Title

Modeling Objective Mobility: The Impact of Travel-Related Attitudes, Personality and Lifestyle on Distance Traveled

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MODELING OBJECTIVE MOBILITY: THE IMPACT OF TRAVEL-RELATED ATTITUDES, PERSONALITY AND LIFESTYLE ON DISTANCE TRAVELED

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EXECUTIVE SUMMARY

This report is one of a series of research documents produced by an ongoing study of individuals' attitudes toward travel. The data are obtained from 1,357 residents of three San Francisco Bay area neighborhoods, who work either part- or full time and commute.

The key premise of this research is as follows: although the demand for travel is, for the most part, derived from the demand to engage in spatially-separated activities (as conventional wisdom holds), travel itself has an intrinsically positive utility that contributes to the demand for it. That affinity for travel itself (partially operationalized in this study through the Travel Liking variables) varies by person, mode, and purpose of travel. The goals of this research are to better understand the factors explaining the observed variations in Travel Liking, and to understand the impact of Travel Liking on other travel-related characteristics. The key variables used in the study can be grouped into 11 categories: Objective Mobility, Perceived Mobility, Relative Desired Mobility, Travel Liking, Attitudes, Personality, Lifestyle, Excess Travel, Mobility Constraints, Travel Modifiers and Demographics.

Ultimately, structural equations models will be developed to properly account for the multiple interrelationships among these variables. As initial building blocks toward that ultimate goal, however, single-equation models are being developed for the major types of endogenous variables in the system. This report focuses on modeling Objective Mobility; companion reports focus on Perceived Mobility and Relative Desired Mobility.

Models of Objective Mobility (the amount of travel demanded) are an integral part of studying travel behavior, and are in some ways the foundation of urban transportation planning. Trip generation models (the number of trips demanded) constitute the first stage of the widely-applied four-stage regional travel demand forecasting process, and models of vehicle- or personal-kilometers traveled are also quite common. In the regional forecasting context, trip generation is generally modeled as a function of Demographic characteristics such as income, household size, and vehicle ownership. The models presented here are distinctive in their incorporation of travel-related Attitudes, Lifestyle, and Personality as explanatory variables, in addition to the traditional Demographic factors. Attitudinal variables have often been incorporated into mode choice models developed for research purposes (as opposed to regional planning/forecasting purposes). They have also occasionally been incorporated into other models of trip-making behavior. To our knowledge, however, the current study is the first to model the quantity of *total* travel demanded or generated, as a function of attitudes toward travel *itself*. The extensive and unique data we have available should provide new insight into the causes of Objective Mobility, and hopefully also provide insight into ways to improve the modeling of Objective Mobility.

For this report, linear regression models were developed for 11 dependent Objective Mobility variables. For short-distance travel these include the *log of weekly miles* (plus one) in each of the following six categories: total, personal vehicle, walking/jogging/cycling, commuting, work/ school-related, and social/recreational/entertainment purposes. For long-distance travel, we modeled the *log of yearly miles* (plus one) in each of five categories: total, social/recreational/ entertainment purposes, work/school-related purposes, personal vehicle and airplane. The log transformation is typical for distance measures, and expresses the diminishing marginal impact of distance, reducing the impact of longer distances.

The results of these Objective Mobility models must be treated with caution, for at least two reasons.

The first reason is the approximate nature of the measurement of distances traveled (especially the long-distance variables). However, the relative comparisons of Table ES-2 below are likely to be robust with respect to these measurement errors. The second, and more important, reason for caution is that the single-equation models reported here are subject to simultaneity (or endogeneity) bias due to the inclusion of variables endogenous to the entire system as explanatory variables, thereby violating the requirement of ordinary least squares regression that the explanatory variables be uncorrelated with the error term. Thus, a more rigorous analysis of the impact of an affinity for travel on actual distance traveled must await the development of the structural equations model in which simultaneity will be appropriately handled. Nevertheless, the current results are useful as preliminary indicators of the effects we are likely to see in the later analysis.

Table ES-1 (Table 13 in the text) presents a qualitative summary indicating the direction of impact of each significant variable in each model. The adjusted R^2s for the models range from 0.097 for the long-distance personal vehicle model, to 0.520 for the short-distance personal vehicle model, probably reflecting both the heterogeneity in the long-distance personal vehicle responses, and the respondents' level of comfort and familiarity with short-distance travel in a personal vehicle. The table shows that, in addition to the usual Demographic variables, our Attitude, Personality, Lifestyle, Excess Travel, and Travel Liking variables are also important to explaining the travel distance demanded in each category. For example, either the adventure seeker Personality factor or the Excess Travel indicator (or both) appears in every model except the one for commuting, with a positive impact on miles traveled in each case. While the absence from the commuting model is not especially surprising, what may be surprising is the presence of these variables in models for other "mandatory" travel, namely short- and long-distance travel for work/school-related purposes. The implication is that even mandatory travel may have a discretionary element – that those who value travel for its own sake are more likely to seek out (or create) and remain in jobs involving work-related travel, and/or to volunteer for optional work assignments involving travel.

Table ES-2 (Table 14 in the text) presents a preliminary quantification of the impacts of several of these variables on the amount of travel demanded: Travel Liking, the travel stress Attitudinal factor, the adventure seeker Personality factor, and the Excess Travel indicator. The cells of the table are the predicted number of miles traveled in the row category, when the given explanatory variable takes on the column value, and all other explanatory variables are evaluated at their sample means. The final column of the table presents the percentage change in miles traveled for someone with a higher value of the given explanatory variable, compared to someone having a reference value.

The results are intriguing – demonstrating sizable effects of the selected variables on miles traveled. For example, all else equal, people whose score on the adventure seeker factor was about one standard deviation above the mean traveled 21% more miles per week for short-distance work-related activities than those having approximately the mean score on this factor. The same people traveled 16% more miles in a personal vehicle per week, 48% more miles in an airplane per year, and 88% more miles per year for long-distance work-related activities than did their "average" counterparts. Overall, the plus-one-standard-deviation adventure-seekers traveled 21.7 more short-distance miles per week, and 1,040 more long-distance miles per year, than those of only average adventure-seeking inclinations.

The travel stress factor illustrates that the effect on distance traveled of these subjective variables is not always positive. For example, all else equal, people having a travel stress score about one standard

deviation above the mean traveled 19% (about 780) fewer miles a year for long-distance trips than those with an average travel stress score.

It can legitimately be argued that the greater amounts of travel by travel-likers and adventure-seekers are not necessarily "excess" (representing travel purely for its own sake, or for the sake of concomitant activities) – they may simply represent a logical distribution of the travel that "needs" to be done (travel required to reach desired destinations), in proportion to the extent that travel is enjoyed by the individual. For example, if one member of a household considers grocery shopping travel to be an adventure, that person is likely to be the one doing the grocery shopping for that household, without *necessarily* inventing excess grocery shopping trips (although the latter outcome is certainly a possibility as well).

However, the frequently significant impact of the Excess Travel indicator (ETI) weakens this argument. The ETI ranges from 0 to 26, where each of 13 excess travel activities is given a score of 0 if it is seldom or never done by the respondent, 1 if it is done sometimes, and 2 if it is done often. The sample mean is 8 and the standard deviation is about 4; hence someone who never engages in excess travel would fall about two standard deviations below the mean. It is relevant to take such a person as the benchmark, as representing "typical" behavior if all travel were purely derived (although part of the point is that it is not, in fact, typical for all travel to be purely derived, since the sample mean ETI is not close to 0). Table ES-2 shows that the individual with an average ETI travels between 21 and 105% more miles in the various categories than does the person with an ETI of 0. Nevertheless, although by definition an "Excess Traveler" must generate some miles that are excess, it is still unknown what proportion of the additional miles seen for Excess Travelers constitutes truly gratuitous travel, as opposed to being a consequence of natural sorting mechanisms that will allocate *needed* travel in greater amounts to those who enjoy it (and conversely, lesser amounts to those who are stressed by it).

Although the specific numbers presented here can only be viewed as tentative, the qualitative message is clear: rather than being purely mechanically generated derived from demographically-driven "needs", at least some component of travel is generated by Attitudinal and other such characteristics. That is, the travel distance demanded on the basis of traditional Demographic trip generation mechanisms (household size, number of vehicles, income) can be stretched or shrunk by non-trivial amounts depending on Attitudes, Travel Liking, Personality, and other variables. All else equal, being an adventure seeker directly translates to traveling more, and being stressed by travel directly translates to traveling less. Thus, improving our understanding of the demand for travel, and the response to policies or trends affecting that demand, requires that we better understand the role of these subjective variables in moderating the "objectively-generated" demand.

Table ES-1: Comparison of Significant Variables Across All Models

	SHORT DISTANCE						LONG DISTANCE				
	Total	Commute	Work/School	Entertainment	Personal Vehicle	Walk/Jog/Cycle	Total	Work/School	Entertainment	Personal Vehicle	Airplane

	SHORT DISTANCE						LONG DISTANCE				
	Total	**Commute**	**Work/School**	**Entertainment**	**Personal Vehicle**	**Walk/Jog/Cycle**	**Total**	**Work/School**	**Entertainment**	**Personal Vehicle**	**Airplane**
N	1308	1313	1313	1301	1308	1351	1263	1307	1298	1335	1302
R^2	0.391	0.330	0.113	0.139	0.523	0.265	0.278	0.220	0.201	0.104	0.294
Adjusted R^2	0.388	0.328	0.107	0.131	0.520	0.261	0.268	0.214	0.193	0.097	0.286
VARIABLE											
Objective Mobility											
Commute speed	+	+	+		+						
Frequency of trips or weekly miles traveled to eat a meal (SD)			+	+			+	+	+		+
Frequency of commute trips (SD)							-				-
Frequency of trips for work/school related activities (SD)								+		+	+
Frequency of trips for entertainment/social/recreational purposes (SD)							+		+	+	
Frequency of travel taking others where they need to go (SD)			+								
Weekly miles in a personal vehicle (SD)										+	
Travel Liking											
Personal vehicle (SD)						-	-		-	-	
Walking/jogging/cycling (SD)						+					
Bus (SD)	+									-	
Trips to eat a meal (SD)										-	
Entertainment/recreational/social (SD)				+							
Personal vehicle (LD)								-		+	-
Work/school-related (LD)			+					+			+
Overall travel (LD)								-			
Attitudes											
Travel stress factor score				-			-		-		-
Commute benefit factor score							-		-		-
Pro-environmental solutions factor score					-						
Travel freedom factor score					+						

	SHORT DISTANCE						LONG DISTANCE				
	Total	Commute	Work/School	Entertainment	Personal Vehicle	Walk/Jog/Cycle	Total	Work/School	Entertainment	Personal Vehicle	Airplane
Pro-high density factor score											+
Feel attached to neighborhood				+							
Lifestyle											
Frustrated factor score				-			-		-	-	-
Workaholic factor score			+						-		
Family & community-oriented factor score						-					
Status seeking factor score							-				
Personality											
Adventure seeker factor score	+		+	+	+	+	+	+			+
Organizer factor score								+			
Excess Travel											
Excess Travel indicator				+		+	+	+	+	+	
Mobility Constraints											
Percent of time a vehicle is available	+			+	+	-				+	
Limitations on flying							-		-		
Demographics											
Respondent has a driver's license							+		+		
Number of others in HH with driver's license							+				
Female	-	-						-	+		+
Age category		-		-							-
Personal income category	+	+	+	+	+		+	+	+		+
Number of personal vehicles in the HH					+						
Number of people in the household			+	-			-				
Number of people 6-15 years old in HH											-
Dummy for Concord						-	-		-	+	-
Dummy for Pleasant Hill				+		-	-		-		
Suburban	+	+			+						

Table ES-2: Preliminary Assessment of the Impacts of Selected Subjective Variables on Objective Mobility

When the corresponding **Travel Liking** variable is → the dependent variable ↓ is:	1	2	3	4	5	% change from 3 to 4
SD Entertainment	7.48	8.80	10.32	12.07	14.10	17.03
SD Walk/Jog/Cycle	1.06	2.15	3.81	6.36	10.25	66.72
LD Work/School-Related	11.40	28.69	70.13	169.40	407.21	141.55
LD Personal Vehicle	83.24	132.67	211.10	335.55	533.02	58.95
When the **Travel Stress** factor is → the dependent variable ↓ is:	-2	-1	0	1	2	% change from 0 to 1
SD Entertainment	14.82	12.97	11.33	9.89	8.61	-12.75
LD Total	6227.27	5034.89	4070.78	3291.25	2660.95	-19.15
LD Entertainment	3424.21	2482.34	1799.46	1304.37	945.42	-27.51
LD Airplane	1708.53	1310.99	1005.89	771.74	592.04	-23.28
When the **Adventure Seeker** factor is → the dependent variable ↓ is:	-2	-1	0	1	2	% change from 0 to 1
SD Total	128.41	145.34	164.49	186.14	210.62	13.16
SD Work/School-Related	3.02	3.70	4.50	5.44	6.53	20.79
SD Entertainment	8.40	9.72	11.24	12.97	14.94	15.38
SD Personal Vehicle	73.80	85.42	98.84	114.34	132.25	15.69
SD Walk/Jog/Cycle	4.17	4.79	5.49	6.26	7.14	14.22
LD Total	2534.94	3191.24	4017.41	5057.38	6366.50	25.89
LD Work/School-Related	15.18	29.20	55.38	104.25	195.47	88.24
LD Airplane	449.65	665.13	983.64	1454.45	2150.37	47.86
When the **Excess Travel indicator** is → the dependent variable ↓ is:	0	4	8	12	16	% change from 0 to 8
SD Entertainment	9.40	10.33	11.34	12.44	13.64	20.67
SD Walk/Jog/Cycle	3.98	4.71	5.53	6.48	7.57	39.00
LD Total	2535.99	3215.85	4077.88	5170.92	6556.86	60.80
LD Work/School-Related	36.18	45.64	57.52	72.42	91.11	58.99
LD Entertainment	879.54	1259.78	1804.21	2583.75	3699.91	105.13
LD Personal Vehicle	138.41	186.18	250.31	336.43	452.06	80.85

Notes: The entries in each cell are the approximate raw miles predicted from our Objective Mobility models, with all explanatory variables except the noted one evaluated at the sample means. SD = Short Distance; dependent variable units are miles/week. LD = Long-Distance; dependent variable units are miles/year.

