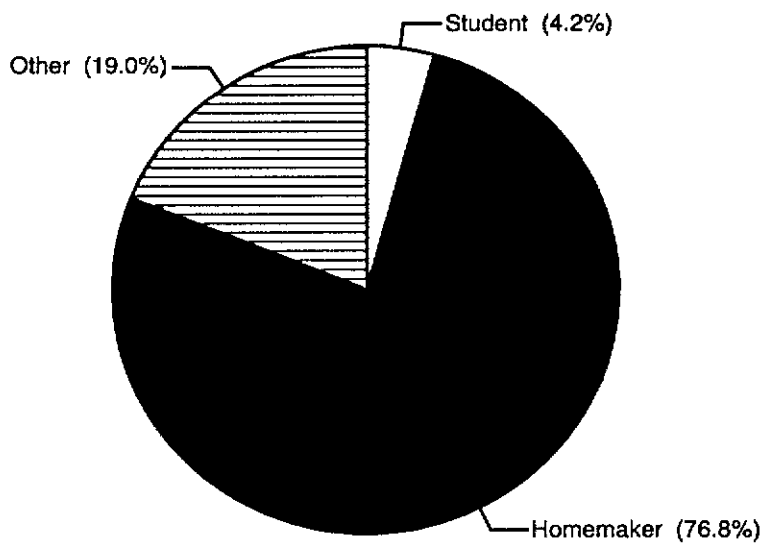


Figure 4.1.17 Role Distribution of Married Adult Households with Dependents

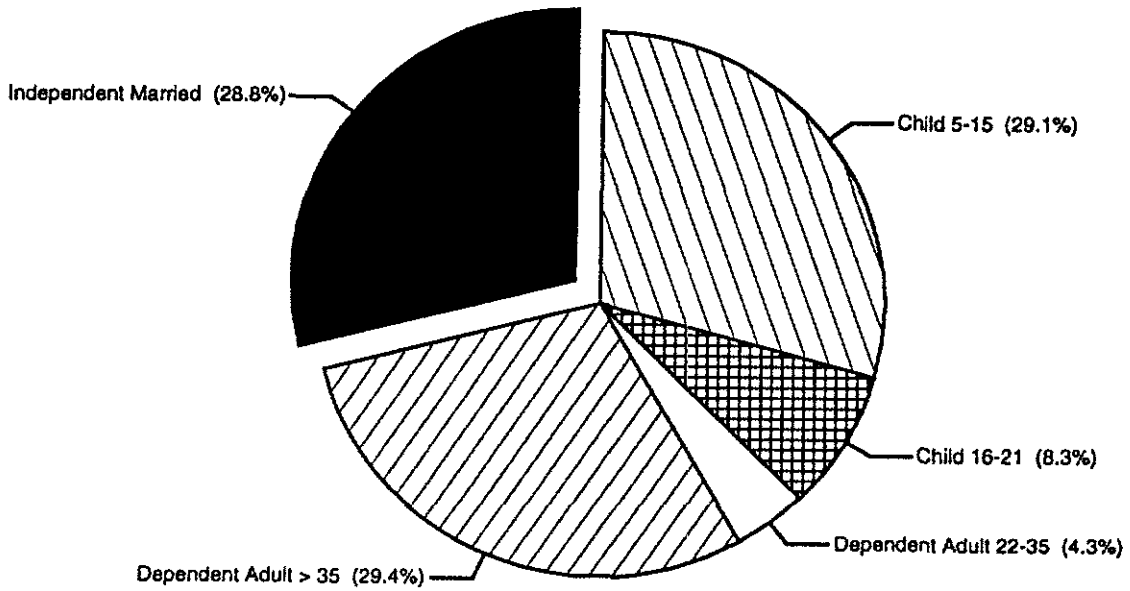


Figure 4.1.18 Role Distribution of Married Adult Households without Dependents

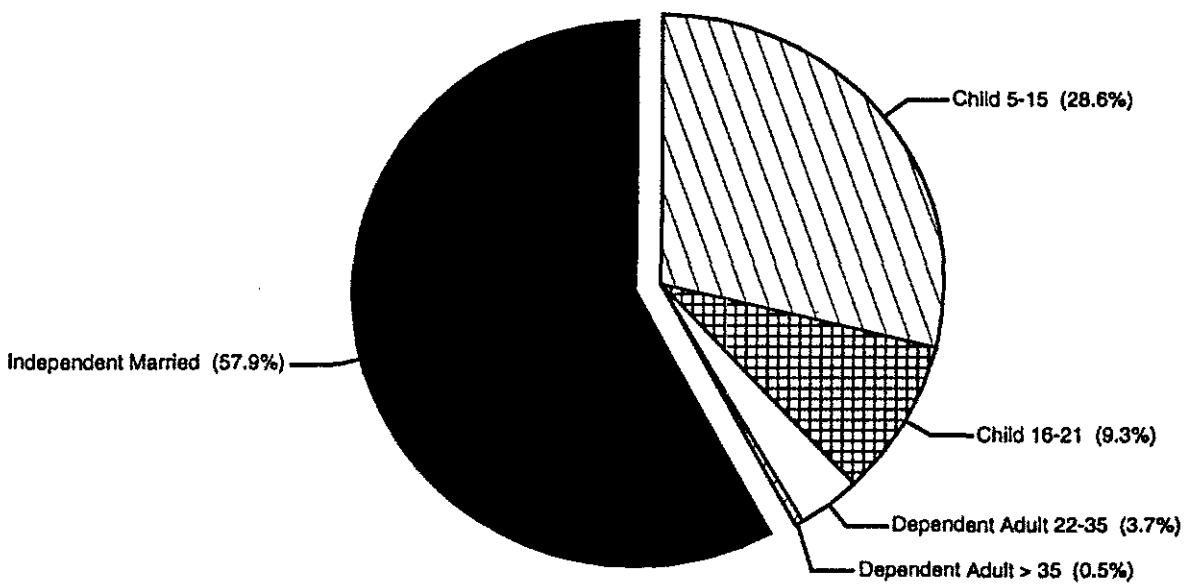


Figure 4.1.19 Role Distribution of Single Adult Households with Dependents

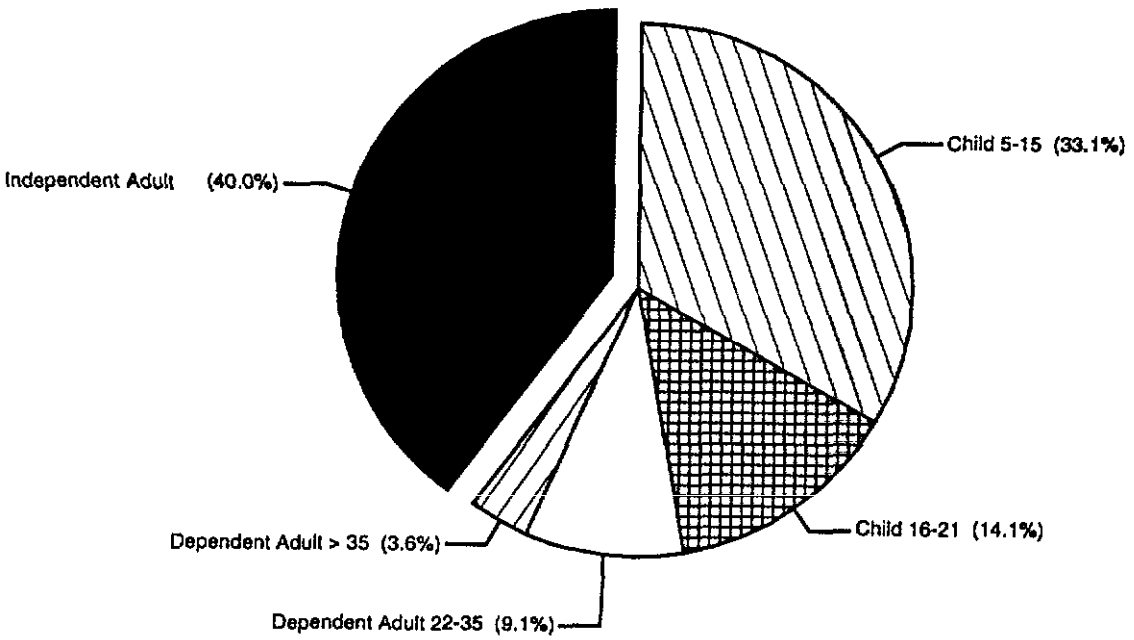


Figure 4.1.20 Role Distribution of Related Adult Households with Dependents

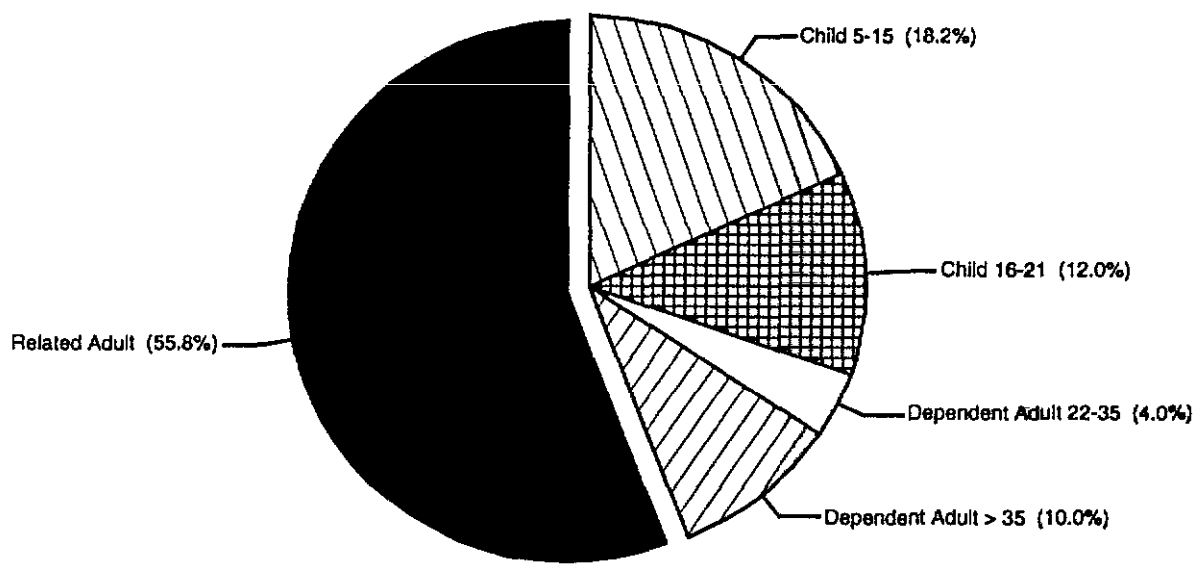


Figure 4.1.21 Role Distribution of Unrelated Adult Households with Dependents

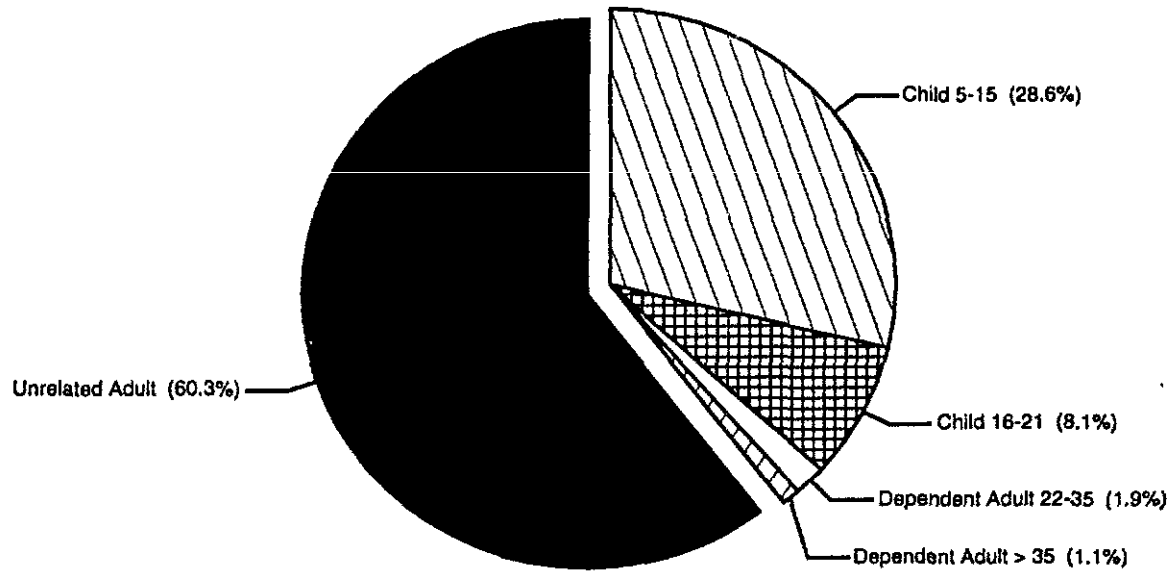
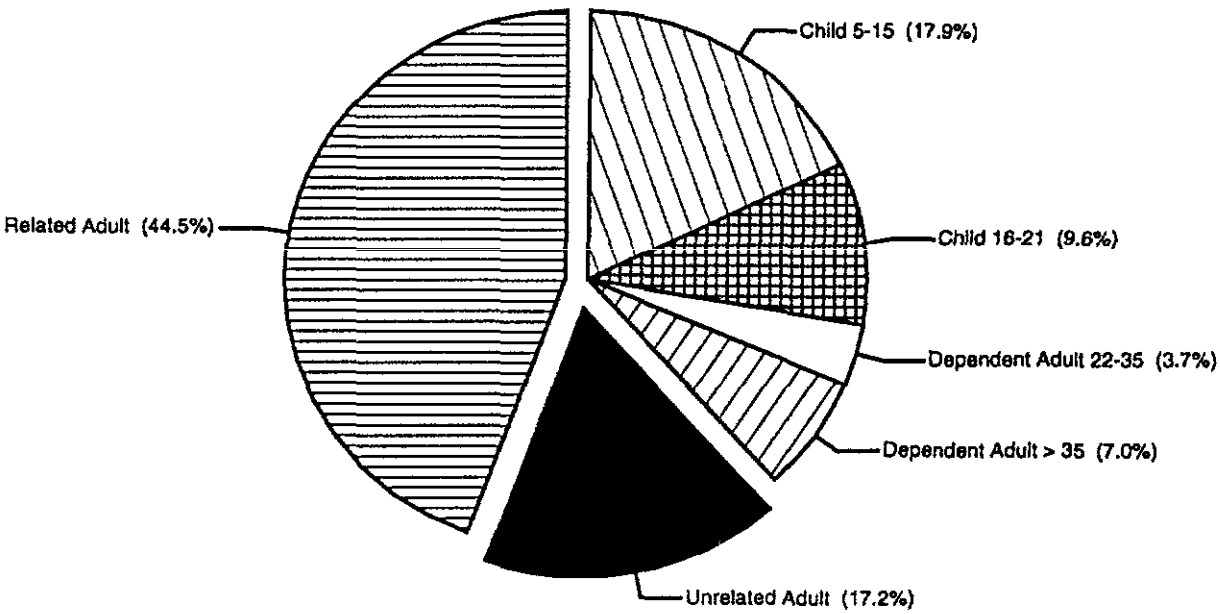


