Title
Modeling the Individual Consideration of Travel-Related Strategy Bundles

Authors
Choo, Sangho
Mokhtarian, Patricia L

Publication Date
2004-05-20

MODELING THE INDIVIDUAL CONSIDERATION OF TRAVEL-RELATED STRATEGY BUNDLES

UCD-ITS-RR-04-7

April 2004

by

Sangho Choo
Department of Civil and Environmental Engineering
and
Institute of Transportation Studies
University of California, Davis 95616, USA
Ph (530) 754-7421
Fax (530) 752-6572
cshchoo@ucdavis.edu

and

Patricia L. Mokhtarian
Department of Civil and Environmental Engineering
and
Institute of Transportation Studies
University of California, Davis 95616, USA
Ph (530) 752-7062
Fax (530) 752-7872
plmokhtarian@ucdavis.edu

Institute of Transportation Studies
One Shields Avenue
University of California
Davis, California 95616
Tel: 530-752-0247 Fax: 530-752-6572
http://www.its.ucdavis.edu/
email: itspublications@ucdavis.edu

MODELING THE INDIVIDUAL CONSIDERATION OF TRAVEL-RELATED STRATEGY BUNDLES

Sangho Choo
Department of Civil and Environmental Engineering
One Shields Avenue
University of California, Davis
Davis, CA 95616
voice: (530) 754-7421
fax: (530) 752-6572
e-mail: cshchoo@ucdavis.edu

and

Patricia L. Mokhtarian
Department of Civil and Environmental Engineering
and
Institute of Transportation Studies
One Shields Avenue
University of California, Davis
Davis, CA 95616
voice: (530) 752-7062
fax: (530) 752-7872
e-mail: plmokhtarian@ucdavis.edu

April 2004

This research is funded by the University of California Transportation Center.

ATTITUDES TOWARD MOBILITY
Patricia L. Mokhtarian, Principal Investigator

Journal Articles Produced by this Project to Date

Cao, Xinyu and Patricia L. Mokhtarian (2003) How do individuals manage their personal travel? Objective and subjective influences on the consideration of travel-related strategies. Under review for publication.

Choo, Sangho and Patricia L. Mokhtarian (2004) What type of vehicle do people drive? The role of attitude and lifestyle in influencing vehicle type choice. *Transportation Research A* **38(3)**, 201-222.

Choo, Sangho, Gustavo O. Collantes, and Patricia L. Mokhtarian (forthcoming) Wanting to travel, more or less: Exploring the determinants of a perceived deficit or surfeit of personal travel. *Transportation*.

Clay, Michael J. and Patricia L. Mokhtarian (forthcoming) Personal travel management: The adoption and consideration of travel-related strategies. *Transportation Planning and Technology*.

Collantes, Gustavo O. and Patricia L. Mokhtarian (2002) Qualitative subjective assessments of personal mobility: Exploring the magnifying and diminishing cognitive mechanisms involved. Under review for publication.

Handy, Susan L., Lisa Weston, and Patricia L. Mokhtarian (2003) Driving by choice or necessity? The case of the soccer mom and other stories. Paper presented at the 82nd annual meeting of the Transportation Research Board, Washington, DC, January, draft available on conference CD-ROM.

Handy, Susan L., Lisa Weston, and Patricia L. Mokhtarian (2004) Driving by choice or necessity? (later version of 2003 paper) Manuscript under review for publication.

Mokhtarian, Patricia L., Ilan Salomon, and Lothlorien S. Redmond (2001) Understanding the demand for travel: It's not purely "derived". *Innovation: The European Journal of Social Science Research* **14(4)**, 355-380.

Mokhtarian, Patricia L. and Ilan Salomon (2001) How derived is the demand for travel? Some conceptual and measurement considerations. *Transportation Research A* **35(8)**, 695-719.

Ory, David T. and Patricia L. Mokhtarian (2004) When is getting there half the fun? Modeling the liking for travel. Manuscript under review for publication.

Ory, David T., Patricia L. Mokhtarian, Ilan Salomon, Lothlorien S. Redmond, Gustavo O. Collantes, and Sangho Choo (2004) When is commuting desirable to the individual? *Growth and Change* **35(3)** (Summer), special issue on Advances in Commuting Studies, Peter Nijkamp and Jan Rouwendal, eds.

Redmond, Lothlorien S. and Patricia L. Mokhtarian (2001) The positive utility of the commute: Modeling ideal commute time and relative desired commute amount. *Transportation* **28(2)** (May), 179-205.

Salomon, Ilan and Patricia L. Mokhtarian (1999) Travel for the fun of it. *Access* (a publication of the University of California Transportation Center) **15** (Fall), 26-31. Available at www.uctc.net/access/access15.pdf or (without graphics) .../access15lite.pdf.

Salomon, Ilan and Patricia L. Mokhtarian (1998) What happens when mobility-inclined market segments face accessibility-enhancing policies? *Transportation Research D* **3(3)**, 129-140.

Salomon, Ilan and Patricia L. Mokhtarian (2002) Driven to travel: The identification of mobility-inclined market segments. Chapter 22 in William R. Black and Peter Nijkamp, eds., *Social Change and Sustainable Transport*. Bloomington, IN: Indiana University Press, pp. 173-179. Included in the Regional Futures Compendium of the Capital Region Institute (Valley Vision), Sacramento, California.

Schwanen, Tim and Patricia L. Mokhtarian (forthcoming) The extent and determinants of dissonance between actual and preferred residential neighborhood type. *Environment and Planning B*.

Schwanen, Tim and Patricia L. Mokhtarian (2003a) Does dissonance between desired and current neighborhood type affect individual travel behaviour? An empirical assessment from the San Francisco Bay Area. *Proceedings of the European Transport Conference (ETC)*, October 8-10, 2003, Strasbourg, France.

Schwanen, Tim and Patricia L. Mokhtarian (2003b) The role of attitudes toward travel and land use in residential location behavior: Some empirical evidence from the San Francisco Bay Area. Under review for publication.

Schwanen, Tim and Patricia L. Mokhtarian (2003c) What affects commute mode choice: Neighborhood physical structure or preferences toward neighborhoods? Under review for publication.

Reports Produced by this Project to Date

Cao, Xinyu and Patricia L. Mokhtarian (2003) *Modeling the Individual Consideration of Travel-Related Strategies*. Research Report UCD-ITS-RR-03-3, Institute of Transportation Studies, University of California, Davis, June.
Available at www.its.ucdavis.edu/publications/2003/RR-03-3.pdf

Choo, Sangho and Patricia L. Mokhtarian (2002) *The Relationship of Vehicle Type Choice to Personality, Lifestyle, Attitudinal, and Demographic Variables*. Research Report, Institute of Transportation Studies, University of California, Davis, October.
Available at www.its.ucdavis.edu/publications/2002/RR-02-06.pdf.

Choo, Sangho and Patricia L. Mokhtarian (2004) *Modeling the Consideration of Travel-Related Strategy Bundles*. Research Report, Institute of Transportation Studies, University of California, Davis, March.

Choo, Sangho, Gustavo O. Collantes, and Patricia L. Mokhtarian (2001) *Modeling Individuals' Relative Desired Travel Amounts*. Research Report UCD-ITS-RR-01-13, Institute of Transportation Studies, University of California, Davis, November.
Available at www.its.ucdavis.edu/publications/2001/RR-01-13.pdf.

Clay, Michael J. and Patricia L. Mokhtarian (2002) *The Adoption and Consideration of Commute-Oriented Travel Alternatives*. Research Report UCD-ITS-RR-02-04, Institute of Transportation Studies, University of California, Davis, September.
Available at www.its.ucdavis.edu/publications/2002/RR-02-04.pdf.

Collantes, Gustavo O. and Patricia L. Mokhtarian (2002) *Determinants of Subjective Assessments of Personal Mobility*. Research Report, Institute of Transportation Studies, University of California, Davis, August.

Curry, Richard W. (2000) *Attitudes toward Travel: The Relationships among Perceived Mobility, Travel Liking, and Relative Desired Mobility.* Master's Thesis, Department of Civil and Environmental Engineering, University of California, Davis, June. Research Report UCD-ITS-RR-00-06, Institute of Transportation Studies, University of California, Davis.
Available at www.its.ucdavis.edu/publications/2000/RR-00-06.pdf

Ory, David T. and Patricia L. Mokhtarian (2004) *Who Likes Traveling? Models of the Individual's Affinity for Various Kinds of Travel*. Research Report UCD-ITS-RR-04-xx, Institute of Transportation Studies, University of California, Davis, April.

Redmond, Lothlorien S. and Patricia L. Mokhtarian (2001) *Modeling Objective Mobility: The Impact of Travel-Related Attitudes, Personality, and Lifestyle on Distance Traveled*. Research Report UCD-ITS-RR-01-09, Institute of Transportation Studies, University of California, Davis, June. Available at http://repositories.cdlib.org/itsdavis/UCD-ITS-RR-01-09/

Redmond, Lothlorien S. (2000) *Identifying and Analyzing Travel-related Attitudinal, Personality, and Lifestyle Clusters in the San Francisco Bay Area.* Master's Thesis, Transportation Technology and Policy Graduate Group, Institute of Transportation Studies, University of California, Davis, September. Research Report UCD-ITS-RR-00-08.
Available at www.its.ucdavis.edu/publications/2000/RR-00-08.pdf

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

For the last three decades, policy makers and transportation planners have devised a series of policy instruments to tackle traffic congestion, starting with supply and demand controls. Transportation Systems Management (TSM) and Transportation Demand Management (TDM) programs are well-known classes of such policy strategies. Although many of these strategies have been implemented, they have failed to reduce traffic congestion. One of the reasons for this failure is that there is often a discrepancy, sometimes large, between the responses to congestion that are assumed by policy makers and those that are actually adopted by individuals. This mismatch in behavioral responses makes policies less effective, and needlessly consumes large amounts of time and money in their trial-and-error implementation.

As one of a series of studies on individuals' adoption and consideration of travel-related strategies in response to congestion, this study explores the relationships between the adoption and consideration of *bundles* of travel-related strategies by identifying characteristics associated with patterns of adoption and consideration among bundles, and by developing discrete choice (binary logit) models for individuals' consideration of each bundle. In particular, we focus on whether the adoption of lower-cost, short-term strategies significantly and/or dynamically (using time since adoption variables) affects the consideration of higher-cost, longer-term ones. We also investigate whether individuals with a high liking for travel, indicative of a positive utility of travel, are resistant to higher-cost, longer-term travel-reduction strategies.

The data for this study were collected from a fourteen-page survey returned by about 1,900 adult residents of three distinct San Francisco Bay area neighborhoods in May 1998: Concord and Pleasant Hill represent suburban neighborhoods, and an area defined as North San Francisco represents an urban neighborhood. The subset of 1,283 cases used in this study constitutes those respondents identified as workers (either part-time or full-time) who commute at least once a month and have relatively complete responses to key questions.

From the initial study in this series, the 17 main travel-related strategies on the survey were grouped into two sets of strategy bundles, based on conceptual and empirical similarities,

respectively. The first set (conceptual bundles) consists of three bundles that were conceptually classified based on the generalized cost and the amount of lifestyle change for each: travel maintaining/increasing, travel reducing, and major location/lifestyle change. The second set (factor-based bundles) comprises eight bundles (including two with only one strategy each) that were identified by factor-analyzing the responses: auto improvement, mobile phone, work-schedule changes, hire someone to do house or yard work, mode change, home-based work, residential/employment relocation, and alter employment status.

Based on these two sets of bundles, we first identified patterns of adoption and consideration among bundles, using correlation tests. Specifically, we examined whether previous adoption is significantly related to current consideration, and whether those relationships are different between groups who are satisfied and unsatisfied with their current travel conditions. The highest correlations are found in most pairs of adoption and consideration of the *same* bundle (all conceptual bundles and six of the factor-based bundles), indicating that the same or similar strategies are likely to be considered/adopted repeatedly throughout an individual's life. Additionally, the correlations of adoption and consideration have similar patterns in both satisfied and unsatisfied groups with current travel conditions, showing that the previous adoption is strongly associated with current consideration, more or less independently of satisfaction with current conditions.

Furthermore, we developed discrete choice models (binary logit models) for individuals' consideration of each bundle in the two sets. Tables ES-1 (Table 4.1 in the text) and ES-2 (Table 4.7 in the text) summarize the significant variables in the models of conceptual and factor-based bundles, respectively, with positive and negative signs indicating the direction of effect for each variable. The ρ^2 values of the conceptual bundle models ranged from 0.106 to 0.210, and those of the factor-based bundle models ranged from 0.103 to 0.434. All models are significantly better than the corresponding market share model at $\alpha << 0.001$. Additionally, models of consideration of each bundle based on non-adopters were developed for all except two bundles (due to small sample sizes and unbalanced shares), the travel maintaining/increasing and mobile phone strategies. The models based on non-adopters have higher ρ^2 values, ranging from 0.151 (0.291) to 0.311 (0.625) for the conceptual (factor-based) bundles. That is, the models on non-

adopters can explain more information in the data by eliminating the potentially heterogeneous adopters (for whom the previously-adopted strategy may or may not still be in force) and the potentially opposite effects of some variables between adopters and non-adopters. As expected, some variables in the models for non-adopters are common to the ones for the full data set, and other variables are similar. Not surprisingly, compared to the conceptual bundle models, the factor-based bundle models have more diverse explanatory variables and better goodness of fit because the factor-based bundles are more finely subdivided than the conceptual ones. We briefly summarize the key findings:

Most Objective Mobility variables are positively associated with consideration of travel-related strategy bundles. This is consistent with our hypothesis that the higher the amount of travel the individual does, the more likely she is to consider travel-related strategy bundles, as opposed to doing nothing. Similar to Objective Mobility, most Subjective Mobility variables are positively related to the consideration of the bundles. That is, the more travel the individual perceives doing, the more likely she is to consider travel-related strategy bundles.

As hypothesized, Relative Desired Mobility variables have logically either positive or negative effects on consideration of travel-related strategy bundles. For example, those who want to increase commute or work travel are less likely to consider travel reducing and major location/lifestyle change bundles (such as mode change and residential/employment relocation), whereas people with a higher desire for discretionary travel are more likely to consider them. It is plausible that the Relative Desired Mobility variables for modes other than driving (e.g. bus) have negative effects on consideration of the travel maintaining/increasing bundle.

As an indicator of a positive utility of travel, Travel Liking for long-distance personal vehicle travel is positively related to consideration of the travel maintaining/increasing strategy bundle, and that for work travel is negatively associated with travel reducing and major location/lifestyle change bundles. These results support the idea that a positive utility of travel will motivate people to keep or increase their current travel.

Among the six Travel Attitude variables, only two are significant, collectively appearing in one of the conceptual strategy bundle models and four of the factor-based bundle models. Logically, pro-environmentalists are more likely to consider the travel reducing and major location/lifestyle change bundles (including work-schedule change, mode change, and home-based work). On the other hand, the individual with a higher commute benefit factor score is less likely to consider travel reducing and major location/lifestyle change bundles (such as work-schedule change and residential/employment relocation).

Three of the four Personality factor variables are significant, collectively influencing the consideration of one of the conceptual strategy bundles and three of the factor-based bundles. Adventure seekers are more likely to consider commute travel reducing and major location/lifestyle change bundles (such as work-schedule change and home-based work) in order to free more time, money, and energy for adventure travel. Interestingly, loners and calm people are less likely to consider travel reducing (such as mode change) and major location/lifestyle change bundles, presumably for different but logical reasons. However, the organizer variable did not turn out to be significant in any model.

Three of the four Lifestyle factor variables are positively associated with medium-to-high-cost strategy bundles (one of the conceptual strategy bundles and four of the factor-based bundles). Frustrated people are more likely to consider the travel reducing and major location/lifestyle change bundles (such as residential/employment relocation and home-based work). Clearly, family/community-oriented people have a greater tendency to consider the travel reducing and major location/lifestyle change bundles. Similar to the organizer Personality, the workaholic Lifestyle factor was not significant in any of the models. As expected, social status seekers are more likely to consider the travel maintaining/increasing bundle (such as hiring domestic help). As hypothesized, as a marker of preference for discretionary travel, the excess travel indicator is positively associated with the consideration of the travel reducing and major location/lifestyle change bundles (such as residential/employment relocation and home-based work).

Mobility Constraint variables are positively associated with all three of the conceptual strategy bundles, and five of the factor-based bundles. The individual who has limitations on driving,

riding a bicycle, or vehicle availability is more likely to consider either the travel reducing and major location/lifestyle change bundles, or the travel maintaining one if travel is necessary.

Socio-demographic variables with respect to gender, age, household, income, and occupation are significantly related to travel-related strategy bundles. Especially, age or number of years lived in the U.S. (a proxy for age) is negatively related to consideration of both the travel maintaining and travel reducing strategies (including two of the conceptual strategy bundles and seven of the factor-based bundles). This suggests that younger people are more likely than older ones to consider the lower-cost strategies against congestion, either maintaining more comfortably (if necessary) or reducing (if possible) their travel. On the other hand, people in a high-income household are more likely to consider strategies in the travel maintaining/increasing bundle (such as auto improvement and hiring domestic help) but less likely to consider the travel reducing strategy bundle. In addition, managers or administrators are positively inclined to consider the travel maintaining/increasing and travel reducing (such as home-based work) bundles, while clerical workers are more likely to consider the major location/lifestyle change bundle (such as alter employment status). Interestingly, the vehicle type variable is significantly related to consideration of the travel reducing and major location/lifestyle change bundles. Specifically, those who drive SUVs most often are less likely to consider the travel reducing strategy bundle (including mode change and residential/employment relocation), suggesting an enjoyment of driving. Focusing on household members, people living with younger children (under six) or older people (ages 65-74) are, not surprisingly, more likely to consider the major location/lifestyle change strategy bundle (including alter employment status).

As hypothesized, the previous adoption of any individual strategies in a bundle positively affects consideration of the same bundle. This indicates that the individual who previously adopted a given strategy is more likely than others to seek either the same or another strategy in the same bundle. Similar to the previous study, the previous adoption of lower-cost individual strategies positively affects the consideration of the higher-cost strategy bundles, and the previous adoption of higher-cost individual strategies positively affects consideration of lower-cost strategy bundles.

In addition, time since adoption variables are significantly associated with consideration of travel-related strategy bundles, with logical signs. For example, the longer ago the individual adopted getting a better car and changing from another means to driving alone, the more likely she is to consider the auto improvement bundle. On the other hand, the more recently the individual adopted changing work trip departure time or hiring domestic help, the more likely she is to consider the corresponding strategy bundles (such as travel maintaining/increasing bundles), presumably to continue or resume enjoying their benefits. Interestingly, the auto improvement bundle is more affected by the time-dependent adoption of individual strategies than the other bundles due to the inevitable decay in the utility of a particular auto with time and frequent use.

In modeling individuals' consideration of travel-related strategy bundles, we found significant, diverse variables (such as qualitative and quantitative Mobility-related variables, Travel Attitudes, Personality, Lifestyle, and Travel Liking), most of which have been little considered in establishing transportation policy strategies to reduce traffic congestion. First, individuals' subjective assessment of the amount of their travel and desire for more or less travel, play key roles in considering which type of strategy can satisfy their travel needs. Second, Travel Liking, representing a positive utility of travel, turns out to be resistant to strategies that could reduce congestion. In other words, this factor can motivate individuals to maintain or increase their current travel. Lastly, individuals' Travel Attitudes, Personality, and Lifestyle also affect their consideration of travel-related strategies either positively or negatively.

In addition, a couple of relationships between previous adoption and consideration of travel-related strategy bundles can be identified in the models. The previous adoption of any individual strategies in a bundle strongly positively affects the consideration of the same bundle, showing an *inertial* or *habitual* response toward travel-related strategies. It suggests that a new transportation policy at a different level may be less likely to be considered by individuals who have never adopted it or a similar one. On the other hand, the previous adoption of any individual strategies in a bundle can significantly increase the consideration of either lower- or higher-cost strategy bundles, showing an *unstable* or *cycling* response toward travel-related strategies. It is natural that individuals keep seeking a better strategy at a different time or cost

level to improve their current travel conditions, although this relationship is less often found in our models than the former (reconsideration of the same bundle). Further, time since adoption variables can partially explain the dynamic nature of individuals' responses to travel-related strategy bundles. That is, depending on the type of travel-related strategy in a bundle, an individual who adopted it longer ago is more (or less) likely to consider the same bundle or another bundle. As a general comment, it should be kept in mind that Clay and Mokhtarian (forthcoming) found that the respondents adopted or are considering individual strategies for a variety of reasons other than travel, although we interpreted the relationships between adoption and consideration from the transportation point of view.

Overall, the results of this study give policy makers and planners insight into understanding the dynamic nature of individuals' responses to travel-related strategies as well as differences between the responses to congestion that are assumed by policy makers and those that are actually adopted by individuals. Our study, however, focused on individuals' responses to the travel-related strategy bundles (i.e., disaggregate behaviors, not aggregate). It would be very useful to develop aggregate approaches to explaining the Travel Attitudes, Personality, Lifestyle, and qualitative Mobility variables that are significant in this study, to support the development and evaluation of more effective transportation policies for reducing traffic congestion and/or improving mobility.

ES-1: Summary of Models of Consideration of Conceptual Strategy Bundles

	Travel maintaining/ increasing	Travel reducing	Major location/life-style change
N	1259	1220	1277
MS ρ^2	0.159	0.106	0.032
ρ^2	0.210	0.201	0.106
Adjusted ρ^2	0.194	0.184	0.091
Variable			
Objective Mobility			
Frequency of commuting (SD)		+	
Weekly miles to eat a meal (SD)	+	+	
Weekly miles by walking/jogging/bicycling (SD)			+
Total trips (LD)		+	
Subjective Mobility			
Take others where they need to go (SD)	+		
Travel by personal vehicle (SD)	+	+	
Relative Desired Mobility			
Travel by walking/jogging/bicycling (SD)			-
Travel by air (LD)			+
Travel Liking			
Travel by personal vehicle (LD)	+		
Attitudes			
Pro-environmental solutions factor score		+	
Personality			
Adventure seeker factor score		+	
Lifestyle			
Frustrated factor score			+
Family & community-oriented factor score			+
Mobility Constraints			
Limitations on driving during the day	+	+	
Socio-demographics			
Years lived in the U.S.	-	-	
Manager/administrator occupation	+		
Household income category		-	
Number of people ages under 6 in HH			+
Number of people ages 65-74 in HH			+
Strategy Adoption			
Buy a mobile phone	-		
Time since getting a fuel efficient car	+		
Change work trip departure time	+	+	
Time since changing work trip departure time			+
Hire somebody to do house or yard work	+		
Time since hiring domestic help	-		
Adopt compressed work week		+	
Change from another means to driving alone		+	
Buy equipment to help work from home		+	+
Work part- instead of full-time			+
Start home-based business		+	+
Retire or stop working			+
Major location/lifestyle change	+		

Notes: SD = Short Distance, LD = Long Distance.
Shaded cells denote significant relationships between consideration of one bundle and prior adoption of strategies in the same bundle.

ES-2: Summary of Models of Consideration of Factor-based Strategy Bundles

Explanatory Variables \ Bundles	Auto improvement	Mobile phone	Work-schedule change	Hire someone to do house or yard work	Mode change	Home-based work	Residential/employment relocation	Alter employment status
N	1146	1263	1204	1238	1203	1241	1222	1261
MS ρ^2	0.043	0.124	0.155	0.219	0.434	0.147	0.316	0.207
ρ^2	0.103	0.202	0.246	0.318	0.519	0.248	0.386	0.262
Adjusted ρ^2	0.083	0.184	0.226	0.304	0.498	0.229	0.367	0.249
Objective Mobility								
Frequency of commuting (SD)			+					
Frequency of work/school-related travel (SD)		+						
Frequency of grocery shopping travel (SD)		+						
Frequency of travel taking others where they need to go (SD)		+						
Total weekly miles (SD)		+						
Weekly miles of grocery shopping travel (SD)		-						
Weekly miles to eat a meal (SD)	+	+				+		
Weekly miles of entertainment travel (SD)				+				
Weekly miles of travel taking others where they need to go (SD)		-						
Weekly miles by train/BART/light rail (SD)							+	
Weekly miles by walking/jogging/bicycling (SD)			-					
Commute distance							+	
Travel miles by personal vehicle (LD)						+		
Sum of log of miles for each trip by air (LD)		+						
Subjective Mobility								
Commute (SD)			+		+			
Travel for grocery shopping (SD)			+				+	
Travel for eating a meal (SD)							-	
Travel for entertainment (SD)		+						
Take others where they need to go (SD)	+							
Travel by personal vehicle (SD)		+			+			
Travel by air (LD)			-					
Relative Desired Mobility								
Commute (SD)							-	
Work/school-related travel (SD)					-			
Travel for grocery shopping (SD)				-				
Travel for entertainment (SD)							+	
Travel by personal vehicle (SD)					-			
Travel by bus (SD)	-							
Travel by train/BART/light rail (SD)					+			
Travel by walking/jogging/bicycling (SD)							+	
Travel by personal vehicle (LD)							-	
Travel Liking								
Work/school-related travel (SD)								-
Travel for eating a meal (SD)					+			
Travel by train/BART/light rail (SD)							+	
Overall (LD)	+							

SD = Short Distance LD = Long Distance

(ES 2 continued)

	Auto improvement	Mobile phone	Work-schedule change	Hire someone to do house or yard work	Mode change	Home-based work	Residential/employment relocation	Alter employment status
Attitudes								
Pro-environmental solutions factor score			+		+	+		
Commute benefit factor score			-				-	
Ideal commute time			+					
Personality								
Adventure seeker factor score			+			+		
Loner factor score					-			
Calm factor score					-			
Lifestyle								
Frustrated factor score						+	+	
Family & community-oriented factor score								+
Status seeker factor score				+				
Excess Travel								
Excess travel indicator						+	+	
Mobility Constraints								
Limitations on driving during the day						+		+
Limitations on driving on the freeway		+						
Limitations on riding a bicycle			+					
Percent of time a vehicle is available	+					-		
Socio-demographics								
Time living in the neighborhood					+			
Age		-						
Female				+				
Year of personal vehicle	-		-					
Vehicle type is SUV					-		-	
Years lived in the U.S.	-			+	-	-	-	+
Total workers in the household					-			
Full-time worker						+		
Manager/administrator occupation						+		
Production/construction/craft occupation				-				
Clerical/administrative support occupation								+
Anyone in household needing special care		+			+			
Personal income category	+			+				
Number of people ages 6-15 in HH								-
Number of people ages 41-64 in HH								+
Number of people ages 65-74 in HH								+
Household with single adult	-							
Household with two or more adults						-		

SD = Short Distance LD = Long Distance

(ES 2 continued)

	Auto improvement	Mobile phone	Work-schedule change	Hire someone to do house or yard work	Mode change	Home-based work	Residential/employment relocation	Alter employment status
Strategy Adoption								
Buy a car stereo system		+						
Get a better car	-			+				
Time since getting a better car	+							
Buy a mobile phone		-						
Change work trip departure time			+					
Time since changing work trip departure time			-					
Adopt flextime			+					
Adopt compressed work week			+					
Hire somebody to do house or yard work				+				
Time since hiring domestic help	-			-				
Change from driving alone to other means					+	+		
Change from another means to driving alone					+			
Squared time since changing from another means to driving alone	+							
Buy equipment to help work from home						+		
Telecommute						+		
Start home-based business				+		+		
Change jobs closer to home	+							
Time since changing jobs closer to home	-							
Work part- instead of full-time								+
Time since retiring or stopping working								+
Work-schedule change bundle							+	
Alter employment status bundle						+		

SD = Short Distance LD = Long Distance

1. INTRODUCTION

Today more than two hundred million vehicles operate on highways in the U.S., and annual vehicle miles traveled (VMT) is more than 2.5 trillion. Traffic congestion has become a common feature of everyday life in metropolitan areas, resulting in high social costs (Arnott and Small, 1994; Downs, 1992; Hanks and Lomax, 1991; *The Economist*, 1998). The costs of lost time and extra fuel consumption caused by congestion were estimated to be as high as $78 billion in 2000, an increase of 39% over those in 1990 (*U.S. News & World Report*, 2001).

For the last three decades, policy makers and transportation planners have devised a series of policy instruments to tackle traffic congestion, starting with supply and demand controls. Transportation Systems Management (TSM) and Transportation Demand Management (TDM) programs are well-known classes of such policy strategies. A number of studies (e.g. Downs, 1992; Giuliano and Small, 1995) have also proposed market-based pricing policies such as congestion pricing, undergirded by the concept that users of a particular transportation facility should pay the costs they impose on others. In addition, promoting the use of information and communication technology (ICT) substitutes for travel, such as telecommuting, has been proposed as a strategy for reducing congestion (e.g. Niles, 1994; US DOT, 1993).