1. INTRODUCTION

1.1 Background and Conceptual Model

This report is one of a series of research documents produced by an ongoing study of individuals' attitudes toward travel. The key premise of this research is as follows: although the demand for travel is, for the most part, derived from the demand to engage in spatially-separated activities (as conventional wisdom holds), travel itself has an intrinsically positive utility that contributes to the demand for it. That affinity for travel itself (partially operationalized in this study through the Travel Liking variables) varies by person, mode, and purpose of travel. The goals of this research are to better understand the factors explaining the observed variations in Travel Liking, and to understand the impact of Travel Liking on other travel-related characteristics. With Travel Liking being both the effect of some relationships and the cause of others, we envision it as being embedded in a structural model representing multi-directional relationships. Figure 1 illustrates our preliminary conceptual model of an individual's affinity for travel; the model will continue to be refined as the study progresses.

The key endogenous variable categories in this model are Travel Liking, Objective Mobility, Perceived Mobility, and Relative Desired Mobility (each of the variable types is described further in Section 2). We envision Travel Liking to be a function of Personality and Lifestyle characteristics, general travel-related Attitudes, Mobility Constraints, Demographic traits and the Perceived amount one travels. In turn, we hypothesize that Travel Liking affects the amount one travels (both Perceived and actual, or Objective). Individuals' Perception of their Mobility is expected to be a function of their Objective Mobility, modified by their Liking for Travel. And one's Relative Desired Mobility (whether one wishes to decrease, hold constant or increase one's travel) is viewed as a function of both current Perceived Mobility and Travel Liking.

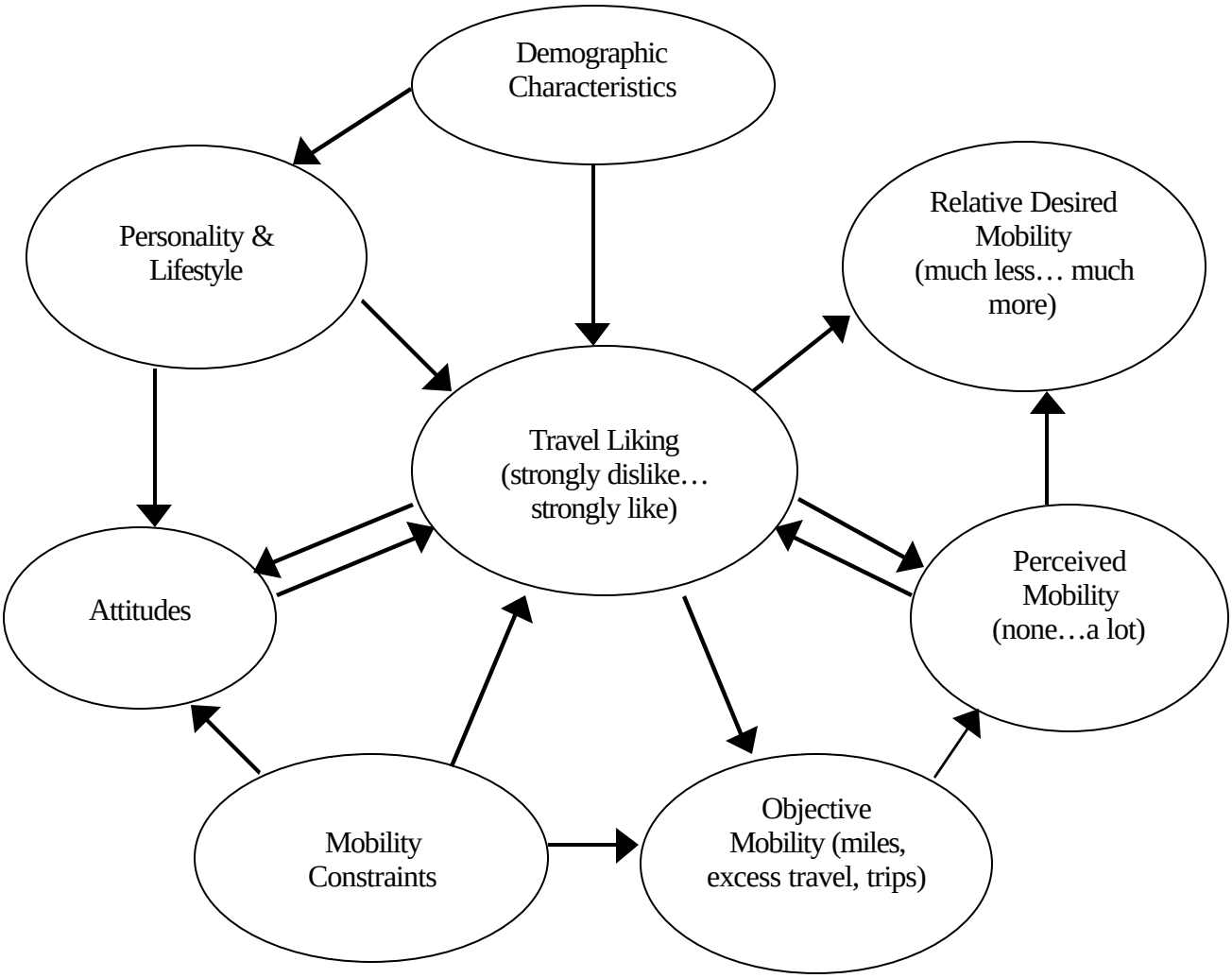
In some sense, Relative Desired Mobility is the apex of the model. As the conceptual model is currently defined, Relative Desired Mobility is directly dependent on Travel Liking and Perceived Mobility, but is not explanatory of any other variables. However in a dynamic context, Relative Desired Mobility at time *t-1* would be expected to affect Objective Mobility at time *t*.

As a reasonable simplification, Demographic characteristics and Mobility Constraints are the only truly exogenous variables in the model (Personality and Lifestyle variables are somewhat exogenous but could be influenced by the stage in one's lifecycle as indicated by Demographic traits). These variables include, for example: gender, income, age, and ability to drive at night or drive at all. These variables affect Attitudes, Personality and Lifestyle characteristics, Travel Liking and Objective Mobility, but they are not in turn, influenced by the other variables in the model.

This initial conceptual model attempts to identify the dominant causal relationships among our defined characteristics; many other relationships could be hypothesized. For instance, the argument could be made that Objective Mobility affects Travel Liking (a relationship not in the model) in that an individual who rarely travels by bus may view it as less burdensome than someone who travels by bus every day, and may therefore "like" it more. However, we are suggesting that the causal relationship from Objective Mobility to Travel Liking is mediated by Perceived Mobility. That is, regardless of the actual amount of travel, the perceived amount of travel is the direct indicator of how much an individual likes it. The person who travels every day by bus may not view that as a lot, and hence like it more

(representing a reciprocal relationship between Travel Liking and Perceived Mobility) than the person who rarely travels by bus but views that as too much as it is.

Figure 1: Conceptual Model of Individual Affinity for Travel



Two key bi-directional relationships exist in this model: between Travel Liking and Attitudes, and between Travel Liking and Perceived Mobility. For example, we could expect a negative impact of Travel Liking on Perceived Mobility (the more one likes traveling, the less burdensome it seems and a given amount may not be perceived as a lot), and also a negative impact of Perceived Mobility on Travel Liking (one reason a person may dislike the travel she is doing is because she has to do it too much). On the other hand, we would expect a positive impact of Travel Liking on Objective Mobility (the more one likes travel the more one tries to do it) and through that, an indirect positive impact on Perceived Mobility. It will be seen that these counteracting relationships are difficult to sort out in single-equation models such as those presented in this report; a more complete accounting of them must await the multiple-equations models to be developed later in the study.

1.2 The Data

The data analyzed in this study come from a fourteen-page self-administered survey mailed in May 1998 to 8000 randomly-selected households in three neighborhoods of the San Francisco Bay Area. Half of the total surveys were sent to an urban neighborhood of North San Francisco and the other half were divided evenly between the suburban cities of Concord and Pleasant Hill. These areas were chosen to represent the diverse lifestyles, land use patterns, and mobility options in the Bay Area. Approximately 2000 surveys were completed by an adult member of the household and returned, for a 25% response rate. The subset of 1357 cases used in this analysis constitutes those respondents identified as workers (part-time or full-time) who commute (using the variable "workcom" = 1).

1.3 The Context of this Report

A number of research documents have been produced by this study to date:

- Salomon and Mokhtarian (1998) review the evidence for an affinity for travel itself, and introduce the key endogenous variables described in Section 1.1 (building on the unpublished dissertation research of Hebrew University PhD student Perl Ramon).
- Mokhtarian and Salomon (forthcoming) extend the conceptual arguments for a positive utility of travel, and present some descriptive statistics from the survey data that support the existence of such a utility.
- Curry (2000) explores the relationship among Travel Liking, Perceived Mobility, and Relative Desired Mobility in several different ways.
- Redmond (2000) develops measures of Attitudes, Personality, and Lifestyle through factor analysis of multiple interrelated indicators of each concept measured by the survey, and identifies distinct clusters of individuals based on their Attitude profiles and their Personality/Lifestyle profiles.
- Redmond and Mokhtarian (2001) model Ideal Commute Time and Relative Desired Commute Amount as functions of the other appropriate variables in the conceptual model.
- Choo and Mokhtarian (2001) analyze variables related to the type of vehicle respondents drive most often.

The empirical work to date can generally be characterized as focusing on one component of the conceptual model and studying it in more detail. Ultimately, the entire model will be operationalized through developing a multiple-equation structural model representing the relationships believed to be most important. In advance of the construction of that highly complex model, however, it is important to continue to analyze simpler components as building blocks for the final model.

Current work is focused on developing single-equation models for the key endogenous variables Objective Mobility, Perceived Mobility, and Relative Desired Mobility. To facilitate the fullest possible exploration of the data, these single-equation models allow all relevant explanatory variables to enter the model, not just the ones hypothesized to *directly* influence the dependent variable as shown in Figure 1. For example, in the models of Objective Mobility, Demographic, Personality/Lifestyle, and Attitude variables are allowed to enter directly, not just indirectly through Travel Liking as shown in Figure 1. This broader exploration is important when multiple equations are not yet being estimated simultaneously, and will assist in suggesting ways to refine the conceptual model. Nevertheless, it must be pointed out that the single-equation models are subject to simultaneity bias due to the inclusion of variables endogenous to the conceptual model as explanatory variables. Thus, the single-equation results

can only be viewed as preliminary rather than definitive. However, we believe them to be quite informative, providing considerable insight into the influences on the endogenous variables of interest to this study.

This report focuses on the development of single-equation models for Objective Mobility. Companion reports are being prepared that develop single-equation models for Perceived Mobility and Relative Desired Mobility.

The organization of this report is as follows. The next section introduces the key types of variables measured by the survey and used in this study. Section 3 discusses the models and the variables that are significant in the models in greater detail. The final section summarizes and comments on the results.

2. THE VARIABLES

The key variables used in the models can be grouped into 11 categories: Objective Mobility, Perceived Mobility, Relative Desired Mobility, Travel Liking, Attitudes, Personality, Lifestyle, Excess Travel, Mobility Constraints, Travel Modifiers (not shown in the conceptual model but discussed below), and Demographics. Each category is described in general terms below; the dependent variables and specific explanatory variables that are significant in the final models will be further explained in Section 3. Descriptive statistics for all variables appearing in any of the models are found in Tables A.1 – A.3 of the Appendix.

