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## **PERSONAL TRAVEL MANAGEMENT: THE ADOPTION AND CONSIDERATION OF TRAVEL-RELATED STRATEGIES**

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Traveler behavior plays a role in the effectiveness of travel demand management (TDM) policies. Personal travel management is explored in this paper by analyzing individuals' adoption and consideration of 17 travel-related alternatives in relation to socio-demographic, mobility, travel-related attitude, personality and lifestyle preference variables. The sample comprises 1282 commuters living in urban and suburban neighborhoods of the San Francisco Bay Area. Among the findings: females were more likely to have adopted/considered the more 'costly' strategies; those with higher mobility were more likely to have adopted/considered travel-maintaining as well as travel-reducing strategies; and those who like travel and want to do more are less likely to consider travel-reducing strategies. These findings, when combined with those of earlier work on this subject, present a compelling argument for the need to further understand traveler behavior -- particularly in response to congestion and TDM policies.

*Keywords:* Traveler behavior, Travel demand management (TDM), Travel alternatives adoption, TDM policy

### **1. INTRODUCTION**

Metropolitan congestion continues to claim a large share of attention as a pressing social problem, on the part of the general public [1–3] as well as academic researchers [4, 5]. Travel demand management

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(TDM) policies intended to alleviate congestion are debated and tested. These policies are often directed at reducing peak-period vehicle travel through increasing its cost (congestion or value pricing, fuel and emission taxes), increasing the attractiveness of modes other than the private automobile (improving transit service, providing a bicycle- and pedestrian-friendly environment), locating activities closer together (through denser and more mixed-use land development) or promoting telecommunications alternatives to travel (such as telecommuting or teleshopping).

Historically, however, many such policies have failed to have the expected or desired effect. Vehicle-kilometers traveled continue to rise. The falling costs, wider availability, increased sophistication, and rising adoption of telecommunications 'substitutes' have not been accompanied by a decrease in travel [6, 7]. It is too soon to judge the actual effect of pricing policies, but there will continue to be political challenges to the implementation of such policies in a form strong enough to have a noticeable effect on system-wide congestion [8–11].

Many reasons have been advanced for the continued rise in vehicle travel, including shifts to smaller households, increasing participation of women in the work force, continued driving by the elderly, greater vehicle availability, increases in trip lengths (due in part to increased suburbanization of the population), and the strong economy [12]. These are indeed major structural or external factors that are quite powerful. We believe, however, that insufficient attention has been paid to internal factors, that is to travel-related attitudes and predispositions. It is these internal motivations (together with external constraints and facilitators) that greatly influence how a person will react to the external factors described above. These attitudes and predispositions will help determine whether a person or household acquires a car (or a second car); whether a mixed-use neighborhood is the chosen residential location; or whether the reaction to a long commute is to telecommute, change job or home location, or make the most of the time in other ways.

Recent studies have illustrated the importance of individuals' attitudes in the acceptance of TDM measures [9] and the need for further research into the decision making processes of travelers [13]. Kitamura *et al.* [14] indicate the need for a better understanding, and identification, of 'pro-self' and 'pro-social' predispositions, which are critical to the acceptance of TDM policies. Earlier studies have demonstrated that the acceptance of TDM 'has only a small impact on

traffic, but has had a significant impact on workers and their families' [15, p. 327].

The key purpose of this paper is to empirically examine the role of socio-demographics, mobility, travel-related attitudes, and predispositions in the adoption and consideration of various possible responses to congestion. Specifically, we approach the issue of travel management by analyzing individuals' adoption and consideration of 17 travel-related strategies (ranging from travel-maintaining decisions like getting a better or more fuel-efficient vehicle, to travel-reducing decisions like adopting flextime or a compressed workweek, to major lifestyle changes such as moving home closer to work or conversely).

In particular we hypothesize that people with a strong positive attitude toward travel, and who want to travel more than they are currently doing, are less likely to adopt or consider alternatives that will reduce or restrict their travel and thus will be resistant to travel demand management policies (and conversely for those with a strong negative attitude toward travel, and who want to travel less). We further hypothesize, based on previous related research, that women will be disproportionately overrepresented in the adoption and consideration of the travel-reducing and major lifestyle changing decisions. (For a full list of initial hypotheses and results see Table X.)

This paper is based on a more detailed report [16] and is part of the sequel to a previous study [17–19] of a similar set of alternatives placed in a questionnaire focused on telecommuting attitudes, preferences and choices. The previous study offered several suggestions for refining the survey design that have been adopted in the current study.

The organization of this paper is as follows. The next section describes the data available for this analysis followed by an explanation of the key concepts used in this study. Section 3 presents some descriptive statistics for the travel-related alternatives, including their frequencies, median years since adoption, and reasons for adoption and consideration. Section 4 details the methods used to create the bundles of travel-related alternatives, and the results from the chi-square and *t*-tests relating the two sets of travel-alternative bundles to the socio-demographic, mobility, travel-related attitude, and personality and lifestyle preference variables. Section 6 explores the implications of these results for TDM policy, as well as presenting some conclusions and suggestions for future work.

