Examining Trip-Chaining Behavior

A Comparison of Travel by Men and Women

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Abstract

Gender and household life-cycle together affect daily travel behavior. While this makes intuitive sense, transportation planners and policy makers/shapers have done little to understand what effect and impact these factors have on daily transportation choices. This paper uses the 1995 Nationwide Personal Transportation Survey (NPTS) to examine trip chaining behavior of adult men and women traveling Monday through Friday. The data show that women continue to make more trips to perform household-sustaining activities such as shopping and family errands to a greater extent than men. Women, especially with children in the household, are more likely to chain these household sustaining trips to the trip to and from work.

Women's participation in the labor force is at an all time high, but women's patterns in travel to work are different from men's patterns, and vary with family and life cycle status. The type and location of jobs that women take are likely affected by their greater household and family responsibilities. The biggest question for the future is whether and how the changes in women's status in the workplace, and perhaps the concomitant change in the household dynamics and responsibilities, will affect travel behavior of both men and women. These changes will deeply impact the development of programs related to transit, land-use planning, work schedules, telecommuting, and other programs related to auto use.

Keywords: Trip Chaining, Work Travel, Gender Differences in Travel, Travel Behavior.

Summary

Women make choices every day in trying to balance competing demands, and these choices influence their daily travel. Over sixty percent of married women are in the paid labor force, but working women still retain substantial child care and domestic obligations. As women have entered the labor force in greater numbers, more shopping and family-errand trips have been pushed into non-work periods, including peak congestion periods, and linked with other trips for efficiency. Day-care and school hours ensure that at least some of these trips must be made during the peak traffic periods.

Using the 1995 Nationwide Personal Transportation Survey this paper examines the effect of gender and life cycle stage on the amount and type of trip chains created by adults (18 to 65 years old) traveling on weekdays. The 1995 NPTS database was marked to distinguish trip chains linking home and work, work and work, or home and home by Research Triangle Institute, who conducted the data collection. All trips in the database are organized into trip tours anchored by home, work, or some other place, without regard to dwell time, purpose, time-of-day, or other commonly used variables.

Previous research has examined the effect of gender or life cycle stage in travel, but it is illuminating, using such a large data set, to be able to examine the different patterns in mothers and fathers in single- and two-parent households, and households with young children. Understanding and quantifying the different travel patterns of men and women at different stages of their lives allows us to discern how marriage and family responsibilities change travel for both men and women, and the greater impact these responsibilities have on women. For instance:

- Overall, adult women are more likely than men to stop at multiple destinations on the way to or from work and make more trips to and from work.
- Single adult men and women in households with no children are more alike in their travel than different.
- In households with children, women create complex trip chains substantially more than women in households without children, or than men.
- Single mothers, especially of small children, are far more likely to create trip chains than either single fathers or mothers in households with two adults.

Understanding the variables which influence trip chaining behavior can be useful in several applications, including development of employer-based employee assistance programs, evaluation of mixed-use development, micro simulation of travel demand and forecasting impacts of travel demand management programs. In particular, current travel demand models use households and household characteristics to forecast the number and distribution of trips. However, individual characteristics, such as gender and work status, used in conjunction with household characteristics, such as life cycle stage, income, housing tenure, may be a key component of effective understanding of the future of travel demand.

Overview

One of the most significant trends in the past three decades is the changing social and economic role of women. Increasing labor force participation, licensing, and changes in the type and amount of trips made by women have had a permanent effect on travel behavior analysis and implications for the future of transportation planning. Trip chaining is relatively new way to look at the series of trips made by people every day, and helps clarify the reasons for choices in mode and the time of day of travel.

The estimation of total commute time and distance is complicated by these subordinate or incidental trips, which may or may not be close to either home or work locations. Strathman and Dueker[1] noted the reliance on the automobile for flexibility in organizing daily activities in coordination with the work commute, and noted that the growth of non-work vehicle trips made during the commute contributes to traffic congestion.

Levinson and Kumar[2] hypothesize that the increase in trip chaining is an adjustment to higher family incomes and less time as women have entered the workforce. They note that dual career households buy services (such as day care) that were formally conducted in the home. They also state that the growth of non-work trips does not constitute more of the same, but rather a fully different behavior pattern.

