CATCHING THE NEXT BIG WAVE: ARE THE OBSERVED BEHAVIORAL DYNAMICS OF THE BABY BOOMERS FORCING US TO RETHINK REGIONAL TRAVEL DEMAND MODELS?

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ABSTRACT
Aging American baby-boomers create a variety of new policy contexts and problems. Their changing demand for transportation services may be positive or negative depending on the preparedness of our institutions and the baby boomers' behavior. In this paper we describe this potential change in demand through an analysis of individual longitudinal histories over a long period (1989 to 2003) exploring the impacts of person-specific changes (e.g., entry to and exit from the labor force) household changes (e.g., relocation and dissolution) and land use. To do this we use the Puget Sound Transportation Panel (PSTP), which is a record of approximately 20,000 person diaries of Seattle residents that provided reports of their travel in two-days repeatedly for ten repeated contacts (waves). In the analysis we study within-household dynamics and the impact events of within-household change have on individual as well as household behavior. We employ focus groups to extract behavioral themes, Latent Class Cluster analysis to identify groups of behavior, and an array of regression models of change to identify key determinants underlying behavioral dynamics. Key findings include a need to focus on employment, heterogeneity in the impact of land uses, and a significant affect of household composition. All this implies a need for models that can handle more diverse behavior and the need to accommodate employment status and within household demographics in the forecasting models.

Keywords: Baby boomers, panel analysis, longitudinal, cluster analysis, focus groups

INTRODUCTION

Baby boomers are persons that were born between the years 1946 and 1964 and they are estimated to be approximately seventy-five million Americans. They are part of what some experts called a demographic revolution and their aging constitutes a critical public policy issue of unknown policy implications that are unprecedented in modern history. These implications may include the need for radical changes in our retirement, health care, and welfare systems and services. It is also expected to cause a major change in labor markets, banking, and stock markets. Transportation is also expecting changes that may be positive or negative depending on the preparedness of institutions. Preparedness, however, requires better understanding of the baby boomers. The character of this wave is shaped by diversity with radically different lifestyles because baby boomers live in a completely different social and economic era than their counterpart older persons, both past and present. It is also shaped by medical and technological advances that are producing increased longevity and the possibility of increased activity at later ages. That we will all have longer and healthier lives is a positive development. The good news, however, are accompanied by many worrisome issues, especially transportation issues that are the focus of this paper.

When we consider suburban living for retired baby boomers that will need to drive to services either by themselves (e.g., serving on a variety of volunteer organizations, pursuing new careers, or simply getting a job to maintain acquired habits and lifestyles) or with others (e.g., older relatives, friends, and spouses in poor health), we will also need to consider that many more persons than today will be driving in the current network at times that are less predictable. If their health does not allow driving, alternate travel means, including public and private transportation services, may be needed that are different than currently available. Unavoidably this will also increase the number of persons with special needs who will be using these services and transportation providers will need to account for that. Baby boomers' travel demand remains somewhat of a mystery and Bush (*1*) offers some information and predictions about the travel behavior of the baby boomers, concluding that they will travel more than predicted by traditional methods that do not account for cohort differences. Her analysis, although interesting and addressing the entire United States, is limited to the number of trips taken (called sojourns in her paper) and does not analyze the time allocated to activities, departure times, and traveling with other persons. Organizations that are dedicated to the present and future of older individuals are also conducting surveys to understand needs, attitudes, intentions, and behavior of baby boomers (see http://www.genpolicy.com/ and http://www.aarp.org/) and they also reach similar findings but with some uncertainty regarding future behavior due to their heterogeneous nature.

The first age group of baby boomers is only recently starting to reach retirement age. Using the first and only transportation panel survey in the U.S. we answer a few questions that shed light on the baby boomer heterogeneity in behavior and compare them to the age group of current retirees. Similarity between these two groups lends support for analyses that examine the behavior of today's retirees and, from that, extrapolate baby boomers' behavior as they start reaching retirement age. It should be noted that within the analysis here we also find senior participants of age 65 and older that are employed outside their residence and can be used as informants of baby boomer behavior as well.

In this paper we examine modeling needs using three tools. First, we examine information from four focus groups with data about baby boomers. Second, using a pattern recognition model we identify distinct behavioral groups. Then, models of the propensity to change travel behavior are used to understand determinants of change. These tools allow us to discover areas of inquiry that can help us build better models for travel demand forecasting.