## 2. EMPIRICAL CONTEXT

### 2.1. Data

The data analyzed in this study come from a 14-page self-administered survey mailed in May 1998 to 8000 randomly selected households in three neighborhoods of the San Francisco Bay Area. Half of the total surveys were sent to an urban neighborhood of North San Francisco and the other half were divided evenly between the suburban cities of Concord and Pleasant Hill. These areas were chosen to represent the diverse lifestyles, land use patterns, and mobility options in the Bay Area. Approximately 2000 surveys were completed by an adult member of the household and returned, for a 25% response rate. The subset of 1282 used in this analysis consists of commuting workers with relatively complete responses to key questions. For a complete explanation of the data treatment see Clay and Mokhtarian [16].

Table I presents some key socio-demographic characteristics of the study data. The sample is relatively balanced in terms of representation by neighborhood and gender. Higher incomes are overrepresented compared to Census data, as is typical for self-administered surveys.

### 2.2. Measurement of Key Concepts

As background to the concepts described below, it should be noted that in the cover letter to the survey, travel was defined as 'moving any distance by any means of transportation, from walking around the block to flying around the world'. In questions relating to the amount of travel conducted or desired by respondents, they were asked (borrowing wording from the *American Travel Survey* [20]) to exclude 'travel you do as an operator or crew member on a train, airplane, truck, bus, or ship'.

Most of the variables measured by the questionnaire can be grouped into 11 categories, of which the following nine are applicable to this study: objective mobility, subjective mobility, relative desired mobility, travel liking, attitudes, personality, lifestyle, travel-related alternatives, and socio-demographics. Each of the nine categories is briefly described below.

TABLE I. Socio-demographic characteristics of sample used in this analysis

		<i>Number</i>	<i>Percentage</i>	
Concord (suburban)		294	22.93%	( <i>n</i> = 1282)
Pleasant Hill (suburban)		346	26.99%	
North San Francisco (urban)		642	50.08%	
Female		650	50.86%	( <i>n</i> = 1278)
Have a driver's license		1263	98.59%	( <i>n</i> = 1281)
Work full-time		1079	84.17%	( <i>n</i> = 1282)
Personal income (US\$)	< 15 000	91	7.26%	( <i>n</i> = 1254)
	15 000–34 999	266	21.21%	
	35 000–54 999	385	30.70%	
	55 000–74 999	229	18.26%	
	75 000–94 999	126	10.05%	
	> 95 000	157	12.52%	
Age	18–23	42	3.28%	( <i>n</i> = 1282)
	24–40	563	43.92%	
	41–64	639	49.84%	
	> 65	38	2.96%	
		Mean	Std. Dev.	
Total people in household		2.40	1.24	( <i>n</i> = 1282)
Total children under 18 in HH		0.46	0.85	( <i>n</i> = 1276)
Total workers in HH (full/part-time)		1.77	0.82	( <i>n</i> = 1279)
Number of personal vehicles in HH		1.87	1.09	( <i>n</i> = 1279)
Average one-way commute distance (km)		23.04	27.13	( <i>n</i> = 1281)

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- and long-distance travel. Consistent with the *American Travel Survey* [20], long-distance trips were defined as those longer than 160.8 km (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, entertainment/social/recreational, grocery shopping, eating a meal, and taking other people where they need to go (note that several purposes were not included, such as personal business, due to survey length constraints). Long-distance measures were obtained for the personal vehicle and airplane modes, and for the work/school-related and entertainment/social/recreational purposes.

### **2.2.1. 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 (besides constituting a major demand on the respondent), 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.

### **2.2.2. 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 160 km 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'.

### **2.2.3. Relative Desired Mobility**

An individual may consider that s/he 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 s/he 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'.

#### **2.2.4. 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 s/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.

#### **2.2.5. 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 fundamental dimensions spanned by these 32 variables. Six relatively uncorrelated underlying dimensions were identified, using principal axis factoring with oblique rotation (see [21] or [22] for details), of which (for brevity) the four offering the most interesting/useful results will be presented in this paper: pro-environmental solutions, commute benefit, travel freedom and pro-high density.

#### **2.2.6. 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, of which (for brevity) two will be presented in this analysis: the adventure-seeker and organizer personalities.

### **2.2.7. 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, of which (for brevity) three will be presented in this analysis: status seeker, workaholic and family/community-oriented.

### **2.2.8. Travel-related Alternatives**

One section of the survey asked respondents if they had made, and were considering, certain choices that would change their travel. For options that were adopted or considered, respondents were further asked to indicate the reason(s): personal, family related, work related, reducing or easing travel and other (multiple responses allowed). For adopted options respondents were asked to indicate how long ago (in years) they were adopted. Analyzing the variables associated with the adoption and consideration of these strategies is the purpose of the present study.

### **2.2.9. 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, gender, years in the USA, education and employment information, and household information such as number of people in the household, their age groups, and personal and household income.

## **3. FREQUENCY ANALYSIS FOR RAW DATA**

Tables II and III present the raw frequency data from the survey ( $N = 1282$ ) for the adoption (Table II) and consideration (Table III) of the 17 travel-related alternatives, as well as the median years since adopted and the respondent's self-reported reasons for adopting/con-

TABLE II. Frequencies for adoption of travel-related alternatives (n = 1282)<sup>a</sup>