Figure 4.1.22 Role Distribution of 3+ Adult Households with Dependents



4.2 Household Structure, Person Role, and Travel Behavior

In this section travel behavior is described for household types and person Roles. The analysis follows the same order as in Section 4.1. Travel variables and their means for the data set are shown in Table 4.2.1.

As defined earlier, a trip is uninterrupted travel from one place to another by any transportation mode. A loop is a journey of two or more trips which begins and ends at home. A complex chain is a sequence of two or more trips between origin and destination anchors. Anchors are defined as home, work, or school trip origins or destinations.

Table 4.2.1: MEAN HOUSEHOLD AND PERSON TRAVEL

	Households	Person
Mean number of person trips per day	7.23 trips	3.07 trips
Mean travel distance per day	66.98 miles	28.71 miles
Mean distance per person trip*	11.23 miles	11.68 miles
Mean number of person-loops per day	3.01 loops	1.49 loops
Mean number of trips per loop*	2.66 trips/loop	2.65 trips/loop
Mean number of complex chains per loop*	0.26 complex chains/loop	0.24 complex chains/loop

* Slight differences in these variables measured at the household level and the person level are due to the different sizes of the data set for each case (see Appendix F).

Single Adults without Dependents

The households of single adults without dependent (H1) and the single independent adult without dependents role (A1) are the same. As seen in Table 4.2.1 and Figures 4.2.1, 4.2.2, and 4.2.3, these independent adults make slightly fewer trips per day (2.91) than the average person, the total travel distance (24.88 miles) is considerably below average, and their mean trip length is the lowest for all independent person roles (9.92 miles per trip). Figures 4.2.4, 4.2.5, and 4.2.6 and Table 4.2.1 show that these person-households make about the average number of person loops per day (1.46), but have the second highest number of person trips per loop (2.79 trips per loop) and a high number of complex chains per loop (0.32 complex chains per loop). The average level of trip making exhibited by this group (trips per day and loops per day) is believed to be influenced by the relatively lower incomes and rates of vehicle ownership of members of this group.

The most striking travel behaviors of this group are their tendency to make short trips and to organize their trips into more complex loops and chains. Since their travel is not tied to the schedules and travel needs of other household members, these individuals may have more freedom to select origins and destinations closer to each other and to organize their travel into complex travel patterns.

Married Households without Dependents

Independent adults in these household groups (A4) make just above average (2.90) trips per day (Table 4.2.1 and Figure 4.2.1). Their daily travel distance is also somewhat above average (32.36 miles, Figure 4.2.2) and they have one of the longest mean trip distances (13.90 miles per trip, Figure 4.2.3). Persons in these groups make slightly less than the average number of loops per day (1.45, Figure 4.2.4), make an average number of trips per loop (2.61, Figure 4.2.5) and have just above the average number of complex chains per loop (0.26, Figure 4.2.6). Except for mean trip distance, the travel behavior of

independent adults in these household groups are close to the average. The longer trip distance may be associated with the high percentage of workers and higher incomes of persons in these roles.

There are also interesting differences between the one and two independent married adult households without dependents. Although these two household types are the same size (2.0 persons) the mean number of trips per household, travel distance per household, and travel distance per trip was different in each case. As seen in Figures 4.2.7, 4.2.8, and 4.2.9, the two independent adult households have 0.68 more trips per day (13%) and travel 11.60 (22%) more miles per day than the one independent adult households, **but** have mean trip lengths that are 0.41 miles (3%) **shorter**. Trip and travel distance differences may in part be attributed to the relatively lower income of the one independent adult households; the shorter average trip length for the one independent adult households could be the result of a higher proportion of adults whose travel is unconstrained by work trips, and who are not required to coordinate their travel with the travel needs of dependents. Consequently, while one independent adult households take fewer trips and travel fewer total miles, they may have the time and flexibility to take longer trips when they do travel.

The relatively greater number of trips per day for the two independent adult households is also reflected in a greater number of loops per day for two independent adult households (2.52 versus 2.31, Figure 4.2.10). However, it appears that there is little difference in the complexity of travel between these household types; the number of trips per loop is only slightly higher for two independent adult households (2.59 versus 2.53, Figure 4.2.11), and there is no difference in the number of complex chains per loop (0.25, Figure 4.2.12).

One and Two Independent Adult Married Households with Dependents

Independent adults in these households (role AD4) have the highest trip making rate (3.63 trips per day, Figure 4.2.1) of all person roles. They also have the highest travel distance (38.03 miles per day, Figure 4.2.2) and one of the longest mean trip distances (13.62 miles per trip, Figure 4.2.3). These independent adults make an above average number of loops per day (1.56 loops per day, Figure 4.2.4), combine a higher than average number of trips into each loop (2.74 trips per loop, Figure 4.2.5), and have a slightly above average number of complex chains per loop (0.25 complex chains per loop, Figure 4.2.6). This could be the result of relatively high income levels and high percentages of workers in these households, as well as a greater ability for multiple adults in the same household to serve the transportation needs of dependents.

Although the average size of these two household types is nearly the same (3.45 and 3.47 persons), mean number of trips per household, travel distance per household, and travel distance per trip for the two independent adult married households were different from the one independent adult households. As seen in Figures 4.2.7, 4.2.8, and 4.2.9, the two independent adult households have one more trip per day (9%), travel 13.77 (15%) more miles per day, and have mean trip lengths 1.36 miles (13%) **longer** than the one independent adult households. As with the comparable households without dependents, income differences may account for trip number and total travel distance differences. However, shorter rather than longer mean trip length for one independent households with dependents may be the result of the limiting influence of dependents on the travel of adult household members who are not otherwise constrained by a work trip.

Two independent adult households also had a greater number of loops per day than the one independent adult households (4.38 versus 4.15, Figure 4.2.10). Although the number of trips per loop is slightly higher for two independent adult households (2.64 versus 2.57, Figure 4.2.11), the number of complex chains per loop is lower (0.22 versus 0.25, Figure 4.2.12). This suggests that members of one independent adult married households with dependents structure the complexity of their travel differently from the two independent adult married households.

It is also interesting to note that the number of complex chains per loop, the same for one and two independent adult married couples without dependents, was equal to one independent adult married couples

