

How do individuals adapt their personal travel? A conceptual exploration of the consideration of travel-related strategies

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Received 3 September 2004; revised 3 March 2005; accepted 4 March 2005

Available online 26 April 2005

Abstract

Preparatory to an empirical analysis, this study conceptually discusses the influences of objective and subjective variables on the consideration of 16 travel-related strategies, reflecting a range of options individuals have to adapt to congestion. The variables considered here were measured by a 1998 survey conducted in the San Francisco Bay Area. The conceptual exploration shows that the consideration of travel-related strategies may be affected by the amounts of travel that individuals actually do, their subjective assessments, desires, affinities, and constraints with respect to travel. Individuals' travel attitudes, personality, lifestyle and prior experience are also likely to affect their current consideration. Socio-economic and demographic characteristics may exhibit distributional effects with respect to the options individuals consider. These potential influences indicate that the individual adaptation process may be influenced by a wide range of qualitative and experiential variables, which are often ignored or omitted by policy makers and planners. A companion paper develops binary logit models of the consideration of each strategy.

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Keywords: Travel behavior; Congestion; Adaptation; Transportation demand management

1. Introduction

It is well known that congestion has become a major problem for urban and suburban areas. Among its multiple outcomes, delay on the roads is the most pervasive and costly (de Palma and Lindsey, 2001). The estimated annual cost of time lost due to congestion in the U.S. was put at \$48 billion in the mid-1990s (Arnott and Small, 1994). Beyond the loss of time, congestion has serious consequences for energy consumption and the environment. Fuel consumptions and tailpipe emissions may increase up to 200% on ring roads under congested conditions (Vlieger et al., 2000). A Texas Transportation Institute study estimated that due to congestion 6.6 billion gallons of fuel were wasted in the U.S. in 1997, which is double the amount in 1982 (TTI, 1999). To alleviate congestion, governments have been

adopting a wide range of policies. During the past two decades, Transportation Demand Management (TDM) strategies, such as increasing the vehicular operating cost, promoting public transit ridership, advocating telecommunication alternatives and so on, have been a centerpiece of public policy. However, the effectiveness of these strategies is limited. As an example, telecommunication applications, aimed at replacing travel, actually tend to have more complementary effects on both industrial and personal vehicular uses worldwide (Plaut, 1997; Plaut, 1999; Mokhtarian, 2002).

Currently, most policies are focused on reducing vehicle miles traveled (VMT) at peak periods, and policy makers seem to assume that individuals will actively respond to these policies in a manner that minimizes social costs. However, in reality, individuals tend to behave in a way that minimizes their personal costs (Loukopoulos et al., 2004; Salomon and Mokhtarian, 1997). The gap between the assumptions on which policies are based and the behaviors with which individuals respond to policy measures greatly affects the effectiveness of such strategies.

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The dynamic nature of individuals' responses to congestion further exacerbates the discrepancy between assumption and reality. A previous empirical study directed by the second author found that an individual first tends to consider or adopt lower-impact, short-term strategies (such as buying a better car or changing work trip departure time), before moving to higher-impact and/or long-term ones (such as changing mode, telecommuting, or relocating) if she does need adaptation alternatives. There was also evidence that if dissatisfaction persists or returns an iterative process is involved in considering some strategies, with cycling back to the same or lower-impact strategies often occurring (Raney et al., 2000). Since it is the higher-impact strategies on which public policy often focuses, this pattern suggests that generally individuals do not behave as policy makers expect. Moreover, the personal impacts and distributional inequities of such TDM strategies may make them less attractive, even criticized (Bhattacharjee et al., 1997; Golob, 1999).

On the other hand, recent studies have illustrated the importance of individuals' attitudes to the acceptance of TDM policies (Thorpe et al., 2000; Ison, 2000), as well as to the choice of environmentally-beneficial commute options (Golob and Hensher, 1998), although there is also evidence that individuals' stated attitudes toward the environment are often at variance with their intentions and/or behavior (Cullinane, 1992; Gärling and Sandberg, 1997; Nilsson and Küller, 2000). Moreover, personal habits greatly contribute to individuals' choices among travel modes (Gärling et al., 2001; Aarts et al., 1997). Therefore, individuals' travel-related attitudes, predispositions, and prior choices seem to play an important role in their response to the policies. A major change in travel behavior may cause disadvantages such as inconvenience and loss of independence for individuals, the prospect of which leads to psychological resistance against policies to reduce private vehicle use. As a result, information campaigns implemented in the Netherlands made little progress in motivating individuals to voluntarily alter their car use patterns (Tertoolen et al., 1997).

