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Understanding Traveler Behavior: The Psychology Behind Managed Lane Use

Final Report

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16. Abstract

Recent analysis of Katy Freeway/Managed Lane (ML) travelers and I-394 Freeway/High Occupancy Toll (HOT) lane traveler data has found that many travelers pay to use these HOT lanes and MLs when adjacent toll-free lanes are operating at nearly the same speed. Assuming that drivers are indeed cognizant of the fact that HOT and ML lanes are traveling at nearly the same speed, then it would seem that travelers are paying for the use of these lanes for reasons other than travel time savings. This project investigated the role of psychological variables, such as risk aversion, that may explain why travelers choose to pay to use these lanes when the travel time is almost equal. The results indicate that some psychological variables had significant relationships with the stated preference questions, but this was very limited.

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EXECUTIVE SUMMARY

This research examined the impact of several personality traits (conscientiousness, general locus of control, personal need for structure, risk tolerance (financial), driving risk perceptions, risky driving style, and careful driving style) on survey respondents' travel choices. The travel choices were between four options: driving alone or with passengers on the general purpose lanes (GPLs) or on the Managed lanes (MLs). The GPLs are typical freeway lanes that get congested, have somewhat unpredictable travel times, but do not require a toll. The MLs do not get congested and save travel time over the GPLs, but require anyone driving alone to pay a toll. Carpoolers do not have to pay a toll to use the MLs. It was hypothesized that several of the personality traits would be significant predictors of travelers' choice between the slower, less predictable modes (including the GPLs and carpooling) versus the predictable, faster, but more expensive mode of driving alone on the MLs.

To begin, the survey was pilot tested using a sample of 24 graduate students at Texas A&M University. The offline pilot test confirmed internal consistency reliability of the psychological measures and demonstrated that the pattern of relationships between the constructs was consistent with their hypothesized associations. Next, the survey was administered offline (on paper) to 231 undergraduate psychology students at Texas A&M University. Relationships between mode choice and the psychological variables found in this effort included:

- Students who chose the MLs reported a significantly higher risk tolerance. This may be because the MLs are a financial risk (if they save little to no time for a particular trip then they were not a good use of money on that trip) and the risk tolerance variable focused on financial risk.
- Students who chose the MLs had higher scores in risky driving style. Risky driving style often relates to faster travel, and MLs offer just that.
- Students who chose the MLs had lower scores in careful driving style. Someone with a low score in careful driving style may not plan long trips in advance or is not patient at intersections—both things that would lead to a logical increased interest in ELs.

Finally, the survey was administered online to travelers in San Diego, Miami, and Denver. Mode choice models were developed using the mixed logit modeling method based on the 664 respondents from the three cities. The models found that several variables, particularly travel time, toll, gender, and income, were better predictors of ML usage than the psychological variables. However, a couple of psychological variables were significant in the models:

- Similar to the student survey above, the respondents with a higher risky driving style score were less likely to choose the carpooling on the GPLs. This seems reasonable since many of the risky driving style questions dealt with faster travel – which MLs allow.
- Respondents with high conscientiousness scores were less likely to choose carpooling on the GPLs. This seems reasonable as those with high conscientiousness liked structure and both carpooling and the GPLs were the least structured options.

Therefore, this research found that some psychological variables have the expected relationships with a traveler's mode choice. However, the impact was minimal based on the models developed here. It is recommended that an additional, larger survey be undertaken to be sure that our results were not simply due to a relatively small sample size.

1. INTRODUCTION

Managed Lanes (MLs) offer travelers the option of congestion-free travel in corridors where the general purpose lanes (GPLs) are often congested. To ensure the MLs do not become congested (and often to help pay for the construction of the lanes) travelers have to pay a toll or meet a certain criteria (such as 3 or more occupants in a vehicle) to use the MLs. The toll generally varies by time of day or by congestion level, increasing as demand for the lane increases. Thus, travelers have to make a decision, often at the spur of the moment, between a tolled, free-flow trip, or an untolled congested trip.

This decision is a difficult one for transportation planners to predict. The decision varies by traveler and the same traveler can easily make a different decision on any given trip due to the constraints of that particular trip. The majority of patrons on the few MLs in operation use the MLs only occasionally. For example, on the rare occasion the traveler is running late for a meeting and is not willing to risk being late. Unfortunately, the ability to predict and value these infrequent uses does not exist. The true value, and therefore benefits, of MLs are unknown.