Figure 4.2.1 Person Trips by Role

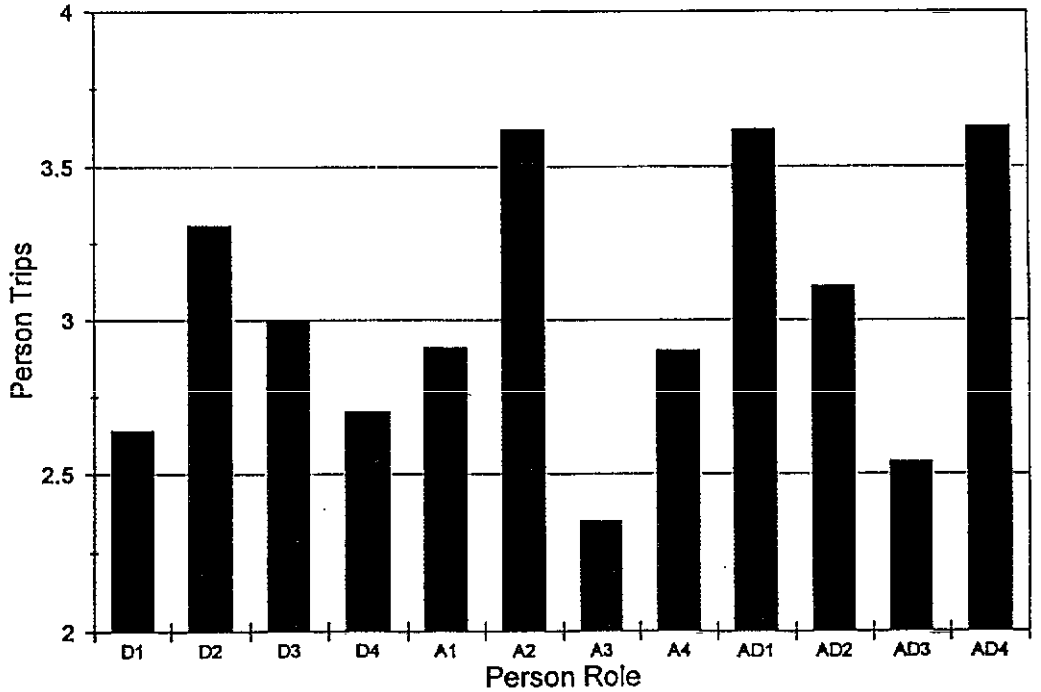


Figure 4.2.2 Travel Distance by Role

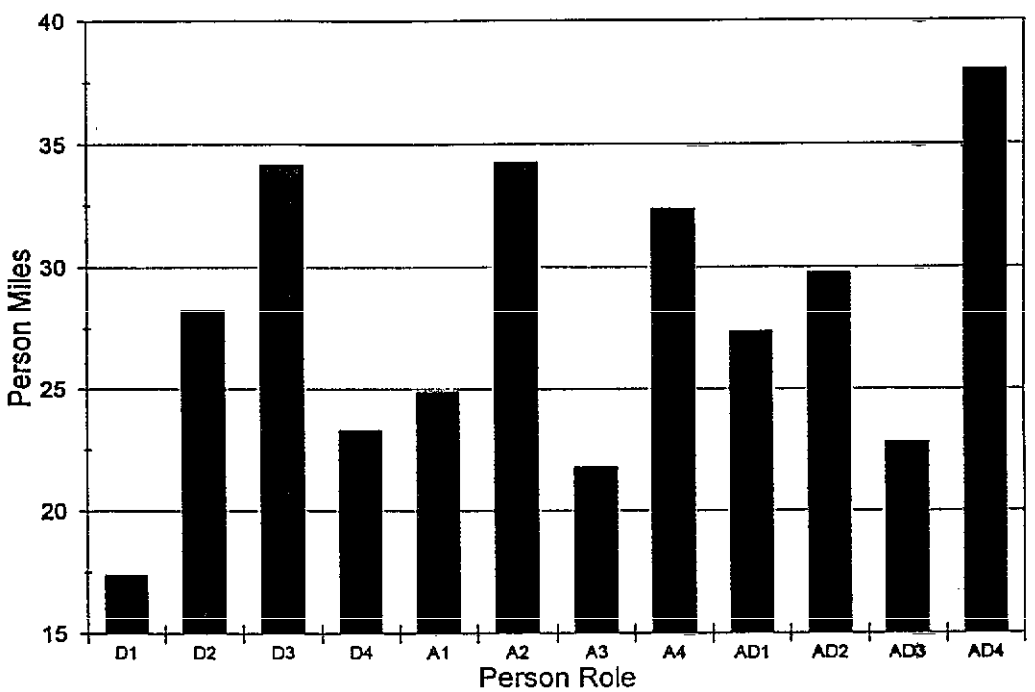


Figure 4.2.3 Miles per Person Trip by Role

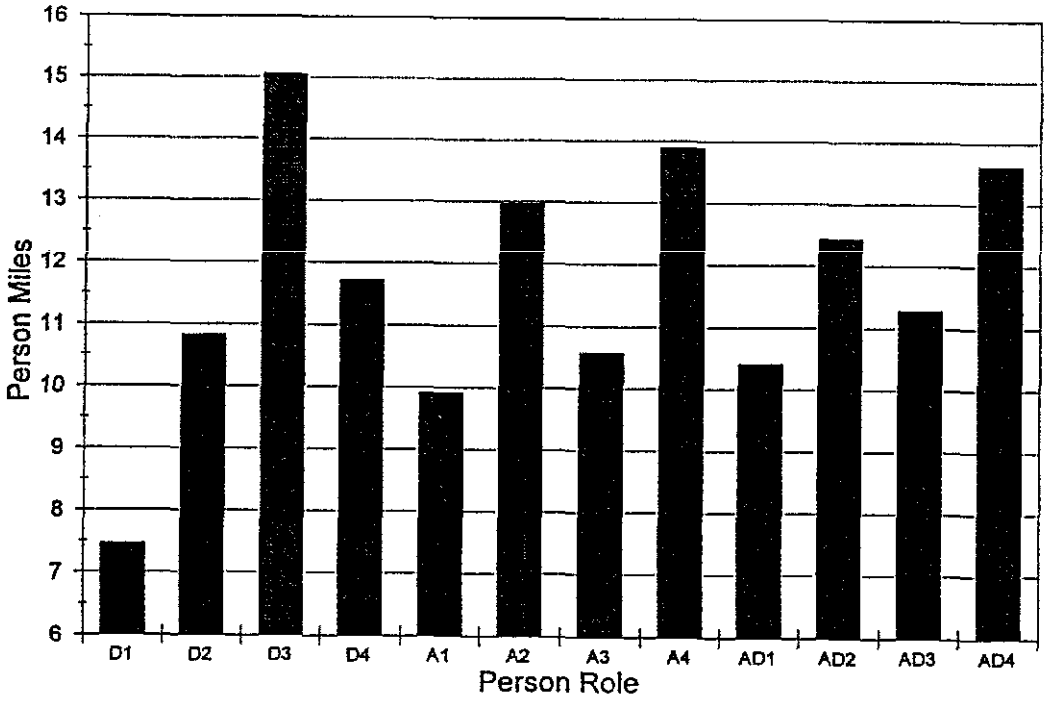


Figure 4.2.4 Person Loops by Person Role

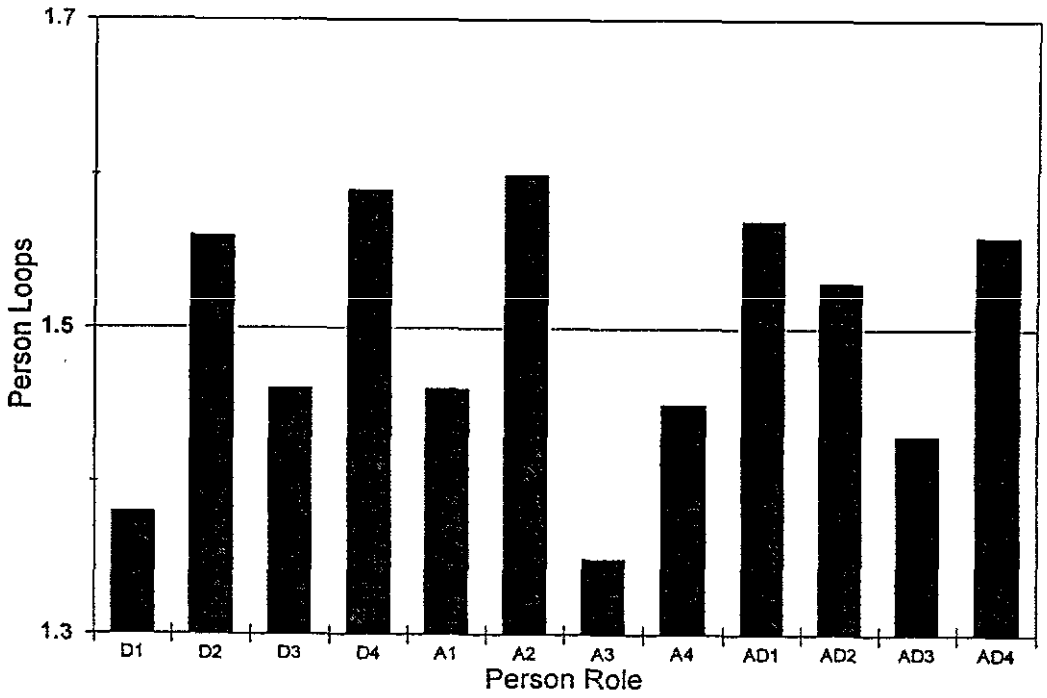


Figure 4.2.5 Person Trips per Loop by Role

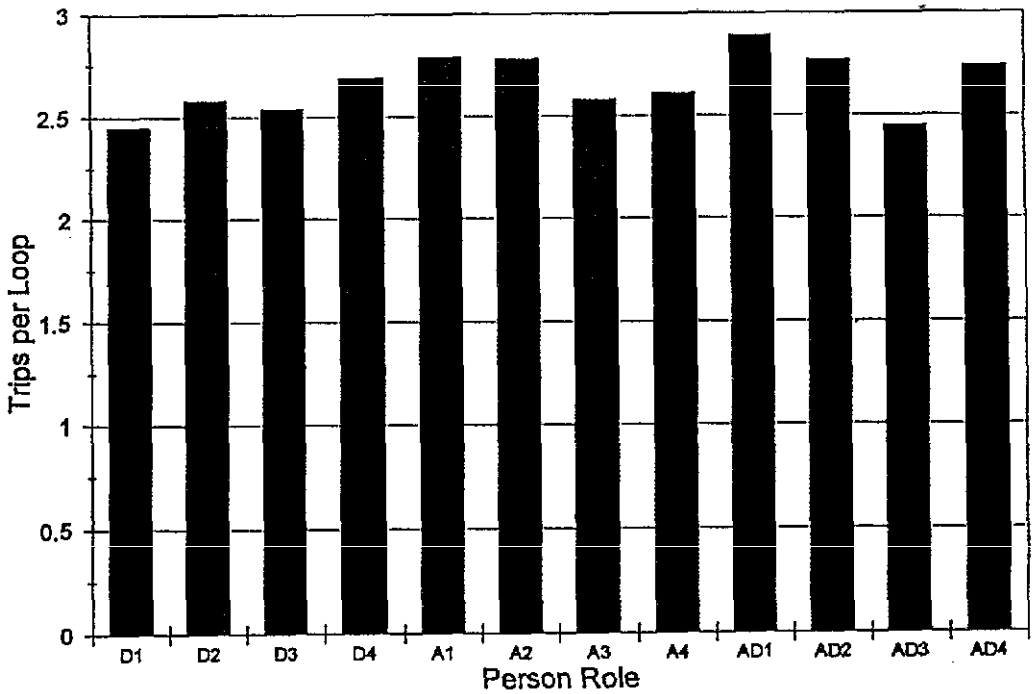


Figure 4.2.6 Complex Chains per Loop by Role

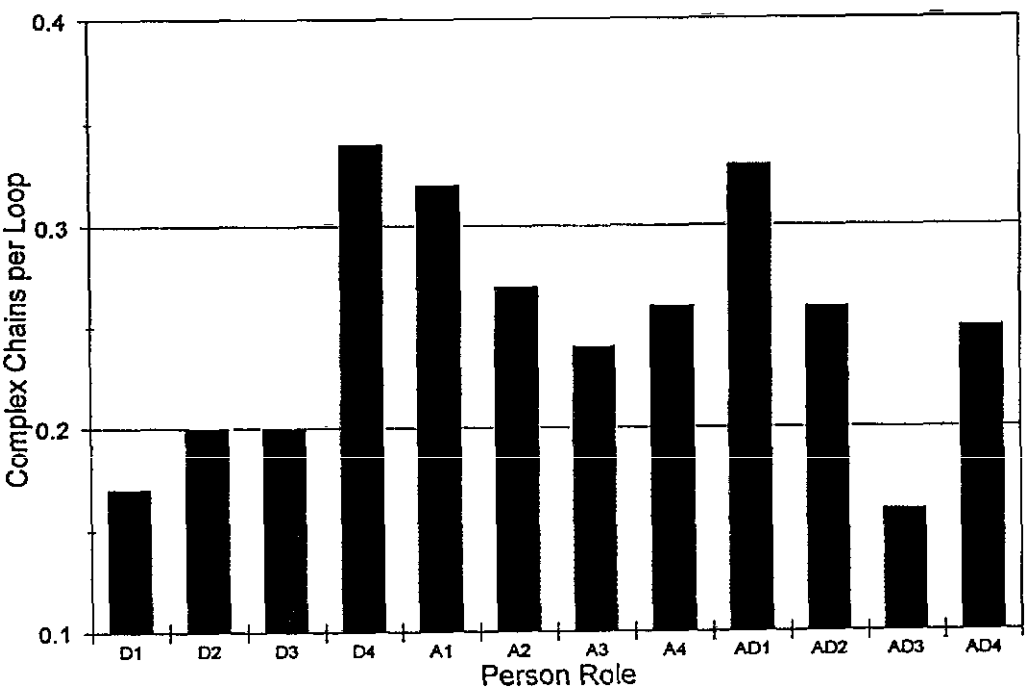


Figure 4.2.7 Person Trips per Household by Household Type

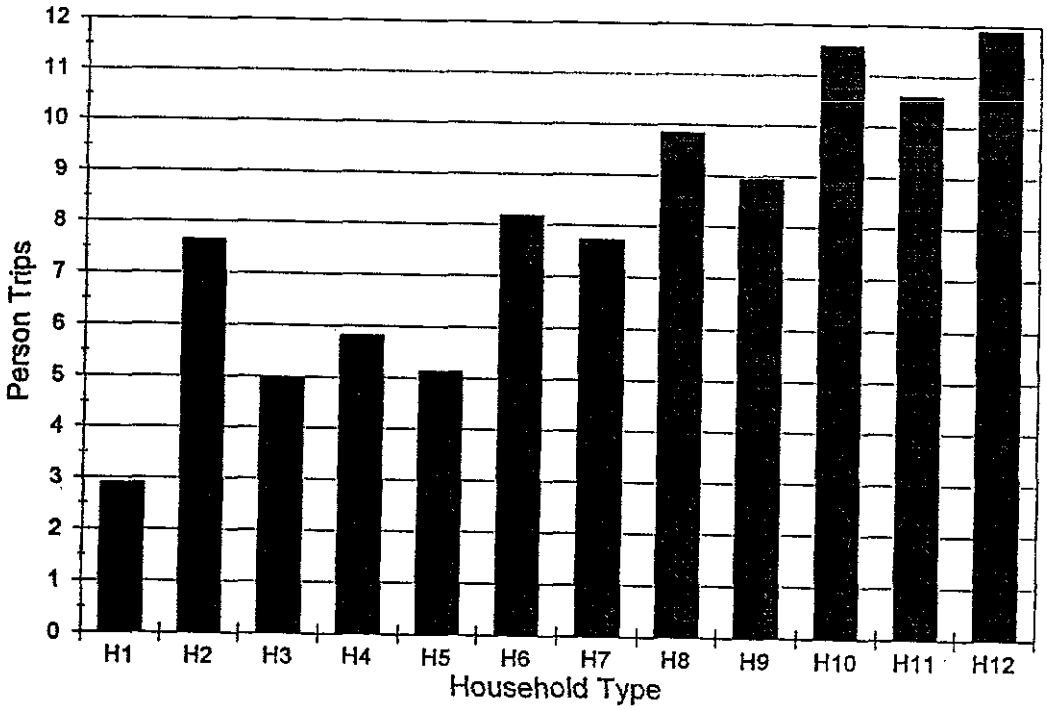


Figure 4.2.8 Person Miles per Household by Household Type

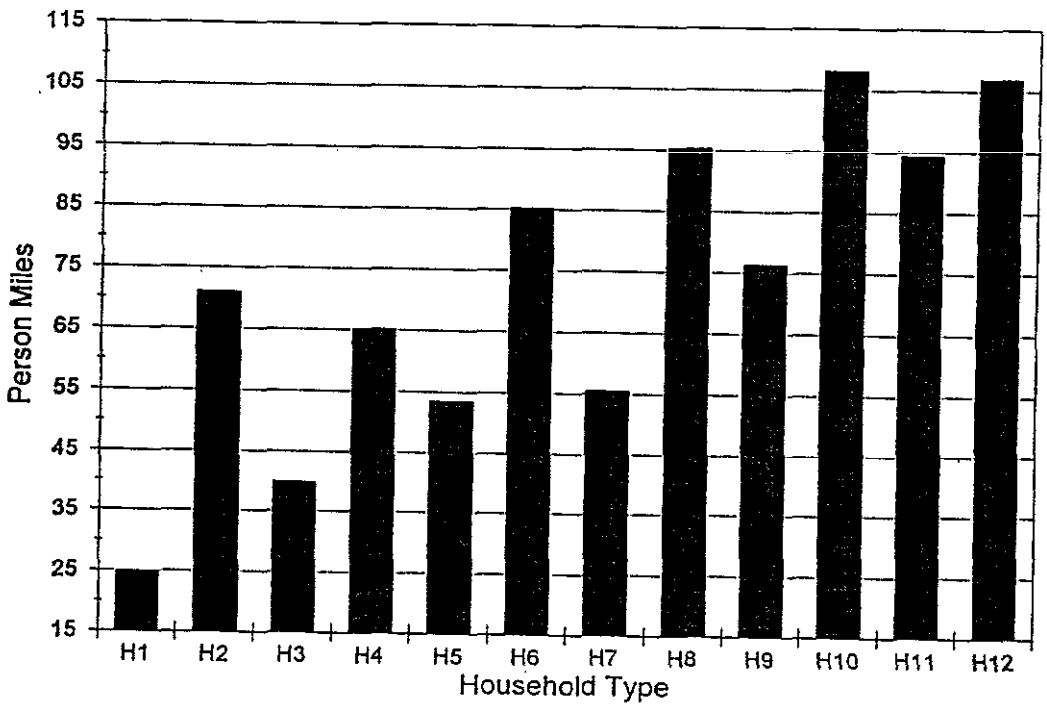


Figure 4.2.9 Person Miles per Trip by Household Type

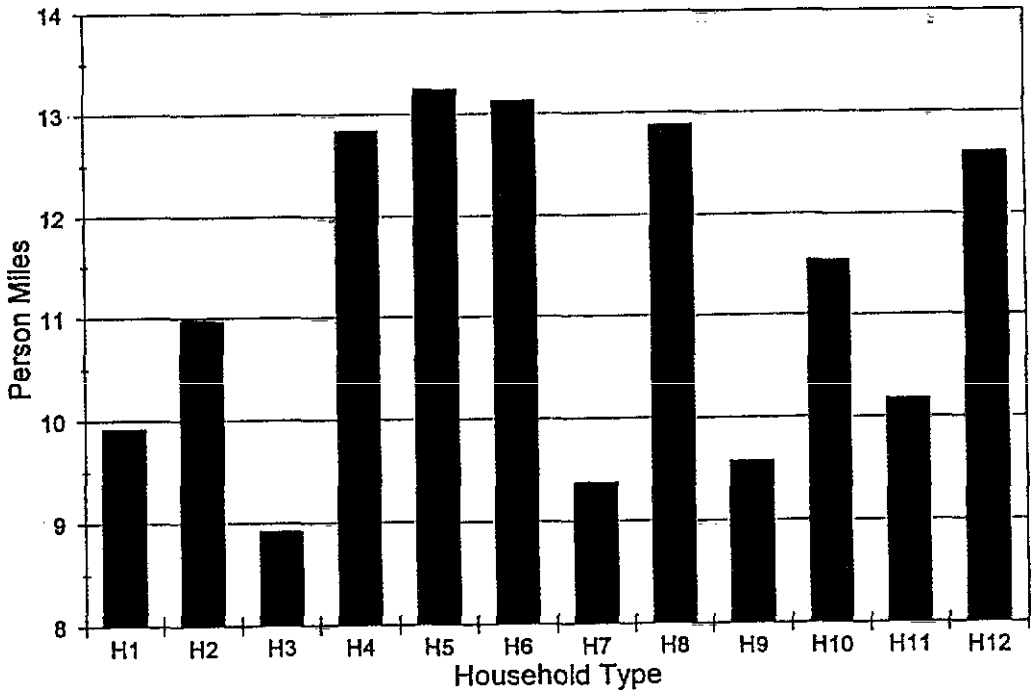


Figure 4.2.10 Person Loops per Household by Household Type

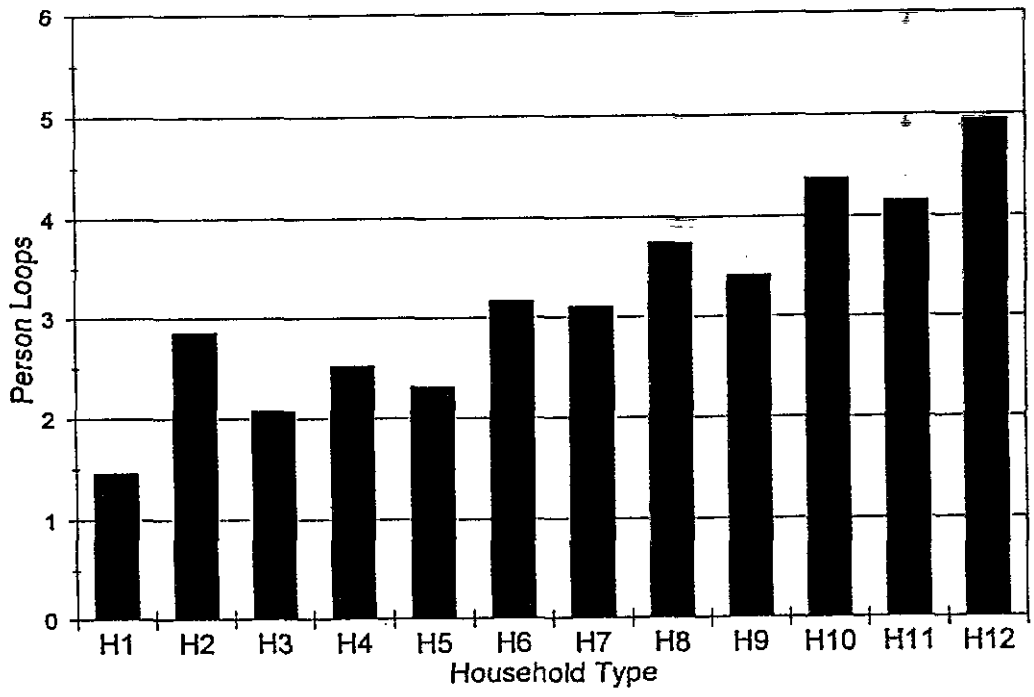


Figure 4.2.11 Trips per Person Loop by Household Type

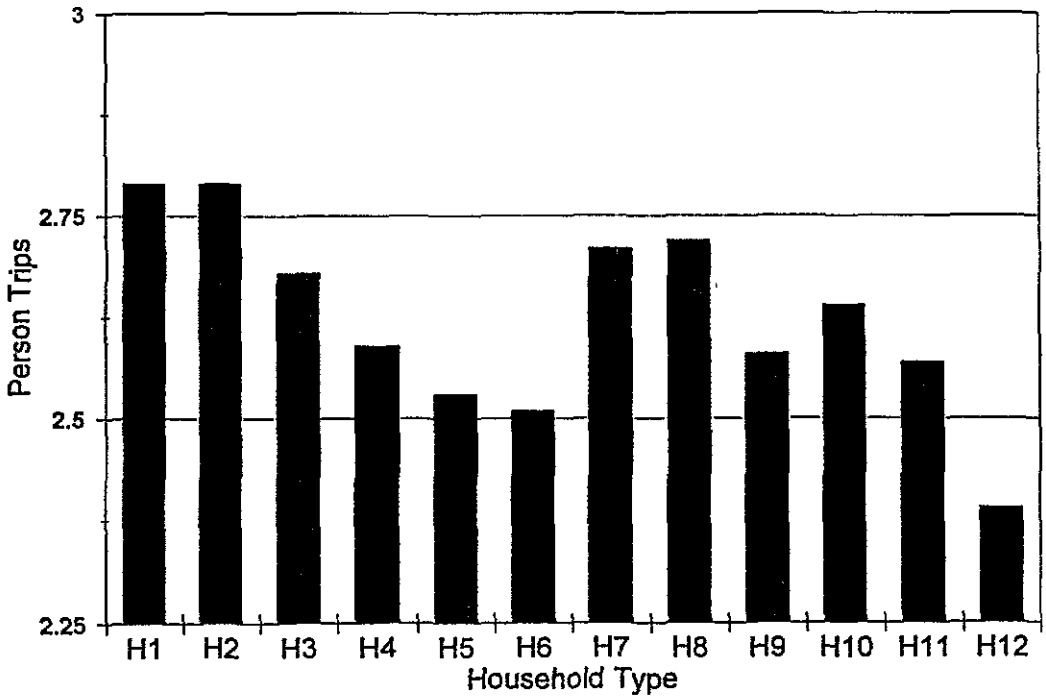
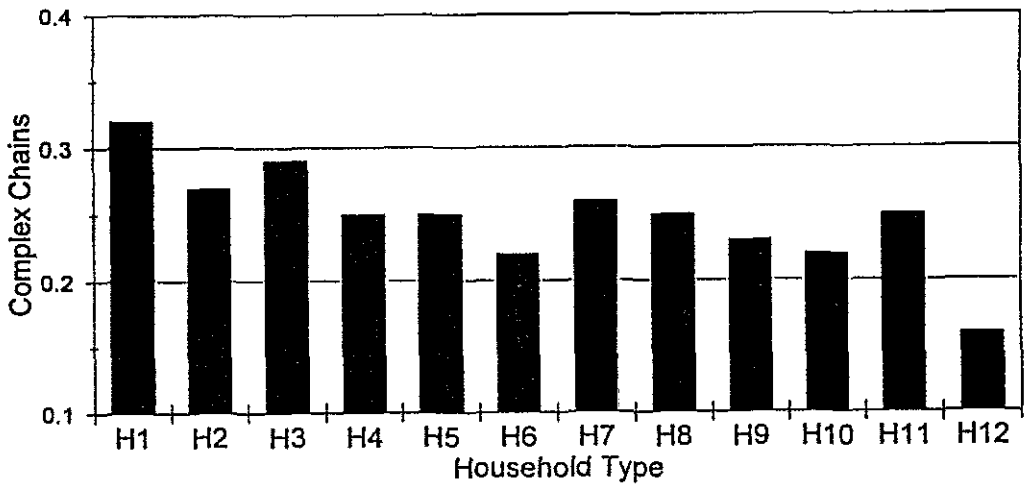


Figure 4.2.12 Complex Chains per Loop by Household Type



with dependents (0.25); only two independent adult married households with dependents were lower (0.22). The lower propensity to form complex chains may be because working adults have relatively less time for travel and less scheduling flexibility, and so are less able to serve the travel needs of dependents. In this case, household members might merge their travel less frequently and fewer chains would contain multiple trips. Dependents may then become more likely to travel alone or forgo some travel altogether.

Single Adults with Dependents

Independent adults in this household category (role AD1) have one of the highest trip rates (3.62 trips per day, Figure 4.2.1), but have a mean travel distance a little below average (27.39 miles per day, Figure 4.2.2) and one of the lowest average distances per trip (10.41 miles per trip, Figure 4.2.3). These independent adults also have a high mean number of loops per day (1.57, Figure 4.2.4), high mean number of trips per loop (2.89, Figure 4.2.5) and high mean number of complex chains per loop (0.33, Figure 4.2.6).