	Number who adopted	Median years since adopted	Personal	Family related	Work related	Reducing or easing travel	Other
a. Buy a car stereo (TM)	620	4	473	96	29	283	19
b. Get a mobile phone (TM)	527	2	<u>318</u>	177	287	128	30
c. Get a better car (TM)	850	3	<u>568</u>	260	235	278	74
d. Get a fuel efficient car (TM)	514	3	<u>337</u>	106	144	112	67
e. Change work trip departure time (TM)	490	1	<u>138</u>	78	<u>271</u>	197	17
f. Hire someone to do house or yard work (TM)	392	2	<u>284</u>	130	55	13	33
g. Adopt flextime (TM)	275	3	136	89	148	82	11
h. Adopt compressed work week (TR)	132	4	70	39	<u>74</u>	29	8
i. Change from driving alone to work, to some other means (TR)	235	2	77	19	104	<u>117</u>	29
j. Change from some other means of getting to work, to driving alone (TM)	160	2	58	5	<u>88</u>	44	16
k. Buy equipment/services to help you work from home (TR)	385	2	212	82	<u>284</u>	99	16
l. Telecommute (part- or full-time) (TR)	204	2	96	43	<u>145</u>	76	8
m. Change job closer to home (LC)	337	2	168	65	190	99	28
n. Move your home closer to work (LC)	177	2	<u>109</u>	46	<u>48</u>	62	15
o. Work part-time instead of full-time (LC)	220	2	<u>146</u>	72	63	23	25
p. Start home-based business or put more effort into an existing one (LC)	145	3	<u>96</u>	28	83	27	15
q. Retire or stop working (LC)	36	5	<u>24</u>	6	9	1	4

Notes: <sup>a</sup>TM: Travel-maintaining/increasing alternatives; TR: travel-reducing alternatives; LC: lifestyle change alternatives.

<sup>b</sup>The most commonly cited reason for adopting each strategy is underlined.

TABLE III. Frequencies for considering adoption of travel-related alternatives (N = 1282)<sup>a</sup>

	<i>Number considering adopting</i>	<i>Personal</i>	<i>Reasons for considering adopting<sup>b</sup> Family related</i>	<i>Work related</i>	<i>Reducing or easing travel</i>	<i>Other</i>
a. Buy a car stereo (TM)	188	137	21	10	76	17
b. Get a mobile phone (TM)	380	<u>273</u>	134	132	71	36
c. Get a better car (TM)	479	<u>348</u>	116	89	130	46
d. Get a fuel efficient car (TM)	365	<u>251</u>	70	80	81	51
e. Change work trip departure time (TM)	226	<u>86</u>	50	<u>113</u>	83	12
f. Hire someone to do house or yard work (TM)	297	<u>226</u>	84	37	13	28
g. Adopt flextime (TM)	193	<u>120</u>	58	78	57	6
h. Adopt compressed work week (TM)	152	<u>88</u>	46	58	41	11
i. Change from driving alone to work, to some other means (TR)	145	<u>74</u>	14	44	<u>74</u>	15
j. Change from some other means of getting to work, to driving alone (TM)	60	<u>30</u>	7	22	12	4
k. Buy equipment/services to help you work from home (TR)	305	176	62	<u>201</u>	76	17
l. Telecommute (part- or full-time) (TR)	264	136	66	<u>145</u>	93	14
m. Change job closer to home (LC)	243	161	75	92	99	19
n. Move your home closer to work (LC)	119	<u>73</u>	45	34	55	4
o. Work part-time instead of full-time (LC)	226	<u>157</u>	82	46	30	15
p. Start home-based business or put more effort into an existing one (LC)	231	<u>168</u>	73	108	54	28
q. Retire or stop working (LC)	179	<u>146</u>	51	33	19	22

Notes: <sup>a</sup>TM: Travel-maintaining/increasing alternatives; TR: travel-reducing alternatives; LC: lifestyle change alternatives.

<sup>b</sup>The most commonly cited reason for considering each strategy is underlined.

sidering. Although each of these strategies has transportation implications, they may be adopted or considered for a variety of reasons, sometimes having nothing to do with travel. Our findings appear to confirm this, with personal and work related motivations dominating. However, it should be noted that while we deliberately avoided a response bias in favor of the travel reason by placing it fourth (just before 'other') in the set of five reasons, there is in fact a response bias in the opposite direction. 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. For example, a respondent could have selected 'family related' recalling that the alternative was adopted to allow more time with family, but not immediately recognizing that the additional time with family was obtained by reducing the amount of time spent driving. Thus, the role of transportation in these choices is most likely understated.

#### 4. ANALYSIS OF BUNDLES OF RELATED STRATEGIES

##### 4.1. Identification of Bundles

To simplify the analysis of how these travel-related alternatives interact with travel attitudes, socio-demographics and the other variables in our analysis, it is useful to group them into bundles based on both conceptual and empirical similarities. We can then analyze the adoption and consideration of bundles, where a bundle is 'adopted' if any alternative in it has been adopted, and similarly for consideration. We expect the focus on bundles to smooth out some of the variation across the individual travel-related alternatives, and thus perhaps to yield stronger and more interpretable results. (Results for the individual alternatives, however, are presented and analyzed in Clay and Mokhtarian [16].)