Although many of these strategies have been implemented, they have failed to reduce traffic congestion. A number of reasons have been offered for this failure. The literature on induced demand (e.g. Noland, 2001) argues that improved highway capacity can stimulate auto travel, resulting in the increase of travel demand. With respect to ICT applications, substitution of telecommunications for travel is the impact most desired from a public policy perspective, but ICT may also have a complementary relationship to travel – generating more, on net (Mokhtarian, 2002). These arguments suggest that there is a discrepancy, sometimes large, between the responses to congestion that are assumed by policy makers and those that are actually adopted by individuals. This mismatch in behavioral responses makes policies less effective, and needlessly consumes large amounts of time and money in their trial-and-error implementation. Giuliano (1992) pointed out that TDM strategies are less likely to be effective

without understanding individuals' current travel behavior and preferences, from which derives the public or political acceptability of those strategies.

Pursuant to the aim of improving our understanding of individuals' behavior and attitudes, Salomon and Mokhtarian (1997) developed a conceptual model of the behavioral response to congestion, that incorporates the dynamics of the decision process for individuals' choices adjusted by costs and benefits from their previous experiences. In a subsequent empirical study, Mokhtarian, *et al*. (1997) identified rank-based (travel maintaining, travel reducing, and major location/lifestyle change) and factor-based (auto improvement, departure time, work schedule change, remote work, relocation, and work/lifestyle change) tiers for a set of coping strategies ranging from lower-cost to higher-cost, and short-term to longer-term, using rank ordering and factor analysis, respectively. This study used data collected from 621 employees of the City of San Diego, California in 1992. More recently, Raney, *et al*. (2000) estimated binary logit models of the consideration of each of 15 congestion-response strategies using the same data, and found that individuals are likely to change their responses to congestion from lower-cost, short-term strategies to higher-cost, long-term ones when dissatisfaction remains. They also pointed out that besides travel-related variables, various non-travel-related motivations and constraints affect individuals' responses.

As a sequel to the above research, a series of studies on a newer set of data explores relationships between adoption and consideration of 17 travel-related strategies, linking them to mobility-related, travel attitudes, personality, lifestyle, travel liking, socio-demographic, and other variables. The first report in this series (Clay and Mokhtarian, 2002) presented descriptive analyses of relationships of these variables to the adoption and consideration of each individual strategy and bundle of strategies. The second report in this series (Cao and Mokhtarian, 2003) developed binary logit models for the consideration of each *individual* strategy, taking the adoption and time since adoption of each strategy as potential explanatory variables among others.

Similarly, in this study, we explore the relationships between the adoption and consideration of *bundles* of travel-related strategies by identifying characteristics associated with patterns of

adoption and consideration among bundles, and by developing discrete choice (binary logit) models for individuals' consideration of each bundle. The adoption and time since adoption for individual or bundles of strategies are included as explanatory variables in the models. In particular, we focus on whether the adoption of lower-cost, short-term strategies significantly and/or dynamically (using time since adoption variables) affects the consideration of higher-cost, longer-term ones. We also investigate whether individuals with a high liking for travel, indicative of a positive utility of travel, are resistant to higher-cost, longer-term travel-reduction strategies. The data for this study were collected from a fourteen-page survey returned by about 1,900 adult residents of three distinct San Francisco Bay area neighborhoods in May 1998; the current analysis is based on a subset of nearly 1,300 commuting workers. This study will give policy makers and planners insight into the dynamic nature of individuals' responses to travel-related strategies, and help them to improve on the currently available strategies.

This report consists of five sections. The following section describes the data for this study, explains key types of variables measured by the survey and used in this study, and suggests some hypotheses to be tested by this study. Section 3 presents the correlations between adoption and consideration of strategy bundles. Section 4 discusses the binary logit model results of consideration of strategy bundles, focusing on the significant variables in the models. In the final section, we summarize the results and suggest policy recommendations.

2. DATA DESCRIPTION

2.1 Data Collection

The data for 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: Concord and Pleasant Hill represent suburban neighborhoods, and an area defined as North San Francisco represents an urban neighborhood. North San Francisco has more mixed land uses, higher residential density, and a more grid-like street system compared to the suburban examples. On the other hand, Concord has more segregated land uses and lower residential density. Pleasant Hill was selected to represent another part of the spectrum of suburban neighborhoods. Compared to Concord, Pleasant Hill has greater residential density, indicating fewer single-family households.

Half of the surveys were sent to North San Francisco, and Concord and Pleasant Hill received 2,000 surveys each. 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 1,283 cases used in this analysis constitutes those respondents identified as workers (either part-time or full-time) who commute at least once a month and have relatively complete responses to key questions.

Table 2.1 presents some key socio-demographic characteristics of the study data. The sample is relatively balanced in terms of representation by neighborhood and gender. Nearly 95% of respondents have one or more personal vehicles in their households. Higher incomes are overrepresented compared to Census data, as is typical for self-administered questionnaires.

The survey consists of six sections: “Your Opinions about Travel” (Section A), “Your Lifestyle as it Relates to Travel” (B), “The Amount You Travel” (C), “How You View Your Travel” (D), “Your Travel-Related Choices” (E), and “General Information” (F). This study mainly focuses on Section E, which measured the adoption, time since adoption, consideration, and reasons for adoption and consideration of various travel-related strategies. These variables are discussed in Section 2.2. The variables from the other sections are classified into 10 categories: Objective Mobility, Subjective Mobility, Relative Desired Mobility, Travel Liking, Attitudes, Personality,

Lifestyle, Mobility Constraints, Excess Travel, and Socio-demographics. These variables are described in detail in Section 2.3. Section 2.4 presents some hypotheses to be tested by this study.

Table 2.1: Socio-demographic Characteristics of the Sample Used in this Analysis

Category	Frequency	Percent
Neighborhood (N=1283)		
Concord (suburban)	294	22.9%
Pleasant Hill (suburban)	346	27.0%
North San Francisco (urban)	643	50.1%
Gender (N=1279)		
Female	651	50.9%
Male	628	49.1%
Employment status (N=1283)		
Full-time worker	1,080	84.2%
Part-time worker	203	15.8%
Age (N=1283)		
18-23	42	3.3%
24-40	563	43.9%
41-64	640	49.9%
> 65	38	2.9%
Personal income (N=1255)		
< $15,000	91	7.3%
$15,000-34,999	266	21.2%
$35,000-54,999	386	30.8%
$55,000-74,999	229	18.2%
$75,000-94,999	126	10.0%
> $95,000	157	12.5%
Family status (N=1277)		
Single	319	25.0%
2 or more adults, no children	609	47.7%
1 adult with children	28	2.2%
2 or more adults with children	321	25.1%
Number of personal vehicles in HH (N=1280)		
0	69	5.4%
1	432	33.8%
2	505	39.5%
3 or more	274	21.3%

2.2 Travel-related Strategies

2.2.1 Individual Strategies

Section E of the survey comprises two pages of questions referring to travel-related alternatives that affect the amount of individuals' travel. Figures 1 and 2 show the original form of the questions. The questions under E1 asked about the adoption, and E2 about the consideration, of 19 options having travel-related implications. The first column of boxes for each question was coded as a binary variable, equal to 1 if the box was checked (i.e. if the alternative was not adopted), and 0 otherwise. Years since adoption was coded as whole years (rounded to the nearest full year, with anything less than 6 months coded as zero). Regarding the reasons for adoption and consideration, since more than one reason could be indicated, they were coded separately as binary variables equal to 1 if the reason was checked and 0 otherwise.

Questions "m" and "n" had two parts each: "change jobs . . . closer to home" and ". . . farther from home" (referred to as "m1" and "m2," respectively), and "move your home . . . closer to work" and ". . . farther from work" ("n1" and "n2"). The format for these two questions, shown in Figures 2.1 and 2.2, was designed to economize on vertical space. Unfortunately, it had the unanticipated effect of confusing many respondents (apparently leading them to think that they needed to respond to only one member of each pair) and resulted in a disproportionately high number of non-responses, particularly on the second half of each question. The missing data on the m2 and n2 alternatives for both adoption and consideration ranged from 10% to 17% of the sample, so we did not use these alternatives to screen out cases with missing data, nor did we attempt to fill any missing data on these variables.

In previous analyses of these data, cases with missing responses on variables of interest were either removed or filled; this resulted in 1,904 cases containing relatively complete data for variables other than the travel-related strategies. Since the travel-related strategies had not been previously analyzed in depth, it was necessary to review this set of variables for missing data before proceeding with this study.

Figure 2.1: Section E1 (Adoption) from the Survey

PART E: YOUR TRAVEL-RELATED CHOICES

A number of choices can be made that affect the amount and nature of people's travel. We are interested in knowing some of the choices you have made or may be considering making. *"How long ago"* refers to the most recent time you made that choice.

1. First, we are interested in knowing which of the following you have already done **and why**.

		Not done or not applicable	*Done: How long ago?*	*Why? (CHECK ALL THAT APPLY)* *Personal*	*Family related*	*Work related*	*Reducing or easing travel*	*Other*
a.	Buy a car stereo system	☐	____yrs	☐	☐	☐	☐	☐
b.	Get a mobile phone	☐	____yrs	☐	☐	☐	☐	☐
c.	Get a better car	☐	____yrs	☐	☐	☐	☐	☐
d.	Get a fuel efficient car	☐	____yrs	☐	☐	☐	☐	☐
e.	Change work trip departure time	☐	____yrs	☐	☐	☐	☐	☐
f.	Hire someone to do house or yard work	☐	____yrs	☐	☐	☐	☐	☐
g.	Adopt flextime	☐	____yrs	☐	☐	☐	☐	☐
h.	Adopt compressed work week (such as a "9/80" schedule)	☐	____yrs	☐	☐	☐	☐	☐
i.	Change from driving alone to work, to some other means	☐	____yrs	☐	☐	☐	☐	☐
j.	Change from another means of getting to work, to driving alone	☐	____yrs	☐	☐	☐	☐	☐
k.	Buy equipment/services to help you work from home	☐	____yrs	☐	☐	☐	☐	☐
l.	Telecommute (part- or full-time)	☐	____yrs	☐	☐	☐	☐	☐
m.	Change jobs...closer to home	☐	____yrs	☐	☐	☐	☐	☐
	...farther from home	☐	____yrs	☐	☐	☐	☐	☐
n.	Move your home...closer to work	☐	____yrs	☐	☐	☐	☐	☐
	...farther from work	☐	____yrs	☐	☐	☐	☐	☐
o.	Work part- instead of full-time	☐	____yrs	☐	☐	☐	☐	☐
p.	Start home-based business or put more effort into an existing one	☐	____yrs	☐	☐	☐	☐	☐
q.	Retire or stop working	☐	____yrs	☐	☐	☐	☐	☐

Figure 2.2: Section E2 (Consideration) from the Survey

2. *Now, even if you have already made some of these choices,* you could be thinking about making a similar change again, or considering new options. For this question we are interested in which of the following you have been considering **and why**.

	Not seriously considering	*Seriously considering: Why? (CHECK ALL THAT APPLY)*				
		Personal	*Family related*	*Work related*	*Reducing or easing travel*	*Other*
a. Buy a car stereo system	☐	☐	☐	☐	☐	☐
b. Get a mobile phone	☐	☐	☐	☐	☐	☐
c. Get a better car	☐	☐	☐	☐	☐	☐
d. Get a fuel efficient car	☐	☐	☐	☐	☐	☐
e. Change work trip departure time	☐	☐	☐	☐	☐	☐
f. Hire someone to do house or yard work	☐	☐	☐	☐	☐	☐
g. Adopt flextime	☐	☐	☐	☐	☐	☐
h. Adopt compressed work week (such as a "9/80" schedule)	☐	☐	☐	☐	☐	☐
i. Change from driving alone to work, to some other means	☐	☐	☐	☐	☐	☐
j. Change from another means of getting to work, to driving alone	☐	☐	☐	☐	☐	☐
k. Buy equipment/services to help you work from home	☐	☐	☐	☐	☐	☐
l. Telecommute (part- or full-time)	☐	☐	☐	☐	☐	☐
m. Change jobs...closer to home	☐	☐	☐	☐	☐	☐
...farther from home	☐	☐	☐	☐	☐	☐
n. Move your home...closer to work	☐	☐	☐	☐	☐	☐
...farther from work	☐	☐	☐	☐	☐	☐
o. Work part-time instead of full-time	☐	☐	☐	☐	☐	☐
p. Start home-based business or put more effort into an existing one	☐	☐	☐	☐	☐	☐
q. Retire or stop working	☐	☐	☐	☐	☐	☐

For this study, any case missing more than two out of the 17 responses (i.e. those other than m2 and n2) for either the adoption or consideration of the travel-related strategies was removed, and stochastic data filling was used for the remaining missing responses (see Section 3 of Clay and Mokhtarian (2002) for details). In all, of the 30,328 (1,784 respondents × 17 alternatives) total alternatives analyzed in the adopted section of the travel-related alternatives, responses for 277 or about 0.91% were missing and subsequently filled. For the consideration of strategies, responses for 248 or about 0.82% were filled. Finally, consistent with the focus of previous analyses of these data on commuting workers (in view of the observation that they tend to have different travel patterns and attitudes than non-commuters or non-workers) cases were removed if the respondent did not report working part- or full-time and commuting to work at least once a month. This reduced the final usable data set for this analysis to 1,283 cases.

2.2.2 Strategy Bundles

The initial study in this series (Clay and Mokhtarian, 2002) grouped the 17 travel-related strategies into two sets of strategy bundles, based on conceptual and empirical similarities, respectively. It then related the adoption and consideration of each individual strategy and bundle of strategies to other variables, by comparing means or frequencies between chooser and non-chooser groups for adoption or consideration. As mentioned earlier, in this study we treat the consideration of strategy *bundles* as dependent variables in discrete choice models, and the prior adoption of strategy *bundles* as key explanatory variables. The bundle variables were defined as 1 if any strategy in the bundle had been adopted or considered, respectively, and 0 otherwise. Here, we briefly summarize the two bundle identification methods (see Section 6 of Clay and Mokhtarian (2002) for a detailed discussion), with the results shown in Figure 2.3. Also, the distributions of adoption and consideration with respect to the two sets of strategy bundles appear in Table 2.2.

Table 2.2: Distribution of Bundle Adoption and Consideration (N = 1,283)

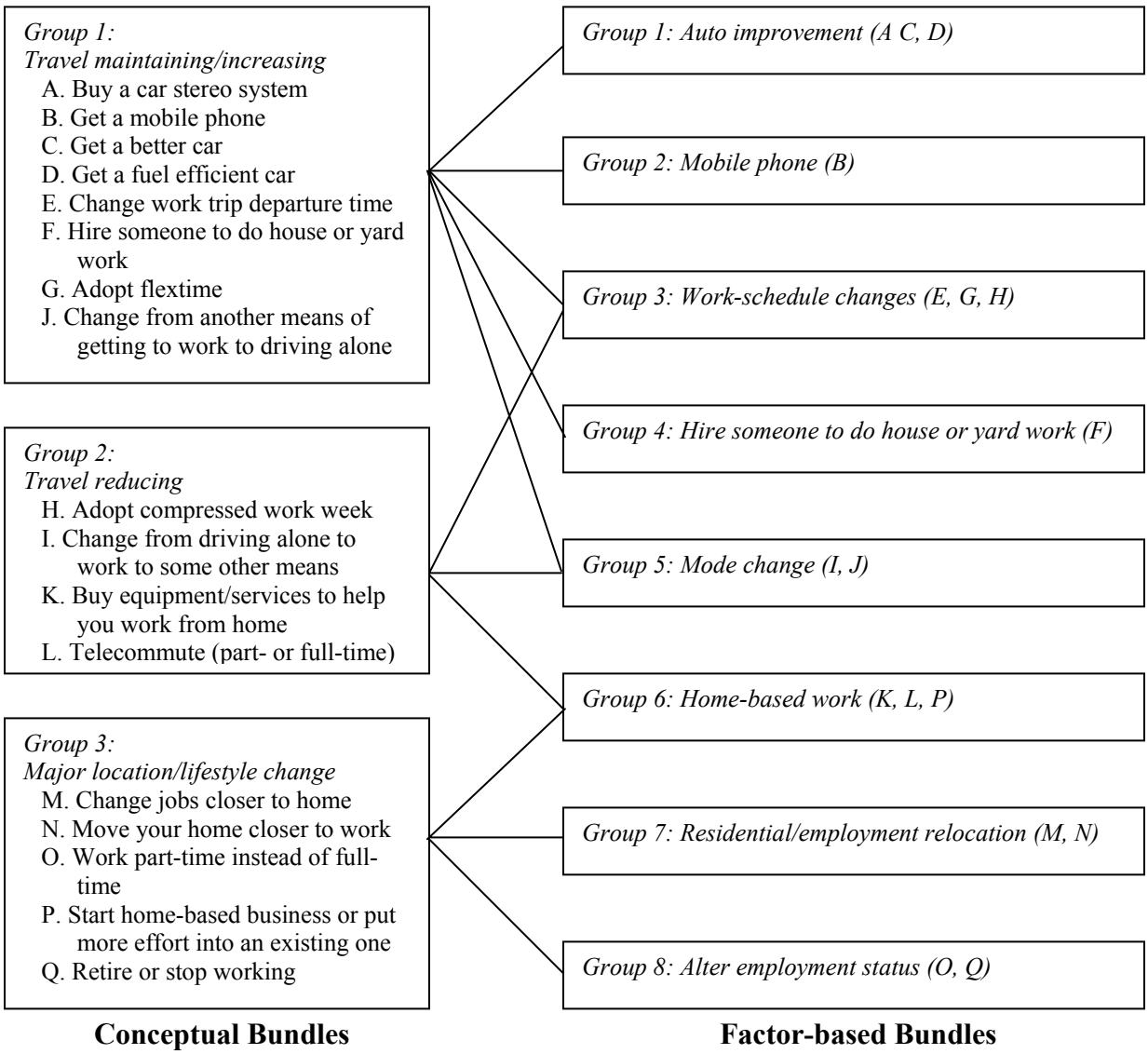
Bundles	Adoption		Consideration	
	Adopted	Not adopted	Considering	Not considering
Conceptual bundles				
Travel maintaining/increasing	1,184 (92.3)	99 (7.7)	926 (72.2)	357 (27.8)
Travel reducing	619 (48.2)	664 (51.8)	503 (39.2)	780 (60.8)
Major location/lifestyle change	640 (49.9)	643 (50.1)	588 (45.8)	695 (54.2)
Factor-based bundles				
Auto improvement	1,048 (81.7)	235 (18.3)	613 (47.8)	670 (52.2)
Mobile phone	528 (41.2)	755 (58.8)	380 (29.6)	903 (70.4)
Work-schedule change	657 (51.2)	626 (48.8)	369 (28.8)	914 (71.2)
Hire someone to do housework	392 (30.6)	891 (69.4)	297 (23.1)	986 (76.9)
Mode change	331 (25.8)	952 (74.2)	180 (14.0)	1,103 (86.0)
Home-based work	474 (36.9)	809 (63.1)	471 (36.7)	812 (63.3)
Residential/employment relocation	448 (34.9)	835 (65.1)	297 (23.1)	986 (76.9)
Alter employment status	239 (18.6)	1044 (81.4)	333 (26.0)	950 (74.0)

Note: Number in parentheses is the percentage of 1,283.

The first method was to classify the strategies conceptually into three bundles based on the generalized cost and the amount of lifestyle change for each. Group one includes low (generalized) cost strategies such as getting a more comfortable car or purchasing a mobile phone. In general, these are strategies that allow one to maintain travel more pleasantly or productively, or may even facilitate increasing one's travel. Group two includes more costly (in

the sense of involving lifestyle changes for the individual or the household) alternatives such as adopting a compressed workweek or telecommuting. These changes reduce one's vehicular travel through reducing the frequency of commuting or changing to shared-ride commute modes. The third group consists of major location or lifestyle changes such as quitting work, working part-time instead of full-time and moving home or work closer to the other. These strategies reduce travel through more drastic means.

Figure 2.3: Conceptual and Factor-based Bundles of the Travel-related Alternatives



The second approach to identifying bundles of strategies was to factor-analyze the responses. This technique identifies patterns of common variation among a group of variables (the binary adoption and consideration variables, in this case), and as such groups the alternatives based on the empirical similarities in responses to them. Using 36 different factor analyses (varying the number of factors extracted, the subsample included and whether adoption and consideration variables were pooled or not), the strategies were classified into the eight bundles that most commonly appeared across all the results and conceptually made the most sense. It should be noted that bundles two and four consist of only one alternative, "get a mobile phone" and "hire someone to do house or yard work", respectively, in view of their independent factor loadings and lack of conceptual (or strong empirical) linkage with the other bundles.

2.3 Key Explanatory Variables

This section describes the key explanatory variables other than those based on the travel-related strategies, by category: Objective Mobility, Subjective Mobility, Relative Desired Mobility, Travel Liking, Attitudes, Personality, Lifestyle, Mobility Constraints, Excess Travel, and Socio-demographics.

Among them, the three mobility categories and the Travel Liking category had similar structures. In each case, measures were obtained both overall and separately by purpose and mode, for short-distance and long-distance travel. Consistent with the American Travel Survey, long-distance trips were defined as those longer than 100 miles, one way. The short-distance modes measured were: personal vehicle, bus, Bay Area Rapid Transit (heavy rail)/light rail/train, walking/jogging/cycling, and other. The short-distance purposes measured were: commuting to work or school, work/school-related, grocery shopping, eating a meal, and taking other people where they need to go. Long-distance measures were obtained for the personal vehicle and airplane modes, and for the work/school-related and entertainment/social/recreational purposes.

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 (a conscious design choice, to reduce the burden on the respondent). Respondents were also asked to specify how many miles they traveled each week, in total and by mode and purpose.

On one hand, reported estimations of *typical* travel, such as we obtained here, are not as reliable as travel diary data. On the other hand, travel diaries can be criticized for generally encompassing only a few days of travel and therefore potentially being unrepresentative at the disaggregate level. Of course, these measures are respondents' *reports* of the distance, frequency, and time they are traveling, and hence are "objective" only in the sense of referring to those *externally measurable* quantities (in contrast to the subjective measures of Subjective and Relative Desired Mobility described below), rather than in the sense of *actually* being measured through external observation.

For long-distance trips, pre-testing indicated that respondents would not be able to estimate distances reliably. Thus, respondents were simply asked to tabulate how many trips they made "last year" for each mode-purpose combination (personal vehicle/work, personal vehicle/entertainment, etc.), to each of nine regions of the world. Those responses indicated number of trips directly, and were also transformed to approximate measures of distance, through judgmental average distances developed between the Bay Area and each of the nine world areas.

In addition, two transformations of the long distance objective mobility indicators are utilized in this report: the natural log of the total miles, and the sum of the natural log of miles for each trip[1]. The reason for performing a natural log transformation was to reduce the weight of long trips, under the assumption that each additional mile traveled would have a diminishing marginal impact (i.e. each additional mile does not have as strong an incremental effect as the previous mile). Also, the sum of the natural log of miles for each trip gives more weight to a larger number of trips traveling a similar number of miles, compared to the natural log of the total miles. For example, nine trips to Western States (counted as 6,300 miles total) could constitute a higher level of travel (e.g. requiring more preparation, involving more disruption and a longer

[1] Actually, ln (miles + 1) was used to prevent combinations having zero miles from being transformed to negative infinity (ln [0]), and to return a value of 0 [= ln (1)] in those cases.

total absence) than one trip to Asia (counted as 7,500 miles total). This higher level of travel is captured by taking the sum of the natural log of miles for each trip: 58.96 (= 9 × ln [700]) for the former case and 8.92 (= 1 × ln [7500]) for the latter (Curry, 2000).

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 categories as for Objective Mobility (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".

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 (in each category) compared to the present, on a five-point scale from "much less" to "much more".

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. To directly measure the affinity for travel, the question was asked, "How do you feel about *traveling* in each of the following categories? We are *not* asking about the activity at the destination, but about the travel required to get there." Respondents were then asked to rate each of the same categories as Subjective Mobility on a five-point scale from "strongly dislike" to "strongly like".

Despite our attempt to alert respondents to distinguish the destination activity from the travel, it is likely that even many of those who actually read the instructions (and more of those who did not) were unsuccessful at doing so. Future studies should perhaps make this distinction even more forcefully to the respondent; interactive interviews would be one mechanism for probing answers and helping the participant to separate these components of the utility for travel. Nevertheless, we

believe that the responses to this question are essentially measuring the degree of the respondent's affinity for travel for its own sake, even if that measurement is imperfect.

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". Factor analysis was then used to extract the relatively uncorrelated fundamental dimensions spanned by these 32 variables. Six underlying dimensions were identified, using principal axis factoring with oblique rotation (see Redmond, 2000 or Mokhtarian, *et al.*, 2001 for details): travel dislike, pro-environmental solutions, commute benefit, travel freedom, travel stress, and pro-high density.

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 calm 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.

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.

Socio-demographics

Finally, the survey included an extensive list of Socio-demographic variables to allow for comparison to other surveys and to Census data. These 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.

2.4 General Hypotheses

In this section, we describe general hypotheses that represent potential relationships of the explanatory variable categories as well as adoption variables to the consideration of strategy bundles, particularly the conceptual strategy bundles (because the factor-based strategy bundles are for the most part subsets of conceptual strategy bundles). It should be emphasized that the individual travel-related strategies, as the basis of the strategy bundles, primarily focus on commute or work-related travel. However, discretionary travel such as recreation and entertainment travel can directly or indirectly affect the consideration of strategy bundles. For instance, people who desire to increase recreation travel may want to reduce their commute time, so that they can spend more time on the desired travel. Thus, as we will see, in several cases consideration of both travel-maintaining and the two types of travel-reducing strategies may be positively associated with the same type of variable, for different reasons. For each category of

variable, the hypotheses are presented below and summarized in Table 2.2 at the end of this section.

Objective Mobility. In general, it might seem that those who travel a lot should be more likely to consider ways to reduce their travel. Thus, it could be expected that Objective Mobility is positively associated with consideration of the travel reducing and major location/lifestyle change strategy bundles. Interestingly, the previous study (Clay and Mokhtarian, forthcoming) found that Objective Mobility variables are positively related to strategies in all three conceptual bundles, based on individual t-tests. This may imply that people who have higher amounts of travel are more likely to seek any type of travel-related strategy than to do nothing. In particular, even travel maintaining strategies may be attractive to the heavy traveler, as a way of ameliorating the travel that *cannot* be easily reduced. In view of our own expectations and these prior findings, our hypothesis is that Objective Mobility is positively related to the consideration of all three strategy bundles.

Subjective Mobility. Choo, *et al*. (forthcoming) found that Subjective Mobility, as a psychological assessment of the amount of travel one does, even more strongly affects individuals' Relative Desire to reduce their travel than Objective Mobility does. This supports our initial hypothesis that those who perceive their travel to be a lot are more likely to consider the travel reducing or major location/lifestyle change strategy bundles. However, the previous study (Clay and Mokhtarian, forthcoming) found that Subjective Mobility variables are also positively related to the consideration of all three bundles. Again, this implies that people with a higher Subjective Mobility seek ways to make their travel more comfortable (by getting a better car) or lessen the psychological burden of travel (by acquiring a better car stereo system or a mobile phone), without necessarily reducing the amount of their current travel. Thus, similar to Objective Mobility, we hypothesize that Subjective Mobility is positively related to the consideration of all three strategy bundles.

Relative Desired Mobility. Clearly, those who generally want to increase their travel (that is, have a higher Relative Desired Mobility) should be more likely to consider the travel maintaining/increasing bundle. In contrast, people with a higher desire specifically for

discretionary travel may consider the travel reducing or major location/lifestyle change strategy bundles to reduce commute time, in order to increase the amount of time available for the desired travel. Thus, it can be hypothesized that some Relative Desired Mobility variables are positively related to the consideration of all three strategy bundles. Relative Desired Mobility for commuting in particular, however, should be negatively related to the consideration of the travel reducing and major location/lifestyle change bundles.

Travel Liking. We first hypothesized that Travel Liking, representing a positive orientation toward travel, would be positively associated with consideration of the travel maintaining/increasing bundle. That is, people who like travel are more likely to consider ways to increase or maintain their travel. However, similar to Relative Desired Mobility (with which it is strongly correlated), the positive relationship of Travel Liking to the consideration of other bundles may also be an outcome for a competitive preference for other travel than work. Consequently, it can be hypothesized that Travel Liking is generally positively related to the consideration of all three strategy bundles, with the same exception for commute Travel Liking as noted for Relative Desired Mobility.

Attitudes. It is hypothesized that variables indicating a positive attitude toward (commute) travel (such as the commute benefit and travel freedom factor scores) are positively related to the travel maintaining/increasing bundle consideration, whereas variables indicating a negative attitude toward travel (such as the travel dislike and travel stress factor scores) are positively related to the travel reducing or major location/lifestyle change bundle consideration. We hypothesize that the higher the pro-environmental solution factor score, the more likely the individual is to consider the travel reducing or major location/lifestyle change bundle. However, the situation for the pro-high density attitude is more complex, with plausible hypotheses in both directions. On the one hand, a pro-high density attitude might be a marker for not liking travel in general (and hence wanting to live in a mixed-use neighborhood that minimizes the need to travel to engage in desired activities). This would suggest a positive (or, if one's situation is already optimized by living in a high-density area, a neutral) association with considering the travel reducing and major location/lifestyle change strategies. On the other hand, living in a neighborhood where auto travel is more difficult (congestion is higher, parking is scarce and

expensive) may create a sort of deprivation response, that stimulates consideration of strategies leading to more travel (or, stated the other way, that those with *low* pro-high density scores, being travel-surfeited, are *more* likely to consider the travel reducing strategies). Perhaps because of these counteracting relationships, this variable was never significant in the final models presented here.