The high trip making rate of independent adults in this household group seems surprising (because of the low income level, low rates of vehicle ownership, and high percentage of independent adult females) until one considers that there is only one independent adult to meet the travel needs of dependents. Single adult households have an average of 1.5 dependents, compared with 1.45 and 1.47 dependents, respectively, in the one and two independent adult married couple households with dependents. The presence of these dependents adds 4.82 trips per day to the 2.9 trips per day made by a single adult household without dependents. This is comparable to the married households with dependents where 5.78 and 5.46 trips per day are added to the 5.82 and 5.14 trips per day made by the married couple households without dependents.

The relatively high level of trip chaining exhibited by this group could be due to the much lower proportion of workers than in married adult households (68.8% and 87.6% respectively, Figures 4.1.12 and 4.1.10) combined with the much smaller proportion of adults available to accompany dependents on trips. As a result, the independent adults in these households may have more time and flexibility to serve dependents' travel needs, while lacking the opportunity to share this necessity with another adult.

Households with two Independent Related Adults, with and without Dependents

Independent adults in related households with and without dependents (roles AD3 and A3) have, respectively, the lowest trip making rates (2.54 and 2.35 trips per person, Figure 4.2.1), the shortest travel distances (22.81 and 21.83 miles per day, Figure 4.2.3), and below average trip lengths (11.28 and 10.57 miles per trip, Figure 4.2.3). The respective number of loops per day (1.43 and 1.35, Figure 4.2.4) and number of trips per loop (2.45 and 2.56, Figure 4.2.5) for independent adults in these households are also below average. The number of complex chains per loop is extremely low (0.16, Figure 4.2.6) for these households with dependents, and average (0.24, Figure 4.2.6) for households without dependents. The low level of trip making and short trip distances is not surprising for this group because of the low income levels and high percentages of retirees. Although both students and retired persons are more highly represented in related adult households, it is not yet clear why the propensity to form complex chains is so low.

