DETERMINANTS OF SUBJECTIVE ASSESSMENTS OF PERSONAL MOBILITY

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EXECUTIVE SUMMARY

This report is one of a series of research documents produced by an ongoing study of individuals' mobility and attitudes toward travel. The data are obtained from 1,358 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 causes and effects of that affinity for travel. The key variables used in the study can be grouped into 11 categories: Objective Mobility, Subjective 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 inherent endogeneity of some of 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 Subjective Mobility; companion reports focus on Objective Mobility and Relative Desired Mobility.

Linear regression models were developed for 10 dependent Subjective Mobility variables, representing the qualitative assessment of various kinds of travel on a five-point ordinal scale from "none" to "a lot". For short-distance travel the categories modeled include Subjective Mobility for travel overall, the commute to work/school, for work/school-related reasons, for entertainment/recreation/social reasons, and by personal vehicle. For long-distance travel, we modeled Subjective Mobility for travel overall, for work/school-related reasons, for entertainment/recreation/social purposes, by personal vehicle and by airplane.

Subjective Mobility is the result of a process though which people filter their actual amounts of travel. Actual mobility can be measured in terms of frequency of trips, average trip distance, total distance traveled, and total travel time. One main purpose of this study is to understand how these various measures are woven together to construct people's subjective assessments of their actual mobility. A second main purpose is to identify other factors that magnify or diminish individuals' subjective assessments of their mobility, after controlling for their objective levels of mobility.

Understanding people's perception of their own mobility provides new insight that may improve our models of objective travel behavior. If we know that one kind of person views 100 km/week as a "little" travel while another views it as a "lot", we might expect the former type of person to be inclined to maintain or even increase her travel (and hence, for example, not to be receptive to policies intended to motivate travel reduction, all else equal), while the latter type may be more inclined to decrease it. It then becomes relevant to characterize the people that tend to exaggerate their perceptions of Objective Mobility, compared to those who tend to minimize them.

Table ES-1 (Table 12 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

0.211 for the long-distance entertainment/recreation/social model, to 0.415 for the long-distance airplane model. The table shows that, in addition to the actual amount of travel, Demographic variables, Attitudes, Personalities, Lifestyles, Excess Travel characteristics, and Travel Liking variables are also important to explaining individuals' Subjective Mobility in each category. To our knowledge, this is the first study involving the modeling of mobility perception, incorporating all these types of individuals' characteristics.

The natural expectation that Objective Mobility would be an important determinant of Subjective Mobility is confirmed in this study. Every model is led by one or (more often) several explanatory variables indicative of Objective Mobility for the specific context given by the dependent variable. In nearly every case, variables representing both trip frequency and total distance are significant, suggesting that both these measures of Objective Mobility are important to individuals' assessment of their Subjective Mobility. Some secondary Objective Mobility variables are usually found, which convey illustrative information regarding lifestyles and demographics.

The proportion of the full model R^2 that can be attributed to Objective Mobility variables (denoted as R^2_{OM}) ranges from 0.34 and 0.69 (lower and upper bound, respectively, for long-distance entertainment/recreation/social) to 0.94 and 0.98 (for short-distance work/school related). The lower-bound contribution of Objective Mobility exceeded 50% of the variance explained in at least seven out of the 10 models estimated (and exceeded 50% in all 10, if the midpoint between the lower and upper bounds is taken as the contribution). As a general trend, the higher the original model R^2, the higher the proportion of that explained variance that is attributable to Objective Mobility. These results are presented in Table ES-1.

Travel Liking variables appeared in all the models and exhibited the greatest complexity in terms of interpretation. Although our initial hypothesis was that Travel Liking would have a negative impact on Subjective Mobility, we found this to be the case for only one model out of 10: the one for commuting. Upon further reflection, we identified two plausible ways in which the effect could be positive. First, Travel Liking (through its positive link to Objective Mobility) may be indirectly capturing some of the positive effect of Objective Mobility on Subjective Mobility. Second, it may well be that the liking for a certain type of travel *enhances* rather than *diminishes* the awareness of that travel. Thus, we suggest that, theoretically, Subjective Mobility increases when we move to either extreme of the Travel Liking scale. This hypothesis was tested by including quadratic Travel Liking terms in the model specifications. While these quadratic terms proved significant in most of the models, models containing them were adopted only when doing so clearly improved a model's goodness-of-fit and interpretability. This situation was found only in the models for short-distance overall, commute and personal vehicle Subjective Mobility; however, the fact that the quadratic relationship was found at all is intriguing.

Casual observation of Table ES-1 may lead one to believe that individuals' attitudinal traits are not important in modeling Subjective Mobility. One must realize however that the Travel Liking variables in fact represent travel-related (affective) attitudes. In view of the central role of these variables in our results, we argue that attitudes are actually extremely important in predicting Subjective Mobility.

Some of the traditional demographic variables used in transportation models, such as age and sex, showed little impact on mobility perception. The incorporation of personal vehicle-related information (vehicle type, percentage of the time a vehicle is available), on the other hand, yielded interesting results. Vehicle-related variables proved important in predicting perception, either directly (e.g. driving a mid-sized vehicle tends to reduce the perception of overall short-distance mobility, perhaps because of its comfort and practicality) or indirectly (e.g. driving a minivan may point to some lifestyle characteristics that in turn affect perception). The fact that such variables repeatedly appeared in the results was a clear indication that vehicle type influences one's subjective assessment of mobility. Interestingly, none of the variables characterizing the personal vehicle appear in the model for the perception of short-distance travel by personal vehicle, which suggests that the role of vehicle type in molding perceptions is related to particular trip purposes. There is also an association of specific vehicle types with local versus long-distance travel: vehicle type dummy variables related specifically to *cars* (compact, mid-sized, and large) affect only models for short-distance Subjective Mobility, while the long-distance models show only SUV and van/minivan vehicle-type dummy variables.

We identified a number of factors influencing individuals' perceptions of their amount of travel upward and downward, holding the objective amount of travel constant, and several cognitive mechanisms are proposed to account for those factors. Some of the mechanisms identified have a magnifying effect on Subjective Mobility; those are summarized in Table ES-2 (Table 13 in the text). These mechanisms fall mainly into two groups: those contributing to a higher enjoyment or keener awareness of one's travel, and those contributing to the perception of travel as a burden. Each of the two basic types of mechanisms enhancing mobility perception is identified in every model presented here, an indication both of their fundamental nature and also of the complexity of the process by which one's mobility is subjectively assessed.

Category 1 in Table ES-2 represents the basic form of the "travel enjoyment/awareness" mechanism. Most of the variables in this category are indicators of an affinity for travel — either Travel Liking directly, the adventure-seeker Personality factor, the Excess Travel indicator, or even the vehicle-related variables, SUV and personal income (interpreted in this context as a proxy for better vehicles). This category by itself has representation in every model presented here, and the association of this mechanism to variables indicating affinity for travel constitutes a central argument of this work.

Category 4 of Table ES-2 constitutes the basic form of the "psychological burden" mechanism. It was identified through five different variables in four different models, with several special cases of the same mechanism identified in succeeding categories. These variables related to age, family considerations, attitudes, and several vehicle types.

Some other mechanisms, on the other hand, are found to have a diminishing effect on Subjective Mobility, and they are summarized in Table ES-3 (Table 14 in the text). The most prevalent of the mechanisms diminishing mobility perception is labeled "psychological burden reduction", with several special cases. This is the opposite-direction counterpart to the "psychological burden" mobility-enhancing mechanism. The factors mitigating the burdensome aspects of travel can include a liking for travel, but other factors can also serve this Subjective Mobility-diminishing role. In particular, the "vehicle comfort/convenience" category is a special case of the burden reduction mechanism that also has a counterpart in category 5 ("vehicle inconvenience") in Table ES-2. These two categories together attest that the "right" vehicle can make travel less burdensome.

The identification of such cognitive mechanisms is, in our opinion, a unique contribution of the present study.

The models presented here are successful in confirming our expectations that, while Subjective Mobility depends heavily on levels of actual mobility, it also depends in a substantive way on other parameters that characterize the traveler, such as (affective) attitudes toward travel, personality (notably the adventure seeker personality type) and the affinity for excess travel.

Table ES-1: Summary of Effects on Mobility Perception

	SHORT DISTANCE					LONG DISTANCE				
	Overall	**Commute**	**Work/School**	**Entertainment**	**Personal Vehicle**	**Overall**	**Work/School**	**Entertainment**	**Personal Vehicle**	**Airplane**
N	1317	1325	1350	1292	1348	1342	1313	1297	1343	1299
R^2_{full}	0.225	0.291	0.391	0.343	0.360	0.308	0.318	0.221	0.231	0.421
Adjusted R^2_{full}	0.217	0.284	0.387	0.334	0.353	0.303	0.313	0.211	0.227	0.415
Upper bound on R^2 due to Objective Mobility variables (R^2_{OM})	0.169	0.253	0.378	0.280	0.331	0.273	0.275	0.146	0.180	0.371
Upper-bound proportion of full-model R^2 due to Objective Mobility variables (R^2_{OM}/R^2_{full})	0.779	0.869	0.977	0.838	0.938	0.886	0.879	0.692	0.793	0.894
Lower bound on R^2 due to Objective Mobility variables ($R^2_{full} - R^2_{non\text{-}OM}$)	0.118	0.201	0.366	0.189	0.171	0.195	0.137	0.076	0.132	0.212
Lower-bound proportion of full R^2 due to Objective Mobility variables [($R^2_{full} - R^2_{non\text{-}OM})/R^2_{full}$]	0.524	0.691	0.936	0.551	0.475	0.633	0.431	0.344	0.571	0.504
VARIABLE										
Objective Mobility										
Frequency of commute (SD)		+								
Frequency of work/school-related travel (SD)		+	+				+			
Frequency of entertainment travel (SD)				+		+		+		
Frequency of grocery shopping travel (SD)				-						
Frequency of travel going to eat a meal (SD)										+
Frequency of travel taking others where they need to go (SD)					+					
Total trip frequency	+									
Weekly miles in a personal vehicle (SD)	+				+	+			+	
Weekly miles in a bus (SD)					-					
Weekly miles in BART (SD)					-					
Weekly miles walking (SD)					-					
Weekly miles commuting (SD)	+	+	+	-						

	SHORT DISTANCE					LONG DISTANCE				
	Overall	Commute	Work/School	Entertainment	Personal Vehicle	Overall	Work/School	Entertainment	Personal Vehicle	Airplane
Weekly miles of work/school-related travel (SD)			+	-				-		
Weekly miles of entertainment travel (SD)				+				+		
Weekly miles to eat a meal (SD)								+		
Total weekly miles (SD)				+						
Average commute time	+	+						-		
Distance to work		+			+		+			
Number of trips by personal vehicle (LD)	+						+		+	
Number of trips by air (LD)						+	+			+
Miles by PV (LD)										-
Miles by air (LD)				-				+	-	
Log of total miles by personal vehicle (LD)		-		+		+		+	+	
Log of total miles by air (LD)						+	+			+
Miles by other means (LD)						+		+		
Travel Liking										
Overall (SD)	-	+		+						
Overall squared (SD)	+									
Commute (SD)	-	-								
Commute squared (SD)		+								
Work/school-related (SD)										
Personal vehicle (SD)					-					
Personal vehicle squared (SD)					+					
Grocery shopping (SD)				-						
Taking others where they need to go (SD)										+
Overall (LD)						+	-			+
Work/school-related (LD)			+				+			
Entertainment (LD)								+		+
Personal vehicle (LD)									+	-
Airplane (LD)						-				
Attitudes										
Pro-environmental solutions factor score				-						
Travel freedom factor score								+		
Pro-high density factor score									-	

	SHORT DISTANCE					LONG DISTANCE				
	Overall	Commute	Work/School	Entertainment	Personal Vehicle	Overall	Work/School	Entertainment	Personal Vehicle	Airplane
Lifestyle										
Frustrated factor					+					
Workaholic factor				-				-		
Family & community-oriented factor					+					
Personality										
Adventure seeker factor score	+			+	+	+	+			+
Organizer factor score							+			
Loner factor score			+							
Excess Travel										
Excess Travel indicator				+				+	+	
Mobility Constraints										
Percent of time a vehicle is available	-				+					-
Limitations on walking					+					
Demographics										
Male										-
Age						+				
Years lived in the U.S.				-						
Educational background	-	-						+		
Number of people in the household	+									
Personal income category				-			+	-		+
Household income category								+		
Number of people 6-15 years old in the household										-
Year of the personal vehicle		-								
Vehicle type is compact			-							
Vehicle type is small		+								
Vehicle type is mid-sized	-									
Vehicle type is large		+								
Vehicle type is SUV							-	+		
Vehicle type is van/minivan			+			+			+	

Table ES-2: Summary of Cognitive Mechanisms Magnifying Subjective Mobility (i.e. with a positive net impact)

Postulated Mechanism		Variables Representing this Mechanism	Subjective Mobility Variable Modeled
1	**Enjoyment/ awareness of the travel (or psychological pleasure)**	Travel Liking overall (SD)	SD Overall[1]
			SD Commute
			SD Entertainment/ Recreation/Social
		Travel Liking work/school-related (LD)	SD Work/School-Related
		Travel Liking overall (LD)	LD Overall
			LD Airplane
		Travel Liking work/ school-related (LD)	LD Work/School-Related
		Travel Liking entertain-ment/recreation/social (LD)	LD Entertainment/Recreation/Social
			LD Airplane
		Travel Liking personal vehicle (SD)	SD Personal Vehicle[1]
		Travel Liking personal vehicle (LD)	LD Personal Vehicle
		SUV vehicle type	LD Entertainment/Recreation/Social
		Personal income	LD Work/School-Related
		Adventure seeker	SD Overall
			SD Entertainment/Recreation/Social
			SD Personal Vehicle
			LD Overall
			LD Work/School-Related
			LD Airplane
		Loner	SD Work/School-Related
		Excess Travel indicator	SD Overall
			SD Entertainment/Recreation/Social
			LD Entertainment/Recreation/Social
			LD Personal Vehicle
2	**Mobility freedom awareness (awareness)**	Travel freedom factor	LD Entertainment/Recreation/Social
		Percentage of the time a personal vehicle is available	SD Personal Vehicle

[1] Represented by the quadratic form in which low as well as high values of the indicated Travel Liking variable have a positive impact on Subjective Mobility.

Postulated Mechanism		Variables Representing this Mechanism	Subjective Mobility Variable Modeled
3	**Relative deprivation (awareness)**	Limitations on walking	SD Personal Vehicle
4	**Psychological burden**	Travel Liking overall (SD)	SD Overall[1]
		Travel Liking personal vehicle (SD)	SD Personal Vehicle[1]
		Family oriented factor score	SD Personal Vehicle
		Van/minivan vehicle type	LD Overall
			LD Personal Vehicle
		Age	LD Overall
		Travel Liking chauffeuring (SD)	LD Airplane
		Male dummy variable[2]	LD Airplane
5	**Vehicle inconvenience (burden)**	Small vehicle type	SD Commute
		Large vehicle type	SD Commute
6	**Negative attitude (burden)**	Frustration factor score	SD Personal Vehicle
7	**Confounding short-distance and long-distance & Travel saturation (burden)**	Number of trips by personal vehicle (LD)	SD Overall
		Miles by personal vehicle (LD)	SD Entertainment/Recreation/Social
		Frequency of entertain-ment/recreation/social travel (SD)	LD Entertainment/Recreation/Social
		Weekly miles for entertain-ment/recreation/social (SD)	LD Entertainment/Recreation/Social
		Weekly miles by personal vehicle (SD)	LD Overall
			LD Personal Vehicle
		Frequency of work/school-related travel (SD)	LD Work/School-Related
		Frequency of entertain-ment/recreation/social travel (SD)	LD Overall
		Commute distance	LD Work/School-Related
		Pro-high-density factor[3]	LD Personal Vehicle

[2] This variable has a negative coefficient, but is included here since we argue that long-distance mobility by airplane is more burdensome to *women*.

[3] Although this variable has a negative coefficient, we postulate that it may represent a travel saturation effect, with suburbanites (having a lower score on this factor and more short-distance personal vehicle travel) perceiving their long-distance personal vehicle mobility more intensely, and conversely for urbanites (see Section 3.10).

Postulated Mechanism		Variables Representing this Mechanism	Subjective Mobility Variable Modeled
8	**Confounding similar purposes & Travel saturation (burden)**	Frequency of work/school-related travel (SD)	SD Commute
		Weekly miles commuting to work/school (SD)	SD Work/School-Related
9	**Complementarity (awareness)**	Number of trips by personal vehicle (LD)	SD Overall
		Travel Liking work/school-related (LD)	SD Work/School-Related
10	**Competing preferences (burden)**	Number of trips by personal vehicle (LD)	SD Overall
		Travel Liking work/school-related (LD)	SD Work/School-Related
		Travel Liking chauffeuring (SD)	LD Airplane
11	**Complexity of travel/ activity environment (burden)**	Number of people in the household	SD Overall
12	**Availability heuristic (awareness)**	Number of people in the household	SD Overall

Table ES-3: Summary of Cognitive Mechanisms Diminishing Subjective Mobility (i.e. with a negative net impact)

Postulated Mechanism		Variables Representing this Mechanism	Subjective Mobility Variable Modeled
1	**Psychological burden reduction**	Travel Liking commute (SD)	SD Overall
			SD Commute[4]
		Travel Liking overall (LD)	LD Work/School-Related
		Travel Liking by airplane (LD)	LD Overall
		Travel Liking by personal vehicle (LD)	LD Airplane
2	**Vehicle comfort/ convenience (burden reduction)**	Mid-sized vehicle type	SD Overall
		Vehicle availability	SD Overall
		Year of personal vehicle	SD Commute
		Compact vehicle type	SD Work/School-Related
		Personal income	SD Entertainment/Recreation/Social
		SUV vehicle type	LD Work/School-Related
3	**Reduced awareness & Anticipation of destination (burden reduction)**	Educational background	SD Overall
			SD Commute

[4] Represented by a quadratic form that slopes downward for most of the range of the Travel Liking variable.

Postulated Mechanism		Variables Representing this Mechanism	Subjective Mobility Variable Modeled
4	**Share of total mileage & Perceptual balance**	Weekly miles commuting to work/school (SD)	SD Entertainment/Recreation/Social
		Commute time	LD Entertainment/Recreation/Social
		Weekly miles work/ school-related (SD)	SD Entertainment/Recreation/Social
			LD Entertainment/Recreation/Social
		Miles by personal vehicle (LD)	SD Commute
		Miles by airplane (LD)	SD Entertainment/Recreation/Social
		Miles by airplane (LD)	LD Personal Vehicle
		Miles by personal vehicle (LD)	LD Airplane
5	**Relative deprivation**	Percentage of the time a personal vehicle is available	LD Airplane
		Personal income	SD Entertainment/Recreation/Social
			LD Entertainment/Recreation/Social
		Workaholic factor	SD Entertainment/Recreation/Social
			LD Entertainment/Recreation/Social
6	**Comparison to past**	Years in the U.S.	SD Entertainment/Recreation/Social
7	**Perceived mobility constraint**	Number of children between 6 and 15	LD Airplane
8	**Substitution effect**	Frequency of travel for grocery shopping (SD)	SD Entertainment/Recreation/Social
		Travel Liking for grocery shopping (SD)	SD Entertainment/Recreation/Social
9	**Cognitive dissonance reduction/ Rationalization**	Pro-environmental factor	SD Entertainment/Recreation/Social
		Workaholic factor	SD Entertainment/Recreation/Social
			LD Entertainment/Recreation/Social

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 (Salomon and Mokhtarian, 1998, Mokhtarian and Salomon, 2001). 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 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.