Nishii, Kondo, and Kitamura[3] note that empirical evidence points to a secondary role for the work trip--that is, to provide an opportunity to link non-work travel. Transportation planners have always contended that the work trip is an organizing element of household travel. Women have always made the kind of household sustaining trips, especially shopping and family errands, that we now see as part of chains. Elder care, like child care, can impact women's choices more than men's.

Bianco and Lawson[4] summarize that the work trip is becoming more complex as workers

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[1]James G. Strathman and Kenneth J. Dueker, "Understanding Trip Chaining", 1990 NPTS Special Reports on Trip and Vehicle Attributes, p. 1-7

[2]David Levinson and Ajay Kumar, "Activity, Travel, and the Allocation of Time," *APA Journal*, Autumn 1995, pp 458 - 470

[3] Kazuo Nishii, Katsunao Kondo, and Ryuichi Kitamura, "Empirical Analysis of Trip Chaining Behavior," *TRR 1203*, p. 49

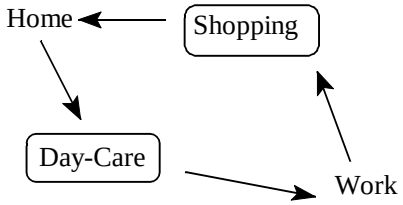
[4]M. Bianco and C. Lawson, "Trip Chaining, Childcare, and Personal Safety", Women's Travel Issues, Proceedings from the Second National Conference, October 1996 p. 124

incorporate personal, household, and child-care activities into their commutes. Many studies have shown that women commute shorter distances than men, and have offered explanations such as lower paying jobs, family commitments, and limited access to automobiles[5]. Additionally, the presence of children in a household results in shorter commuting times and greater voluntary part-time work by women.[6] Shorter commute trips and part-time work may reflect the desire to balance labor-force participation with family activities.

As we enter the next century, more people will be able to work from home as the use of technology creates a more flexible work-force. This revolution may impact women, part-time workers, and people involved in child- or elder-care the most. However, one intriguing development may come from men's working at home: more male involvement in home-related activities and travel. In addition, men's greater role at home may allow women to work farther from home. This possibility arises from the findings that women may work closer to home than men do because of greater family and household responsibilities.[7]

Definitions of Terms

Although there is no formal agreement on the definition of a chained trip, many transportation professionals believe that they know a trip chain when they see one. Different terms and expectations exist as to what types of trips should be considered part of a chain. For instance, the following configuration could be considered:



C Four separate trips

[5]Winston Allen, "Equitable Transportation in the Journey to Work for Part-Time Workers", FHWA, May 1998 p. 2/10

[6] ibid. p. 2/12

[7] Susan Hanson, "Gender, Work and Space in an Information Society", Women's Travel Issues, Proceedings from the Second National Conference, October 1996 p. 287

- Two trip chains, one from home to work and one from work to home (our definition for this research)
- One home-based trip tour

In most trip chaining analysis the primary anchors are generally considered home and work. A chain is the series of trips in a tour, a tour is defined by the anchors, such as home to work or work to home chains.

In this analysis, a trip is a one-way segment of travel between an origin and a destination, by any means of travel. The terminology used in this analysis also includes the following:

- ***Stop***. These are the trip ends between the anchors of home and work. If a person leaves home, goes to a day care center, and continues to work, that is one stop.
- ***Chain***. A chain is a set of trips in a tour. If a person leaves work, stops at a store, stops at a day care center, and goes home, that is one chain. In this preliminary analysis we are also examining stops made between home and home, and work and work as chains.
- ***Tour type***. A tour is defined by the anchors of home and work. The four possible types are: Home to Work, Work to Home, Work to Work (trips made during the workday), Home to Home (the remainder of non-work trips).

This analysis is limited to adults of working age (18 to 65 years old) traveling on weekdays, accounting for about 44 percent of all of the trips in NPTS. In trip analysis, travel by children under 18, the elderly, and travel on weekends accounts for a lot of the dispersion of the data. We developed this subset to sharpen our focus. Nearly 80 percent of these adult respondents are employed (86 percent of the men and 73 percent of the women).

This analysis includes the number and the purpose of stops made, the dwell time of stops made for different purposes, and the number and type of stops made by people in different family-types, such as single adults, retired, single parents or two-parent families.

Because we have included home-to-home tours in the analysis, virtually all of the weekday trips in the NPTS daily travel file are part of this analysis, whether one trip-end is work or not.