Similar to Mokhtarian *et al.* [18], two methods were used to develop bundles of travel-related alternatives, with the results shown in Table IV. First, variables were grouped conceptually into three bundles based on the generalized cost and the adoption timeframe associated with each travel alternative. (Generalized cost refers to lifestyle impacts on the individual and household as well as monetary costs.) Group one includes low cost, short-term, travel-maintaining/increasing strategies

Table IV. Conceptual and factor-based bundles of the travel-related alternatives

<i>Conceptual bundles</i>	
Group 1. Travel maintaining/increasing	a. Buy a car stereo system b. Get a mobile phone c. Get a better car d. Get a more fuel efficient car e. Change work trip departure time f. Hire someone to do house or yard work g. Adopt flextime j. Change from another means of getting to work to driving alone
Group 2. Travel reducing	h. Adopt compressed work week (such as a '9/80' schedule) i. Change from driving alone to work to some other means k. Buy equipment/services to help you work from home l. Telecommute (part- or full-time)
Group 3. Major location/lifestyle change	m. Change jobs closer to home n. Move your home closer to 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
<i>Factor-based bundles</i>	
Group 1. Auto improvement	a. Buy a car stereo system c. Get a better car d. Get a more fuel efficient car
Group 2. Mobile phone	b. Get a mobile phone
Group 3. Work-schedule changes	e. Change work trip departure time g. Adopt flextime h. Adopt compressed work week (such as a '9/80' schedule)
Group 4. Hire someone to do house or yard work	f. Hire someone to do house or yard work
Group 5. Mode change	i. Change from driving alone to work to some other means j. Change from some other means of getting to work to driving alone
Group 6. Home-based work	k. Buy equipment/services to help you work from home l. Telecommute (part- or full-time) p. Start home-based business or put more effort into an existing one
Group 7. Residential/employment relocation	m. Change jobs closer to home n. Move your home closer to work
Group 8. Alter employment status	o. Work part-time instead of full-time q. Retire or stop working

such as getting a more comfortable car or purchasing a mobile phone. Group two includes more costly, medium-term, travel-reducing alternatives such as adopting a compressed workweek or telecommuting. The third group consists of long-term, major lifestyle changes such as quitting work, working part-time instead of full-time and moving home or work closer to the other.

In the second method, factor analysis of the responses was performed to identify bundles. Factor analysis identifies patterns of common variation among a group of variables (the binary adoption and consideration variables, in this case), and as such, groups our alternatives based on the empirical affinities in responses to them. The bundles developed in this analysis are a composite of the results of 36 different factor analyses (varying the number of factors selected, the comprehensiveness of the sample, and whether adoption and consideration variables were factored together or separately). The factor-based bundles that appear in Table IV were the groupings that most commonly appeared across all 36 factor analyses and conceptually made the most sense.

Eight bundles were identified from this process. Note that bundles two and four consist of only one alternative each. In the previous study [18] the 'get a mobile phone' alternative was grouped with the auto improvement alternatives. For this analysis it remains independent based on factor loadings and the conceptual argument that mobile phones represent a unique alternative in comparison to the purely auto-oriented solutions. Bundle four, 'hire someone to do house or yard work', emerged as an independent factor in the earlier study, and remains independent in this analysis for lack of conceptual (or strong empirical) linkage with the other bundles in the study.

#### 4.2. Frequency Analysis for Bundles

As with the individual strategies, we tabulated the frequency of adoption and consideration of each bundle of alternatives. We expected the frequency distribution to roughly inversely correspond to the generalized cost of each bundle. The results, shown in Table V (where the bundles are listed in approximate order of increasing generalized cost), did not correspond well with our expectations. The conceptual bundle rankings were approximately consistent with our hypothesis, with the second- and third-most frequently adopted/considered bundles nearly tied in both cases. The rankings for the factor-

TABLE V. Frequencies for adoption and consideration of travel-related alternative bundles ( $N = 1282$ )

<i>Strategy bundle</i>	<i>Adoption frequency</i>	<i>Percent</i>	<i>Consideration frequency</i>	<i>Percent</i>	
Conceptual bundles	1. Travel maintaining/increasing	1183	92.28	926	72.23
	2. Travel reducing	619	48.28	503	39.24
	3. Major location/lifestyle change	640	49.92	588	45.87
Factor-based bundles	1. Auto improvement	1047	81.67	613	47.82
	2. Mobile phone	527	41.11	380	29.64
	3. Work-schedule change	656	51.17	369	28.78
	4. Hire someone to do house or yard work	392	30.58	297	23.17
	5. Mode change	331	25.82	180	14.04
	6. Home-based work	474	36.97	471	36.74
	7. Residential/employment relocation	448	34.95	297	23.17
	8. Alter employment status	239	18.64	333	25.98

based bundles, however, exhibited substantial variations from the hypothesized order, with, for example, the residential/job change bundle being adopted/considered more frequently than the mode change bundle. It may be that one reason for this result is the 'infinite' time window allowed for the change – over a lifetime, very many respondents will have changed job or residence in a way that reduced the commute, whereas (in American society) changing one's commute mode away from driving alone would be more rare. The rankings are likely to be different if, for example a two-year window were imposed on each strategy; that is if 'adoption' were defined as adoption within the past two years.

#### 4.3. Chi-square and T-tests

The two sets of alternative bundles were analyzed for significant relationships with socio-demographic characteristics, objective mobility indicators, subjective mobility indicators, relative desired mobility, travel liking, travel attitudes, personality types and lifestyle preferences. Variables measured by discrete categories (specifically, the socio-demographic characteristics analyzed here) were cross-tabulated with the adoption and consideration variables and chi-square tests of independence were performed. For variables measured on continu-

ous or ordinal (treated as quasi-continuous) scales (specifically, objective mobility, subjective mobility, relative desired mobility, travel liking, travel attitudes, personality types and lifestyle preferences), *t*-tests were performed to determine whether the mean on the continuous variable differed significantly by adoption/consideration status. A large number of relationships were analyzed, and with a significance standard of  $\alpha=0.05$ , about one in twenty relationships found significant at that level might in fact be due to chance alone. For this reason, we focus on general patterns and trends rather than on individual relationships.