THE PUGET SOUND TRANSPORTATION PANEL

The Puget Sound Transportation Panel (PSTP) was designed as a "general purpose" urban household panel survey tailored to transportation analysis. The PSTP was also created as a tracking device of changes in employment, work characteristics, household composition, vehicle availability, travel behavior and responses to changes in the transportation environment, and attitudes and values (*2, 3*). The PSTP data used here are a longitudinal record of travel behavior aiming to represent approximately 3.3 million residents (based on data from the US Census of 2000) in Seattle and its surroundings. The survey started in 1989 and continued through 2002 in the four counties (King, Kitsap, Pierce, and Snohomish) of the Puget Sound region in the Northwest corner of the continental US. In each wave, a household questionnaire and a two-day travel diary are administered by design to the same households (with replacement) and their members 15 years or older. In this way, we accumulate data on households that participated at multiple time points. Unlike more traditional transportation cross-sectional surveys, PSTP takes similar measurements (i.e., surveys) repeatedly on the same observations over time. Each wave of the PSTP includes a questionnaire that collects information on household demographics, personal social and economic circumstances, and a travel diary that records reported travel behavior on two consecutive days for each person in the recruited household that is 15 years or older, to capture driving age individual behavior. The PSTP currently has data from ten travel surveys in the years 1989, 1990, 1992, 1993, 1994, 1996, 1997, 1999, 2000, and 2002. This provides a database with unique capability in studying behavioral change as households and persons move from one life-cycle stage to another. In this way, PSTP since 1989 contains more than 1700 households at each wave. Each survey wave includes three main groups of data: household demographics, people's social and economic information, and reported travel behavior. In the travel diary each person of driving age reports every trip made during two consecutive weekdays. In subsequent contacts respondents are asked to report trips in the same weekdays as their first contact. For each wave the data are stored in three databases (files): one for the household (each record is a household), one for the person (each record is a person), and one for the trips (each record is a trip, in addition to a record indicating where the person began each day). Suitable identifiers are also included to match trips, persons, and households that belong together. Using the panel observations we can study paths of change over time and develop individual and household longitudinal histories allowing us to study in more detail individual and household changes. However, PSTP does not contain questions about intentions and it is not designed exclusively for baby boomers. For this reason a set of focus group meetings were created with participants from PSTP.

FOCUS GROUP FINDINGS AND PSTP DATA EVIDENSE

Four focus groups were organized by the Northwest Research Group (NRG) using a small sample from PSTP of the retired individuals that are 60 years or older. From these four groups themes emerged and are summarized in a brief report (*4*). In this section we use the same themes and findings, combine them with other notes from the meetings and offer additional evidence from the PSTP data either finding agreement, disagreement, or complementary information to the focus group findings. The targeted population for the focus groups are people 60 years or older that were in the labor force at some point in their life. PSRC staff identified more than 400 panel participants for recruitment. One younger (50 to 60 year old) group of baby boomers was also selected for comparison with their older counterparts in the other three focus groups. As NRG points out, the focus group participants are not a statistically representative sample of the Puget Sound population and they simply allow identification of themes for further scrutiny. The focus groups offer, however, insights about possible implications for policy and areas for further examination using more

sophisticated tools. The participants are King county (the county surrounding and including the Seattle Metropolitan area) residents that were recruited by telephone. Each participant received a 70 USD incentive to attend the focus groups and NRG called them randomly from the list PSRC generated. Recruiting was conducted in late September and early October and all focus group meetings took place on October 11th and 12th, 2004. Although there were only four focus groups and only a few of the participants meet the strict definition of a baby-boomer, past studies and the analysis here show some similarity in behavior between today's seniors that are still working and the older baby-boomers. When people are not working, however, we find differences as one would expect due to wider variety in personal arrangements and circumstances within this group of persons. Some reached early retirement and are active in organized groups and exercise clubs, and engage in regular shopping. Others cared for elderly parents or friends and when their care was no longer needed returned to part time work. Among the focus group participants we also find another group that continues working in regular full time jobs and expect to continue working even after retirement from a life long career/job. Most persons live alone but they did go through a period of living with an older relative and often caring for that person. The majority of the focus group participants feel good about their added freedom in traveling at times of their own choice. They enjoy having free time to spend with family and friends, in hobbies, and in volunteer organizations. When asked about changes and different perceptions since retirement the focus group participants made a variety of comments that offer some insight about the type of travel behavior changes one could expect. Most retirees thought that everything changed in terms of commitments and required work tasks. For example, there was a clear decrease in travel because the commute trips were gone. This change, however, took some time to get adjusted to and the long commutes were replaced by shorter shopping and personal business trips.