The inclusion of non-work travel (home-to-home tours) is sometimes confusing, since most other trip-chaining analysis has focused on stops made between home and work. For example, if an individual leaves home, makes one stop, and arrives at work it is commonly referred to as a trip chain. If an individual leaves home, makes one stop, and returns home it is not commonly thought

of as a chained trip, although Kitamura[8], et al. included such trips in their early analysis of time-space paths. For example, a one-stop trip from home to a place where more than one activity can be accomplished, such as a shopping mall, allows trip chaining (by foot, predominately) within the mall.

About five percent of the tours in the full data file never arrived at a workplace, or never returned home during the travel day. These tours are coded as anchored, not by home or work, but at "some other place". Trips made in these types of tours were not included in this analysis.

Findings

Trip Chaining by Workers and Non-Workers

Everyone trip chains, both workers and non-workers. However, most trips are completed in home-to-home tours (98 million weighted daily trips by adults traveling on weekdays). This is consistent with earlier findings by Adiv (1983) showing that although non-work activities are conducted during the work-trip, most daily activities of the San Francisco sample in his study were independent of the trip to or from work[9].

Because the large majority of the adults aged 18 to 65 years in the NPTS sample are workers (86 percent of the men and 73 percent of the women), and because many of their trips to and from work occur at peak period, we need to examine home-to-work tours (33.6 million daily trips) and work-to-home tours (38.7 million daily trips) .

Tours Between Work and Home by Number of Stops

Overall, adult women make more person trips than men in the same age group, and are more likely to form complex work-trip travel chains than men, stopping at multiple destinations to and from work. However, the majority of people don't stop anywhere on their way *to* work. Only one out of five men and one out of three women reported stopping for any reason on their trip from home to work.

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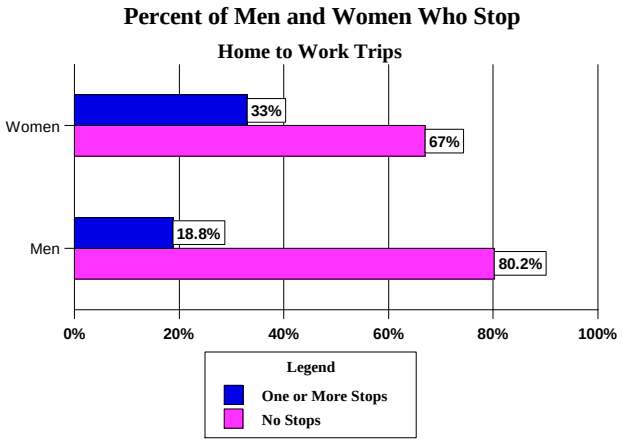
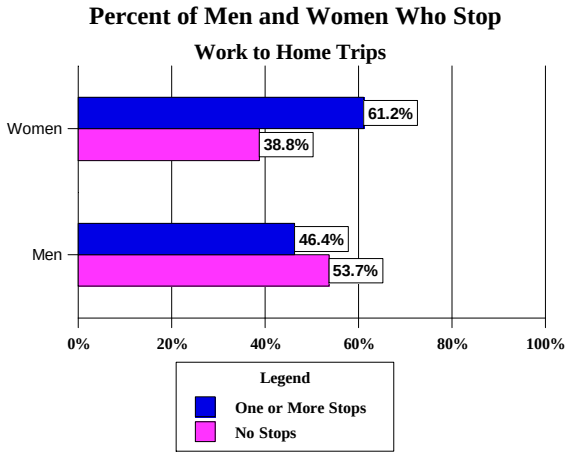
[8]Ryuichi Kitamura, Lidia P. Kostyniuk, and Michael J. Uteno, “Basic Properties of Urban Time-Space Paths: Empirical Tests,” *TRR 794*, pp. 8 - 19.