The likelihood that a traveler will use a toll road is often estimated using stated preference surveys. However, based on very limited data, stated preference surveys for MLs and high occupancy/toll (HOT) lanes appear to underestimate willingness to pay. For instance, recent analysis of Katy Freeway/Managed Lane travelers (Devarasetty et al., 2012a) and I-394 Freeway/High Occupancy Toll lane traveler data (Burris et al., 2012) has shown that many travelers pay to use these MLs when adjacent toll-free lanes are operating at the nearly same speed. Assuming that drivers are indeed cognizant of the fact that MLs are traveling at nearly the same speed, then it would seem that travelers are paying for the use of these lanes for reasons other than travel time savings. Therefore, current models do not capture the full story. Consequently, this research examined if pertinent individual difference variables (i.e., differences in personality, attitudes, and preferences between individuals) can contribute to an explanation and understanding of travelers choosing MLs

It has long been empirically established that individual differences play an important role in driving-related behavior and choices. However, the typical outcome variable of interest has been errors and violations as anomalous behaviors that have typically been operationalized as crashes and moving violations (i.e., tickets) (Arthur and Day, 2009). Recent research has also began to pay some attention to driving anger expression as a potentially relevant driving outcome (Dahlen et al., 2012). Regardless of the specific outcome, there are three general classes of variables that have been considered as predictors of driving behaviors: demographic and exposure factors, information processing variables, and personality traits (Arthur and Day, 2009). Conceptually, the viability of these variables as predictors of driving outcomes is concordant with the well-established relationship between knowledge, general mental ability, and personality traits with performance in the workplace (Barrick and Mount, 1991; Hunter, 1986). Although general mental ability and declarative knowledge of driving principles have not performed well as predictors of driving outcomes, personality traits have been shown to be successful predictors (Clarke and Robertson, 2005). Consequently, an investigation of the role individual differences play in the choices that travelers make to pay to use MLs is an important extension. A preliminary review of the extant literature identified a cluster of variables as being theoretically germane to the domain of traveler choices. These are conscientiousness, locus of control, personal need for structure, risk tolerance, driving risk perceptions, and driving styles. The general theoretical and conceptual basis for the role of these variables is that individuals who have a low tolerance for uncertainty when traveling and a high preference for predictable or safe travel conditions may be more likely to use ML because of the perceived predictability of travel speed and time associated with the use of these lanes.

2. BACKGROUND AND LITERATURE REVIEW

One of the main objectives of this research is to improve our understanding of the behavior of travelers using the MLs. Specifically, a primary objective is to study the influence of psychological traits of travelers that may help in understanding their use of those lanes. The variables influencing an individual's preference can be broadly categorized as trip characteristics and driver characteristics. Literature on the variables influencing ML usage, survey design, psychological characteristics, and related aspects is presented in this chapter.

2.1 Managed Lanes

Vehicle miles traveled (VMT) has been increasing rapidly in the U.S. However, due to revenue scarcity, available lane miles have not increased at the same pace. This is causing congestion on most urban highways. Congestion is a major problem in the U.S., costing Americans billions of dollars in wasted fuel and wasted time spent in traffic (Shrank and Lomax, 2011). Thus, careful planning and innovative financing are required to construct new facilities or manage existing facilities to help minimize the impact of congestion. MLs are frequently newly constructed toll lanes closest to the middle of an existing freeway. The ML toll is set to be large enough to ensure congestion does not occur on the MLs. Thus, the toll increases during periods of peak demand and drops during off-peak periods. The tolls are also frequently reduced or eliminated for vehicles engaged in carpooling, thereby encouraging ride-sharing. They also encourage transit use, as most facilities allow transit vehicles to use the lane for free. In this way, MLs offer a revenue stream to (1) support the financing of their construction, and (2) pay for their operations and management. In addition, MLs offer a guaranteed high-speed alternative, provide significant mobility benefits, and can even offer incentives to carpool (Burris et al., 2011).

ML facilities include HOV lanes (usually two or more people per vehicle), HOT lanes, and exclusive special use lanes (e.g., express lanes (ELs), bus only lanes) (Federal Highway Administration [FHWA], 2004). The FHWA defines managed lanes as "a limited number of lanes set aside within an expressway cross section where multiple operational strategies are utilized, and actively adjusted as needed, for the purpose of achieving pre-defined performance objectives" (FHWA, 2004).