In summary, the idea of a *typical day* traveling is challenged by retirement which is accompanied by increased flexibility and consolidation of travel in one day. Employed baby boomers, however, cannot enjoy this flexibility and continue typical work weeks and associated travel. In terms of *cars and driving,* the majority of focus group participants are car owners, have more cars than drivers in their household, learned how to drive early in their lives, they still have a driver's license, and have no intention of either stopping driving or disposing of their vehicle(s). This was also confirmed by the PSTP data in which only 718 out of 10,612 observations do not have a valid driver's license. From among the employed, 98% have a driver's license. The average number of vehicles in the 55 to 64 group is 2.33 and in the 65 to 98 group it is 1.81. Only 341 observations have no car (84 are in the age group 55-64 and 257 in the age group 65 to 98). As mentioned earlier the baby boomers *lifestyles* differ from other retirement groups. They are active in fulltime and part time jobs and they are involved in volunteer organizations and other types of civic activities. They are also characterized by a preference for living alone. Caring for others including family members is prevalent among women that as the PSTP data confirm are 80.7% of the single adult households older than 65 years. In *information technology*, the majority of the focus group participants use the internet frequently and they have access to broadband connections (high-speed internet). They also seem to rely on the internet to reach services such as banking and shopping. A few of them mentioned the substitution effect of using the internet instead of traveling, and working baby boomers seem to use online mapping sites. Confirmation of these findings comes from the PSTP sample in which in the year 2000 approximately 41% of the seniors (65 and above) had access to the internet at home while 67% of the baby boomer group (55 to 64 years old) had such access. Both groups at that time experienced growth in technology use. *Relocation* is an important theme for baby boomers (PSTP does not provide the required data to examine this - people moving out of the study region are dropped from

the panel) and the focus group participants indicate unwillingness to leave the region. However, move into the city after retirement is a possibility for some but also moving further away from the city for others. Relocating is possibly motivated by a desire to decrease home maintenance and the expense and time required. In addition, some opt for in-house caregivers but from among the employed none planned relocation after retirement. In terms of *stress and health,* participants said it is more difficult to travel today than in the past due to congestion, speeding, aggressive and disrespectful drivers. They also believe that medical advances will help them and all enjoyed good health, they are physically fit, and many of them exercise regularly. In a *comparison with past generations* all participants pointed out many differences between them and their parents. Overall they perceive their generation as more active and "outgoing" than their parents. They are also wealthier, less thrifty, more dependent on the private automobile, and technologically savvier and able to communicate with others using modern technologies. However, they also expect later retirement ages and the need to plan ahead because they will live longer. Interestingly, the working focus group participants expect to retire when they reach "normal" retirement age (and some of them earlier) although they expect younger baby boomers to retire at later ages because "Social Security" may not be available to them and their poor financial planning will force them to continue working. Others gave different reasons for this expectation, including increased debt among the younger baby boomers and having children later in life.

ANALYSIS OF ACTIVITY AND TRAVEL PATTERNS

Before analyzing change we go through a step of pattern recognition and identification of homogeneous clusters using *latent class cluster analysis (LCCA).* This technique is described in (*5*). Six behavioral clusters are identified using as criteria variables:

- Total number of trips on the first day of the travel diary
- Total number of trips on the second day of the travel diary
- Total out-of-home activity duration on the first day of the travel diary
- Total out-of-home activity duration on the second day of the travel diary
- Number of trips car sharing on the first day of the travel diary
- Number of trips car sharing on the second day of the travel diary

Using these variables and starting from a one-cluster model we build in a sequence models with more clusters until the cluster sizes become too small to be meaningful and the difference in goodness of fit between successive models is not significant. In this way we derive six distinct patterns of behavior. A sample of these patterns is shown in Table 1.

Approximately one third of the sample is in the "traveler" group that makes the most trips per day and travels with relatives. The second large group, of again about one third of the sample, are the "loners" that make approximately 4 trips per day but no trips with relatives. Both groups spend a considerable amount of time out of home (with the loners spending about one hour more than the travelers). The third group, or approximately 15% of the sample, contains persons that make about 4 trips per day but a little less than a fourth of these trips are with relatives. We call this group the "moderates". The next two groups confirm one of the focus group findings that when people can they consolidate trips into one day and stay home the next. This group includes both employed and unemployed individuals implying that some of these persons may be taking a vacation day during the interview period. The last group are persons that stayed home for both days. The last three groups and their substantial popularity show that a typical day may no longer be a defensible approach for modeling and simulation and that we may need to examine this issue in practice.

Emphasis in this paper is given to the propensity to change using the longitudinal

nature of the data at hand. Table 2 shows the transitions taking place among the different groups between 1999 and the year 2000. The "loner" is the most stable group with very few transitions to other behaviors except to become travelers (14.5%). Similarly the "traveler" group has a high percentage of persons staying in the same group between 1999 and 2000 but more than 50% switch patterns across years. All the other groups are not "stable" between 1999 and 2000. With six groups representing behavior, Table 2 shows a remarkable movement in behavioral patterns from one year to the next.

A first pass at the data analysis showed very little change in home-based land use characteristics. In addition, studying the correlation between cluster membership change and a variety of explanatory variables, we found that changes in household composition lead to travel behavior changes. From the cluster analysis no land use variables were found significant in explaining transitions from cluster to cluster. This is most likely due to masking of small changes when clustering people together and when combining behavioral indicators. This motivates the person by person and indicator by indicator analysis that follows.