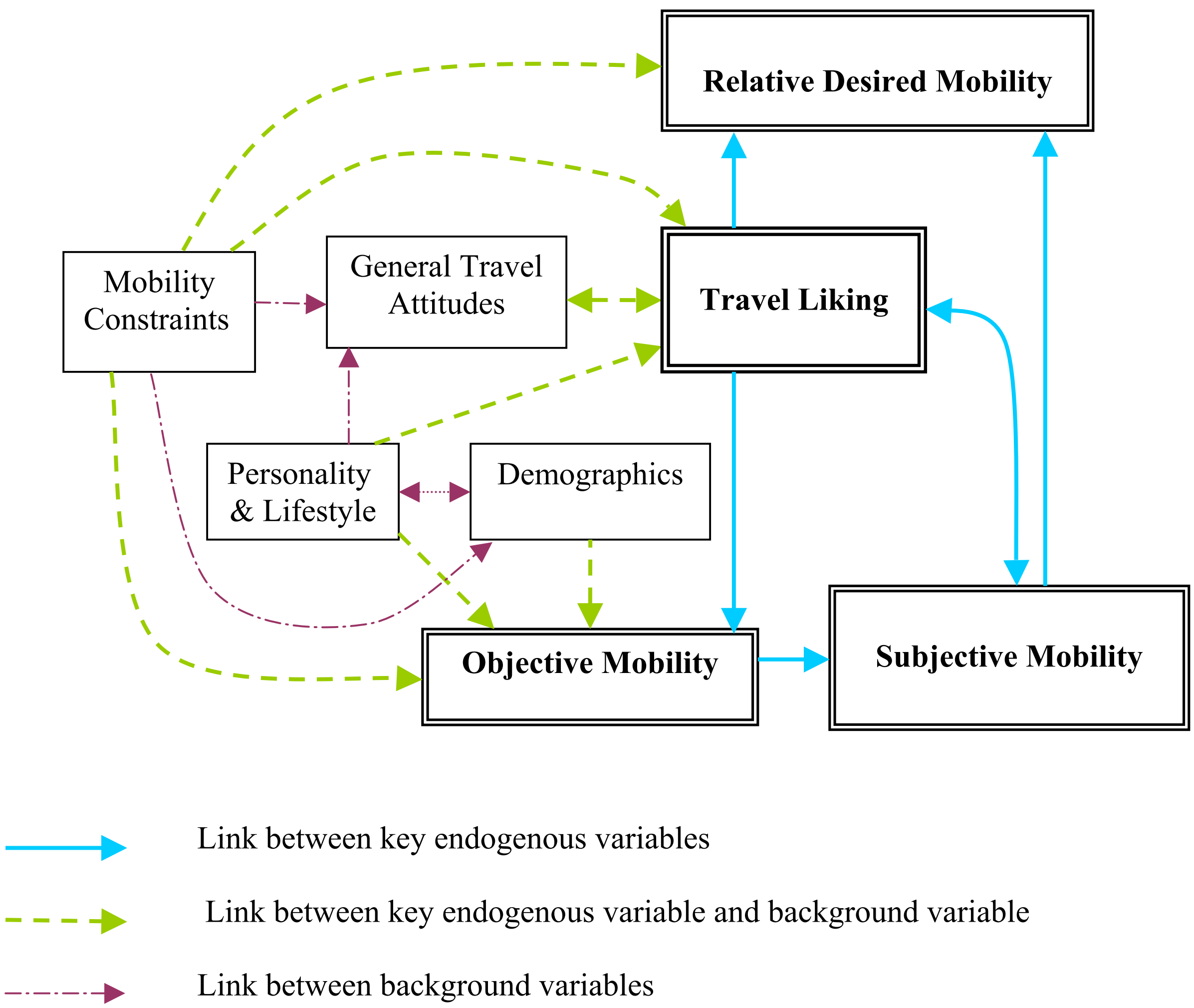
The key endogenous variable categories in this model are Travel Liking, Objective Mobility, Subjective Mobility, and Relative Desired Mobility (each of the variable types is described further in Section 2). We envision Travel Liking to be a function of Personality and Lifestyle characteristics, general travel-related Attitudes, Mobility Constraints, Demographic traits and the subjective amount one travels. In turn, we hypothesize that Travel Liking affects the amount one travels (both Subjective 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 current Subjective Mobility and Travel Liking, as well as Mobility Constraints.

In some sense, Relative Desired Mobility is the apex of the model. As the conceptual model is currently portrayed, Relative Desired Mobility is directly dependent on Travel Liking, Subjective Mobility, and Mobility Constraints, but is not explanatory of any other variables. 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, Mobility Constraints are the only basically exogenous variables in the model. These variables include limitations on the ability to fly, walk, ride a bike, take public transit, drive, drive at night, or drive on the freeway. Such limitations are postulated to affect Attitudes, Travel Liking, Objective Mobility, and Relative Desired Mobility, but not to be influenced by the other variables in the model. Some Demographic variables (e.g. age, gender) are exogenous but others are endogenous (e.g. vehicle ownership is a function of income, which is a function of occupation, which is a function of education; driver's license holding may be a function of Mobility Constraints and Travel Liking with respect to personal vehicles; residential location may be a function of the pro-high-density Attitude; and so on). Personality and Lifestyle variables are somewhat exogenous but could be influenced by the stage in one's lifecycle as indicated by Demographic traits (e.g. older people with families may be less adventure-seeking, and are presumably more likely to be family-oriented, than are young singles).

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 Subjective 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 Subjective 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 Subjective Mobility. For example, we could expect a negative impact of Travel Liking on Subjective 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 Subjective 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 Subjective 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 8,000 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 2,000 surveys were completed by a randomly-selected adult member of the household and returned, for a 25% response rate. The subset of 1,358 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 (2001) 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 relationships among Travel Liking, Perceived Mobility (now referred to as Subjective 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 (2001a) model Ideal Commute Time and Relative Desired Commute amount as functions of the other appropriate variables in the conceptual model.
- Choo and Mokhtarian (2002) analyze variables related to the type of vehicle the respondents drive most often.
- Redmond and Mokhtarian (2001b) estimate single-equation models of Objective Mobility (distance traveled) in 11 categories.
- Mokhtarian *et al*. (2001) present key findings from earlier reports in the series, augmented by additional evidence from the literature for a positive utility of travel.

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, Subjective 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 Subjective 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 Subjective Mobility. Companion reports are being prepared that develop single-equation models for Objective Mobility (Redmond and Mokhtarian, 2001b) and Relative Desired Mobility (Choo, *et al*., 2001).

While the importance of developing models for Objective Mobility (actual behavior) is universally acknowledged, studying the underpinnings of the cognitive processes related to actual travel is also important. As Krech and Crutchfield (1948, p. 77) put it: "if we are to understand social behavior, we must know how all perceptions, memories, fantasies are combined or integrated or organized into…cognitive structures"[1]. The cognitive approach to social psychology is, by far, the most widely adopted today. This approach proposes the incorporation of an active organism (O) mediating between stimulus and response (S-R). In fact, it advocates that behavior is to be represented by an O-S-O-R chain where internal states (Os) select what environmental stimuli to attend to and regulate the responses to such stimuli. Applying this representation in the context of traveling, we conclude that internal states will be very active both in processing the stimuli an individual is subjected to while traveling and in recovering memories about his/her travel. It is believed that many cognitive structures (schemas) affect memory. Quoting Markus and Zajonc (1985, p. 144), "(a)n understanding of how perceivers process information in the social environment, how they categorize, evaluate, and assign causality, or what they remember or infer from a situation depends on an understanding of the cognitive structures that are responsible for selectivity in information processing." The models presented in this report are related to cognitive processes originating in the social experience of traveling. We expect that a better understanding of these cognitive processes will improve our ability to forecast travel behavior and potentially to influence that behavior in socially desirable ways.

[1] "Cognitive structures are organizations of conceptually related representations of objects, situations, events, and of sequences of events and actions." (Markus and Zajonc, 1985, p. 143).

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, Subjective 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/recreation/social activities, and for the purpose of taking others where they need to go. The short-distance modes measured were: personal vehicle, bus, train/heavy rail/light rail and walking/jogging/bicycling. Long-distance measures were obtained for the work/school-related and entertainment/recreation/social 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 Subjective 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.

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.
2. Log of miles, the natural logarithm of one plus the total number of miles. 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.

Discriminating each of these variables by travel mode (personal vehicle, airplane, and other means), plus retaining the original "total" variables, yielded a set of 12 measures of distance, which were eventually used in the models.

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 (and other variables; see Koppelman, 1981) 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).

Especially in the context of the present study, then, it is pertinent to stress that these measures are not "objective" in the strictest sense of the word. As self-reported information, they are clearly prone to subjective reporting error, and the translation from trips destined for various regions to miles traveled is obviously only a crude approximation of objective reality. Nevertheless, given the impracticality of obtaining externally, purely objectively measured data on mobility, these self-reported measures can still serve as useful estimates. We refer to them as "objective" to distinguish them from the qualitative assessments of mobility described next.

According to our conceptual model, Objective Mobility will be affected by the Mobility Constraints of the individual, Travel Liking, Demographic characteristics and Personality/Lifestyle traits, and will, in turn, affect Subjective Mobility.

Subjective 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". In the context of the current study, it is important to keep in mind that no specific units are attached to this variable. That is, viewing oneself as traveling "a lot" may be a function of trip frequency, average trip length in time or distance (especially for often-repeated trips such as the commute), total travel distance or time over a given calendar period, or some combination of those measures (Redmond and Mokhtarian, 2001a). One of the purposes of this study is to better understand how these various measures of Objective Mobility are weighted and combined in different contexts to influence one's subjective assessment of mobility.

We view Subjective Mobility as the result of a *post hoc* process through which individuals assess their Objective Mobility. Thus, in the models we allow Objective Mobility to affect Subjective Mobility, but not vice versa. Further, as a simplification we hypothesize that Relative Desired Mobility is affected by Subjective Mobility but not vice versa, and that (as indicated in Section 1.1) there is reciprocal causation between Travel Liking and Subjective 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 Subjective 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". As with Subjective Mobility, no units are assigned to this variable, so a desire to travel "less" could mean less frequently, shorter single-trip or total distances, taking less time (e.g. traveling the same distances at higher speeds), or some combination of these.

In our conceptual model Relative Desired Mobility is primarily affected by Travel Liking and Subjective Mobility, as well as by Mobility Constraints.

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 Subjective Mobility, on a five-point scale from "strongly dislike" to "strongly like".

The Travel Liking variables are viewed as indicators of affective attitudes — specifically attitudes toward travel.

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 General Travel Attitudes; and influences Objective Mobility and Relative Desired Mobility. Finally, we hypothesize that the Travel Liking variables have a reciprocal relationship with Subjective 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. Taken at face value, the travel freedom factor measures the respondent's cognitive evaluation of how free s/he is to travel, rather than an emotion toward travel *per se*. However, it is likely that many respondents endowed the word "freedom" (in the dominant statements comprising this factor) with an affective component, and answered in terms of the degree to which they value travel as an expression of freedom. These Attitude factors were then used as explanatory variables in the models. Attitudes are the main tool used by social psychologists in predicting behavior, as opposed to personality traits, which are the focus of interest of personality psychology. For a good general treatment of the concept of attitudes and personality traits, see Ajzen (1988). A number of studies exist on the relationship between attitudes and behavior (e.g. Bentler and Speckart, 1979, 1981), and, more specifically, between attitudes and travel behavior (e.g. Dobson *et al.*, 1978; Gärling *et al.*, 1998; Koppelman and Lyon, 1981).

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 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 or her/his 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 report we allowed only the variable indicating ownership of a cell phone (whose potential impact on mobility perception was of particular interest) to enter. However, it was not significant in any of the final models. The rest of the Travel Modifiers were not included since their levels of missing data tended to substantially reduce the sample size.

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 10 dependent Subjective Mobility variables, and estimated using ordinary least squares (OLS) regression. For short-distance travel these include the Subjective Mobility for travel overall, for commuting to work/school, for work/school-related reasons, for entertainment/recreation/social purposes, and by personal vehicle. For long-distance travel, we modeled the Subjective Mobility for travel overall, for work/school-related reasons, for entertainment/recreation/social purposes, by personal vehicle and by airplane. As discussed earlier, this effort constitutes a first step toward a more theoretically consistent and comprehensive analysis to be undertaken within the framework of a set of structural equations. As such, the single-equation approach almost inevitably poses some difficulties in model specification and interpretation. For example, we hypothesize that Subjective Mobility is a function of Travel Liking, among other variables: intuitively, the greater liking for travel of a certain kind may reduce its perceived burden and stimulate the desire for more, with the result being a lower Subjective Mobility than for someone traveling the same objective amount who hates that type of travel (the analyses will show that this relationship is actually more complex). On the other hand, we also hypothesize that Travel Liking is a function of (subjectively assessed) mobility, among other variables: an individual may dislike a certain type of travel precisely because s/he has to do it so much. In econometric parlance, Travel Liking is an endogenous variable to the system, and (since it is partly determined by both the observed and unobserved components of Subjective Mobility) its inclusion as an explanatory variable for Subjective Mobility technically violates the assumption required by OLS, that explanatory variables (Travel Liking) be uncorrelated with the unobserved factors determining the dependent variable (Subjective Mobility). Thus, the results presented here can only be considered preliminary.

It was mentioned that Subjective Mobility was measured separately for short distance and long distance travel. The respondent was requested to classify trips of less than 100 miles one way as short distance. While this distinction was formally stated in the survey, it is expected that the boundary will be somewhat blurred in the mind of the respondent, and that perceptions with respect to one category are likely to some extent to spill over into the other.

Only the sub-sample of 1,358 working commuters was used to estimate these models. This decision was based on the importance of including certain variables that apply only to commuters, e.g. average commute time and commute distance. Our analysis confirms the central role this kind of variable takes in understanding travel perceptions. That is, these models attest that commute variables affect the travel perception of *commuters*. Since there is reason to expect non-commuters to have a different basis for their perceptions, it would have not been appropriate to pool the data. As time did not permit fully parallel analyses for all groups of possible interest (e.g. non-commuting workers, non-workers), we chose to focus on the group most important in terms of their contribution to total travel: working commuters. After considerable exploration of different options, we chose to confine our analysis to those who are employed full- or part-time, commute at least once a month and report a commute time or distance (or both).

Several key decisions were made about groups of potential explanatory variables. For example, Subjective Mobility variables were not allowed to be explanatory variables in order to reduce the endogeneity bias. Relative Desired Mobility variables were not included because we hypothesize the opposite direction of causality. That is, we suggest that individuals' subjective assessment of their mobility will help determine whether they would like to increase, decrease or maintain their current levels of mobility.

From the group of Travel Modifiers, only one was allowed in the set of explanatory variables: the dummy variable for ownership of a mobile phone. This group of variables had substantial amounts of missing data, which had a negative impact on the resulting sample size. Even more importantly, most of the questions within this group were not appropriate as explanatory variables.

A number of interaction variables were created (e.g. frequency of commute times average commute time, male dummy variable times commute distance, etc.) and tested for inclusion in the models. Although it is understood that some of these variables can be important, they were excluded from the final models. The results displayed a level of complexity that not only posed some interpretability challenges but could also be unnecessarily concealing the role of the primary variables on which they were based. Furthermore, the quality of the models containing interaction variables was not superior in terms of R^2s.

A set of 130 independent variables believed to have some explanatory power was finally selected from among the remaining groups to perform the initial estimation of each model. In some cases a few of these variables had to be excluded because of entering the models with counterintuitive signs. With the exception of these minor distillations, the set of variables included in the initial run remained the same across the board.

Stepwise regression was used to refine initial trial specifications allowing numerous explanatory variables to enter the models. Explanatory variables were incorporated whenever their *F*-probability was at least 0.05 and were released whenever the same indicator was bigger than 0.1. (The *F*-probability refers to the chance of being wrong if one concludes that a given variable is significant in the model. When this probability is small, the variables should be retained, all else equal).

The richness of our set of variables makes it unrealistic to assume them to be totally independent of each other. Depending on the context of a specific model, a certain explanatory variable entering the results may be not only representing itself but also acting as a proxy for other variable/s. For example, the frequency of weekly trips for a given activity may be an indicator of lifestyle and/or income characteristics. This potential multi-faceted nature of the variables made the interpretation process particularly interesting.

The interrelated nature of the set of variables included in the analysis provides a fertile ground in which multicollinearity effects can arise. Although not a necessary condition for collinearity to be a problem, high pair-wise correlations among variables usually favor its appearance. Obvious candidates for high correlations are original variables and their transformations (e.g. commute time, its natural logarithm, its square and its square root). In view of the above, some indicators of multicollinearity — particularly the variance inflation factor (VIF) — were systematically monitored during the model-refining process. A generally accepted rule of thumb is to avoid VIFs bigger than 10 (Neter *et al*., 1996), although some authors suggest that a value over five is already a symptom of undesirable multicollinearity effects (Judge *et al*., 1988). We were in general able to be more conservative than the VIF = 10 threshold because, when VIFs were below but near 10, the richness of our dataset permitted us to obtain alternative models where collinearity effects were negligible, thus enhancing the interpretability of the coefficients[2].

In the tables that follow, coefficients are reported to the third significant digit.

3.2 Short-Distance Overall

The "overall" categories proved particularly difficult to model. This is not surprising since each comprises trips of all sorts, therefore making perceptions more diffuse. For some people, an overall perception of their travel may be dominated by the perception of their commutes, for other people by recreational trips and for yet other people by a balanced blend of all their trips. The "overall" questions were placed at the beginning of their respective sections, in order to obtain respondents' impressions of their general perceptions uncontaminated by rationalizations originating in their responses to the questions on specific modes and purposes of travel.

Table 2 presents the resulting model, with the explanatory variables categorized by type (thus the ordering of the variables does not represent their importance to the model; this can be inferred from the magnitudes of the beta coefficients and the t-statistics).

Table 2: Short-Distance Overall Subjective Mobility Results (N = 1317)

Variable	Coefficient	t	Beta
Constant	3.659	10.122	
Objective Mobility			
Total trip frequency category (SD) [1, 2, …, 6]	0.218	6.492	0.169
Square root of miles per week to work/school (SD) [≥0]	0.0178	2.377	0.0985
Natural log of (miles per week by personal vehicle + 1) (SD) [≥0]	0.0997	3.758	0.141
Average commute time [≥0]	0.00866	5.010	0.1780
Number of trips by personal vehicle during last year (LD) [0, 1, …]	0.00323	2.670	0.0664
Travel Liking [1,2, …, 5]			
Overall (SD)	-0.365	-1.857	-0.268
Overall squared (SD)	0.0711	2.372	0.339
Commute to work/school (SD)	-0.158	-5.050	-0.152
Personality			
Adventure seeker factor score [-2.6, ..., 2.7]	0.0966	3.438	0.0868
Demographics			
Educational background category [1, 2, …., 6]	-0.0867	-4.351	-0.107
Number of persons in the household [1, 2, …]	0.0692	3.368	0.0850
Personal vehicle type is mid-sized [0, 1]	-0.146	-2.234	-0.0553
Percentage of time a vehicle is available [0, 20, …, 100]	-0.00405	-3.359	-0.103

SD = Short Distance LD = Long Distance [ ] = range of possible or observed responses
Adjusted R^2 =0.217 (R^2 = 0.225) F-statistic = 29.027 (p = 0.000)

The value of the adjusted R^2, 0.217, is the second lowest of all the values obtained from our set of models. By comparison, the counterpart of this model in the Objective Mobility group

[2] The exceptions are some models where a Travel Liking variable and its square transformation are kept despite their relatively high collinearity—but only when both were statistically significant, and with reasonable signs. The motivation for retaining both variables lies in the conceptual importance of the quadratic form, which is discussed in Section 3.2 and throughout the rest of the report.