Personality. We hypothesize that the higher the score on the adventure seeker factor, the more likely one is to consider the travel reducing or major location/lifestyle change bundle. This factor suggests a preference for entertainment travel over work, with heavily loading variables of "variety-seeking", "like being outdoors", and "risk-taking". It could also be hypothesized that those who are *less* calm are *more* bothered by congestion and hence more likely to consider travel-related solutions, suggesting a negative relationship of the calm factor score to the consideration of all three bundles. Hypotheses for the other two personality factor variables are considerably weaker and more speculative. However, the variables are included in our modeling to explore whether they significantly affect each strategy bundle.

Lifestyle. The frustrated factor represents those who are "unsatisfied" or "lacking control". Thus, people with a high score on this factor may be more likely to seek any travel-related strategy bundles, and to change from one to another seeking more satisfaction. We expect the family/community oriented factor to be positively related to consideration of the travel reducing or major location/lifestyle change strategy bundle, permitting the individual to spend more time with family or community by reducing commute time. Similarly, workaholics tend to want to spend more time on work, so they may consider commuting to be wasting time that could be better spent on work. Thus, this factor variable may positively affect the consideration of the travel reducing strategy bundle but negatively affect the consideration of the major location/lifestyle change strategy bundle which includes "retire or stop working". On the other hand, career-oriented professionals are often willing to accept a longer commute to a better job (e.g., Pazy, *et al.*, 1996), suggesting that workaholics may also be more inclined to consider travel maintaining strategies to make more comfortable a commute that they deem necessary for their career. We expect the status seeker factor to be positively associated with consideration of

the travel maintaining/increasing bundle since people with high status seeker scores may want to travel more to show off their cars or to buy a better car as a status symbol.

Excess Travel. As an indicator of a preference for discretionary travel, we expect Excess Travel to be positively associated with the travel reducing or major location/lifestyle change bundle consideration. People with a higher Excess Travel value may have a higher Objective Mobility and tend to want to reduce mandatory travel such as commuting.

Mobility Constraints. It can be hypothesized that Mobility Constraints are positively related to the consideration of all strategy bundles. For example, people who have limitations on or anxieties about driving during the day are likely to consider either travel maintaining (changing work trip departure time), travel reducing (telecommuting), or major location change (changing jobs closer to home) strategies. That is, similar to the arguments for Objective Mobility and Subjective Mobility, those people are more likely to seek any travel-related strategy bundles than to do nothing to overcome their mobility constraints.

Socio-demographics. We hypothesize relationships of key socio-demographic variables to consideration of the strategy bundles. As found in the previous related study (Mokhtarian, *et al*., 1997), we hypothesize that females are more likely to consider the more costly strategy bundles, namely the travel reducing and major location/lifestyle change bundles. We suggest that older people are less likely to consider the first two travel-related strategy bundles, because they may have been able to optimize their current circumstances or have become more accustomed to their commute travel. On the other hand, we expect older people to be more likely to consider the third strategy bundle, which includes changing from full-time to part-time work (as a transition stage to retirement) and retiring altogether. In addition, we expect that people with higher incomes are more likely to consider all strategy bundles than to do nothing because they can afford to buy a better car or to pay the additional costs associated with the more costly strategies.

Strategy Adoption. As suggested by Raney, *et al*. (2000), the previous adoption of a bundle or single strategy could logically either positively or negatively affect the consideration of other (and the same) strategies. For example, the adoption of a higher-cost strategy could reduce the

probability of considering a lower-cost strategy if the higher-cost strategy were effective, but it could increase the probability of considering lower-cost strategies if the effectiveness of the higher-cost strategy had diminished over time or was not as great as expected. In general, we could hypothesize a progression from lower-cost to higher-cost strategies, but it is also natural to expect some respondents to cycle within a given strategy bundle (i.e. repeating strategies such as getting a better car or changing work trip departure time) or to cycle back to a lower-cost strategy after adopting a higher-cost one. Also, some strategies within a given bundle may be complements (so that adopting one strategy in the bundle increases the probability of considering another one in the same bundle − e.g. buying equipment to support working from home, and telecommuting), whereas others may be substitutes (so that adopting one strategy in the bundle decreases the probability of considering the same bundle − e.g. flextime and compressed work week schedules). With respect to the time since adoption variable, we might initially expect that people with a longer (shorter) time since adoption of an individual strategy are more (less) likely to consider the corresponding bundle strategy. However, again, to the extent that strategies in a given bundle are complements, the reverse may be true. Thus, for these variables we are in the somewhat unaccustomed position of being able to justify virtually any relationship of prior adoption of one strategy to the consideration of the same or a different strategy. However, it would be of interest to identify which of the many *conceptually* possible relationships are *empirically* dominant for this dataset. We explore this descriptively in Section 3, and analytically through the models presented in Section 4.

Table 2.3: General Hypotheses

Explanatory Variable Category	Dependent Variable (Consideration of Strategy Bundle)		
	Travel maintaining/increasing	**Travel reducing**	**Major location/ lifestyle change**
Objective Mobility	+	+	+
Subjective Mobility	+	+	+
Relative Desired Mobility	+	+ (- for commute)	+ (- for commute)
Travel Liking	+	+ (- for commute)	+ (- for commute)
Attitudes			
• commute benefit	+	-	-
• travel freedom	+		
• travel dislike		+	+
• travel stress		+	+
• pro-environmental solutions		+	+
• pro-high density		+/-	+/-
Personality			
• adventure seeker	+	+	+
• organized	undecided	undecided	undecided
• loner	undecided	undecided	undecided
• calm	-	-	-
Lifestyle			
• frustrated	+	+	+
• family/community oriented		+	+
• workaholic	+	+	-
• status seeker	+		
Excess Travel		+	+
Mobility Constraints	+	+	+
Socio-demographics			
• female		+	+
• age	-	-	+
• income	+	+	+
Strategy Adoption			
• adoption	+/-	+/-	+/-
• time since adoption	+/-	+/-	+/-

3. DESCRIPTIVE RELATIONSHIPS BETWEEN ADOPTION AND CONSIDERATION

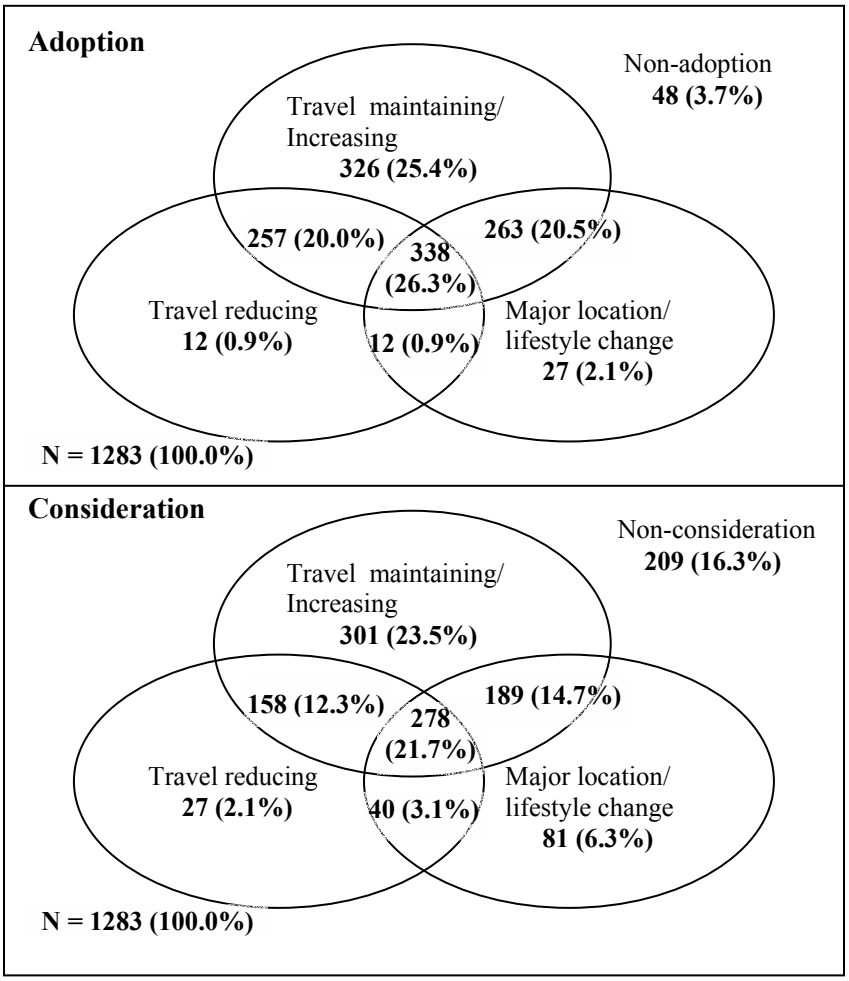
This section explores the descriptive relationships between previous adoption and current consideration of strategy bundles, without considering the other variables. It is of interest to explore whether the previous adoption of a strategy bundle is directly associated with the current consideration of the corresponding or other strategy bundles. We first discuss the distribution of previous adoption and current consideration for each set of strategy bundles, and then examine not only their correlations but also their relationships to measures of satisfaction with current travel conditions, using correlation tests.

3.1 Distribution of Adoption and Consideration of Strategy Bundles

As indicated in Section 2.4, Raney, *et al*. (2000) identified several possible relationships between adoption and consideration of travel-related strategies. Given that lower-cost strategies have been adopted, the individual is more likely to consider a higher cost strategy if she is unsatisfied with the current strategy. On the other hand, given that lower-cost strategies have been adopted, the individual is less likely to consider a higher cost strategy if she is satisfied with the current strategy. In addition, it is plausible that the individual is more likely to consider the same or another strategy in the same bundle regardless of her satisfaction. That is, if the individual has been satisfied with the currently adopted strategy, she is more likely to keep adopting it. If not, she may be more likely to seek another strategy in the same bundle (particularly before escalating to a higher-cost bundle), especially under travel time (or cost) budget constraints.

Further, it should be emphasized that the combined adoption of more than one strategy bundle might complicate the current consideration. If the individual is dissatisfied with the combined adoption of strategy bundles, she may consider adding one or more strategy bundles, dropping one or more adopted strategy bundles, or both. In fact, the Venn diagram in Figure 3.1 shows that 68% of the sample has adopted two or more strategy bundles, and that the category for adoption of all bundle strategies has the highest proportion. Also, it is possible that the individual adopts more than one strategy in a given bundle. For example, 81% of the 326 respondents who adopted only the travel maintaining/increasing bundle have adopted more than one individual

strategy in that bundle. Thus, this indicates that people are likely to engage in more than one strategy to control or reduce their work travel, with a probable synergistic effect.



Note: Numbers and percentages shown are mutually exclusive and collectively exhaustive.

Figure 3.1: Adoption and Consideration of Conceptual Strategy Bundles

For current consideration, similar to previous adoption, more than half of the respondents are considering two or more conceptual strategy bundles. The category of the consideration of just the travel maintaining/increasing bundle strategy has the highest proportion of the sample (nearly one-fourth), and the category of the consideration of all bundles has also a high proportion (more than one-fifth). Interestingly, 16.3% of the sample is not considering any strategy bundles at all. The non-consideration rate is almost five times higher than that of non-adoption. Such people may either be so *satisfied* with the results of their previous adoptions that they are not motivated

to seek changes, or may be so *dissatisfied* with their previous adoptions that they believe nothing they can do will improve their current travel conditions, resulting in a disinclination to pursue new strategies.

Analyzing the survey responses (see Figures 1 and 2 in Section 2), Clay and Mokhtarian (forthcoming) found that the respondents adopted or are considering individual strategies for a variety of reasons other than (or in addition to) travel. "[R]educing or easing travel" is the most-commonly cited reason for only one strategy (change from driving alone to some other means of travel) in both adoption and consideration, and the second most-commonly cited reason for four of the 19 strategies in adoption, and five of the 19 in consideration. However, they pointed out (p. 15) that "although respondents were invited to check as many reasons as applied, many would have stopped after checking the first relevant reason. Even when they were willing to check multiple reasons, they may not always have realized the importance of transportation to their choices." Keeping this in mind, we will mainly interpret the relationships between adoption and consideration from the transportation point of view, while remembering the broader context in which these activities take place.

Table 3.1 presents the cross-tabulation of previous adoption against current consideration of combinations of the conceptual strategy bundles. For the 48 non-adopters (adoption segment 1), more than half of the respondents in this category are considering one or more strategy bundles, especially the travel maintaining/increasing strategy bundle. These people have likely been mostly satisfied with their current travel conditions or are just starting to feel some dissatisfaction, so they are more likely to consider a lower-cost strategy like those in the travel maintaining/increasing bundle. On the other hand, 189 (14.7%) respondents in the sample are not considering any strategy bundle, despite having previously adopted one or more bundles. As discussed before, such non-considerers might think that they have gained few (current) benefits from the strategy bundles they have adopted, even the higher-cost ones. Or, these people are satisfied with their current travel conditions due to previous adoptions, so they are not motivated to consider any strategy bundle at this time. Looking at the absolute frequencies in the final row and column, it is reasonable that either or both of the travel reducing and major location/lifestyle

change bundles are least likely to have been adopted or to be considered because of their higher costs, compared to the other (separate or combined) groups.

Looking at the rows of Table 3.1, for every adoption segment except segment 7 (adoption of Groups 2 & 3), the diagonal elements have the highest or second-highest proportion of consideration for that category. That is, as could be expected, those who previously adopted single or combined strategy bundles are more likely to consider the same strategy category than to extend their consideration to other categories. For example, those who previously adopted a single strategy in a bundle tend to consider adding another strategy in the same bundle (or re-adopting the same strategy), rather than changing to another bundle. Looking down the columns and focusing on the bold numbers, Table 3.1 also shows that previous adopters of a particular combination of bundles are generally more likely than adopters of other combinations to consider the same combination.

Interestingly, as shown by the cross-hatched cells in Table 3.1, in contrast to the single-bundle adopter segments 2, 3, and 4, those who adopted two strategy bundles (segments 5, 6, and 7) tend to consider adding another strategy bundle (i.e. to consider all strategy bundles, as for segments 5 and 7), dropping the higher-cost one (as for segment 6), or dropping both (as for segment 7). It may well be that people dissatisfied with their previously adopted strategies tend to consider adding another strategy bundle, whereas people who are satisfied with their previously adopted strategies tend to contemplate keeping or dropping one or more bundles.

Turning to the factor-based strategy bundles, there are a large number of combinations for all strategy bundles (2^8=256 possibilities), so we (1) consider only the respondents who have adopted and are considering at least one strategy bundle, and (2) do not distinguish combinations of bundles. That is, the adoption (consideration) of each strategy bundle can include the adoption (consideration) of single or multiple strategy bundles. For example, the adoption of Group 1 means the adoption of either Group 1 alone, or in combination with any other bundle(s).

Table 3.1: Adoption and Consideration of Combinations of Conceptual Strategy Bundles (N=1283)

Adoption segment	**Consideration**								
	None	Group 1 only	Group 2 only	Group 3 only	Groups 1 & 2	Groups 1 & 3	Groups 2 & 3	Groups 1 & 2 & 3	Total
1. Non-adoption	**20 (41.7)**	12 (25.0)	0 (0.0)	1 (2.1)	2 (4.2)	7 (14.6)	3 (6.3)	3 (6.3)	48 (100.0)
2. Group 1 only: Travel maintaining/increasing	68 (20.9)	**107 (32.8)**	6 (1.8)	26 (8.0)	28 (8.6)	57 (17.5)	5 (1.5)	29 (8.9)	326 (100.0)
3. Group 2 only: Travel reducing	2 (16.7)	1 (8.3)	**2 (16.7)**	0 (0.0)	1 (8.3)	**3 (25.0)**	**1 (8.3)**	2 (16.7)	12 (100.0)
4. Group 3 only: Major location/lifestyle change	5 (18.5)	3 (11.1)	0 (0.0)	**7 (25.9)**	4 (14.8)	5 (18.5)	2 (7.4)	1 (3.7)	27 (100.0)
5. Groups 1 & 2	37 (14.4)	45 (17.5)	9 (3.5)	13 (5.1)	**48 (18.7)**	27 (10.5)	9 (3.5)	69 (26.8)	257 (100.0)
6. Groups 1 & 3	41 (15.6)	72 (27.4)	1 (0.4)	21 (8.0)	23 (8.7)	57 (21.7)	4 (1.5)	44 (16.7)	263 (100.0)
7. Groups 2 & 3	3 (25.0)	2 (16.7)	1 (8.3)	0 (0.0)	2 (16.7)	1 (8.3)	0 (0.0)	3 (25.0)	12 (100.0)
8. Groups 1 & 2 & 3	33 (9.8)	59 (17.5)	8 (2.4)	13 (3.8)	50 (14.8)	32 (9.5)	16 (4.7)	**127 (37.6)**	338 (100.0)
Total	209 (16.3)	301 (23.5)	27 (2.1)	81 (6.3)	158 (12.3)	189 (14.7)	40 (3.1)	278 (21.7)	1283 (100.0)

Note: The numbers in parentheses are the percents of the corresponding row category; the table focuses on the percentage of people that have previously adopted a particular combination of bundles, who are considering each possible combination of bundles. Bold numbers indicate the highest row percentage for that column, that is, the adoption group having proportionately the highest rate of consideration of that combination of strategies. Cross-hatched cells indicate the highest row percentage for that row, that is, the combination of bundles most often considered by a given adoption segment. Shaded cells simply highlight the main diagonal, i.e. the consideration of a given combination by those who have adopted the same combination.

Table 3.2 shows the cross-tabulation of adoption and consideration of the factor-based strategy bundles. Looking first at the columns, we see that, similar to the conceptual strategy bundles, in five out of eight cases, the group most often considering a given bundle is the one who has previously adopted it − that is, the diagonal element is the highest row percent of the column (and is therefore bolded). To some extent, the respondents who adopted lower-cost strategy bundles may tend to consider the next higher-cost bundle.

Turning to the rows, it is striking (though not very surprising, in view of its low cost) that the bundle considered most often by every adoption group except number 6 (home-based work) is bundle 1, auto improvement strategies. Perhaps surprisingly, the highest rate of consideration of auto improvement comes from those who have adopted the mode change strategy bundle. However, it is logical that those who changed from another means for commuting to driving alone (82 of the 173 who adopted mode change and are considering auto improvement) are more likely to improve their cars to make their driving commutes more comfortable. On the other hand, those who changed from driving alone for commuting to other means (125 of the 173) may have more money to invest in auto improvement strategies, because they spend less money on auto maintenance than they would if they were commuting by driving alone.

3.2 Descriptive Analyses of Adoption and Consideration of Strategy Bundles

In this section, we conduct descriptive analyses for previous adoption and current consideration to examine whether previous adoption is significantly related to current consideration, and whether their relationships are significantly different between groups who are satisfied and unsatisfied with their current travel conditions. First, a test of pairwise correlation between adoption and consideration is carried out for each set of strategy bundles. Then, we conduct a cluster analysis of four travel attitude factor scores – travel dislike, travel stress, commute benefit, and travel freedom – to identify two groups, those who are unsatisfied and those who are satisfied with their current travel conditions. Finally, we present correlation tests to explore whether adoption and consideration are different between the two groups.

Table 3.2: Cross-tabulation of Adoption and Consideration Pairs for Factor-based Strategy Bundles (Adopters Only)

Adoption (N=Adopters)	**Consideration (N=Considerers)**							
	Group 1 (N=613)	Group 2 (N=380)	Group 3 (N=369)	Group 4 (N=297)	Group 5 (N=180)	Group 6 (N=471)	Group 7 (N=297)	Group 8 (N=333)
Group 1: Auto improvement (N=1048)	512 (48.9)	317 (30.2)	299 (28.5)	259 (24.7)	150 (14.3)	385 (36.7)	239 (22.8)	266 (25.4)
Group 2: Mobile phone (N=528)	258 (48.9)	117 (22.2)	154 (29.2)	149 (28.2)	63 (11.9)	214 (40.5)	123 (23.3)	124 (23.5)
Group 3: Work-schedule change (N=657)	329 (50.1)	208 (31.7)	**254 (38.7)**	175 (26.6)	117 (17.8)	292 (44.4)	194 (29.5)	180 (27.4)
Group 4: Hire someone to do house work (N=392)	189 (48.2)	116 (29.6)	120 (30.6)	**159 (40.6)**	58 (14.8)	158 (40.3)	74 (18.9)	108 (27.6)
Group 5: Mode change (N=331)	**173 (52.3)**	106 (32.0)	122 (36.9)	75 (22.7)	**94 (28.4)**	155 (46.8)	**104 (31.4)**	78 (23.6)
Group 6: Home-based work (N=474)	238 (50.2)	151 (31.9)	163 (34.4)	143 (30.2)	84 (17.7)	**299 (63.1)**	136 (28.7)	135 (28.5)
Group 7: Residential/employment relocation (N=448)	231 (51.6)	149 (33.3)	145 (32.4)	102 (22.8)	74 (16.5)	191 (42.6)	114 (25.4)	99 (22.1)
Group 8: Alter employment status (N=239)	118 (49.4)	**81 (33.9)**	71 (29.7)	66 (27.6)	32 (13.4)	111 (46.4)	56 (23.4)	**117 (49.0)**

Note: Numbers in parentheses are the percents of the adopters of the row bundle who are considering the column bundle. Respondents can consider multiple bundles, so the sum of row percents will exceed 100. Bold numbers indicate the highest row percentage for that column. Cross-hatched cells indicate the highest row percentage for that row. Shaded cells simply highlight the main diagonal, i.e. the consideration of a given bundle by those who have adopted the same bundle.

3.2.1 Correlation Test of Adoption and Consideration

Pearson correlation tests were conducted to identify pairwise correlations between previous adoption and current consideration. Table 3.3 presents the results of the tests for the conceptual strategy bundles. Interestingly, except for Group 1 adoption and Group 3 consideration, previous adoption of any bundle is significantly, positively correlated with current consideration of each of the strategy bundles. The implication is that those who have any experience in adopting a travel-related strategy bundle are more likely to consider another or the same bundle than are non-adopters. The highest correlations are between adoption and consideration of the *same* bundle (the major diagonal elements), indicating that the same or similar strategies are likely to be considered/adopted repeatedly throughout an individual's life. The adoption of higher-cost strategy bundles tends to be somewhat more strongly associated with the consideration of all three strategy bundles, compared to the adoption of the lower-cost bundles. In particular, higher-cost bundle adopters are slightly more inclined to consider lower-cost bundles than lower-cost bundle adopters are to consider higher-cost ones.

Table 3.3: Correlation between Adoption and Consideration of Conceptual Strategy Bundles (N=1283)

Adoption	**Consideration**		
	Group 1	Group 2	Group 3
Group 1: Travel maintaining/increasing	0.127^{++}	$0.071^{+,1C,\ 2A}$	
Group 2: Travel reducing	$0.088^{++,2C}$	0.336^{++}	$0.101^{++,2C}$
Group 3: Major location/lifestyle change	$0.080^{++,2C}$	0.112^{++}	0.124^{++}

Notes:
+: positive correlation with $0.01 < \text{p-value} \leq 0.05$, ++: positive correlation with p-value ≤ 0.01, insignificant correlation omitted for simplicity. 1C: partial correlation becomes insignificant when Group 1 consideration is controlled for. 2C: partial correlation becomes insignificant when Group 2 consideration is controlled for. 2A: partial correlation becomes insignificant when Group 2 adoption is controlled for.

Additionally, we did partial correlation tests to explore whether or not a third variable (consideration or adoption) affects a pairwise relation between adoption and consideration. That is, if Corr(A, B) is significant (and conceptual considerations support the causal direction A→ B rather than B → A), but Corr(A, B | C) is not significant, it suggests that a more appropriate model is A → C → B rather than A → B directly. The test results suggest that the impact of

previous adoption of bundle A on the current consideration of a lower- or higher-cost bundle B is moderated by the simultaneous consideration of bundle A (e.g., Group 1 adoption → Group 1 consideration → Group 2 consideration, or Group 2 adoption → Group 2 consideration → Group 1 consideration) or the simultaneous consideration of a different bundle (Group 3 adoption → Group 2 consideration → Group 1 consideration). In the one case in which controlling for prior adoption significantly affected the correlation, the results are consistent with two interpretations: Group 1 adoption → Group 2 adoption → Group 2 consideration, or Group 2 adoption affects both Group 1 adoption and Group 2 consideration separately.

Table 3.4 shows the results of the correlation tests for the factor-based bundles. More than a third of the pairs of adoption and consideration of strategy bundles are significantly correlated with each other. Especially, six of the eight diagonal correlations are strongly significant. All of those six except the mobile phone strategy are positively correlated. This is further support for the observation that the previous adoption significantly affects the current consideration of the same strategy bundle. As shown by the number, magnitudes and significance levels of correlations on the upper half of the matrix compared to the lower half, the adopters of lower-cost strategy bundles are somewhat more likely to consider higher-cost strategy bundles than the converse (in partial contrast to the results for the conceptual bundles). Together with the adopters of two other strategy bundles, the adopters of the higher-cost residential/employment relocation bundle have the greatest number of significant correlations with consideration variables, and especially tend to be considering the lower-cost travel maintaining bundles (however, the correlations, although statistically significant, are small in magnitude). It is intriguing that these adopters consider home-based work as well, even though their travel distances for work were reduced by moving home closer to work, or vice versa. Taken together, these results suggest that such people may be inclined to reduce or eliminate commute trips but maintain travel for other purposes. Adopters of medium-cost work-schedule changes and home-based work have an equal number of significant correlations with the consideration variables, all of them representing medium or higher-cost strategy bundles.

Table 3.4: Correlation between Adoption and Consideration of Factor-based Strategy Bundles (N=1283)

Adoption	Consideration							
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
Group 1. Auto improvement				0.078^{++}				
Group 2. Mobile phone		-0.137^{--}		0.101^{++}		0.066^{+}		
Group 3. Work-schedule changes			0.224^{++}	0.085^{++}	0.111^{++}	0.164^{++}	0.155^{++}	
Group 4. Hire someone for domestic help				0.274^{++}			-0.067^{-}	
Group 5. Mode change			0.105^{++}		0.244^{++}	0.124^{++}	0.116^{++}	
Group 6. Home-based work			0.095^{++}	0.127^{++}	0.081^{++}	0.419^{++}	0.101^{++}	
Group 7. Residential/employment relocation	0.055^{+}	0.058^{+}	0.058^{+}			0.090^{++}		-0.064^{-}
Group 8. Alter employment status						0.097^{++}		0.251^{++}

Notes:
+ (-): positive (negative) correlation with $0.01 < \text{p-value} \leq 0.05$,
++ (--): positive (negative) correlation with p-value ≤ 0.01,
insignificant correlations omitted for simplicity.

3.2.2 Clustering on Travel Attitudes

It is of great interest to examine whether the relationships of prior adoption to current consideration are different between those who are satisfied with their current travel conditions, and those who are dissatisfied. Naturally enough, we hypothesize a positive relationship to be stronger for those who are dissatisfied, whereas those who are satisfied might have a neutral or even negative relationship between adoption and consideration. To test these hypotheses, we first classified the sample into two groups based on the travel attitude factor score variables (only one of which, commute benefit, is specific to work trips). The "quick cluster" (k-means) analysis method in SPSS was employed, together with manually provided initial cluster centers. We first tried to use all six travel attitude factor scores to classify the groups, but two variables, pro-environmental solution and pro-high density, did not have any distinctive differences across clusters, and in any case those two variables are less directly related to satisfaction with traveling itself than are the remaining four. Thus, the final two clusters were created from the other four variables: travel dislike, travel stress, commute benefit, and travel freedom. Table 3.5 presents

the final cluster centers with the 95% confidence interval, number of cases in each cluster, and other work-related mobility variables. Based on the cluster centroids, people in the first group tend to like travel, are not very stressed by it, find commuting beneficial, and feel free to go where they want. The opposite is true for those in the second group, thus justifying the respective "satisfied" and "unsatisfied" labels. With respect to the other variables, as expected, for commute or work-related travel, on average the satisfied group has higher values for relative desired mobility and travel liking, and lower values for subjective mobility (specifically for commuting) than the other group. This indicates that the satisfied group has relatively positive attitudes toward work trips.

Table 3.5: Description of Clusters for Travel Satisfaction

Characteristics	**Cluster**	
	Satisfied	Unsatisfied
Number of cases	726 (56.6%)	557 (43.4%)
Final cluster centers with the 95% confidence interval		
travel dislike factor	-0.510 ± 0.040	0.671 ± 0.061
travel stress factor	-0.411 ± 0.046	0.540 ± 0.060
commute benefit factor	0.414 ± 0.051	-0.539 ± 0.063
travel freedom factor	0.194 ± 0.051	-0.257 ± 0.060
Mean values of other variables		
Subjective Mobility [1, 2, …, 5]		
commuting to work/school	3.46*	3.68*
work/school-related activities	2.54	2.48
Relative Desired Mobility [1, 2, …, 5]		
commuting to work/school	2.48*	2.24*
work/school-related activities	2.71*	2.59*
Travel Liking [1, 2, …, 5]		
commuting to work/school	2.96*	2.46*
work/school-related activities	3.03*	2.73*

Notes:
All factor scores are standardized.
* There is a significant difference of means between the clusters at a level of α=0.05.