PROPENSITY TO CHANGE BEHAVIOR

In addition to the cluster memberships and switching from year to year among clusters a variety of other variables were identified as worthy of analysis. One of the analysis objectives is to find out if trip rates change over time and how they change with social and economic variables (e.g., household size, workers, and income). Trip rates, however, are also a function of other behavioral indicators (e.g., travel distances, activity time, consolidation of trips into chains and so forth). We turn our attention here to variables that are two day sums of the number of trips, total time for travel, total time to non-work travel, total amount of time at home, and trip chains. We address the travel behavior change question by studying change of behavioral indicators and their relationship with many other variables representing changes within the household, personal changes, and changes in land use characteristics (e.g., when a household moves). For each of the five variables we create regression models that use as explanatory variables each person's characteristics, household characteristics, land use indicators, and level of service measured by the presence of public transportation and distances to arterial (car-based connectivity). The regression models that we estimate account for heteroskedasticity using a Generalized Least Squares (GLS) approach. To account for the relationship among the travel behavior indicators we also build a model that examines the relationship among the regression error terms (called the Seemingly Unrelated Regression Estimation, SURE). Table 3 lists the variables used for 1077 participants in the two PSTP waves of 1999 and 2000. Land use indicators were also developed in a preliminary step using land use information from a grid of 150 meters by 150 meters raster map (*6*). To decrease the number of variables in the analysis and capture as much variance as possible in the data we select groups of variables to summarize using factor analysis employing the principal components method. In this analysis we identify a few underlying variables that explain the pattern of correlations within the large group of land use indicators. Four factors are extracted using the resident's TAZ distances from urban centers and the indicators of water presence in the vicinity of the residence (indicated as TAZF1, TAZF2, TAZF3, and TAZF4). In the regression models we use DTAZFx, which is the difference in TAZFx between the two waves and used as the explanatory variables. Another set of four factors are extracted to capture land use density and composition (number of persons, households, units, jobs, and square feet for industry, government, and commercial land use). These factors are named DENF1, DENF2, DENF3, DENF4 and their difference across years DDENFx. For the job mix variables we needed seven factors that were extracted to capture the variance in the 20 different job categories and counts within a 750 by 750 square around each residence. These factors are named DMIX1 to DMIX7 and their differences DDMIXx.

Tables 4 and 5 show the regression results using linear regression and accounting for heteroskedasticity in the error terms. A negative coefficient means the independent variable causes a decrease in the dependent variable (behavioral indicator). A positive coefficient indicates the opposite. A ratio of b/St.Er. greater that 1.96 indicates a significant effect of the variable on behavioral change at the 5% confidence level.

Change in the Number of Trips

The sample average shows a decrease by 1.23 trips in two days and a standard deviation of 4.9 trips. The regression model shows that persons in households that increase their car ownership also increase their trip making. As children grow older they also motivate an increase in trips. Increases in number of adults decreases trip making (either by sharing chores or just staying home to care for the older adults). Increasing the number of driver licenses also increases trips. Change in land use characteristics has two opposite and almost equal effects with net result no or minimal change. It is also worth noting that all the personal characteristics and change variables were not significantly different than zero (age, gender, employment, occupation).

Change in the Amount of Time for Travel

The sample average shows a decrease of approximately 21 minutes in two days and the standard deviation is approximately 110 minutes. In this regression model very few variables are significantly different than zero at the 5% confidence level (b/st.er > 1.96). However, the majority of the significant variables are land use and level of service indicators. This may point out to a change in the spatial organization of destination choices from one wave to the next and the impact the transportation network configuration has on these choices.

Change in the Number of Trip Chains

The sample average shows a decrease of 0.32 trip chains in two diary days and a standard deviation of 1.5 chains. This is not an informative regression model except for people finding a job outside home and they are decreasing their trip chaining and the confirmation that again land use and closeness to major roads is important when people attempt to consolidate trips into chains.

Change in the Amount of Time for Nonwork Travel

The sample average shows a decrease of a little over 17 minutes and standard deviation of 101 minutes. This variable is another indicator of possible change in destination choice between 1999 and 2000. In the regression model King and Kitsap residents show a decrease in this travel time by about 8 minutes per day (Snohomish and Pierce show zero change between waves). As children grow older they motivate longer travel times. The increase in adults motivates a decrease in travel times. More drivers in the house motivate longer travel times. Land use indicators show all kinds of impacts that are positive and negative.

Change in the Amount of Time at Home

The sample average shows an increase of approximately 53 minutes in two days of travel diary and a standard deviation of 497 minutes. The regression model shows those few persons that experience a move that resulted in a change of land use characteristics they also experience an increase in staying at home that is the result of two opposite forces (DTAZF1 and DDMIX1). Dropping out of the labor force causes an increase in staying at home for an average of 524.4 minutes in two days. When other people in the household join the labor force they also stay at home longer than the previous wave by an average of 109.6 minutes.