(Redmond and Mokhtarian, 2001b) had the second highest adjusted R^2 (0.388). This suggests that the factors affecting the perception of an individual's overall short-distance mobility are among the most idiosyncratic, and in particular more idiosyncratic than the factors determining his/her *actual* mobility. Nevertheless, explaining 22% of the variance in the dependent variable is at or above par for disaggregate models of travel behavior.

A cursory review of this model indicates that the overall perception of short-distance travel is dominated by measures of Objective Mobility, with five of the 12 significant variables (besides the constant term) falling into this category. Thus, the intuitively expected direct relationship between the amount of travel and its perception is here strongly evidenced and will continue to appear in the remaining models. The presence of the square root of the weekly miles commuting to work/school, and the average commute time, demonstrate the central role played by commute mobility in determining the overall mobility perception. We also obtain two indicators of amount of travel in personal vehicles. The natural logarithm of the weekly miles by personal vehicle is particularly strong. We do not infer from this that personal vehicles engender higher mobility perceptions than other means, but rather that personal vehicles are the overriding means of transportation in the short-distance range. Interestingly, the "number of trips in personal vehicle" variable concerns *long-distance* trips. The appearance of this variable is attributed mainly to a carry-over effect, meaning that respondents tend to mix their perceptions of long- and short-distance mobility in their personal vehicles. Also a travel time budget argument can be made: if one desires a relatively fixed total time of travel and is traveling a great deal for long-distance trips already, then the additional short-distance travel required may be especially burdensome (the same argument could of course be made for the perception of long-distance travel given high short-distance mobility, and the two possibilities are not mutually exclusive). Finally, a "complementarity" effect may be present: the more people travel in the long-distance range the more they may also do it in the short-distance range. This effect may represent direct causality (preparation for long-distance travel often necessitates some short-distance trips) and/or, more likely, the indirect effect of third-party variables such as income stimulating both short- and long-distance travel.

The roles played by Travel Liking variables in explaining the perception of mobility proved more complex than expected throughout this study, and here we have the first example of this complexity. Initially we believed that, with Objective Mobility controlled for, the liking for the type of travel whose perception was being modeled would have a negative coefficient. That is, we hypothesized that the more a person enjoyed doing something, the less s/he would perceive s/he was doing it. The message these variables conveyed to us throughout the analyses was that we were oversimplifying their meaning. In fact, as our thinking evolved we identified two ways in which Travel Liking could have a *positive* impact on Subjective Mobility. On the one hand, we had always expected that the liking for a certain sort of travel would generate more of that type of travel and hence a greater perception of the amount of that travel. We had initially expected that effect to be completely accounted for by the inclusion of the corresponding Objective Mobility variables. However, it is quite possible that the objective variables appearing in the model do not completely capture the impact of Objective Mobility on Subjective Mobility, and that some of the residual portion of this effect is captured through the inclusion of the Travel Liking variable.

On the other hand, we also came to realize that the liking for a certain type of travel could *enhance* rather than *diminish* the awareness of that travel, with the enjoyment of it intensifying and magnifying the experience. Thus, rather than being uniformly negative as we had initially assumed, the impact of Travel Liking on Subjective Mobility is likely to be non-linear: if one *dislikes* travel, the greater the dislike the greater the psychological *burden* of the travel and hence the greater the perception of mobility. And if one *likes* travel, the greater the liking the greater the psychological *pleasure* of the travel and hence the greater (more intense) the perception of mobility. These considerations suggested that the relationship of Travel Liking to Subjective Mobility could have a quadratic-type form.

This model is an example in which the coefficients for both the linear and quadratic overall Travel Liking variables for short-distance travel are significant. Assuming the rest of the explanatory variables are held at a fixed value, the relationship between Subjective Mobility and Travel Liking can be expressed as $SM = aTL^2 + bTL + c$, where in this case $a = 0.0711$ and $b = -0.365$. This expression reaches a minimum at $TL = 2.567$, indicating that values of overall short-distance Travel Liking below or above this value enhance the overall short-distance Subjective Mobility, due to the psychological burden and psychological pleasure mechanisms, respectively. Recall that Travel Liking is measured by the integers 1 through 5, so the minimum of 2.6 approximately corresponds to the "neutral" value of 3. The VIF levels indicate that collinearity effects are present, with a VIF of 35.027 for the overall Travel Liking variable and of 34.304 for the square of the same variable. Given the conceptual importance of these variables, and the fact that their coefficients are reasonably statistically significant, keeping them in the model (and later models where similar combinations of Travel Liking variables appear) is, in our opinion, justified despite some loss in estimator efficiency.

A negative coefficient is found for the "commute liking" variable, consistent (in view of the major contribution of the commute to overall short-distance travel) with the hypothesis that, for a given Objective Mobility, the greater the Travel Liking the lesser one's perception of its amount or weight. Further, bivariate correlations suggest that people with higher liking for commute trips tend to have shorter commute distances. Therefore, it could also partly be reflecting the opposite direction of causality — that one likes travel *because* one doesn't do it too much. If high liking for commute trips also indicates a work-centered lifestyle, such individuals may also have lower amounts and enjoyment of recreational travel. Thus, this variable may be acting in part as an indicator of Objective Mobility.

The "adventure seeker" factor is the only Personality trait entering the model and it does so holding an intuitive positive sign. Adventure seekers are likely to be mobile people as well as to enjoy their travel, the latter fact inducing high awareness (perception) of their mobility. "Travel" is probably a central concept in the definition of these people's self-images, and this is likely to enhance their recall of traveling experiences. There is substantial evidence that individuals tend to better remember material that is consistent with their self-images (e.g. Markus, *et al*., 1982).

Similar to (and arguably even more than) adventure seekers, excess travelers find pleasure in the very fact of traveling, and by definition seek to engage in travel beyond what could strictly be considered as necessary. A natural conclusion is that these people have both a higher-than-average awareness and enjoyment of their traveling and consequently a higher perception as well. The argument about satisfaction of self-images outlined in the interpretation of the adventure seeker factor is valid for excess travelers as well. This variable may also be capturing a residual effect of greater Objective Mobility.

Among the Demographic variables, "educational background" is the most powerful as indicated by its beta coefficient. Its negative sign poses interesting questions, since at first glance, one would expect higher education to be associated with higher income, which is associated with greater Objective Mobility and hence Subjective Mobility. However, we suggest that as education increases, individuals' concerns may reside more heavily in intellectual/occupation-related issues thereby diminishing their awareness of other activities, including travel. Some further evidence of this distinctive attitude toward travel as a function of increasing education will be seen in the following model, for commute travel.

As interaction between its members is one feature that characterizes a household, it follows directly that more trips per person are to be expected as the household size increases. The positive sign of the "number of persons in the household" variable surely has an Objective Mobility nuance then. Besides this rather straightforward interpretation, we may turn to the *availability heuristic* effect (e.g. Myers, 1999) to interpret this coefficient assuming Objective Mobility is controlled for by the other variables in the model. This effect, well known to social psychologists, refers to the tendency to articulate judgments and opinions based on what is most readily available in our minds. Such ready availability is generally due to our frequent exposure to certain environmental or external inputs. The household constitutes, generally, an individual's most natural/frequent environment. Thus, its members and the activities related to them (including mobility) are most likely readily available in our minds, probably influencing our perception of mobility. In other words, when trying to respond to how much a person thinks s/he travels overall, the members of her/his family, particularly those who depend on her/him, are very likely to come to mind, engendering a clearer realization of the mobility they generate for her/him. Therefore this coefficient has also an interesting psychological interpretation. Also, it is plausible to think that a larger household "feels" busier — that the need for coordination and presence of constraints makes a given amount of travel feel weightier than would be the case for a single person.

The availability of a personal vehicle is certainly a convenience. Not only does it give people more freedom to move around, it also makes them *feel* freer. Viewing this from the opposite angle, any sort of mode captivity arising from the non-availability of a personal vehicle will enhance one's perception of the burdensome side of traveling. Thus the negative coefficient of vehicle availability is logical.

3.3 Short-Distance Commute

Commute trips have some unique features. They are generally regular in time and space, and mandatory for most people. A number of factors limit the ability to choose if, when, and how much to commute. The stereotypical commute is portrayed as a stressful, expensive, congestion-filled nightmare. On the other hand, there is also ample evidence that the commute fulfills a beneficial role and is valued by many people. In a previous analysis of these data, Redmond and Mokhtarian (2001a) found an average "ideal commute time" of not zero, but about 16 minutes. However, it is also the case that on average, respondents' actual commute time exceeds their ideal by about 14 minutes. The impact of these counteracting influences on one's Subjective Mobility for commuting is not clear *a priori*, but perhaps here as much as anywhere we can expect attitudinal variables to play an important role in moderating objective indicators of mobility.

Questions relating to mobility and Travel Liking with respect to the commute were included under short distance travel, which requires the respondent to report on trips of not more than 100 miles one way. To the extent that respondents with commutes in excess of 100 miles refrained from responding to this question, they would have been excluded from this analysis. Since our definition of commuter (see Section 3.1) highlights the role of frequency of trips to work (requiring a commute at least once a month), it follows that only a negligible portion of commuters (according to our definition) would have a commute falling in the long-distance category — in fact, just three cases with 100-mile and one case with 108-mile commutes belong to the subset being studied. Allowing long distances in this category would also increase the probabilities for commutes to be made by airplane, which would introduce an undesirable heterogeneity, particularly when dealing with perceptions. Thus, the model presented here pertains to local commuting only.

The results of our analysis are presented in Table 3. Notice the increase in the adjusted R^2 (to 0.28) relative to the model for overall short-distance travel perception. Narrowing the purpose or mode of the trips reduces the idiosyncratic variability in Subjective Mobility, and later models will provide further evidence in this respect. In the current model, the Objective Mobility variables predominantly affecting the perception are, as expected, related to the commute. Interestingly, all of the dimensions along which the amount of commuting is measured in our data are represented: time, single-trip distance, frequency and total miles per week. Thus, each dimension contributes something unique to the perceived amount of commuting, which is quite a rich result. As also expected, the coefficients of these variables are positive and need no further explanation.

Table 3: Short-Distance Commute to Work/School Subjective Mobility Results (N = 1325)

Variable	Coefficient	t	Beta
Constant	1.461	3.262	
Objective Mobility			
Frequency of commuting to work/school (SD) [1, 2, ..., 6]	0.331	6.027	0.149
Frequency of travel for work/school-related reasons (SD) [1, 2 …, 6]	0.0817	4.338	0.103
Square root of miles per week commuting to work/school (SD) [≥0]	0.0290	2.797	0.133
Square root of average commute time [≥0]	0.135	4.981	0.199
Square root of commute distance [≥0]	0.104	2.756	0.152
Natural logarithm of (total miles by personal vehicle + 1) (LD) [≥0]	-1.997	-2.075	-0.049
Travel Liking [1, 2, …, 5]			
Overall (SD)	0.107	2.345	0.065
Commute to work/school (SD)	-0.531	-3.652	-0.421
Commute to work/school squared (SD)	0.0666	2.634	0.301
Demographics			
Educational background category [1, 2, …, 6]	-0.0894	-3.896	0.301
Year of the personal vehicle […, 97, 98]	-0.00468	-3.417	-0.092
Personal vehicle type is small [0, 1]	0.149	2.138	-0.087
Personal vehicle type is large [0, 1]	0.482	2.317	0.051

SD = Short Distance LD = Long Distance [ ] = range of possible or observed responses
Adjusted R^2 =0.284 (R^2 = 0.291) F-statistic = 41.399 (p = 0.000)

As already suggested by previous discussions, multicollinearity was an issue during the selection of the final variables. This was not surprising since several transformations of these dominant variables were allowed in the initial model specification simultaneously. The model refining process then included dropping some of these variables, trying to minimize VIFs while maximizing R^2. The model shown in the table constitutes the outcome of this heuristic optimization process. It is worth pointing out that the presence of at least minor multicollinearity is inevitable if all these variables are to be included, given the correlations of the distance to work with the time it takes to cover that distance and with the miles traveled to work/school in an average week. Nevertheless, all variables included in this model are significant at p = 0.05 or better. In particular, p-values for the coefficients of the four commute variables are less than 0.01.

Keeping in mind that the sample being analyzed is restricted to commuters, trips for work/school-related reasons are theoretically taking place *in addition* to commute trips. This tends to impose an extra burden on the travelers, which explains the heightened perception of the amount of their commute travel as the frequency of this kind of trip goes up. Such an effect may be viewed as some sort of travel saturation. There is also evidence that participants failed to completely distinguish between commute and work/school-related travel in their responses, and hence that these two purposes are somewhat confounded in the models.

Whereas in the overall short-distance model a measure of long-distance Objective Mobility by personal vehicle (number of trips) had the effect of increasing Subjective Mobility, here a measure of long-distance Objective Mobility by personal vehicle (log transformation of miles) has a negative impact on Subjective Mobility. This result is logical in that, the more miles one travels long-distance in a personal vehicle, the lower the share of total travel the commute will constitute, and hence the less it will feel like.

Both linear and quadratic forms of the commute liking variable enter the model. The parabola they constitute achieves its minimum at TL = 3.986, that is on the "like" side of the scale. The implication is that, compared to the overall model, it takes a higher liking for this category of travel for the psychological pleasure mechanism to start enhancing perceptions. The structure of this fit indicates that for most people (since most observations lie on the left side of the minimum), an elevated perception will be due to the psychological burden mechanism rather than to the pleasure mechanism. This is a natural result.

The set of Demographic explanatory variables shows some tendencies of the personal vehicle to influence perceptions. The model year variable indicates that the newer the vehicle, the lower the commute perception is. The interpretation of this is that newer vehicles provide a more comfortable, efficient and possibly higher-status means to travel, thus reducing some of the burden of commuting. The dummy variable for cars classified as "large" enters with a positive coefficient. One possible explanation for this is that large cars may be the least maneuverable in the congested traffic and tight parking situations often associated with the commute. On the other hand, the dummy variable for "small" cars also appears with a positive coefficient, perhaps because small cars tend to have fewer amenities, may feel more cramped, and be more likely to have manual transmissions — all of which would increase the burden of the commute.

Resuming our discussion about educational background tempering the perception of mobility, we suggest in the present context that we can expect the level of satisfaction with the job to increase with education. There may well be a carryover from one's attitude toward the job to one's perception of the commute required to access the job: the greater the satisfaction with the job, the greater the tolerance for the commute associated with the job (and hence the lower the assessment of the amount of commute), and conversely the lower the satisfaction with the job, the more burdensome the associated commute may be assessed to be. This argument is consistent with other studies finding that career-oriented people are more willing to accept longer commutes (Pazy, *et al.*, 1996).

It is known that, on average, commuting constitutes a major portion of the amount of short-distance travel made by a commuting person. In the dataset analyzed here, for example, commute miles represent on average 57% of the total weekly miles. In view of this fact, we might have expected the overall and the commute models to be somewhat similar. In fact, although at first glance the two models appear to have many variables unique to each, a closer look shows considerable consonance between them. Both measures of short-distance Subjective Mobility show positive relationships to several measures of short-distance Objective Mobility, especially relating to commuting. Both are negatively related to Travel Liking for commuting, and to level of education. Together, both models suggest the relative desirability of a mid-sized car, compared to either a small car or a large car, for short-distance travel. The main differences between the two models are also natural, with the overall model containing some variables relating to total travel and to short-distance personal vehicle travel, as well as the adventure seeker factor— all of which could reasonably be tapping aspects of overall short-distance travel *other* than commuting itself.

3.4 Short-Distance Work/School-Related

Here we model the assessed amount of travel for reasons related to work or school — nominally excluding commutes to those locations (although, as mentioned earlier, there is evidence suggesting that respondents confounded this two categories somewhat). A compact model containing only eight variables (plus the constant) explained nearly 40% of the variance in the dependent variable, the highest of all the short-distance models presented in this report. The final model is presented in Table 4.

As shown by the beta coefficients, the explanation of the subjectively assessed amount of work/school-related travel is strongly dominated by precisely the objective amount of this sort of travel — both frequency and (two variables related to) distance. Commute miles per week is also significant, indicating that a given amount of work/school-related travel is perceived as being greater when it comes in addition to heavier commute loads. This suggests, from a cognitive angle, a travel saturation effect (similar to the effect of work/school-related Objective Mobility on commute Subjective Mobility postulated in the previous model).

Table 4: Short-Distance Work/School-Related Subjective Mobility Results (N = 1350)

Variable	Coefficient	t	Beta
Constant	0.967	10.252	
Objective Mobility			
Frequency of travel for work/school related reasons (SD) [1, 2, …, 6]	0.323	15.372	0.411
Square of miles per week commuting to work/school [≥0]	0.00000136	3.832	0.0820
Natural log of (miles per week work/school-related + 1) (SD) [≥0]	0.135	5.888	0.193
Miles per week work/school-related (SD) [≥0]	0.00163	3.457	0.0962
Travel Liking [1, 2, …, 5]			
Work/school-related activities (LD)	0.0647	2.427	0.0522
Personality			
Loner factor score [-2.40, …, 2.29]	0.0574	2.033	0.0437
Demographics			
Personal vehicle type is compact [0, 1]	-0.236	-3.052	-0.0654
Personal vehicle type is van/minivan [0, 1]	0.329	2.762	0.0593

SD = Short Distance LD = Long Distance [ ] = range of possible or observed responses
Adjusted $R^2 = 0.387$ ($R^2 = 0.391$) F-statistic = 107.616 (p = 0.000)

The positive sign for the coefficient of "Travel Liking for long distance work/school-related trips" may represent competing preferences: the more one likes *long-distance* work/school-related trips, the more heightened is one's awareness of *short-distance* trips of this type (resenting the competition of short-distance travel with the more desired long-distance travel, one may feel the short-distance travel as more of a burden). There may also be a complementarity effect, representing those who enjoy both types of work/school-related travel and thus for whom long distance Travel Liking for such trips is an indicator of enhanced perception of short-distance mobility for the same kind of trip. Neither a linear nor a quadratic term for short-distance for work/school-related Travel Liking entered the model.

The appearance of the loner Personality trait is an interesting finding. The characteristic tendency of these individuals to be alone is likely to result in an enhanced awareness of their travel. There may be a tangential Objective Mobility component to this variable if loners are more likely to choose jobs involving more time "on the road" and hence less time in a fixed workplace requiring constant interaction with others.

The impact of vehicle characteristics appears through two dummy variables. The negative coefficient for compact cars could be interpreted to mean that these cars are the most efficient in coping with the demands posed by urban traffic. The "van/minivan" dummy variable is likely to be serving as an indicator or consequence of the demand for work/school-related travel, and hence as a proxy for Objective Mobility. This type of personal vehicle is often associated with two relevant types of trips: dropping off/picking up children at school, and work-related trips necessitating a high-capacity vehicle.