Households with two Independent Unrelated Adults, with and without Dependents

In contrast with households of related adults, independent adults in unrelated adult households with and without dependents (role AD2 and A2) have relatively high trip making rates (3.11 and 3.62, Figure 4.2.1), travel distances (29.77 and 34.25, Figure 4.2.2) and trip lengths (12.43 and 12.96, Figure 4.2.3). The mean values for unrelated adults with dependents are only slightly lower than those for married households with dependents. This may be accounted for by their similar work status profiles and because the presence of dependents implies a strong possibility that adults in these households interact in ways similar to married adults. Trip making rates and total travel distance for unrelated individuals without dependents, however, are higher than for independent adults in other household groups without dependents. This may be due to the small proportion of retirees in this group and the high percentage of students and student workers.

Average trip distance for independent adults in unrelated households without dependents is exceeded only by those in married adult households with or without dependents.

For these households, with and without dependents respectively, the number of loops per day (1.53 and 1.60, Figure 4.2.4) and the number of trips per loop (2.77 and 2.78, Figure 4.2.5) are all considerably above average, while the number of complex chains per loop (0.26 and 0.27, Figure 4.2.6) are just above average.

Households with Three or more Independent Adults, with and without Dependents

These categories of households contain a mixture of related and unrelated independent adults. Comments here pertain only to data for household level trip making. These households have an average size of 4.83 and 3.15, respectively (Table 4.1.1). The number of trips per household are 11.9 and 8.19 (Figure 4.2.7) or an average of 2.46 and 2.60 trips per person. This is considerably below the overall average for all persons in the data set of 3.07 trips per person. The mean person miles for these households are 106.90 miles and 85.21 miles per day (Figure 4.2.8), or a daily average of 22.13 miles and 27.05 miles per person. These are also below the per person average for the data set. However, mean distance per trip is 13.13 and 12.61 miles respectively (Figure 4.2.9), which is well above average.

The mean number of person loops per household for these households is 4.95 and 3.17 respectively (Figure 4.2.10). This is an average of 1.02 and 1.01 loops per person, well below the average for the entire data set. The average number of person trips per loop is 2.39 and 2.51 (Figure 4.2.11), the lowest for all household structure categories. Finally, the number of complex chains per loop, 0.16 and 0.22 (Figure 4.2.12), are the lowest for all household types. These low levels of trip chaining may partially be attributed to the effects of the larger household sizes in this group. As the number of persons in a household increases, so does the number of competing schedules and destinations. As the number of competing travel needs increases, it probably becomes more difficult for household members to travel together.

Dependents

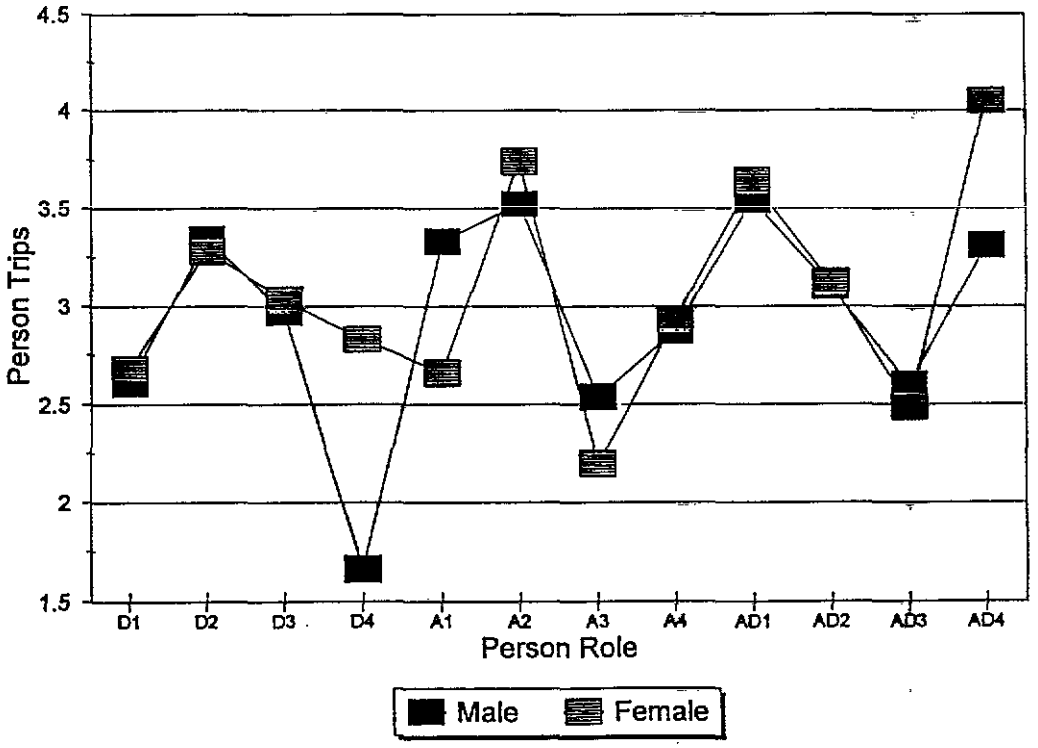
Trip making rates for dependents range above and below the mean for the data set (2.64 to 3.31 trips per person per day, Figure 4.2.1). Only those aged 16 to 21 exceed the mean. Trip distances are short for dependents under 21 years of age (7.47 to 10.82 miles per trip, Figure 4.2.3). However, young adults have a very high mean trip distance (15.06 miles per trip, Figure 4.2.3), and adults over 35 are close to the mean (11.7 miles per trip, Figure 4.2.3). Total travel distances are very low for dependents under 16 years of age (17.38 miles per trip, Figure 4.2.2) and very high for young adults aged 22 to 35 (34.15 miles per trip, Figure 4.2.2).

Children under 16 years old have well below average rates of person loops per day (1.38, Figure 4.2.4), trips per loop (2.45, Figure 4.2.5) and the second lowest number of complex chains per loop (0.17, Figure 4.2.6). Children aged 16 to 21 have among the highest number of loops per day (1.56, Figure 4.2.4), but have below average rates of trips per loop (2.58, Figure 4.2.5) and rates of forming complex chains per loop (0.20, Figure 4.2.6). Dependents aged 22 to 35 have a similar pattern, except that they have fewer loops per day (1.46, Figure 4.2.4). Not surprisingly, dependent adults older than 35, primarily comprised of homemakers, have one of the highest number of loops per day (1.59, Figure 4.2.4) and the highest number of complex chains per loop (0.34, Figure 4.2.6).

Gender Effects

Gender alone does not have a large influence on number of trips per person for the data base as a whole (3.02 trips per day for males and 3.11 trips per day for females). However, larger differences become apparent when person role and household structure are taken into account. As seen in Figure 4.2.13, differences in number of person trips are largest for dependent adults over 35 years of age (males make 41% fewer trips per day than females - 1.66 trips compared with 2.83 trips). Similarly independent male

Figure 4.2.13 Person Trips by Role and Gender



members of married households with dependents make 18% fewer trips than their female counterparts (3.31 trips compared with 4.05 trips per day). On the other hand single males without dependents make 25% more trips per day than their female counterparts (3.33 trips per day compared with 2.66).

Data presented in Figure 4.2.13 suggest that trip making by independent females may be more greatly influenced by person role than it is for independent males. The range of the number of trips per day for females is 2.20 (related adults, no dependents) to 4.05 (married adults, with dependents) while the range for males is 2.54 (related adults, no dependents) to 3.52 (single with dependents).

As seen in Figure 4.2.14, total person miles of travel are strongly influenced by gender for the data base as a whole and for each person role. In general, males travel more miles than females; the only exception is for dependent adults over 35 years old, which includes a high proportion of homemakers. Travel distance for males and females is very close for unrelated adults without dependents.

Mean trip lengths (Figure 4.2.15) are also longer for males, with the exception of unrelated independent adults without dependents in which trip length for females is slightly higher than for males. Trip length for females is also very close to that of males for single persons without dependents.

The number of loops per day are very close for males and females in many roles (Figure 4.2.16); this is consistent with the role-gender influence on number of trips per day. The data show number of trips per loop and number of complex chains per loop (Figures 4.2.17 and 4.2.18) are generally higher for females than for males.