Getting a job outside the house decreases home stay by an average of 334.4 minutes in two days.

Similar findings were also encountered when studying the change in behavioral indicators between the year 2000 and 2002 with significant differences for each regression pointing out the possible volatility of these relationships. In addition, similar findings are also confirmed by the SURE estimation that allows for cross-correlation of change in the unobserved components of variance. However, regression coefficient values and significance of many variables are different between the GLS and SURE (identified by an * in Tables 4 and 5). These findings point to a few directions. First, the small change in the explanatory variables is unable to explain the changes in the dependent variables. Second, a model that allows for more complete and detailed correlations among the dependent variables is required to identify possible sequencing, or possible causality, in these changes. Third, the explanatory variables used here are not sufficient informants (e.g., attitudinal and cognitive indicators are not included in this study) of change. Fourth, the time span considered here may be too short. Unfortunately, extending the period to many more years would stretch the credibility of the land use indicators that are vintage 2000 and no land use longitudinal records were available for this study.

SUMMARY AND CONCLUSIONS

In this paper we use three analytical tools to examine the likely activity and travel behavior of baby boomers. The three tools are focus group theme extraction with descriptive analysis of data, latent class cluster analysis, and regression models estimating propensity for change in activity and travel indicators. Older and early-retiring baby boomers are not significantly different in their activity and travel behavior than other groups when one accounts for differences in factors affecting activity and travel behavior such as gender, car ownership and driver's license holding status. This enables analysis of today's seniors to be used as informants about the behavior of baby boomers when they reach seniority (see also *7*). This is particularly appropriate when employment (part time or full time) continues beyond retirement age.

Both the focus group statements and themes as well as the data analysis in this paper and an earlier report (*8*) point to a somewhat more mobile baby boomer segment that will continue using their private vehicles until they are forced into driving cessation. Even in that case, however, they may still motivate car trips as passengers with relatives and maybe friends until they are forced by context and circumstances to use door-to-door paratransit services that are costly public services or even other transit services. In fact, only the group of people that owns no car at all makes a substantial number of trips by transit. Early evidence also shows that persons 65 and older may continue to work either full time or part time and to raise children until later in life (and a confirmation of this at the national level is discussed in *7*). These trends indicate that many baby boomers will simply continue travel behavior patterns that are observed today (e.g., many trips, long distances, and departures that are spread throughout the day) but maybe for different reasons. If they are also unemployed, they will exhibit richer diversity in their behavior. All these findings are not good news for planning and policy making. An increase in population heterogeneity means a need to provide wider variety of services, possibly lower degree of predictability, and potentially the need for services that may not reach suitable economies of scale.

The analysis in this paper shows that employment is more likely to motivate a change in activity and travel behavior. Changes of the household composition such as departure of children, arrival of older adults, reallocation of tasks within the household and changes in car ownership, availability, and driving roles are also associated with a change in activity and travel patterns. Models for regional travel demand forecasting need to account for these

important determinants of travel behavior. These findings provide evidence that a more detailed analysis of changes will yield important information about changes in the lives of the baby boomers and will lead to a different set of explanatory variables to use in travel demand forecasting models. The level of service and land use indicators used here show that we need to differentiate between the two when using them as predictors of travel behavior.

Less clear from the analysis here are the spatial preferences of older individuals today and of the baby boomers. For example, we find shorter travel times and distances but we know little about specific locations, although the focus groups participants tell us they changed their destinations after retirement. In addition, the focus group findings and the data analysis show a possible increase in the freedom of scheduling travel in more desirable ways than in the past. This freedom undermines the concept of a representative day, particularly when we look at the year to year transition of behavioral patterns and may suggest a need to build multi-day models. The impact of all this on the activity space of individuals and households is unknown and most likely shows wide variance of activity spaces and an increase in the destination choice variability, which again undermines trip distributions procedures in the typical four step models and points out that replacing them with destination choice models is wise. In addition, of particular interest for active living and related analysis are questions about non-motorized travel and acquired driving habits as well as other general time allocation and traveling habits, home and work location characteristics, and places visited and the significance of these places. This has implications for neighborhood services and opportunities for the baby boomers. Although land use changes seem to be correlated with behavioral change, the lack of a substantial number of households that experience change in land use characteristics does not allow for clear conclusions about this aspect except that there are land use indicators with exactly opposite impacts on travel behavior. From a data collection standpoint we can also explore longer periods for activity-travel diaries using tracking with GPS or other technologies that decrease respondent burden and provide more information about day to day variability.