3.5 Short-Distance Entertainment/Recreation/Social

In this subsection we model perceptions of the amount of short-distance (less than 100 miles one-way) travel that is essentially recreational in nature. In contrast with the model for work/school-related travel, this time we obtained the voluminous model presented in Table 5, involving 19 significant explanatory variables plus the constant. However rich, the explanatory power of the present model (in terms of its R^2) is not superior to the compact model for work/school-related mobility perceptions, although explaining a third of the variance in those perceptions is quite respectable for disaggregate models of this type. The diversity of factors influencing perceptions of entertainment/recreation/social travel may be due to the very nature of this category. Here is where individuals are freer to choose the frequency, duration and conditions of their travel, rendering their perception less conditioned by the psychological burdens of imposed travel. In this category one's mobility is molded to a larger extent by one's personality traits, preferences, demographic characteristics, limitations and attitudes. We expect to obtain then a model expressing a closer relationship between people's subjective characteristics and their travel perceptions.

Table 5: Short-Distance Entertainment/Recreation/Social Subjective Mobility Results (N = 1275)

Variable	Coefficient	t	Beta
Constant	1.970	8.616	
Objective Mobility			
Frequency of travel for entertainment/recreation/social purposes (SD) [1, 2, …, 6]	0.259	10.328	0.275
Frequency of travel grocery shopping (SD) [1, …,6]	-0.0620	-2.570	-0.0609
Miles per week commuting to work/school [≥0]	-0.00114	-4.002	-0.170
Miles per week work/school-related (SD) [≥0]	-0.00137	-3.550	-0.106
Natural logarithm of (miles per week for entertainment/recreation/ social + 1) (SD) [≥0]	0.113	4.021	0.154
Miles per week for entertainment/recreation/social (SD) [≥0]	0.00244	2.591	0.0935
Total miles per week (SD) [≥0]	0.000490	2.096	0.102
Miles traveled by airplane (LD) [≥0]	0.00000426	-3.328	-0.0837
Natural logarithm of (miles by personal vehicle + 1) (LD) [≥0]	0.0228	3.155	0.0740
Travel Liking [1, 2, …, 5]			
Overall (SD)	0.0850	2.700	0.0679
Grocery shopping	-0.0933	-3.129	-0.0772
Attitudes			
Pro-environmental factor score [-2.3, …, 2.4]	-0.0978	-3.765	-0.0917
Lifestyle			
Workaholic factor score [-2.1, …, 2.7]	-0.0970	-3.410	-0.0808
Personality			
Adventure seeker factor score [-2.6, …, 2.7]	0.0924	3.505	0.0901
Excess Travel			
Excess Travel indicator [0, 1, …, 26]	0.0302	5.408	0.139
Demographics			
Natural logarithm of (number of years in the U.S. + 1)	-0.119	-2.525	-0.0603
Personal income [1, 2, …, 6]	-0.0329	-1.968	-0.0518

SD = Short Distance LD = Long Distance [ ] = range of possible or observed responses
Adjusted R^2 =0.334 (R^2 =0.343) F-statistic = 39.076 (p = 0.000)

Observation of the standardized coefficients reveals that assessed amounts of entertainment/ recreation/social travel are heavily influenced by the objective frequency of such trips. Two variables representing objective distance traveled for such purposes are also strongly significant, although their two beta coefficients combined are still lower than the one for trip frequency.

The miles per week traveled either to work/school or for work/school-related reasons inversely affect Subjective Mobility in this category. This comes as no surprise since the more time those trips consume, the less time will remain available for recreational trips. However, since Objective Mobility for recreational trips is already largely accounted for, perhaps a more important explanation for the negative signs of these coefficients can be found from a perceptual perspective. The nature of work-related trips is very different from that of recreational trips: the former are normally associated with obligations while the latter are associated with relaxation. It seems natural to seek some kind of balance between them and therefore, for a given amount of recreational Objective Mobility, someone would tend to perceive it as increasingly insufficient as the amount of work-related travel increases.

This was one of the models that motivated the creation of the 12 mode-specific long-distance variables that were eventually allowed to enter all the models. Initially only four long-distance variables were employed: number of trips per year, total miles of those trips, natural logarithm of the total miles, and the sum of the natural logarithm of the miles of each trip. This restricted set of variables did not always provide adequate insight into the ways long-distance Objective Mobility affected perceptions. We consequently decided to split each of them into three more fine-grained variables according to the mode of the trip, as specified in the three categories provided in the survey: personal vehicle, airplane and other. Thus, for example, an older version of the present model contained both the total miles for long-distance trips with a negative coefficient and the natural logarithm of the total long-distance miles with a positive sign. The current model contains instead the total miles for long-distance trips *by airplane* with a negative sign and the natural logarithm of the total miles for long-distance trips *by personal vehicle* with a positive sign.

Clearly the more specific variables are easier to interpret. The negative impact of long-distance airplane travel suggests a perceptual comparison argument similar to that proposed for short-distance work/school-related travel: the more one *also* travels long distances by airplane, the less a given amount of short-distance travel will seem to be by contrast. There may also be an Objective Mobility component to the effect, if those engaged in a lot of long-distance airplane travel simply have less time for short-distance recreational travel, or less inclination for it through finding recreational aspects to their long-distance travel. Finally, to the extent that long-distance airplane travel is associated with income, a higher income may help reduce the awareness of entertainment/recreation/social activities through a lower perception of the costs involved. On the other hand, the positive coefficient of long-distance travel by personal vehicle may indicate that those with lower incomes tend both to engage in more long-distance travel by personal vehicle (in lieu of flying) and to engage in recreational activities closer to home. It also suggests extrapolation of perceptions. The mode of choice for short-distance entertainment trips is predominantly the personal vehicle and the dominant purpose for personal vehicle long-distance trips is recreation, therefore it seems reasonable that the amount of the latter type of trips made would affect the perception of the former.

We believe that grocery-shopping-related travel behavior is one indicator of lifestyle preferences, and as such can tell us something about attitudes related to other types of traveling. Our model includes two variables related to grocery shopping: Travel Liking and frequency of travel, both with negative coefficients. Taking these two variables together it seems logical to associate them with some sort of substitution effect. Some people view grocery shopping as a source of recreation in itself and use it and the associated travel to some extent to satisfy their recreational needs.

There is one additional Travel Liking variable in the model: overall liking for short-distance travel. Its positive sign has an immediate Objective Mobility interpretation (the more one likes short-distance travel overall, the more one does it, implying greater amounts of discretionary travel and hence a higher perception of such travel). Here we think of the overall Travel Liking as a proxy for the liking of what we previously called the “relaxing” aspects of traveling. This is directly related to the type of travel being analyzed in this subsection and will result in generating more “relaxing” trips as well as in a higher enjoyment with its consequently enlarged awareness (perception).

In view of the nature of this dependent variable as described in the introduction of this subsection, the abundance of "psychological" explanatory variables entering the model is gratifying. The pro-environmental Attitudinal factor appears in the model. High scores on this factor represent people concerned about the reduction of air pollution. From this follows an Objective Mobility explanation of the negative sign for this coefficient: those most concerned about polluting the environment may be most likely to curtail their discretionary travel. Alternatively, they may be more likely to *rationalize* that their discretionary travel is not high compared with others, in order to reduce cognitive dissonance. Similarly, both the workaholic (negative coefficient) and adventure seeker (positive coefficient) factors may also have both Objective Mobility and psychological interpretations. The workaholic may be so focused on work that s/he actually *does* travel less for leisure activities; s/he may also mentally downplay the recreational travel s/he does do, as inconsistent with her/his self-image. The adventure-seeking Personality factor has entered the models repeatedly, consistently indicating a greater mobility perception for people with high scores, which may reflect both higher amounts of actual travel, and a view of travel (especially recreational travel) as an adventure with thereby a heightened awareness of it (enlarged perception).

We note the logical, though still interesting, finding that excess travelers have a stronger perception of these trips (notice the relatively high beta). Besides being another possible indicator of Objective Mobility, there is a clear psychological component as well: these are people for whom the trip itself is already a recreational activity.

Within the Demographic variables, we see the number of years lived in the U.S. and personal income, both with negative coefficients. The former is highly correlated with age, and in some ways a more accurate indicator of age, since the survey obtained age itself only as a five-level categorical variable. It may well be that, even controlling for a given current level of Objective Mobility, it feels like less to older respondents compared with what they used to do. On the other hand, to the extent that the variable applies directly to immigrants, it is plausible to think that the perceptual impact of a given amount of recreational travel would diminish as one settles in to a new country. Controlling for the amount of recreational short-distance travel, a higher income would act to reduce its perception, for example through a lower perception of the expenses incurred, or the availability of a better, more comfortable vehicle. This may explain the negative coefficient of the personal income coefficient. Similar effects of this variable will be seen in the *long-distance* entertainment/recreation/social model.

3.6 Short-Distance Personal Vehicle

We arrive now at the only mode-specific model we will present for short-distance travel: perception of mobility by personal vehicle. In terms of transportation mode, the culture of mobility in the U.S. is dominated by the personal vehicle. Personal vehicle use appears as an explanatory variable in eight of the other nine models in this report (including long distance personal vehicle Subjective Mobility), indicating that it is instrumental as a modifier of mobility perceptions. It is then especially interesting — and important — to try to uncover the factors affecting the perception of mobility by this means.

Table 6 summarizes the characteristics of the resulting model. The set of mode-specific Objective Mobility variables nicely illustrates the expected result that the greater the use of the personal vehicle, and the less the use of other means of transportation, the greater the perception of personal-vehicle mobility. Notice the disproportionate magnitude of the coefficient corresponding to the weekly miles traveled by personal vehicle that definitely confers it the leading role in shaping this perception. Directly connected to the mode choice is the frequency of taking others where they need to go — usually done with the personal vehicle — appearing with a positive sign.

Table 6: Short-Distance Personal Vehicle Subjective Mobility Results (N = 1348)

Variable	Coefficient	t	Beta
Constant	2.0231	6.267	
Objective Mobility			
Frequency of travel taking others where they need to go (SD) [1, 2, …, 6]	0.0518	6.267	0.0629
Natural logarithm of (miles/week by personal vehicle + 1) (SD) [≥0]	0.314	2.702	0.375
Natural logarithm of (miles per week by bus + 1) (SD) [≥0]	-0.0704	12.245	-0.0829
Miles per week by bus (SD) [≥0]	-0.00113	-2.720	-0.0580
Miles per week by BART (SD) [≥0]	-0.00155	-2.404	-0.0881
Miles per week walking (SD) [≥0]	-0.00712	-3.912	-0.0883
Square of commute distance [≥0]	0.0000706	-3.845	0.0526
Travel Liking [1, 2, …, 5]			
Personal vehicle (SD)	-0.306	-1.900	-0.306
Personal vehicle squared (SD)	0.0697	2.890	0.0697
Lifestyle			
Family oriented factor score [-3.9, …, 2.1]	0.0953	2.664	0.0599
Frustration factor score [-2.0, …, 2.7]	0.0894	2.747	0.0625
Personality			
Adventure seeker factor score [-2.6, …, 2.7]	0.0688	2.237	0.0519
Mobility Constraints			
Percentage of time a personal vehicle is available [0, 20, …, 100]	0.00368	2.758	0.0782
Degree of limitation on walking [1, 2, 3]	0.261	2.159	0.0476

SD = Short Distance LD = Long Distance [ ] = range of possible or observed responses
Adjusted R^2 =0.353 (R^2 = 0.360) F-statistic = 53.531 (p = 0.000)

Commute distance was also expected among the explanatory variables. Here it enters the model through a square transformation, with an intuitive positive sign. This naturally derives from the personal vehicle being the dominant mode chosen for commuting. It may reflect also an increasing probability of choosing the personal vehicle to commute to work/school as the distance of the commute grows.

This model includes the short-distance personal vehicle Travel Liking variable and its quadratic transformation. Assuming $SM = 0.0697 \times TL^2 - 0.306 \times TL + const$, a minimum is found at $TL = 2.20$, indicating that values of Travel Liking toward both ends of the scale have positive impacts on Subjective Mobility.

People with high scores on the family-oriented Lifestyle factor give importance to spending time with family and friends. Out-of-home activities with the family are a source of personal-vehicle use, which leads to an Objective Mobility interpretation of this coefficient. On the other hand, a “psychological burden” interpretation in which the respondent feels keenly that the personal vehicle travel s/he is required to do (e.g. for work) prevents him/her from spending desired time with the family is also plausible.

Certain variables posed particular challenges to interpretation — the frustrated Lifestyle factor (having a positive coefficient) being one of them. People with high scores on this factor are generally unsatisfied with their lives. Perhaps for these people, traveling represents some sort of escape from their problems, which would induce them to travel more (i.e. have a higher Objective Mobility, leading to a higher Subjective Mobility). We can also think of a perceptual interpretation if we take Objective Mobility as fixed. To people who are already frustrated in general, the inconveniences of travel by personal vehicle (e.g. congestion, lack of parking) are likely to be amplified in their minds, causing them to exaggerate their perception of the amount of travel in this category. Conversely, those who are satisfied with life in general may consider the inconveniences of personal-vehicle travel to be trivial, and pay less attention to them, thereby reducing their perception of the amount of personal-vehicle travel they do.

Once again we encounter the adventure-seeking Personality factor. The interpretation of its positive coefficient is similar to what we outlined in previous models.

The Mobility Constraints category incorporates a couple of interesting explanatory variables. The percentage of time a vehicle is available has an immediate Objective Mobility explanation. In fact most of the explanatory variables in these models could be interpreted to varying degrees through similar arguments. It is clear however, and we have been witnessing this through the examination of the preceding models, that this rich set of variables has more to say than just "Objective Mobility". The concept of perception relates to our appreciation of reality, so the real challenge of this modeling effort resides in understanding the factors determining discrepancies between reality (Objective Mobility) and cognition (Subjective Mobility). With this in mind, consider two people with identical mobility by personal vehicle. It is likely that the one with higher vehicle availability would have his/her vehicle needs more satisfied than the one with a lower availability who probably does not have a higher mobility precisely because of not having access to a vehicle. Further, when a vehicle is readily available, Subjective Mobility is likely to be influenced not only by the trips made but also by the ones that *can* be made. There is then a feeling of mobility freedom that may tend to enlarge the Subjective Mobility.

The positive coefficient for the variable indicating physical or mental limitations on walking is another good example of the possible incompleteness of an Objective Mobility interpretation. We can explain the perceptual nature of this variable with the argument that people with limitations on walking perceive themselves as mode captives, whose mobility is extremely dependent on a personal vehicle. Thus, for a fixed level of Objective Mobility by personal vehicle, walk-constrained individuals are likely to perceive higher levels of personal-vehicle mobility than unconstrained individuals, considering the personal-vehicle share of their total travel, or comparing themselves to peers who accomplish some of the same activities by walking. In social psychology, this mental process is known as *relative deprivation* (e.g. Myers, 1999).

3.7 Long-Distance Overall

We turn now to the models of Subjective Mobility for *long-distance* travel. Again we presented to the respondents first the question about overall mobility perception. The results of our regression model are presented in Table 7.

In the discussion of the model for overall short-distance mobility perception we commented on the heterogeneity of short-distance travel as a justification of the relatively low R^2 obtained. In view of this, the relatively high R^2 (0.31) yielded by the long distance overall model could come as a surprise. While long distance travel can also be quite diverse in distance and destination, it is probably less diverse than short-distance travel in terms of purpose and modes used. Apparently, either that greater homogeneity results in less variability in overall ratings of long-distance Subjective Mobility, or else the variables available to us are more successful in explaining the variability in long distance ratings than for short distance measures.

Table 7: Long-Distance Overall Subjective Mobility Results (N = 1342)

Variable	Coefficient	t	Beta
Constant	1.184	6.927	
Objective Mobility			
Frequency of travel for entertainment/recreation/social (SD) [1, 2, …, 6]	0.0832	3.405	0.0831
Miles per week by personal vehicle (SD) [≥0]	0.000554	4.272	0.100
Natural logarithm of (total miles by airplane + 1) (LD) [≥0]	0.0318	4.341	0.115
Natural logarithm of (total miles by personal vehicle + 1) (LD) [≥0]	0.0453	5.935	0.139
Number of trips by airplane (LD) [1, 2, …]	0.0351	12.041	0.320
Total miles by other means (LD) [≥0]	0.0000448	4.681	0.108
Travel Liking [1, 2, …, 5]			
Overall (LD)	0.141	4.520	0.125
Airplane (LD)	-0.07608	-2.889	-0.0796
Personality			
Adventure seeker factor score [-2.6, …, 2.7]	0.142	5.124	0.131
Demographics			
Personal vehicle type is van/minivan [0, 1]	0.317	3.062	0.0703
Natural logarithm of the age category (ln [1, 2, …, 5])	0.224	2.666	0.0628

SD = Short Distance LD = Long Distance [ ] = range of possible or observed responses
Adjusted R^2 =0.308 (R^2 = 0.308) F-statistic = 53.916 (p = 0.000)

The model is dominated by a group of long-distance Objective Mobility variables that present a mode-specific picture of how Objective Mobility affects overall perception. Several interesting findings appear within this group. First, although distance traveled by each mode has the expected positive impact on Subjective Mobility, distance traveled by airplane has the highest impact on perception. Thus, a given amount of air travel feels like more than an equivalent amount of personal vehicle travel. This may be initially a somewhat unexpected result, since a 3,000-mile trip by auto might be expected to feel like a greater amount of travel than an equally-long trip by air. However, in our sample there are very few of such long-distance auto trips; most air trips are far longer than most auto trips. Thus, this result is likely confounding mode and distance, with the greater perceptual weight of air travel primarily due to its longer trips. Second, for a given amount of air mileage, the assessed amount of overall long distance travel increases with the number of trips involved — both due to the explicit "number of trips by airplane" variable, and to the particular transformation of the distance by airplane variable, which as noted in Section 2 gives some weight to the number of trips comprising a given distance. This is a logical result: 4,000 air miles traveled in four trips will seem like more travel than the same distance covered in one trip.

The positive coefficient of the short-distance weekly miles by personal vehicle can be attributed to a travel-saturation effect: the more one also travels at the local level, the greater a fixed amount of long distance travel is apt to feel. This may result from two different forms of travel saturation: travel need fulfillment or travel time budget exhaustion. The former relates to the subjective capacity of tolerance for traveling. We all feel the need to do some amount of travel and therefore welcome some traveling, which then constitutes (at least to some extent) a pleasant experience. Once the amount (and quality) of travel we do has satisfied such need, any additional travel can be considered *unwanted*, and will thus constitute a not-so-pleasant experience. It seems reasonable to think that the accumulation of such unwanted travel will result in increasingly burdensome traveling experiences which eventually will lead to a state of saturation — our tolerance for traveling would have been virtually exhausted. The concept of the travel time budget is here understood as the objective side of travel saturation. In general terms, we can think that an individual has a certain amount of time that s/he can (as opposed to wants to) devote to traveling (of course this amount will vary across individuals). S/he has then to allocate a number of travel purposes within this budget, creating the conditions for different travel purposes to compete with one another. In this specific case, the greater the demand for short-distance personal-vehicle travel, the more intrusive long-distance travel may be perceived to be. The two saturation effects just described should not be viewed as independent from each other — they are rather likely to interact in complex ways. For example, travel needs are usually purpose-related so, if one's travel time budget does not allow one to allocate time to a type of travel s/he would like to do, the enlarging effect on perception will be especially important.

The positive coefficient of the short-distance weekly miles by personal vehicle may also represent some confounding of short- and long-distance Objective Mobility, with respondents including some of their short-distance travel in their rating of overall long-distance travel.