#### ***4.3.1. Socio-demographics***

Eight socio-demographic characteristics of the respondents were analyzed in this study: (1) gender; (2) personal income; (3) household income; (4) employment status (for this analysis only those respondents who reported working full- or part-time were included); (5) education; (6) vehicle type (what type of vehicle the respondent drives most often, categorized, based on the *Consumer Reports* magazine, as: small, compact, mid-sized, large, luxury, sports car, minivan/van, pickup truck, and sport utility vehicle); (7) family status (categorized as single adult without children, two or more adults without children, one adult with children, and two or more adults with children); and (8) household employment (three categories: single worker with or without non-workers in the home, part-time worker with other workers in the home, and full-time worker with other workers in the home).

As can be seen in Table VI, the socio-demographic variables as a whole had more significant relationships with adoption than with considering adoption. People from all income groups, for example, were equally likely to indicate consideration of all but one of the travel-related alternative bundles, but typically those of the higher income groups were more likely to have actually adopted them. This may be due to the unconstrained nature of ‘considering adoption’ (even though the survey wording referred to ‘seriously considering’). Respondents may consider a wide range of travel alternatives but because of constraints, in this case socio-demographic constraints, those with higher incomes, higher levels of education and full-time employment are more likely actually to have the ability to adopt these alternatives.





Factor-based bundles					
Group 1. Auto improvement	Male			*	
Group 2. Mobile phone					*
Group 3. Work-schedule changes		Full-time			
Group 4. Hire someone to do house or yard work	Female		+	*	*
Group 5. Mode change					
Group 6. Home-based work	Male		+	*	*
Group 7. Residential/employment relocation					
Group 8. Alter employment status	Female	Part-time			*

Notes: "In this table '+' means that higher values of the column variables are associated with greater adoption of the row alternatives, and '-' means that lower values are associated with greater adoption. The '\*' is used to denote significant relationships in which directionality either was not found or would not make sense (i.e. categorical variables). For the binary variables, labels such as 'Female' or 'Full-time' denote the category that was more likely to adopt the travel alternative. For education, 'Middle' is used to label relationships in which the middle-education levels ('high school diploma' through '4-year college/technical school degree') were most likely to adopt the travel alternative.

In both the three- and eight-bundle groupings for adoption and the eight-bundle grouping for consideration, females were more likely to have adopted and considered adopting the more costly travel-related alternatives involving relocation or altering employment status. This provides additional evidence for previous claims that women are disproportionately represented in the higher, more costly tiers of travel-related alternatives [18].

For the vehicle type variable, the drivers of small cars and sports cars were most likely to have adopted the mode change bundle, while the drivers of large cars, luxury cars and minivans were the least likely to have adopted the mode change bundle. The alter employment status bundle was least adopted by the owners of sports cars, pickup trucks and sport utility vehicles (SUVs) and most likely to be adopted by the owners of large or luxury vehicles. Consideration generally follows a similar trend.

When the family status variable has a significant relationship with the travel-related bundles, the two or more adults with children category is typically the most likely to adopt or consider. The presence of children is also typically associated with adoption and consideration. It is quite plausible that families with children have a greater need to utilize a wide range of travel strategies.

Generally, single worker households were less likely to *adopt* the travel-reducing, major lifestyle change, or auto-oriented bundles and more likely to adopt or consider bundles that increase flexibility (e.g. work schedule change). However, respondents from single worker households were more likely to *consider* travel-reducing bundles than were respondents from households with multiple workers.

#### **4.3.2. Objective and Subjective Mobility**

Objective and subjective mobility are discussed together because of the degree of similarity in their relationships with the travel-related alternatives (when the overall pattern is positive or negative for one it tends to be similarly positive or negative for the other). The survey asked similar questions for both short and long distance travel; only the major short distance ( $< 160.8$  km) travel categories will be considered here (see [16] for the analysis of the major long distance travel categories). Table VII shows that for the most part, the group

TABLE VII. Relationships of objective mobility (OM) and subjective mobility (SM) indicators with bundle adoption and consideration (N = 1282)

	OM, SD, overall	OM, SD, commute	OM, SD, personal vehicle	SM, SD, overall	SM, SD, commute	SM, SD, personal vehicle
<i>Adoption</i>						
<b>Conceptual bundles</b>						
Group 1. Travel maintaining/increasing	+	+	+	+	+	+
Group 2. Travel reducing	+	+	+	+	-	-
Group 3. Major location/lifestyle change	-	-	-	-	-	-
<b>Factor-based bundles</b>						
Group 1. Auto improvement	+	+	+	+	+	+
Group 2. Mobile phone	+	+	+	+	+	+
Group 3. Work-schedule changes	+	+	+	+	+	+
Group 4. Hire someone to do house or yard work	+	+	+	+	+	+
Group 5. Mode change	-	-	-	-	-	-
Group 6. Home-based work	+	+	+	+	+	+
Group 7. Residential/employment relocation	-	-	-	-	-	-
Group 8. Alter employment status	-	-	-	-	-	-
<i>Consideration</i>						
<b>Conceptual bundles</b>						
Group 1. Travel maintaining/increasing	+	+	+	+	+	+
Group 2. Travel reducing	+	+	+	+	+	+
Group 3. Major location/lifestyle change	+	+	+	+	+	+
<b>Factor-based bundles</b>						
Group 1. Auto improvement	+	+	+	+	+	+
Group 2. Mobile phone	+	+	+	+	+	+
Group 3. Work-schedule changes	+	+	+	+	+	+
Group 4. Hire someone to do house or yard work	+	+	+	+	+	+
Group 5. Mode change	+	+	+	+	+	+
Group 6. Home-based work	+	+	+	+	+	+
Group 7. Residential/employment relocation	+	+	+	+	+	+
Group 8. Alter employment status	-	-	-	-	-	-

Note: SD = short distance

adopting or considering a given alternative had significantly higher objective and subjective mobility indicators than did the other group. That is, the more one travels (objective) and the more one feels that she travels (subjective), the more likely she is to adopt or consider adopting a wide range of travel-related alternatives.