There are numerous benefits of MLs to society and users, the main benefits for travelers are travel time savings and more reliable travel times. Unlike the general purpose lanes (GPLs), which are often quite congested during the peak hours, ML facilities operate at speeds close to or at free-flowing (i.e., no congestion) speeds. Speed variations on eastbound Katy Freeway MLs and GPLs during peak hours (7:00 AM to 9:00 AM) are shown in Figure 1. These data were from all weekdays (except holidays) for the year 2009. The GPL curve is flatter, and the speeds are widely spread. On the other hand, the ML curve has one peak in between 60 and 70 mph. Nearly 70 percent of the travelers are able to drive between 60 and 70 mph, while only 40 percent of GPL travelers are able to travel at these speeds. This indicates that MLs are more reliable than GPLs. According to Burris and Patil (2009), an efficiently operated ML can carry more traffic than a general purpose lane. Thus, MLs provide travel time savings to users and reduce fuel consumption. By reducing the congestion, MLs are also expected to cause less pollution and fewer traffic crashes (Collier and Goodin, 2002).

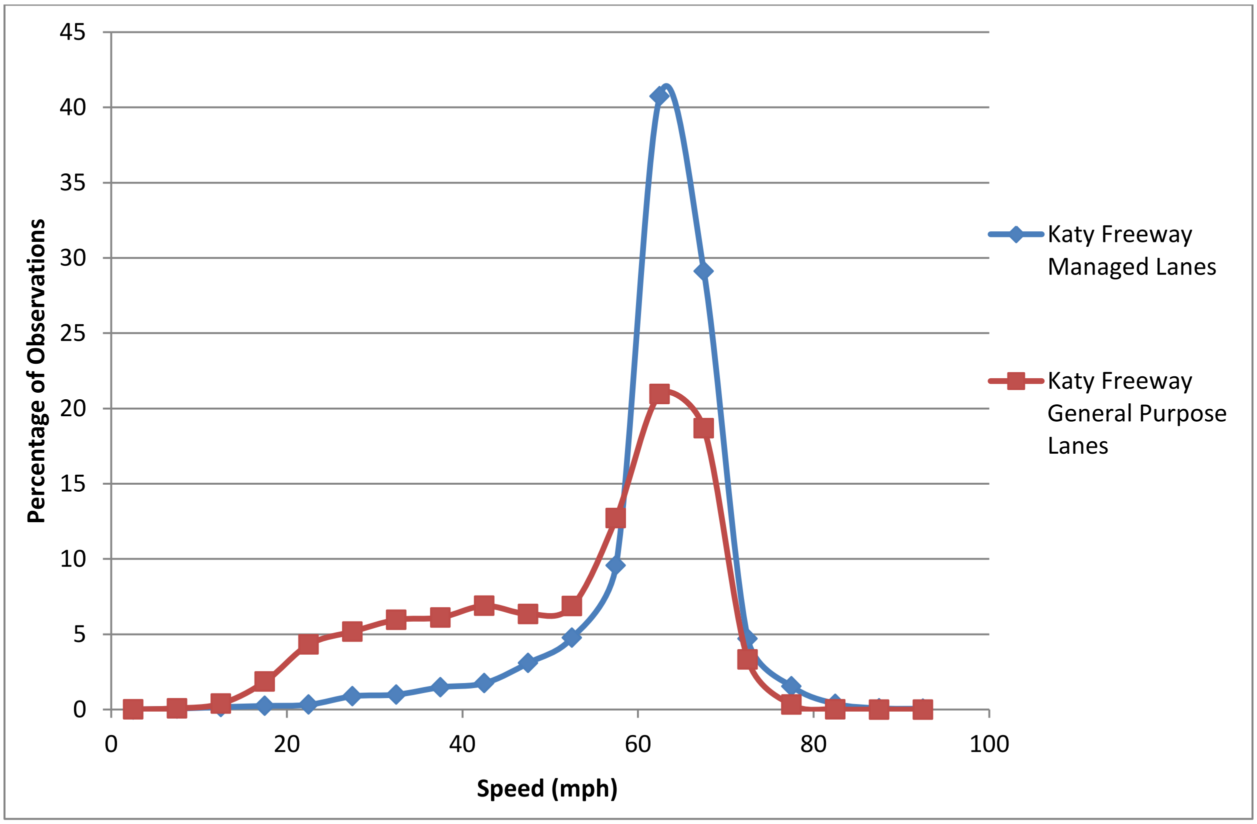

Figure 1: Speed Variation on Katy Freeway (Eastbound) during Peak Hours (7:00 AM to 9:00 AM) (Burris et al., 2011)