3.2.3 Comparison of Adoption and Consideration between the Clusters

This section explores the statistical differences in previous adoption and current consideration for the two clusters. We use Pearson pairwise correlation tests between adoption and consideration for each cluster, and then compare the results between the two.

Table 3.6 presents the test results for the conceptual strategy bundles. Similar to the results of the previous correlation tests, adoption and consideration are significantly, positively correlated for most pairs of strategy bundles except one (adoption of the travel maintaining/increasing bundle and consideration of the major location/life style change bundle), in either the satisfied or the unsatisfied group, or both. As expected, the diagonal elements have the highest correlations of their row and column except for the major location/life style change bundle (especially for the satisfied group). This suggests that one who has adopted a particular strategy is more likely to consider either the same strategy or another strategy in the same bundle whether she is satisfied with her current travel conditions or not.

Table 3.6: Correlations between Adoption and Consideration of Conceptual Strategy Bundles (Satisfied and Unsatisfied Groups)

Adoption		**Consideration**		
		Group 1	Group 2	Group 3
Group 1: Travel maintaining/increasing	S	0.132***		
	U	0.120**	0.107*	
Group 2: Travel reducing	S	0.078*	0.346***	0.115**
	U	0.100*	0.324***	
Group 3: Major location/lifestyle change	S	0.111**	0.093*	0.107**
	U		0.134**	0.149***

Notes:
* 0.01 < p-value ≤ 0.05, ** 0.001 < p-value ≤ 0.01, *** p-value ≤ 0.001 from a pairwise correlation test statistic, insignificant correlations omitted for simplicity. S : satisfied group (N = 726), U : unsatisfied group (N = 557).

Interestingly, unsatisfied people who have adopted the travel maintaining/increasing strategy bundle are more likely to consider the same bundle (r = 0.120) than the higher-cost travel reducing strategy bundle (r = 0.107). It indicates that those people may be likely to consider another strategy in the same bundle, without spending extra money on higher-cost strategies. It is clear that satisfied people who have adopted this bundle tend to consider the same bundle, not higher-cost ones. On the other hand, satisfied people who have adopted the major location/life-style change strategy bundle are more likely to consider the travel maintaining/increasing strategy bundle than unsatisfied people. That is, those adopters have already reduced their commute distances and appear to be satisfied with the result, so they tend to try and maintain

their current (reduced) work travel. Movers who remain dissatisfied, however, continue to consider the higher-cost travel reducing and major location/lifestyle change bundles more readily than their satisfied counterparts.

Table 3.7 shows the test results for the factor-based strategy bundles. Similar to the results of the previous correlation tests, nearly a third of adoption and consideration pairs are significantly correlated in each group. As expected, diagonal correlations are strongly significant. It is also found that the unsatisfied group has higher correlations than the satisfied one in five of six diagonal elements. Overall, however, it does not appear that an individual's satisfaction with her current travel conditions plays a key role in considering a type of strategy bundle. For off-diagonal correlations, regardless of satisfaction, lower-cost bundle adopters are more likely to consider higher-cost bundles, and vice versa. This supports our hypotheses. Interestingly, only the unsatisfied groups who adopted the work-schedule change and home-based work bundles have consistently higher correlations for higher-cost strategy bundles than the corresponding satisfied groups. Perhaps considering these strategy bundles can be more affected by individuals' psychological assessments of their travel conditions. Similar to the conceptual bundles, those who adopted residential/employment relocation are more likely to consider lower-cost strategy bundles in both the satisfied and unsatisfied groups.

Consequently, the statistical tests show that previous adoption is strongly associated with current consideration regardless of satisfaction with current travel conditions. Actually, we do not know whether the respondents are satisfied with their current travel conditions due to the adoption of a certain strategy or due to other factors such as personality and socio-demographics. Thus, we do not consider these satisfied and unsatisfied groups for the in-depth analysis of each bundle strategy presented in Section 4.

The analysis in this section has neglected the dynamic aspect of the relationship between adoption and consideration. For example, we would expect the impact of prior adoption on current consideration to vary with the time since adoption, and with whether the strategy previously adopted is still in force or has been discontinued. In the following section, we will

consider the time since adoption of a strategy as a key explanatory variable in modeling consideration of a strategy bundle.

Table 3.7: Correlations between Adoption and Consideration of Factor-based Strategy Bundles (Satisfied and Unsatisfied Groups)

Adoption		Consideration							
		Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
Group 1: Auto improvement	S								
	U				0.098*				
Group 2: Mobile phone	S		-0.132***		0.126**				
	U		-0.141**				0.102*		
Group 3: Work-schedule changes	S			0.174***	0.091*	0.102**	0.134***	0.118**	
	U			0.289***		0.124**	0.206***	0.202***	
Group 4: Hire someone for domestic help	S				0.273**			-0.091*	
	U				0.275***		0.095*		
Group 5: Mode change	S			0.112**		0.261***	0.121**	0.143***	
	U			0.100*		0.227***	0.122**	0.092*	
Group 6: Home-based work	S				0.110**		0.388***	0.097**	
	U			0.139**	0.150***	0.112**	0.462***	0.108*	
Group 7: Residential/employment relocation	S	0.087*	0.100**				0.078*		-0.077*
	U			0.115**			0.100*	0.094*	
Group 8. Alter employment status	S						0.117**		0.240***
	U								0.266***

Notes: * 0.01 < p-value ≤ 0.05, ** 0.001 < p-value ≤ 0.01, *** p-value ≤ 0.001 from a pairwise correlation test statistic, insignificant correlation omitted for simplicity. S : satisfied group, U : unsatisfied group.

4. MODELING THE CONSIDERATION OF STRATEGY BUNDLES

4.1 General Model Specification Issues

In the previous section, we discussed the descriptive relationships between previous adoption and current consideration without involving other variables (except for travel satisfaction, in Section 3.2), and the results show that adoption and consideration are significantly related in both directions, from lower-cost strategy bundles to higher-cost ones, and conversely. In this section, we develop models for consideration of each bundle strategy, as a function not only of adoption and time since adoption, but potentially also of the explanatory variables described in Section 2.3. We model only consideration and not adoption, because the respondents' adoption takes place at various points in the past while the explanatory variables available in our cross-sectional data set represent measures in the present. To model past adoption as a function of present attitudes, say, would run the risk of reversing cause and effect: the present attitude is likely to be a consequence of, rather than a cause of, the prior adoption (Clay and Mokhtarian, forthcoming). The dependent consideration variables are binary – 1 if the respondent seriously considered any individual strategy in the bundle and 0 otherwise – so binary logit models were selected for this study.

In particular, the logistic regression function of SPSS was used to estimate the models, due to its stepwise methods of selecting significant variables for a model. For each bundle, two specification approaches were used to obtain two (potentially) different semi-final models. First, based on initial specifications using various subsets of the explanatory variables, a forward likelihood ratio method was repeatedly conducted to get a semi-final model in which all explanatory variables were conceptually interpretable and had a significance level of 0.05 or better. Second, based on an initial model specification containing all of the more than 200 potential variables, a semi-final model was also achieved, after manually eliminating statistically insignificant and conceptually counter-intuitive variables step by step, allowing us to check for any important variables that were missed through the automatic forward stepwise method due to a marginal level of significance. After comparing semi-final models from the two methods and testing the inclusion of variables appearing in only one of the two models into the other model, we selected the final model. Through this procedure the final models were obtained, all of

whose explanatory variables were not only statistically significant, but also conceptually interpretable.

It should be noted that a critical survey design feature affected model development for several of the travel-related strategies. The respondents were asked in Question 1 of Part E of the survey to indicate which alternatives they had adopted, and in Question 2 (after stating "even if you have already made some of these choices, you could be thinking about making a similar change again, or considering new options") to indicate which they were seriously considering. This design leaves two serious ambiguities. First, some respondents who had adopted, and were still engaged in, a particular strategy (such as telecommuting), may have felt uncomfortable indicating they "were not seriously considering" something they were in fact actually doing. On the other hand, we have no way of ascertaining whether a strategy such as telecommuting, once adopted, remained in place or not – it is well-established that many telecommuting engagements are temporary (Varma, *et al*., 1998).

The result of these two situations is that when someone who has previously adopted a certain strategy indicates she is currently considering it, we do not know whether she is actually currently doing it, or whether she has previously discontinued the strategy and is now considering it again. Naturally these two groups of people could be quite different in terms of explanatory variables. Similarly, "non-considerers" who have previously adopted a strategy comprise at least two distinct groups: those who are not considering it because their prior adoption is still in force, and those who are not considering it because they have previously discontinued the strategy and do not wish to re-visit it at this time. For these reasons, where possible, we chose to estimate two models: one on the full data set, and one on non-adopters only.

However, analyzing just the models with only non-adopters is not an ideal solution either, since we wish to understand the behavior of adopters as well as non-adopters. Although the adopters constitute less than half of the sample in eight of the 11 conceptual and factor-based strategy bundles, we believe that a comparison of the full-data and non-adopter models will be fruitful, with both the similarities and the differences between them being instructive. In such a

comparison, it should be kept in mind that, for the non-adopter models (unlike the full-data models), adoption, time since adoption of the given strategy and its quadratic term must of necessity be excluded as potential explanatory variables. Furthermore, we have limitations on modeling only non-adopters for a couple of strategy bundles – the travel maintaining/in-creasing and mobile phone strategies – due to smaller sample sizes and unbalanced shares of consideration.

It is appropriate to comment in general on the inclusion of the adoption and time since adoption variables in the models on the full sample. First, we used the adoption variables of either individual or strategy bundles to exploit their potential explanatory power in the model. If we use only the adoption of strategy bundles, we may lose significant information on the adoption of a particular individual strategy in a given bundle. That is, due to the insignificance of the adoption of the other individual strategies in the bundle, the adoption of the bundle strategy may not be significant in the model, although the adoption of the particular individual strategy *is* significant. In addition, it was not obvious how to define the time since adoption variables for strategy bundles: e.g., time since adopting the most recently-chosen strategy in the bundle, time since the most long-ago-chosen strategy, the average time since adopting a strategy in the bundle. Thus, we used time since adoption variables only for individual strategies.

As discussed in Section 3, some evidence suggests that individuals first tend to consider or adopt lower-impact strategies, moving to higher-impact ones if dissatisfaction still persists or returns, and there is a weaker tendency for them to cycle back to lower-impact strategies if dissatisfaction reoccurs after they have adopted a higher-impact one. On the other hand, if the adoption of a strategy has met individuals' needs, its adoption may decrease the probability of considering the other strategies. Therefore, the former adoption of a strategy could be either *positively or negatively* associated with the consideration of *other* strategies. By contrast, for most of the strategies we are studying, we expect that the former adoption of a strategy *positively* affects the consideration of the *same* strategy. Either the individual is enjoying and still wants to enjoy the benefits from the previous adoption, or such strategies are attractive again as circumstances change. Given that they are adopted once, it is natural to expect them to be adopted repeatedly

over a person's working life. We have already seen support for this hypothesis in the pairwise correlations analyzed in Section 3.2.

Moreover, the time since adoption of a strategy is generally expected to be positively related to its reconsideration. That is, the longer ago an individual adopts a strategy, the more likely she is to consider the same strategy. The time since adoption variable posed a difficulty with respect to the treatment of non-adopters, however. Non-adopters had to be given a value for this variable in order for them (and this variable) to be included in the full-sample models. The standard practice of setting a variable to zero for cases for which it was not applicable was unsatisfying in this situation, however. Setting time since adoption to zero for non-adopters lumped non-adopters together with very recent adopters (having nearly zero time since adoption), whereas, in reality one might expect those two groups to be quite different (perhaps even opposite) in their propensity to consider the same alternative (with non-adopters far more likely to consider a strategy than recent adopters).

To reflect the expectation that consideration of a strategy would generally increase with time since adoption, with non-adopters being most likely to consider of all, we experimented with a "synthetic" time since adoption variable for each strategy. For non-adopters we set time since adoption of that strategy equal to the longest time since adoption found in the sample, plus an arbitrary inflation factor of 20%. That is, for all non-adopters, time since adoption of a given strategy was defined to be 1.2 times the longest time since adoption in the sample. But the models containing these synthetic variables were unsatisfactory – difficult to interpret and producing coefficients with counterintuitive signs. In retrospect, our hypothesis that the propensity of non-adopters to consider a strategy would be similar to that of a long-ago adopter was probably too simplistic: in many cases individuals may not have adopted a strategy precisely because of a disinclination toward it that still persists and makes them unwilling to consider it.

Ultimately then, we abandoned the synthetic time since adoption variable, and returned to the original variable that was defined as zero for non-adopters. We interpret this variable as the interaction or product of the binary adoption variable and time since adoption, and hence as representing the impact of time since adoption *for adopters*. We also included a squared time

since adoption variable for each strategy, to allow for non-linear effects. One could imagine that the propensity to consider a strategy might be highest for intermediate times since adoption: recent adopters of course may be less likely to consider it again, but also, an adoption long ago and *not* more recently may signify rejection of the strategy for whatever reasons (it was not deemed effective, it is no longer deemed appropriate or desirable or available), and hence a lower propensity to consider it.

As a final comment with respect to specification and interpretation, 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 model may be not only representing itself but also acting as a proxy for other variable(s). For example, the number of vehicles in the household may be an indicator of a mobility constraint and/or income characteristics. This potential multi-faceted nature of the variables made the interpretation process particularly interesting.

The following sections discuss the model results by type of bundle: conceptual and factor-based bundles in order. In each section, we first make some observations over all the bundle models, and then briefly discuss each bundle model, comparing (where appropriate) the model with all respondents to that with only non-adopters.

4.2 Conceptual Strategy Bundles

The conceptual bundle classification contains three strategy bundles ranging from a low-cost, short-term bundle to a high-cost, long-term one: travel maintaining/increasing, travel reducing, and major location/lifestyle change. Table 4.1 summarizes the results of the three models on the full sample. Looking at the ρ^2 values, they are relatively low, ranging from 0.106 to 0.210. Comparison to the corresponding market share models (which include a constant term only) shows that the constant term alone seems to account for a sizable proportion of the explanatory power of at least the first two models. However, the ρ^2 values of the models having the same final specification except excluding the constant term ranged from 0.106 to 0.203. Thus, there is very little difference between the two models with and without the constant term, and hence the included variables in fact carry the bulk of the explanatory power of the models, accounting for up to 20% of the information in the data (Hauser, 1978).

Turning to the explanatory variables, all Objective Mobility variables have positive signs in the models. It is clear that the greater the amount of travel the individual does, the more likely she is to consider the travel reducing or major location/lifestyle change strategy. Interestingly, the amount of travel for eating out also positively affects both travel maintaining/increasing and travel reducing strategies. Similarly, Choo *et al*. (forthcoming) found that the frequency of traveling to eat a meal is positively related to the Relative Desired Mobility for overall short-distance travel. They suggested that for some people, a higher amount of this travel indicates a substitute fulfillment of the desire to undertake more recreational/social travel under the current constraints. So, it is plausible that this group of people is more likely to consider the travel maintaining/increasing strategy bundle.

Table 4.1: Summary of Models of Consideration of Conceptual Strategy Bundles

	Travel maintaining/ increasing	Travel reducing	Major location/life-style change
N	1259	1220	1277
MS ρ^2	0.159	0.106	0.032
ρ^2	0.210	0.201	0.106
Adjusted ρ^2	0.194	0.184	0.091
Variable			
Objective Mobility			
Frequency of commuting (SD)		+	
Weekly miles to eat a meal (SD)	+	+	
Weekly miles by walking/jogging/bicycling (SD)			+
Total trips (LD)		+	
Subjective Mobility			
Take others where they need to go (SD)	+		
Travel by personal vehicle (SD)	+	+	
Relative Desired Mobility			
Travel by walking/jogging/bicycling (SD)			-
Travel by air (LD)			+
Travel Liking			
Travel by personal vehicle (LD)	+		
Attitudes			
Pro-environmental solutions factor score		+	
Personality			
Adventure seeker factor score		+	
Lifestyle			
Frustrated factor score			+
Family & community-oriented factor score			+
Mobility Constraints			
Limitations on driving during the day	+	+	
Socio-demographics			
Years lived in the U.S.	-	-	
Manager/administrator occupation	+		
Household income category		-	
Number of people ages under 6 in HH			+
Number of people ages 65-74 in HH			+
Strategy Adoption			
Buy a mobile phone	-		
Time since getting a fuel efficient car	+		
Change work trip departure time	+	+	
Time since changing work trip departure time			+
Hire somebody to do house or yard work	+		
Time since hiring domestic help	-		
Adopt compressed work week		+	
Change from another means to driving alone		+	
Buy equipment to help work from home		+	+
Work part- instead of full-time			+
Start home-based business		+	+
Retire or stop working			+
Major location/lifestyle change	+		

Notes: SD = Short Distance, LD = Long Distance.
Shaded cells denote significant relationships between consideration of one bundle and prior adoption of strategies in the same bundle.

Similar to Objective Mobility, all Subjective Mobility variables also have positive signs. It is intriguing that two of them, travel for taking others where they need to go and by personal vehicle, are significant in the consideration of the travel maintaining/increasing strategy bundle. The former probably indicates travel that is considered essential in some respects, so the individual is more likely to maintain such travel rather than to eliminate it. The latter may initially seem counter-intuitive. But, similar to the chauffeuring variable, if the personal vehicle travel is considered *necessary*, those who must do it a lot are more likely to try and improve their current travel conditions by making driving more comfortable, or to reschedule their travel by changing trip departure time. A similar argument can be found in Salomon and Mokhtarian (1997).

As an indicator of a positive utility of travel, the liking for long-distance personal vehicle travel has a positive effect on the consideration of the travel maintaining/increasing strategy bundle. This supports the expectation that a positive utility of travel will motivate people to keep or increase their current travel. Also, two Relative Desired Mobility variables specific to mode are significant in the model of the major location/lifestyle change strategy bundle, with opposite signs. The signs are reasonable in each case. In our sample, higher levels of walking/jogging/bicycling are associated with lower incomes, suggesting that such travel is done out of necessity rather than by choice. Therefore, it is natural that those who want to decrease their walking/jogging/bicycling would be more likely to consider the major location/lifestyle change bundle that would reduce such travel, at least for commuting. On the other hand, the desire for long-distance travel by air is highly correlated with that for long-distance travel for entertainment or recreation ($r = 0.517$). Thus, the individual with a higher desire for air travel may consider the major location/lifestyle change bundle in order to save work travel time and expense (as well as work time itself, in the case of the part time work and retirement strategies) and then reallocate the saved resources to recreational travel.

Some Attitudes/Personality/Lifestyle variables are positively associated with higher-cost strategies. As expected, pro-environmentalists are more likely to consider the travel reducing strategy bundle. Adventure seekers want to do outdoor activities more, perhaps often putting a higher value on recreation or entertainment travel than on work. Consequently, they are more

likely to consider the travel reducing strategy bundle. Frustrated people tend to seek a better lifestyle or environment because they are currently unsatisfied with their lives and feel they have little control over them. Thus, those people are more likely to consider the major location/lifestyle strategy bundle. Not surprisingly, those who are family/community-oriented are more likely to consider the major location/lifestyle strategy bundle, so that they can spend more time on their family or community and less on commuting and/or work.

Interestingly, the same Mobility Constraint variable is positively associated with both the travel maintaining and travel reducing strategy bundles. Those who have limitations on driving during the day are more likely to consider ways to make their necessary driving more comfortable, and ways to reduce their unnecessary driving, so as to lessen their physical or psychological travel burdens. Socio-demographic variables with respect to household, income, and occupation are significantly related to various strategy bundles. The number of years lived in the U.S., as a proxy for age, is also related to both the travel maintaining and travel reducing strategy bundles, in this case negatively. That is, younger people are more likely than older ones to consider the lower-cost strategies against congestion, either maintaining more comfortably (if necessary) or reducing (if possible) their travel. On the other hand, people in a high-income household are less likely to consider the travel reducing strategy bundle, perhaps because they can more easily afford the monetary costs associated with adopting strategies in the other two bundles. Similarly, managers or administrators, typically higher-income jobs, are positively inclined to consider the travel maintaining/increasing strategy bundle, perhaps in view of a relative inability to reduce the amount they must travel. People living with children under six years old or with people ages 65-74 are more likely to consider the major location/lifestyle change strategy bundle, presumably in order to free more time to take care of their dependents.

As hypothesized, the previous adoption of any individual strategies in a bundle generally positively affects the consideration of the same bundle. The interpretation is that the individual who previously adopted a given strategy is more likely than others to seek either the same or another strategy in the same bundle. On the other hand, the previous adoption of lower-cost individual strategies positively affects the consideration of the higher-cost strategy bundles, and the previous adoption of higher-cost individual strategies positively affects the consideration of

lower-cost strategy bundles. In addition, three time since adoption variables are found in two models. Our general hypothesis on time since adoption variables is that the longer ago the individual has adopted a strategy, the more likely she is to consider the same strategy bundle or higher-cost ones. Two of the significant variables are consistent with the hypothesis: the longer ago the individual adopted getting a fuel efficient car (changing trip departure time), the more likely she is to consider the travel maintaining/increasing bundle (the major location/lifestyle change bundle, as a higher-cost one). In contrast, the time since adoption of "hiring domestic help" has a negative effect on the consideration of the travel maintaining/increasing strategy bundle. It is plausible that the more recently the individual hired someone to help with house or yard work, the more likely she is to consider the travel maintaining/increasing strategy bundle because the time she is saving by hiring help can be spent on other activities outside the home.

4.2.1 Travel maintaining/increasing strategies

As a lower-cost, short-term strategy, the travel maintaining/increasing strategy bundle permits one either to keep on doing the current work travel more comfortably or conveniently (by rescheduling departure time or improving the automobile), or even to create additional travel (by changing from other means to driving alone, or hiring domestic help). Here, we discuss only the model based on all respondents because the non-adopter model for the consideration of this strategy has a small sample size, only 7.7% (99 respondents) of the total. Table 4.2 presents the final model of the consideration of the travel maintaining/increasing bundle strategy, based on all respondents. The ρ^2 value of the model is 0.210, indicating that the model explains 21% of the information in the data. Compared to the ρ^2 value of 0.159 for the market share model (the model containing only a constant term), the final model explains more information, and the χ^2 value of 89.5 indicates that the final model is significantly better at $\alpha << 0.005$.

As discussed earlier, three Objective and Subjective Mobility variables have positive signs. Two of them, eating out and taking others where they need to go, are related to an "on-the-go" lifestyle, doing something on the way to or from home/work. For these travel purposes, individuals are more likely to consider ways to maintain their current work travel. Clearly, the Travel Liking variable for long-distance travel by personal vehicle is positively associated with

the consideration of this strategy. The more the individual likes personal vehicle travel, the more likely she is to consider ways to maintain or increase it. On the other hand, the Subjective Mobility variable for short-distance travel by personal vehicle is also positively related to the consideration of this strategy. A reasonable interpretation is that such travel might be mandatory, so those who perceive it to be a lot are likely to want to make the current travel more efficient and comfortable, by rescheduling or improving their existing travel conditions.

Table 4.2: Model of Consideration of the Travel Maintaining/Increasing Bundle

Variable	Estimated coefficient	p-value
Constant	-2.565	0.003
Objective Mobility		
Weekly miles to eat a meal (SD)	0.017	0.009
Subjective Mobility		
Take others where they need to go (SD)	0.229	0.002
Travel by personal vehicle (SD)	0.188	0.001
Travel Liking		
Travel by personal vehicle (LD)	0.223	0.001
Mobility Constraints		
Limitations on driving during the day	1.718	0.022
Socio-demographics		
Years lived in the U.S.	-0.017	0.001
Manager/administrator occupation	0.453	0.008
Strategy Adoption		
Get a mobile phone	-0.299	0.032
Time since getting a fuel efficient car	0.043	0.027
Change work trip departure time	0.297	0.036
Hire somebody to do house or yard work	0.717	0.000
Time since hiring domestic help	-0.072	0.004
Major location/lifestyle change	0.308	0.020
Number of observations (considering, not considering)	1259 (909, 350)	
Log likelihood at 0 (LL(**0**))	-872.672	
Log likelihood of market share (MS) model (LL(**MS**))	-734.126	
Log likelihood at convergence (LL(**β**))	-689.364	
MS ρ^2 = 1 - (LL(MS)/LL(0))	0.159	
ρ^2 = 1 - (LL(**β**)/LL(0))	0.210	
Adjusted ρ^2 = 1 - [LL(**β**)- # of parameters]/LL(0)	0.194	
χ^2 = -2[LL(**MS**) - LL(**β**)]	89.525	

SD = Short Distance LD = Long Distance

A Mobility Constraint and two Socio-demographic variables are significant in the model. The individual who has limitations on driving during the day may want to reschedule travel time (e.g. by changing departure time), or to ameliorate driving conditions (e.g. by getting a better car) in order to reduce the physical or psychological burden of such travel. In addition, those who have

lived longer in the U.S., mostly older people, are less likely to consider strategies to maintain or increase their travel. It may be that they are more patient or have more control over their travel under the current circumstances, or it may be that they are more actively considering major lifestyle change strategies that will *reduce* their travel (as the models of Section 4.2.3 suggest). Managers tend to have higher incomes, so they can afford a better car or hiring someone for domestic help to make travel easier and more comfortable. They may also be more able and inclined to reschedule their work trip departure time than other occupation categories, and more likely to consider getting a mobile phone.

Three of the four significant previous adoption (binary) variables relate to strategies in the same bundle. Among these variables, the adoption of "hire somebody to do house or yard work" has the highest impact on the consideration of the travel maintaining/increasing bundle strategy, with a coefficient of 0.717. It is logical that those who hire someone for domestic help want to spend more time on out-of-home activities including work, so they are more likely to consider maintaining or increasing such travel. In general, those hiring domestic help tend to have higher incomes, so they may be more able to invest in auto improvement, as a part of this strategy bundle, than those with lower incomes. Two time since adoption variables for strategies in the same bundle are significant in the model, with opposite but logical signs. Our interpretation is based on the presence of the same variables in the corresponding individual strategy models found in Cao and Mokhtarian (2003): the longer ago the individual purchases a fuel efficient car, the more likely she is to consider a newer one to get the same benefit. On the other hand, those who recently hired someone for domestic help are less likely to reconsider it, lowering the probability of considering the bundle as a whole.

4.2.2 Travel reducing strategies

The travel reducing strategy bundle contains four individual strategies: compressed work week, changing to other modes from driving alone, telecommuting, and buying work-at-home equipment. Most individual strategies in this bundle can reduce a certain amount of travel relating to work, but not entirely eliminate the current travel. Two final models for the consideration of this strategy are discussed: one based on all respondents and the other for only non-adopters (nearly 52% of the sample).

4.2.2.1 The model with all respondents

As shown in Table 4.3, the final model for this bundle based on all respondents has a ρ^2 value of 0.201, explaining 20% of the information in the data. Compared to a ρ^2 value of 0.106 for the market share model, the final model explains substantially more information. The χ^2 value also shows that the final model is significantly better than the market share model at $\alpha << 0.005$.

Table 4.3: Model of Consideration of Travel Reducing Bundle (all respondents)

Variable	Estimated coefficient	p-value
Constant	-3.952	0.000
Objective Mobility		
Frequency of commuting (SD)	0.161	0.000
Weekly miles to eat a meal (SD)	0.009	0.042
Total trips (LD)	0.009	0.022
Subjective Mobility		
Travel by personal vehicle (SD)	0.144	0.015
Attitudes		
Pro-environmental solutions factor score	0.423	0.000
Personality		
Adventure seeker factor score	0.221	0.005
Mobility Constraints		
Limitations on driving during the day	1.873	0.000
Socio-demographics		
Years lived in the U.S.	-0.020	0.000
Household income category	-0.181	0.000
Strategy Adoption		
Change work trip departure time	0.387	0.005
Adopt compressed work week	0.708	0.001
Change from another means to driving alone	0.630	0.002
Buy equipment to help work from home	1.441	0.000
Start/expand home-based business	0.674	0.002
Number of observations (considering, not considering)	1220 (477, 743)	
Log likelihood at 0 (LL(**0**))	-845.640	
Log likelihood of market share (MS) model (LL(**MS**))	-755.904	
Log likelihood at convergence (LL(**β**))	-675.401	
MS ρ^2 = 1 - (LL(MS)/LL(0))	0.106	
ρ^2 = 1 - (LL(**β**)/LL(0))	0.201	
Adjusted ρ^2 = 1 - [LL(**β**)- # of parameters]/LL(0)	0.184	
χ^2 = -2[LL(**MS**) - LL(**β**)]	161.006	

SD = Short Distance LD = Long Distance

Turning to the explanatory variables, as expected, all significant Objective and Subjective variables are positively related to the consideration of the travel reducing strategy bundle. That is, the higher the amount of travel the individual does or perceives, the more likely she is to consider the travel reducing strategy bundle. Similar to the travel maintaining/increasing model,

the two variables of "weekly miles to eat a meal" and Subjective Mobility for short-distance personal vehicle travel have positive signs. This indicates that the individual with higher values on such variables is more likely than others to consider both travel maintaining/increasing and travel reducing strategies.