Similar arguments can be made for the positive effect of the frequency of short-distance entertainment/recreation/social travel.

The two Travel Liking variables in this model exhibit the complex relationship to Subjective Mobility that we have now come to expect. The negative sign of liking for airplane travel represents the "psychological burden" view of travel: for a given amount of air travel (accounted for by the Objective Mobility variables for airplane miles and frequency), the more one likes airplane travel (a substantial component of overall long-distance travel), the lower the perceived amount of overall travel (i.e. the less of a burden it is). The positive sign of the overall Travel Liking variable, on the other hand, represents the "psychological pleasure" view of travel: the more one likes long-distance travel overall, the greater the intensity of the perception of the amount one does. (The effect of Travel Liking through Objective Mobility may also be a factor here.) The net impact of both variables will generally be positive; only when the rated liking for airplane travel is at least one point higher than the overall Travel Liking will the impact be neutral to negative.

The adventure-seeker Personality factor appears in this model as well, and needs no further explanation.

Two Demographic variables enter the model. The positive sign of the transformed age category may indicate travel becoming more burdensome with age, and/or the higher Objective Mobility derived from the rise in income with age. As for the van/minivan dummy variable, a vehicle type choice study based on our dataset (Choo and Mokhtarian, 2002) verified that this type of vehicle is associated with larger households with children, and female/homemaker drivers. Thus, the positive coefficient of this variable may represent two different effects: long-distance trips taken with family may be rather burdensome when children are in the group, and long-distance trips without family may be more stressful for those (especially women) with children left at home.

3.8 Long-Distance Work/School-Related

Although the final model for long-distance work/school-related Subjective Mobility is not as parsimonious as its short-distance counterpart in Table 4, the 12 significant variables plus the constant term still explain a respectable 32% of the variance in the dependent variable. The results are presented in Table 8.

The impact of Objective Mobility on the perception of work-related long-distance mobility is strongly (positively) influenced by the frequency of air trips, complemented by a transformation of the mileage of these trips. This is natural since air is the dominant mode for long-distance work/school-related travel, constituting 54% of the trips and an estimated 87% of the miles for this purpose (keeping in mind that our measures of long-distance trip distances are only approximate).

The beta coefficient corresponding to the number of air trips is nearly three times as large as the one for the number of long-distance trips by personal vehicle. The fact that an airplane trip contributes more strongly to the perceived amount of travel than does a personal vehicle trip is logical, on the assumption that the typical airplane trip will be much longer than the typical personal vehicle trip. Two short-distance Objective Mobility variables appear in the model with positive coefficients: the frequency of work/school-related travel and the one-way commute distance. Both seem to point to a saturation effect, indicating that the more short-distance travel (for related purposes) one does, the greater a fixed amount of long-distance travel is perceived to be. A confounding of short and long distance is also possible, similar to effects seen in several short-distance models.

Table 8: Long-Distance Work/School-Related Subjective Mobility Results (N = 1313)

Variable	Coefficient	t	Beta
Constant	0.546	3.249	
Objective Mobility			
Frequency of work/school-related trips (SD) [1, 2, …, 6]	0.114	6.034	0.141
Commute distance [≥0]	0.0110	5.580	0.131
Number of trips by airplane (LD) [1, 2, …]	0.0419	11.032	0.306
Number of trips by personal vehicle (LD) [1, 2, …]	0.00529	3.790	0.0883
Natural logarithms of (miles by airplane + 1) (LD) [≥0]	0.0311	3.379	0.0896
Travel Liking [1, 2, …, 5]			
Overall (LD)	-0.102	-2.847	-0.0720
Work/school-related activities (LD)	0.183	5.756	0.144
Personality			
Organizer factor score [-2.9, …, 2.6]	0.0907	2.567	0.0598
Adventure seeker factor score [-2.6, …, 2.7]	0.0903	2.633	0.0661
Demographics			
Personal income category [1, 2, …, 6]	0.104	4.769	0.123
Personal vehicle type is SUV [0, 1]	-0.225	-2.477	-0.0572

SD = Short Distance LD = Long Distance [ ] = range of possible or observed responses
Adjusted $R^2 = 0.313$ ($R^2 = 0.318$) F-statistic = 55.263 (p = 0.000)

The positive sign for the first of the Travel Liking variables — for work/school-related purposes — suggests the "psychological pleasure" interpretation, with enjoyment of the travel intensifying the perception of the amount. On the other hand, overall Travel Liking has the opposite sign, consistent with the "psychological burden" interpretation. Taking these two variables together, we see that the net impact will generally be positive. Only when overall Travel Liking is at least one point higher than the liking specifically for work-related travel will the net impact be neutral or negative. This is a natural result, since if one likes other long distance travel (presumably recreational) much more than work-related long distance travel, the latter type of travel will seem more burdensome in a relative sense.

Two Personality variables are significant, with positive coefficients: the adventure-seeking factor (familiar from previous models) and the organizer-type factor. People with a high score on the latter factor (who felt they fitted descriptions such as "like to be in charge", "aggressive" and "ambitious") are more likely to hold managerial (or independent-contractor-type) positions that may tend to involve more travel than average (making this variable another Objective Mobility indicator). There may be a link to income (which is also significant in the model) as well, with higher income being both an effect of managerial occupations and an independent generator of increased Objective Mobility (through the availability of greater discretionary income for leisure travel).

Among the significant Demographic variables we find the dummy variable representing driving a sport utility vehicle. SUVs are often marketed to appeal to a love for driving for its own sake, and hence a coefficient of either sign could have been plausible, similar to the dual nature of the effect of Travel Liking discussed earlier. The fact that the negative impact dominates may also reflect an Objective Mobility component, since a preference for travel in the SUV may result in less total distance traveled than if air travel were given priority. The positive coefficient of the personal income variable has a rather straightforward interpretation, in that people with higher incomes engage more often in this kind of travel, thus enhancing their subjective assessment.

One possible cognitive interpretation of this coefficient is that higher incomes could make the travel experience more enjoyable through, for example, the comfort of better personal vehicles, flying first or business class instead of coach, or staying at the destination for longer periods of time.

3.9 Long-Distance Entertainment/Recreation/Social

Like the preceding model, the model for long distance entertainment/recreation/social Subjective Mobility is not as successful (in terms of goodness of fit) as its short-distance counterpart, explaining nearly a quarter of the variance in the dependent variable, compared to 34% of the variance for the short distance model (but using three fewer variables).

The Objective Mobility group of explanatory variables presented in Table 9 is led by transformations of the mode-specific miles covered in long-distance trips, with the expected positive signs. It is interesting the degree to which *short-distance* entertainment/recreation/social mobility has an impact on the long-distance perception of the same sort of travel. The positive coefficients for the frequency and weekly miles of short-distance entertainment/recreation/social trips may represent an extrapolated perception of short-distance mobility to the long-distance context, although it seems primarily to be a complementary lifestyle indicator — people actively traveling for recreation in the short-distance range are likely to be active in the long-distance range as well. This lifestyle interpretation can be extended to the positive coefficient of the weekly-miles traveled to eat a meal. Two variables within this category carry negative coefficients: a transformation of the average commute time and the weekly miles traveled for work/school-related purposes. As in many other cases, these variables may have both Objective Mobility and psychological interpretations. Objectively, they may represent a substitution effect, with people who are more focused on local work-related activities having less time and/or inclination for long-distance recreational travel. The psychological interpretation seems more plausible, however: if two people have identical amounts of objective travel for long-distance recreational purposes, the one with more short-distance work-related travel may rate his/her long-distance mobility lower because it feels like a lower proportion of his/her total travel.

One of our six attitudinal factors entered the solution: travel freedom. The positive sign of its coefficient points to the correlation between mobility freedom and Objective Mobility. Feeling freer to travel will result not only in a higher actual mobility but potentially also in a more positive perception of present actual mobility. The Travel Liking variable corresponding to the category of the dependent variable (long-distance entertainment/recreation/social travel) also enters with a positive sign, consistent with the combination Objective Mobility/psychological pleasure interpretation given to Travel Liking earlier.

The workaholic Lifestyle factor enters with a negative sign just as it did in the short-distance version of this model (shown in Table 5 of Section 3.5). The interpretation of this variable thus follows what we outlined there, based on an assumed self-restriction of actual recreational mobility, as well as a rationalization effect minimizing the perception of the amount of such travel.

The Excess Travel indicator appears just as it did in the *short-distance* model for entertainment/recreation/social/entertainment mobility perception — the interpretation is then similar.

Table 9: Long-Distance Entertainment/Recreation/Social Subjective Mobility Results (N = 1243)

Variable	Coefficient	t	Beta
Constant	0.488	2.621	
Objective Mobility			
Frequency of travel for entertainment/recreation/social (SD) [1, 2, …, 6]	0.116	3.848	0.106
Miles per week work/school-related (SD) [≥0]	-0.000740	-1.942	-0.0492
Miles per week for entertainment/recreation/social (SD) [≥0]	0.00258	3.205	0.0852
Miles per week to eat a meal (SD) [≥0]	0.00438	2.200	0.0577
Square of the average commute time [≥0]	-0.0000499	-3.598	-0.0906
Natural logarithm of (total miles by personal vehicle + 1) (LD) [≥0]	0.0500	5.527	0.141
Natural logarithm of (total miles by airplane + 1) (LD) [≥0]	0.0253	3.068	0.0842
Total miles by other means (LD) [≥0]	0.0000370	3.350	0.0836
Travel Liking [1, 2, …, 5]			
Entertainment/recreation/social (LD)	0.161	5.460	0.140
Attitudes			
Travel freedom [-3.0, …, 2.3]	0.0886	2.373	0.0621
Lifestyle			
Workaholic factor score [-2.1, …, 2.7]	-0.0883	-2.476	-0.0636
Excess-Travel			
Excess Travel indicator [0, 1, …, 26]	0.0336	5.021	0.134
Demographics			
Personal vehicle type is SUV [0, 1]	0.205	2.402	0.0599
Educational background [1, 2, …, 6]	0.0701	3.006	0.0817
Personal income category [1, 2, …, 6]	-0.0799	-2.999	-0.109
Natural logarithm of household income category (ln[1, 2, …, 6])	0.267	3.020	0.105

SD = Short Distance LD = Long Distance [ ] = range of possible or observed responses
Adjusted R^2 =0.227 (R^2 = 0.237) F-statistic = 23.837 (p = 0.000)

During the analysis of the long-distance work-related model we discussed the negative sign for the SUV dummy variable. As we mentioned there, either sign on this variable is plausible and now we encounter it with the opposite sign. Again, this variable can represent both Objective Mobility and psychological effects. The psychological argument suggests that drivers of sport utility vehicles may have a greater-than-average tendency to love travel and adventure, and hence to experience an intensified perception of their recreational travel.

The positive coefficient of educational background may be interpreted from various angles. It seems reasonable to expect a third-party effect here, where higher education leads to higher long-distance mobility through higher incomes and greater incidence of white-collar occupations. Individuals with higher education and higher income may also be more aware of, more inclined toward, and more able to afford more distant and unusual destinations, which in turn would increase their perception of those experiences.

Interpreting the combination of the natural logarithm of the household income (positive coefficient) with personal income (negative coefficient) required some ingenuity. When the former was dropped from the model, the number of workers in the household entered the model, and this gave us a clue to understanding the combination of income variables. When recreational long-distance Objective Mobility is controlled for, the greater one's personal income the less s/he may perceive s/he travels since s/he feels s/he could actually do it more. There may be an added "grass-is-always-greener" effect in which s/he feels s/he is not traveling as much as his/her peers with comparable income.

When there is only one income in the household, the overall effect of the income variables will be negative and the argument above remains valid. When there are additional household members contributing to the total income we can draw two conclusions: first, we have for certain now a group/family sharing the household and second, the financial comfort of the group will be higher. These two facts give optimal conditions for the respondent to embark on long-distance recreational trips, since s/he would both be financially able and have a ready supply of companions (who may both stimulate the demand for more trips and increase their enjoyment). This would explain the positive sign for the natural logarithm of the household income, and the positive net impact of both income variables when household income is at least one category higher than personal income.

3.10 Long-Distance Personal Vehicle

This subsection introduces the first of two mode-specific models of long-distance mobility perception that we present in this report. The results presented in Table 10 confirm the trend shown by the preceding models of the relatively lower goodness of fit of the long-distance specific models vis-à-vis their short-distance counterparts. In this case the contrast is not surprising since the use of a personal vehicle for long-distance trips is a more complex decision to make (compared to its use for short-distance trips, which is a given for most Americans) with more diverse implications for the perception of such trips.

Table 10: Long-Distance Personal Vehicle Subjective Mobility Results (N = 1284)

Variable	Coefficient	t	Beta
Constant	0.841	5.187	
Objective Mobility			
Natural logarithm of (miles/week by personal vehicle + 1) (SD) [≥0]	0.153	6.721	0.173
Natural logarithm of (total miles by personal vehicle + 1) (LD) [≥0]	0.107	9.697	0.254
Number of trips by personal vehicle (LD) [1, 2, …]	0.00531	3.352	0.0858
Total miles by airplane (LD) [≥0]	-0.00000633	-3.679	-0.0904
Travel Liking [1, 2, …, 5]			
Personal vehicle (LD)	0.176	5.355	0.135
Attitudes			
Pro-high-density factor score [-2.5, …, 2.6]	-0.169	-4.167	-0.109
Excess Travel			
Excess Travel indicator [0, 1, …, 26]	0.0306	4.102	0.104
Demographics			
Personal vehicle type is van/minivan [0, 1]	0.378	2.688	0.0651

SD = Short Distance LD = Long Distance [ ] = range of possible or observed responses
Adjusted R^2 =0.226 (R^2 = 0.231) F-statistic = 47.778 (p = 0.000)

We see, as expected, the Objective Mobility variables dominated by those reflecting the level of use of the personal vehicle. Most interestingly, the same variable (log of short-distance personal vehicle weekly miles) that was most influential in the *short-distance* model appears again here (still with a positive sign and with a beta coefficient second only to that of long-distance personal vehicle miles), which seems to indicate the presence of both extrapolation and saturation effects. When reporting perceptions, the respondents may experience conscious and subconscious difficulties in distinguishing short-distance from long-distance travel. These difficulties may lead to perceptions being extrapolated from one distance range to the other.

The liking for long-distance traveling by personal vehicle enters the model with a positive coefficient, consistent with the short-distance results. Again we attribute this to enhanced perception engendered by the enjoyment of this type of travel, and to possible additional Objective Mobility effects not captured by the pertinent variables.

Finding the pro-high-density attitudinal factor in the solution with a negative coefficient is interesting. Preferring high-density mixed-use residential neighborhoods may be associated with a preference for modes other than the automobile (i.e. walking and transit for short-distance trips, and airplane for long-distance trips), which may result in lower Objective Mobility with respect to long-distance personal-vehicle travel. Stereotypically, a preference for long automobile vacations is more likely to be associated with family-oriented suburbanites than with younger, professional, urban dwellers. Some evidence for this stereotype is found in the model for Objective Mobility with respect to long-distance personal-vehicle travel (Table 11 in Redmond and Mokhtarian, 2001b), in which a dummy variable for residents of the suburb of Concord had a significant and positive coefficient. There may also be a psychological component to this variable, expressing a saturation or travel-time budget effect: for a given objective amount of long-distance personal-vehicle travel, the suburbanite, who has a lot of short-distance personal-vehicle travel compared to the urbanite, will perceive his/her long-distance mobility more intensely (and conversely the urbanite will perceive his/her long-distance mobility comparatively less intensely).

Once again we obtain the Excess Travel indicator with a positive coefficient and hence with an interpretation similar to that in previous models.

The interpretation of the positive coefficient for drivers of vans/minivans is similar to that for the long-distance overall model found in Table 7 of Section 3.7. There may be also an Objective Mobility interpretation similar to that in Table 4. Alternatively, long-distance personal-vehicle trips with family may be memorable for positive reasons as well.

3.11 Long-Distance Airplane

Table 11 reports the highest adjusted R^2 of all the models in this report — 0.43 — which is quite high for disaggregate models of travel-related measures. One possible reason for the relative goodness of fit of this model may be that trips by airplane are still, even today, more accessible to those with higher incomes. Many of the variables in the final model shown in Table 11 relate to income and/or an affluent lifestyle. Adding them to a set of Travel Liking characteristics seems to suffice to explain a considerable amount of the perception of air mobility.

Two objective measures of the distance traveled by airplane are significant, with self-explanatory positive coefficients. The number of airplane trips taken is also significant (and positive), indicating that each trip carries a perceptual "overhead" regardless of length. Long-distance miles traveled by personal vehicle has a negative coefficient, indicating a perceptual balance effect: the more one travels by personal vehicle, the smaller the share of total long-distance travel a given amount of air travel will be, and hence the less it will feel like. The positive impact of the frequency of short-distance trips to eat a meal is probably representing an income/lifestyle effect.

The Travel Liking variables, once again, posed a challenge to variable selection and interpretation. A number of short-distance variables in this group were excluded from the model because of lacking enough justification for the intended direction of causality. The overall goodness of fit of the model remained virtually oblivious to this variable selection, with alternative, more interpretable Travel Liking variables superseding the excluded ones.

The liking for overall and recreational long-distance travel promotes higher levels of Objective Mobility by airplane, which is in accordance with the positive signs of their coefficients. They may also increase the rating of the perceived amount of travel through the higher awareness deriving from the enjoyment of long-distance trips.

Table 11: Long-Distance Airplane Subjective Mobility Results (N = 1284)

Variable	Coefficient	t	Beta
Constant	1.125	5.523	
Objective Mobility			
Frequency of trips to eat a meal (SD) [1, 2, …, 6]	0.0693	2.761	0.0603
Number of trips by airplane (LD) [1, 2, …]	0.0322	9.719	0.250
Natural logarithm of (total miles by airplane + 1) (LD) [≥0]	0.114	13.608	0.349
Total miles by personal vehicle (LD) [≥0]	-0.0000177	-3.132	-0.0676
Travel Liking [1, 2, …, 5]			
Taking others where they need to go (SD)	0.0664	2.263	0.0487
Overall (LD)	0.112	2.737	0.0842
Entertainment/recreation/social (LD)	0.0729	1.989	0.0583
Personal vehicle (LD)	-0.110	-3.793	-0.0912
Personality			
Adventure seeker factor score [-2.6, …, 2.7]	0.125	4.170	0.0967
Mobility Constraints			
Percentage of time a vehicle is available [0, 20, …, 100]	-0.00318	-3.185	-0.0705
Demographics			
Male (dummy variable) [0, 1]	-0.0909	-1.755	-0.0394
Number of persons between 6 and 15 years old in the household [0, 1, 2, …]	-0.103	-2.425	-0.0530
Personal income category [1, 2, …, 6]	0.0717	3.570	0.0896

SD = Short Distance LD = Long Distance [ ] = range of possible or observed responses
Adjusted R^2 =0.429 (R^2 = 0.435) F-statistic = 69.747 (p = 0.000)

The negative coefficient of personal vehicle Travel Liking also has an Objective Mobility flavor since a liking for long-distance personal vehicle travel is likely to result in trips taken by car instead of airplane. However, it can also be explained by a perceptual argument: people tolerant of long distance trips by personal vehicle should find airplane travel to be even less burdensome, and would therefore have an attenuated perception of such trips. The liking for taking others where they need to go is the only short-distance variable within this subgroup, and is considered an indicator of a family-oriented lifestyle. As such, the variable has an interpretation similar to that of the minivan dummy in the long-distance overall and personal vehicle models (Tables 7 and 10).