In closing, at a minimum travel demand models and travel behavior analysis need to consider more carefully employment and job type as key explanatory variables as argued already elsewhere and confirmed in this paper. Some of this information can be recovered from other agencies that are focused on labor force dynamics and could provide us with useful information. In addition, household composition that goes beyond the typical household life cycle stage analysis needs a more careful scrutiny. Finally, availability of land use data at the microscale used here (gridcells of 150 by 150 meters with informative variables included) offer a unique opportunity to test hypotheses about land use and travel behavior. Different sizes of buffers around the residence can be tested and used in regressions models. This information can also be used to build other types of geographic areas around the residence, workplace, or a variety of spatial anchors to better reflect behavior. Tracking of this type of land use information to provide a longitudinal record can provide the needed link between travel behavior, transportation level of service, and activity opportunities. In fact, we would strongly recommend future surveys to be stored in a GIS format that also contains land use information of the same vintage as the survey data.

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TABLE 1 Six Clusters in the Sample Used

Cluster modal		Number of trips in day 1	Number of trips in day 2	Total activity time in day 1	Total activity time in day 2	Carpool trips with relatives in day 1	Carpool trips with relatives in day 2
Traveler	Mean	5.68	5.59	436.53	442.51	2.55	2.65
	N	4441	4440	4422	4413	4441	4440
	SD	2.788	2.646	225.738	231.139	2.288	2.190
Loner	Mean	4.20	4.10	509.83	505.74	.02	.02
	N	4470	4469	4424	4403	4470	4469
	SD	2.281	2.268	175.698	178.484	.154	.129
Moderate	Mean	3.31	3.13	116.16	110.36	.72	.76
	N	2124	2124	2080	2069	2124	2124
	SD	1.543	1.418	84.213	80.704	1.175	1.177
Homestay B	Mean	3.99	.00	226.44	.00	1.55	.00
	N	1328	1328	1291	1328	1328	1328
	SD	2.274	.000	196.865	.000	2.148	.000
Homestay A	Mean	.00	3.95	.00	209.11	.00	1.68
	N	999	999	999	970	999	999
	SD	.000	2.205	.000	185.985	.000	2.147
Inactive	Mean	.00	.00	.00	.00	.00	.00
	N	831	831	831	831	831	831
	SD	.000	.000	.000	.000	.000	.000
Total	Mean	3.97	3.78	336.00	329.01	1.06	1.07
	N	14193	14191	14047	14014	14193	14191
	SD	2.817	2.784	256.975	262.265	1.871	1.840

TABLE 2 Change of Behavioral Pattern Between 1999 and 2000

			Cluster In 2000						Total
			Traveler	Loner	Moderate	Homestay B	Homestay A	Inactive	
Cluster In 1999	Traveler	Count	178	84	49	29	28	12	380
		% within Cluster	46.8%	22.1%	12.9%	7.6%	7.4%	3.2%	100.0%
	Loner	Count	50	208	26	29	18	15	346
		% within Cluster	14.5%	60.1%	7.5%	8.4%	5.2%	4.3%	100.0%
	Moderate	Count	17	19	43	27	20	8	134
		% within Cluster	12.7%	14.2%	32.1%	20.1%	14.9%	6.0%	100.0%
	Homestay B	Count	21	15	24	22	10	15	107
		% within Cluster	19.6%	14.0%	22.4%	20.6%	9.3%	14.0%	100.0%
	Homestay A	Count	13	12	14	12	9	9	69
		% within Cluster	18.8%	17.4%	20.3%	17.4%	13.0%	13.0%	100.0%
	Inactive	Count	2	5	8	6	6	14	41
		% within Cluster	4.9%	12.2%	19.5%	14.6%	14.6%	34.1%	100.0%
Total		Count	281	343	164	125	91	73	1077
		% within Cluster	26.1%	31.8%	15.2%	11.6%	8.4%	6.8%	100.0%