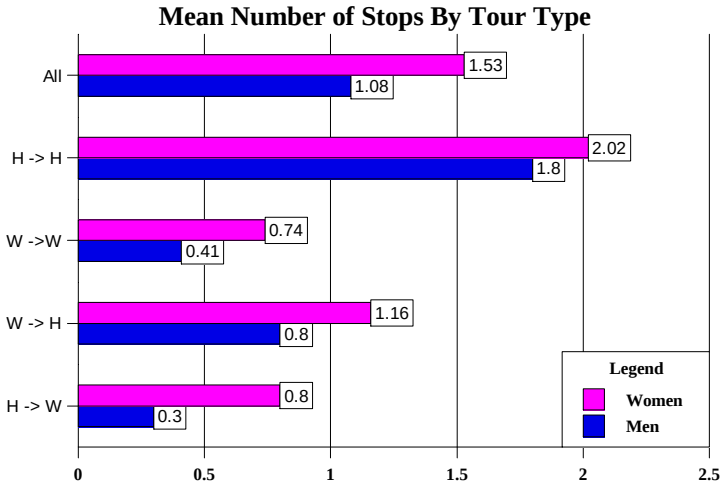
[9]A. Adiv, The Structure of the Work Trip Based on Analysis of Trip Diaries in the San Francisco Bay Area. *Recent Advances in Travel Demand Analysis*, Gower, Aldershot, England, 1983, pp. 117 - 136.

However, the majority of women (61.2%) do make at least one stop after work, and almost thirty percent (28.3%) make two stops or more. Just under half (46.4 percent) of men stop on the way home from work, and only about one out of six (17.7%) make two stops or more.





On average, women make fifty percent more stops on the way home from work, and eighty percent more work-based tours. In fact, each tour type shows women making more stops, overall accounting for about half a trip per day more than men.

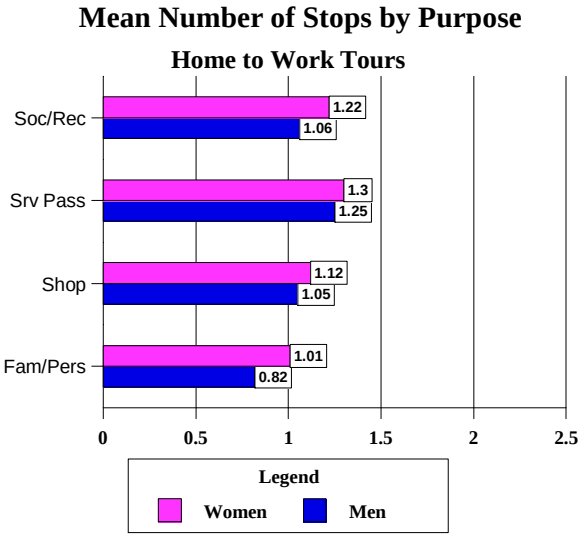


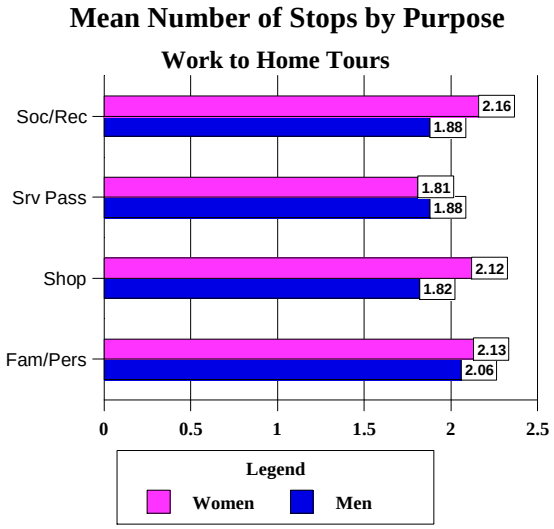
The vast majority of trips in the NPTS are private vehicle trips, and being the driver of a car increases the percent of trips that are chained. For instance, overall 67 percent of women do not

stop on the way to work, but 73 percent of those women who are not drivers go directly to work.

Stops by Trip Purpose

The stops people make do not vary greatly by purpose for men and women--overall, both men and women seem to be stopping for the same general purposes--stopping at the store, running errands, or visiting friends and other social activities. This follows the analysis of Adiv[10], looking at the travel in the San Francisco Bay area, who found that various activities were linked to the work trip in frequencies which were not different from the overall set of trips.