The only factor score significant in this model is the adventure seeker Personality, with its familiar positive coefficient.

Turning to the Mobility Constraint and Demographic variables, we find that perception diminishes as personal vehicle availability increases. Although one might not have expected this variable to be significant *a priori*, it is plausible that the less available a car is to the respondent, the greater significance a fixed amount of airplane travel will acquire in his/her mind. Income was anticipated to appear in this model, and as expected, personal income has a positive impact on perception. The interpretation is similar to that for the long-distance work/school-related model (Table 8 of Section 3.8): higher income can stimulate the demand for more, and more expensive, travel directly, as well as being an indicator of occupations involving greater long-distance travel. Controlling for income, the more school-age children there are in the household, the less time and disposable income there will be to spend on air travel. There may be a perceptual as well as an objective component to this effect, with the presence of children feeling like a constraint on the ability to travel by air as much as desired, even when objectively the individual flies as much as someone without children.

The male dummy variable (male = one) indicates that men perceive a given amount of airplane travel as being less than women do. There may be an Objective Mobility component to this, since the corresponding model for Objective Mobility (Table 12 in Redmond and Mokhtarian, 2001b) shows that, all else being equal, women travel more by air than do men. There is probably also a psychological component, however, with women being more likely to feel an absence from home, particularly for work-related trips taking them away from their family.

4. DISCUSSION AND CONCLUSIONS

4.1 Overview of Results

The adjusted R^2s obtained for the models range from and 0.211 for long-distance entertainment/recreation/social Subjective Mobility, to 0.415 for long-distance airplane Subjective Mobility.

We commented in Section 2.2 on the subtle interconnectedness between the independent variables and how this could lead to multi-layered interpretations. In view of this, we shall not pay *excessive* attention to which precise variables entered the models more frequently. While, say, income itself could have entered a certain model, it may be represented by another variable in a different model. We will then comment on the explanatory variables in broader terms.

Table 12 summarizes the direction of impact for each significant variable in the 10 models presented here, and forms the basis for the following discussion.

Every model is led by one or (more often) several explanatory variables indicative of the Objective Mobility for the specific context given by the dependent variable. For instance, commute travel perceptions are strongly influenced by the square root of the average commute time and the frequency of commuting. In nearly every case, variables representing both trip frequency and total distance are significant, suggesting that both these measures of Objective Mobility are important to individuals' assessment of their Subjective Mobility.

Some secondary Objective Mobility variables are usually found, which convey illustrative information regarding lifestyles and demographics. These variables improved the model by representing multi-faceted aspects of the individual, including capturing characteristics not contained in our set of four Lifestyle factors.

To investigate the extent of the role played by the Objective Mobility variables in these models, we re-estimated each model in two ways. In the first way, we allowed only the originally-significant Objective Mobility variables to enter. The R^2s for the resulting models (denoted R^2_{OM}) are presented in Table 12, and the proportions of the full-model R^2s that are accounted for by the Objective-Mobility-only models are also presented. These proportions constitute upper bounds for the influence of the indicated Objective Mobility variables on Subjective Mobility, since when some variables are excluded from the original models, the remaining included variables (to the extent that they are correlated with the excluded variables) pick up some of their explanatory power.

Secondly, we re-estimated each model *excluding* the originally-significant Objective Mobility variables, and subtracted the resulting $R^2_{non\text{-}OM}$ from R^2_{full} to obtain another measure of the impact of Objective Mobility on Subjective Mobility. The latter approach constitutes a lower bound for the contribution of Objective Mobility, since the included non-Objective-Mobility variables will be picking up some of the explanatory power of the excluded Objective Mobility variables with which they are correlated. These lower-bound measures are also presented in Table 12, together with the proportion they represent of the respective R^2_{full}.

The results show that Objective Mobility does indeed carry the bulk of the explanatory power for these models, with proportions ranging from 0.34 and 0.69 (lower and upper bound, respectively, for long-distance entertainment/recreation/social) to 0.94 and 0.98 (for short-distance work/school related). The lower-bound contribution of Objective Mobility exceeded 50% of the variance explained in at least seven out of the 10 models estimated (and exceeded 50% in all 10, if the midpoint between the lower and upper bounds is taken as the contribution). As a general trend, the higher the original model R^2, the higher the proportion of that explained variance that is attributable to Objective Mobility.

The vehicle type dummy variables repeatedly appeared in the results. This is a clear indication that vehicle type influences one's subjective assessment of mobility. Interestingly, none of these variables appear in the model for the perception of short-distance travel by personal vehicle, which suggests that the role of vehicle type in molding perceptions is related to particular trip purposes. There is also an association of specific vehicle types with local versus long-distance travel: vehicle type dummy variables related specifically to *cars* (small, compact, mid-sized, and large) affect only models for short-distance Subjective Mobility, while the long-distance models show only SUV and van/minivan vehicle-type dummy variables.

Two variables deserve special mention: the adventure-seeker Personality factor and the Excess Travel indicator. The first appears in six of the models while the second does so in three and they consistently elevate mobility perception. People with high scores on these variables are likely to engage in substantial amounts of travel, which will in turn elevate their Subjective Mobility. Besides this interpretation, we argue that these people have a higher enjoyment of the travel experience. Also, "traveling" is likely to be a very important concept in the self-image of these people. Their cognitive processes are likely then to be influenced by a drive to satisfy their self-image.

The educational background and income level seem to interact to influence mobility perception in an interesting way. These variables, and related proxies, tend to deflate mobility perception of short-distance travel, while they inflate it for long-distance travel. The negative impact on short-distance mobility perception contrasts with the positive impact that personal income showed on Objective Mobility. More positive attitudes toward the commute (due to higher levels of satisfaction with one's job as education and income increase) and the orientation of concerns toward more intellectual/occupational issues help interpret the negative coefficients of these variables in the short-distance models. A more pronounced inclination and financial accessibility to long-distance travel seem to explain the positive signs in the long-distance models.

The male dummy variable appears in only one model (long distance airplane), although our interpretations of some coefficients in other models involved gender differences either in roles or perceptions. In contrast, five of the 11 models for Objective Mobility contained a significant gender variable. Specifically, it was found that, all else being equal, women travel less in the short-distance range overall, commute less, and do less work/school-related long-distance travel, while they engage in more entertainment and airplane long-distance travel.

4.2 Effects of Travel Liking on Subjective Mobility

Travel Liking is the category of explanatory variables that exhibited greatest complexity in terms of interpretability. The somewhat unclear direction of causality these variables showed at times highlights the necessity of a structural-equations approach to model the multi-directional relationships between the key endogenous variables: Objective Mobility, Subjective Mobility, Travel Liking and Relative Desired Mobility.

Travel Liking constitutes in actuality an indicator of attitude — specifically one's affective attitude toward traveling. Thus, our dataset provides us information about attitudes toward traveling specific to modes and purposes. Socio-psychological research shows that attitudes become better predictors of behavior when the attitudes relate to the specific behavior in question (Myers, 1999). However, other factors affect the correlation between attitude and behavior, like external constraints on a certain behavior.

It is interesting to note that in only four of the 11 models of Objective Mobility (Redmond and Mokhtarian, 2001b) was a Travel Liking variable significant in explaining the actual amount of travel done in the corresponding category (short distance entertainment and walking, and long-distance work-related and personal vehicle). By contrast, Travel Liking variables are explicitly significant to the corresponding measure of Subjective Mobility in seven of the 10 models presented here (the pertinent cells in Table 12 are shaded). We contend, further, that the corresponding Travel Liking variable is implicitly significant in the model for short-distance work/school-related Subjective Mobility[3]. These results suggest that, although variables other than mode- and purpose-specific travel attitudes are the primary causes of actual mobility, these attitudes enter the process by adjusting perceptions (of mobility). Thus, for example, although one's liking for short-distance travel by personal vehicle did not directly influence Objective Mobility in that category, it did intensify one's subjective assessment of mobility in that category.

Although our initial hypothesis was that Travel Liking would have a negative impact on Subjective Mobility, we found this to be directly the case for only one model out of 10: the one for commuting. Upon further reflection, we identified two plausible ways in which the effect could be positive. First, Travel Liking (through its positive link to Objective Mobility) may be indirectly capturing some of the positive effect of Objective Mobility on Subjective Mobility. Second, it may well be that the liking for a certain type of travel *enhances* rather than *diminishes* the awareness of that travel.

Thus, we suggest that, theoretically, Subjective Mobility increases when we move to either extreme of the Travel Liking scale. For a fixed amount of volitional travel of a certain type, the more one enjoys that particular kind of travel, the more readily one may recover those experiences from the memory, and thus the higher one's subjective assessment of that amount of travel will be. (This is not to argue that subjective assessments can be reduced to a memory retrieval process, but rather that memory retrieval is the part of the subjective assessment process that Travel Liking affects.) On the other hand, if one dislikes a particular category of travel, the actual travel s/he has to do regardless of that dislike may increase the subjective assessment of that amount of travel.

[3] The model for short-distance work/school-related Subjective Mobility includes only the *long-distance* version of the corresponding Travel Liking variable. However, the relatively high correlation between short- and long-distance work/school-related Travel Liking (0.32) suggests that the latter captures, at least to some extent, the effect we are discussing here.

Table 12: Summary of Effects on Subjective Mobility Assessment

	SHORT DISTANCE					LONG DISTANCE				
	Overall	**Commute**	**Work/School**	**Entertainment**	**Personal Vehicle**	**Overall**	**Work/School**	**Entertainment**	**Personal Vehicle**	**Airplane**
N	1317	1325	1350	1292	1348	1342	1313	1297	1343	1299
R^2_{full}	0.225	0.291	0.391	0.343	0.360	0.308	0.318	0.221	0.231	0.421
Adjusted R^2_{full}	0.217	0.284	0.387	0.334	0.353	0.303	0.313	0.211	0.227	0.415
Upper bound on R^2 due to Objective Mobility variables (R^2_{OM})	0.169	0.253	0.378	0.280	0.331	0.273	0.275	0.146	0.180	0.371
Upper-bound proportion of full-model R^2 due to Objective Mobility variables (R^2_{OM}/R^2_{full})	0.779	0.869	0.977	0.838	0.938	0.886	0.879	0.692	0.793	0.894
Lower bound on R^2 due to Objective Mobility variables (R^2_{full} -$R^2_{non\text{-}OM}$)	0.118	0.201	0.366	0.189	0.171	0.195	0.137	0.076	0.132	0.212
Lower-bound proportion of full R^2 due to Objective Mobility variables [(R^2_{full} -$R^2_{non\text{-}OM}$)/R^2_{full}]	0.524	0.691	0.936	0.551	0.475	0.633	0.431	0.344	0.571	0.504
VARIABLE										
Objective Mobility										
Frequency of commute (SD)		+								
Frequency of work/school-related travel (SD)		+	+				+			
Frequency of entertainment travel (SD)				+		+		+		
Frequency of grocery shopping travel (SD)				-						
Frequency of travel going to eat a meal (SD)										+
Frequency of travel taking others where they need to go (SD)					+					
Total trip frequency	+									
Weekly miles in a personal vehicle (SD)	+				+	+			+	
Weekly miles in a bus (SD)					-					
Weekly miles in BART (SD)					-					
Weekly miles walking (SD)					-					
Weekly miles commuting (SD)	+	+	+	-						

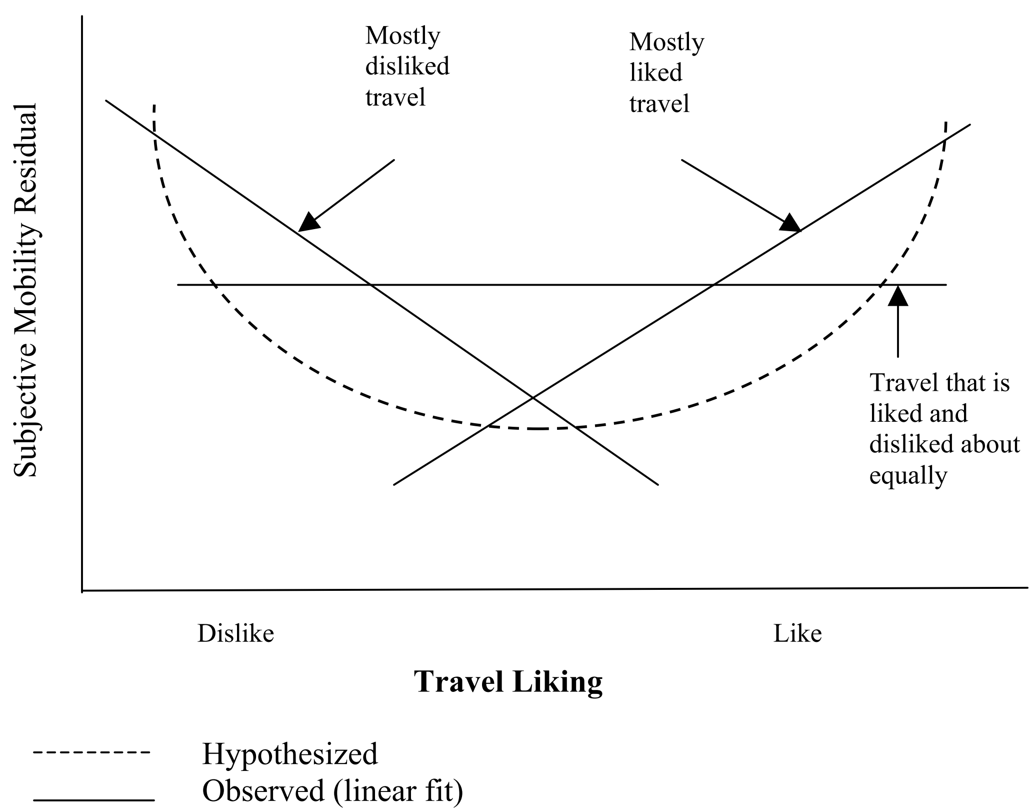
	SHORT DISTANCE					LONG DISTANCE				
	Overall	Commute	Work/School	Entertainment	Personal Vehicle	Overall	Work/School	Entertainment	Personal Vehicle	Airplane
Weekly miles of work/school-related travel (SD)			+	-				-		
Weekly miles of entertainment travel (SD)				+				+		
Weekly miles to eat a meal (SD)								+		
Total weekly miles (SD)				+						
Average commute time	+	+						-		
Distance to work		+			+		+			
Number of trips by personal vehicle (LD)	+						+		+	
Number of trips by air (LD)						+	+			+
Miles by PV (LD)										-
Miles by air (LD)				-				+	-	
Log of total miles by personal vehicle (LD)		-		+		+		+	+	
Log of total miles by air (LD)						+	+			+
Miles by other means (LD)						+		+		
Travel Liking										
Overall (SD)	-	+		+						
Overall squared (SD)	+									
Commute (SD)	-	-								
Commute squared (SD)		+								
Work/school-related (SD)										
Personal vehicle (SD)					-					
Personal vehicle squared (SD)					+					
Grocery shopping (SD)				-						
Taking others where they need to go (SD)										+
Overall (LD)						+	-			+
Work/school-related (LD)			+				+			
Entertainment (LD)								+		+
Personal vehicle (LD)									+	-
Airplane (LD)						-				
Attitudes										
Pro-environmental solutions factor score				-						
Travel freedom factor score								+		
Pro-high density factor score									-	

	SHORT DISTANCE					LONG DISTANCE				
	Overall	Commute	Work/School	Entertainment	Personal Vehicle	Overall	Work/School	Entertainment	Personal Vehicle	Airplane
Lifestyle										
Frustrated factor					+					
Workaholic factor				-				-		
Family & community-oriented factor					+					
Personality										
Adventure seeker factor score	+			+	+	+	+			+
Organizer factor score							+			
Loner factor score			+							
Excess Travel										
Excess Travel indicator				+				+	+	
Mobility Constraints										
Percent of time a vehicle is available	-				+					-
Limitations on walking					+					
Demographics										
Male										-
Age						+				
Years lived in the U.S.				-						
Educational background	-	-						+		
Number of people in the household	+									
Personal income category				-			+	-		+
Household income category								+		
Number of people 6-15 years old in the household										-
Year of the personal vehicle		-								
Vehicle type is compact			-							
Vehicle type is small		+								
Vehicle type is mid-sized	-									
Vehicle type is large		+								
Vehicle type is SUV							-	+		
Vehicle type is van/minivan			+			+			+	

Assume for the sake of discussion that Objective Mobility is largely being controlled for (as we believe it to be, in view of the extensive set of Objective Mobility variables significant in the models), so that we are really modeling the impact of Travel Liking on the amount by which a given level of Objective Mobility is stretched or shrunk, so to speak (that is, the impact of Travel Liking on the residual of Subjective Mobility after Objective Mobility is accounted for).

The above considerations led us to hypothesize that this Subjective Mobility residual effect might be a U-shaped (tentatively quadratic) function of Travel Liking (as shown in Figure 2), which would explain the observed results. If the true relationship were quadratic but most of the observations *for a given level of Objective Mobility* clustered around the "dislike" end of the Travel Liking scale, a linear fit of Travel Liking to the Subjective Mobility residual would exhibit a negative slope. We would mostly expect such a clustering to occur for mandatory or non-volitional travel, and thus the negative coefficient of Travel Liking that we observed for the commuting model is precisely what would be predicted for that least volitional of the travel categories. (We can point out that 78% of the commuters in our sample disliked or were neutral about commuting, and in this case that supports our point, but just examining Travel Liking in isolation can be misleading, since directly observed measures of Travel Liking will be based on different levels of Objective Mobility and hence be confounding the effects of those two variables on Subjective Mobility).

Figure 2: Schematic of Hypothesized and Observed Relationships between Travel Liking and Subjective Mobility



Conversely, if most observations for a given level of Objective Mobility clustered around the "like" end of the Travel Liking scale, a linear fit of Travel Liking to the Subjective Mobility residual would exhibit a positive slope. We believe a predominant "liking" to be a common occurrence for the more discretionary or volitional types of travel measured in our data (again, supported but not proven by the raw distributions of the Travel Liking variables, as shown in the

Appendix), and hence this would explain the positive slope of the Travel Liking variable observed in *at least* seven of our 10 models.

Additional model building offered only a certain amount of support for this hypothesis. Including quadratic Travel Liking terms in the long distance models replaced the corresponding linear terms (i.e. drove them into insignificance) with the same positive sign. This means that the relationship of Travel Liking to Subjective Mobility was a monotonically increasing one throughout the observed range of Travel Liking (the integers 1-5) since, with no linear term, the minimum of the upward-opening parabola would occur at Travel Liking = 0. Thus, the long distance models with quadratic terms did not reveal a relationship between Travel Liking and Subjective Mobility that was substantially different from the linear models[4], and in fact in two cases the quadratic model had an inferior adjusted R^2. Given these circumstances, the linear Travel Liking variables were kept in the long distance models.

The quadratic Travel Liking terms *do* play an important role in the short distance overall, commute, and personal vehicle models, however, and hence those are the models that are presented in Tables 2, 3, and 6. Both a linear Travel Liking variable with a negative coefficient and a quadratic term with a positive coefficient were significant in these models. In these three cases the parabolas attain their minima at Travel Liking equal to 2.57, 3.99, and 2.20 respectively, meaning that both disliking and liking travel will result in an elevated Subjective Mobility, as hypothesized. The relative locations of the minima for the three models are of interest. For overall short-distance travel, it occurs approximately at the neutral point (3) on the five-point Travel Liking scale, meaning that similar levels of liking and disliking for overall short-distance travel result in similar elevations of Subjective Mobility. For short-distance personal vehicle travel, the minimum falls approximately at the "dislike" point (2) on the scale. Since the majority (88.3%) of the sample falls to the right of that point, this case represents the "mostly liked travel" example shown in Figure 2. The opposite is true for short distance commute travel, where the minimum falls at the "like" point (4) on the scale, and where 76.6% of the sample falls to the left of that point.