The positive relationships of short distance travel to adoption for both the travel-maintaining and travel-reducing bundles reflect complex causal relationships: higher objective mobility may be a cause of adopting the travel-reducing and (at least partly) an effect of adopting the travel-maintaining alternatives. However, higher objective mobility may also *cause* the adoption of travel-maintaining alternatives: given that an individual *must* travel a lot, he may choose to adopt strategies that will make that travel more comfortable, productive or inexpensive. On the other hand, the negative relationship to adoption of the major location/lifestyle change strategies is logical: the more an individual travels, the less likely she is to have moved her residence or employment closer to the other (but the more likely she is to consider doing so).

When comparing actual (objective) mobility to perceived (subjective) mobility, notice that, for adoption of the mode change bundle (bundle 5 in the factor based groups), the actual amount of commute travel lacks a significant relationship but the perceived amount has a positive, significant relationship to adoption. This could also be interpreted in terms of either direction of causality. Either, regardless of how much a respondent actually travels, the amount he feels he is traveling is much more important in whether or not he will change modes, or conversely, because he has changed modes (the commute distance not changing) he now feels more keenly the impact of the commute (what was once a 10 to 15 min car drive is now a 20 to 30 min bus ride, for example). For consideration, higher amounts of both objective and subjective mobility are positively related to considering the mode change bundle, which is logical.

From a planning or TDM perspective, Table VII indicates that people who are traveling a lot and/or feel that they are traveling a lot are adopting and considering a variety of strategies to mitigate the impacts of that travel, including: mode change, residential/employment relocation (closer to each other) and work schedule changes (work trip departure time, compressed work week, and flextime).

#### ***4.3.3. Relative Desired Mobility and Travel Liking***

Relative desired mobility (RDM) and travel liking are similar to objective and subjective mobility in terms of the temporal and causal nature of their relationship to adoption and consideration. Either type of variable can logically be considered a cause of consideration. Our hypothesis was that those who want to increase their current travel and who like travel are less likely to consider travel-reducing alternatives or major location/lifestyle changes that further limit or reduce travel. The volume of negative relationships (presented in Table VIII) between the RDM and travel liking variables and the travel-reducing and major location/lifestyle change bundles supports this hypothesis. (However, the absence of a number of significant relationships should also be noted, which, while at least not contradicting the hypothesis, do not support it either.)

With respect to adoption (upper portion of Table VIII), the situation is again more complex. Since the relative desired mobility and travel liking measurements are taken after any adoptions occur, it may well be that the expressed attitude is a consequence of the alternatives already adopted. For instance, after moving home and work closer together, or changing one's employment status to reduce commuting, an individual may feel that he does not travel enough, and want to travel more. Similarly, after such a major change, he may like his commute travel precisely because he has reduced his exposure to stressful congestion and can now enjoy the benefits the commute trip may offer. In some cases, however, the RDM and travel liking ratings are 'in the same direction' as the change, suggesting that the adopted strategy supports but does not fully satisfy one's travel desires. For example, although the individual has already adopted travel-reducing strategies, she still dislikes her travel and wishes to reduce it further.

The results for both consideration and adoption have significant policy implications: there are people whose desire to increase travel and whose affinity for travel may make them more resistant to (less likely to consider) travel-reducing strategies.

#### ***4.3.4. Travel Attitudes, Personality and Lifestyle Preference***

It was hypothesized that respondents with attitudes favoring travel (e.g. high scores on the 'commute benefit' and 'travel freedom' factors) would be more likely to adopt and consider travel-maintaining strategies while those with attitudes less favorable to travel (e.g. high

TABLE VIII. Relationships of relative desired mobility (RDM) and travel liking indicators with bundle adoption and consideration ( $N = 1282$ )

	RDM, SD, overall	RDM, SD, commute	RDM, SD, personal vehicle	Travel liking, SD, overall	Travel liking, SD, commute	Travel liking, SD, personal vehicle
<i>Adoption</i>						
<b>Conceptual bundles</b>						
Group 1. Travel maintaining/increasing	-	-	-	-	-	-
Group 2. Travel reducing	-	+	-	+	+	+
Group 3. Major location/lifestyle change	-	-	-	-	-	-
<b>Factor-based bundles</b>						
Group 1. Auto improvement	-	-	-	-	-	-
Group 2. Mobile phone	-	-	-	-	-	-
Group 3. Work-schedule changes	-	-	-	-	-	-
Group 4. Hire someone to do house or yard work	-	-	-	-	-	-
Group 5. Mode change	-	-	-	-	-	-
Group 6. Home-based work	-	+	+	+	+	+
Group 7. Residential/employment relocation	-	-	-	-	-	-
Group 8. Alter employment status	-	-	-	-	-	-
<i>Consideration</i>						
<b>Conceptual bundles</b>						
Group 1. Travel maintaining/increasing	-	-	-	-	-	-
Group 2. Travel reducing	-	-	-	-	-	-
Group 3. Major location/lifestyle change	-	-	-	-	-	-
<b>Factor-based bundles</b>						
Group 1. Auto improvement	-	-	-	-	-	-
Group 2. Mobile phone	-	-	-	-	-	-
Group 3. Work-schedule changes	-	-	-	-	-	-
Group 4. Hire someone to do house or yard work	-	-	-	-	-	-
Group 5. Mode change	-	-	-	-	-	-
Group 6. Home-based work	-	-	-	-	-	-
Group 7. Residential/employment relocation	-	-	-	-	-	-
Group 8. Alter employment status	-	-	-	-	-	-