Figure 4.2.14 Person Miles by Role and Gender

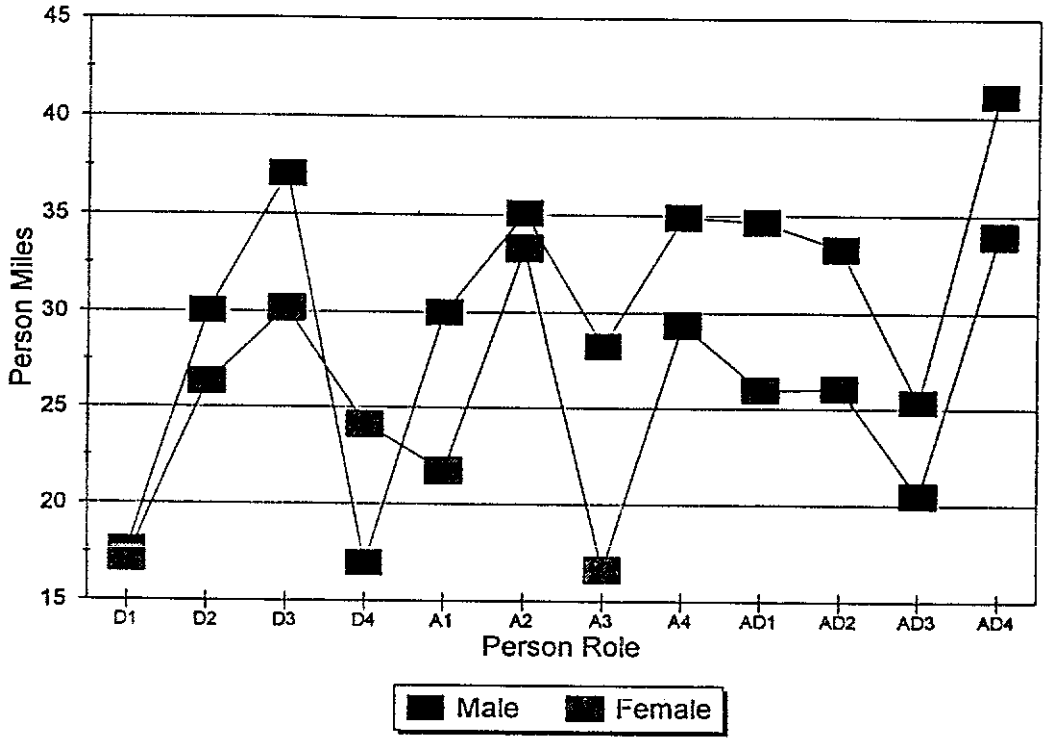


Figure 4.2.15 Mean Trip Length by Role and Gender

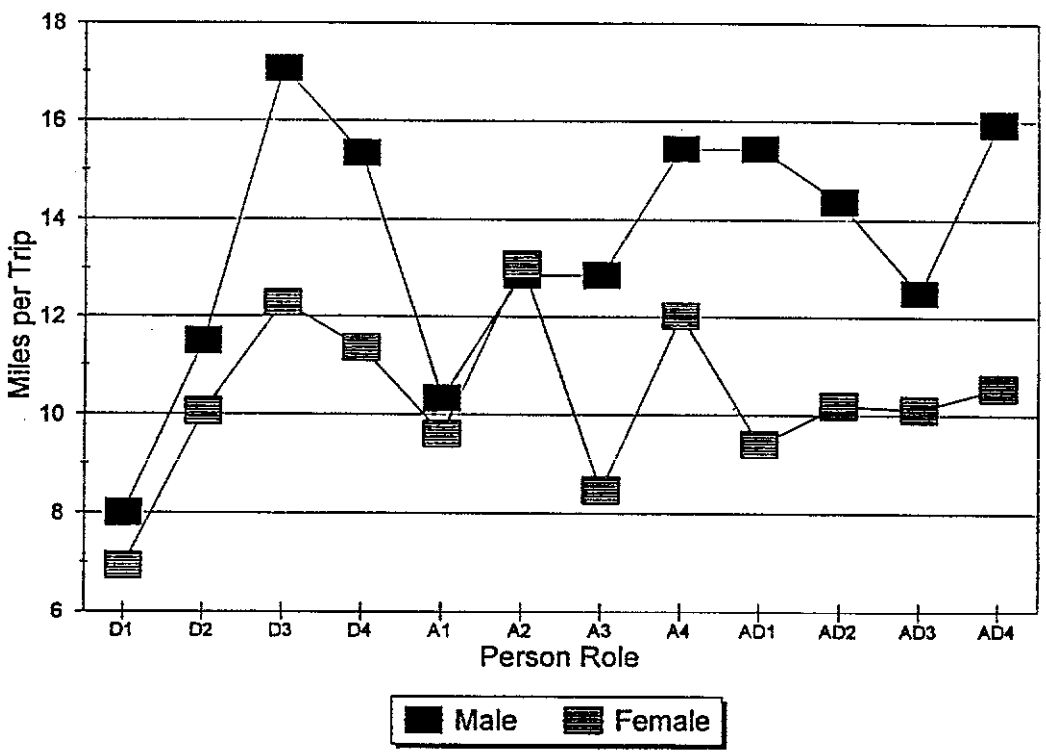


Figure 4.2.16 Person Loops by Role and Gender

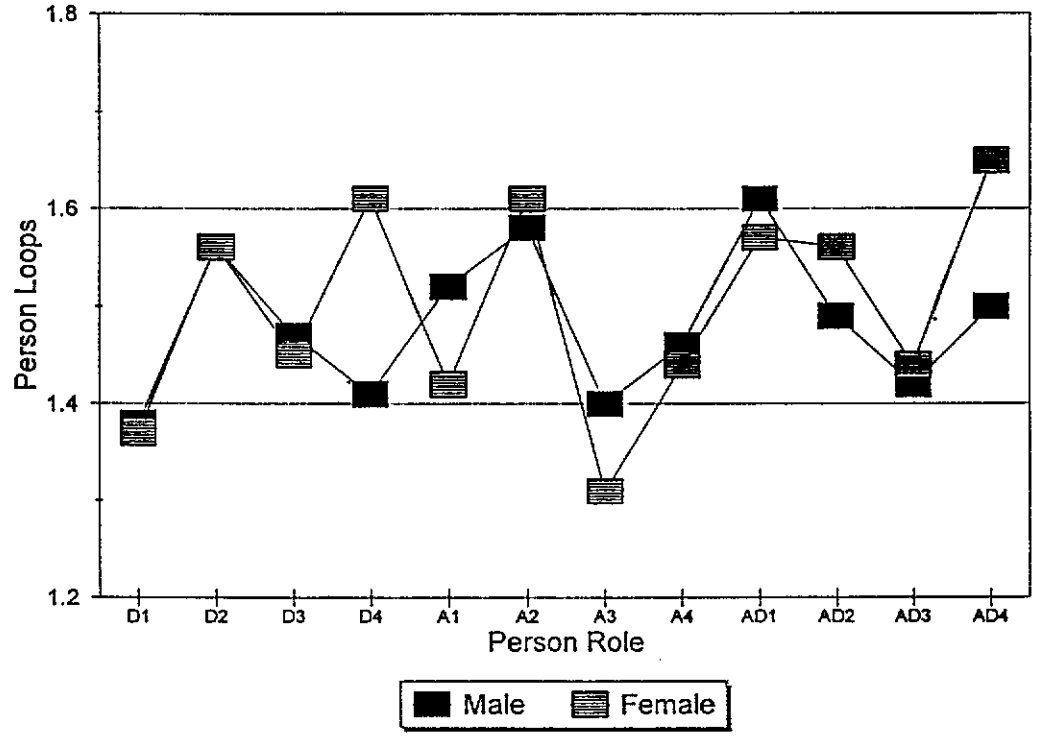


Figure 4.2.17 Trips per Loop by Role and Gender

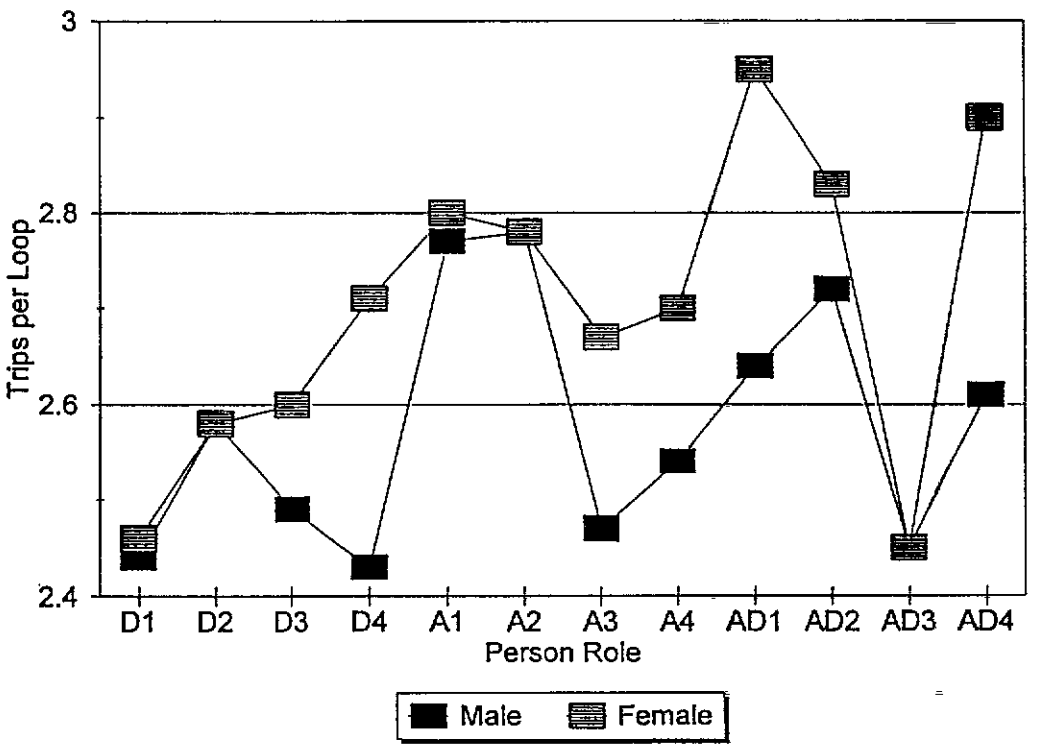
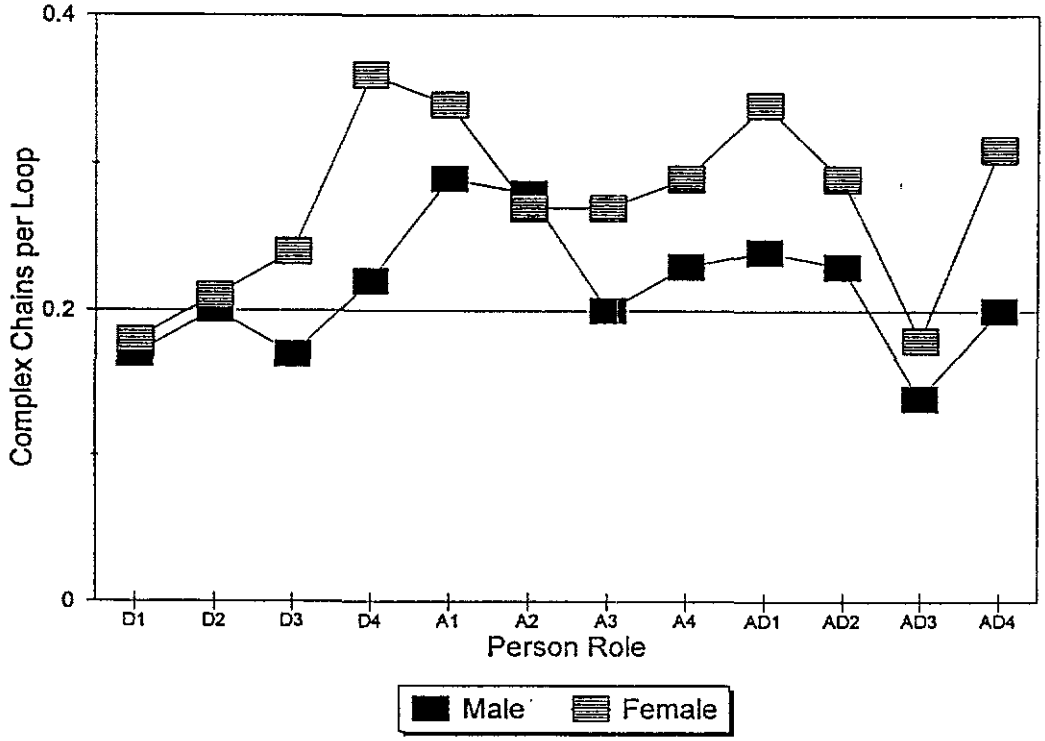


Figure 4.2.18 Complex Chains per Loop by Role and Gender



Work Status Effects

The effect of work status on trip making, shown in Tables 4.2.1 to 4.2.6, is consistent across all person roles. Student/workers, workers, and students have the highest number of trips per day and the highest mean travel distance per day. Workers also have the highest mean distance per person trip but students and student workers have a mean distance per trip close to the average for the data set. Student/workers exhibit the highest number of loops per day. Workers and students have only slightly above average number of loops per day. Students and student/workers exhibit a very low propensity to form complex chains, shown by a low number of complex chains per loop, while workers have an average number of complex chains per loop.

Retired persons and homemakers exhibit quite different trip making characteristics in comparison with workers, student/workers, and students. The number of trips per day is very low for retired persons and a little higher for homemakers, but still below the average. These groups also have the lowest mean travel distance per day compared with the average. The mean distance per trip is close to the average for homemakers, but much higher for retired persons.

Effect of Ages of Dependents

At the household level the age of the youngest child in the household has a strong effect on the number of trips per day, mean travel distance per day, and mean distance per person trip (see Table 4.2.7). The mean number of person trips is highest for households with youngest child aged 5 to 15, but total person miles of travel is highest for households with youngest child aged 16 to 21; and mean trip length is longest for households with youngest dependent aged 22 to 35. These differences are largely due to the travel behavior of the dependents.

Table 4.2.2: MEAN PERSON TRIPS BY ROLE AND WORK STATUS

Role	Worker	Retired	Student	Student/ Worker	Home-making	Other
D1 (Child 5-15)	—	—	2.64**	—	—	—
D2 (Child 16-21)	3.51	—	3.00	4.31	2.50	2.45
D3 (Dependent Adult 22-35)	3.18	—	2.24*	3.27*	2.07	2.47
D4 (Dependent Adult >35)	—	—	3.26	—	2.83	2.04
A1 (Single Adult; No DPTS)	3.81	1.96	3.48	4.75	2.07	2.09
A2 (Unrelated; No DPTS)	3.82	1.66	3.49	5.03	2.14	2.96
A3 (Related; No DPTS)	2.93	1.34	2.60*	3.28*	2.31	2.05*
A4 (Married; No DPTS)	3.36	2.18	2.89*	4.16*	2.41	2.80
AD1 (Single Adult; w/DPTS)	4.01	1.94	4.34*	5.64*	2.57	2.98
AD2 (Unrelated; w/DPTS)	3.37	1.00*	2.69*	3.58*	2.70	2.15*
AD3 (Related; w/DPTS)	2.87	1.13	3.56*	4.44*	2.63*	1.83
AD4 (Married; w/DPTS)	3.68	2.51	4.18*	4.09	3.63	3.03

* Groups with less than 50 cases

** Shown in data as "other," assumed to be students

Table 4.2.3: MEAN PERSON MILES BY ROLE AND WORK STATUS

Role	Worker	Retired	Student	Student/ Worker	Home-making	Other
D1 (Child 5-15)	—	—	17.39**	—	—	—
D2 (Child 16-21)	35.10	—	23.78	28.31	19.95	22.17
D3 (Dependent Adult 22-35)	37.06	—	24.02*	49.64*	17.19	22.74
D4 (Dependent Adult >35)	—	—	34.99	—	21.78	26.91
A1 (Single Adult; No DPTS)	37.61	12.62	19.96	52.31	10.41	12.04
A2 (Unrelated; No DPTS)	35.77	50.73	33.03*	27.73*	17.83	24.11
A3 (Related; No DPTS)	30.97	8.00	18.80*	16.56*	19.47*	13.78*
A4 (Married; No DPTS)	40.63	19.40	43.83*	38.29*	19.40	39.97
AD1 (Single Adult; w/DPTS)	32.65	13.29	18.93	26.36	14.72	19.42
AD2 (Unrelated; w/DPTS)	33.23	18.84*	11.75*	39.80*	16.00	24.80
AD3 (Related; w/DPTS)	27.00	5.65	27.84*	46.50*	20.33*	19.07
AD4 (Married; w/DPTS)	39.27	21.84	32.19*	32.75*	28.86	39.47

* Groups with less than 50 cases

** Shown in data as "other," assumed to be students

TABLE 4.2.4: MEAN TRIP LENGTH BY ROLE AND WORK STATUS

Role	Worker	Retired	Student	Student/ Worker	Home-making	Other
D1 (Child 5-15)	—	—	7.47**	—	—	—
D2 (Child 16-21)	13.02	—	9.78	7.01	8.45	14.74
D3 (Dependent Adult 22-35)	15.16	—	12.18*	18.27*	16.70*	13.19
D4 (Dependent Adult >35)	—	—	13.06	—	9.97	20.52
A1 (Single Adult; No DPTS)	11.83	7.32	7.93*	11.77*	5.83	7.02
A2 (Unrelated; No DPTS)	11.41	72.79*	13.19	8.10	8.50*	7.70
A3 (Related; No DPTS)	12.12	7.23	8.15*	4.72*	9.07*	6.15*
A4 (Married; No DPTS)	15.11	11.42	16.85*	14.30*	8.68	17.68
AD1 (Single Adult; w/DPTS)	11.12	8.03*	4.00*	4.49*	7.33	14.91*
AD2 (Unrelated; w/DPTS)	11.84	45.33*	5.26*	9.54*	6.99	24.37*
AD3 (Related; w/DPTS)	11.70	5.39	9.80*	9.61*	12.31*	17.47*
AD4 (Married; w/DPTS)	13.77	12.74	9.36*	9.43*	11.04	16.53