TABLE 3 Household and Person Level Variables Tested

Household Level Variables	King_9= 1 if participant resides in King County; 0 otherwise
	Kitsap_9 = 1 if participant resides in Kitsap County; 0 otherwise
	Snoho_9 = 1 if participant resides in Snohomish County; 0 otherwise
	SOV = 1 if participant is in the SOV sample; 0 otherwise
	TRANSIT = 1 if participant is in the transit sample; 0 otherwise
	LOWINC_9 = 1 if Household Income < $35,000; 0=Otherwise
	MIDINC_9 = 1 if $35,000 ≤ Household Income < $75,000; 0=Otherwise
	HHSIZE = Number of persons in household
	INVEHL_9 = 1 if an increase in household vehicles took place between 1999 and 2000; 0 otherwise
	ENVEHL_9 = 1 if no change in household vehicles took place between 1999 and 2000; 0 otherwise
	IRVEHLI_9 = 1 if increase in ratio vehicles/licenses; 0 otherwise
	DRVEHLI_9 = 1 if decrease in ratio vehicles/licenses; 0 otherwise
	INBABY_9 = 1 if increase in number of children 1-5 years old; 0 otherwise
	DNBABY_9 = 1 if decrease in number of children 1-5 years old; 0 otherwise
	INKID_9 = 1 if increase in number of children 6-17 years old; 0 otherwise
	DNKID_9 = 1 if decrease in number of children 6-17 years old; 0 otherwise
	INADUL_9 = 1 if increase in number of 18 and older; 0 otherwise
	DNADUL_9 = 1 if decrease in number of 18 and older; 0 otherwise
	INEMP_9 = 1 if increase in number of employed; 0 otherwise
	ENEMP_9 = 1 if no change in the number of employed; 0 otherwise
	INLICE_9 = 1 if increase in number of drivers with license; 0 otherwise
	ENLICE_9 = 1 if no change in the number of drivers with license; 0 otherwise
	INPUPI_9 = 1 if increase in number of students; 0 otherwise
	DNPUPI_9 = 1 if decrease in number of students; 0 otherwise
	PELAP = time elapsed since entry in PSTP
	PELAP2 = square of time elapsed since entry in PSTP
	IINCOM = 1 if increase in income; 0 otherwise
	EINCOM = 1 if no change in income; 0 otherwise
	DKINCOM = 1 if decrease in income; 0 otherwise
Person Level Variables	MALE = 1 if person is male; 0 otherwise
	Asenior = 1 if person is 50 to 64 years old; 0 otherwise
	Bsenior = 1 if person is 65 to 79 years old' 0 otherwise
	Csenior = 1 if person is 80 years and above; 0 otherwise
	EXPEMP_9 = 1 if worked outside the home in both current and previous wave; 0 otherwise
	NOVEMP_9 = 1 if started working outside the home in current wave; 0 otherwise
	QUITEMP_9 = 1 if stopped working outside the home in current wave; 0 otherwise
	EXPLICE_9= 1 if has driver's license in both current and previous wave; 0 otherwise
	NOVLICE_9= 1 if started having a driver's license in current wave; 0 otherwise
	QUITLIC_9= 1 if stopped having a driver's license in current wave; 0 otherwise
Land Use and Level of Service Indicators	INT450_9 = Count of arterial intersections per surrounding 450 by 450 meters gridcells
	INT750_9 = Count of arterial intersections per surrounding 750 by 750 meters gridcells
	PTAM75_A = Transit availability in the AM average per gridcell of surrounding 750 by 750 METERS gridcells
	PTMD75_A = Transit availability in mid-day average per gridcell of surrounding 750 by 750 METERS gridcells
	INT150_9 = Count of arterial intersections per gridcell of 150 meters
	INT450_9 = Count of arterial intersections per gridcell of surrounding areas at 450 meters
	INT750_9 = Count of arterial intersections per gridcell of surrounding areas at 750 meters
	ARTL_D_A = Distance to nearest arterial line (from each gridcell centroid)
	ARTL_I_A = Distance to nearest arterial line (from each gridcell centroid)

TABLE 4 Regression Estimates for Change in Trip, Travel Time, and Trip Chains

Difference in the number of trips

	Coeff.	Std.Err.	t-ratio	P-value
Constant	-2.42	0.523	-4.63	0.00
INVEHL_9 = 1 if vehicles increased; 0 otherwise*	1.14	0.514	2.22	0.03
INKID_9 = 1 if # of children 6-17 years old increased; 0 otherwise	2.61	1.227	2.13	0.03
INADUL_9 = 1 if increase in number of 18 and older; 0 otherwise	-3.30	1.135	-2.91	0.00
ENADUL_9 = 1 if no change in number of 18 and older; 0 otherwise	-1.05	0.660	-1.59	0.11
INLICE_A = 1 if drivers increased; 0 otherwise	3.39	0.984	3.44	0.00
ENLICE_A = 1 if no change in drivers; 0 otherwise	2.26	0.716	3.16	0.00
DTAZF1*= 1 if change in TAZ factor 1; 0 otherwise	5.26	1.342	3.92	0.00
DDMIX1= 1 if change in DMIX factor 1; 0 otherwise	-5.79	0.168	-34.48	0.00

Difference in the amount of travel time

	Coeff.	Std.Err.	t-ratio	P-value
Constant	-19.33	12.472	-1.55	0.12
MALE=1 if male; 0 otherwise	-11.49	7.191	-1.60	0.11
INVEH_9= 1 if vehicles increased; 0 otherwise	19.82	12.831	1.54	0.12
INKID_9=1 if # of children 6-17 years old increased; 0 otherwise*	48.77	21.954	2.22	0.03
INADUL_A=1 if increase in number of 18 and older; 0 otherwise	-34.66	23.076	-1.50	0.13
ENADUL_A = 1 if no change in number of 18 and older; 0 otherwise	-21.79	13.899	-1.57	0.12
INLICE_A= 1 if drivers increased; 0 otherwise*	40.55	19.910	2.04	0.04
ENLICE_A= 1 if no change in drivers; 0 otherwise	22.29	13.830	1.61	0.11
DTAZF1= 1 if change in TAZ factor 1; 0 otherwise*	120.98	37.274	3.25	0.00
DDMIX1= 1 if change in DMIX factor 1; 0 otherwise*	-165.52	5.847	-28.31	0.00
INT450_9 = # arterial intersections in 450 X 450 square meters	1.68	0.900	1.86	0.06
INT750_9= # arterial intersections in 750 X 750 square meters*	-0.78	0.375	-2.09	0.04
PTAM75_A = Transit frequency in 750 X 750 square meters	1.36	0.649	2.09	0.04