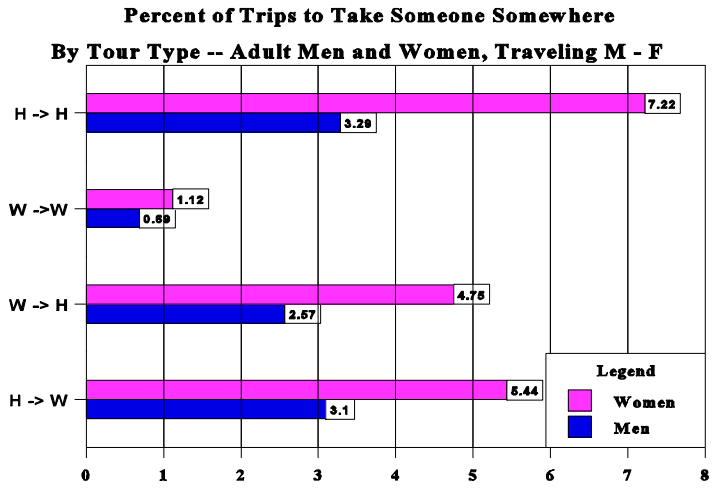




* Srv Pass is used as short-hand for “serve passenger”, or trips to pick someone up or take someone somewhere

In the NPTS, one major exception may be trips made to drop-off or pick-up a passenger. In the subset of adults traveling on weekdays, these trips account for a slightly larger percent of all trips (10.5 percent of the trips made on Home to Home tours, for instance, vs. 7 percent of all trips) than in the general population and show visible differences for men and women.

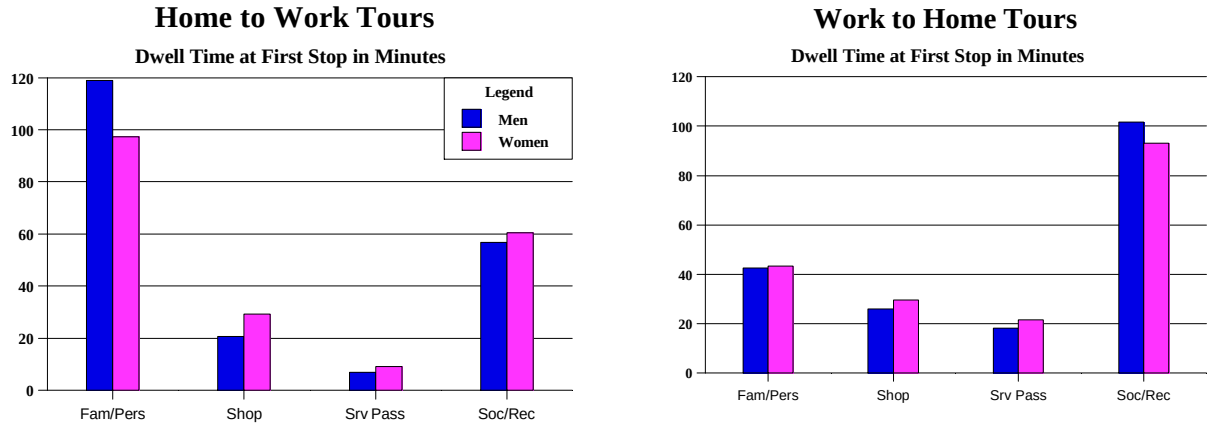
[10] A. Adiv, The Structure of the Work Trip Based on Analysis of Trip Diaries in the San Francisco Bay Area. *Recent Advances in Travel Demand Analysis*, Gower, Aldershot, England, 1983, pp. 117 - 136.



Dwell Time at Stops

Just like the number of stops, the amount of time spent at the first stop location shows the greatest variation by the type of tour. On the way to work, women and men both spend the greatest amount of time at work-related and family and personal activities, with men spending slightly longer at both. The least amount of time is spent dropping someone off, eight minutes on average, and for shopping trips (average of 25 minutes).

On the trip from work to home, the time spent at the first stop for dropping a passenger, shopping, and especially trips for social and recreational purposes are all longer. It looks as if picking someone up takes nearly twelve minutes longer than dropping them off, and social recreation stops are more than a half-hour longer after work than before. Surprisingly, trips for family and personal errands are nearly an hour shorter--perhaps the type of trip makes a difference here. Errands can include doctor's and dentist's appointments which might be scheduled before work when these services are accessible.