Recognizing the various benefits offered by MLs, many state departments of transportation (DOTs) are considering MLs as a potential solution to reduce congestion. A recent study by Devarasetty et al. (2012a) on Katy Freeway MLs found that many travelers are using the MLs when there are minimal or no travel time savings (see Figure 2). It can be seen that during off-peak hours there are between 2 to 6 percent of travelers paying to use the MLs (including SOVs and HOVs) when the actual travel time savings was less than a minute during these time periods. Similar results were also found by Burris et al. (2012) based on their study on I-394 MnPass ELs in Minnesota and I-15 ELs in San Diego. They found that 35 percent of the MnPass travelers paid to use the I-394 ELs when the travel time savings was less than a minute. The study suggested that travelers were not just paying for travel time savings but also for other benefits such as the added reliability of travel times. With increased interest in MLs there is a need for research to further understand and identify variables that influence travelers' use of

MLs. This would help in estimating the benefits of the MLs more accurately and enable better estimates of the potential use of MLs.

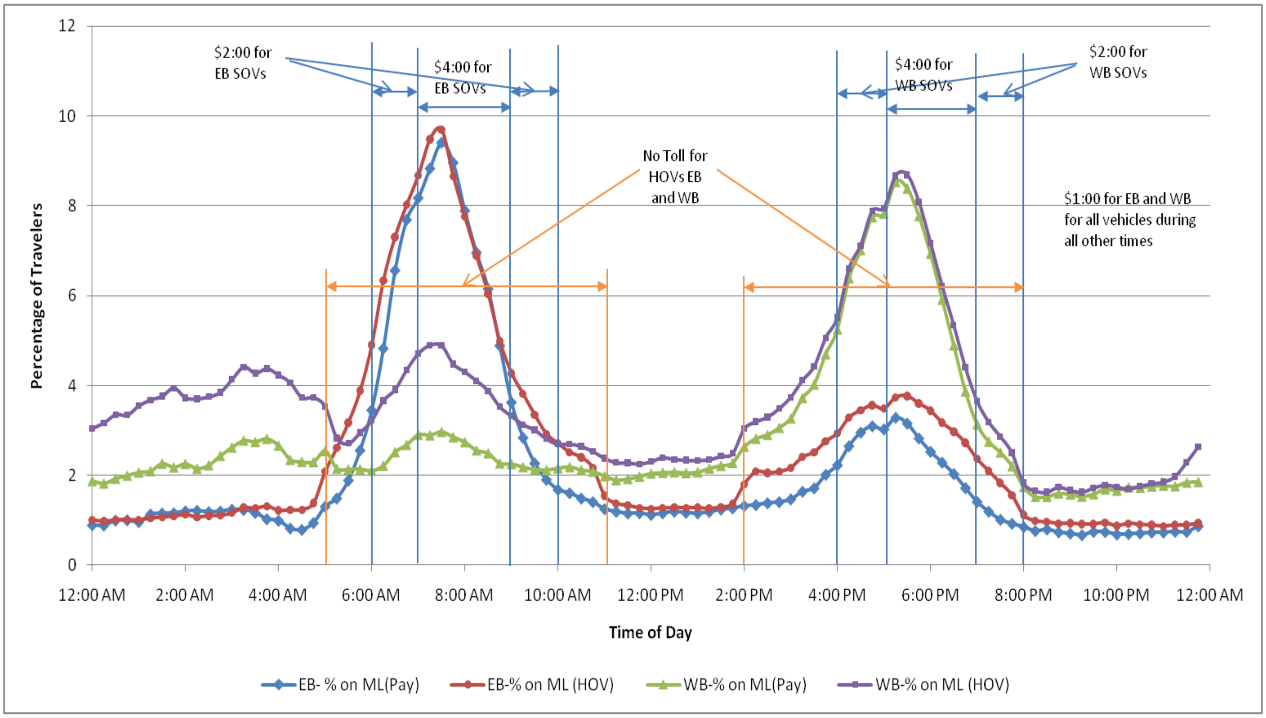

Figure 2: Average Percentage of Travelers on the Katy Freeway MLs by Time of Day Obtained using 2009 Weekday Data (Devarasetty et al., 2012a)