To improve the prediction of the impacts of proposed policies and to design more effective policies, it is necessary for policy makers to understand the variables affecting individuals' choice of adaptation alternatives. In a survey conducted in May 1998, several groups of variables as well as the consideration of 17 travel-related strategies (shown later in Table 1) were captured. The aim of this paper is to conceptually explore the influence of these variables on the consideration of these adaptation alternatives. All of the alternatives may be (but are not necessarily) adopted in response to congestion and all of them have travel implications. This conceptual exploration constitutes the foundation for an empirical examination, which is pursued in a companion paper (Cao and Mokhtarian, 2005).

The organization of this paper is as follows. The next section presents an overview of the variables considered in this study. Section 3 discusses the travel-related adaptation alternatives studied. Section 4 describes the explanatory variables of interest in more detail and explores their potential influences on the consideration of these alternatives. Section 5 summarizes this study.

2. Overview of variables studied

The variables analyzed in this study were measured by a fourteen-page self-administered survey mailed to 8000 randomly selected households in the San Francisco Bay Area in 1998. An urban neighborhood of North San Francisco and two suburban cities of Concord and Pleasant Hill were chosen to represent the diverse lifestyles, land use patterns, and mobility options in the Bay area. Approximately 25% of surveys were completed by a randomly selected adult member of the household and returned.

Most variables measured by the questionnaire can be grouped into 10 categories: travel-related strategies, objective mobility, subjective mobility, relative desired mobility, travel liking, travel attitudes, personality, lifestyle, mobility constraints, and socio-economic and demographic (SED) characteristics. 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. Only the most commonly-used modes, and selected purposes of interest, were captured in order to reduce the burden on the respondent. 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/bicycling, and 'other'. The short-distance purposes measured were: commuting to work or school, work/school-related, grocery shopping, eating a meal, entertainment/social/recreational, 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.

3. Travel-related adaptation strategies

One section of the survey asked respondents if they had made, and were considering, certain specified choices that would affect the amount and nature of their travel. For adopted alternatives respondents were asked to indicate how long ago they were adopted. The consideration of these travel-related strategies is the focus of this study.

Table 1
Conceptual and factor-based bundles of the travel-related strategies

Conceptual bundles	
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
Group 3. Major location/lifestyle change	l. Telecommute (part- or full-time) 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
Factor-based bundles	
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 another 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

Source: Clay and Mokhtarian (2004).

To better understand how these travel-related strategies interact with travel attitudes, SED and other variables in our analysis, it is useful to group them into bundles based on both conceptual and empirical similarities. Similar to Mokhtarian et al. (1997), two methods were used to develop bundles of travel-related strategies. First, as shown in Table 1, variables were grouped conceptually into three bundles in increasing order of the generalized cost (including time, stress, household impacts, and other factors as well as monetary cost) associated with each adaptation alternative. In the second method, factor analysis of the responses was performed to identify eight bundles based on shared traits among various strategies (refer to Clay and Mokhtarian (2004) for detailed information about identification of bundles). Note that bundles two and four consist of only one strategy each, based on their lack of strong linkage with other bundles in the study.

4. The explanatory variables

4.1. Former adaptation

As mentioned previously, 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 recurs after they have adopted a higher-impact one. On the other hand, the adoption of higher-cost alternatives may prevent individuals from implementing the lower-cost ones (Loukopoulos et al., 2004). And if the adoption of a strategy has completely met individuals' needs, its adoption is likely to decrease, even eliminate, the likelihood 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. On the other hand,

it is evident that individuals' travel experiences shape their future travel behavior (Gitelson and Kerstetter, 1992). For most strategies we are studying, it is plausible 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 and recalled 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. Moreover, since the utility of a recent adaptation may still be in force, we expect the time since adoption of a strategy 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 now.

4.2. 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.