The three mobility categories and the Travel Liking category of variables had similar structures. In each case, measures were obtained both overall and separately by purpose and mode, for short-distance and long-distance travel. Short-distance trips were defined as those of 100 miles or less, one way. The short-distance purposes measured in the survey were: commute, work/school-related travel, grocery shopping, to eat a meal, for entertainment/social/recreational activities, and for the purpose of taking others where they need to go. The short-distance modes measured were: personal vehicle, bus, train/BART/light rail and walking/jogging/bicycling. Long-distance measures were obtained for the work/school-related and entertainment/social/recreational purposes, and for the personal vehicle and airplane modes.

Objective Mobility:

These questions asked about distance and frequency of travel by mode and trip purpose, as well as travel time for the commute trip. For short-distance trips, respondents were asked how often they traveled for each purpose, with six categorical responses ranging from "never" to "5 or more times a week". Frequency of trips by mode was not obtained. Respondents were also asked to specify how many miles they traveled each week, in total and by mode and purpose.

The long-distance Objective Mobility variables come from a section of the survey in which respondents were asked how often they traveled to various parts of the globe "last year", by purpose (for entertainment and work/school-related activities) and mode (personal vehicle, airplane and other) combinations, with an "other" category to catch any remaining travel. Whereas the Objective Mobility questions for short-distance travel, and the Perceived Mobility, Travel Liking and Relative Desired Mobility questions for both short- and long-distance travel, were asked for purpose and mode separately in order to save space and reduce the burden on the respondent, in this section it was relatively convenient to ask for purpose-mode combinations. These responses indicated number of trips directly, and were also converted into approximate distances by measuring from a central position in the Bay Area to a central location within the destination region. The conversion factors used are shown in Table 1.

For a given long-distance category (total or purpose or mode-based), trips were combined across world regions to obtain three different measures of distance:

1. Total miles, the simple sum of the estimated miles for each reported trip in the category.
2. Log of miles, the natural logarithm of one plus the total number of miles in the category. One mile was added to each total so that when zero miles were actually traveled in a given category, the log transformation would return the value zero (=ln(1)) rather than $-\infty$ (=ln(0)).

3. Sum of the log-miles, obtained by taking the natural logarithm of one plus the number of miles of each trip in the category *separately*, and summing across all trips in the category.

Table 1: Long-distance Trip Frequency to Miles Traveled Conversion Factors

Region	Miles assigned to each trip
California or adjacent states (Oregon, Nevada, Arizona)	200
Other western states (Wash., Wyo., Idaho, Utah, Mont., Colorado, New Mexico)	700
Elsewhere in the US (except Alaska or Hawaii)	2000
Alaska, Canada, Mexico	3000
Central/South America, Caribbean	6000
Asia	7500
Australia, New Zealand, Pacific (including Hawaii)	5000
United Kingdom/Europe/Middle East	7300
Africa	9000

Log transformations of miles traveled are common in transportation demand modeling. They reduce the weight of longer trips, and represent a diminishing marginal impact of distance traveled (the marginal impact of 50 miles added to a 3,000-mile trip should be much smaller than the impact of 50 miles added to a 101-mile trip). As shown by the example in Section 4.1.1 of Curry (2000), the third distance measure described above (sum of log-miles) gives more weight to a larger number of trips traveling the same number of miles, compared to the second distance measure (log of total miles).

According to our conceptual model, Objective Mobility will be affected by the Mobility Constraints of the individual and Travel Liking and will, in turn, affect Perceived Mobility.

Perceived Mobility:

We are interested not only in the Objective amount an individual travels, but also in how that amount of travel is perceived. One person may consider 100 miles a week to be a lot, while another considers it minimal. For each of the same overall, purpose, and mode categories for short- and long-distance, respondents were asked to rate the amount of their travel on a five-point semantic-differential scale anchored by “none” and “a lot”.

We view Perceived Mobility as the *post hoc* filter through which individuals assess their Objective Mobility. Thus, in the models we allow Objective Mobility to affect Perceived Mobility, but not vice versa. Further, as a simplification we hypothesize that Relative Desired Mobility is affected by Perceived Mobility but not vice versa, and that (as indicated in Section 1.1) there is reciprocal causation between Travel Liking and Perceived Mobility.

Relative Desired Mobility:

An individual may consider that she travels "a lot", but want to do even more. Thus, Relative Desired Mobility refers to how much a person wants to travel compared to what she is doing now. The structure of this question mirrors the structure for Perceived Mobility, with respondents rating the amount of travel they want to do compared to the present, on a five-point scale from "much less" to "much more".

In our conceptual model Relative Desired Mobility is primarily affected by Travel Liking and Perceived Mobility.

Travel Liking:

Whether a respondent who already travels a lot wants to reduce it or do even more is likely to depend on how much he enjoys traveling. Respondents were asked to rate each of the same categories as for Perceived Mobility, on a five-point scale from "strongly dislike" to "strongly like".

Travel Liking is central to our conceptual model and interacts with all of the other characteristics in the model: it is affected by Demographics, Mobility Constraints, and Personality and Lifestyle characteristics; has a reciprocal relationship with Perceived Mobility and Attitudes; and finally, influences Objective Mobility and Relative Desired Mobility.

Attitudes:

The survey contained 32 attitudinal statements related to travel, land use, and the environment, to which individuals responded on the five-point Likert-type scale from "strongly disagree" to "strongly agree". These 32 variables were then distilled, through factor analysis (Redmond, 2000), into six underlying dimensions: travel dislike, pro-environmental solutions, commute benefit, travel freedom, travel stress, and pro-high density. These Attitude factors were then used as explanatory variables in the models.

Attitudes are directly affected by Personality and Lifestyle characteristics and Mobility Constraints, and have a reciprocal interaction with Travel Liking.

Personality:

Respondents were asked to indicate how well (on a five-point scale from "hardly at all" to "almost completely") each of 17 words and phrases described their personality. Each of these traits was hypothesized to relate in some way to one's orientation toward travel, or to reasons for wanting to travel for its own sake. These 17 attributes reduced to four personality factors: adventure seeker, organizer, loner, and the placid personality.

Lifestyle:

The survey contained 18 Likert-type scale statements relating to work, family, money, status and the value of time. These 18 questions comprised four lifestyle factors: status seeker, workaholic, family/community-oriented and a frustrated factor. These variables are expected to affect either attitudes toward travel, Travel Liking, or the Travel Modifiers described below.

Excess Travel:

Thirteen statements asked how often (on a three-point scale: "never/seldom"=0, "sometimes"=1, "often"=2) the respondent engaged in various activities that would be considered unnecessary or excess travel. The Excess Travel indicator is the sum of the responses to these statements, ranging from 0 for the respondent who never/seldom did any of them to 26 for the respondent who often did all of them. This variable can be considered an indicator of Objective Mobility, but also has a psychological flavor as indicating an enjoyment of travel beyond the purely utilitarian. The index may represent a strong desire for travel generally, or a preference for discretionary travel which may have a negative relationship with mandatory travel for such purposes as commuting and taking others where they need to go.

Mobility Constraints:

In our study, Mobility Constraints are physical or psychological limits on travel. These constraints may affect the amount an individual travels and her enjoyment of that travel. In our survey, these constraints are measured by questions concerning limitations on traveling by certain modes or at certain times of day (with ordinal response categories "no limitation", "limits how often or how long", and "absolutely prevents"), and the availability of an automobile when desired.

Travel Modifiers:

One section of the survey asked respondents if they had made, or were considering, certain choices to ease or change their travel. Previous analysis (Salomon and Mokhtarian, 1997; Mokhtarian, *et al*., 1997; Raney, *et al*., 2000) of a similar list provided in an earlier survey classified the options as *travel maintaining* strategies (such as getting a mobile phone or buying a more comfortable car), *travel reducing* strategies (such as compressed work week schedules or telecommuting), and *major lifestyle/location changes* (such as moving home and work closer together, changing to part-time work, or quitting work altogether). We expect that people who want to travel more or the same amount compared to what they are currently doing will be more likely to adopt travel maintaining strategies, whereas those who want to travel less will be more receptive to the other two types of strategies. Hence, understanding people's Relative Desired Mobility will be important to forecasting the response to policies intended to reduce travel.

These variables are being extensively analyzed in a separate stage of the project. For the models developed in the present stage, we were extremely selective in the Travel Modifying variables we allowed to enter. However, none of the Travel Modifiers were significant in the final Objective Mobility models.

Demographics:

Finally, the survey included an extensive list of Demographic variables to allow for comparison to other surveys and to Census data. A number of relationships between these variables and the key endogenous variables can be hypothesized. The Demographic variables include neighborhood and car type dummies, age, years in the U.S., education and employment information, and household information such as number of people in the household, their age group, and personal and household income.

3. THE MODELS

3.1 General Specification Issues

Linear regression models were developed for 11 dependent Objective Mobility variables. For short-distance travel this includes the *log of weekly miles* (plus one) in each of the following six categories: total, personal vehicle, walking/jogging/cycling, commuting, work/school-related, and social/recreational/entertainment purposes. For long-distance travel, we modeled the *log of yearly miles* (plus one) in each of five categories: total, social/recreational/entertainment purposes, work/school-related purposes, personal vehicle and airplane. We chose the log of the sum of the miles after trying several other transformations. As explained in Section 2, this transformation expresses the diminishing marginal impact of distance, reducing the impact of longer distances.

The multiplicity of Objective Mobility variables available necessitated some judgment regarding the appropriateness of their inclusion as *explanatory* variables in these models. For example, we considered whether it was appropriate to allow the measure of trip *frequency* in a certain category to enter the model for trip *distance* in the same category. We concluded that it was not, since frequency and distance could be considered two simultaneously determined indicators of underlying travel demand, rather than frequency sequentially determining distance. For similar reasons, short-distance mode- and purpose-specific distance (as well as frequency) variables were excluded from the model of Total Short-Distance Objective Mobility (and similarly for Total Long-Distance Objective Mobility), since it is something of a tautology to model total travel as a function of its mode and purpose constituents. We also excluded mode-specific frequency variables from models of short-distance purpose-specific distance traveled and vice versa, with similar restrictions for the long-distance models. We did, however, allow all short-distance Objective Mobility variables to enter models for Long-Distance Objective Mobility, and vice versa. We also allowed models for one purpose to include Objective Mobility variables related to other purposes, and similarly for mode. These two policies allowed substitution or complementarity effects between different kinds of travel to appear.

As mentioned in Section 2, Perceived Mobility and Relative Desired Mobility variables were excluded from the Objective Mobility models in keeping with the conceptual model of Figure 1. All other categories of variables were allowed to enter.

Initially, 120 explanatory variables were considered for inclusion in the linear regression models. While this number seems large, many of the variables represent alternate ways of measuring similar underlying constructs (such as using number of workers, number of adults, or number of children as alternate indicators of household size). Many others represent variables not often measured for models of travel behavior (such as Personality, Lifestyle, and Attitudes), that are nevertheless expected to be important.

Models of Objective Mobility (the amount of travel demanded) are an integral part of studying travel behavior, and are in some ways the foundation of urban transportation planning. Trip generation models (the number of trips demanded) constitute the first stage of the widely-applied four-stage regional travel demand forecasting process (see, e.g., Oppenheim, 1995), and models of vehicle- or personal-kilometers traveled are also quite common.

In the regional forecasting context, trip generation is generally modeled as a function of Demographic characteristics such as income, household size, and vehicle ownership. The models presented here are

distinctive in their incorporation of travel-related Attitudes, Lifestyle, and Personality as explanatory variables, in addition to the traditional Demographic factors. Attitudinal variables have often been incorporated into mode choice models developed for research purposes (as opposed to regional planning/forecasting purposes). They have also occasionally been incorporated into other models of trip-making behavior (e.g. Dobson, *et al*., 1978; Dumas and Dobson, 1979; Tischer and Phillips, 1979; Kitamura, *et al*., 1997). Those studies, however, focused on modeling numbers or shares of trips by specific modes, as a function of attitudes toward the same modes, with the logical hypothesis that positive attitudes toward a given mode will increase its use. Without modeling total travel in some way, however, such equations are at least as much mode choice models as trip generation models, since increases in the use of one mode may occur at the expense of others.

To our knowledge, the current study is the first to model the quantity of *total* travel demanded or generated, as a function of attitudes toward travel *itself* (of course, we also model distance traveled by mode, and include mode-specific travel attitudes among the explanatory variables). The extensive and unique data we have available should provide new insight into the causes of Objective Mobility, and hopefully also provide insight into ways to improve the modeling of Objective Mobility.

In the following sections, first the short-distance model results are discussed, and then the long-distance models.