There is no Travel Liking variable in this model. Instead, two Travel Attitude and Personality variables are significantly, positively associated with the consideration of the travel reducing strategy bundle. It is clear that pro-environmentalists would consider travel reducing strategies to reduce any vehicle-related pollution. However, adventure seekers would presumably want to increase outdoor activities for entertainment or recreation. It seems likely that they seek travel reducing strategies in order to apply the time and money they would save on work trips to entertainment travel.

Individuals who have limitations on driving during the day may consider the higher-cost travel-reducing strategies of this bundle in order to reduce their travel stress. The argument for the negative impact of the years lived in the U.S., a proxy for age, is similar to that for the travel maintaining/increasing model: older people may have either already adjusted to their current travel conditions, or may be more inclined to consider the even higher-cost major lifestyle/location change strategies as a solution. Individuals in higher income households are less likely to consider reducing their current travel, presumably because they already have a greater ability to control the amount of travel they do and/or make it more productive/comfortable through other strategies.

Five individual strategy adoption variables are positively related to the consideration of the travel reducing strategy bundle. Two of them, parts of this strategy bundle, have higher coefficients than the others. Especially, the adoption of "buy equipment to help work from home" (with a coefficient of 1.441) has more than double the impact on the consideration of this strategy, compared to the others (with coefficients of 0.387-0.708). Generally, the adoption of a home-based business (here classified into the major lifestyle/location change bundle) is related to travel-reducing strategies such as telecommuting or buying equipment to help work from home (with all three classified together in the factor-based bundles). In particular, the home-based

business requires workers to occasionally renew or expand the equipment needed to effectively conduct their work at home. For the adoption variables for changing work trip departure time or from other modes to driving alone, it is logical that the individual who previously adopted a lower-cost strategy and is now dissatisfied with it is more likely to consider a higher-cost strategy.

4.2.2.2 The model with only non-adopters

The model of consideration of the travel reducing strategy bundle estimated for only non-adopters is shown in Table 4.4. Compared to the model based on all respondents, this model has a higher ρ^2 value of 0.311, explaining an additional 11 percentage points of the information in the data. Four variables in the model are common to the one on the full data set, and other variables are similar. It is of interest that there were no adoption variables for other strategies in the model. This result (coupled with the necessary exclusion of adoption variables for travel-reducing strategies) suggests that the previous adoption of strategies in this bundle plays a major role in the difference between the two models. The fact that the model for non-adopters only has a better goodness-of-fit, despite the availability of the additional variables for the model on the full sample, tends to confirm the heterogeneous nature of adopters as discussed in Section 4.1. This observation holds across all bundles for which two models were estimated.

As expected, the frequency of work/school-related travel is positively related to the consideration of the travel reducing strategy bundle. It is analogous to the frequency of commuting variable in the model with all respondents. In addition, similar to the variables of years lived in the U.S. and household income in the model with all respondents, the age and number of vehicles in household variables have negative signs in this model. Two occupation variables, manager and professional occupations, are newly found in this model. As previously found in a number of studies on telecommuting (e.g. Mokhtarian, *et al*., 1998), managers and professionals are more likely to consider telecommuting than are other occupation categories, due to their job suitability.

Table 4.4: Model of Consideration of Travel Reducing Bundle (non-adopters only)

Variable	Estimated coefficient	p-value
Constant	-3.764	0.000
Objective Mobility		
Frequency of work/school-related travel (SD)	0.068	0.017
Subjective Mobility		
Travel by personal vehicle (SD)	0.371	0.000
Attitudes		
Pro-environmental solutions factor score	0.364	0.005
Personality		
Adventure seeker factor score	0.394	0.001
Mobility Constraints		
Limitations on driving during the day	2.222	0.005
Socio-demographics		
Age	-0.522	0.001
Number of vehicles in household	-0.331	0.003
Manager/administrator occupation	0.972	0.000
Professional/technical occupation	0.664	0.005
Number of observations (considering, not considering)	660 (154, 506)	
Log likelihood at 0 (LL(**0**))	-457.477	
Log likelihood of market share (MS) model (LL(**MS**))	-348.774	
Log likelihood at convergence (LL(**β**))	-315.152	
MS ρ^2 = 1 - (LL(MS)/LL(0))	0.238	
ρ^2 = 1 - (LL(**β**)/LL(0))	0.311	
Adjusted ρ^2 = 1 - [LL(**β**)- # of parameters]/LL(0)	0.289	
χ^2 = -2[LL(**MS**) - LL(**β**)]	67.244	

SD = Short Distance LD = Long Distance

4.2.3 Major location/lifestyle change strategies

The major location/lifestyle change strategy bundle consists of five individual strategies: changing job closer to home, moving home closer to work, changing to working part-time, starting a home-based business (or putting more effort into an existing one), and retiring or stopping working. Generally, this strategy bundle involves higher costs and longer time periods than the other strategies. The ρ^2 values for the models are relatively low, explaining 11% to 15% of the information in the data. However, several different kinds of variables are found to be significant in the models, including mobility variables.

4.2.3.1 The model with all respondents

Table 4.5 presents the model based on all respondents, for the consideration of the major location/lifestyle change strategy bundle. The ρ^2 value of the model is only 0.106, but at least it

is much higher than that of the market share model, 0.032. The χ^2 test indicates that the final model is significantly better than the market share model at $\alpha << 0.005$.

Table 4.5: Model of Consideration of Major Location/Lifestyle Change Bundle (all respondents)

Variable	Estimated coefficient	p-value
Constant	-0.023	0.941
Objective Mobility		
Weekly miles by walking/jogging/bicycling (SD)	0.014	0.001
Relative Desired Mobility		
Travel by walking/jogging/bicycling (SD)	-0.551	0.000
Travel by air (LD)	0.142	0.030
Lifestyle		
Frustrated factor score	0.145	0.049
Family & community-oriented factor score	0.318	0.000
Socio-demographics		
Number of people ages under 6 in HH	0.297	0.039
Number of people ages 65-74 in HH	0.815	0.001
Strategy Adoption		
Time since changing work trip departure time	0.066	0.031
Buy equipment to help work from home	0.322	0.018
Work part- instead of full-time	0.747	0.000
Start or expand home-based business	0.766	0.000
Retire or stop working	1.057	0.011
Number of observations (considering, not considering)	1277 (586, 691)	
Log likelihood at 0 (LL(**0**))	-885.149	
Log likelihood of market share (MS) model (LL(**MS**))	-856.507	
Log likelihood at convergence (LL($\boldsymbol{\beta}$))	-791.454	
MS ρ^2 = 1 - (LL(MS)/LL(0))	0.032	
ρ^2 = 1 - (LL($\boldsymbol{\beta}$)/LL(0))	0.106	
Adjusted ρ^2 = 1 - [LL($\boldsymbol{\beta}$)- # of parameters]/LL(0)	0.091	
χ^2 = -2[LL(**MS**) - LL($\boldsymbol{\beta}$)]	130.106	

SD = Short Distance LD = Long Distance

One Objective Mobility variable is significant in the model. The higher the amount of walking/jogging/bicycling travel the individual does, the more likely she is to consider the major location/lifestyle change bundle. One interpretation might be that individuals who place a high priority on these exercise-providing means of transportation may want to shorten their commutes in order to maintain or expand the inclusion of that exercise into their daily routines. Conversely, to the extent that these modes are primary travel modes due to lack of an automobile, it is natural for the respondent to consider reducing the amount of commuting that must be done by such means. Similarly, the corresponding Relative Desired Mobility variable is negatively associated with consideration of the bundle: the less people want to increase their walking/jogging/bicycling,

the more likely they are to consider these strategies. On the other hand, the desire for more long-distance air travel may be indicative that the individual wants to increase entertainment or recreational travel. Thus, the individuals wanting more long-distance air travel are more likely to consider strategies in this bundle (e.g. retirement or working part-time) to free up more time for such travel.

Two Lifestyle variables are positively associated with the consideration of this strategy bundle. Frustrated people tend to be looking for new circumstances, to diminish the dissatisfaction with their lives. Thus, it is natural that they would be more likely to consider the major location/lifestyle strategy bundle. Family/community-oriented people are likely to be considering this strategy bundle to save time currently spent on the commute or work, so that they can spend more time on their family or community activities.

Two Socio-demographic variables, both relating to other household members, are significant in the model. It is reasonable that the individual who has younger or older dependents in the household is more likely to consider this strategy bundle, to free up more time to spend with them.

Four adoption variables are positively related to the consideration of this strategy. Three of them are individual strategies in this bundle. That is, individuals who have previously adopted this type of strategy may be more likely to reconsider it to obtain the same benefits they had. Additionally, the purchase of equipment to facilitate work from home, although classified in the second bundle as a travel-reducing strategy, can also be interpreted as supporting the home-based business strategy in this bundle. As hypothesized, the time since adoption of changing work trip departure time is positively associated with the consideration of this bundle. The individual who adopted this lower-cost strategy longer ago might be dissatisfied with it under the recent, worse travel conditions. As a result, she is more likely to consider the higher-cost strategies in this bundle.

4.2.3.2 The model with only non-adopters

Table 4.6 presents the model with only non-adopters (nearly 50% of the sample). The ρ^2 value of this model is slightly higher than that with all respondents (although the incremental increase beyond the market share ρ^2 is slightly lower). Looking at the explanatory variables in the two models, only three variables are common. This model has no binary adoption variables, but only the time since adoption variable for changing work trip departure time.

Table 4.6: Model of Consideration of Major Location/Lifestyle Change Bundle (non-adopters only)

Variable	Estimated coefficient	p-value
Constant	-1.454	0.086
Objective Mobility		
Weekly miles to eat a meal (SD)	-0.014	0.042
Relative Desired Mobility		
Commute (SD)	-0.873	0.000
Travel Liking		
Travel for entertainment (LD)	0.330	0.001
Lifestyle		
Family & community-oriented factor score	0.327	0.006
Mobility Constraints		
Limitations on driving during the day	1.672	0.017
Socio-demographics		
Number of people ages 65-74 in HH	1.096	0.001
Clerical/administrative support occupation	0.580	0.047
Strategy Adoption		
Time since changing work trip departure time	0.113	0.018
Number of observations (considering, not considering)	636 (253, 383)	
Log likelihood at 0 (LL(**0**))	-440.842	
Log likelihood of market share (MS) model (LL(**MS**))	-399.625	
Log likelihood at convergence (LL(**β**))	-374.416	
MS ρ^2 = [1 - (LL(MS)/LL(0))]	0.093	
ρ^2 = 1 - (LL(**β**)/LL(0))	0.151	
Adjusted ρ^2 = 1 - [LL(**β**)- # of parameters]/LL(0)	0.130	
χ^2 = -2[LL(**MS**) - LL(**β**)]	50.417	

SD = Short Distance LD = Long Distance

Two mobility-related variables are significant in the model. As found in the other bundle models, the individual with a higher amount of travel for eating out is less likely to consider this bundle because such travel may indicate an "on-the-go" lifestyle. Clearly, people who want to decrease commute travel are more likely to consider this strategy. As expected, the Travel Liking variable for entertainment has a positive sign. The individual with a higher value on this measure

probably wants to spend more time on recreational or entertainment activities by reducing work time or commute travel.

The individual who has limitations on driving during the day is more likely to consider reducing such travel, if possible, even at the higher costs of the strategies in this bundle. Interestingly, clerical workers are more likely to consider this strategy. Focusing on altering work status in this bundle, clerical/administrative work may lend itself better than professional or managerial work to being available on a part-time basis. Clerical workers are predominantly female (83% in this sample), and women are still more likely than men to work part-time, often to combine work with raising a family. Additionally, the routine nature of much clerical work may not generate an emotional attachment to the job, and may make doing it full-time more burdensome than for less routine jobs. Consequently, clerical workers may be more likely to retire from the current job earlier or to seek a different job, closer to home. It is plausible that clerical workers would also be more likely to consider being involved in the administration of a home-based business.

4.3 Factor-based Strategy Bundles

The factor-based approach, using empirical similarities in adoption and consideration patterns, identified eight strategy bundles ranging from a low-cost, short-term bundle to a high-cost, long-term one: auto improvement, mobile phone, work-schedule change, hire someone to do house or yard work, mode change, home-based work, residential/employment relocation, and alter employment status. Among them, the second and fourth bundles contain only one alternative, "Get a mobile phone" and "Hire someone to do house or yard work", respectively. We did not model these two bundles because their results are identical to those of the individual strategies, so the results presented here for completeness are borrowed from the previous study (Cao and Mokhtarian, 2003). Table 4.7 summarizes the results of the eight models. The ρ^2 values of the models ranged from 0.103 to 0.434. Compared to the conceptual bundle models, more diverse explanatory variables are significant in these models.

Looking at the Objective Mobility variables, all significant variables except three have positive effects on the consideration of the factor-based bundles. This is consistent with our hypothesis that the more people travel, the more likely they are to consider travel-related strategy bundles. Two Objective Mobility variables, weekly miles of grocery shopping travel and taking others

where they need to go, are negatively associated with the consideration of the mobile phone strategy bundle. However, the corresponding frequency variables are also in the model, with the expected positive signs. Taken together, the combined effect of the frequency and distance pair of variables in each case is still positive. Interestingly, the variable of weekly miles by walking/jogging/bicycling has a negative effect on the consideration of the work-schedule change strategy bundle. In our sample, those who travel more by non-motorized modes tend to have low incomes and relatively lower accessibilities to autos than do others, so they may be less likely to consider the work-schedule change bundle that may require a more frequent use of vehicles in response to flexible work times, or perhaps less likely to have the kind of job for which work-schedule changes are an option.

Similarly, all Subjective Mobility variables except two are positively related to the consideration of the factor-based bundles. That is, the more travel the individual perceives doing, the more likely she is to consider travel-related strategy bundles. The two negative signs are logical. Traveling to eat a meal may indicate a substitute fulfillment of the desire for recreational/social travel under current constraints. Thus, the individual who perceives such eating out travel to be a little is more likely to consider the residential/employment relocation bundle, in order to free more time and resources for the desired leisure travel. This is supported by the Relative Desired Mobility for entertainment variable discussed below. Additionally, the individual with higher Subjective Mobility for long-distance air travel may spend less time on short-distance travel (or by comparison, perceive that she does so). Thus, she may be less motivated to consider the work-schedule change bundle as a means of reducing the impact of the commute.

As hypothesized, those who want to increase commute or work travel are less likely to consider the mode change and residential/employment relocation strategy bundles. In contrast, people with a higher desire for discretionary travel have a greater tendency to consider the residential/employment relocation strategy bundle, in keeping with the explanation for Subjective Mobility for eating out given above. Relative Desired Mobility variables by mode have logical signs for each case. For example, those who want to increase travel by train/BART/light rail bus or by walking/jogging/bicycling are more likely to consider the mode change strategy bundle or the residential/employment relocation one, respectively. It is plausible

that people with a higher desire for long-distance vehicle travel also tend to want to maintain or increase their current local travel, so they are less likely to consider the residential/employment relocation bundle.

Travel Liking variables are significant in four models, with logical signs. Clearly, it is natural that liking for work travel is negatively associated with consideration of the alter employment status bundle. On the other hand, the individual who likes train/BART/light rail travel may consider changing her home or job to be closer to a rail station. Not surprisingly, those who like travel for eating out are likely to seek a more convenient mode for such travel. For example, in the 1995 Nationwide Personal Transportation Survey, the average vehicle occupancy for the social/recreational purpose was 2.04 persons per vehicle, which ranks first among all the purposes presented (Hu and Young, 1999). This indicates that travel for social events is most susceptible to the use of means of travel other than driving alone. Further, alcohol drinking is associated with many eat meal activities, which would make driving alone undesirable. Based on these and other considerations, we speculate that individuals who actually do a lot of travel for eating out may be (1) more socially-oriented to start with, and thus more open to shared forms of commute transportation; (2) younger and therefore more receptive to change; and (3) more likely to chain social/recreation/entertainment trips to the commute. Such people are likely, in association with the commute, to want to be traveling with other companions, and/or to be drinking alcohol and thus not wanting to drive alone. Either of these factors could influence the individual to consider changing commute mode from driving alone.

Two Travel Attitude factors plus the ideal commute time variable (another measure of travel attitude) are significantly related to consideration of some strategy bundles, with the expected signs. Logically enough, pro-environmentalists are more likely to consider the travel reducing strategy bundles of work-schedule change, mode change, and home-based work. In contrast, the individual with a higher commute benefit factor score is less likely to consider the work-schedule change and residential/employment relocation bundles, which can reduce commute travel. Interestingly, the individual who has a higher ideal commute time presumably enjoys her commute travel but may not want to spend more time on congested highways. Thus, in considering the work-schedule change bundle, she may be seeking a way to reduce her exposure

to traffic congestion by changing departure time or adopting a flexible work schedule, while maintaining her commute travel.

Three Personality factor variables appeared in the models. Adventure seekers in our sample engage in recreation/entertainment travel more than others, so they are more likely to consider commute travel reducing bundles such as work-schedule change and home-based work in order to free more time, money, and energy for adventure travel. In general, loners like being alone and being independent, so it is logical that they would be less likely to consider changing commute mode, particularly from driving alone to another mode. The calm factor score is also negatively related to the consideration of the mode change bundle. Individuals scoring highly on this factor tend to be those who are patient, neither aggressive nor restless, and hence are less likely to be irritated by congestion than others. Therefore, they would be less motivated to consider this strategy bundle.

Three Lifestyle factor variables are positively associated with medium-to-high-cost strategy bundles. Frustrated people naturally tend to seek a better lifestyle or environment because they are currently unsatisfied with their lives, so it is reasonable that they are more likely to consider the residential/employment relocation and the home-based work bundles. By definition, family/community-oriented people tend to prioritize their family or community over work, so they are more likely to consider the alter employment status bundle. As expected, those who seek higher social status related to wealth are more likely to consider the hiring domestic help strategy, as a time-buying strategy with status overtones. As a marker of preference for discretionary travel, the excess travel indicator may be negatively associated with mandatory travel such as commuting. Thus, it is plausible that the excess travel indicator is positively associated with the consideration of travel reducing bundles such as residential/employment relocation and home-based work, to allow more time for desired discretionary travel.

Four Mobility Constraint variables are found significant among the models, with the expected signs. The individual who has limitations on driving, riding a bicycle, or vehicle availability is more likely to consider either travel reducing bundles, or travel maintaining ones if travel is necessary.

Many Socio-demographic variables appear in the models. Especially, age or number of years lived in the U.S. (a proxy for age) is significant in all bundle models except the work-schedule change one. As expected, older people are less likely to consider travel reducing strategy bundles, perhaps because they tend to be higher income (that is, they have a greater ability to control the amount of travel they do and/or make it more productive/comfortable through other strategies) and more patient with their travel than younger people are. Logically, those who drive SUVs most often are less likely to consider travel reducing strategy bundles such as mode change and residential/employment relocation, because this vehicle type is stereotypically "fun to drive", presumably even for commuting.

Several occupation categories are also significantly related to factor-based bundles. As expected, managers are more likely to consider the home-based work bundle due to greater job autonomy (Mokhtarian *et al*., 1998). The average personal and household incomes of those in production/construction/craft occupations are significantly smaller than those of the other occupations in the sample, and as such they may be unable to afford domestic help. Similar to the conceptual bundle model of considering major location/lifestyle change, clerical workers are more likely to consider altering their employment status, probably due to a lack of emotional attachment to their jobs involving routine work. Obviously, higher income people are more likely to consider the travel maintaining/increasing bundles requiring a cash outlay, such as auto improvement and hiring domestic help. It is natural that number of older people in a household is positively associated with the altering employment status bundle, and that the number of school-age children is negatively associated with it. Not surprisingly, the household with two or more adults and no children is negatively inclined toward considering the home-based work bundle. This result is consistent with previous empirical studies on telecommuting (e.g. Mannering and Mokhtarian, 1995). The single-adult household is also negatively inclined toward considering the auto improvement bundle. This group of people tends to be lower income and to live in North San Francisco (NSF) in our sample. Thus, they may be less able to afford a better car, and less motivated to acquire one given that NSF has higher accessibility to transit than the other neighborhoods.

All previous adoptions of individual strategies, except for adoption of moving your home closer to work, are significantly related to the consideration of factor-based bundles. Similar to the conceptual bundles, the previous adoption of any individual strategies in a bundle, except for the auto improvement and mobile phone bundles, positively affects the consideration of the same bundle. In addition, some previous adoption variables are also positively related to a different factor-based bundle that was classified into the same conceptual bundle. It is plausible that the previous adoption of getting a better car or a mobile phone is negatively related to the corresponding bundle. Cars and mobile phones are generally durable and expensive goods (considering the survey year 1998, a mobile phone was less affordable at that time), so once the individual purchases one, it may take a longer time to buy a new one. In our sample, nearly 70% (80%) of the adoption of getting a better car (a mobile phone) occurred within the last three years.

Six time since adoption variables are found significant across the models, with logical signs. Interestingly, the model of consideration of the auto improvement bundle has four of them. These four strategies closely relate to auto use. For example, the longer ago the individual adopted getting a better car and changing from another commute mode to driving alone, the more likely she is to consider the auto improvement bundle. This probably indicates that this bundle is more affected by the time-dependent adoption of individual strategies than the other bundles, due to the inevitable decay in the utility of a particular auto with time and frequent use. On the other hand, two time since adoption variables have negative signs in the corresponding bundle models. The longer ago the individual adopted changing work trip departure time or hiring domestic help, the less likely she is to consider the corresponding strategy bundles. There are two possible explanations: if these strategies are still in force, adopters might still be satisfied with their benefits; if the strategies had been discontinued, it might be because adopters were dissatisfied with them and therefore no longer inclined to consider them.

Table 4.7: Summary of Models of Consideration of Factor-based Strategy Bundles

Explanatory Variables \ Bundles	Auto improvement	Mobile phone	Work-schedule change	Hire someone to do house or yard work	Mode change	Home-based work	Residential/employment relocation	Alter employment status
N	1146	1263	1204	1238	1203	1241	1222	1261
MS ρ^2	0.043	0.124	0.155	0.219	0.434	0.147	0.316	0.207
ρ^2	0.103	0.202	0.246	0.318	0.519	0.248	0.386	0.262
Adjusted ρ^2	0.083	0.184	0.226	0.304	0.498	0.229	0.367	0.249
Objective Mobility								
Frequency of commuting (SD)			+					
Frequency of work/school-related travel (SD)		+						
Frequency of grocery shopping travel (SD)		+						
Frequency of travel taking others where they need to go (SD)		+						
Total weekly miles (SD)		+						
Weekly miles of grocery shopping travel (SD)		-						
Weekly miles to eat a meal (SD)	+	+				+		
Weekly miles of entertainment travel (SD)				+				
Weekly miles of travel taking others where they need to go (SD)		-						
Weekly miles by train/BART/light rail (SD)							+	
Weekly miles by walking/jogging/bicycling (SD)			-					
Commute distance							+	
Travel miles by personal vehicle (LD)						+		
Sum of log of miles for each trip by air (LD)		+						
Subjective Mobility								
Commute (SD)			+		+			
Travel for grocery shopping (SD)			+				+	
Travel for eating a meal (SD)							-	
Travel for entertainment (SD)		+						
Take others where they need to go (SD)	+							
Travel by personal vehicle (SD)		+			+			
Travel by air (LD)			-					
Relative Desired Mobility								
Commute (SD)							-	
Work/school-related travel (SD)					-			
Travel for grocery shopping (SD)				-				
Travel for entertainment (SD)							+	
Travel by personal vehicle (SD)					-			
Travel by bus (SD)	-							
Travel by train/BART/light rail (SD)					+			
Travel by walking/jogging/bicycling (SD)							+	
Travel by personal vehicle (LD)							-	
Travel Liking								
Work/school-related travel (SD)								-
Travel for eating a meal (SD)					+			
Travel by train/BART/light rail (SD)							+	
Overall (LD)	+							

SD = Short Distance LD = Long Distance

(Table 4.7 continued)

	Auto improvement	Mobile phone	Work-schedule change	Hire someone to do house or yard work	Mode change	Home-based work	Residential/employment relocation	Alter employment status
Attitudes								
Pro-environmental solutions factor score			+		+	+		
Commute benefit factor score			-				-	
Ideal commute time			+					
Personality								
Adventure seeker factor score			+			+		
Loner factor score					-			
Calm factor score					-			
Lifestyle								
Frustrated factor score						+	+	
Family & community-oriented factor score								+
Status seeker factor score				+				
Excess Travel								
Excess travel indicator						+	+	
Mobility Constraints								
Limitations on driving during the day						+		+
Limitations on driving on the freeway		+						
Limitations on riding a bicycle			+					
Percent of time a vehicle is available	+					-		
Socio-demographics								
Time living in the neighborhood					+			
Age		-						
Female				+				
Year of personal vehicle	-		-					
Vehicle type is SUV					-		-	
Years lived in the U.S.	-			+	-	-	-	+
Total workers in the household					-			
Full-time worker						+		
Manager/administrator occupation						+		
Production/construction/craft occupation				-				
Clerical/administrative support occupation								+
Anyone in household needing special care		+			+			
Personal income category	+			+				
Number of people ages 6-15 in HH								-
Number of people ages 41-64 in HH								+
Number of people ages 65-74 in HH								+
Household with single adult	-							
Household with two or more adults						-		

SD = Short Distance LD = Long Distance

(Table 4.7 continued)

	Auto improvement	Mobile phone	Work-schedule change	Hire someone to do house or yard work	Mode change	Home-based work	Residential/employment relocation	Alter employment status
Strategy Adoption								
Buy a car stereo system		+						
Get a better car	-			+				
Time since getting a better car	+							
Buy a mobile phone		-						
Change work trip departure time			+					
Time since changing work trip departure time			-					
Adopt flextime			+					
Adopt compressed work week			+					
Hire somebody to do house or yard work				+				
Time since hiring domestic help	-			-				
Change from driving alone to other means					+	+		
Change from another means to driving alone					+			
Squared time since changing from another means to driving alone	+							
Buy equipment to help work from home						+		
Telecommute						+		
Start home-based business				+		+		
Change jobs closer to home	+							
Time since changing jobs closer to home	-							
Work part- instead of full-time								+
Time since retiring or stopping working								+
Work-schedule change bundle							+	
Alter employment status bundle						+		

SD = Short Distance LD = Long Distance

4.3.1 Auto improvement strategies

The auto improvement bundle contains three low-cost, short-term, and travel-maintaining adjustments: “Buy a car stereo system”, “Get a better car”, and “Get a fuel efficient car”. Although individuals cannot reduce their actual amount of travel by adopting this strategy bundle, they can obtain a more comfortable, satisfying and functional travel environment when frustrated by congestion (Salomon and Mokhtarian, 1997). Thus, the likely consequence of this bundle is to reduce the costs of travel without reducing objective mobility. Two models (for all respondents and for only non-adopters) for consideration of this bundle were developed.

It should be kept in mind that the definition of a better car was intentionally left ambiguous, with respondents answering according to their own ideas. Different people could have different criteria for classifying a car as "better", such as being larger, more luxurious or even more fuel efficient, but at a minimum, it is better in some function(s) than their current one. Generally, when individuals consider getting a better/fuel-efficient car, the car could be either a brand new one, or a used one but better (newer) than their current one. Therefore, for either of these two strategies, the perceived benefits could be mainly focused on providing a more comfortable, reliable means of travel, reducing the out-of-pocket costs of travel, and/or improving the environment (since newer, more fuel-efficient cars also generally pollute less).

Buying a car stereo system costs relatively less than the other two alternatives in the bundle, and it seems to be a maintenance strategy, not a replacing one. Thus, we developed another model for the consideration of the remaining two strategies alone (the "Get a better car" and "Get a fuel efficient car" strategies), referred to as the car-replacement strategy bundle. In respective subsections below, we discuss the two models for consideration of the auto improvement bundle, followed by a third model for consideration of the car-replacement strategy bundle.

4.3.1.1 The model with all respondents

Table 4.8 presents the model based on all respondents, for the consideration of the auto improvement strategy bundle. The ρ^2 value of the model is only 0.103, the smallest among all the models, but at least it is much higher than that of the market share model, 0.043. The χ^2 test indicates that the final model is significantly better than the market share model at $\alpha << 0.001$.

Three Mobility variables are significant in the model. Weekly miles to eat out is positively related to considering the auto improvement strategy bundle. More travel for eating out implies that an individual is social-oriented, with a lifestyle focused outside the home; therefore she is more likely to consider the auto improvement bundle to make that "on-the-go" lifestyle more comfortable. Similarly, those perceiving that they do a lot of travel for taking others where they need to go are more likely to consider this bundle. Logically, those who desire more travel by bus are less likely to consider this bundle.