* Srv Pass is used as short-hand for "serve passenger", or trips to pick someone up or take someone somewhere

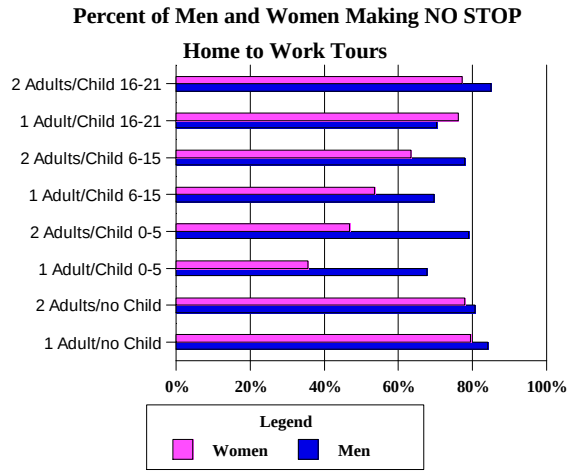
These dwell times are different than the sojourn durations shown by Nishii, et al[11], who found that before work stop(s) were over 120 minutes, and after work stops(s) generally longer for single-stops, and shorter for multiple-stops (1980, using Japanese data). In earlier work, Kitamura et al. found that the average duration of each stop was negatively correlated to the number of stops in the chain.

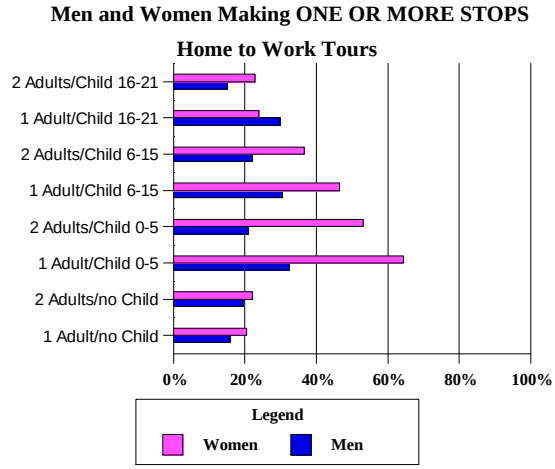
Stops by Gender and Family Composition

The differences in the travel characteristics of men and women analyzed as a group seem slight--a consistent greater number of stops across all purposes for women, and very similar times spent at activities. However, when the family composition of the travelers are considered, the differences are brought into sharp focus.

Single adults and men and women in households with no children actually show the same small difference in the trip chaining patterns that are seen when examining men and women as whole groups. Eighty percent of both men and women in households with no children make no stops on the way to work, and forty to fifty percent make no stops on the trip from work to home.

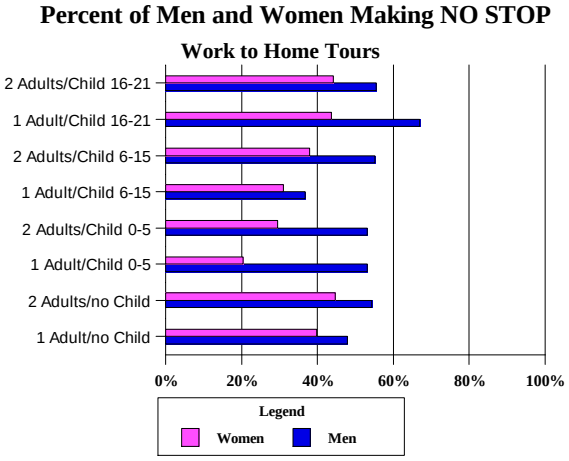
[11]Kazuo Nishii, Katsunao Kondo, and Ryuichi Kitamura, "Empirical Analysis of Trip Chaining Behavior," *TRR 1203*, p.54

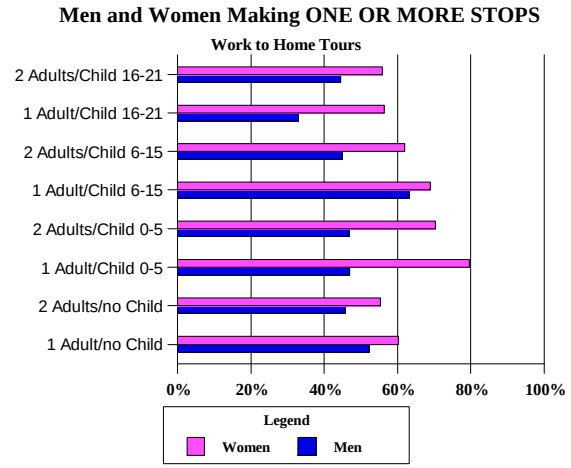




The biggest difference arises in the categories of households with children, where women's travel really diverges from men's. More women in household's with children are making stops on the way to work than either single men or women--65 percent of the single moms of children less than five and over half (53 percent) of women with children 6 -15 years old are stopping, vs. a third of single dads with children under 5 and only one in five (20 percent) of those in two-parent households.