3.2 Short-Distance Total Miles Per Week

This is one of the many models that illustrate the complex relationships among our variables. In this case, two variables, liking for commuting to work and the commute benefit attitudinal factor, initially entered the model with counterintuitive signs. Our expectation was that more positive attitudes toward commuting would lead to longer commutes and hence greater total short-distance miles. Instead these variables appeared with negative coefficients. Negative signs would be consistent with expectation in the *opposite* direction of causality, in which Objective Mobility affects Travel Liking rather than the converse. That is, the less I travel the more I like it, or in other words, one reason why I like my travel is that I don't have to do much of it. Since this is not the direction of causality represented by this model, however, those two variables were excluded.

As seen in Table 2, seven explanatory variables plus the constant term are significant in this model, which explains almost 39% of the variance in the log of total short-distance miles. By far the two most important explanatory variables (based on the beta coefficients) are commute speed and the suburban dummy. Together, these variables create a picture of highway use due to low density development and segregated land use patterns, leading to higher total weekly miles.

Table 2: Short-Distance Total Miles Per Week Model Results (N = 1308)

Dependent Variable	The natural log of [total weekly miles (by all modes) +1].		
Explanatory Variables	**Coefficient**	**t**	**Beta**
Constant	3.732	37.444	
Objective Mobility			
Commute speed [≥0]	0.0215	17.409	0.415
Travel Liking [1, …, 5]			
Bus travel (SD)	0.0525	2.585	0.057
Personality			
Adventure seeker factor score [-2.6, 2.7]	0.123	5.803	0.128
Mobility Constraints			

Percent of time a vehicle is available [0, 20, …, 100]	0.00252	3.156	0.075
Demographics			
Female [0,1]	-0.167	-4.259	-0.097
Personal income category [1, …, 6]	0.0895	6.330	0.150
Suburban [0,1]	0.364	8.687	0.211

SD = Short Distance LD = Long Distance [ ] = range of possible or observed responses
Adjusted R^2 =0.388 (R^2 = 0.391) F-statistic = 119.45 (p = 0.000)

Interestingly, commute speed is the only Objective Mobility variable that is significant in the final model. This variable was created using one-way commute time and distance. Higher commute speeds indicate access to a freeway. Thus, this variable is likely serving as a general supply-side indicator, specifically of the degree of network accessibility and level of service experienced by the respondent. It may also be indicating the specific relationship observed in these data, that higher commute speeds are associated with longer commute distances, which lead to greater total distance traveled. It is interesting that the explanatory power of this variable is so strong, even when controlling for a suburban residential location, suggesting that the same mechanism is at work regardless of neighborhood type.

The suburban dummy is used in those models in which the Pleasant Hill and Concord dummies have similar estimated coefficients, and can be combined into one representative "suburban" variable. The significance of this variable clearly illustrates the connection between travel and land use. In this case, as expected, living in a suburb is an indication of more weekly short-distance travel (in miles).

The rest of the Demographic and Mobility Constraint variables illustrate a similarly intuitive picture – people with higher incomes travel greater distances and the more a personal vehicle is available the more an individual travels. Further, our model shows that all else equal, men travel farther than women in an average week, a pattern found in previous studies of gender and travel.

The adventure seeking Personality type and affinity for traveling by bus are both positively related to total weekly miles, and may also both be indicating an affinity for travel in general. These variables are consistent with our expectations that the more one likes traveling, the more one travels.

3.3 Short-Distance Commute Miles Per Week

The short-distance commute model shown in Table 3 is similar to the total weekly miles model above, with a slightly lower goodness of fit (33% variance explained) and four out of the five significant variables common with the other model. Because the commute constitutes such a high percentage of the total miles traveled for the subsample of commuting workers that is analyzed in this report, it is natural that these models would be similar.

As with the total weekly miles model, commute speed is extremely significant in this model, again indicating a level of service and access to freeway travel that leads to longer commutes on average. And once again, the suburban explanatory variable is highly significant. As indicated in studies of land use and travel and, in particular, travel patterns associated with suburban development, commutes tend to be longer for those living in suburbs. The income and female variables are also similar in direction and magnitude to the model for total miles, with income positively related to commute distance and female negatively related to commute distance. However, commute distance is also a function of age, with the older age categories commuting shorter distances per week than younger age categories. This is partially a function of our inclusion of individuals working part-time as well as those working full-time, and

partially due to the age categories available in the data. Two categories, 24-40 and 41-64, dominate our data and comprise almost 94% of the responses, with one category younger than these and two older. This means that this coefficient is largely indicating that people ages 24-40 commute farther than those 41-64. This may be explained by the younger group being perhaps more likely to have two-career households, and/or to want a suburban home for their young families. We hypothesized that the relationship between age and commute distance should be more of a unimodal curve, with the youngest and oldest age groups traveling the least and the peak commute distance occurring somewhere in the 30s or 40s. However, attempted non-linear transformations of age and length of time in the U.S. did not prove to be useful.

Table 3: Short-distance Commute Miles Per Week Model Results (N = 1313)

Dependent Variable	The natural log of [total short-distance weekly commute miles +1].		
Explanatory Variables	**Coefficient**	**t**	**Beta**
Constant	3.421	25.984	
Objective Mobility [≥0]			
Commute speed	0.0303	17.176	0.422
Demographics			
Female [0,1]	-0.201	-3.581	-0.085
Age category [1, …, 5]	-0.212	-4.882	-0.116
Personal income category [1, …, 6]	0.123	6.214	0.150
Suburban [0,1]	0.482	8.110	0.203

SD = Short Distance LD = Long Distance [ ] = range of possible or observed responses
Adjusted R^2 =0.328 (R^2 = 0.330) F-statistic = 128.98 (p = 0.000)

3.4 Short-Distance Work or School-Related Miles Per Week

This dependent variable is intended to refer to the travel that is made for work or school-related activities *of the respondent*, other than commuting between home and work. However, some of the low R^2 (the lowest among the short distance models) seen in Table 4 is probably due to respondent error in answering this question. It is likely that some respondents included such trips as taking their children to school or after-school activities (which should have been classified as "taking others where they need to go") in these responses. Further, this category is very broad and many possible reasons for travel and constraints upon that travel can be imagined, making prediction and explanation more difficult. The fact that both work *and* school-related travel may be included in these responses adds further variability, as travel patterns and associated responsibilities may differ between work and school trips.

Table 4: Short-distance Work/School-Related Miles Per Week Model Results (N = 1313)

Dependent Variable	The natural log of [total weekly work and school-related miles +1].		
Explanatory Variables	**Coefficient**	**t**	**Beta**
Constant	-0.520	-2.043	
Objective Mobility			
Commute speed [≥0]	0.00672	2.456	0.066
Frequency of trips to eat a meal (SD) [1, …, 6]	0.102	2.258	0.060
Frequency of trips taking others where they need to go (SD) [1, …, 6]	0.218	6.202	0.187
Travel Liking [1, …, 5]			
For work or school-related travel (LD)	0.132	2.805	0.075
Lifestyle			
Workaholic factor score [-2.1, 2.7]	0.189	3.168	0.085
Personality			
Adventure seeker factor score [-2.6, 2.7]	0.157	3.149	0.084
Demographics			
Personal income category [1, …, 6]	0.106	3.339	0.090
Number of people in the household [1, 2, 3, …]	0.114	2.733	0.083

SD = Short Distance LD = Long Distance [ ] = range of possible or observed responses
Adjusted R^2 =0.107 (R^2 = 0.113) F-statistic = 20.68 (p = 0.000)

Eight explanatory variables plus the constant term entered this model. As in the previous two models, the Objective Mobility variable, commute speed, is positively related to work/school-related travel and should be seen as a level of service indicator. Two interesting frequency variables are significant in this model: the frequency of traveling to eat a meal and the frequency of taking others where they need to go (the latter being the most important variable in the model according to the beta coefficients), both positively related to short-distance work and school-related miles. These frequency variables may be lifestyle indicators. Traveling to eat a meal may be an indicator of a lifestyle "on the go" including many responsibilities outside of the normal routines of work and home (it could also partly be indicating the opposite direction of causality, or joint causality by an antecedent variable, with being "on the road" for work or school purposes necessitating eating out a lot). The "taking others where they need to go" variable may be significant partly due to the respondent erroneously double-counting chauffeuring trips under work/school-related travel as well. However, it may also show the juggling of work, school, and family responsibilities as days at work or school are interrupted by trips to help others. The "number of people in the household" variable has a similar interpretation.

The Travel Liking for *long-distance* work or school-related activities is positively related to the amount of *short-distance* travel for the same purpose, i.e., the more individuals like traveling long-distance for work or school-related purposes, the more they *are* traveling for work and school-related purposes within short distances. This result may be somewhat a function of our definitions of long- (greater than 100 miles) and short-distance (less than or equal to 100 miles) and the significant distances many people travel in the Bay Area. Thus the liking for "long-distance" travel in this category (which is also significant in the model for *long-distance* travel for work or school, as shown in Table 9) may be reflecting a general liking for this type of travel, with an effect spilling over into short-distance travel in the same category.

The workaholic Lifestyle factor and the adventure seeking Personality factor are both positively related to travel for work or school-related activities. The workaholic result is certainly a natural one: the person for whom work is a major priority is more likely to accept and remain in a job requiring significant travel, and more likely to accept discretionary work assignments involving travel. The adventure-seeking Personality is positively related to nearly all travel types and seems to indicate a

general affinity for travel. Finally, income has the expected positive impact on work and school-related travel.

3.5 Short-Distance Entertainment Miles Per Week

This purpose is intended to include all entertainment, recreational, and social activities – that is, to comprise the category referred to as discretionary travel. We expected discretionary travel to be the most difficult to model, because it is quite diverse and by definition is the least constrained. Indeed, the adjusted R^2 of 0.131, shown in Table 5, is among the lowest of this set of models.

As may be expected from this dependent variable, several explanatory variables that could be considered lifestyle indicators are significant in this model. The combination of a positive affinity for entertainment travel, the frequency of making trips to eat a meal and for Excess Travel, and the adventure-seeking Personality type, give the impression of a lifestyle that emphasizes entertainment travel. Likewise, if travel is generally stressful, weekly travel for such discretionary purposes as entertainment is likely to be lower.

The more frustrated an individual is, the less she travels for entertainment. The opposite direction of causality is quite plausible here (people are frustrated in part *because* they don't get out for entertainment as much as they'd like), but we left this variable in the model because it may also represent an effect of frustration on the inclination to travel, a withdrawal reaction to frustration.

This is the only model in which feeling attached to one's neighborhood is significant. The positive relationship between feeling attached to one's neighborhood and entertainment travel is probably an example of the interactive causality that exists between many of our variables. We have a case of "which came first". Both the feeling of attachment and the additional entertainment travel may be consequences of having many friends and valued activities available in the neighborhood. And given that antecedent condition, engaging in many nearby entertainment activities may strengthen the feeling of attachment, which may in turn lead to more such activities.

Table 5: Short-distance Entertainment Miles Per Week Model Results (N = 1301)

Dependent Variable	The natural log of [total miles per week for entertainment/recreational/social purposes +1].		
Explanatory Variables	**Coefficient**	**t**	**Beta**
Constant	0.917	2.978	
Objective Mobility			
Frequency of trips to eat a meal (SD) [1, …, 6]	0.147	4.388	0.119
Travel Liking [1, …, 5]			
Entertainment/recreational/social travel (SD)	0.144	3.216	0.087
Attitudes			
Travel stress factor score [-1.9, 2.9]	-0.125	-2.813	-0.083
Feel attached to neighborhood [1,2,3]	0.139	2.687	0.071
Lifestyle			
Frustrated factor score [-2.0, 2.7]	-0.109	-2.691	-0.073
Personality			
Adventure seeker factor score [-2.6, 2.7]	0.132	3.154	0.095
Excess Travel [0, …, 26]			
Excess Travel indicator	0.0214	2.476	0.072
Mobility Constraints			

Percent of time a vehicle is available [0, 20, …, 100]	0.00494	3.650	0.101
Demographics			
Personal income category [1, …, 6]	0.0751	3.138	0.087
Age category [1, …, 5]	-0.171	-3.218	-0.090
Number of people in the household [1, 2, …]	-0.0862	-3.230	-0.085
Dummy for Pleasant Hill [0,1]	0.219	2.945	0.078

SD = Short Distance LD = Long Distance [ ] = range of possible or observed responses
Adjusted R^2 =0.131 (R^2 = 0.139) F-statistic = 17.29 (p = 0.000)

The Demographic characteristics and Mobility Constraints show similarly intuitive relationships. Entertainment travel goes up with income and the availability of a personal vehicle. Entertainment travel goes down as the number of people in the household goes up, probably representing the time, travel and financial constraints that come with larger families. Interestingly, only the Pleasant Hill dummy variable is significant in this model, showing that individuals from Pleasant Hill travel more (or farther) for entertainment purposes (short-distance), all else equal, than residents of the other two neighborhoods. This is most likely a combination of the demographics of the population of Pleasant Hill (income, age) and land use, as this distance could represent either people making more trips or traveling farther to find entertainment.