Table 4.8: Model of Consideration of Auto Improvement (all respondents)

Variable	Estimated coefficient	p-value
Constant	6.277	0.000
Objective Mobility		
Weekly miles to eat a meal (SD)	0.012	0.010
Subjective Mobility		
Take others where they need to go (SD)	0.207	0.002
Relative Desired Mobility		
Travel by bus (SD)	-0.238	0.000
Travel Liking		
Overall (LD)	0.191	0.010
Mobility Constraints		
Percent of time a vehicle is available	0.012	0.019
Socio-demographics		
Year of personal vehicle	-0.086	0.000
Years lived in the U.S.	-0.016	0.002
Personal income category	0.132	0.008
Household with single adult	-0.425	0.008
Strategy Adoption		
Get a better car	-0.561	0.004
Time since getting a better car	0.106	0.000
Time since hiring domestic help	-0.051	0.017
Squared time since changing from another means to driving alone	0.015	0.009
Change jobs closer to home	0.716	0.000
Time since changing jobs closer to home	-0.100	0.012
Number of observations (considering, not considering)	1146 (563, 583)	
Log likelihood at 0 (LL(**0**))	-794.347	
Log likelihood of market share (MS) model (LL(**MS**))	-760.434	
Log likelihood at convergence (LL(β))	-712.323	
MS ρ^2 = 1 - (LL(MS)/LL(0))	0.043	
ρ^2 = 1 - (LL(β)/LL(0))	0.103	
Adjusted ρ^2 = 1 - [LL(β)- # of parameters]/LL(0)	0.083	
χ^2 = -2[LL(**MS**) - LL(β)]	96.222	

SD = Short Distance LD = Long Distance

Liking of overall long-distance travel is positively associated with considering the auto improvement strategy bundle. In our sample, this variable is strongly correlated with the liking (r = 0.409) and desiring (r = 0.259) of long-distance travel by personal vehicle, although less strongly than its correlation with the liking (r = 0.538) and desiring (r = 0.368) of long-distance travel by air. The connection to long-distance vehicle travel is clear: someone liking and desiring more of such travel is inclined to consider either buying a car stereo, getting a better car, or getting a fuel-efficient car for making such travel even more enjoyable. The potential connection to long-distance air travel is more subtle, but still plausible. First, even air travel

generally involves airport ground access in a personal vehicle, and in any case individuals doing a lot of flying are likely to be doing above-average amounts of traveling in general, and personal vehicle traveling in particular. The person who likes long-distance traveling overall, and wants to do more of it, may be especially motivated to consider a fuel-efficient car, so as to minimize – as far as possible – the environmental impacts of the travel he/she wants to do. Thus, the liking for long-distance travel overall may be a marker for a complex constellation of variables and relationships.

As expected, the percent of time a vehicle is available is positively related to the consideration of this strategy bundle. That is, individuals with higher vehicle mobility want to make their travel more comfortable, so they are more likely to consider this strategy bundle. Also as expected, the model year of the personal vehicle is negatively associated with the consideration of the auto improvement strategy bundle. Generally, those having older cars are more likely to consider replacing or improving their cars to make driving more comfortable or safer. The number of years lived in the U.S., both taken at face value and as a proxy for age, is negatively related to the consideration of this bundle. It is logical that recent immigrants and younger people are more likely to be starting out with a lower-end car and thus more likely to need or want to upgrade it. As expected, individuals with higher personal incomes are more likely to consider this bundle. Being in a single-adult/no-children household is negatively related to considering this bundle. In our sample, such respondents tend to have lower incomes, which makes the relationship to consideration logical. Further, such households would not have family-based reasons for considering auto improvement strategies. Such reasons constitute one important class of influences on considering these strategies, as confirmed by the presence of the family/community-oriented factor score in the model for non-adopters (Section 4.3.1.2).

Two previous adoption variables and four time since adoption variables are significant in the model. It is logical that the more recently the individual purchased a better car, the less likely she is to consider this strategy bundle. Interestingly, the previous adoption of changing jobs closer to home is positively associated with the consideration of this bundle. Although there are many stimuli to affect a change in job, in many cases, such a change involves a higher personal income or a higher status. Therefore, plausibly, individuals are more likely to consider getting a

newer car or equipment (e.g. a car stereo system) as a symbol of their advancement after they get a better salary or a higher position. Similarly, the time since changing jobs closer to home is negatively related to the consideration of this strategy bundle; the more *recently* they change jobs, the *more* likely they are to consider the auto improvement bundle. Interestingly, the time since hiring domestic help is positively associated with the consideration of this bundle; the more recently individuals have hired domestic help, the more likely they are to consider the auto improvement bundle. This may indicate that they want or need to engage in more travel after adopting this time-buying strategy, and wish to increase the comfort of that travel. The squared time since changing from another mode to driving alone positively affects the consideration of the auto improvement bundle. It is logical that the longer ago individuals changed to driving alone, the more likely they are to consider replacing or improving their old cars.

4.3.1.2 The model with only non-adopters

Only 235 (18.3%) people of the sample had never adopted any of the auto improvement strategies (see Table 2.2). Compared to the rest of the sample, non-adopters are more likely to be young, single, and lower income. As shown in Table 4.9, the ρ^2 value of the model with only non-adopters is substantially higher than that for the model with all respondents (0.291 versus 0.103). The χ^2 test indicates that the final model is significantly better than the market share model at $\alpha << 0.001$. Ten explanatory variables are significant in the model. Half of them are the same as in the model with all respondents; we focus here on the new variables.

Two Relative Desired Mobility variables are significant in the model. Interestingly, desiring more overall short-distance travel is negatively related to the consideration of this bundle. In the sample, desiring more overall short-distance travel is significantly negatively correlated with the perceived amount of that travel ($r = -0.266$). That is, individuals with higher desires for more overall short-distance travel tend to have lower perceived amounts of such travel. Therefore, they are not necessarily motivated to improve or replace their current cars. Conversely, liking of personal vehicle travel is positively associated with the consideration of this strategy bundle. Those with higher liking for such travel tend to do more of it, so they are more likely to want to make this travel more comfortable or enjoyable. It is logical that desiring more travel for eating

out positively affects the consideration of the auto improvement bundle, because more travel for eating out indicates an on-the-go lifestyle.

Table 4.9: Model of Consideration of Auto Improvement (only non-adopters)

Variable	Estimated coefficient	p-value
Constant	3.814	0.239
Subjective Mobility		
Take others where they need to go (SD)	0.518	0.007
Relative Desired Mobility		
Overall (SD)	-0.645	0.031
Travel for eating out (SD)	1.436	0.001
Travel Liking		
Travel by bus (SD)	-0.674	0.002
Travel by personal vehicle (LD)	0.475	0.019
Lifestyle		
Frustrated factor score	0.484	0.030
Family & community-oriented factor score	0.760	0.008
Socio-demographics		
Year of personal vehicle	-0.089	0.007
Strategy Adoption		
Time since changing from driving alone to other means	0.520	0.006
Change jobs closer to home	1.674	0.003
Number of observations (considering, not considering)	174 (90, 84)	
Log likelihood at 0 (LL(**0**))	-120.608	
Log likelihood of market share (MS) model (LL(**MS**))	-116.241	
Log likelihood at convergence (LL($\boldsymbol{\beta}$))	-85.480	
MS ρ^2 [1 - (LL(MS)/LL(0))]	0.036	
ρ^2 [1 - (LL($\boldsymbol{\beta}$)/LL(0))]	0.291	
Adjusted ρ^2 {1 - [LL($\boldsymbol{\beta}$)- # of parameters]/LL(0)}	0.200	
χ^2 = -2[LL(**MS**) - LL($\boldsymbol{\beta}$)]	61.522	

SD = Short Distance LD = Long Distance

Two Lifestyle variables are significant in the model. Individuals in our sample who are frustrated may view these auto improvement strategies as one way to increase control and/or life satisfaction (through an improved travel environment and/or saved travel costs), or at least to provide a welcome diversion from their difficulties. Family/community-oriented people presumably want to spend time traveling to activities with family members or friends. Similar to Subjective Mobility for taking others where they need to go, family/community-oriented people are more likely to consider auto improvement strategies to make family travel time more comfortable, safer, or more economical in fuel consumption. Time since changing from driving

alone to other commute modes is positively related to the consideration of the auto improvement bundle. It is logical that the more recently the individual changed from driving alone to other means of commute travel, the less likely she is to consider the auto improvement strategy bundle due to a lower use of the personal vehicle.

4.3.1.3 The model for the car-replacement strategy bundle

Table 4.10 presents the model for the consideration of the car-replacement strategy bundle, including "Get a better car" and "Get a fuel efficient car", based on all respondents. At 0.137, the ρ^2 value of the model is slightly higher than that for the consideration of the auto improvement bundle with all respondents. The χ^2 test indicates that the final model is significantly better than the market share model at $\alpha << 0.001$. Comparing to the model for the consideration of the auto improvement bundle with all respondents, 13 out of 19 explanatory variables in this model are common. The other variables have logical signs as well.

The pro-high density factor score is negatively associated with the consideration of the car-replacement strategy bundle. This land-use factor is based on attitudes about residential density and about proximity to services, and a positive pro-high density factor score may indicate those who have a relative aversion to travel by auto and prefer travel by walking or transit (Redmond, 2000). Therefore, those with a higher score for this factor may be less likely to consider "replacing their cars". Logically, the small vehicle type is positively related to the consideration of this bundle: the smaller the vehicle the individual has, the more likely she is to consider a better one to make her driving more comfortable.

Interestingly, not only the time since getting a better car but also the square of the time since getting a better car are significant in the model, with opposite signs. The combined effect on the consideration of this bundle is positive over the range of times found in this sample, and increases with time for 97.7% of the sample (i.e. until consideration peaks at 11.5 years). Thus, overall, the longer ago the individual purchased a better car, the more likely she is to consider replacing the car.

Table 4.10: Model of Consideration of Car-replacement Bundle

Variable	Estimated coefficient	p-value
Constant	6.328	0.000
Objective Mobility		
Weekly miles to eat a meal (SD)	0.014	0.007
Subjective Mobility		
Take others where they need to go (SD)	0.209	0.002
Relative Desired Mobility		
Travel by bus (SD)	-0.164	0.018
Travel Liking		
Overall (LD)	0.244	0.002
Attitudes		
Pro-high density factor score	-0.217	0.017
Lifestyle		
Frustrated factor score	0.212	0.009
Socio-demographics		
Year of personal vehicle	-0.087	0.000
Years lived in the U.S.	-0.013	0.017
Personal income category	0.240	0.000
Vehicle type is small	0.340	0.033
Household with single adult	-0.482	0.004
Strategy Adoption		
Get a better car	-1.183	0.000
Time since getting a better car	0.300	0.000
Squared time since getting a better car	-0.013	0.015
Time since hiring domestic help	-0.062	0.006
Buy equipment to help work from home	0.353	0.020
Change jobs closer to home	0.645	0.001
Time since changing jobs closer to home	-0.107	0.010
Time since starting/expanding home-based business	0.109	0.008
Number of observations (considering, not considering)	1114 (486, 628)	
Log likelihood at 0 (LL(**0**))	-772.166	
Log likelihood of market share (MS) model (LL(**MS**))	-730.910	
Log likelihood at convergence (LL($\boldsymbol{\beta}$))	-666.620	
MS ρ^2 = 1 - (LL(MS)/LL(0))	0.053	
ρ^2 = 1 - (LL($\boldsymbol{\beta}$)/LL(0))	0.137	
Adjusted ρ^2 = 1 - [LL($\boldsymbol{\beta}$)- # of parameters]/LL(0)	0.111	
χ^2 = -2[LL(**MS**) - LL($\boldsymbol{\beta}$)]	128.580	

SD = Short Distance LD = Long Distance

In addition, the previous adoption of buying equipment to help work from home is positively related to the consideration of this strategy bundle. The adoption of buying equipment to help work from home might have reduced commute travel, but not eliminated it entirely. Alternatively, a home-based business has travel requirements of its own, perhaps including the need for a better car to symbolize success to potential clients. Thus, it is plausible that consideration of such a travel-maintaining strategy would support home-based work, either by

ameliorating the disutility or increasing the perceived status of the remaining necessary travel. On the other hand, the time since starting/expanding a home-based business is positively related to the consideration of this bundle strategy. Thus, the more recently the individual started or expanded the home-based business, the less likely she is to consider this bundle, either because she has substantially reduced her commute travel, or because the fledgling business is not yet in a financial position to allow her to upgrade her car.

4.3.2 Mobile phone

The mobile phone bundle contains only one individual strategy. Table 4.11 presents the model of consideration of mobile phones. The proportion of information in the data explained by the model, ρ^2, is 0.202. The proportion of information in the data explained by the market share model, MS ρ^2, is 0.124. This means that all explanatory variables other than the constant term explain 7.8 additional percentage points of information in the data. The final model re-estimated without the constant term resulted in a ρ^2 of 0.191, meaning that the true variables carry about 95% of the full explanatory power of the model.

A cursory review of the model indicates that the consideration of a mobile phone is greatly affected by Objective Mobility. Eight Objective Mobility variables are significant in this model, six with positive signs. The positive association is quite natural: the more one travels, the more useful it becomes to have mobile communication capabilities. The two negative coefficients relate to weekly miles of grocery shopping travel and taking others where they need to go. In both cases, the *frequency* of travel for that purpose is also in the model, with the expected positive sign. Thus, the negative effect of the distance variables partly modifies the direct positive effect of the frequency variables. Generally, the combined impact of the frequency-distance pair of variables in each case is still positive. Specifically, the combined impact of frequency and distance for grocery shopping is positive for three-quarters of the sample, and the impact of taking others where they need to go is positive for 57.8% of the sample. In any case, it is plausible that the perceived utility of a mobile phone would be higher for a person making many trips than for one making fewer trips covering the same or longer distance, because of the increased uncertainty and scheduling complexity associated with making many trips.

Table 4.11: Model of Consideration of Getting a Mobile Phone

Variable	Estimated coefficient	p-value
Constant	-2.341	0.000
Objective Mobility		
Frequency of work/school-related travel (SD)	0.0572	0.004
Frequency of grocery shopping travel (SD)	0.0927	0.002
Frequency of travel taking others where they need to go (SD)	0.0739	0.006
Total weekly miles (SD)	0.00104	0.006
Weekly miles of grocery shopping travel (SD)	-0.0178	0.025
Weekly miles to eat a meal (SD)	0.0185	0.001
Weekly miles of travel taking others where they need to go (SD)	-0.0173	0.002
Sum of log of miles for each trip by air (LD)	0.0122	0.033
Subjective Mobility		
Travel for entertainment (SD)	0.149	0.039
Travel by personal vehicle (SD)	0.158	0.009
Mobility Constraints		
Limitations on driving on the freeway	0.645	0.019
Socio-demographics		
Age	-0.391	0.000
Anyone in household needing special care	0.973	0.004
Strategy Adoption		
Buy a car stereo system	0.284	0.034
Buy a mobile phone	-0.978	0.000
Number of observations (considering, not considering)	1263 (373, 890)	
Log likelihood at 0	-875.445	
Log likelihood of MS model	-766.457	
Log likelihood at convergence	-698.661	
MS ρ^2 = 1 - (LL(MS)/LL(0))	0.124	
ρ^2 = 1 - (LL($\boldsymbol{\beta}$)/LL(0))	0.202	
Adjusted ρ^2 = 1 - [LL($\boldsymbol{\beta}$)- # of parameters]/LL(0)	0.184	
χ^2 = -2[LL(**MS**) - LL($\boldsymbol{\beta}$)]	135.592	

SD = Short Distance LD = Long Distance

Similarly, both Subjective Mobility effects are positive. If individuals perceive that they do a lot of short-distance entertainment travel and travel by personal vehicle, they are more likely to consider mobile phones to utilize their travel time effectively and to coordinate with other people. Individuals having limitations on driving on the freeway are more likely to consider obtaining a mobile phone, perhaps to alleviate higher-than-average fears about safety, or travel stress in general.

Two Socio-demographic variables enter the model. The negative sign of the age variable indicates younger people are more likely to consider mobile phones – a logical result for a technological innovation still in its infancy at the time the data were collected (1998). For those who have anyone in the household needing special care, mobile phones could provide direct and

timely communications with the family whenever they are working or traveling. Thus, the positive coefficient of this variable is logical.

The former adoption of a car stereo system has a positive impact on the consideration of mobile phones. Both are considered travel-maintaining strategies, and may complement each other. On the other hand, prior adoption of a mobile phone has a strongly negative impact on considering the same strategy, which is natural since the prior adoption is probably still in force.

4.3.3 Work-schedule change

The work-schedule change bundle contains three individual strategies: "Change work trip departure time", "Adopt flextime", and "Adopt compressed work week". This strategy bundle focuses on rescheduling either commute or work travel to avoid peak period congestion. Two final models for the consideration of this bundle are discussed: one based on all respondents and the other for only non-adopters.

4.3.3.1 The model with all respondents

Table 4.12 presents the model based on all respondents, for the consideration of the work-schedule change strategy bundle. The ρ^2 value of the model is 0.246, and the χ^2 test indicates that the final model is significantly better than the market share model at $\alpha << 0.001$.

Two Objective Mobility and three Subjective Mobility variables are significant in the model. It is logical that Objective or Subjective Mobility with respect to commuting is positively related to the consideration of the work-schedule change bundle. The individuals with higher values on these mobility variables are more likely to seek a strategy to reduce their travel stress. Similarly, the greater the individual perceives grocery shopping travel to be, the more likely she is to consider the work-schedule change bundle to reduce or improve her commute travel. Interestingly, the individual with a higher amount of walking/jogging/bicycling is less likely to consider this strategy bundle. In our sample, the individuals with higher amounts of such travel tend to have low incomes and to use public transit or walking/bicycling for their primary commute modes, so they may be less inclined to consider the work-schedule change bundle since it may be more effective with driving than with taking transit or walking. Long-distance air

travel is negatively associated with the consideration of this bundle. Those who are away on long-distance flights a lot may not have a regular enough commuting schedule to be bothered by congestion a great deal. More likely, they may already have adopted this strategy bundle in order to provide more flexibility (e.g. an extra day or two every two weeks) for the long-distance air travel they are making (it is noteworthy that this variable does not appear in the model for non-adopters only, Table 4.13).

Table 4.12: Model of Consideration of Work-Schedule Change (all respondents)

Variable	Estimated coefficient	p-value
Constant	-3.315	0.000
Objective Mobility		
Frequency of commuting (SD)	0.143	0.003
Weekly miles by walking/jogging/bicycling (SD)	-0.019	0.002
Subjective Mobility		
Commute (SD)	0.161	0.012
Travel for grocery shopping (SD)	0.220	0.009
Travel by air (LD)	-0.206	0.001
Attitudes		
Pro-environmental solutions factor score	0.228	0.008
Commute benefit factor score	-0.316	0.000
Ideal commute time	0.024	0.009
Personality		
Adventure seeker factor score	0.346	0.000
Mobility Constraints		
Limitations on riding a bicycle	0.405	0.031
Socio-demographics		
Years lived in the U.S.	-0.020	0.000
Strategy Adoption		
Change work trip departure time	0.898	0.000
Time since changing work trip departure time	-0.100	0.022
Adopt flextime	0.783	0.000
Adopt compressed work week	0.795	0.000
Number of observations (considering, not considering)	1204 (350, 854)	
Log likelihood at 0 (LL(**0**))	-834.549	
Log likelihood of market share (MS) model (LL(**MS**))	-704.965	
Log likelihood at convergence (LL(β))	-629.547	
MS ρ^2 = 1 - (LL(MS)/LL(0))	0.155	
ρ^2 = 1 - (LL(β)/LL(0))	0.246	
Adjusted ρ^2 = 1 - [LL(β)- # of parameters]/LL(0)	0.226	
χ^2 = -2[LL(**MS**) - LL(β)]	150.897	

SD = Short Distance LD = Long Distance

Two Travel Attitude factors, the ideal commute time attitude, and a Personality variable are significant in the model, with logical signs. Pro-environmentalists are more likely to consider

travel reducing strategy bundles, including this one, to decrease vehicle emissions. It is logical that the individual having a higher score on the commute benefit factor is less likely to consider a work-schedule change that may reduce his amount of commuting. On the other hand, adventure seekers may be more likely to consider this strategy bundle in order to apply the time and money they would save on work trips to increase outdoor activities for entertainment or recreation. Interestingly, the ideal commute time variable is positively associated with the consideration of the work-schedule change strategy bundle. Individuals with a longer ideal commute time presumably enjoy their commute travel but may not want to spend more time on congested highways. Thus, they seek a way to reduce their exposure to traffic congestion, while maintaining their commute travel.

Logically, the individual having limitations on riding a bicycle is more likely to consider the work-schedule change bundle to reduce her travel burden. The number of years lived in the U.S., as a proxy for age, has a negative effect on the consideration of this strategy bundle. Older people may generally be more adapted to their current commute conditions, and/or they may have more control over their travel without the need to consider travel-reducing strategies. Of course, they may have adapted by previously adopting this strategy, an interpretation supported by the absence of this variable in the model for non-adopters only.

Three adoption variables are positively related to the consideration of this strategy, namely the three individual strategies in the work-schedule change bundle. As hypothesized, individuals who have previously adopted this type of strategy may be more likely to reconsider it to obtain the same benefits they had. On the other hand, it is interesting that the longer ago an individual adopted changing work departure time, the less likely she is to reconsider this type of strategy. Since changing departure time is the one among the three strategies comprising this bundle that can be adopted most readily, it seems that only having adopted it a long time ago signifies that the strategy is no longer useful, for whatever reasons.

4.3.3.2 The model with only non-adopters

As shown in Table 4.13, the ρ^2 value of the model with only non-adopters (0.39) is higher than that for the model with all respondents (0.25). The χ^2 test indicates that the final model is

significantly better than the market share model at $\alpha << 0.001$. Eight explanatory variables are significant in this model, and five of them are common to the model on the full sample.

Table 4.13: Model of Consideration of Work-Schedule Change (only non-adopters)

Variable	Estimated coefficient	p-value
Constant	-5.326	0.000
Objective Mobility		
Frequency of commuting (SD)	0.198	0.022
Commute time	0.011	0.043
Subjective Mobility		
Commute (SD)	0.242	0.016
Travel Liking		
Travel for grocery shopping (SD)	0.362	0.024
Attitudes		
Commute benefit factor score	-0.293	0.035
Personality		
Adventure seeker factor score	0.269	0.029
Strategy Adoption		
Time since getting a better car	-0.122	0.017
Time since hiring domestic help	-0.253	0.018
Number of observations (considering, not considering)	625 (115, 510)	
Log likelihood at 0 (LL(**0**))	-433.217	
Log likelihood of market share (MS) model (LL(**MS**))	-289.651	
Log likelihood at convergence (LL($\boldsymbol{\beta}$))	-264.406	
MS ρ^2 = 1 - (LL(MS)/LL(0))	0.331	
ρ^2 = 1 - (LL($\boldsymbol{\beta}$)/LL(0))	0.390	
Adjusted ρ^2 = 1 - [LL($\boldsymbol{\beta}$)- # of parameters]/LL(0)	0.369	
χ^2 = -2[LL(**MS**) - LL($\boldsymbol{\beta}$)]	50.492	

SD = Short Distance LD = Long Distance

Similar to the frequency of commuting, it is logical that the longer the commute time the individual has, the more likely she is to consider the lower-cost work-schedule change strategy bundle. Two time since adoption variables are significant in the model, with negative signs. It is found that the more recently the individual purchased a better car, the more likely she is to consider this strategy bundle. This may imply that individuals are seeking travel adjustment strategies to optimize their utilities of travel, while maintaining their current travel. Similarly, the time since adoption of hiring someone to do house or yard work is negatively associated with the consideration of this strategy bundle. That is, the more recently domestic help was hired, the more likely the individual is to consider this strategy bundle. In our sample, it seems to be the case that, on average, this form of buying time does not fully meet the individual's needs, or the risk it carries was found to exceed its utility (for example, a housecleaner may threaten the

individual's privacy and security), and these considerations leave him searching for further low-cost ways of obtaining more flexibility.

4.3.4 Hire someone to do house or yard work

"Hire somebody to do house or yard work" was classified into an independent bundle. It is a time-buying strategy involving some monetary cost, and it is conceptually different from the other strategies. The descriptive analysis found that many fewer respondents regard reducing or easing travel as the reason to adopt or consider this strategy (Clay and Mokhtarian, forthcoming). This suggests the strategy has fewer travel implications. In the previous study (Mokhtarian, *et al.*, 1997; Raney, *et al*., 2000), "Hire somebody to do house or yard work" was eliminated from the analysis because in the factor analysis, it oddly loaded on a conceptually inappropriate bundle. Salomon and Mokhtarian (1997) viewed its adoption as one of the potential externalities of travel, and argued that congestion levels can motivate its adoption to some extent. Since there appears to be little further exploration of this strategy in the transportation literature, we believe that modeling its consideration could offer some insightful information.

4.3.4.1 The model with all respondents

Table 4.14 presents the model of consideration of "Hire somebody to do house or yard work" based on all respondents. The proportion of information in the data explained by the model, ρ^2, is 0.319. The proportion of information in the data explained by the market share model, MS ρ^2, is 0.219. This means that all explanatory variables other than the constant term explain 10 additional percentage points of information in the data. The final model re-estimated without the constant term resulted in a ρ^2 of 0.298, meaning that the true variables carry 93% of the full explanatory power of the model.

Two Mobility variables are significant in this model, but one of them is more an indicator of lifestyle than of mobility, as discussed below. Consistent with the suggestion of the descriptive analysis, factors other than travel seem to dominate the consideration of this strategy.

The model shows that the more one travels (short distance) for entertainment, the more likely the individual is to consider hiring somebody to do house or yard work. This suggests that a higher

Objective Mobility, especially for out-of-home entertainment activities, makes this time-buying strategy attractive. Conversely, desiring more travel for grocery shopping may characterize an individual whose lifestyle is focused on the home, and it is not surprising that such an individual would be less likely to consider outsourcing domestic responsibilities. Also not surprisingly, a status seeker would be more likely to consider this strategy.

Table 4.14: Model of Consideration of Hiring Somebody to Do House or Yard Work (all respondents)

Variable	Estimated coefficient	p-value
Constant	-2.872	0.000
Objective Mobility		
Weekly miles of entertainment travel (SD)	0.00379	0.048
Relative Desired Mobility		
Travel for grocery shopping (SD)	-0.301	0.037
Lifestyle		
Status seeker factor score	0.213	0.017
Socio-demographics		
Female	0.665	0.000
Years lived in the U.S.	0.0205	0.000
Production/construction/craft occupation	-1.228	0.051
Personal income category	0.155	0.009
Strategy Adoption		
Get a better car	0.360	0.034
Hire somebody to do house or yard work	1.408	0.000
Time since hiring domestic help	-0.125	0.000
Start/expand home-based business	0.740	0.000
Number of observations (considering, not considering)	1238 (287, 951)	
Log likelihood at 0	-858.116	
Log likelihood of MS model	-670.343	
Log likelihood at convergence	-584.923	
MS ρ^2 = 1 - (LL(MS)/LL(0))	0.219	
ρ^2 = 1 - (LL($\boldsymbol{\beta}$)/LL(0))	0.318	
Adjusted ρ^2 = 1 - [LL($\boldsymbol{\beta}$)- # of parameters]/LL(0)	0.304	
χ^2 = -2[LL(**MS**) - LL($\boldsymbol{\beta}$)]	170.840	

SD = Short Distance LD = Long Distance

Four Socio-demographic variables are significant in this model. As the partner typically shouldering the greater share of domestic responsibilities (Turner and Niemeier, 1997; Tingey, *et al.*, 1996), it is logical that females are more likely to consider hiring somebody to do house or yard work. With years lived in the U.S. acting as a proxy for age, it is reasonable that older people may have some physical limitations on doing house or yard work, and hence be more likely to hire outside help. Older workers would additionally tend to have higher incomes, and

the model separately shows that, as expected, people with higher incomes are more likely to consider this strategy. The average personal and household incomes of those with production/construction/craft occupations are significantly smaller than those of the other occupations in this sample, and as such they may be unable to afford or hesitate to prioritize adopting this strategy.

The former adoption of a better car tends to increase the probability of considering hiring somebody to do house or yard work. The acquisition of a better car indicates higher income, and hence its effect is consistent with the finding of personal income discussed above. Similar to previous results, the former adoption of hiring somebody to do house or yard work positively affects its reconsideration. And the longer the time since adoption of this strategy, the less likely an individual is to reconsider it. If the strategy is still in force, it may be indicative of a trusted and reliable long-time domestic worker (*i.e.*, the respondent is not considering hiring someone *different*); if the strategy had been discarded at some point, it may indicate habituation to doing the house or yard work oneself over time. The former adoption of a home-based business is positively associated with the consideration of hiring somebody to do house or yard work. It is plausible that someone who already spends much of the time at home working for the business may not want to spend more time at home on domestic duties. Also, in this sample the adoption of a home-based business is marginally associated with higher household incomes, and it makes sense that people with higher household incomes prefer this strategy.

4.3.4.2 The model with only non-adopters

As shown in Table 4.15, ten variables are significant in the model of consideration of "Hire somebody to do house or yard work" estimated only for non-adopters. Compared to the all-respondent model, this model contains five common variables. This shows substantial commonality between the models.

Similar to the entertainment Objective Mobility variable found in the all-respondent model, a higher frequency of travel to eat out implies an individual is social-oriented and less likely to stay at home, thus she would be more likely to consider hiring somebody to do house or yard work. Traveling a lot long distance by modes other than personal vehicle or airplane is

indicative of some kind of special circumstance; at a minimum, it suggests being far away from home a great deal (unlike the previous variable, which involves short-term, local absences from home), which may reduce both the need for a housecleaner, and the ability to monitor one. On the other hand, for those who perceive that they do a lot of airplane travel, this time-buying strategy can help compensate for time lost during trips.