4.3 Analysis of the Cognitive Mechanisms Identified

While there have been a number of studies relating objective values of travel-related variables (such as travel time or distance, or noise) to individuals' perceived values measured on the same dimension (e.g. Koppelman, 1981; Golledge and Zannaras, 1973; Canter and Tagg, 1975), we are not aware of other studies relating objective, quantitative measures[5] of one's general mobility levels to subjective, qualitative assessments of that mobility. Our goal was to learn more about

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[4] Strictly speaking, of course, the quadratic relationship, even though monotonic, *is* different from the linear one. Specifically, the quadratic relationship implies an increasing marginal impact of Travel Liking in the range of interest; that is, that the impact of one unit of Travel Liking is stronger at the liking end of the scale than at the disliking end. However, given that the goodness-of-fit measures did not markedly improve with the quadratic form in these models, we did not have a strong basis for accepting an increasing marginal impact in these cases.

[5] As indicated in Section 2, the variables we refer to as "Objective Mobility" are in fact self-reported like all the other variables in this study (except residential neighborhood), and as such inevitably have a subjective element. Nevertheless, in the sense that they are reported on objectively measurable dimensions (miles, trips), they clearly differ from the qualitative assessments that we refer to as Subjective Mobility, and it is reasonable to attempt to see how the two types of measures are related.

the way people cognitively process the objective amount of travel they do, to obtain more insight into their attitudes toward travel.

We identified a number of factors influencing individuals' perception of their amount of travel upward or downward, holding the objective amount of travel constant, and we postulated several cognitive mechanisms accounting for the observed results. A summary of these mechanisms is presented in Tables 13 and 14.

Table 13 presents the mechanisms postulated to *enhance* Subjective Mobility. Recall that our hypothesis of a quadratic type of relationship between Subjective Mobility and Travel Liking was developed from the argument that both pleasant as well as unpleasant activities can make a strong impression on memory, therefore be more readily retrieved, and hence influence perceptions upward. It should not be surprising, then, that the enhancing mechanisms identified in Table 13 fall mainly into two groups: those contributing to a higher enjoyment or keener awareness of one's travel, and those contributing to the perception of travel as a burden. Categories 1 and 4 of Table 13 represent the basic forms of these two groups, respectively, but most of the remaining 10 categories in the table are identified as constituting special cases of one or the other of those two basic groups. (The only exceptions are the "confounding" explanations for categories 7 and 8, which as we discuss below are really survey response mechanisms more than travel-oriented cognitive mechanisms). Each of these two basic types of mobility-enhancing mechanism is identified in every model presented here, an indication both of their fundamental nature and also of the complexity of the process by which one's mobility is subjectively assessed.

Category 1, then, represents the basic form of the "travel enjoyment/awareness" mechanism. Most of the variables in this category are indicators of an affinity for travel — either Travel Liking directly, the adventure-seeker Personality factor, the Excess Travel indicator, or even a vehicle-related variable, the SUV vehicle type. This category by itself has representation in every model presented here, and the association of this mechanism to variables indicating affinity for travel constitutes a central argument of this work.

The "mobility freedom awareness" and "relative deprivation" mechanisms are presented as special cases of the "travel enjoyment/awareness" mechanism because they involve some degree of consciousness (and subsequent judgment) of the amount of actual mobility. In the examples we see of the first case, a sense of freedom to travel — either generally, or specifically by personal vehicle — enhances one's awareness of one's actual travel, for discretionary purposes and by personal vehicle. In the example identified of the second case, a sense of deprivation with respect to *one* mode of travel (walking) enhances one's awareness of travel by *another* mode (personal vehicle).

The basic form of the "psychological burden" mechanism shown in category 4 was identified through five different variables in four different models. The three categories immediately following represent special cases of the burden mechanism: an inconvenient vehicle type for commuting, a generally negative attitude, and a particular need to concentrate while driving.

"Confounding short-distance and long-distance" and "travel saturation" were initially proposed as separate Subjective Mobility magnifying mechanisms. They are combined into a single group in Table 13 because, although they are different mechanisms, they manifest themselves in the same way and thus there is little basis for asserting one over the other in any given instance. Both mechanisms typically involve a *short-distance* measure of Objective Mobility (or in one case, an Attitude related to short-distance travel) magnifying the assessment of the counterpart or a related *long-distance* measure of Subjective Mobility, or conversely. The first mechanism explains this relationship by suggesting that respondents consciously or subconsciously consider short-distance versions of the long-distance travel in question, and transfer their short-distance experiences to the long-distance range in evaluating their mobility (and conversely). Thus, in its purest sense, this mechanism represents a survey response bias (which is nevertheless a cognitive effect worth knowing about).

Table 13: Summary of Cognitive Mechanisms Magnifying Subjective Mobility (i.e. with a positive net impact)

Postulated Mechanism	Variables Representing this Mechanism	Subjective Mobility Variable Modeled
1 **Enjoyment/ awareness of the travel (or psychological pleasure)**	Travel Liking overall (SD)	SD Overall[5]
		SD Commute
		SD Entertainment/ Recreation/Social
	Travel Liking work/school-related (LD)	SD Work/School-Related
	Travel Liking overall (LD)	LD Overall
		LD Airplane
	Travel Liking work/ school-related (LD)	LD Work/School-Related
	Travel Liking entertain-ment/recreation/social (LD)	LD Entertainment/Recreation/Social
		LD Airplane
	Travel Liking personal vehicle (SD)	SD Personal Vehicle[6]
	Travel Liking personal vehicle (LD)	LD Personal Vehicle
	SUV vehicle type	LD Entertainment/Recreation/Social
	Personal income	LD Work/School-Related
	Adventure seeker	SD Overall
		SD Entertainment/Recreation/Social
		SD Personal Vehicle
		LD Overall
		LD Work/School-Related
		LD Airplane
	Loner	SD Work/School-Related
	Excess Travel indicator	SD Overall
		SD Entertainment/Recreation/Social
		LD Entertainment/Recreation/Social

[6] Represented by the quadratic form in which low as well as high values of the indicated Travel Liking variable have a positive impact on Subjective Mobility.

Postulated Mechanism	Variables Representing this Mechanism	Subjective Mobility Variable Modeled
		LD Personal Vehicle
2 Mobility freedom awareness (awareness)	Travel freedom factor	LD Entertainment/Recreation/Social
	Percentage of the time a personal vehicle is available	SD Personal Vehicle
3 Relative deprivation (awareness)	Limitations on walking	SD Personal Vehicle
4 Psychological burden	Travel Liking overall (SD)	SD Overall[5]
	Travel Liking personal vehicle (SD)	SD Personal Vehicle[5]
	Family oriented factor score	SD Personal Vehicle
	Van/minivan vehicle type	LD Overall
		LD Personal Vehicle
	Age	LD Overall
	Travel Liking chauffeuring (SD)	LD Airplane
	Male dummy variable[7]	LD Airplane
5 Vehicle inconvenience (burden)	Small vehicle type	SD Commute
	Large vehicle type	SD Commute
6 Negative attitude (burden)	Frustration factor score	SD Personal Vehicle
7 Confounding short-distance and long-distance & Travel saturation (burden)	Number of trips by personal vehicle (LD)	SD Overall
	Miles by personal vehicle (LD)	SD Entertainment/Recreation/Social
	Frequency of entertain-ment/recreation/social travel (SD)	LD Entertainment/Recreation/Social
	Weekly miles for entertain-ment/recreation/social (SD)	LD Entertainment/Recreation/Social
	Weekly miles by personal vehicle (SD)	LD Overall
		LD Personal Vehicle
	Frequency of work/school-related travel (SD)	LD Work/School-Related
	Frequency of entertain-ment/recreation/social travel (SD)	LD Overall
	Commute distance	LD Work/School-Related

[7] This variable has a negative coefficient, but is included here since we argue that long-distance mobility by airplane is more burdensome to *women*.

Postulated Mechanism		Variables Representing this Mechanism	Subjective Mobility Variable Modeled
		Pro-high-density factor[8]	LD Personal Vehicle
8	**Confounding similar purposes & Travel saturation (burden)**	Frequency of work/school-related travel (SD)	SD Commute
		Weekly miles commuting to work/school (SD)	SD Work/School-Related
9	**Complementarity (awareness)**	Number of trips by personal vehicle (LD)	SD Overall
		Travel Liking work/school-related (LD)	SD Work/School-Related
10	**Competing preferences (burden)**	Number of trips by personal vehicle (LD)	SD Overall
		Travel Liking work/school-related (LD)	SD Work/School-Related
		Travel Liking chauffeuring (SD)	LD Airplane
11	**Complexity of travel/ activity environment (burden)**	Number of people in the household	SD Overall
12	**Availability heuristic (awareness)**	Number of people in the household	SD Overall

The travel saturation mechanism, by contrast, represents not a reporting error on the part of the respondents, but a genuine carryover of the effects of travel in one realm to the assessment of travel in another realm. That is, the suggestion is that the greater the amount of, say, short-distance work/school-related travel, the more burdensome long-distance work/school-related travel *truly* feels to the respondent.

Such a saturation effect is not confined to the impact of short-distance travel on a long-distance counterpart (or vice versa); it may also occur between two related trip purposes. In particular, we found both that Objective Mobility for short-distance work/school-related travel enhanced Subjective Mobility for commuting, and also the converse.

Yet, there is an alternate explanation for both of those purpose-linked effects. Analogous to the "confounding short-distance and long-distance" mechanism of category 7, respondents may also confound similar purposes, and be thinking of all their work-related travel when they answer with respect to commuting, and vice versa. Thus, category 8 combines the indistinguishable (in

[8] Although this variable has a negative coefficient, we postulate that it may represent a travel saturation effect, with suburbanites (having a lower score on this factor and more short-distance personal vehicle travel) perceiving their long-distance personal vehicle mobility more intensely, and conversely for urbanites (see Section 3.10).

outcome) "confounding similar purposes" and "travel saturation" hypotheses for the observed effects.

Like category 7, two other categories of mechanisms also involve the impact of short-distance variables on long-distance Subjective Mobility, or vice versa. Category 9, complementarity, refers to the belief that conditions being positive in one realm can contribute to conditions being positive in the other realm. Two variables were identified as possibly representing this effect. The first, number of long-distance personal-vehicle trips in the short-distance overall Subjective Mobility model, also appeared under category 7. Here, the additional hypothesis is that a high number of long-distance trips by personal vehicle can actually be associated with a high short-distance overall mobility, both because long-distance personal-vehicle trips may literally generate a number of short-distance trips in preparation for them, and also simply because people with high mobility with respect to long-distance personal-vehicle travel may tend to have a high local mobility as well (due to some third party variable such as an occupation requiring a lot of travel of both kinds, a general liking for both kinds of travel, or a high income supporting higher mobility in both realms).

The second variable representing the complementarity effect involves Travel Liking directly. In this case, a high Travel Liking for *long-distance* work/school-related travel is associated with a high Subjective Mobility for *short-distance* work/school-related travel. We hypothesize that the liking for the one form is somewhat transferable to the other form, leading possibly to greater short-distance *Objective Mobility* in that category (and hence greater Subjective Mobility) or to an enhanced awareness of short-distance travel in that category, or both. (It is also possible that long-distance and short-distance travel in the same category are being confounded, as in mechanism 7, although none of the other examples of that mechanism involved Travel Liking).

An alternate explanation for the same result is that a high Travel Liking for long-distance work-related travel causes one to more deeply resent, as competition for the time one would rather spend on long-distance travel, the time one must spend on short-distance travel in the same category. Thus, category 10, competing preferences, refers to the idea that an individual's awareness of engagement in one form of travel may be heightened by a liking or preference for engagement in a different form of travel (this can also be considered another type of relative deprivation). In another example of this effect, one's liking for short-distance travel serving others is hypothesized to exaggerate one's perceived amount of long-distance airplane travel, taking one away from home and the ability to meet those needs. And in the third example, a desired travel-time budget argument is invoked to suggest that if one is traveling a great deal for long distance, then additional required short-distance travel may be more burdensome than would otherwise be the case.

Finally, as the number of people close to the respondent increases, her Subjective Mobility may be affected. Such a possibility is represented by two mechanisms: "complexity of travel/activity environment" and "availability heuristic". In the first case, the argument is that a given amount of travel may feel more burdensome when a higher number of people in the household requires greater coordination and imposes more constraints. This mechanism is represented also by the male dummy variable. The negative coefficient of this variable is related to women still carrying the greater part of the responsibility for child care and domestic maintenance, which may complicates their travel scheduling, thus enhancing their commute perception. The availability heuristic, a phenomenon cited by social psychologists (Myers, 1999), refers to people's tendency to retrieve more easily memories related to their closest environment. In our case then, the argument is that the respondent's assessment of mobility is heavily influenced by the ready mental availability of household members.

Table 14 presents the cognitive mechanisms that, we postulate, *reduce* Subjective Mobility. The most prevalent of these mechanisms is labeled "psychological burden reduction", with several special cases. Note that this is the opposite-direction counterpart to the "psychological burden" (category 4 and other special cases) mobility *enhancing* mechanism identified in Table 13. That is, if factors emphasizing the burdensome aspects of travel magnify its subjective assessment, then factors mitigating those burdensome aspects can diminish its assessment. Such factors can include a liking for travel, as illustrated by four variables appearing in five models, such as a liking for airplane travel reducing one's perception of the amount of overall long-distance travel.

Factors other than Travel Liking can also serve this Subjective Mobility-diminishing role. The "vehicle comfort/convenience" category is a special case of the burden reduction mechanism that also has a counterpart in category 5 ("vehicle inconvenience") of Table 13. These two categories together attest that the "right" vehicle can make travel less burdensome.

Category 3, "reduced awareness and anticipation of destination", is a more narrowly-focused counterpart to the "enjoyment/awareness" mechanism of Table 13. As discussed under the individual models, in both cases the idea is that factors that call one's attention to the travel itself enhance the subjective assessment of it, while factors that draw the focus away from the travel itself, perhaps to the destination, diminish the mental weight of the travel.

The next four mobility-reducing mechanisms all involve comparisons of one form or another (often probably subconscious), with the comparison again acting to diminish the cognitive weight of the type of travel being modeled. In category 4, "share of total mileage/perceptual balance", the hypothesis is that the greater the actual amount of travel of one kind, the lower the perceived amount of travel of a different kind. In five of the six observed instances of this mechanism, it was entertainment travel whose perception was affected, suggesting that it is the type of travel most affected by this type of mental comparison.

In the "relative deprivation" mechanism (category 5), the hypothesis is that a given current level of travel may not seem as high when compared to what peers are doing (or are believed to be doing). Note that relative deprivation in other ways can act to enhance Subjective Mobility, as indicated by category 3 of Table 13. The next two categories may be special cases of the relative deprivation mechanism. In the "comparison to past" mechanism (category 6 of Table 14), the hypothesis is that a given current level of travel may not seem as high when it is compared to higher levels in the past. And one example of the related "perceived mobility constraint" (category 7) was identified by arguing that the presence of school-age children can serve as a constraint that makes a given amount of long-distance air travel seem less (either by comparison to peers without children or by comparison to one's ideal amount of such travel) than it would without the constraint.

Table 14: Summary of Cognitive Mechanisms Diminishing Subjective Mobility (i.e. with a negative net impact)

Postulated Mechanism	Variables Representing this Mechanism	Subjective Mobility Variable Modeled
1 Psychological burden reduction	Travel Liking commute (SD)	SD Overall
		SD Commute[9]
	Travel Liking overall (LD)	LD Work/School-Related
	Travel Liking by airplane (LD)	LD Overall
	Travel Liking by personal vehicle (LD)	LD Airplane
2 Vehicle comfort/ convenience (burden reduction)	Mid-sized vehicle type	SD Overall
	Vehicle availability	SD Overall
	Year of personal vehicle	SD Commute
	Compact vehicle type	SD Work/School-Related
	Personal income	SD Entertainment/Recreation/Social
	SUV vehicle type	LD Work/School-Related
3 Reduced awareness & Anticipation of destination (burden reduction)	Educational background	SD Overall
		SD Commute

[9] Represented by a quadratic form that slopes downward for most of the range of the Travel Liking variable.