The travel-related strategies discussed in this study represent some possible ways to cope with congestion and higher amounts of travel. Thus, we hypothesize that those who travel a lot are more likely to consider the travel-reducing and major location/lifestyle change strategies of Table 1. The situation with respect to the travel-maintaining/increasing strategies is not as clear. On one hand, it is possible that individuals with a higher objective mobility want to reduce their travel, and hence are reluctant to consider an adjustment that would maintain or increase their travel. However, the descriptive analyses in Clay and Mokhtarian (2004) found that those who actually did a lot of travel were more inclined to consider even the travel-maintaining/increasing strategies (as well as the others), apparently in order to make the 'necessary' trips less costly and/or more productive. Therefore, we expect that the more individuals travel, the more likely they would be to consider all these strategies if adaptations are necessary.

4.3. 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 (Collantes and Mokhtarian, 2002). Therefore, individuals' perceptions tend to further differentiate their behavior. 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'.

Similarly to objective mobility, we expect that individuals perceiving that they do a lot of travel will be more inclined to consider travel-reducing and major location/lifestyle change strategies. With respect to travel-maintaining/increasing strategies, individuals with high subjective mobility may either be less inclined to consider them because they do not *want* to maintain or increase travel, or more inclined to consider them in order to make the extensive travel they *must* do more comfortable or productive. Again, the findings in Clay and Mokhtarian (2004) support the latter expectation. Thus, we hypothesize that a higher subjective mobility tends to be positively related to considering a wide range of strategies.

4.4. 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 (Choo et al., 2005). 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'.

Individuals having a higher relative desired mobility want to increase their travel, thus we expect that such people are more inclined to consider travel-maintaining/increasing strategies and less likely to consider travel-reducing and major location/lifestyle change strategies.

4.5. Travel liking

Affective beliefs represent a pro or con attitude to the object (Sudman and Bradburn, 1982). Thus, whether a respondent who already travels a lot wants to reduce it or do even more is likely to depend on how much she 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'.

Similar to relative desired mobility, a higher rating for travel liking indicates a positive utility of travel. Therefore, we expect that the more an individual likes travel, the more likely she would be to consider travel-maintaining/increasing strategies, and the less likely she would be to consider travel-reducing and major location/lifestyle changing strategies.

4.6. 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. As shown in Table 2, six underlying dimensions were identified, using principal axis factoring with oblique rotation: travel dislike, pro-environmental solutions, commute benefit, travel freedom, travel stress, and pro-high density. The highest-magnitude pairwise correlation among this group was 0.38 (between pro-environmental solutions and pro-high density), which did not cause any empirical problem in the companion analysis (probably at least in part due to the substantial sample size).

Travel attitudes have long been found to significantly influence individuals’ related behavior (e.g. Dobson et al., 1978; Dumas and Dobson, 1979). Therefore, travel attitudes are likely to affect individuals’ adaptation process. However, the different travel attitude factors we have measured may affect the consideration of each strategy differently. Generally, a positive commute benefit or travel freedom factor score indicates a utility of travel or lack of constraints on individuals’ travel, respectively, so they could be expected to be negatively associated with the consideration of strategies that reduce travel. Conversely, a positive score on the other factors indicates some kind of disutility of travel or anti-travel attitude, thus they are expected to be positively associated with the consideration of travel-reducing and major location/lifestyle change strategies.

4.7. 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. Applying the same data reduction techniques as for attitudes, these 17 attributes reduced to four personality factors: adventure-seeker, organizer, loner, and the calm personality (see Table 3).

Personality characteristics have also been found to have some impacts on travel behavior (Prevedouros, 1992). Further, earlier in this series of studies, Mokhtarian et al. (2001) concluded that those with a higher score on the adventure seeker factor traveled longer distances than their counterparts, all else equal. Clay and Mokhtarian (2004) found a strong positive association of this factor with a number of different strategies, suggesting that to some extent adventure seekers may value change or variety for its own sake (see Drolet (2002) for an exploration of this idea in the context of consumer choice). Thus, we hypothesize that adventure seekers are more likely to consider most

travel-related strategies. The impacts of the other personality factors are less predictable, but we include them in the empirical analysis to explore the role they may play in the consideration of travel-related strategies.