Limitations on freeway driving may be physical or psychological. If the latter, domestic help may be a useful stress-reduction strategy; if the former, physical limitations may make domestic help an attractive alternative for maintaining the household. Homes and yards (when present) in urban North San Francisco are smaller on average than those of the suburban residents in this sample. Therefore, it is not surprising that the urban residents are less likely to hire somebody to do house or yard work.

Table 4.15: Model of Consideration of "Hire Somebody to Do House or Yard Work" (non-adopters only)

Variable	Estimated coefficient	p-value
Constant	-5.827	0.000
Objective Mobility		
Frequency of travel to eat a meal (SD)	0.0759	0.042
Log of sum of miles for each trip by other means (LD)	-0.146	0.019
Subjective Mobility		
Travel by air (LD)	0.319	0.001
Lifestyle		
Status seeker factor score	0.340	0.010
Mobility Constraints		
Limitations on driving on the freeway	0.890	0.009
Socio-demographics		
North San Francisco	-0.501	0.021
Female	0.800	0.000
Years lived in the U.S.	0.0261	0.001
Personal income category	0.263	0.002
Strategy Adoption		
Start/expand home-based business	0.898	0.002
Number of observations (considering, not considering)	851 (133, 718)	
Log likelihood at 0	-589.868	
Log likelihood of MS model	-368.875	
Log likelihood at convergence	-327.618	
MS ρ^2 = 1 - (LL(MS)/LL(0))	0.375	
ρ^2 = 1 - (LL($\boldsymbol{\beta}$)/LL(0))	0.445	
Adjusted ρ^2 = 1 - [LL($\boldsymbol{\beta}$)- # of parameters]/LL(0)	0.426	
χ^2 = -2[LL(**MS**) - LL($\boldsymbol{\beta}$)]	82.514	

SD = Short Distance LD = Long Distance

4.3.5 Mode Change

The mode change bundle consists of two individual strategies: "Change from driving alone to work, to some other means" and "Change from another means of getting to work, to driving alone". The strategies are theoretically opposite in terms of the direction of respondents' behavior. Not surprisingly, in this sample, 67% of the 180 respondents who are considering this bundle are considering the first individual strategy only, 19% of them are considering the other one only, and 14% of them are considering both. The dominance of the first strategy is expected because driving alone has long been the major commute mode in the U.S., with a 79.6% share in the 1995 Nationwide Personal Transportation Survey (Hu and Young, 1999). Our sample is similar, with 79% of respondents having a personal vehicle as their primary commute mode[2]. Thus, when interpreting consideration of this bundle, it should be kept in mind that an individual is far more likely to consider changing from driving alone to work to some other means than changing in the other direction, although they are in the same bundle. On the other hand, the individuals who use other means (e.g. transit, walking, bicycling) for commute travel are also considering this bundle, particularly changing from another means to driving alone, because they might be stressed by the inconvenience, waiting time, or discomfort from using this means, compared to driving alone. Additionally, some of the individuals who previously changed from driving alone for commute travel to another means may not be satisfied with its benefits with respect to time and costs, so they are likely to consider driving alone again (i.e., cycling back to their previous choice). Those who are considering both strategies in this bundle are probably those with mixed or multimodal commutes (i.e. they may drive alone some days and carpool on others, or drive alone to a park-and-ride lot and take transit for the rest of the way), who are considering their options at either extreme.

---

[2] The survey did not directly ask for the commute mode, but we were able to impute the primary commute mode for each respondent, by comparing reported weekly miles traveled by each mode to the fraction of weekly miles traveled for commuting. Ultimately, one of the five modes (personal vehicle/motorcycle, bus/ferry, train/BART/light rail, walking/jogging/bicycling, and other) on the survey was assigned to each individual as a primary commute mode. The assignment was made with 100% confidence for 13.5% (single-mode users) of the sample of 1,357 commuting workers, with a high degree of confidence for an additional 55.6% (those whose miles of travel by a single mode exceeded half their commute miles traveled, with travel by all other modes summing to less than half the commute miles), and with moderate confidence for the remaining 30.9% (by identifying the mode used for the greatest proportion of total weekly distance traveled). We have no way of distinguishing driving alone from carpooling, so the personal vehicle category includes both cases. For the 1,283 commuting workers analyzed in this study, the shares of the primary commute modes are 79.1%, 10.2%, 8.0%, 2.5%, and 0.2%, respectively.

Modeling the consideration of the mode change strategy bundle might be expected to be difficult, especially in interpreting model results, because both directions of changing modes are included in this bundle. Also, some variables may not be significant in the model due to the nature of this bundle (containing opposite individual strategies). Nonetheless, the two final models (based on all respondents and only non-adopters, separately) have the highest ρ^2 values among all the factor-based bundle models. As expected, many significant variables in the models are more related to the consideration of changing from driving alone to another means than to the consideration of the other direction of change.

4.3.5.1 The model with all respondents

Table 4.16 shows the model based on all respondents, for the consideration of the mode change strategy bundle. The ρ^2 value of the model is 0.519, which is the highest among the factor-based bundle models based on all respondents. Although the MS ρ^2 is also quite high (0.434) due to the unbalanced shares for this bundle (14.3% versus 85.7%), the ρ^2 for the model excluding the constant term is 0.512, indicating that the true explanatory variables account for 98.7% of the information explained by the full model. The χ^2 test indicates that the final model is significantly better than the market share model at $\alpha << 0.001$. The final model has 16 significant variables; interestingly, no Objective Mobility variables are among them.

However, two Subjective Mobility variables are found in the model, with positive signs. It is logical that the greater the individual perceives her commute travel to be, the more likely she is to consider the mode change strategy bundle. A change of mode in either direction might be advantageous, depending on the specific characteristics of the current commute mode and its alternatives. By changing to another means, the individual may actually reduce her commute time or cost, or she may simply diminish the psychological burden of the commute. In particular, for personal vehicle travel, the individual with a higher subjective amount of this travel may be considering changing from driving alone to transit or other means to avoid traffic congestion, and/or to be able to use the commute time more productively.

Three Relative Desired Mobility variables are significant in the model. Similar to Subjective Mobility, desiring more short-distance work/school-related travel and personal vehicle travel are

negatively related to the consideration of this strategy bundle. Those who want *less* travel in those categories are *more* likely to consider changing commute mode, for the same reasons given above. In this sample, the distance traveled for short-distance work/school-related activities is strongly correlated (r = 0.49) with that by personal vehicle. Logically, those who want more short-distance travel by train/BART/light rail are more inclined to consider commuting by modes other than driving alone. As discussed in Section 4.3 (p. 56), it is plausible that liking short-distance travel for eating a meal is positively associated with the consideration of the mode change bundle, especially changing from driving alone to another means.

Table 4.16: Model of Consideration of Mode Change (all respondents)

Variable	Estimated coefficient	p-value
Constant	-2.826	0.002
Subjective Mobility		
Commute (SD)	0.217	0.010
Travel by personal vehicle (SD)	0.230	0.011
Relative Desired Mobility		
Work/school-related travel (SD)	-0.340	0.008
Travel by personal vehicle (SD)	-0.259	0.037
Travel by train/BART/light rail (SD)	0.241	0.013
Travel Liking		
Travel for eating a meal (SD)	0.306	0.020
Attitudes		
Pro-environmental solutions factor score	0.491	0.000
Personality		
Loner factor score	-0.220	0.033
Calm factor score	-0.405	0.001
Socio-demographics		
Time living in the neighborhood	0.003	0.005
Total workers in the household	-0.340	0.008
Years lived in the U.S.	-0.028	0.001
Vehicle type is SUV	-0.887	0.019
Anyone in household needing special care	0.986	0.014
Strategy Adoption		
Change from driving alone to other means	1.052	0.000
Change from another means to driving alone	0.837	0.000
Number of observations (considering, not considering)	1203 (172, 1031)	
Log likelihood at 0 (LL(**0**))	-833.856	
Log likelihood of market share (MS) model (LL(**MS**))	-472.297	
Log likelihood at convergence (LL(**β**))	-401.381	
MS ρ^2 = 1 - (LL(MS)/LL(0))	0.434	
ρ^2 = 1 - (LL(**β**)/LL(0))	0.519	
Adjusted ρ^2 = 1 - [LL(**β**)- # of parameters]/LL(0)	0.498	
χ^2 = -2[LL(**MS**) - LL(**β**)]	141.832	

SD = Short Distance LD = Long Distance

As expected, pro-environmentalists are more likely to consider this strategy bundle, primarily changing from driving alone to another means, presumably to reduce air pollution from driving a vehicle. It is natural that loners are less likely to consider this strategy bundle, since they are independent and like to be alone, and hence may prefer driving alone. The calm factor score is also negatively associated with the consideration of this bundle. Individuals scoring highly on this factor tend to be more patient, neither aggressive nor restless, and hence are less likely to be irritated by congestion than others. Therefore, they could be less motivated to consider changing their current commute modes.

An individual who has lived longer in the neighborhood is more familiar with its transportation conditions and alternatives, so she is more likely to consider the mode change bundle based on her experiences, compared to those who have arrived in the neighborhood more recently. On the other hand, number of years lived in the U. S., acting as a proxy for age, is negatively related to the consideration of this bundle. It is natural that older people tend to use a car due to their mobility constraints. Similarly, Curtis and Headicar (1997) found that older people (50+) appear to be less likely to have considered changing from car to other transport for the journey to work. Number of workers in the household is also negatively related to the consideration of this mode change bundle. Commute travel in the multi-worker household may be optimally-organized among its members, including carpooling or dropping off at a transit station. Thus, the individual in this type of household may be less likely to consider the mode change bundle, because it may require rescheduling other members' commute travel. It is plausible that an individual who drives an SUV tends to enjoy outdoor activities or driving itself, so she is not inclined to change to another commute mode. Those who have someone in the household needing special care may be considering changing from another means to driving alone, in order to have greater mobility in case of an emergency. If they are already driving alone, they may be considering an alternative mode if it reduces commute time, cost, or stress as discussed above.

As hypothesized, the two individual adoption variables for this bundle are positively related to the consideration of this strategy bundle. That is, individuals who have previously adopted this type of strategy may be more likely to consider it again or switch to the other strategy in the

same bundle – because they want to obtain the same benefits they had or to cycle back due to dissatisfaction with the previous mode change.

4.3.5.2 The model with only non-adopters

Table 4.17 presents the model of considering the mode change bundle based on only non-adopters. The ρ^2 value of 0.625 is the highest among all models based on only non-adopters (of course, the MS ρ^2 is already relatively high, due to the unbalanced shares). The χ^2 test indicates that the final model is significantly better than the market share model at $\alpha << 0.001$. Compared to the model with all respondents, seven out of ten explanatory variables (considering the age and years in the U.S. variables to be measuring similar constructs) are common between the two models.

Table 4.17: Model of Consideration of Mode Change (only non-adopters)

Variable	Estimated coefficient	p-value
Constant	-5.998	0.000
Subjective Mobility		
Commute (SD)	0.243	0.036
Travel by personal vehicle (SD)	0.422	0.001
Work/school-related travel (LD)	0.190	0.038
Relative Desired Mobility		
Overall (SD)	-0.416	0.014
Travel by walking/jogging/bicycling (SD)	0.353	0.028
Travel Liking		
Travel for eating a meal (SD)	0.408	0.025
Attitudes		
Pro-environmental solutions factor score	0.634	0.000
Socio-demographics		
Time living in the neighborhood	0.002	0.046
Age	-0.561	0.011
Anyone in household needing special care	1.343	0.006
Number of observations (considering, not considering)	932 (84, 848)	
Log likelihood at 0 (LL(**0**))	-646.013	
Log likelihood of market share (MS) model (LL(**MS**))	-273.983	
Log likelihood at convergence (LL($\boldsymbol{\beta}$))	-242.460	
MS ρ^2 = 1 - (LL(MS)/LL(0))	0.576	
ρ^2 = 1 - (LL($\boldsymbol{\beta}$)/LL(0))	0.625	
Adjusted ρ^2 = 1 - [LL($\boldsymbol{\beta}$)- # of parameters]/LL(0)	0.608	
χ^2 = -2[LL(**MS**) - LL($\boldsymbol{\beta}$)]	63.045	

SD = Short Distance LD = Long Distance

Logically, the higher the perceived amount of long-distance work/school-related travel the individual has, the more likely she is to consider (usually) travel reducing strategies like the mode change bundle. Two Relative Desired Mobility variables are found with the expected signs in the model. Desiring more overall short-distance travel is negatively related to the consideration of this strategy bundle. In this sample, the relative desire for overall short-distance travel is strongly, positively correlated with that for commute travel (r=0.57) and for short-distance travel by personal vehicle (r=0.42). This indicates that the individuals who want to increase their overall short-distance travel also want to increase their commute or short-distance personal vehicle travel. Thus, they are less likely to consider this strategy bundle. On the other hand, desiring more walking/jogging/bicycling is positively associated with the consideration of this bundle. It is natural that the individual with a higher value for this variable is more likely to consider changing from driving alone to another means, to increase such travel.

4.3.6 Home-based work

The home-based work bundle consists of three individual strategies: "Buy equipment/services to help you work from home", "Telecommute (part- or full-time)" and "Start home-based business or put more effort into an existing one". These are generally considered travel-reducing strategies, but involve a higher (generalized) cost than other travel-reducing strategies such as the work-schedule and mode change bundles. For example, buying equipment/services for work from home or home-based business entails monetary costs, and telecommuting strongly depends on manager and household support, in addition to job suitability and other external and internal factors.

4.3.6.1 The model with all respondents

Table 4.18 presents the model based on all respondents, for the consideration of the home-based work strategy bundle. The ρ^2 value of the model is 0.248, and is quite a bit higher than that of the market share model (0.147). The χ^2 test indicates that the final model is significantly better than the market share model at $\alpha << 0.001$.

Interestingly, only two Objective Mobility variables, related to short-distance travel for eating out and long-distance travel by personal vehicle, are found in the model, with positive signs. In

general, individuals having higher amounts of these types of travel are more likely to consider travel-reducing strategies either to reduce the corresponding travel stress or to help maintain the current travel in other categories by reducing commute time. No other mobility or Travel Liking variables are significant in this model.

Table 4.18: Model of Consideration of Home-based Work (all respondents)

Variable	Estimated coefficient	p-value
Constant	-2.194	0.001
Objective Mobility		
Weekly miles to eat a meal (SD)	0.010	0.027
Travel miles by personal vehicle (LD)	0.00004	0.034
Attitudes		
Pro-environmental solutions factor score	0.281	0.001
Personality		
Adventure seeker factor score	0.435	0.000
Lifestyle		
Frustrated factor score	0.219	0.010
Mobility Constraints		
Limitations on driving during the day	1.296	0.010
Percent of time a vehicle is available	-0.008	0.005
Socio-demographics		
Years lived in the U.S.	-0.013	0.014
Full-time worker	0.643	0.010
Manager/Administrator occupation	0.354	0.032
Household with two or more adults	-0.415	0.003
Strategy Adoption		
Change from driving alone to other means	0.354	0.042
Buy equipment to help work from home	1.307	0.000
Telecommute	0.573	0.005
Start home-based business	1.301	0.000
Alter employment status bundle	0.722	0.001
Number of observations (considering, not considering)	1241 (456, 785)	
Log likelihood at 0 (LL(**0**))	-860.196	
Log likelihood of market share (MS) model (LL(**MS**))	-733.543	
Log likelihood at convergence (LL($\boldsymbol{\beta}$))	-646.509	
MS ρ^2 = 1 - (LL(MS)/LL(0))	0.147	
ρ^2 = 1 - (LL($\boldsymbol{\beta}$)/LL(0))	0.248	
Adjusted ρ^2 = 1 - [LL($\boldsymbol{\beta}$)- # of parameters]/LL(0)	0.229	
χ^2 = -2[LL(**MS**) - LL($\boldsymbol{\beta}$)]	174.068	

SD = Short Distance LD = Long Distance

Three Attitude/Personality/Lifestyle variables are significant in the model, one from each group. It is logical that pro-environmentalists are more likely to consider this strategy bundle to reduce their commute travel, thereby decreasing vehicle emissions. The adventure seeker factor score has a positive impact on considering the home-based work strategy bundle. As discussed in the

conceptual bundle models, adventure seekers engage in more recreation/entertainment travel than others, so they may be more likely to consider reducing their commute travel in favor of maintaining or increasing their "adventure" travel. Alternatively, some adventure seekers may value change for its own sake, and consider a change just for variety, while others may relish the challenge and risk involved in a home-based business. Since frustrated people are generally dissatisfied with and have less control over their lives, they may be seeking ways to increase their satisfaction by decreasing regular commute and work stresses. Thus, it is plausible that frustrated people are more likely to consider this strategy bundle.

Two Mobility Constraint variables are significant with logical signs in the model. Those who have limitations on driving during the day are more likely to consider this bundle in order to lessen their physical or psychological travel burdens by reducing their commute driving. Similarly, the individual who has lower vehicle availability may be more likely to consider the home-based work bundle so that she can reduce the need for a vehicle for commuting.

Number of years lived in the U.S., acting as a proxy for age, is negatively related to the consideration of this strategy bundle. This suggests that older people are less likely to consider the home-based work strategies, perhaps because they may be more accustomed to their current commute conditions, more to aversive change in general and more reluctant to tackle the information technology challenges associated with teleworking. Logically, having a more frequent and thus more onerous commute is likely to motivate full-time workers to consider this strategy bundle. Also, it is likely that part-time workers have already obtained the flexibility they sought (by choosing part-time work), and because they are already only in the office part-time, further absence due to remote work may not be feasible or favored by management. As expected, managers are more likely to consider the home-based work bundle due to job suitability. Consistent with previous empirical studies (e.g. Mannering and Mokhtarian, 1995), households with two or more adults and no children are less likely than others to consider the home-based work strategy bundle.

Five previous adoption variables are positively related to the consideration of the home-based work strategy bundle. Three of them are the individual strategies in this bundle. Given the

complementary nature of these strategies, it is logical that individuals who have previously adopted one or more of them are more likely to consider the same or related ones again. Similarly, the mode change bundle was classified into the travel-reducing conceptual bundle together with this strategy bundle. That is, the individual who previously changed from driving alone to another means of commuting and is now dissatisfied with it is more likely to consider another travel-reducing strategy, probably a higher-cost one. On the other hand, as hypothesized, the individual who previously adopted altering employment status is also more likely to consider this strategy bundle. This supports the pattern that if an individual adopted a higher-cost strategy and becomes dissatisfied with it, she tends to seek another alternative with lower cost. Also, it is plausible that the individual who previously adopted working part-time instead of full-time or who quit work altogether may tend to consider starting a home-based business as a flexible supplement to or substitute for a part-time job or complete unemployment.

4.3.6.2 The model with only non-adopters

As shown in Table 4.19, the model based on only non-adopters for the consideration of the home-based work bundle has 13 significant variables. The χ^2 test indicates that the final model is significantly better than the market share model at $\alpha << 0.001$. Compared to the model based on all respondents, six variables are common between the two models. We discuss the remaining variables here.

Generally, a higher objective or subjective amount of travel is positively related to the consideration of travel-reducing strategies, so as to lessen the physical or psychological travel burden. In this model, two Objective Mobility variables with respect to commute or work/school-related activities are found with positive signs. Logically, the individual who has a higher frequency of work/school-related travel or a longer commute time is more likely to consider this strategy bundle to diminish her current travel stress by decreasing such travel. Likewise, the individual who perceives travel by walking/jogging/bicycling to be a lot is more likely to consider the home-based work bundle. If the non-vehicular travel is mostly "derived", the individual may want to reduce it; if it is mostly recreational, the individual may want to reduce (vehicular) commuting time and use the saved time for recreational travel.

In addition to the adventure seeker factor of the full-sample model, here the excess travel indicator is positively associated with the consideration of this strategy bundle. The individual with a higher Excess Travel value is hypothesized to have a higher Objective Mobility and to tend to want to reduce mandatory travel such as commuting.

Table 4.19: Model of Consideration of Home-based Work (only non-adopters)

Variable	Estimated coefficient	p-value
Constant	-4.738	0.000
Objective Mobility		
Work/school-related trips (LD)	0.016	0.026
Commute time	0.014	0.004
Subjective Mobility		
Travel by walking/jogging/bicycling (SD)	0.254	0.004
Personality		
Adventure seeker factor score	0.349	0.003
Lifestyle		
Frustrated factor score	0.269	0.021
Mobility Constraints		
Limitations on driving during the day	1.853	0.003
Excess Travel		
Excess travel indicator	0.055	0.021
Socio-demographics		
Attachment to the neighborhood	0.294	0.049
Years lived in the U.S.	-0.031	0.000
Number of people ages 16-18 in HH	0.566	0.046
Manager/administrator occupation	1.072	0.000
Professional/technical occupation	0.562	0.015
Household with two or more adults	-0.483	0.016
Number of observations (considering, not considering)	779 (167, 612)	
Log likelihood at 0 (LL(**0**))	-539.962	
Log likelihood of market share (MS) model (LL(**MS**))	-393.731	
Log likelihood at convergence (LL(**β**))	-351.341	
MS ρ^2 = 1 - (LL(MS)/LL(0))	0.271	
ρ^2 = 1 - (LL(**β**)/LL(0))	0.349	
Adjusted ρ^2 = 1 - [LL(**β**)- # of parameters]/LL(0)	0.323	
χ^2 = -2[LL(**MS**) - LL(**β**)]	84.779	

SD = Short Distance LD = Long Distance

Attachment to the neighborhood is positively related to the consideration of this bundle. Those who feel a higher attachment to their neighborhoods are very comfortable in their current circumstances and are probably acquainted with their neighbors, and hence they are more likely to consider the telecommuting or home-based business strategies in this bundle. The number of people ages 16-18 in the household is also positively associated with the consideration of this strategy bundle. It is quite possible that a parent would want to be home during after-school

hours throughout their children's sensitive late adolescent years. Similar to managers or administrators, professionals are more likely to consider the home-based work strategy bundle due to their job suitability (less restricted to office locations but more oriented toward work productivity).

4.3.7 Residential/employment relocation

The residential/employment relocation bundle comprises two individual strategies: "Change jobs closer to home" and "Move your home closer to work". Both strategies are high-cost, long-term adjustments, and involve risk to the individual (for example, dissatisfaction with the new residential/employment location). However, the impacts of each strategy on the household may be different. When residential relocation takes place, all household members may have to alter previous habit patterns and adapt to the new environment; during this process, dissatisfaction and tension may occur. Moreover, the commuting time of other household members may increase when the relocation was made to ease the commute for only one household member (Salomon and Mokhtarian, 1997). On the contrary, except for a possible salary change or a significant change in stress levels or in time available for household activities, the impacts of employment relocation are mainly focused on the individual making the change. Overall, adopting this bundle strongly contributes to reducing commute travel, but may result in other stresses among household members. In this sample, 60% of the respondents (n=297) who are considering this bundle are considering the first individual strategy only, 18% of them are considering the other one only, and 22% of them are considering both. So, we may expect that a model for consideration of this bundle explains characteristics common between the two strategies and leans toward the first individual strategy, changing to a job closer to home.

4.3.7.1 The model with all respondents

Table 4.20 presents the model based on all respondents, for the consideration of the residential/employment relocation strategy bundle. The ρ^2 value of the model is 0.386, which is the second highest among the factor-based bundle models. The χ^2 test indicates that the final model is significantly better than the market share model at $\alpha << 0.001$.

Table 4.20: Model of Consideration of Residential/Employment Relocation Bundle (all respondents)

Variable	Estimated coefficient	p-value
Constant	0.331	0.041
Objective Mobility		
Weekly miles by train/BART/light rail (SD)	0.002	0.023
Commute distance	0.016	0.007
Subjective Mobility		
Travel for grocery shopping (SD)	0.393	0.000
Travel for eating a meal (SD)	-0.344	0.004
Relative Desired Mobility		
Commute (SD)	-0.836	0.000
Travel by walking/jogging/bicycling (SD)	0.223	0.021
Travel for entertainment (SD)	0.363	0.003
Travel by personal vehicle (LD)	-0.238	0.019
Travel Liking		
Travel by train/BART/light rail (SD)	0.172	0.035
Attitudes		
Commute benefit factor score	-0.244	0.021
Lifestyle		
Frustrated factor score	0.245	0.011
Excess Travel		
Excess travel indicator	0.067	0.001
Socio-demographics		
Years lived in the U.S.	-0.025	0.000
Vehicle type is SUV	-0.687	0.013
Strategy Adoption		
Work-schedule change bundle	0.331	0.041
Number of observations (considering, not considering)	1222 (279, 943)	
Log likelihood at 0 (LL(**0**))	-847.026	
Log likelihood of market share (MS) model (LL(**MS**))	-579.733	
Log likelihood at convergence (LL(**β**))	-520.243	
MS ρ^2 = 1 - (LL(MS)/LL(0))	0.316	
ρ^2 = 1 - (LL(**β**)/LL(0))	0.386	
Adjusted ρ^2 = 1 - [LL(**β**)- # of parameters]/LL(0)	0.367	
χ^2 = -2[LL(**MS**) - LL(**β**)]	118.981	

SD = Short Distance LD = Long Distance

Two Objective Mobility variables are positively related to the consideration of this bundle. Logically, those who do a lot of travel for commuting or by train are more likely to consider changing residential or employment location in order to reduce their current high-cost (in the generalized sense) travel. Two Subjective Mobility variables are also found in the model, probably acting largely as lifestyle markers. Individuals who think they do a lot of grocery shopping travel may well tend to be those with larger families. Such people may be more inclined to consider this bundle to reduce their commute travel, thereby freeing more time for

cooking family meals and other domestic activities. On the other hand, as found in other models, the individual with a higher subjective amount of travel for eating out is less likely to consider this strategy bundle because such travel may indicate an "on-the-go" lifestyle.

Interestingly, four Relative Desired Mobility variables are significant in the model, with both signs. As expected, those who want to increase commute travel or long-distance travel by personal vehicle (the latter potentially suggesting at least a higher tolerance for local commuting by personal vehicle, if not an active enjoyment of it) are less likely to consider this bundle. In contrast, desiring more short-distance entertainment travel is positively related to the consideration of this bundle. It implies that the individual with a high desire for such travel wants to decrease time currently spent on her commute, so that she can spend more time on entertainment or recreational activities. Likewise, the individuals who want to increase travel by walking/jogging/bicycling are more likely to consider this strategy bundle. This strategy bundle can allow them to increase time for such activities, either by reducing commute time or by making a bicycle or walk commute possible. It is reasonable that liking for travel by train/BART/light rail is positively associated with the consideration of this bundle. That is, those who like such travel may be more likely to consider moving their current residential or employment locations to other places near rail stations.

Obviously, the individual who has a higher commute benefit factor score is less likely to consider this commute-reducing strategy bundle. As discussed before, frustrated people are probably more likely to consider the residential/employment relocation bundle because they could be looking for new circumstances to diminish the dissatisfaction with their lives. The excess travel indicator probably represents a preference for discretionary travel, as opposed to commute travel. The positive relationship of the indicator to the consideration of this bundle is therefore logical, since individuals are able to spend more time on such travel by reducing their commute time.

Number of years lived in the U. S., as a proxy for age, is negatively associated with the consideration of this bundle. It is possible that older people have adapted to their current commute conditions, and have established strong ties with a neighborhood and/or an employer

over time. Hence they would be less motivated to reduce their commute travel, particularly by changing residence or job. An individual who drives an SUV tends to enjoy driving or outdoor activities, so (similar to the result for Relative Desired Mobility for long-distance personal vehicle travel) it is logical that she is less likely to consider this strategy bundle that can reduce commute time or driving.

Only one adoption variable is significant in the model, and it has a positive impact on considering this strategy bundle. As hypothesized, an individual tends to seek a higher-cost strategy bundle to alleviate travel stress after she has adopted a lower-cost bundle such as work-schedule change but dissatisfaction still persists or recurs.

4.3.7.2 The model with only non-adopters

Table 4.21 presents the model based on only non-adopters, for the consideration of the residential/employment relocation bundle. This model has a higher value of ρ^2 (0.448) (as well as a higher incremental improvement beyond the MS model) than that with all respondents, indicating that non-adopters alone are more predictable than the sample taken as a whole. Also, the χ^2 test indicates that the final model is significantly better than the market share model at $\alpha << 0.001$. Compared to the model based on all respondents, only six out of 16 variables are common between the two models. We discuss the remaining 10 variables below.

In contrast to the negative impact of the subjective amount of travel for eating out in the model for all respondents, here, those who want to increase such travel are *more* likely to consider this bundle. Presumably that is because it can reduce commute travel and thereby increase time for the desired travel to eat out, but the fact that the tendency is opposite to that of the previous model suggests that adopters and non-adopters may constitute two distinct segments, at least in this respect.