Postulated Mechanism	Variables Representing this Mechanism	Subjective Mobility Variable Modeled
4 Share of total mileage & Perceptual balance	Weekly miles commuting to work/school (SD)	SD Entertainment/Recreation/Social
	Commute time	LD Entertainment/Recreation/Social
	Weekly miles work/ school-related (SD)	SD Entertainment/Recreation/Social
		LD Entertainment/Recreation/Social
	Miles by personal vehicle (LD)	SD Commute
	Miles by airplane (LD)	SD Entertainment/Recreation/Social
	Miles by airplane (LD)	LD Personal Vehicle
	Miles by personal vehicle (LD)	LD Airplane
5 Relative deprivation	Percentage of the time a personal vehicle is available	LD Airplane
	Personal income	SD Entertainment/Recreation/Social
		LD Entertainment/Recreation/Social
	Workaholic factor	SD Entertainment/Recreation/Social
		LD Entertainment/Recreation/Social
6 Comparison to past	Years in the U.S.	SD Entertainment/Recreation/Social
7 Perceived mobility constraint	Number of children between 6 and 15	LD Airplane
8 Substitution effect	Frequency of travel for grocery shopping (SD)	SD Entertainment/Recreation/Social
	Travel Liking for grocery shopping (SD)	SD Entertainment/Recreation/Social
9 Cognitive dissonance reduction/ Rationalization	Pro-environmental factor	SD Entertainment/Recreation/Social
	Workaholic factor	SD Entertainment/Recreation/Social
		LD Entertainment/Recreation/Social

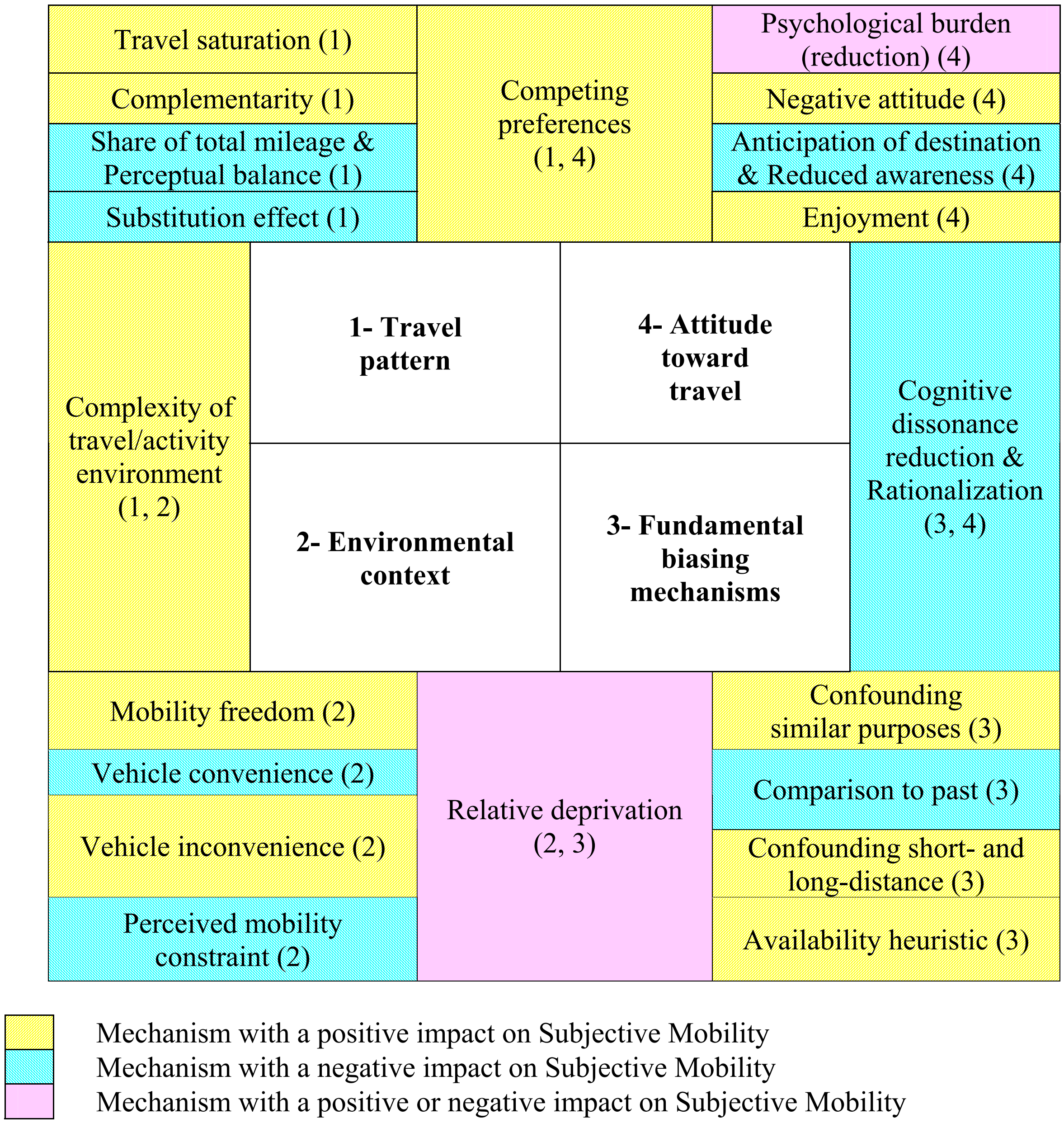
An individual may satisfy her needs for a particular kind of travel (e.g. social/entertainment, in our case) by engaging in an alternative sort of travel (here, grocery shopping — suggesting the substitution of in-home for out-of-home socializing and entertainment), thereby having a reduced perception of her mobility in the first category. This mechanism, referred to here as the "substitution effect", has then strong Objective Mobility roots. Note, therefore, that the engagement in, or liking for, travel of one kind can either enhance (as in the case of the enjoyment/ awareness, psychological burden, confounding short distance and long distance, travel saturation, confounding similar purposes, complementarity, and competing preferences mechanisms of Table 13) or diminish (as in the case of the burden reduction, share of total mileage/perceptual balance, and substitution effects of Table 14) one's assessment of the amount of travel of another kind.

It was contended in the discussion of the models for entertainment/recreation/social travel that an individual could adjust her perception of her mobility so as to be in concordance with her attitudes or lifestyle. Thus, for example, someone who sees himself as a workaholic may tend to downplay the recreational travel that he does, as inconsistent with his self-image. This effect is referred to as “cognitive dissonance reduction/rationalization”. Without labeling it separately, a similar effect in the opposite direction was identified, in which we suggested that the positive impact on Subjective Mobility of being an adventure seeker or excess traveler (see category 1 of Table 13) may be due in part to responding to the relevant questions in a manner congruent with one’s self-image.

We may categorize all the mechanisms in both Tables 13 and 14, independently of the direction of their impact on Subjective Mobility, into four groups as shown in Table 15. This organization proposes that the groups are not totally independent, but rather that in each case there is a mechanism that constitutes a transition from one group to another. Starting in the upper left corner of the inner block and moving counterclockwise, the first group, *travel pattern*, gathers mechanisms rooted in the way the individual organizes her travel agenda. The mechanisms belonging only in this category are grouped in the upper left corner of the table and are all numbered “1” corresponding to the first category. The “complexity of travel/activity environment” variable characterizes both travel patterns as well as the external conditions under which one engages in travel. Thus, this variable serves as a transition between the first group and the second: *environmental context*, as indicated by assigning to it the numbers 1 and 2, corresponding to both categories. The “relative deprivation” variable is an indicator of physical factors affecting mobility but, from a purely cognitive perspective, it stands for a process in which an individual compares her mobility to others’. Thus, this variable is a link between the second group and the third: *fundamental biasing mechanisms*. This group collects universal mental mechanisms that can work independently of individual predispositions or environmental inputs, introducing a bias in the resulting assessment. Within this group we find the “cognitive dissonance reduction” mechanism, which can also be viewed as part of the fourth and last group: *attitude to travel*. A cognitive dissonance exists whenever an individual’s attitudes and respective behavior do not match. In such situations, she will tend to reduce the discrepancy by either changing her attitude or her behavior.

Table 15 provides then a convenient categorization of the mechanisms affecting subjective assessments of an individual’s mobility. This broader picture of the cognitive mechanisms summarized in Tables 13 and 14 suggests that Subjective Mobility can be modified by re-distributing the amount of travel done, by changing the context in which the travel occurs, and by a change in travel-related attitudes. The fourth group, containing the fundamental biasing mechanisms, is less controllable.

Table 15: Categories of Cognitive Mechanisms Affecting Subjective Mobility



4.4 General Conclusions

In this study we examined, for 1358 commuting workers in the Bay Area, the variables influencing their perceived amount of travel in 10 categories: short distance overall, short distance commute to work/school, short distance work/school-related, short distance entertainment/recreation/ social, short distance personal vehicle, long distance overall, long distance work/school-related, long distance entertainment/recreation/social, long distance personal vehicle and long distance airplane.

The models presented here confirm the expectation that the perception of one's mobility depends heavily on objective measures of mobility. They also, and more importantly, confirm that it does not depend *only* on Objective Mobility. Individuals with positive affective attitudes toward travel (mostly benchmarked by the Travel Liking variables), with an adventure-seeking Personality profile, and/or with a proclivity to engage in Excess Travel tend to have a higher Subjective Mobility, given a fixed amount of actual mobility.

Some of the traditional Demographic variables used in transportation models, such as age and sex, showed little impact on mobility perception. The incorporation of personal vehicle-related information (vehicle type, percentage of the time a vehicle is available) yielded interesting results, proving important in predicting perception, either directly (e.g. a higher availability of a personal vehicle tends to increase the mobility perception by personal vehicle) or indirectly (e.g. ownership of a minivan may point to some lifestyle characteristics that in turn affect perception).

The identification of a number of cognitive mechanisms that potentially affect Subjective Mobility upward and/or downward is, in our opinion, a unique contribution of the present work.

The most important limitation of the present results is, as outlined above, the inherent endogeneity of some of the explanatory variables utilized here as predictors of Subjective Mobility, particularly the key endogenous variables: Objective Mobility and Travel Liking. Dealing with these and other limitations will form the basis for future research in this area.

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APPENDIX:

DESCRIPTIVE STATISTICS

FOR THE VARIABLES IN THE MODELS

Table A.1 Descriptive Statistics for Dependent Variables

Variable		Frequency	Valid Percent
Subjective Mobility			
Short distance overall N = 1355 Mean = 3.57	None	3	0.2
	2	177	13.1
	3	502	37.3
	4	345	25.6
	A lot	320	23.8
Short distance commute N = 1355 Mean = 3.57	None	29	2.1
	2	302	22.3
	3	328	24.2
	4	267	19.7
	A lot	431	31.8
Short distance work/school-related N = 1355 Mean = 2.54	None	249	18.3
	2	542	39.9
	3	302	22.3
	4	118	8.7
	A lot	146	10.8
Short distance entertainment/recreation/social N = 1355 Mean = 2.79	None	55	4.1
	2	509	37.5
	3	518	38.2
	4	209	15.4
	A lot	66	4.9
Short distance personal vehicle N = 1355 Mean = 3.92	None	37	2.7
	2	190	14.0
	3	230	16.9
	4	284	20.9
	A lot	616	45.4
Long distance overall N = 1355 Mean = 2.75	None	77	5.7
	2	537	39.6
	3	485	35.7
	4	166	12.2
	A lot	92	6.8
Long distance work/school-related N = 1355 Mean = 2.03	None	603	44.4
	2	399	29.4
	3	170	12.5
	4	85	6.3
	A lot	100	7.4
Long distance entertainment/recreation/social N = 1355 Mean = 2.74	None	134	9.9
	2	488	36.0
	3	430	31.7
	4	210	15.5
	A lot	95	7.0

Long distance personal vehicle N = 1355 Mean = 2.96	None	154	11.3
	2	419	30.9
	3	328	24.2
	4	236	17.4
	A lot	220	16.2
Long distance airplane N = 1355 Mean = 2.72	None	170	12.5
	2	506	37.3
	3	335	24.7
	4	222	16.4
	A lot	124	9.1

Table A.2 Descriptive Statistics for Continuous Explanatory Variables

Variable	N	Mean	Standard Deviation
Short-distance Objective Mobility			
Miles/week by personal vehicle	1357	176.960	176.641
Miles/week by bus	1357	9.130	60.758
Miles/week by train/BART/light rail	1357	19.760	67.338
Miles/week by walking	1357	10.460	14.799
Miles/week total	1357	220.410	191.817
Miles/week commuting	1357	125.830	136.503
Miles/week work/school-related	1351	25.100	70.549
Miles/week to eat a meal	1351	9.860	13.905
Miles/week entertainment/recreation/social	1351	23.830	35.432
Average commute time	1357	29.850	20.475
Commute distance	1356	13.990	14.571
Long-distance Objective Mobility			
Number of trips by personal vehicle	1345	6.940	20.272
Number of trips by airplane	1345	5.470	8.903
Number of trips by other means	1345	0.639	3.51658
Total mileage by personal vehicle	1345	1728.550	4357.448
Total mileage by airplane	1345	8909.890	17914.198
Total mileage by other means	1345	528.550	2347.527
Natural logarithm of (sum of the miles by personal vehicle + 1)	1345	5.524	2.987
Natural logarithm of (sum of the miles by airplane + 1)	1345	6.902	3.531
Sum of the natural logarithms of (miles for each trip by personal vehicle + 1)	1345	37.267	107.561
Sum of the natural logarithms of (miles for each trip by airplane + 1)	1345	36.495	60.267
Attitude			
Pro-environmental solutions factor score	1358	0.000686	0.859
Travel freedom factor score	1358	0.00644	0.737
Pro-high density factor score	1358	0.00368	0.811
Lifestyle			
Frustration factor score	1358	0.0387	0.832
Family/community related factor score	1358	0.0727	0.749
Workaholic factor score	1358	0.0104	0.759
Personality			
Adventure seeker factor score	1358	0.0567	0.901
Loner factor score	1358	0.0697	0.913
Excess Travel			
Excess Travel indicator	1358	7.97	4.253

Variable	N	Mean	Standard Deviation
Demographics			
Number of years in the U.S.	1340	39.63	13.657
Number of people in HH	1351	2.39	1.226
Number of people 6-15 years old in HH	1351	0.24	0.591

Table A.3 Descriptive Statistics for Discrete Explanatory Variables

Variable		Frequency	Valid Percent
Short-distance Travel Frequency			
Commute N = 1355 Mean = 5.756	1-3 times a month	10	0.7
	1-2 times a week	51	3.8
	3-4 times a week	199	14.7
	5 or more times a week	1098	80.9
Work/School-related N = 1355 Mean = 3.333	Never	160	11.8
	Less than once a month	281	20.7
	1-3 times a month	355	26.1
	1-2 times a week	243	17.9
	3-4 times a week	147	10.8
	5 or more times a week	172	12.7
Grocery Shopping N = 1355 Mean = 3.789	Never	27	2.0
	Less than once a month	50	3.7
	1-3 times a month	372	27.4
	1-2 times a week	681	50.1
	3-4 times a week	190	14.0
	5 or more times a week	38	2.8
Eat a Meal N = 1355 Mean = 3.789	Never	17	1.3
	Less than once a month	97	7.1
	1-3 times a month	361	26.6
	1-2 times a week	598	44.0
	3-4 times a week	208	15.3
	5 or more times a week	77	5.7
Entertainment/Recreation/Social N = 1355 Mean = 3.914	Never	4	0.3
	Less than once a month	75	5.5
	1-3 times a month	376	27.7
	1-2 times a week	564	41.5
	3-4 times a week	255	18.8
	5 or more times a week	84	6.2

Variable		**Frequency**	**Valid Percent**
Chauffeuring N = 1355 Mean = 2.925	Never	230	16.9
	Less than once a month	376	27.7
	1-3 times a month	326	24.0
	1-2 times a week	220	16.2
	3-4 times a week	104	7.7
	5 or more times a week	102	7.5
Short-distance Travel Liking			
Overall N = 1355 Mean = 3.173	Strongly dislike	15	1.1
	Dislike	178	13.1
	Neutral	762	56.1
	Like	360	26.5
	Strongly like	43	3.2
Commute N = 1355 Mean = 2.749	Strongly dislike	123	9.1
	Dislike	424	31.2
	Neutral	520	38.3
	Like	254	18.7
	Strongly like	37	2.7
Grocery shopping N = 1355 Mean = 3.049	Strongly dislike	37	2.7
	Dislike	219	16.1
	Neutral	773	56.9
	Like	299	22.0
	Strongly like	30	2.2
Chauffeuring N = 1355 Mean = 2.785	Strongly dislike	133	9.8
	Dislike	236	17.4
	Neutral	804	59.2
	Like	158	11.6
	Strongly like	27	2.0
Personal vehicle N = 1355 Mean = 3.546	Strongly dislike	34	2.5
	Dislike	125	9.2
	Neutral	410	30.2
	Like	647	47.6
	Strongly like	142	10.5
Long-distance Travel Liking			
Overall N = 1355 Mean = 3.648	Strongly dislike	19	1.4
	Dislike	119	8.8
	Neutral	368	27.1
	Like	671	49.4
	Strongly like	181	13.3

<table>
<tr><th colspan="2">Variable</th><th>Frequency</th><th>Valid Percent</th></tr>
<tr><td rowspan="5">Work/School-related
N = 1355
Mean = 2.776</td><td>Strongly dislike</td><td>153</td><td>11.3</td></tr>
<tr><td>Dislike</td><td>331</td><td>24.4</td></tr>
<tr><td>Neutral</td><td>576</td><td>42.4</td></tr>
<tr><td>Like</td><td>267</td><td>19.7</td></tr>
<tr><td>Strongly like</td><td>31</td><td>2.3</td></tr>
<tr><td rowspan="5">Entertainment/Recreation/Social
N = 1355
Mean = 3.840</td><td>Strongly dislike</td><td>23</td><td>1.7</td></tr>
<tr><td>Dislike</td><td>83</td><td>6.1</td></tr>
<tr><td>Neutral</td><td>320</td><td>23.6</td></tr>
<tr><td>Like</td><td>597</td><td>44.0</td></tr>
<tr><td>Strongly like</td><td>335</td><td>24.7</td></tr>
<tr><td rowspan="5">Personal vehicle
N = 1355
Mean = 3.362</td><td>Strongly dislike</td><td>48</td><td>3.5</td></tr>
<tr><td>Dislike</td><td>211</td><td>15.5</td></tr>
<tr><td>Neutral</td><td>420</td><td>30.9</td></tr>
<tr><td>Like</td><td>563</td><td>41.5</td></tr>
<tr><td>Strongly like</td><td>116</td><td>8.5</td></tr>
<tr><td rowspan="5">Airplane
N = 1355
Mean = 3.691</td><td>Strongly dislike</td><td>54</td><td>4.0</td></tr>
<tr><td>Dislike</td><td>130</td><td>9.6</td></tr>
<tr><td>Neutral</td><td>272</td><td>20.0</td></tr>
<tr><td>Like</td><td>632</td><td>46.5</td></tr>
<tr><td>Strongly like</td><td>270</td><td>19.9</td></tr>
<tr><td colspan="4">Mobility Constraints</td></tr>
<tr><td rowspan="6">Percentage of time a personal vehicle is available
N = 1350
Mean = 91.274</td><td>0</td><td>64</td><td>4.7</td></tr>
<tr><td>20</td><td>1</td><td>.1</td></tr>
<tr><td>40</td><td>34</td><td>2.5</td></tr>
<tr><td>60</td><td>17</td><td>1.3</td></tr>
<tr><td>80</td><td>10</td><td>.7</td></tr>
<tr><td>100</td><td>62</td><td>4.6</td></tr>
<tr><td rowspan="3">Limitations on walking
N = 1355
Mean = 3.691</td><td>No limitation</td><td>1305</td><td>96.2</td></tr>
<tr><td>Limits how often/long</td><td>46</td><td>3.4</td></tr>
<tr><td>Absolutely prevents</td><td>5</td><td>0.4</td></tr>
<tr><td colspan="4">Demographics</td></tr>
<tr><td rowspan="5">Age category
N = 1354
Mean = 2.548</td><td>23 or younger</td><td>44</td><td>3.2</td></tr>
<tr><td>24-40</td><td>584</td><td>43.0</td></tr>
<tr><td>41-64</td><td>686</td><td>50.6</td></tr>
<tr><td>65-74</td><td>28</td><td>2.1</td></tr>
<tr><td>75 or older</td><td>15</td><td>1.1</td></tr>
</table>

Variable		Frequency	Valid Percent
Educational background N = 1353 Mean = 4.248	Some grade school or high school	6	0.4
	High school diploma	73	5.4
	Some college or technical school	328	24.2
	4-year college/technical school degree	460	33.9
	Some graduate school	151	11.1
	Completed graduate degree(s)	338	24.9
HH income N = 1319 Mean = 4.301	Less than $15,000	31	2.3
	$15,00 - $34,999	141	10.7
	$35,000 - $54,999	269	20.3
	$55,000 - $74,999	250	18.9
	$75,000 - $94,999	220	16.6
	$95,000 or more	411	31.1
Personal income N = 1324 Mean = 3.406	Less than $15,000	96	7.2
	$15,00 - $34,999	282	21.3
	$35,000 - $54,999	406	30.6
	$55,000 - $74,999	241	18.2
	$75,000 - $94,999	132	9.9
	$95,000 or more	170	12.8
Sex dummy N = 1349 Mean = .489	Female	692	51.2
	Male	660	48.8
Professional dummy N = 1355 Mean = 0.477	0	709	52.2
	1	649	47.8
Compact vehicle type N = 1324 Mean = 0.130	0	1187	87.4
	1	171	12.6
Large vehicle type N = 1324 Mean = 0.020	0	1332	98.1
	1	26	1.9
Small vehicle type N = 1324 Mean = 0.226	0	1062	78.2
	1	296	21.8

Variable		**Frequency**	**Valid Percent**
Van/minivan vehicle type N = 1324 Mean = 0.051	0	1292	95.1
	1	66	4.9
SUV vehicle type N = 1324 Mean = 0. 114	0	1209	89.0
	1	149	11.0
Mid-sized vehicle type N = 1324 Mean = 0.176	0	1128	83.1
	1	230	16.9