* Groups with less than 50 cases

** Shown in data as "other," assumed to be students

Table 4.2.5: MEAN PERSON LOOPS BY ROLE AND WORK STATUS

Role	Worker	Retired	Student	Student/ Worker	Home-making	Other
D1 (Child 5-15)	—	—	1.38**	—	—	—
D2 (Child 16-21)	1.57	—	1.49	1.72	1.48	1.47
D3 (Dependent Adult 22-35)	1.46	—	1.39*	1.50*	1.55*	1.43
D4 (Dependent Adult >35)	—	—	1.60	—	1.60	1.49
A1 (Single Adult; No DPTS)	1.49	1.38	1.81*	2.17*	1.36	1.47
A2 (Unrelated; No DPTS)	1.56	1.30*	1.78	1.91	1.59*	1.57
A3 (Related; No DPTS)	1.34	1.33	1.23*	1.64*	1.57*	1.43*
A4 (Married; No DPTS)	1.45	1.44	1.33*	1.90*	1.43	1.52
AD1 (Single Adult; w/DPTS)	1.59	1.40*	1.79*	2.11*	1.45	1.52*
AD2 (Unrelated; w/DPTS)	1.53	1.67*	1.30*	1.40*	1.56	1.48*
AD3 (Related; w/DPTS)	1.41	1.39	1.36*	2.07*	1.56*	1.56*
AD4 (Married; w/DPTS)	1.55	1.52	2.00*	1.78*	1.76	1.69

* Groups with less than 50 cases

** Shown in data as "other," assumed to be students

Table 4.2.6: MEAN PERSON TRIPS PER LOOP BY ROLE AND WORK STATUS

Role	Worker	Retired	Student	Student/ Worker	Home-making	Other
D1 (Child 5-15)	—	—	2.45**	—	—	—
D2 (Child 16-21)	2.61	—	2.48	2.69	2.55	2.65
D3 (Dependent Adult 22-35)	2.54	—	2.33*	2.88*	2.47*	2.55
D4 (Dependent Adult >35)	—	—	2.66	—	2.70	2.63
A1 (Single Adult; No DPTS)	2.96	2.53	2.44*	2.63*	2.65	2.65
A2 (Unrelated; No DPTS)	2.86	2.44*	2.47	2.60	2.43*	2.90
A3 (Related; No DPTS)	2.65	2.36	2.42*	2.33*	2.61*	2.55*
A4 (Married; No DPTS)	2.68	2.46	2.45*	2.37*	2.59	2.77
AD1 (Single Adult; w/DPTS)	2.95	2.57*	2.90*	2.91*	2.70	2.93*
AD2 (Unrelated; w/DPTS)	2.76	2.11*	2.57*	3.30*	3.06	2.54*
AD3 (Related; w/DPTS)	2.46	2.30	2.65*	2.39*	2.67*	2.25*
AD4 (Married; w/DPTS)	2.74	2.50	2.68*	2.64*	2.80	2.62

* Groups with less than 50 cases

** Shown in data as "other," assumed to be students

Table 4.2.7: MEAN COMPLEX CHAINS PER LOOP BY ROLE AND WORK STATUS

Role	Worker	Retired	Student	Student/ Worker	Home-making	Other
D1 (Child 5-15)	—	—	0.17**	—	—	—
D2 (Child 16-21)	0.21	—	0.16	0.19	0.29	0.33
D3 (Dependent Adult 22-35)	0.18	—	0.09*	0.21*	0.31*	0.32
D4 (Dependent Adult >35)	—	—	0.20	—	0.36	0.28
A1 (Single Adult; No DPTS)	0.32	0.31	0.18*	0.21*	0.35	0.32
A2 (Unrelated; No DPTS)	0.29	0.29*	0.16	0.19	0.29*	0.36
A3 (Related; No DPTS)	0.23	0.25	0.19*	0.20*	0.31*	0.40*
A4 (Married; No DPTS)	0.24	0.26	0.18*	0.15*	0.34	0.35
AD1 (Single Adult; w/DPTS)	0.32	0.31*	0.42*	0.37*	0.36	0.35*
AD2 (Unrelated; w/DPTS)	0.24	0.11*	0.27*	0.10*	0.41	0.33*
AD3 (Related; w/DPTS)	0.15	0.21	0.27*	0.08*	0.39*	0.15*
AD4 (Married; w/DPTS)	0.24	0.27	0.25*	0.20*	0.37	0.25

* Groups with less than 50 cases

** Shown in data as "other," assumed to be students

All three conventional measures of trip making are lowest for households with youngest dependent over 35 years of age. This reflects the lower trip making rates and travel distances of dependents over 35 years of age, and that independent adults in these households are likely to be older than those in households with younger dependents and therefore likely to have lower trip making rates and distances. The trip making measures are also low for households with youngest child aged 0 to 4 years. This is partly due to the fact that trips for children under 5 years of age are not recorded in the data base, and due to some likely correlation of age of youngest dependent and household size.

As seen in Table 4.2.8, the effect of the age of the youngest dependent on number of loops per day is similar to the effect on number of trips per day. The mean number of trips per loop and the number of complex chains per loop are both higher for households with youngest child aged 0 to 4 and for households with youngest dependent aged over 35. Thus the households with the lower level of trip making are also the households with the greater propensity to form more complex travel patterns. This again may be partly related to a smaller household size and to the presence of more homemakers and/or retirees in these households.

The effect of the age of youngest dependent on person level trip frequencies and trip lengths is shown in Table 4.2.9. The highest number of trips per person and travel distance per person occurs with youngest child aged 16 to 21, and the longest trip distance occurs with youngest dependent aged 21 to 35. Again these differences reflect the travel behavior of the dependents. But it is interesting to note that the effect is much less marked here, after adjusting for household size, than it is for household level travel. The effect of age of youngest dependent on mean number of person loops, trips per loop, and complex chains per loop (Table 4.2.10) is similar to that seen at the household level.

Table 4.2.8: CONVENTIONAL DESCRIPTORS OF HOUSEHOLD TRAVEL BY DEPENDENT AGE

	Youngest Child 0-4*	Youngest Child 5-15	Youngest Child 16-21	Youngest Child 22-35	Dependent Adult >35
Mean Person Trips	8.98	12.50	10.74	8.26	4.64
Mean Person Miles	81.88	102.74	108.38	91.45	46.73
Mean Person Miles per Trip	11.31	9.34	12.71	14.10	11.52

* Does not include travel by children aged 0 to 4 years

TABLE 4.2.9: STRUCTURAL DESCRIPTORS OF HOUSEHOLD TRAVEL BY DEPENDENT AGE

	Youngest Child 0-4*	Youngest Child 5-15	Youngest Child 16-21	Youngest Child 22-35	Dependent Adult >35
Mean Loops per Person	3.39	4.87	4.06	3.39	2.11
Mean Trips per Loop	2.75	2.56	2.60	2.53	2.67
Mean CMPX Chains per Loop	0.27	0.21	0.23	0.21	0.28

* Does not include travel by children aged 0 to 4 years

Table 4.2.10: CONVENTIONAL PERSONAL TRAVEL DESCRIPTORS BY DEPENDENT AGE

	Youngest Child 0-4*	Youngest Child 5-15	Youngest Child 16-21	Youngest Child 22-35	Dependent Adult >35
Mean Person Trips	3.22	3.21	3.25	2.82	2.87
Mean Person Miles	30.64	27.68	32.84	31.73	29.47
Mean Person Miles per Trip	13.53	12.14	14.78	17.56	14.88

* Does not include travel by children aged 0 to 4 years

Table 4.2.11: STRUCTURAL PERSONAL TRAVEL DESCRIPTORS BY DEPENDENT AGE

	Youngest Child 0-4*	Youngest Child 5-15	Youngest Child 16-21	Youngest Child 22-35	Dependent Adult >35
Mean Loops per Person	1.45	1.52	1.49	1.41	1.44
Mean Trips per Loop	2.73	2.58	2.59	2.53	2.66
Mean CMPX Chains per Loop	0.26	0.21	0.21	0.21	0.27

* Does not include travel by children aged 0 to 4 years

4.3 Comparison of Conventional Travel Variables with Household Structure and Person Role Variables

One purpose of this research was to evaluate the importance of household structure relative to the conventional demographic variables in differentiating the conventional travel descriptors: number of person trips, mean distance traveled per household, and mean distance per person trip. Table 4.3.1 shows the ratio of the highest to the lowest value of these travel descriptor variables for household structure, for person role, and for conventional demographic variables. Using the ratio of the highest to the lowest number of person trips, household structure provides more differentiation in number of person trips than all variables except number of persons in the household (4.09 vs. 5.33). The ratio generated by the extreme values of number of vehicles is a close third (4.04).

The same three variables are important in differentiating the mean distance per household, although the order is rearranged: number of vehicles has the greatest effect (a ratio of 9.55), while number of persons in the household is second (5.04) and household structure third (4.35). Travel mode and household income are the only other variables that are similar in their effect (ratios of 4.28 and 4.26 respectively).

The mean distances traveled per person are much less variable. The three most influential variables here are household income, number of vehicles, and person role — to be discussed in the next section of this report (with ratios of 2.36, 2.23 and 2.02 respectively).

In Table 4.3.2, similar ratios are presented for the travel pattern descriptors: number of person loops per day, number of person trips per loop, and number of complex chains per loop. Household structure remains among the most important factors influencing the newly developed travel pattern variables. It is

second in importance in its effect on the mean number of person loops per household (with a ratio of 3.39), behind the number of persons in the household (4.18) and ahead of travel mode (2.68). And it is tied for second with person role in affecting the mean number of complex chains per loop (with a ratio of 2.0), behind work status (2.06) and just ahead of travel mode (1.93).

The mean number of trips per loop is relatively constant across the values of all variables, varying between ratios of 1.06 and 1.18. Household structure and person role are at the high end of this limited range (1.17 and 1.18 respectively). Household size, income, and travel mode, and the individual's work status are intermediate in their effect, with ratios between 1.11 and 1.13.

Another goal of this study was to evaluate the importance of person role in differentiating the conventional travel descriptors and the new travel pattern variables. Although person role, by itself, has less

Table 4.3.1: RATIO OF HIGH TO LOW VALUES ON CONVENTIONAL TRAVEL DESCRIPTORS FOR HOUSEHOLD STRUCTURE, PERSON ROLE, AND THE TRADITIONAL DEMOGRAPHIC VARIABLES

	Mean Number of Person Trips per Household	Mean Distance Per Household per Trip	Mean Distance
Household			
Structure	4.09	4.35	1.49
Income	2.31	4.26	2.36
Number of vehicles	4.04	9.55	2.23
Number of persons	5.33	5.04	1.36
Age of dependents	2.69	2.31	1.51
Travel mode	3.06	4.28	1.28
Person			
Role	1.54	2.19	2.02
Gender	1.03	1.27	1.28
Work status	2.16	2.29	1.51

Table 4.3.2: RATIO OF HIGH TO LOW VALUES ON THE NEW TRAVEL PATTERN VARIABLES FOR HOUSEHOLD STRUCTURE, PERSON ROLE, AND THE TRADITIONAL DEMOGRAPHIC VARIABLES

	Mean Number of Person Loops per Household	Mean Number of Trips per Loop	Mean Number of Complex Chains Per Loop
Household			
Structure	3.39	1.17	2.00
Income	1.63	1.11	1.16
Number of vehicles	2.13	1.09	1.33
Number of persons	4.18	1.13	1.78
Age of dependents	2.31	1.09	1.33
Travel mode	2.68	1.12	1.93
Person			
Role	1.19	1.18	2.00
Gender	1.02	1.06	1.29
Work status	1.23	1.11	2.06

effect, relative to the conventional demographic variables, on the mean number of person trips and mean distance traveled per person, it is one of the three most influential variables affecting mean distance per trip (along with household income, and number of vehicles). And while it is among the least important in differentiating the mean number of person loops per person, it is among the most important in its affect on the mean number of trips per loop (first) and mean number of complex chains/loop (tied for second).

Controlling for gender increases the effect of person role on mean travel distance per person for men, while lowering it for women (a ratio of 2.42 for men, 1.98 for women, but 2.19 for role uncontrolled). However, gender does not markedly change the effect of role on mean distance per person trip.

In contrast, controlling for gender does not change the effect of person role on the new travel pattern variables: mean number of person loops per person, and mean number of trips and complex chains per loop. The effect of person role controlling for work status could not be properly evaluated since there were insufficient cell sizes for some roles in all but the worker status.

However, where the number of person trips is concerned, the effect of person role increases when controlling for gender. While the ratio of high to low number of person trips is 1.54 for role alone, it increases to 1.84 for women and 2.12 for men. Similarly, the effect of gender on some roles increases when role is introduced, from 1.03 for gender alone to 1.7 for dependent adults over 35. This reflects the interaction between gender and person role.

Implications

5.1 Mobility and Transportation Policy

Transportation research has come to rely on a limited number of conventional variables to measure and explain travel behavior. Conventional dependent variables, such as number of trips, trip length, and miles traveled, gained acceptance at a time when transportation planning and policy were mainly concerned with accommodating increasing personal vehicle travel and easing traffic congestion. Independent variables were chosen from individual and household characteristics readily available from existing data sources that correlate well with conventional dependent variables. Although conventional variables didn't provide accurate descriptions of travel behavior or comprehensive explanations for why people travel, they seemed to work reasonably well for analyzing one-dimensional traffic problems.