Once again, age is significant with a negative sign. We tried various transformations of age and number of years in the U.S. in this model to clarify the true relationship between age and entertainment travel, and again these transformations proved either insignificant or generated inferior models. The negative sign for age indicates that individuals travel less (short-distance) for entertainment purposes as they get older. However, as arguments could reasonably be made for people traveling more at various ages – from young and relatively responsibility free, to mid-career and established and enjoying financial freedom with older families, to empty-nesters traveling and enjoying their freedom – the full relationship between this variable and travel needs to be explored further. It is noteworthy that age does *not* appear in the model for long-distance entertainment travel, suggesting that at least for that category, different circumstances at different ages may result in similar outcomes.

3.6 Short-Distance Personal Vehicle Miles Per Week

The personal vehicle model shown in Table 6 is very similar to both the commute model and the total short-distance travel model, probably because personal vehicle is the mode that dominates so much travel. In fact, six of the eight explanatory variables in the personal vehicle model are significant in one or both of the commute and total models.

Similar to the total and commute models, we find that living in a suburb and being an adventure seeker are positively related to the amount of travel in a personal vehicle. Further, income, the percent of time a vehicle is available and commute speed also have positive relationships to the dependent variable. The explanations for these relationships are similar to those given for the models of commute miles and total miles. As expected, this model is strongly influenced by the percent of time a vehicle is available.

Table 6: Short-distance Personal Vehicle Miles Per Week Model Results (N = 1308)

Dependent Variable	The natural log of [total weekly miles in a personal vehicle +1].		
Explanatory Variables	**Coefficient**	**t**	**Beta**
Constant	1.301	10.482	

Objective Mobility [≥0]			
Commute speed	0.0271	14.990	0.317
Attitudes			
Pro-environmental solutions factor score [-2.3, 2.3]	-0.133	-3.707	-0.080
Travel freedom factor score [-3.0, 2.3]	0.106	2.545	0.055
Personality			
Adventure seeker factor score [-2.6, 2.7]	0.144	4.405	0.091
Mobility Constraints			
Percent of time a vehicle is available [0, 20, …, 100]	0.0204	16.132	0.365
Demographics			
Number of personal vehicles in the household [1, 2, …]	0.0698	2.371	0.052
Personal income category [1, …, 6]	0.0934	4.656	0.095
Suburban [0,1]	0.388	5.990	0.136

SD = Short Distance LD = Long Distance [ ] = range of possible or observed responses
Adjusted R^2 =0.520 (R^2 = 0.523) F-statistic = 177.82 (p = 0.000)

The number of personal vehicles in a household is also positively related to weekly miles in a personal vehicle, a typical result in trip generation models. This may simply be another measure of vehicle availability, and/or reflecting the third-party correlation with a dispersed land use pattern that both fosters dependence on the automobile and results in greater distances traveled by personal vehicle.

Two Attitudinal variables are unique to this model – pro-environmental solutions and travel freedom. A pro-environmental attitude is negatively related to weekly miles traveled in a personal vehicle. High scores on this factor identify individuals who prioritize environmental problems and ways to resolve them, and its negative impact on personal vehicle travel is consistent with both logic and previous research. High scores on the travel freedom factor are associated with individuals who, whether for reasons of income, access, or lack of family responsibilities, feel relatively unconstrained in their travel opportunities. Logically then, the travel freedom factor is also positively associated with personal vehicle travel.

3.7 Short-Distance Walk Miles Per Week

It was important to consider personal vehicle trips because they constitute such a large share of travel and for many, really define travel. Non-vehicle trips such as walking, cycling or jogging, on the other hand, do not generally hold such a central place in local travel in the U.S. For many people, especially those in suburbs, maintenance and mandatory trips are almost never made on foot, and only discretionary and recreational travel may be conducted by walking. Nevertheless, it is of interest to identify factors associated with amounts of walk travel. In discussing this model, shown in Table 7, we will refer to "walking" for convenience, but it is important to remember that the dependent variable actually measures distance traveled by jogging or cycling as well as walking.

Table 7: Short-distance Walk Miles Per Week Model Results (N = 1351)

Dependent Variable	The natural log of [total walking/jogging/cycling miles per week +1].		
Explanatory Variables	**Coefficient**	**t**	**Beta**
Constant	0.842	4.363	
Travel Liking [1, …, 5]			
Personal vehicle travel (SD)	-0.120	-4.023	-0.096
Walking/jogging/cycling travel (SD)	0.424	14.463	0.361
Lifestyle			
Family & community-oriented factor score [-3.9, 2.1]	-0.0781	-2.215	-0.053
Personality			
Adventure seeker factor score [-2.6, 2.7]	0.114	3.645	0.092
Excess Travel [0, …, 26]			
Excess Travel indicator	0.0339	4.992	0.130
Mobility Constraints			
Percent of time a vehicle is available [0, 20, …., 100]	-0.00297	-2.722	-0.068
Demographics			
Dummy for Concord [0,1]	-0.327	-4.728	-0.125
Dummy for Pleasant Hill [0,1]	-0.152	-2.342	-0.061

SD = Short Distance LD = Long Distance [ ] = range of possible or observed responses
Adjusted R^2 =0.261 (R^2 = 0.265) F-statistic = 60.54 (p = 0.000)

This model is, not surprisingly, heavily influenced by how much an individual likes to walk. This affinity probably affects everything from where the individual chooses to live to how many vehicles the family owns. Whereas liking for walking is positively related to the amount people walk, a liking for travel by personal vehicle is negatively related to how much people walk, revealing a complementary effect and suggesting that, at least at the margin, travel-related choices (certainly mode, but also destination and frequency) among available alternatives are influenced by the relative affinities for each mode.

Walking is also shown to be positively associated with adventure seekers and excess travelers. This may be capturing those people who love to travel, but who do not exclusively associate that love with the speed or status of auto travel. All but one of the Excess Travel activities comprising the index (the exception being "travel in an off-road vehicle") could be accomplished by walking as well as by other means.

The negative impact of walking on being family and community-oriented probably reflects the spatio-temporal constraints associated with family and community responsibilities, constraints that decrease the opportunities for traveling by the slower mode of walking (whether to reach specific activities or as a recreational activity itself). Concord and Pleasant Hill residents, consistent with stereotypical suburban travel patterns, walk less than North San Francisco residents (with the difference being doubly pronounced for Concord, consistent with it having a lower density than Pleasant Hill).

Finally, although many may view not having a vehicle available 100% of the time as a burden, this may also be a choice made by those who value other travel options. It is logical that individuals who do not always have access to a vehicle walk more, but this is not necessarily a sign of a disutility or mode captivity for those individuals.

3.8 Long-Distance Total Miles Traveled Per Year

Consistent with the American Travel Survey, which periodically measures the long-distance travel of a large, representative sample of Americans, long distance was defined in our survey as greater than 100 miles one way. This definition is suited for local travel and for the purposes of discussing everyday

travel. However, it has the inevitable consequence of lumping trips between San Francisco and the Sacramento, California metropolitan area with trips from San Francisco to Thailand. Obviously these trips, while both defined as long distance, will vary significantly in who can and will make them, what constraints there are on the trip, the modes that may be used, and numerous other factors. This should be kept in mind when considering the long-distance models below. Further, where the short-distance models were for weekly travel, the long-distance models are based on yearly estimates.

In view of the diverse nature of the trips comprising total long-distance miles, it is not surprising that it required 17 variables plus the constant term to explain 27% of the variance in this variable (see Table 8). By far, the most important explanatory variable in this model is income. The higher the personal income, the more yearly long-distance travel. The other Demographic variables also have generally intuitive signs: e.g. the more driver's licenses in the household the more travel in general could be expected. Particularly with our definition of long distance (both in view of the 100-mile cutoff which allows many personal-vehicle trips to qualify as long distance, and in view of the log transformation which reduces the impact of longer trips that are more likely to be by air), the number of driver's licenses may substantially affect the long-distance travel. To balance this effect, as the number of people in the household increases, the amount of long-distance travel decreases, probably owing to both the expense of traveling long-distance with more people and the responsibilities of a family constraining the individual's travel opportunities. Not surprisingly, physical or mental limitations on flying also reduce the amount of long-distance travel that an individual does.

Table 8: Long-distance Total Miles Traveled Per Year Model Results (N = 1263)

Dependent Variable	The natural log of [total long-distance miles traveled per year (for all purposes and by all modes) +1].		
Explanatory Variables	**Coefficient**	**t**	**Beta**
Constant	7.714	9.817	
Objective Mobility			
Frequency of trips to eat a meal (SD) [1, …, 6]	0.192	3.384	0.097
Frequency of commute trips (SD) [1, …, 6]	-0.258	-2.874	-0.070
Frequency of trips for entertainment/recreational/social purposes (SD) [1, …, 6]	0.153	2.529	0.075
Travel Liking [1, …, 5]			
Personal vehicle travel (SD)	-0.195	-3.399	-0.087
Attitudes			
Travel stress factor score [-1.9, 2.9]	-0.213	-3.123	-0.088
Commute benefit factor score [-2.9, 2.6]	-0.191	-3.055	-0.083
Lifestyle			
Frustrated factor score [-2.0, 2.7]	-0.197	-2.995	-0.082
Status seeking factor score [-1.7, 2.7]	-0.142	-2.242	-0.058
Personality			
Adventure seeker factor score [-2.6, 2.7]	0.230	3.606	0.103
Excess Travel [0, …, 26]			
Excess Travel indicator	0.0594	4.591	0.125
Mobility Constraints			
Limitations on flying [1,2,3]	-0.726	-3.043	-0.075
Demographics			
Respondent has a driver's license [0,1]	1.0218	2.475	0.061
Number of others in household with driver's license [0, 1, …]	0.291	3.761	0.129
Personal income category [1, …, 6]	0.336	9.376	0.244
Number of people in the household [1, 2, …]	-0.212	-3.722	-0.130
Dummy for Concord [0,1]	-0.653	-5.087	-0.139
Dummy for Pleasant Hill [0,1]	-0.292	-2.466	-0.065

SD = Short Distance LD = Long Distance [ ] = range of possible or observed responses
Adjusted R^2 =0.268 (R^2 = 0.278) F-statistic = 28.15 (p = 0.000)

One interesting finding is that residents of Concord and Pleasant Hill travel less for long-distance than residents of North San Francisco. This may be partially a function of income and family size (incomes in North San Francisco are higher, and households are smaller than in our suburbs). But since those two variables are also in the model directly, it appears to be telling us something beyond that. It may reflect a sort of overall travel time budget, with suburban residents trading off greater short-distance travel (as indicated in Tables 2, 3, 5, and 6) for less long-distance travel, and conversely for urban residents.

The remaining explanatory variables may be, to a greater or lesser extent, Lifestyle indicators. They create a relatively consistent picture. The more an individual is an adventure seeker and excess traveler, and the more she makes short-distance trips to eat a meal or for entertainment or social purposes, the more she travels long-distance as well. Conversely, the more she commutes (and sees the benefit of the commute), is frustrated or status seeking, and experiences travel stress, the less she travels long distance. Like the suburban dummies, the commute variables probably also reflect a tradeoff between short-distance and long-distance travel, whereas the other, positively-related, short-distance variables indicate a complementary effect. It is not surprising that both mechanisms are at work, but it illustrates the complex nature of these relationships.

The interpretation of the frustrated factor score is similar to that associated with the model for short-distance entertainment miles per week shown in Table 5. The negative coefficient of status seeking is somewhat surprising, since we expected long-distance travel to be one manifestation of status. However, since the main statements comprising our status seeking factor relate to cars (with "a car is nothing more than a convenient way to get around" loading negatively, and "a car is a status symbol" loading positively) and material goods (with "the one who dies with the most toys wins" and "a lot of the fun of having something nice is showing it off" both loading positively), this score may tend to reflect the person whose priorities are home, personal luxuries, and car rather than expensive long distance travel. It is also important to realize that seeking or valuing status (which is what the factor measures) does not confer the means to achieve it. Thus, not all status seekers have the income, occupation, or lifestyle to support a lot of long-distance travel, even if that were one desired form of status.

3.9 Long-Distance Work or School-Related Miles Traveled Per Year

As mentioned before, due to our definition of long-distance travel, people may find themselves traveling "long-distance" for many activities. These activities may include any range of responsibilities, duties or opportunities through either the workplace or school. However, the respondents were explicitly asked to exclude regular commuting from this category.