2.2 Potential Variables Influencing Managed Lane Usage

Numerous factors may influence a traveler's decision to use MLs. Those can be broadly categorized as (1) characteristics of the trip and (2) characteristics of the driver. In this section, literature regarding both aspects is examined. This is not an exhaustive list and focuses on those aspects most pertinent to ML use. These include travel time, travel time reliability, and the toll. For the sake of brevity, there are a number of other variables, such as trip purpose, that have not been discussed in the literature review but will be examined when developing and analyzing the survey.2.2.1 Characteristics of the Trip

2.2.1.1 Travel Cost

Travel cost refers to out-of-pocket expenses involved in taking the trip. It may include fuel cost, toll, wear and tear of the vehicle, etc. (Lee and Burris, 2005). In this study, we are more interested in the effect of toll on the mode choice, so only toll is considered as one of the attributes defining the alternative (mode). Additionally, since the mode is automobile in this study, the other costs change little between MLs and GPLs. Not surprisingly, studies have shown that travelers have a disutility for paying a toll, that is travelers would prefer a lower tolled alternative over a higher tolled alternative, ceteris paribus (Cherlow, 1981; Lam and Small, 2001; Small et al., 2005; and De Jong et al., 2007). Toll always enters the utility function in discrete choice models with a negative coefficient.

2.2.1.2 Travel Time

One of the most influential attributes that affects a traveler's preference for MLs is the travel time savings offered by the lanes. Many researchers have shown that travelers have a disutility for higher travel time and would prefer an alternative that has a lower travel time (Devarasetty et al., 2012a; Devarasetty et al., 2012b; Ghosh, 2001; and Hensher et al., 2005). Studies have shown that people value travel time savings and are willing to pay for reducing their travel time. There is abundant literature estimating value of travel time savings (VTTS) also referred to as value of time (VOT). VTTS is the amount of money an individual is willing to pay to save a unit of travel time. The earliest studies on VOT date back to the 1960s (Becker, 1965; Beesley, 1965; Oort, 1969). Travelers' VTTS is typically estimated using SP surveys. It is calculated from the discrete travel choice models and is derived as the marginal rate of substitution (MRS) between travel time and cost in the choice models (De Jong et al., 2007).

The value individuals place on travel time savings is influenced by six main factors: the time of day of the trip, the purpose of the trip, the characteristics of the trip (routine, congested, or free-flow), the length of the trip, the mode of travel, and the size of travel time savings (Mackie et al., 2001). Apart from these above-mentioned factors, the travel time savings value may also depend on socio-economic characteristics of the travelers. In the same context, Patil et al. (2011b) tried to estimate the VTTS for different situations including one normal and six urgent situations. They found that travelers place a higher value for travel time savings when in an urgent, important travel situation than in a normal situation.

Cherlow (1981) summarized various studies conducted on the evaluation of VTTS. The estimated VTTS varied from as low as 9 percent of the wage rate to as high as 140 percent of the wage rate. He suggested that there is no single VTTS that can be applicable to all people in all circumstances. A more recent study by Lam and Small (2001) estimated the average VTTS to be $22.87 per hour, or 72 percent of the average wage rate. There have been a few studies in the recent literature trying to estimate the VTTS on MLs. A study by GDOT using SP survey data estimated the VTTS of passenger car users to be in the range of $7 to $15 per hour. They have also observed that VTTS varied with the type of vehicle, such that truck users with 6-axles value travel time savings at a higher price than passenger cars (GDOT, 2010). A more recent study on I-25 travelers in Miami by FDOT estimated the VTTS as 49 percent of the hourly wage, with a range of $2.27 to $79.32 per hour with a mean value of $32 per hour (Perk et al., 2011).

2.2.1.3 Travel Time Reliability

Travel time reliability (TTR) refers to the predictability or variation in the travel time of a particular mode/alternative. Higher variation in the travel time indicates that the mode is less reliable or less predictable. Research has shown that travelers have a disutility for unreliable travel time (Devarasetty et al., 2012a, Devarasetty et al., 2012b) and often are willing to pay for a mode that has a low variation in travel time. According to Barry et al. (2005), in the presence of substantial road congestion, a reduction the travel time variability is valued more than a reduction in travel time savings. It is often calculated from the discrete travel choice models and is derived as the MRS between travel time variability and cost in the choice models.

TTR or travel time variability is defined differently by different researchers. Several researchers have defined variability to be the difference between the 90^{th} percentile and 50^{th} percentile travel time (Ghosh, 2001; Lam and Small, 2001), whereas, some have assumed it to be the difference between the 75th and the 25th percentile of travel time (Small et al., 2005). Some have defined it as the standard deviation of the travel time.