4.8. 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, as presented in Table 4.

Lifestyle is a way of living that affects and is a sign of individuals’ behavior (Bin and Dowlatabadi, 2005). Previous research has found that lifestyle patterns strongly influence travel behavior (Hildebrand, 2003; Tranter and Whitelegg, 1994). In this context, being frustrated may be positively related to considering a wide range of strategies because such people may believe that a change would bring them greater satisfaction or control. The family/community oriented factor score is expected to be positively associated with the consideration of travel-reducing and major location/lifestyle change strategies, since these strategies could save time for family and community activities. A positive score on the workaholic factor is expected to positively affect the consideration of the strategies beneficial to work, such as telecommuting. Status seekers may be more inclined to consider strategies involving material acquisition, such as getting a better car or a mobile phone.

4.9. Mobility constraints

In our study, mobility constraints are physical or psychological limits on travel. 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’), the possession of a drivers’ license, and the availability of an automobile when desired (the later two are oppositely-oriented measurements of mobility constraints). These constraints may affect the amount an individual travels or her enjoyment of that travel. Hildebrand (2003) found that individuals with mobility constraints are more likely to conduct in-home amusements and choose to share rides. Therefore, mobility constraints are likely to positively affect the consideration of a variety of strategies, especially the medium- and higher-cost ones.

4.10. SED characteristics

Finally, the survey included an extensive list of SED variables to allow for comparison to other surveys and to Census data. These variables include neighborhood and vehicle type dummies, gender, age, years lived in the U.S., education and employment information, household

Table 2
Pattern matrix for attitude factors (commuters only, $N=1,427$)

Variable	Factor label					
	Travel dislike	Pro-environment	Commute benefit	Travel freedom	Pro-high density	Travel stress
Traveling is boring.	0.62					
I like exploring new places.	-0.54					
The only good thing about traveling is arriving at your destination.	0.53					
“Getting there is half the fun”.	-0.47					
To improve air quality, I am willing to pay a little more to use an electric or other clean-fuel vehicle.		0.64				
We should raise the price of gasoline to reduce congestion and air pollution.		0.62				
We need more public transportation, even if taxes have to pay for a lot of the costs.		0.61				
We can find cost-effective technological solutions to the problem of air pollution.		0.35				
I limit my auto travel to help improve congestion and air quality.		0.37				
We need more highways, even if taxes have to pay for a lot of the costs.		-0.19				
My commute is a real hassle.			-0.70			
My commute trip is a useful transition between home and work.			0.58			
The traveling that I need to do interferes with doing other things I like.			-0.53			
I use my commute time productively.			0.47			
Travel time is generally wasted time.	0.38		-0.46			
Getting stuck in traffic doesn't bother me too much.			0.42			
In terms of local travel, I have the freedom to go anywhere I want to.				0.51		
In terms of long-distance travel, I have the freedom to go anywhere I want to.				0.42		
The vehicles I travel in are comfortable.				0.30		
It is nice to be able to do errands on the way to and from work.				0.27		
I am willing to pay a toll to travel on an uncongested road.				0.21		
Living in a multiple family unit would not give me enough privacy.					-0.62	
I like living in a neighborhood where there's a lot going on.					0.49	
Having shops and services within walking distance of my home is important to me.		0.24			0.40	
I like having a large yard at my home.					-0.32	
I worry about my safety when I travel.						0.54
Traveling makes me nervous.	0.20					0.54
Traveling is generally tiring for me.	0.27	-0.23				0.41
Usually, I'd rather have someone else do the driving.					0.23	0.33
I tend to get sick when traveling.						0.32
I am uncomfortable being around people I don't know when I travel.						0.30
I like traveling alone.						-0.19

Source: Mokhtarian et al. (2001). Note: For ease of interpretation, only loadings higher than about 0.2 in magnitude are shown.

information such as number of people in the household, family status, and personal and household income.