Over the past two decades increasing concern with a wide range of transportation-related problems has diminished the usefulness of traffic-specific methods. It is widely recognized that problems as diverse as energy security, air pollution, and community and regional development are affected by transportation policy and planning. It is also widely accepted that many transportation problems are interrelated, making it difficult to address one problem without aggravating others. Unfortunately, methods that are more oriented to analyzing traffic flows than actual travel behavior are not well suited for understanding complex transportation problems.

One legacy of the uncritical embrace of conventional methods is revealed by legislative mandates to address and resolve transportation problems. Government agencies responsible for transportation policy and planning are often directed by law to attain some reduction or minimization goal related to vehicle use, such as minimizing fuel consumption, hours of traffic delay, vehicle miles traveled, vehicle trips, or vehicle emissions. Clearly, vehicle use is minimized by simply eliminating it. But no one seriously advocates eliminating vehicle use; in most cases travelers have no realistic alternative. Instead, transportation planning is implicitly committed to maintaining personal mobility. In effect, preserving mobility has become another goal of an already complex planning process. But because mobility constraints are implicit, they are difficult to specify and the mobility impacts of various plans and policies are difficult to evaluate. Difficulties in analyzing contemporary transportation issues reflect the complexity of the social relationships that structure travel behavior. The inability to estimate travel needs and evaluate the mobility impacts of various policies and plans has become a serious drag on efforts to develop more effective, acceptable solutions to multi-objective transportation problems.

5.2 Mobility and Travel Strategies

Analysis of structured travel strategies is essential for understanding travel behavior and needs. People need to travel in order to access geographically dispersed activities. Activities with others are socially structured, and travel that links them together becomes integrated with those structures. Who travels, where they travel, when and with whom they travel is significantly affected by the relationships that structure activities. Travelers devise multi-dimensional travel strategies in order to integrate structured activities through travel.

A structural analysis of travel strategies requires two methodological elements to accurately measure and describe personal travel behavior and needs. First, travel behavior and needs should be understood in terms of the complex travel strategies that integrate structured activities. Second, it is essential to identify categories of travelers based on the way social structure affects individuals' travel behavior and needs.

Recognition that household structure is one of the more important structural influences on travel behavior is not new. Lifecycle methods have been the principal approach used to try to capture structural

influences and analyze travel behavior. However, lifecycle concepts are not pure structural variables. Lifecycle variables incorporate a number of disparate influences, such as household composition and size, age of household members, and work status. Combining many different kinds of influences into a single measure makes it impossible to distinguish structural influences from other variables that correlate well with travel behavior. Another drawback is that lifecycle concepts only apply to travel behavior at the household level. Although relatively good correlations may be estimated for household travel, lifecycle variables cannot be used to disaggregate household members' travel. Because structural influences are confounded with other influences, and because individual behavior cannot be analyzed through lifecycles, the effects of structural influences on individual travel behavior and needs cannot be accurately specified and measured. Although these weaknesses may not be debilitating for traffic flow analyses, they impede complex transportation problem solving.

Information developed in the preceding chapters of this study will be used to suggest how a structural analysis could enhance transportation planning and policy. The twelve household structure types are used to describe relative differences in household travel strategies. The twelve person roles presented in the preceding chapters of this report are used as categories of individual travelers whose travel behavior and needs are influenced by the household division of labor. However, because the results of this study are preliminary rather than exhaustive, the intent of this exploration is to guide further research on structural analyses rather than to draw definitive conclusions.

5.3 Dimensions of Travel Strategies

Four dimensions of travel strategies are derived from the six measures of travel behavior used in this report: travel frequency, travel complexity, dispersion of activities, and geographic reach. Travel times and total time traveled could also be incorporated into analyses of travel strategies. However, this information was not compiled for this report.

Travel frequency is estimated from number of person trips and person loops. Person trips can be thought of as activity links. The more activities a person needs to link together, the more trips they take. Person loops measure how frequently travelers leave home to link activities. Travel frequencies reflect the number of activities and the frequency with which travelers link activities from home.

Person trips per loop and complex chains per loop can be used to estimate the complexity of travel strategies. Trips per loop reflects travel complexity in terms of the number of activities linked together in the average excursion out of the house. Complex chains per loop suggests how concentrated travel complexity is by indicating the frequency with which complex travel is undertaken. Complexity is an important dimension of travel strategies because it can account for scheduling constraints of activities linked together, such as the necessity for adults to adapt travel strategies to accommodate the travel needs of children.

Average trip length is an indicator of the overall dispersion of activities that are linked through travel. More dispersed activities are associated with relatively longer average trip lengths than more centralized activities occurring near each other.

Finally, person miles traveled is a measure of the total distance covered in travel and reflects a traveler's overall geographic reach when linking activities together.

5.4 Structural Influences on Travel Strategies

Table 5.4.1 presents a summary of travel strategies by household type and Table 5.4.2 presents a summary of travel strategy by person role. The values presented in Tables 5.4.1 and 5.4.2 are subjective estimates based on the relative difference from mean values for all households or persons. While not an

objective, quantified measure of relative differences in travel strategies, these estimates can provide insight into differences in travel behavior and needs.

The household travel strategies summarized in Table 5.4.1 suggest several important relationships. First, when household travel frequency is analyzed by household type, the number of independent adults in a household appears to have little effect, but when dependents are present it increases substantially. It could be that adults substitute some activities within the household for outside activities when other adults are present but need to travel more frequently when dependents are present. Second, complexity of travel decreases as the number of independent adults increases and is greatest for households without dependents. This suggests that the number of schedules that need to be coordinated impede complex travel, and dependents' schedules may be particularly difficult to coordinate. Third, dispersion of linked activities increases with number of independent adults, but decreases when children are present. This may be because adults must serve many of dependents' travel needs, so everyone in the household restricts the dispersion of their activities in order to coordinate their travel according to the proportions of adults and dependents in the household. Finally, geographic reach shows the same pattern as travel frequency, ranging higher with the presence of dependents than with increasing numbers of independent adults. While only tentative, these findings suggest that household travel needs as reflected by household travel strategies are affected greatly by household structure.

The differences in travel strategies by person role presented in Table 5.4.2 are less straight forward. Frequency and reach are similar, but not as strong as for household travel strategies. Although there is a considerable amount of variation from one role to the next, readily apparent patterns are not so easily discerned. This is probably because additional structural and economic variables at the person level must be taken into account, which, unfortunately, is beyond the scope of this exploration.

Table 5.4.1: TRAVEL STRATEGY CHARACTERISTICS BY HOUSEHOLD TYPE

Households Without Dependents	Frequency[1]	Complexity[2]	Dispersion[3]	Reach[4]
H1 (Single Adult)	LOW	HIGH	AVERAGE	LOW
H2 (Unrelated Adults)	AVERAGE	ABOVE AVERAGE	AVERAGE	AVERAGE
H3 (Related)	LOW	ABOVE AVERAGE	LOW	LOW
H4 (2 Independent, Married)	BELOW AVERAGE	AVERAGE	HIGH	AVERAGE
H5 (1 Independent, Married)	LOW	BELOW AVERAGE	HIGH	AVERAGE
H6 (3+ Adults)	AVERAGE	LOW	HIGH	AVERAGE
Households With Dependents	**Frequency[1]**	**Complexity[2]**	**Dispersion[3]**	**Reach[4]**
H7 (Single Adult)	AVERAGE	AVERAGE	LOW	AVERAGE
H8 (Unrelated)	HIGH	AVERAGE	HIGH	HIGH
H9 (Related)	ABOVE AVERAGE	BELOW AVERAGE	LOW	AVERAGE
H10 (2 Independent, Married)	HIGH	BELOW AVERAGE	AVERAGE	HIGH
H11 (1 Independent, Married)	HIGH	AVERAGE	AVERAGE	HIGH
H12 (3+ Adults)	HIGH	LOW	AVERAGE	HIGH

1) person trip and person loop frequencies 2) trips per loop and complex chains per loop 3) average trip length
4) daily person miles traveled

Table 5.4.2: TRAVEL STRATEGY CHARACTERISTICS BY PERSON ROLE

Dependent Roles	Frequency[1]	Complexity[2]	Dispersion[3]	Reach[4]
D1 (Child 5-15)	LOW	LOW	LOW	LOW
D2 (Child 16-21)	AVERAGE	BELOW AVERAGE	AVERAGE	AVERAGE
D3 (Dependent Adult 22-35)	AVERAGE	LOW	HIGH	HIGH
D4 (Dependent Adult >35)	BELOW AVERAGE	ABOVE AVERAGE	AVERAGE	LOW
Adult Roles w/o Dependents	**Frequency[1]**	**Complexity[2]**	**Dispersion[3]**	**Reach[4]**
A1 (Single Adult; No DPTS)	AVERAGE	HIGH	LOW	LOW
A2 (Unrelated; No DPTS)	HIGH	ABOVE AVERAGE	AVERAGE	HIGH
A3 (Related; No DPTS)	LOW	AVERAGE	AVERAGE	LOW
A4 (Married; No DPTS)	AVERAGE	AVERAGE	HIGH	HIGH
Adult Roles with Dependents	**Frequency[1]**	**Complexity[2]**	**Dispersion[3]**	**Reach[4]**
AD1 (Single Adult; w/DPTS)	ABOVE AVERAGE	HIGH	LOW	AVERAGE
AD2 (Unrelated; w/DPTS)	AVERAGE	ABOVE AVERAGE	AVERAGE	AVERAGE
AD3 (Related; w/DPTS)	BELOW AVERAGE	LOW	AVERAGE	LOW
AD4 (Married; w/DPTS)	ABOVE AVERAGE	AVERAGE	HIGH	HIGH

1) person trip and loop frequency 2) trips per loop and complex chains per loop 3) average trip length
4) daily person miles traveled

To take the comparative analysis a step further, we have taken the twelve person roles and grouped them under four headings: children, single adults, non-traditional roles, and traditional roles. Children and single adult roles are self-explanatory, and the reasons for separating them out is to control for some of the more important influences related to dependence, which isn't sufficiently developed in this study to analyze thoroughly, and household income, which also affects travel in important ways.

The traditional quality of a role was determined in comparison with the "typical" modern nuclear family composed of a married mom and dad with children. Research on changing family division of labor has established that household responsibilities do not necessarily change when a married mom enters the paid labor force, so working moms, working dads (AD4), and homemakers (D4) are included in the traditional category. Because the D4 category is overwhelmingly female and because most of the persons in D4 are homemakers, travel by men in this category is omitted. The non-traditional roles, broken down by gender, include married without children (A4), unrelated adult with and without children (A2 and AD2), and related adult with and without children (A3 and AD3).

As can be seen in Figures 4.4.13 and 14 (5.2.1&5.2.2), gender seems to effect the number of activities linked and the number of excursions out of the home for some roles but not for others. Children's roles are largely undifferentiated by gender; single adult roles are different by gender, but this may be a result of the income differences between men and women; non-traditional roles do not seem to differentiates frequency; but gender is clearly different for traditional roles. Traditional roles are a different matter; married dads come out higher than homemakers, but lower than working moms on these measures. This suggests that, although each role makes a difference, women in traditional roles generally have frequency needs different from men in the same roles.

Measures of travel complexity show a surprisingly different picture. Women's travel behavior presented in Figures 4.4.17 and 18 (Figures 5.2. 2&4) reflects greater overall and concentrated complex travel needs greater than men's, except for unrelated adults without dependents and related adults with dependents, where there is no difference. The lack of difference in the single adults is also surprising, suggesting that income and complexity are not closely related, and that the lack of household structural differences by gender translate into similar travel needs.

Dispersion of travel (Figure 4.4.15[5.2.5] shows a very similar pattern of travel behavior. It could be that women's restricted dispersion of activities is closely related to the complexity of their travel; where many activities and schedules must be integrated and coordinated, it seems likely that travel flexibility would be reduced and activity dispersion would reduced accordingly to accommodate the lack od flexibility. Closely related to dispersion is total reach (Figure 4.4.14[5.2.6]. The principal difference here is that single adults are different by gender, probably reflecting the income related differences by gender in number of activities and number of excursions from home.

In summary, it would seem that women in households with others do have special needs for more complex travel. However, only women in traditional roles differ substantially from men in the number of activities the need to link or the number of excursions they need to take away from home. Dispersion of activities is also a gender-based difference for most roles, probably constrained by women's greater travel complexity. This also translates into a more restricted reach in daily travel, also probably constrained by special complexity needs. It is also apparent that income can have a substantial effect on travel needs. But comparison with female single parent roles suggests that role can override income effects, at least in some circumstances.

- Traditional v Non and Class accounts for differentiation by gender for PT and PL.
- Gender accounts for differences for complexity.
- Complexity differences account for differences in trip length.
- Trip length differences account for differences in PMT.
- As more women move into non-traditional roles, their travel may look more like men's?
- Also as income gap narrows (men's incomes relatively declining?), men's will look more like women's?

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Publication No. FHWA-PL-95-032
HPM-40/2-95(6.5M)E