Note: SD = short distance

scores on 'pro-environmental', or 'pro-high density' factors) would be more likely to adopt and consider travel-reducing and major location/lifestyle-change strategies. For the personality and lifestyle preferences it was expected that the 'adventure seeker' along with the 'workaholic' and the 'status seeker' would be more likely to adopt travel maintaining/increasing alternatives while those with a 'family/community-oriented' lifestyle preference would be more likely to adopt and consider adopting travel reducing and perhaps major location/lifestyle change alternatives.

In general our findings support these hypotheses. For example, 'pro-environmental' was negatively associated with the auto-oriented and travel-maintaining bundles for adoption, and positively associated with the travel-reducing and major location/lifestyle change bundles for both adoption and consideration. The adventure seeker personality type is more likely to adopt and consider adopting a variety of alternatives that could be used to create flexibility in travel, including (counter to expectation) those that reduce as well as those that potentially increase the amount of travel. It may well be that the adventure seeker tries to reduce routine commute travel in order to have more time for other more desirable trips and activities.

Not surprisingly, organizers are more likely to have adopted the time management tools of mobile phone and domestic hired help. Perhaps because of their efficient time management and the adoption of auto improvement strategies, they feel little need to consider commute mode changes or residential or employment relocation.

The family/community-oriented lifestyle preference is positively associated with adopting both the auto-oriented and major lifestyle change bundles (in the three-bundle grouping) and work schedule and travel mode flexibility (in the eight-bundle grouping). Interestingly, it is not associated with adopting the travel-reducing bundle. It is also interesting that the family/community-oriented lifestyle was not significantly associated with adopting the smaller, factor based bundles (groups 6 through 8) that essentially comprise the major location/lifestyle change bundle in the conceptual grouping, whereas it was significantly associated with adopting the latter bundle. Apparently the overall tendency is weak enough that it only emerges when several related strategies are analyzed as a group.

For considering adoption the family/community-oriented lifestyle preference is positively associated with all three bundles in the first grouping and six of the eight bundles in the second grouping. Respondents with a high score on this factor are likely to consider adopting



nearly every type of travel-related alternative including the travel-reduction strategies that were absent from the significant relationships for adoption. Similar to the argument for households with children, it is not surprising that family demands motivate a search for a wide variety of coping mechanisms.

It is natural that the status-seeker is more likely to have adopted the consumption-oriented auto-improvement and mobile phone bundles, as well as the travel-maintaining bundle that facilitates displaying a status automobile. By the same logic, it is also natural that s/he is less likely to have adopted the mode change strategy, which, as Table II shows, is dominated by those who changed from driving alone to some other mode. Status seekers are also more likely to consider hiring domestic help, which can be a symbol of status as well as a 'time purchasing' approach.

In general, workaholics have adopted, or are considering, strategies that will enable them to work better or more: the travel-reducing bundles (more time for work), mobile phone (work from anywhere, efficiency/productivity tool), work-schedule changes (can support time for work), domestic help (more time for work) and home-based work (facilitates overtime). Conversely, they are less likely to have adopted, or to consider, altering their employment status (work part-time or quitting) and to have changed residential or job location (especially the latter suggesting a commitment to a particular job, and/or a disinclination to change jobs frequently). All of these relationships are expected.

#### 4.4. Summary

In general the results were consistent with prior hypotheses (see Table X), but a few unexpected relationships emerged. For example, adventure seekers and the family/community-oriented appeared inclined to try the full range of travel-related alternatives, not just those supporting travel (in the former case) or reducing it (in the latter case). Ambiguous directions of causality were likely responsible for some unexpected results. While a given variable could generally be viewed as antecedent to consideration (and hence plausible as a cause), it could often be viewed as a cause or an effect in the case of adoption.