The same pattern is seen in the stops made after work. And when we look at these stops across tour types, we see that the women with children chain trip destinations far more than those women in households without children, or than men.





Conclusions

In this paper , we have used the NPTS to examine the kinds of trip chains made by adult men and women, traveling on weekdays. We have looked at the number and type of stops for four types of tours: home to work, work to home, work to work, and home to home. Most of the analysis of the purpose of the stops and examining the time spent at destinations focused on stops made between home and work or work and home. The greatest difference in the number, purpose, and time spent at activities related to the type of tour. Women consistently made slightly more stops, but men and women stopped for the same purposes, and men showed slightly longer times spent at the activities.

Although the total amount of travel has changed over time, women's trips to support the household activities have always occurred. However, as women have entered the workforce in greater number, the workday has pushed these trips into the peak travel periods. Today, women with children have little choice but to travel in private vehicles. Their need to combine work with household and family responsibilities makes it likely that they will make one or more stops on the way between work and home.

Although women's participation in the labor force has been rising, men's and women's jobs are not equal. Women's jobs are more concentrated in retail and service jobs, that are often lower paid, and are spatially distributed in many locations close to residential areas. Because they are closer to home may be a significant factor in the decision to assign these responsibilities to the woman in two-worker households. And visa versa, the need to fulfill these responsibilities may affect women's decisions on choices of work and occupation. Our expectations of how family needs are to be met are also part of our social roles and expectations. These then directly affect our daily travel. These results support Martin Wachs' assertion that "travel patterns are among the most clearly 'gendered' aspects of American life."[13]

While women have made great strides and accomplishments in the last twenty years, it is likely that in the next twenty years, these "gendered" differences in our travel will continue to hold, even as we see the patterns beginning to converge. Perhaps with more women completing college, and entering more varied occupations, the resemblance of job types and pay between men and women will also result in child care patterns and family responsibilities which are more evenly divided between men and women.

No analysis has been conducted here on an important aspect: the effect of travel mode on the number, type and duration of stops. Some researchers hypothesize that people are reluctant to use

[13]Martin Wachs, "The Automobile and Gender," in *Women's Travel Issues: Proceedings from the Second National Conference*, FHWA-PL-97-024, July 1998.

public transit because they trip chain, and that it is the convenience of the private automobile that encourages it's use for commuting (including these non-work stops linked to the commute). On the other hand, some people say that the car itself, and the land-use pattern growing up with the auto, are the reason that people trip chain. Our destinations are separated by arterials and freeways, and ample parking, and a plethora of drive-through services allow, or even encourage us, to drive from stop to stop.

Current evidence suggests that the private vehicle has given us freedom to access a wide range of services, and we don't necessarily choose the closest available. So, even if services are available at our work location, or within walking distance, or if services are available within walking distance to our home, we may still make as many, or more, private vehicle trips to access specialty goods and services or to satisfy our desire for different levels of quality in the product or service.

More research is needed. Especially interesting questions on the effect of density and commuting distance on the probability of trip chaining have been raised. Nishii, Kondo, and Kitamura have also raised the importance of incorporating more information about the travel environment into analysis of trip chaining[14]. The clear next step is an analysis with a geographic component:

- density analysis using the Claritas-based data on each household record, including residential density, work-force participation, income, race, and other demographic variables
- the intriguing question on trip length and density of opportunities and the effect on trip chaining
- whether stops occur close to the home end or work end, and if difference are found by purpose, time-of-day, or other variables

In addition to these questions of the conditions of the travel environment which encourage or discourage trip chaining, further research into the conditions of the traveler, specifically looking at demographic factors as we have looked at gender and life cycle, would be useful.

[14]Kazuo Nishii, Katsunao Kondo, and Ryuichi Kitamura, "Empirical Analysis of Trip Chaining Behavior," *TRR 1203*, pp. 48 -52

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