Attachment to the neighborhood is negatively related to the consideration of this bundle. It is natural that the individual who feels a greater attachment to her neighborhood is less inclined to move. Number of people ages 24-40 in the household, perhaps a stand-in for number of workers, is positively associated with the consideration of this bundle. It is legitimate that a household

with more workers would tend to seek a better home location to optimize the commute travel of all household members. Alternatively, one of the household members might consider changing to a job closer to home. Thus, such a household is more likely to consider this strategy bundle, with the survey respondent reporting on behalf of the household. Interestingly, a household having two or more adults with no children is less likely to consider this bundle. The working adults in such households may tend to be of two types. They may be older and hence nearing retirement, and not inclined to change job or move residence to reduce a commute that will not last much longer anyway. Alternatively, they may be younger with no children and hence less motivated to change a satisfactory job or home in order to reduce the commute. In addition, it is logical that residents living in North San Francisco are less likely to consider this bundle. They may consider their home location to be near-optimal because of its centrality in the region, and their relatively higher accessibility to transit (compared to those in the suburban neighborhoods) may allow them to make more productive use of their commute time and hence be less motivated to try to reduce it.

Three adoption variables and a time since adoption variable are significant in the model. Similar to the previous model, the previous adoption of lower-cost strategy bundles (such as getting a better car and changing from another means to driving alone) may positively affect considering a higher-cost strategy bundle (such as residential/employment relocation) if the prior adoption was not (or no longer is) effective. Interestingly, the previous adoption of hiring domestic help is negatively related to considering this strategy bundle. Individuals could obtain time benefits by adopting this time-buying strategy, and thus may have less motivation to consider reducing their commute travel by either changing homes or jobs. It is plausible that the longer ago the individual adopted changing work-trip departure time as a lower-cost strategy, the more likely she is to consider this bundle as a higher-cost strategy, because benefits she had from the previous adoption may have diminished over time.

Table 4.21: Model of Consideration of Residential/employment Relocation Bundle (only non-adopters)

Variable	Estimated coefficient	p-value
Constant	-2.046	0.039
Objective Mobility		
Weekly miles by train/BART/light rail (SD)	0.003	0.033
Relative Desired Mobility		
Commute (SD)	-1.090	0.000
Travel for eating a meal (SD)	0.707	0.002
Travel by walking/jogging/bicycling (SD)	0.288	0.019
Travel by personal vehicle (LD)	-0.440	0.001
Travel Liking		
Travel for entertainment (LD)	0.267	0.026
Attitudes		
Commute benefit factor score	-0.272	0.039
Excess Travel		
Excess travel indicator	0.082	0.002
Socio-demographics		
Attachment to the neighborhood	-0.375	0.016
Number of people ages 24-40 in HH	0.448	0.000
Household with two or more adults, no children	-0.530	0.012
North San Francisco	-0.563	0.015
Strategy Adoption		
Get a better car	0.687	0.003
Time since changing work trip departure time	0.091	0.023
Hire somebody to do house or yard work	-0.542	0.023
Change from another means to driving alone	0.700	0.020
Number of observations (considering, not considering)	824 (182, 642)	
Log likelihood at 0 (LL(**0**))	-571.153	
Log likelihood of market share (MS) model (LL(**MS**))	-369.659	
Log likelihood at convergence (LL(β))	-314.997	
MS ρ^2 = 1 - (LL(MS)/LL(0))	0.353	
ρ^2 = 1 - (LL(β)/LL(0))	0.448	
Adjusted ρ^2 = 1 - [LL(β)- # of parameters]/LL(0)	0.419	
χ^2 = -2[LL(**MS**) - LL(β)]	109.324	

SD = Short Distance LD = Long Distance

4.3.8 Alter employment status

The alter employment status bundle consists of two individual strategies: "Work part- instead of full-time" and "Retire or stop working". Like the previous bundle, this strategy bundle involves higher costs and longer time periods than other bundles. Generally, this bundle can be expected to reduce commute or work-related stresses, but to decrease household income. Thus, this strategy bundle may result in other stresses such as financial burdens, which may be much greater than the reduced commute stress (Salomon and Mokhtarian, 1997). Therefore, considering this bundle would not be a common response to a desire to reduce travel.

4.3.8.1 The model with all respondents

Table 4.22 presents the model based on all respondents, for the consideration of the alter employment status bundle. The ρ^2 value of the model is 0.262. The χ^2 test indicates that the final model is significantly better than the market share model at $\alpha << 0.001$.

Interestingly, there is no significant mobility variable, except a Mobility Constraint, in the model. This is consistent with the expectation that the actual or subjective amount of travel is not a strong motivation for considering this bundle. Logically, individuals liking long-distance work/school-related travel are less likely to consider this strategy bundle, which would reduce or eliminate the opportunities for such travel. Those who are family and community-oriented are more likely to consider this strategy bundle to save time on commuting or working, so that they can spend more time on their family or community activities.

The individual who has limitations on driving during the day is more likely to consider this strategy bundle in order to reduce or eliminate such travel stress. It is natural that older people are more likely to consider this bundle, either retiring altogether or working part-time as a transition into eventual full retirement. Thus, number of years in living in the U.S. (a proxy for age) and numbers of older people in the household both have positive impacts on considering this bundle. Conversely, the number of people ages 6-15 in the household is negatively related to the consideration of this bundle. Clearly, an adult having younger dependents is less likely to consider this bundle, which would probably curtail household income. As found in the conceptual model of considering major location/lifestyle change, clerical workers are more likely to consider this strategy bundle – perhaps due to the routine nature of such jobs, and family-related obligations (given that clerical workers are predominantly female, and that women are still the predominant dependent care givers).

Table 4.22: Model of Consideration of Altering Employment Status Bundle (all respondents)

Variable	Estimated coefficient	p-value
Constant	-2.846	0.000
Travel Liking		
Work/school-related travel (LD)	-0.169	0.020
Lifestyle		
Family & community-oriented factor score	0.494	0.000
Mobility Constraints		
Limitations on driving during the day	1.053	0.011
Socio-demographics		
Years lived in the U.S.	0.015	0.017
Number of people ages 6-15 in HH	-0.254	0.042
Number of people ages 41-64 in HH	0.237	0.013
Number of people ages 65-74 in HH	0.958	0.000
Clerical/administrative support occupation	0.437	0.035
Strategy Adoption		
Work part- instead of full-time	1.119	0.000
Time since retiring or stopping working	0.305	0.005
Number of observations (considering, not considering)	1261 (329,932)	
Log likelihood at 0 (LL(**0**))	-874.059	
Log likelihood of market share (MS) model (LL(**MS**))	-692.718	
Log likelihood at convergence (LL(**β**))	-645.101	
MS ρ^2 = 1 - (LL(MS)/LL(0))	0.207	
ρ^2 = 1 - (LL(**β**)/LL(0))	0.262	
Adjusted ρ^2 = 1 - [LL(**β**)- # of parameters]/LL(0)	0.249	
χ^2 = -2[LL(**MS**) - LL(**β**)]	95.234	

SD = Short Distance LD = Long Distance

A previous adoption variable and a time since adoption variable are positively related to the consideration of this bundle. Both variables are related to the individual strategies in this bundle. As hypothesized, individuals who have previously adopted this type of strategy, and the longer ago they have adopted it, the more likely they are to consider the same bundle. This indicates that reducing one's work hours or even quitting work altogether is a lifestyle choice that may be made repeatedly over the course of one's working life, at least for a segment of the population.

4.3.8.2 The model with only non-adopters

Table 4.23 presents the model based on only non-adopters, for the consideration of the alter employment status bundle. The χ^2 test indicates that the final model is significantly better than the market share model at $\alpha << 0.001$. Compared to the model based on all respondents, six out of 11 variables are common between the two models.

Logically, individuals liking long-distance travel for entertainment are more likely to consider this strategy bundle in order to free more time to engage in such travel. Not surprisingly, individuals who drive a sports car tend to be adventurous and variety-seeking. They may see work as providing variety, adventure, and an "audience" for their car, and hence be less likely to consider this strategy bundle. Additionally, in logical contrast to the model for residential/employment relocation shown in Table 4.21, a household having two or more adults with no children is more likely to consider this bundle. Since these households tend to be high income and have no younger dependents to be taken care of, they may be less affected by the financial impacts of adopting this bundle. They may also, of course, simply be "empty-nesters" nearing retirement.

Table 4.23: Model of Consideration of Altering Employment Status Bundle (only non-adopters)

Variable	Estimated coefficient	p-value
Constant	-4.503	0.000
Travel Liking		
Work/school-related travel (LD)	-0.240	0.009
Travel for entertainment (LD)	0.208	0.032
Lifestyle		
Family & community-oriented factor score	0.634	0.000
Strategy Adoption		
Time since changing work trip departure time	0.088	0.029
Change jobs closer to home	-0.520	0.013
Mobility Constraints		
Limitations on driving during the day	1.327	0.009
Socio-demographics		
Years lived in the U.S.	0.033	0.000
Number of people ages 65-74	0.883	0.008
Vehicle type is sports	-0.740	0.023
Clerical/administrative support occupation	0.725	0.003
Household with two or more adults, no children	0.415	0.015
Number of observations (considering, not considering)	988 (208, 780)	
Log likelihood at 0 (LL(**0**))	-684.829	
Log likelihood of market share (MS) model (LL(**MS**))	-494.431	
Log likelihood at convergence (LL(**β**))	-453.566	
MS ρ^2 = 1 - (LL(MS)/LL(0))	0.278	
ρ^2 = 1 - (LL(**β**)/LL(0))	0.338	
Adjusted ρ^2 = 1 - [LL(**β**)- # of parameters]/LL(0)	0.320	
χ^2 = -2[LL(**MS**) - LL(**β**)]	81.731	

SD = Short Distance LD = Long Distance

A previous adoption variable and a time since adoption variable are in the model. Interestingly, the previous adoption of changing jobs closer to home is negatively related to the consideration of this bundle. That is, the individual who adopted a higher-cost, longer-term strategy to reduce commute stress tends not to consider another strategy at a similar magnitude of time and cost. Similar to the model of considering residential/employment relocation, the longer ago the individual adopted changing work-trip departure time (a lower-cost strategy), the more likely she is to consider this bundle (a higher-cost strategy), since the benefits from the previous adoption decrease over time.

5. SUMMARY AND CONCLUSIONS

5.1 Summary

The previous study (Clay and Mokhtarian, forthcoming) grouped 17 travel-related strategies into two sets of strategy bundles (conceptual and factor-based bundles) based on both conceptual and empirical similarities. The first set consists of three bundles (travel maintaining/increasing, travel reducing, and major location/lifestyle change), and the second set consists of eight bundles (auto improvement, mobile phone, work-schedule change, hire someone to do house or yard work, mode change, home-based work, residential/employment relocation, and alter employment status). Focusing on these strategy bundles, as one of a series of studies, this study explored the relationships between adoption and consideration of the bundles, linking them to Mobility-related, Travel Attitude, Personality, Lifestyle, Travel Liking, Socio-demographic, and other variables. The data for this study was collected from a fourteen-page survey returned by about 1,900 adult residents of three distinct San Francisco Bay area neighborhoods in May 1998. The current study is based on a subset of nearly 1,300 commuting workers.

We first identified patterns of adoption and consideration among bundles, using pairwise correlation tests. Specifically, we examined whether previous adoption is significantly related to current consideration, and whether those relationships are different between groups who are satisfied and unsatisfied with their current travel conditions. The test results show that previous adoption of a given bundle is strongly (generally positively) associated with current consideration of the same bundle, regardless of satisfaction with current travel conditions. Where previous adoption is significantly correlated with consideration of other bundles, the association is always positive. Both higher-cost and lower-cost bundles are considered, with no clear dominance between the two groups. Taken together, these results indicate that those who have adopted coping strategies continue to seek for improvements across the spectrum of generalized cost, but perhaps most often repeating the consideration of a previously-adopted bundle.

Furthermore, we developed discrete choice models (binary logit models) for individuals' consideration of each bundle in the two sets. The ρ^2 values of the conceptual bundle models ranged from 0.106 to 0.210, and those of the factor-based bundle models ranged from 0.103 to 0.434. All models are significantly better than the corresponding market share model at $\alpha <<$

0.001. Additionally, models of consideration of each bundle based on non-adopters were developed for all except two bundles (due to small sample sizes and unbalanced shares), the travel maintaining/increasing and mobile phone strategies. The models based on non-adopters have higher ρ^2 values, ranging from 0.151 (0.291) to 0.311 (0.625) for the conceptual (factor-based) bundles. That is, the models on non-adopters can explain more information in the data by eliminating the potentially heterogeneous adopters (for whom the previously-adopted strategy may or may not still be in force) and the potentially opposite effects of some variables between adopters and non-adopters. As expected, some variables in the models for non-adopters are common to the ones for the full data set, and other variables are similar. Not surprisingly, compared to the conceptual bundle models, the factor-based bundle models have more diverse explanatory variables and better goodness of fit because the factor-based bundles are more finely subdivided than the conceptual ones.

Table 5.1 presents a comparison of initial hypotheses and model results from both sets of bundles. Key explanatory variables in the models are generally consistent with our initial hypotheses, although a few of them failed to support some hypotheses. Interestingly, several Attitudes/Personality/Lifestyle variables did not turn out to be significant in the models, whereas the loner factor variable has a significant effect that was not originally hypothesized. Additionally, some variables have counter or mixed effects but they are logical. We briefly summarize the key findings:

Most Objective Mobility variables are positively associated with consideration of travel-related strategy bundles. This is consistent with our hypothesis that the higher the amount of travel the individual does, the more likely she is to consider travel-related strategy bundles, as opposed to doing nothing. Similar to Objective Mobility, most Subjective Mobility variables are positively related to the consideration of the bundles. That is, the more travel the individual perceives doing, the more likely she is to consider travel-related strategy bundles.

Table 5.1: Comparison of Initial Hypotheses and Selected Results

Explanatory Variable Category	Dependent Variable – Consideration of Strategy Bundle		
	Travel maintaining/increasing (auto improvement, mobile phone, hiring domestic help, work-schedule change)	**Travel reducing** (work-schedule change, mode change, home-based work)	**Major location/ lifestyle change** (home-based work, residential/employment relocation, alter employment status)
Objective Mobility	+	+	+
Subjective Mobility	+	+	+
Relative Desired Mobility	+ → –	+ (– for commute)	+ (– for commute)
Travel Liking	+	+ (– for commute)	+ (– for commute)
Attitudes			
Commute benefit	+	–	–
Travel freedom	+		
Travel dislike		+	+
Travel stress		+	+
Pro-environmental solutions		+	+
Pro-high density		+/–	+/–
Personality			
Adventure seeker	+	+	+
Organizer			
Loner		–	
Calm	–	–	–
Lifestyle			
Frustrated	+	+	+
Family/community oriented		+	+
Workaholic	+	+	–
Status seeker	+		
Excess Travel		+	+
Mobility Constraints	+	+	+
Socio-demographics			
Female	+	+	+
Age	–	–	+
Income	+	+ → –	+
Manager/administrator	+	+	
Clerical occupation			+
Vehicle type (SUV)		–	–
HH (1 adult & no children)	–		
HH (>1 adults & no children)		–	
Strategy Adoption			
Adoption	+/–	+/– → +	+/– → +
Time since adoption	+/–	+/– → –	+/ – → +

Key for cells containing a "+" and/or "-":

Significant effect that was hypothesized.

Hypothesized effect that did *not* turn out significant.

Significant effect that was not originally hypothesized.

Significant (and logical) effect different than originally hypothesized (e.g. "+" → "-" means a positive effect was originally hypothesized but a negative effect was identified).

As hypothesized, Relative Desired Mobility variables have logically either positive or negative effects on consideration of travel-related strategy bundles. For example, those who want to increase commute or work travel are less likely to consider travel reducing and major location/lifestyle change bundles (such as mode change and residential/employment relocation), whereas people with a higher desire for discretionary travel are more likely to consider them. It is plausible that the Relative Desired Mobility variables for modes other than driving (e.g. bus) have negative effects on consideration of the travel maintaining/increasing bundle.

As an indicator of a positive utility of travel, Travel Liking for long-distance personal vehicle travel is positively related to consideration of the travel maintaining/increasing strategy bundle, and that for work travel is negatively associated with travel reducing and major location/lifestyle change bundles. These results support the idea that a positive utility of travel will motivate people to keep or increase their current travel.

Among the six Travel Attitude variables, only two are significant, collectively appearing in one of the conceptual strategy bundle models and four of the factor-based bundle models. Logically, pro-environmentalists are more likely to consider the travel reducing and major location/lifestyle change bundles (including work-schedule change, mode change, and home-based work). On the other hand, the individual with a higher commute benefit factor score is less likely to consider travel reducing and major location/lifestyle change bundles (such as work-schedule change and residential/employment relocation).

Three of the four Personality factor variables are significant, collectively influencing the consideration of one of the conceptual strategy bundles and three of the factor-based bundles. Adventure seekers are more likely to consider commute travel reducing and major location/lifestyle change bundles (such as work-schedule change and home-based work) in order to free more time, money, and energy for adventure travel. Interestingly, loners and calm people are less likely to consider travel reducing (such as mode change) and major location/lifestyle change bundles, presumably for different but logical reasons. However, the organizer variable did not turn out to be significant in any model.

Three of the four Lifestyle factor variables are positively associated with medium-to-high-cost strategy bundles (one of the conceptual strategy bundles and four of the factor-based bundles). Frustrated people are more likely to consider the travel reducing and major location/lifestyle change bundles (such as residential/employment relocation and home-based work). Clearly, family/community-oriented people have a greater tendency to consider the travel reducing and major location/lifestyle change bundles. Similar to the organizer Personality, the workaholic Lifestyle factor was not significant in any of the models. As expected, social status seekers are more likely to consider the travel maintaining/increasing bundle (such as hiring domestic help). As hypothesized, as a marker of preference for discretionary travel, the excess travel indicator is positively associated with the consideration of the travel reducing and major location/lifestyle change bundles (such as residential/employment relocation and home-based work).

Mobility Constraint variables are positively associated with all three of the conceptual strategy bundles, and five of the factor-based bundles. The individual who has limitations on driving, riding a bicycle, or vehicle availability is more likely to consider either the travel reducing and major location/lifestyle change bundles, or the travel maintaining one if travel is necessary.

Socio-demographic variables with respect to gender, age, household, income, and occupation are significantly related to travel-related strategy bundles. Especially, age or number of years lived in the U.S. (a proxy for age) is negatively related to consideration of both the travel maintaining and travel reducing strategies (including two of the conceptual strategy bundles and seven of the factor-based bundles). This suggests that younger people are more likely than older ones to consider the lower-cost strategies against congestion, either maintaining more comfortably (if necessary) or reducing (if possible) their travel. On the other hand, people in a high-income household are more likely to consider strategies in the travel maintaining/increasing bundle (such as auto improvement and hiring domestic help) but less likely to consider the travel reducing strategy bundle. In addition, managers or administrators are positively inclined to consider the travel maintaining/increasing and travel reducing (such as home-based work) bundles, while clerical workers are more likely to consider the major location/lifestyle change bundle (such as alter employment status). Interestingly, the vehicle type variable is significantly related to consideration of the travel reducing and major location/lifestyle change bundles. Specifically,

those who drive SUVs most often are less likely to consider the travel reducing strategy bundle (including mode change and residential/employment relocation), suggesting an enjoyment of driving. Focusing on household members, people living with younger children (under six) or older people (ages 65-74) are, not surprisingly, more likely to consider the major location/lifestyle change strategy bundle (including alter employment status).

As hypothesized, the previous adoption of any individual strategies in a bundle positively affects consideration of the same bundle. This indicates that the individual who previously adopted a given strategy is more likely than others to seek either the same or another strategy in the same bundle. Similar to the previous study (Raney, *et al.*, 2000), the previous adoption of lower-cost individual strategies positively affects the consideration of the higher-cost strategy bundles, and the previous adoption of higher-cost individual strategies positively affects consideration of lower-cost strategy bundles.

In addition, time since adoption variables are significantly associated with consideration of travel-related strategy bundles, with logical signs. For example, the longer ago the individual adopted getting a better car and changing from another means to driving alone, the more likely she is to consider the auto improvement bundle. On the other hand, the more recently the individual adopted changing work trip departure time or hiring domestic help, the more likely she is to consider the corresponding strategy bundles (such as travel maintaining/increasing bundles), presumably to continue or resume enjoying their benefits. Interestingly, the auto improvement bundle is more affected by the time-dependent adoption of individual strategies than the other bundles due to the inevitable decay in the utility of a particular auto with time and frequent use.

5.2 Conclusions

In modeling individuals' consideration of travel-related strategy bundles, we found significant, diverse variables (such as qualitative and quantitative Mobility-related variables, Travel Attitudes, Personality, Lifestyle, and Travel Liking), most of which have been little considered in establishing transportation policy strategies to reduce traffic congestion. First, individuals' subjective assessment of the amount of their travel and desire for more or less travel, play key

roles in considering which type of strategy can satisfy their travel needs. Second, Travel Liking, representing a positive utility of travel, turns out to be resistant to strategies that could reduce congestion. In other words, this factor can motivate individuals to maintain or increase their current travel. Lastly, individuals' Travel Attitudes, Personality, and Lifestyle also affect their consideration of travel-related strategies either positively or negatively.

In addition, a couple of relationships between previous adoption and consideration of travel-related strategy bundles can be identified in the models. The previous adoption of any individual strategies in a bundle strongly positively affects the consideration of the same bundle, showing an *inertial* or *habitual* response toward travel-related strategies. It suggests that a new transportation policy at a different level may be less likely to be considered by individuals who have never adopted it or a similar one. On the other hand, the previous adoption of any individual strategies in a bundle can significantly increase the consideration of either lower- or higher-cost strategy bundles, showing an *unstable* or *cycling* response toward travel-related strategies. It is natural that individuals keep seeking a better strategy at a different time or cost level to improve their current travel conditions, although this relationship is less often found in our models than the former (reconsideration of the same bundle). Further, time since adoption variables can partially explain the dynamic nature of individuals' responses to travel-related strategy bundles. That is, depending on the type of travel-related strategy in a bundle, an individual who adopted it longer ago is more (or less) likely to consider the same bundle or another bundle. As a general comment, it should be kept in mind that Clay and Mokhtarian (forthcoming) found that the respondents adopted or are considering individual strategies for a variety of reasons other than travel, although we interpreted the relationships between adoption and consideration from the transportation point of view.

Overall, the results of this study give policy makers and planners insight into understanding the dynamic nature of individuals' responses to travel-related strategies as well as differences between the responses to congestion that are assumed by policy makers and those that are actually adopted by individuals. Our study, however, focused on individuals' responses to the travel-related strategy bundles (i.e., disaggregate behaviors, not aggregate). It would be very useful to develop aggregate approaches to explaining the Travel Attitudes, Personality, Lifestyle,

and qualitative Mobility variables that are significant in this study, to support the development and evaluation of more effective transportation policies for reducing traffic congestion and/or improving mobility.

ACKNOWLEDGEMENTS

This research is funded by the University of California Transportation Center. The report has benefited from discussions with Xinyu Cao, Gustavo O. Collantes, Michael J. Clay, Tim Schwanen, and Arno Hendricks. Some of Sections 2 and Section 4 of this report are borrowed from Clay and Mokhtarian (2002) and Cao and Mokhtarian (2003).

REFERENCES

Arnott, Richard and Kenneth Small (1994) The economics of traffic congestion. *American Scientist* 82 (September – October), 446-455.

Cao, Xinyu and Patricia L. Mokhtarian (2003) *Modeling the Consideration of Travel-Related Strategies.* Research Report UCD-ITS-RR-03-03, Institute of Transportation Studies, University of California, Davis, May. Available at www.its.ucdavis.edu/publications/2003/RR-03-03.pdf.

Choo, Sangho, Gustavo Collantes, and Patricia L. Mokhtarian (forthcoming) Wanting to travel, more or less: Exploring the determinants of the deficit and surfeit of personal travel. *Transportation*.

Clay, Michael J. and Patricia L. Mokhtarian (2002) *The Adoption and Consideration of Commute-oriented Travel Alternatives.* Research Report UCD-ITS-RR-02-04, Institute of Transportation Studies, University of California, Davis, September. Available at www.its.ucdavis.edu/publications/2002/RR-02-04.pdf.

Clay, Michael J. and Patricia L. Mokhtarian (forthcoming) Personal travel management: The adoption and consideration of travel-related strategies. *Transportation Planning and Technology*.

Curry, Richard (2000) *Attitudes toward Travel: The Relationships among Perceived Mobility, Travel Liking ,and Relative Desired Mobility*. Master's Thesis, Department of Civil and Environmental Engineering, University of California, Davis, June. Research Report UCD-ITS-RR-00-06, Institute of Transportation Studies, University of California, Davis. Available at www.its.ucdavis.edu/publications/2000/RR-00-06.pdf.

Curtis, Carey and Peter Headicar (1997) Targeting travel awareness campaigns: Which individuals are more likely to switch from car to other transport for the journey to work? *Transport Policy* 4(1), 51-65.

Downs, Anthony (1992) *Stuck in Traffic: Coping with Peak-hour Traffic Congestion*. The Brookings Institution, Washington, D.C.

The Economist (1998) To travel hopefully: A survey of commuting. September 5, 2-18.

Giuliano, Genevieve (1992) Transportation demand management: Promise or panacea. *Journal of the American Planning Association* 58(3), 327-335.

Giuliano, Genevieve and Kenneth A. Small (1995) Alternative strategies for coping with traffic congestion. In Herbert Giersch, ed., *Urban Agglomeration and Economic Growth*. Berlin: Springer-Verlag, 199-226.

Hanks, Jr., James W. and Timothy J. Lomax (1991) Roadway congestion in major urban areas: 1982 to 1988. *Transportation Research Record* 1305, 177-189.

Hauser, John R. (1978) Testing the accuracy, usefulness, and significance of probabilistic choice models: An information-theoretic approach. *Operations Research* 26(3), 406-421.

Hu, Patricia S. and Jennifer R. Young (1999) *Summary of Travel Trends: 1995 Nationwide Personal Transportation Survey*. Publication No. FHWA-PL-00-006, US Department of Transportation, Federal Highway Administration, Washington, D.C.

Mannering, Jill S. and Patricia L. Mokhtarian (1995) Modeling the choice of telecommuting frequency in California: A exploratory analysis. *Technological Forecasting and Social Change* 49(1), 49-73.

Mokhtarian, Patricia L., Michael N. Bagley, and Ilan Salomon (1998) The impact of gender, occupation and presence of children on telecommuting motivations and constraints. *Journal of the American Society for Information Science* 49(12), 1115-1134.

Mokhtarian, Patricia L., Elizabeth A. Raney, and Ilan Salomon (1997) Behavioral response to congestion: Identifying patterns and socio-economic differences in adoption. *Transport Policy* 4(3), 147-160.

Mokhtarian, Patricia L. (2002) Telecommunications and travel: The case for complementarity. *Journal of Industrial Ecology* 6(2), 43-57.

Mokhtarian, Patricia L., Ilan Salomon, and Lothlorien S. Redmond (2001) Understanding the demand for travel: It's not purely "derived". *Innovation: The European Journal of Social Science Research* 14(4), 355-380.

Niles, John S. (1994) *Beyond Telecommuting: A New Paradigm for the Effect of Telecommunications on Travel*. Prepared for the US Department of Energy, Offices of Energy Research and Scientific Computing, Washington, D.C. 20585, Report No. DOE/ER-0626, September. Available at http://www.lbl.gov/ICSD/Niles.

Noland, Robert B. (2001) Relationships between highway capacity and induced vehicle travel. *Transportation Research A* 35(1), 47-72.

Pazy, Asya, Ilan Salomon, and Tovi Pintzov (1996) The impacts of women's careers on their commuting behavior: A case study of Israeli computer professionals. *Transportation Research A* 30(4), 269-286.

Raney, Elizabeth A., Patricia L. Mokhtarian, and Ilan Salomon (2000) Modeling individuals' consideration of strategies to cope with congestion. *Transportation Research F* 3(3), 141-165.

Redmond, Lothlorien S. (2000) *Identifying and Analyzing Travel-related Attitudinal, Personality, and Lifestyle Clusters in the San Francisco Bay Area*. Master's Thesis, Transportation Technology and Policy Graduate Group, Institute of Transportation Studies, University of California, Davis, September. Research Report UCD-ITS-RR-00-08. Available at www.its.ucdavis.edu/publications/2000/RR-00-08.pdf.

Salomon, Ilan and Patricia L. Mokhtarian (1997) Coping with congestion: Understanding the gap between policy assumptions and behavior. *Transportation Research D* 2(2), 107-123.

Tingey, Holly, Gary Kiger, and Pamela J. Riley (1996) Juggling multiple roles: Perceptions of working mothers. *The Social Science Journal* 33(2), 183-191.

Turner, Tracy and Debbie Niemeier (1997) Travel to work and household responsibility: New evidence. *Transportation* 24, 397-419.

U.S. News & World Report (2001) American gridlock. May 28, 16-22.

United States Department of Transportation (1993) *Transportation Implications of Telecommuting.* US DOT, Washington, D.C., April.

Varma, Krishna V., Chaang-Iuan Ho, David M. Stanek, and Patricia L. Mokhtarian (1998) Duration and frequency of telecenter use: Once a telecommuter, always a telecommuter? *Transportation Research C* 6(1/2), 47-68.