TABLE IX. Relationships of travel attitudes and personality types/lifestyle preferences with bundle adoption and consideration (N = 1282)

	Attitudes			Personality			Lifestyle		
	Pro-environmental	Pro-high density	Commute benefit	Travel freedom	Adventure seeker	Organizer	Family/community-oriented	Status seeker	Workaholic
<i>Adoption</i>									
<b>Conceptual bundles</b>									
Group 1. Travel maintaining/increasing	-	-	-	+	+		+	+	+
Group 2. Travel reducing	+	+	-						-
Group 3. Major location/lifestyle change	+		+				+		
<b>Factor-based bundles</b>									
Group 1. Auto improvement	-	-	-	+	+	+		+	+
Group 2. Mobile phone	-	-	-	+	+	+		+	+
Group 3. Work-schedule changes			-	+	+		+		+
Group 4. Hire someone to do house or yard work			-	+	+	+	-		+
Group 5. Mode change	+	+		-			+	-	+
Group 6. Home-based work			+	+	+				-
Group 7. Residential/employment relocation			+						-
Group 8. Alter employment status	+		+	-					-
<i>Consideration</i>									
<b>Conceptual bundles</b>									
Group 1. Travel maintaining/increasing	+	+	-	+	+		+	+	+
Group 2. Travel reducing	+		-				+		
Group 3. Major location/lifestyle change	+		-				+		
<b>Factor-based bundles</b>									
Group 1. Auto improvement		-	-	+	+	+		+	+
Group 2. Mobile phone		-	-	+	+	+		+	+
Group 3. Work-schedule changes	+	-	-		+		+		+
Group 4. Hire someone to do house or yard work		-	-						+
Group 5. Mode change	+	+	-	+	+		+		+
Group 6. Home-based work	+	+	-				+		+
Group 7. Residential/employment relocation	+		-				+		-
Group 8. Alter employment status			-						-

TABLE X. Summary of hypotheses and results

<i>Variable type</i>	<i>General hypotheses</i>	<i>Results</i>
Socio-demographics	(1) Females are disproportionately represented among the most costly/travel-reducing alternatives. (2) Those in upper income and education categories are more able and therefore more likely to adopt and consider a wide range of alternatives.	(1) Our findings support this hypothesis.  (2) Our findings provide support for this; however, income appears to be related to the adoption and consideration of more alternatives and bundles than is education. Further, both income and education play more of a role in the adoption of alternatives and bundles than in the consideration of alternatives and bundles.
Objective mobility	(1) The more respondents travel the more likely they will be to adopt and consider travel alternatives.	(1) Our findings support this hypothesis. Both travel maintaining and travel reducing alternatives are involved, for different reasons.
Subjective mobility	(1) The more respondents feel that they travel the more likely they will be to adopt and consider travel-related alternatives/bundles.	(1) Our findings support this hypothesis, similarly to objective mobility.
Relative desired mobility	(1) The more respondents want to travel the less likely they will be to consider travel-reducing or major lifestyle change alternatives/bundles and the more likely they will be to consider travel-maintaining/increasing alternatives/bundles.	(1) Our findings generally support this hypothesis, for the relationships that are significant.
Travel liking	(1) The more respondents like to travel the less likely they will be to adopt or consider travel-reducing or major lifestyle change alternatives/bundles and (2) the more likely they will be to adopt and consider travel-maintaining/increasing alternatives and bundles.	(1) Our findings offer mixed support for this hypothesis.  (2) Our findings provide some support for this, however, this hypothesis holds much better for consideration than for adoption.

TABLE X. (continued)

<i>Variable type</i>	<i>General hypotheses</i>	<i>Results</i>
Travel attitudes	(1) Respondents with attitudes favouring travel would be more likely to adopt and consider travel-maintaining strategies while (2) those with attitudes not favouring travel would be more likely to adopt and consider travel-reducing and major lifestyle change strategies.	(1)(2) Our findings provide support for these hypotheses although that support is stronger for consideration than for adoption.
Personality types/lifestyle preference	(1) The 'adventure seeker' along with the 'workaholic' and the 'status seeker' would be more likely to adopt and consider travel maintaining/increasing alternatives while (2) those with a 'family/community-oriented' lifestyle preference would be more likely to adopt and consider adopting travel reducing and perhaps major lifestyle changing alternatives.	(1) Our findings provide some support for this hypothesis. Adventure seekers were also more likely to adopt/consider travel reducing strategies, however.  (2) Our findings provide some support for this hypothesis. However, they also adopt/consider travel-maintaining strategies.

## 5. POLICY IMPLICATIONS AND CONCLUSIONS

The results of this study are presented to better inform TDM policy decisions. Similar to how knowledge of elasticities (individuals' reactions to changes in price) can inform pricing strategies, the understanding of the internal mechanisms that influence individuals' reactions to current and past travel conditions can aid in the creation of more realistic TDM strategies. For instance, the findings that respondents who are currently doing a great deal of travel are considering a variety of travel-reducing strategies, including working from home (e.g. telecommuting) and that people of higher incomes are more likely to have already adopted travel-reducing strategies, mean that what might be termed 'personal travel demand management' is a meaningful phenomenon.

This paper also presents evidence that individuals with an affinity for travel and/or who want to travel more than they are currently doing

may be resistant to TDM policies (less likely to have adopted or considered travel-reducing strategies). This, together with the finding that the most commonly adopted strategies were those aimed at allowing respondents to maintain or even increase their current levels of travel (see Tables II and III), illustrates the gap that exists between current TDM policy and behavior.

These findings, when combined with those of earlier work on this subject ([13–15], [17–19]) present a compelling argument for the need to further understand traveler behavior – particularly in response to congestion and TDM policies.

While additional research is needed to clarify many of the complex relationships discussed in this paper, the results presented here are useful in that they identify pairwise relationships between the respondents' characteristics (amount of travel, perception of travel, desire for travel, socio-demographics, attitudes, liking of travel, and personality and lifestyle preferences) and the travel-related strategies that they have adopted and are considering. Future analysis will treat the consideration of the travel-related alternatives and bundles as the dependent variables in binary logit models, with multiple explanatory variables to control for correlations of individual influences with other variables in the data set.

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