As with many of the long-distance models, the most important explanatory variable in this model (Table 9) is personal income, and as expected it is positively related to total travel for long-distance work or school-related activities. The female dummy is negatively related to long-distance work/school-related activities, meaning, all else equal, that men are traveling more for work/school-related purposes – perhaps pointing to either a priority difference or a difference in education or employment opportunities between men and women.

Those who travel more for work or school-related activities tend to have the adventure seeking and organizer personality types. Other analyses of these data have shown that the organizer personality is associated with managerial occupations, and this group would naturally be expected to travel for work more than average. Presumably, someone who loves adventure is more likely to seek out opportunities to travel for work or school, and then to stay in those positions, than someone who is not adventure seeking. Similar arguments can be made to support the positive relationship between Excess Travel and long-distance work or school-related activities.

Table 9: Long-distance Work/School-Related Miles Traveled Per Year Model Results (N = 1307)

Dependent Variable	The natural log of [all long-distance work-related miles (by all modes) +1].		
Explanatory Variables	**Coefficient**	**t**	**Beta**
Constant	0.222	0.304	
Objective Mobility			
Frequency of trips to eat a meal (SD) [1, …, 6]	0.228	2.173	0.055
Frequency of trips for work/school-related activities (SD) [1, …, 6]	0.197	2.884	0.072
Travel Liking [1, …, 5]			
Personal vehicle travel (LD)	-0.382	-3.235	-0.088
Work/school-related travel (LD)	0.874	7.646	0.203
Long-distance travel overall	-0.429	-3.041	-0.090
Personality			
Adventure seeker factor score [-2.6, 2.7]	0.624	4.958	0.136
Organizer factor score [-2.9, 2.6]	0.317	2.454	0.062
Excess Travel [0, …, 26]			
Excess Travel indicator	0.0567	2.103	0.058
Demographics			
Female [0,1]	-0.635	-2.969	-0.077
Personal income category [1, …, 6]	0.756	9.966	0.264

SD = Short Distance LD = Long Distance [ ] = range of possible or observed responses
Adjusted R^2 =0.214 (R^2 = 0.220) F-statistic = 36.50 (p = 0.000)

The frequency with which short-distance trips are made for work or school-related activities and to eat a meal are also positively related to the dependent variable. We argue, once again, that these variables illustrate a lifestyle in which work or school-related activities are important (or at least frequent). Going out to eat a meal may be part of this lifestyle as late trips to the library or to work for the evening may include a stop by a restaurant for a meal. It indicates a lifestyle where more time is spent outside of the home.

Turning to the three significant Travel Liking variables, it is not surprising that a dominant liking for long-distance travel by personal vehicle results in fewer miles traveled (long distance), both since car trips will almost inevitably tend to be shorter than airplane trips, and since someone with a relative dislike for airplane travel may try to avoid work assignments involving such travel. The remaining two Travel Liking variables should be considered together. The Travel Liking for work or school-related trips reflects the expected positive relationship that the more I like travel in a certain category, the more I will do it. The negative coefficient of Travel Liking for long-distance travel overall tempers this straightforward effect. If one's overall affinity for long-distance travel is dominated by how one feels about work or school-related travel, then the values of those two variables will tend to be equal and the net effect on Objective Mobility will be the expected positive one. On the other hand, if one's affinity for long-distance travel overall is much higher than that for work or school-related travel in particular, then one is presumably more fond of long-distance entertainment travel than of long-distance work or school-related travel, and the negative net impact of the two variables on Objective Mobility is also reasonable: the more I prefer entertainment travel over work or school-related travel, the less I may try to travel for work or school-related purposes.

3.10 Long-Distance Entertainment Miles Traveled Per Year

Our use of the word "entertainment" to describe this category is shorthand for the label presented to the respondents in the survey, which was "entertainment/recreational/social (including vacation, etc.)".

The most interesting aspect of this model, shown in Table 10, is that it is one of only two Objective Mobility models where the female explanatory variable is positive, meaning that – all else equal – women travel more than men in the categories represented by the dependent variables. However, it is unclear at this point why this is so. We could be capturing the effect of young, economically independent women in San Francisco (in view of the negative suburban dummies) who are at a life stage in which they have the money, time and inclination to travel. Perhaps it indicates a different set of priorities for women compared to men with otherwise similar demographic characteristics. We could be capturing a difference in family trips: perhaps women are becoming more responsible for family vacations and taking more trips without their spouses. Or it may simply be indicating, not that women are traveling more frequently than men, but that they are traveling greater distances (which is supported by the other model in which female is positive, long-distance air travel). The question "why" still remains, however, since conventional wisdom holds that men travel greater distances than women (as in fact we find to be the case in the model for long-distance work/school-related travel). Most of the prior empirical evidence on this point, though, relates to local (short-distance) travel; much less is known about gender differences in long-distance travel, and this result points to a fascinating direction for further research.

The neighborhood dummies are also significant in this model, and are negatively related to long-distance entertainment travel. The suburban areas have a higher percentage of families and greater short-distance travel. These aspects of the suburban neighborhoods may partially explain why they travel less for entertainment purposes. Having a family may constrain the distance or frequency of travel (or both), in which case discretionary trips may be limited. And the larger amount of short-distance travel may have the effect of using up time (and inclination) for travel so that other, discretionary, long-distance trips are not as appealing.

The rest of the Demographic explanatory variables are generally intuitive. The higher the personal income, the more entertainment travel is possible. A condition which limits an individual's ability to fly will ultimately limit the total distance, if not necessarily the frequency, of long-distance travel. Such a condition may not be absolute, and hence it is interesting but not surprising that it is significant to discretionary entertainment travel but not to the more mandatory work-related travel modeled in the previous section. Having a driver's license makes travel in general and long distance travel in particular more possible.

The Objective Mobility explanatory variables that are significant in this model are the frequency of short-distance trips for social activities and the weekly miles to eat a meal. The positive relationships between these variables and the dependent variable indicate a lifestyle which prioritizes social and entertainment trips. The liking for short-distance personal vehicle trips and the Excess Travel indicator further support long-distance entertainment travel by indicating an affinity for travel in general. In contrast, the commute benefit factor score and workaholic factor score are negatively associated with long-distance entertainment travel and indicate a prioritization of work. Finally, as seen in the model for total long-distance travel, the more stress associated with travel, and the more frustrated respondents are in general, the less they travel for entertainment purposes.

Table 10: Long-distance Entertainment Miles Traveled Per Year Model Results (N = 1298)

Dependent Variable	The natural log of [all the long-distance entertainment/recreation/social miles (by all modes) +1].		
Explanatory Variables	**Coefficient**	**t**	**Beta**
Constant	4.827	6.543	
Objective Mobility			
Weekly miles traveled to eat a meal (SD) [≥0]	0.0149	3.298	0.086
Frequency of trips for entertainment/recreational/social purposes (SD) [1, …, 6]	0.334	4.916	0.133
Travel Liking [1, …, 5]			
Personal vehicle travel (SD)	-0.222	-3.077	-0.081
Attitudes			
Travel stress factor score [-1.9, 2.9]	-0.322	-3.947	-0.109
Commute benefit factor score [-2.9, 2.6]	-0.256	-3.296	-0.091
Lifestyle			
Frustrated factor score [-2.0, 2.7]	-0.276	-3.129	-0.094
Workaholic factor score [-2.1, 2.7]	-0.237	-2.527	-0.074
Excess Travel [0, …, 26]			
Excess Travel indicator	0.09897	5.773	0.156
Mobility Constraints			
Limitations on flying [1,2,3]	-0.623	-2.087	-0.053
Demographics			
Female [0,1]	0.425	3.265	0.087
Respondent has a driver's license [0,1]	1.270	2.408	0.061
Personal income category [1, …, 6]	0.264	5.637	0.157
Dummy for Concord [0,1]	-0.946	-5.961	-0.166
Dummy for Pleasant Hill [0,1]	-0.437	-2.926	-0.080

SD = Short Distance LD = Long Distance [ ] = range of possible or observed responses
Adjusted R^2 =0.193 (R^2 = 0.201) F-statistic = 23.12 (p = 0.000)

3.11 Long-Distance Personal Vehicle Miles Traveled Per Year

The adjusted R^2 for this model (shown in Table 11) is quite low. This may be due to counteracting effects of variables such as income (which may explain its lack of significance here – one of only two of these 11 models in which income does not appear) – high income may generate high personal vehicle miles in Winnebagos or driving to second homes, but low income may also generate high personal vehicle miles as people choose vacation destinations within driving distance rather than those requiring more expensive airline travel. Our definition of long-distance will further increase the heterogeneity of this category in terms of attitudes and reasons for traveling, making the variation in the dependent variable more difficult to explain.

Four Travel Liking variables are significant in this model, with the most important variable in the model being the liking for long-distance personal vehicle travel. The direction of causality for this variable is intuitively correct: the more I like to travel long distances in a personal vehicle, the more yearly miles I travel long-distance in a personal vehicle. However, this is tempered by the other three Travel Liking variables – liking for short-distance travel in a bus, in a personal vehicle, and to eat a meal – which are all negatively related to long-distance travel in a personal vehicle. These may show an income effect (particularly liking for bus and to eat a meal) or a prioritization of short-distance over long-distance travel. In particular, considering the two liking for personal vehicle travel variables together, we can see a potential tradeoff effect. If one likes personal vehicle travel equally whether it is short distance or long

distance, the net effect of those two variables will be positive as expected. However, if one likes short-distance personal vehicle travel much more than long-distance personal vehicle travel, the net impact is negative, which is also a natural result.

Table 11: Long-distance Personal Vehicle Miles Traveled Per Year Model Results (N = 1335)

Dependent Variable	The natural log of [all long-distance miles by personal vehicle, for both entertainment and work and school-related travel +1].		
Explanatory Variables	**Coefficient**	**t**	**Beta**
Constant	2.972	4.401	
Objective Mobility			
Frequency of trips for work/school -related activities (SD) [1, …, 6]	0.116	2.192	0.059
Frequency of trips for entertainment purposes (SD) [1, …, 6]	0.195	2.316	0.064
Weekly miles traveled in a personal vehicle (SD) [≥0]	0.00207	4.206	0.118
Travel Liking [1, …, 5]			
Personal vehicle travel (SD)	-0.267	-2.586	-0.079
Bus travel (SD)	-0.281	-3.322	-0.089
Travel to eat a meal (SD)	-0.257	-2.206	-0.061
Personal vehicle travel (LD)	0.462	4.997	0.148
Lifestyle			
Frustrated factor score [-2.0, 2.7]	-0.287	-3.006	-0.080
Excess Travel [0, …, 26]			
Excess Travel indicator	0.0737	3.723	0.105
Mobility Constraints			
Percent of time a vehicle is available [0, 20, …., 100]	0.0133	4.034	0.113
Demographics			
Dummy for Concord [0,1]	0.467	2.442	0.066

SD = Short Distance LD = Long Distance [ ] = range of possible or observed responses
Adjusted R^2 =0.097 (R^2 = 0.104) F-statistic = 13.98 (p = 0.000)

On the other hand, the actual miles traveled in a personal vehicle for short-distance trips, together with the other Objective Mobility variables as well as the Excess Travel indicator, suggest a *complementary* effect between short-distance and long-distance travel: the more one travels short distance, the more one also travels long distance. The fact that both tradeoff (substitution) and complementarity effects appear – in the same model, no less – is further testimony to the complexity of the relationships under study, but also testimony to the potential for sorting out some of the complexity through a rich set of variables and carefully specified models. While a single-equation model is very limited in this regard, we expect to be able to analyze these relationships even more effectively as we progress to the multiple-equation model structure described in Section 1.

The more frustrated individuals feel with their lives, the less long-distance travel they do in a personal vehicle. When this variable is significant in a model it is consistently negative, showing a negative relationship to travel in general.

Finally, the Concord dummy and the percent of time a vehicle is available are significant in this model. While residents of North San Francisco and Pleasant Hill travel more by air than Concord residents, all else equal (see next model), residents of Concord travel farthest by personal vehicle for long-distance

travel. Vehicle availability has the logical positive sign in this model – the more a vehicle is available, the farther an individual drives for long-distance travel.

3.12 Long-Distance Air Miles Traveled Per Year

This dependent variable includes all air travel over 100 miles, whether between San Francisco and Los Angeles or between San Francisco and Bangkok. With this broad a definition, the ability of the model (Table 12) to explain 30% of the variation in long-distance air travel is fairly impressive.

Several Demographic characteristics immediately stand out as interesting in this model. First, as with many other models, personal income is a very important predictor of air travel – the most important variable in the model. Second, in contrast to the personal vehicle model, residents of Concord travel the least by air, all else equal. And third, this is the second model in which the female variable is positive, so women tend to travel more for entertainment purposes (long distance) and by air than men. The final two Demographic variables are age of respondent and number of people in the household 6-15 years old. The household composition should obviously affect the amount of air travel that is possible, and having children in school is a limiting factor on air travel. The older the respondent, the less air travel he does as well. As with previous models, we attempted several transformations of the age category variable, but none provided a better interpretation or improved the model.