SED characteristics are likely to play some role in considering travel-related strategies. Previous findings (Mokhtarian et al., 1997; Clay and Mokhtarian, 2004) suggest that females are more inclined to consider the more costly, travel-reducing and major location/lifestyle change strategies, and that personal and household incomes would be positively associated with consideration of a variety of strategies. We also hypothesize that age would be negatively correlated with consideration of a number of

changes, believing that older people may be more resistant to change and/or more habituated to their current situation. Based on a stated preference survey, Arentze et al. (2004) also concluded that SED characteristics affect the intention to adjust and the choice of adaptation alternatives if congestion pricing is imposed. Particularly, they found that gender, age, education level, employment status, the presence of children in the household, marital status, and auto ownership frequently appear in the models for the choice of adaptation alternatives. As an example, older people are more likely to choose changing the departure

Table 3
Pattern matrix for personality factors (N=1,904)

Variable	Factor label			
	Adventure seeking	Organizer	Loner	Calm
Adventurous	0.78			
Variety seeking	0.69			
Spontaneous	0.57			
Risk taking	0.56			
Like to stay close to home	-0.44			
Ambitious	0.42	0.33		-0.22
Like moving at high speeds	0.40			-0.35
Like being outdoors	0.39			
Efficient		0.62		
On time		0.37		
Like a routine	-0.36	0.36		
Like being alone			0.94	
Like being independent	0.25	0.30	0.31	
Aggressive		0.31		-0.60
Patient				0.53
Restless				-0.39
Like being in charge		0.36		-0.38

Source: Mokhtarian et al. (2001).

time of the trip and working at home but are reluctant to switch mode for work-related activities. These findings exhibit distributional effects of SED characteristics with respect to the options individuals consider (Salomon and Mokhtarian, 1997).

Table 4
Pattern matrix for lifestyle factors (N=1,904)

Variable	Factor label			
	Frustrated	Family/community oriented	Status seeking	Workaholic
I often feel I don't have much control over my life.	0.72			
I am generally satisfied with my life.	-0.62			
Work and family do not leave me enough time for myself.	0.36	0.26		0.20
I won't necessarily have to like my work that much, as long as I made enough money.	0.21			
I feel that I am wasting time when I have to wait.	0.16			0.16
I'd like to spend more time with my family and friends.		0.59		
My family and friends are more important to me than my work.		0.47		-0.23
I'd like to spend more time on social, environmental, or religious causes.		0.42		
Occasionally, I would be willing to give up a day's pay to get a day off work.		0.27		

Table 4 (continued)

Variable	Factor label			
	Frustrated	Family/community oriented	Status seeking	Workaholic
To me, the car is a status symbol.			0.70	
A lot of the fun of having something nice is showing it off.			0.52	
To me, the car is nothing more than a convenient way to get around.			-0.41	
"The one who dies with the most toys wins."			0.41	
I'm pretty much a workaholic.				0.65
I'd like to spend more time on work.		-0.16		0.37
I generally try to spend some time each week just on myself.				-0.18
I don't like to stay in one place for long.				0.17

Source: Mokhtarian et al. (2001).

5. Summary

As one element of an ongoing study of individuals' adoption and consideration of travel-related strategies, this paper conceptually discusses the influences of various variables on the consideration of travel-related adaptation strategies. This exploration establishes the foundation for the empirical examination that follows in a separate paper (Cao and Mokhtarian, 2005).

The variables discussed in this paper comprise both objective and subjective components. Objective variables include objective mobility, previous adaptations, mobility constraints, and SED characteristics, while subjective components include subjective mobility, relative desired mobility, travel liking, travel attitudes, personality, and lifestyle. Generally, we expect the consideration of travel-related strategies to be affected by the amounts of travel that individuals actually do, their subjective assessments, desires, affinities, and constraints with respect to travel. Individuals' travel attitudes, personality, lifestyle and prior experience are also likely to affect their current consideration. And SED characteristics may exhibit distributional effects with respect to the options individuals consider. These potential influences, based on the literature and our informed speculation, indicate that the individual adaptation process may be affected by a wide range of qualitative and experiential variables, which are often ignored or omitted by policy makers and planners. An empirical analysis is necessary to verify these prospective influences.

Acknowledgements

This research was funded by the University of California Transportation Center. Parts of Sections 2–4 are borrowed from Mokhtarian et al. (2001); Clay and Mokhtarian (2004). Advice from Ilan Salomon and several anonymous referees was also helpful in improving this paper.

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