Difference in the number of trip chains

	Coeff.	Std.Err.	t-ratio	P-value
Constant	-0.15	0.089	-1.67	0.09
CSENIOR = 1 if person is 80 years and above; 0 otherwise	-0.22	0.156	-1.41	0.16
DNBABY_9=1 if children 1-5 years old decreased; 0 otherwise*	0.84	0.342	2.46	0.01
DNKID_9=1 if children 6-17 years old decreased; 0 otherwise	-0.72	0.267	-2.68	0.01
INPUPI_A=1 if students increased; 0 otherwise	0.38	0.248	1.53	0.13
NOVEMP_9=1 if the person joined the labor force; 0 otherwise	-0.60	0.260	-2.32	0.02
QUITLI_A=1 if person lost driver's license; 0 otherwise	-0.99	0.644	-1.54	0.12
DDMIX1=1 if change in DMIX factor1; 0 otherwise*	-0.82	0.405	-2.02	0.04
INT750_9=# arterial intersections in 750 X 750 square meters	0.00	0.002	-1.48	0.14

* indicates large difference between SURE and single equation GLS impacting conclusions about significance

TABLE 5 Change in the Amount of Time at Home and for Nonwork Travel

Difference in nonwork travel

	Coeff.	Std.Err.	t-ratio	P-value
Constant	-10.93	13.213	-0.83	0.41
KING_9= 1 if participant resides in King County; 0 otherwise	-16.37	6.895	-2.37	0.02
KITSAP_9= 1 if participant resides in Kitsap County; 0 otherwise	-18.76	13.240	-1.42	0.16
MIDINC_9= 1 if $35,000 ≤ Household Income < $75,000; 0=Otherwise	11.73	6.322	1.86	0.06
IINCOM_A= 1 if increase in income; 0 otherwise*	-15.33	8.445	-1.82	0.07
EINCOM_A= 1 if no change in income; 0 otherwise*	-11.59	7.729	-1.50	0.13
INKID_9=1 if children 6-17 years old increased; 0 otherwise*	42.28	19.281	2.19	0.03
DNBABY_9=1 if children 1-5 years old decreased; 0 otherwise	50.49	25.961	1.95	0.05
INADUL_A=1 if increase in number of 18 and older; 0 otherwise	-33.85	19.408	-1.74	0.08
ENADUL_A=1 in no change in 18 and older;0 otherwise	-22.55	12.375	-1.82	0.07
INLICE_A= 1 if drivers increased; 0 otherwise*	32.15	15.140	2.12	0.03
ENLICE_A= 1 if no change in drivers; 0 otherwise*	25.00	11.896	2.10	0.04
EXPEMP_9=1 in continued working; 0 otherwise	11.93	6.491	1.84	0.07
DTAZF1= 1 if change in TAZ factor 1; 0 otherwise*	214.97	39.666	5.42	0.00
DDMIX1=1 if change in DMIX factor1; 0 otherwise	-239.79	7.845	-30.56	0.00
INT450_9= # arterial intersections in 450 X 450 square meters	1.67	0.871	1.92	0.06
INT750_9=# arterial intersections in 750 X 750 square meters*	-0.78	0.363	-2.16	0.03
PTAM75_A= Transit frequency in 750 X 750 square meters*	1.15	0.610	1.89	0.06

Difference in at home stay

	Coeff.	Std.Err.	t-ratio	P-value
Constant	-93.09	55.309	-1.68	0.09
DNBABY_9=1 if children 1-5 years old decreased; 0 otherwise	-189.94	120.644	-1.57	0.12
INEMP_9= 1 if workers increased in household; 0 otherwise*	109.64	55.922	1.96	0.05
QUITEM_A=1 if stopped working; 0 otherwise	524.42	89.124	5.88	0.00
NOVEMP_9=1 if started working in 2000; 0 otherwise	-334.39	100.409	-3.33	0.00
DTAZF1= 1 if change in TAZ factor 1; 0 otherwise*	336.10	89.047	3.77	0.00
DDMIX1=1 if change in DMIX factor1; 0 otherwise*	-137.94	38.290	-3.60	0.00
PELAP_9	51.87	21.496	2.41	0.02
PELAP2_9	-3.84	1.608	-2.39	0.02

* indicates large difference between SURE and single equation GLS impacting conclusions about significance