The Travel Liking variables that are significant in the model are intuitive: the more I like traveling long-distances in a personal vehicle, the less I travel by airplane, and the more I like traveling long-distance for work or school-related activities, the more I travel in an airplane.

The frequency of short-distance travel by various purposes shows a similar lifestyle tendency as in the model for work/school-related travel: the more I go out to eat a meal or travel for work or school related activities, the more my life exists outside the home and the more willing I am to travel by airplane. On the other hand, the more I commute the less air travel I will do. This commute prioritization is supported by the negative sign of the commute benefit factor. These could be taken together to indicate an emphasis on work and a willingness to use travel time for local commuting rather than for making air trips for those with high values on these variables. Travel stress and the frustrated Lifestyle factor are negatively associated with traveling by air (as they are in any model in which they appear), while being an adventure seeker is, once again, positively associated with long-distance travel. The high-density attitude factor is positively associated with air travel, a further indication that residents of North San Francisco travel by air more than suburban residents, all else equal.

Table 12: Long-distance Air Miles Traveled Per Year Model Results (N = 1302)

Dependent Variable	The natural log of [all long-distance miles by airplane, for both entertainment and work and school-related travel +1].		
Explanatory Variables	**Coefficient**	**t**	**Beta**
Constant	7.573	6.742	
Objective Mobility			
Frequency of trips to eat a meal (SD) [1, …, 6]	0.345	4.024	0.098
Frequency of commute trips (SD) [1, …, 6]	-0.488	-3.146	-0.075
Frequency of trips for work/school-related activities (SD) [1, …, 6]	0.139	2.452	0.060
Travel Liking [1, …, 5]			
Personal vehicle travel (LD)	-0.364	-3.896	-0.098

Work/school-related travel (LD)	0.215	2.359	0.058
Attitudes			
Travel stress factor score [-1.9, 2.9]	-0.265	-2.169	-0.062
Commute benefit factor score [-2.9, 2.6]	-0.237	-2.200	-0.058
Pro-high density factor score [-2.5, 2.3]	0.590	4.999	0.136
Lifestyle			
Frustrated factor score [-2.0, 2.7]	-0.406	-3.741	-0.095
Personality			
Adventure seeker factor score [-2.6, 2.7]	0.391	3.710	0.099
Demographics			
Female [0,1]	0.399	2.238	0.056
Age category [1, …, 5]	-0.367	-2.653	-0.067
Number of people 6-15 years old in household [0, 1, …]	-0.798	-5.470	-0.134
Personal income category [1, …, 6]	0.647	10.080	0.264
Dummy for Concord [0,1]	-1.277	-5.974	-0.154

SD = Short Distance LD = Long Distance [ ] = range of possible or observed responses
Adjusted R^2 =0.286 (R^2 = 0.294) F-statistic = 35.76 (p = 0.000)

4. DISCUSSION AND CONCLUSIONS

The adjusted R^2s for these models range from 0.097 for the long-distance personal vehicle model, to 0.520 for the short-distance personal vehicle model, probably reflecting both the heterogeneity in the long-distance personal vehicle responses (as discussed in Section 3.10), and the respondents' level of comfort and familiarity with short-distance travel in a personal vehicle. The observant reader will have noticed that several variables appear in many of the 11 models of Objective Mobility. Table 13 recapitulates the variables significant in each model, with positive and negative signs indicating the direction of influence for each variable. Of the 41 variables significant in at least one model, 17 are significant in at least half of the short- or long-distance travel models (represented by the shaded rows in Table 13). The directions of influence for these 17 explanatory variables are generally intuitive and consistent, and illustrate interesting trends.

For instance, the commute speed variable is positively related to distance traveled in four of the six short-distance models but is significant in none of the long-distance models, a natural result for this indirect indicator of local/regional accessibility and highway level of service. On the other hand, the amount of travel for short-distance purposes such as to eat a meal, for work or school-related activities, and for entertainment purposes seems to have a more consistent influence on long-distance travel. As we suggested in the discussions of the individual models, the influence of these short-distance purpose variables seems to be tied to prioritization of certain types of travel and lifestyle decisions. In general they indicate a complementary effect between short-distance and long-distance travel, as well as complementarity among short-distance travel for work or school-related purposes, entertainment, and eating a meal. Both effects are quite plausible.

The Travel Liking variables are key to the central theses of this study, that there is an intrinsic affinity for travel for its own sake (varying by individual, purpose, mode and circumstance), and that such an affinity will result in adding travel at the margin that is unnecessary or excess from the perspective of simply meeting the demand for spatially separated activities (it is not excess from the standpoint of maximizing the individual's utility). The significance of Travel Liking variables (and related variables, discussed below) in a number of these models of Objective Mobility provides empirical support for these hypotheses. Whenever liking for travel in a certain category appears in the model of Objective Mobility in that same category (entertainment and walking for short distance and work/school-related and personal vehicle travel for long distance), it has a positive sign, consistent with our expectation that people generally try to do more of things they like.

There are some natural "cross-category" relationships as well. For example, liking for long-distance work or school-related travel is positively related to Objective Mobility not only in its own category, but for long-distance airplane travel and short-distance work and school-related travel as well. In other cases the cross-category relationship is negative but also logical, suggesting some tradeoffs. For example, liking for short-distance travel in a personal vehicle has a negative impact on long-distance travel in a personal vehicle, and liking for long-distance personal vehicle travel has a negative impact on long-distance travel for work or school-related purposes and travel in an airplane.

Table 13: Comparison of Significant Variables Across All Models

	SHORT DISTANCE	LONG DISTANCE

	Total	Commute	Work/School	Entertainment	Personal Vehicle	Walk/Jog/Cycle	Total	Work/School	Entertainment	Personal Vehicle	Airplane
N	1308	1313	1313	1301	1308	1351	1263	1307	1298	1335	1302
R^2	0.391	0.330	0.113	0.139	0.523	0.265	0.278	0.220	0.201	0.104	0.294
Adjusted R^2	0.388	0.328	0.107	0.131	0.520	0.261	0.268	0.214	0.193	0.097	0.286
VARIABLE											
Objective Mobility											
Commute speed	+	+	+		+						
Frequency of trips or weekly miles traveled to eat a meal (SD)			+	+			+	+	+		+
Frequency of commute trips (SD)							-				-
Frequency of trips for work/school related activities (SD)								+		+	+
Frequency of trips for entertainment/social/recreational purposes (SD)							+		+	+	
Frequency of travel taking others where they need to go (SD)			+								
Weekly miles in a personal vehicle (SD)										+	
Travel Liking											
Personal vehicle (SD)						-	-		-	-	
Walking/jogging/cycling (SD)						+					
Bus (SD)	+									-	
Trips to eat a meal (SD)										-	
Entertainment/recreational/social (SD)				+							
Personal vehicle (LD)								-		+	-
Work/school-related (LD)			+					+			+
Overall travel (LD)								-			
Attitudes											
Travel stress factor score				-			-		-		-
Commute benefit factor score							-		-		-
Pro-environmental solutions factor score					-						
Travel freedom factor score					+						
Pro-high density factor score											+

	SHORT DISTANCE						LONG DISTANCE				
	Total	Commute	Work/School	Entertainment	Personal Vehicle	Walk/Jog/Cycle	Total	Work/School	Entertainment	Personal Vehicle	Airplane
Feel attached to neighborhood				+							
Lifestyle											
Frustrated factor score				-			-		-	-	-
Workaholic factor score			+						-		
Family & community-oriented factor score						-					
Status seeking factor score							-				
Personality											
Adventure seeker factor score	+		+	+	+	+	+	+			+
Organizer factor score								+			
Excess Travel											
Excess Travel indicator				+		+	+	+	+	+	
Mobility Constraints											
Percent of time a vehicle is available	+			+	+	-				+	
Limitations on flying							-		-		
Demographics											
Respondent has a driver's license							+		+		
Number of others in HH with driver's license							+				
Female	-	-						-	+		+
Age category		-		-							-
Personal income category	+	+	+	+	+		+	+	+		+
Number of personal vehicles in the HH					+						
Number of people in the household			+	-			-				
Number of people 6-15 years old in HH											-
Dummy for Concord						-	-		-	+	-
Dummy for Pleasant Hill				+		-	-		-		
Suburban	+	+			+						

Of the Travel Liking variables that enter the models, only the personal vehicle liking (for short-and long-distance) affects the Objective Mobility dependent variables with any regularity. This may be expected as for most individuals, the personal vehicle is the dominant mode of transportation.

The (two) Attitude and (one) Lifestyle factors that most commonly influence the dependent variables are

travel stress, commute benefit and frustrated. All three of these consistently negatively influence Objective Mobility, particularly long-distance travel. The commute benefit factor influences three long-distance models (total, entertainment, personal vehicle), but none of the short-distance models. The adventure seeker Personality factor score and Excess Travel indicator, as expected, each positively influence over half of the dependent variables studied; one or the other of these variables appears in every model except the one for commuting. While the absence from the commuting model is not especially surprising, what may be surprising is the presence of these variables in models for other "mandatory" travel, namely short- and long-distance travel for work/school-related purposes. The implication is that even mandatory travel may have a discretionary element – that those who value travel for its own sake are more likely to seek out (or create) and remain in jobs involving work-related travel, and/or to volunteer for optional work assignments involving travel.

Together, these variables provide further powerful evidence of the degree to which our travel choices are influenced by attitudes and personality, and not purely driven by a mechanical response to demographically generated needs. Traditional disaggregate models of Objective Mobility that contain only demographic (and occasionally transportation supply) variables offer a seriously incomplete picture of the factors generating a demand for travel.

Nevertheless, several of the strongest explanatory variables are in the Demographic section. Personal income appears in nine of the eleven models and, in the long-distance models, tends to carry the most explanatory weight. Personal income is always positively related to amount of travel. Female is significant in five of the models and holds several surprises. While (as expected) being female is negatively related to travel for the two short-distance travel models in which it is significant and for long-distance work or school travel, it is positively related to long-distance entertainment travel and airplane travel. This pattern may illustrate the difference between discretionary and mandatory travel, but further analysis is needed to truly understand the significance of this commonly used variable in our Objective Mobility models. The percent of time a vehicle is available has a significant influence on more than half of the models, positively affecting each except walking trips. This is further evidence of the well-known relationship that a vehicle owned is a vehicle used.

Finally, the neighborhood dummies are consistently significant. Either the Concord dummy, Pleasant Hill dummy or the suburban variable (which was used when Concord and Pleasant Hill were both significant in the model and had similar coefficients) are significant in nine of the eleven models. This seems to show the connection between land use patterns and amount of travel.

Table 14 presents a preliminary quantification of the impacts of several of these variables on the amount of travel demanded: Travel Liking, the travel stress Attitudinal factor, the adventure

Table 14: Preliminary Assessment of the Impacts of Selected Subjective Variables on Objective Mobility

When the corresponding **Travel Liking** variable is → / the dependent variable ↓ is:	1	2	3	4	5	% change from 3 to 4
SD Entertainment	7.48	8.80	10.32	12.07	14.10	17.03
SD Walk/Jog/Cycle	1.06	2.15	3.81	6.36	10.25	66.72
LD Work/School-Related	11.40	28.69	70.13	169.40	407.21	141.55
LD Personal Vehicle	83.24	132.67	211.10	335.55	533.02	58.95

When the **Travel Stress** factor is → the dependent variable ↓ is:	-2	-1	0	1	2	% change from 0 to 1
SD Entertainment	14.82	12.97	11.33	9.89	8.61	-12.75
LD Total	6227.27	5034.89	4070.78	3291.25	2660.95	-19.15
LD Entertainment	3424.21	2482.34	1799.46	1304.37	945.42	-27.51
LD Airplane	1708.53	1310.99	1005.89	771.74	592.04	-23.28
When the **Adventure Seeker** factor is → the dependent variable ↓ is:	-2	-1	0	1	2	% change from 0 to 1
SD Total	128.41	145.34	164.49	186.14	210.62	13.16
SD Work/School-Related	3.02	3.70	4.50	5.44	6.53	20.79
SD Entertainment	8.40	9.72	11.24	12.97	14.94	15.38
SD Personal Vehicle	73.80	85.42	98.84	114.34	132.25	15.69
SD Walk/Jog/Cycle	4.17	4.79	5.49	6.26	7.14	14.22
LD Total	2534.94	3191.24	4017.41	5057.38	6366.50	25.89
LD Work/School-Related	15.18	29.20	55.38	104.25	195.47	88.24
LD Airplane	449.65	665.13	983.64	1454.45	2150.37	47.86
When the **Excess Travel indicator** is → the dependent variable ↓ is:	0	4	8	12	16	% change from 0 to 8
SD Entertainment	9.40	10.33	11.34	12.44	13.64	20.67
SD Walk/Jog/Cycle	3.98	4.71	5.53	6.48	7.57	39.00
LD Total	2535.99	3215.85	4077.88	5170.92	6556.86	60.80
LD Work/School-Related	36.18	45.64	57.52	72.42	91.11	58.99
LD Entertainment	879.54	1259.78	1804.21	2583.75	3699.91	105.13
LD Personal Vehicle	138.41	186.18	250.31	336.43	452.06	80.85

Notes: The entries in each cell are the approximate raw miles predicted from our Objective Mobility models, with all explanatory variables except the noted one evaluated at the sample means. SD = Short Distance; dependent variable units are miles/week. LD = Long-Distance; dependent variable units are miles/year.

seeker Personality factor, and the Excess Travel indicator. The columns of the table represent the given explanatory variable taking on five different values. For Travel Liking, those values are simply the five points of the ordinal scale on which it was measured, coded from 1 to 5. For the two standardized factor scores, the points are 0, +/-1, and +/-2, roughly corresponding to the sample mean, and one and two standard deviations above and below the sample mean (the correspondence is not exact, since the means and standard deviations differ slightly for this subsample of the entire data set, but the integer points are chosen for convenience). For the Excess Travel indicator, the points are 0, 4, 8, 12, and 16, corresponding approximately to the sample mean (7.97) plus or minus one and two standard deviations (4.26), respectively. The cells of the table are the predicted number of miles traveled in the row category, when the given explanatory variable takes on the column value, and all other explanatory variables are evaluated at their sample means. The final column of the table presents the percentage change in miles traveled for someone with a higher value of the given explanatory variable, compared to someone having a reference value.