Empirical estimates of VOR have varied considerably, ranging from as low as 0.55 times (Black and Towriss, 1993) to 3.22 times (Small et al., 1999) the VOT. Brownstone and Small (2005), using the data from SR-91 and I-15 high occupancy toll (HOT) lanes, estimated the VOR to be 95 to 140 percent of the median travel time. Small et al. (2005) calculated the median VOR using RP data of travelers in Los Angeles and estimated it be 85 percent of the average wage rate ($19.56/hr). A recent study by Tilahun and Levinson (2010) found that the travelers value travel time reliability very close to their value of time.

2.2.2 Characteristics of the Driver

2.2.2.1 Socio-economic Characteristics

Many socio-economic characteristics of travelers have been shown to influence their use of MLs. The most important being income, with higher income travelers more likely to use the MLs more often (Sullivan, 2000). However, travelers from all income levels will use the lanes. Additionally, females tend to use the lanes more often than males (Devarasetty et al., 2012a). This may be due to more constrained schedules on both ends of their trips.

2.2.1.5 Psychological Characteristics

Arthur and Day (2009) distinguished between three categories of predictors of driving outcomes, specifically, demographic and exposure variables, information processing variables, and personality traits. In this section, we briefly review the research on predictor variables from the personality literature, and provide the rationale for considering these variables in the present study.

Some personality traits commonly used in personnel and organizational psychology research have been successfully used in the prediction of crash involvement and moving violations. For instance, Clarke and Robertson's (2005) meta-analysis revealed that extroversion, conscientiousness, and agreeableness are all valid predictors of crash involvement (corrected mean validities of .24, .26, and .21, respectively; mean validity represents the mean correlation between two variables across numerous studies).

The documented role that individual differences play in driving performance outcomes served as the impetus for considering and exploring the role that they could play in travel choices. Consequently, on the basis of a detailed review of the extant literature, a number of personality traits that seemed theoretically germane to driving choices were identified. These individual difference variables are briefly described in the following paragraphs.

Conscientiousness was determined to be a variable related to the choices individuals make when traveling. Conscientious individuals describe themselves as more careful, reliable, self-disciplined, persevering, and perceptive. In contrast, individuals low in conscientiousness describe themselves as careless, undependable, lazy, and disorganized (McCrae and Costa, 1987). Therefore, conscientious individuals may be more likely to make decisions ahead of time and thus leave plenty of time to travel and not require MLs in order to arrive at a destination on time. By the same token, these individuals may also prefer the predictability in scheduling provided by the use of MLs.

Locus of control as a predictor of driving outcomes represents the extent to which individuals perceive rewards or reinforcement as contingent upon their own behavior, skills, or internal dispositions (Rotter, 1966). For instance, if a driver believes that crashes are the result of luck or other factors outside of the driver's control, then he/she will regard safety-related behaviors as less important, and these behaviors will be less likely to be learned or enacted. Consistent with this, Arthur et al.'s (1991) meta-analysis obtained a mean validity of .20 for locus of control and crash involvement. Extending locus of control to the use of MLs, it is posited that individuals who have an internal locus of control (i.e., they regard outcomes as dependent upon their own behavior) are more likely to use MLs because they prefer to exert personal control over their driving outcomes through avoiding traffic, and other unforeseen events that may negatively impact their travel time and the potential to be late.

Risk attitudes represent a person's generic orientation towards taking or avoiding a risk when deciding how to proceed in situations with uncertain outcomes. Weber et al. (2002) conceptualize risk taking within a risk-return framework wherein individual choices reflect a trade-off between risk (fear) and expected return (hope). In addition, Weber et al. regard risk taking as a highly domain-specific construct meaning that individual risk taking attitude is not necessarily consistent across different domains (i.e., the same individual may dislike investing money in uncertain markets but at the same time would take the risk of making unpopular statements in public). Risk attitudes are likely to be reflected in an individual's travel decisions whereby those with a high tolerance for risk are less likely to use MLs because they have a greater tolerance for the uncertainties associated with the use of regular travel lanes.

According to Neuberg and Newsom (1993) people create and use abstract mental representations of their experiences to reduce information complexity and lessen cognitive loading. Accordingly, *personal need for structure* speaks to a preference for structure and simplicity in one's thinking. People high in need for structure are likely to enjoy a consistent routine and prefer structured situations mainly because under these circumstances their need for structure is fulfilled. Individual differences in need for structure represent a potentially important trait for predicting the use of MLs as individuals with a high need for structure are expected to prefer the confidence that comes from knowing what to expect when using a ML—that is, predictable travel time.