The results are intriguing – demonstrating sizable effects of the selected variables on miles traveled. For example, all else equal, people who "liked" long-distance personal vehicle travel (scoring 4 on the 5-point scale) covered nearly 60% more long-distance personal vehicle miles than those who were "neutral" about that type of travel (scoring 3). People who liked long-distance work/school-related trips, traveled more than twice as far as those who were neutral (the per-person distances in this category shown in Table 14 are small because they include a sizable proportion of the sample who made few or no such trips, but presenting the numbers in this way is important for understanding the relative magnitudes of each type of travel in the sample as a whole, not just among those who engage in a given type of travel).

People whose score on the adventure seeker factor was about one standard deviation above the mean traveled 21% more miles per week for short-distance work-related activities than those having approximately the mean score on this factor. The same people traveled 16% more miles in a personal vehicle per week, 48% more miles in an airplane per year, and 88% more miles per year for long-distance work-related activities than did their "average" counterparts. Overall, the plus-one-standard-deviation adventure-seekers traveled 21.7 more short-distance miles per week, and 1,040 more long-distance miles per year, than those of only average adventure-seeking inclinations.

We examined the impact of the travel stress factor to illustrate that the effect on distance traveled of these subjective variables is not always positive. For example, all else equal, people having a travel stress score about one standard deviation above the mean traveled 19% (about 780) fewer miles a year for long-distance trips than those with an average travel stress score.

It can legitimately be argued that the greater amounts of travel by travel-likers and adventure-seekers are not necessarily "excess" (representing travel purely for its own sake, or for the sake of concomitant activities) – they may simply represent a logical distribution of the travel that "needs" to be done (travel required to reach desired destinations), in proportion to the extent that travel is enjoyed by the individual. For example, if one member of a household considers grocery shopping travel to be an adventure, that person is likely to be the one doing the grocery shopping for that household, without *necessarily* inventing excess grocery shopping trips (although the latter outcome is certainly a possibility as well).

However, the frequently significant impact of the Excess Travel indicator (ETI) weakens this argument. Recall that the ETI ranges from 0 to 26, where each of 13 excess travel activities is given a score of 0 if it is seldom or never done by the respondent, 1 if it is done sometimes, and 2 if it is done often. The sample mean is 8 and the standard deviation is about 4; hence someone who never engages in excess travel would fall about two standard deviations below the mean. It is relevant to take such a person as the benchmark, as representing "typical" behavior if all travel were purely derived (although part of the point is that it is not, in fact, typical for all travel to be purely derived, since the sample mean ETI is not close to 0). Table 14 shows that the individual with an average ETI travels between 21 and 105% more miles in the various categories than does the person with an ETI of 0. Nevertheless, although by definition an "Excess Traveler" must generate some miles that are excess, it is still unknown what proportion of the additional miles seen for Excess Travelers constitutes truly gratuitous travel, as opposed to being a consequence of natural sorting mechanisms that will allocate *needed* travel in greater amounts to those who enjoy it (and conversely, lesser amounts to those who are stressed by it).

Overall, these models carry satisfactory explanatory power for disaggregate models of miles and set the stage for the structural equations models. Further, they offer intriguing insights into travel behavior by illustrating the importance of predictors (such as Attitudes, Personality and Lifestyle characteristics and Travel Liking) other than the typical Demographic characteristics in explaining travel behavior in general, and distance traveled in particular. Although the specific numbers presented here can only be viewed as tentative, the qualitative message is clear: rather than being purely mechanically generated derived from demographically-driven "needs", at least some component of travel is generated by Attitudinal and other such characteristics. That is, the travel distance demanded on the basis of traditional Demographic trip generation mechanisms (household size, number of vehicles, income) can be stretched or shrunk by non-trivial amounts depending on Attitudes, Travel Liking, Personality, and other variables. All else equal, being an adventure seeker directly translates to traveling more, and being stressed by travel directly translates to traveling less. Thus, improving our understanding of the demand for travel, and the response to policies or trends affecting that demand, requires that we better understand the role of these subjective variables in moderating the "objectively-generated" demand.

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APPENDIX:

DESCRIPTIVE STATISTICS

FOR THE VARIABLES IN THE MODELS

Table A.1: Descriptive Statistics for Dependent Variables (before log transformation)

Variable	N	Mean	Standard Deviation
Total weekly short-distance miles	1356	220.544	191.825
Weekly short-distance commute miles	1356	125.742	136.608
Weekly short-distance miles for work/school-related purposes	1350	25.190	70.598
Weekly short-distance miles for entertainment/social/recreational purposes	1350	23.848	35.441
Weekly short-distance personal vehicle miles	1356	177.056	176.666
Weekly short-distance miles walking/jogging/cycling	1356	10.468	14.801
Total yearly long-distance miles	1343	11173.492	18817.137
Yearly long-distance miles for work/school-related activities	1343	4616.902	14517.317
Yearly long-distance miles for entertainment/social/recreational purposes	1343	6401.266	8088.289
Yearly long-distance personal vehicle miles	1343	1730.975	4360.238
Yearly long-distance air miles	1343	8913.179	17925.583

Table A.2: Descriptive Statistics for Continuous Explanatory Variables

Variable	N	Missing	Mean	Standard Deviation
Objective Mobility				
Commute speed	1349[1]	3	26.457	16.794
Weekly miles in a personal vehicle (SD)	1354[1]	1	175.176	169.867
Attitudes				
Pro-environmental solutions factor score	1357	0	0.000	0.859
Travel stress factor score	1357	0	0.001	0.821
Travel freedom factor score	1357	0	0.005	0.736
Commute benefit factor score	1355[2]	0	-0.010	0.870
Pro-high density factor score	1355[2]	0	0.002	0.811
Lifestyle				
Status seeker factor score	1355[2]	0	-0.003	0.814
Frustration factor score	1357	0	0.039	0.832
Family/community related factor score	1357	0	0.072	0.749
Workaholic factor score	1357	0	0.009	0.758
Personality				
Organizer factor score	1355[2]	0	0.018	0.809
Adventure seeker factor score	1357	0	0.057	0.902
Excess Travel				
Excess Travel indicator	1357	0	7.968	4.255
Demographics				
Number of people in the household	1357	0	2.388	1.228
Number of people 6-15 years old in HH	1348[2]	7	0.239	0.591
Number of personal vehicles in the HH	1351[1]	5	1.868	1.058
Number of others in HH with driver's license	1306[2]	49	1.008	0.887

1. These variables have outliers that were removed from the analysis: Commute speed = 5 outliers, Weekly miles in a personal vehicle (SD) = 2 outliers, Number of personal vehicles in HH = 1 outlier.
2. These variables are only significant in the Long Distance models and therefore, the means are calculated only for those 1355 cases used in the LD models (2 cases were removed from these models as having outlying values on the dependent variable of interest).

Table A.3: Descriptive Statistics for Discrete Explanatory Variables

Variable (N)		Frequency	Valid Percent
Objective Mobility			
Frequency of commute trips (SD) (1355)	1-3 times a month	10	0.74
	1-2 times a week	51	3.76
	3-4 times a week	198	14.61
	5 or more times a week	1096	80.89
Frequency of trips for work/school-related activities (SD) (1355)	Never	160	11.81
	Less than once a month	279	20.59
	1-3 times a month	355	26.20
	1-2 times a week	243	17.93
	3-4 times a week	147	10.85
	5 or more times a week	171	12.62
Frequency of trips to eat a meal (SD) (1357)	Never	16	1.18
	Less than once a month	97	7.15
	1-3 times a month	361	26.60
	1-2 times a week	598	44.07
	3-4 times a week	208	15.33
	5 or more times a week	77	5.67
Frequency of trips for entertainment/recreation/social activities (SD) (1355)	Never	4	0.30
	Less than once a month	75	5.54
	1-3 times a month	375	27.68
	1-2 times a week	564	41.62
	3-4 times a week	254	18.75
	5 or more times a week	83	6.13
Frequency of trips taking other people where they need to go (SD) (1357)	Never	230	16.95
	Less than once a month	376	27.71
	1-3 times a month	326	24.02
	1-2 times a week	219	16.14
	3-4 times a week	104	7.66
	5 or more times a week	102	7.52
Travel Liking			
Personal vehicle travel (SD) (1357)	Strongly dislike	33	2.43
	Dislike	125	9.21
	Neutral	410	30.21
	Like	647	47.68
	Strongly like	142	10.46

Variable (N)		**Frequency**	**Valid Percent**
Travel by bus (SD) (1357)	Strongly dislike	389	28.67
	Dislike	473	34.86
	Neutral	384	28.30
	Like	103	7.59
	Strongly like	8	0.59
Walking/jogging/bicycling travel (SD) (1357)	Strongly dislike	54	3.98
	Dislike	66	4.86
	Neutral	332	24.47
	Like	663	48.86
	Strongly like	242	17.83
Travel to eat a meal (SD) (1355)	Strongly dislike	14	1.03
	Dislike	93	6.86
	Neutral	715	52.77
	Like	480	35.42
	Strongly like	53	3.91
Entertainment/recreation/social travel (SD) (1357)	Strongly dislike	5	0.37
	Dislike	66	4.86
	Neutral	543	40.01
	Like	605	44.58
	Strongly like	138	10.17
Overall travel (LD) (1355)	Strongly dislike	18	1.33
	Dislike	118	8.71
	Neutral	368	27.16
	Like	670	49.45
	Strongly like	181	13.36
For work/school-related activities (LD) (1357)	Strongly dislike	152	11.20
	Dislike	331	24.39
	Neutral	576	42.45
	Like	267	19.68
	Strongly like	31	2.28
Personal vehicle travel (LD) (1355)	Strongly dislike	46	3.39
	Dislike	211	15.57
	Neutral	420	31.00
	Like	562	41.48
	Strongly like	116	8.56
Attitudes			
Feel attached to neighborhood (1342)	Yes	697	51.94
	Somewhat	535	39.87
	No	110	8.20
Mobility Constraints			

Variable (N)		**Frequency**	**Valid Percent**
Percent of time a vehicle is available (1352)	0	65	4.81
	20	34	2.51
	40	17	1.26
	60	10	0.74
	80	62	4.59
	100	1164	86.09
Limitations on flying (1353)	No limitation	1314	97.12
	Limits how often or how long	33	2.44
	Absolutely prevents	6	0.44
Demographics			
Female (1351)	No	660	48.85
	Yes	691	51.15
Age category (1356)	23 or younger	44	3.24
	24-40	584	43.07
	41-64	685	50.52
	65-74	28	2.06
	75 or older	15	1.11
Personal income category (1326)	Less than $15,000	96	7.24
	$15,00 - $34,999	282	21.27
	$35,000 - $54,999	405	30.54
	$55,000 - $74,999	241	18.17
	$75,000 - $94,999	132	9.95
	$95,000 or more	170	12.82
Respondent has driver's license (1353)	No	18	1.33
	Yes	1335	98.67
Dummy for Pleasant Hill (1357)	No	988	72.81
	Yes	369	27.19
Dummy for Concord (1357)	No	1039	76.57
	Yes	318	23.43
Suburban (1357)	No	670	49.37
	Yes	687	50.63