Driving risk perceptions comprise an individual's cognitive and emotional reactions to traffic safety. Prior research has shown driving risk perceptions to be related to speeding and crashes (Rundmo and Iverson, 2004). The indicators of risk perceptions are measured using both emotional- and cognitive-based aspects of perceiving risks while driving. The emotion-based risk perceptions assess the degree to which drivers are fearful or anxious about traffic crashes, whereas the cognitive-based aspects measure the extent to which drivers think about the possibility of such outcomes. Driving risk perceptions may play a role in the choices and decisions drivers make concerning MLs. For example, a driver who perceives a lot of risk while traveling may choose MLs as a safer alternative to GPLs.

The final set of individual differences considered important in the study of travel choices are *driving styles*. Driving styles describe the way drivers choose to drive or the way they habitually drive (Taubman-Ben-Ari et al., 2004). In addition to personality factors, researchers posit that the type of driving style is also an important determinant in predicting driving outcomes (Elander et al., 1993). Because driving styles are behavioral tendencies, they may play a role in the choices drivers make with respect to the use of MLs. Specifically, individuals with a risky driving style may prefer GPLs because they feel allowed to engage in risky behaviors that cannot be executed in MLs, such as getting through traffic faster or purposefully tailgating other drivers.

2.3 Stated Preference Survey Design

Stated preference (SP) surveys are often used in transportation research to estimate or forecast the behavior of travelers. SP survey methods allow researchers to study the travelers' response to different potential travel alternatives, where the alternatives may currently exist or may not (i.e., they may be reasonable but hypothetical alternatives). A typical SP survey consists of several choice sets, where each choice set contains a set of two or more alternatives. Each alternative in the choice set is in turn defined by a set of attributes. The values of the attributes vary in their levels. The respondents of the survey are asked to choose an alternative in each choice set that best suits their travel. For example, consider the following situation where the traveler has two routes for travel between destinations A and B. The alternative routes are described by two attributes, time and toll. Suppose that route 1 has a travel time of 10 minutes and a toll of $1, and route 2 has a travel time of 15 minutes and a toll of $0.50. Using the standard stated choice modeling language, the alternatives for this choice set are route 1 and route 2 and the attributes are the respective travel time and toll rates for each (travel time: 10, 15 minutes; toll: $0.50, $1). The values of these attributes allow the respondent to consider trade-offs between the alternatives. In this study, two attributes toll and travel time are used to describe the alternatives. Travel time reliability can be an important attribute that has a considerable influence on a travelers' preference for MLs. But, it was not used in this study as it is difficult to present travel time reliability in simple words and too much information on the alternatives may make the mode choice decision difficult for the respondent. Also, since the main objective of this survey is to identify psychological variables that may influence the mode choice decision, the alternatives were described with a minimal number of attributes.

The levels of attributes allocated across the different alternatives in an SP experiment are chosen by the researcher in the design process and have a direct influence on the statistical significance of the estimates of the mode choice model (Dellaert et al., 1999; Hensher, 2004; Ohler et al., 2000; Rose et al., 2008). Hence, choice of attribute levels to be presented to describe the alternatives is an essential aspect in the design of an SP survey. There exists several design techniques to obtain the attribute levels across the various alternatives. In this study two of those methods were tested, they are: (1) Bayesian efficient designs and (2) adaptive random designs.

2.3.1 Bayesian Efficient Designs

Efficiency means that the parameters in the resulting mode choice models have been estimated using an approach that results in the smallest standard errors for the parameters, ensuring the largest possible *t* statistics that indicate significant difference from a zero influence on the choices. For generating efficient designs, the attribute levels across various choice sets are chosen based on an appropriate efficiency criterion. The fundamental concept behind the efficiency criterion for generating choice designs is to therefore minimize the asymptotic standard errors (the square roots of the diagonal elements of the asymptotic variance-covariance

[AVC] matrix) of the parameter estimates of the discrete choice models (Bliemer et al., 2008). Huber and Zwerina (1996) showed that efficient designs either improve the reliability of the parameters estimated from the stated choice experiment data at a fixed sample size or reduce the sample size requirements for a chosen level of reliability of parameter estimates for a given experimental design. In this study, D-error efficiency criterion is used, where the efficient design is obtained by minimizing the D-error (a measure of efficiency calculated as the determinant of the AVC matrix) of the AVC matrix of the parameter estimates of the discrete choice model (Bliemer et al., 2008; Huber and Zwerina, 1996). For a discrete choice model the AVC matrix is equal to the inverse of the Fisher information matrix (see Equation 1).

$$AVC = -\frac{1}{N}\left(\frac{\partial^2 LL(\boldsymbol{\beta})}{\partial\boldsymbol{\beta}\partial\boldsymbol{\beta}'}\right)^{-1} \qquad (1)$$

where, N = number of respondents (usually only one complete design for a single respondent is considered for estimation of the D-error while searching for the D-efficient design),

LL = log-likelihood function for the discrete choice model, and

$\boldsymbol{\beta}$ is a vector of parameters used in the model.

It is apparent that to estimate the AVC matrix for the choice model, it is required to know the design and also the estimated parameter values ($\boldsymbol{\beta}$). Since the parameter values are not known in advance of conducting the survey and estimating the choice models, an educated guess based on literature is often made for those values. Using these guesses is consistent with Bayesian statistical analysis. In some cases, it is possible to obtain prior estimates (priors) from the literature. However those priors are obtained, there will always be some uncertainty in the values. The experimental design thus generated will only be efficient for the specified priors assumed. If the priors are incorrectly specified, the efficiency of the designs may be lowered (Bliemer et al., 2008). In order to increase the efficiency of the design from the assumed values, Bayesian techniques were proposed by Sándor and Wedel (2001). In this approach, instead of taking a fixed value for priors, a random distribution is assumed for the priors. The designs thus obtained are known as Bayesian efficient designs. The Bayesian D_b-error can be calculated using Equation 2.

$$D_b - error = \int_{\beta} \det\left(AVC(\beta|X)\right)^{1/K} \phi(\beta|\theta)\, d\beta \qquad (2)$$

where, $\phi(\beta|\theta)$ is the joint distribution of the assumed parameter priors,

θ are the corresponding parameters of the distribution, and

K is the number of parameters in the model.

The computation of the integral in Equation 2 is complicated, as it cannot be calculated analytically. The integral is approximated using several methods. In this study, Halton draws are used for simulating the distributions (see Ngene, 2012 for more details on Halton draws). Independent of the method used for simulation, the following steps are used to generate an efficient design. First, R independent draws are taken from each of the prior distributions of the K-parameters. Then, D_b-error is calculated for each of the designs for each of the R draws.

Finally the D_b-error of the design is approximated as the average of all the computed D_b-errors. The computed D_b-error can be written as Equation 3.

$$D_b - error = \ {}_{r=1}^{R} \det AVC(\beta^r \ X \ {}^{1/K} /R \qquad (3)$$

where, $\tilde{\beta}^r = [\tilde{\beta}_1^1,...,\tilde{\beta}_k^r]$, and r denotes the draw (1,2,…,R).

2.3.2 Adaptive Random Designs

Adaptive random design, as the name suggests, is a non-experimental approach to generate the attribute levels in a design. In this approach the attribute levels adapt to the respondent’s previous responses in a logical manner. The attribute levels are generated by utilizing the information provided by the respondent in his/her previous SP response in the same survey (Richardson, 2002). The main benefit of using adaptive random designs over other designs is that it allows the researcher to estimate a more exact value a respondent attaches to an attribute of interest (Fowkes, 2007; Richardson, 2002; Smalkoski and Levinson, 2005; Tilahun et al. 2007). More information per respondent is obtained as the method can estimate traveler valuations at the individual traveler level (i.e., disaggregate), thus it needs smaller sample sizes to obtain statistically significant estimates. Adaptive random designs were successfully used by many researchers to estimate the willingness to pay values (Devarasetty et al., 2012a; Patil et al., 2011a; Richardson, 2002). Patil et al. (2011a) tested three survey design techniques (D-efficient, random, adaptive random) to estimate the value of travel time savings of the ML users and found that adaptive random design outperformed the other two designs.

2.4 Discrete Choice Modeling

Discrete choice models are used to develop utility models based on the traveler responses to the survey. These models are further used to estimate the implied willingness to pay for travel time savings.

2.4.1 Multinomial Logit Model

The multinomial logit (MNL) model was first developed by McFadden to model choice behavior (McFadden, 1974). In transportation planning, these models are used to model mode choice behavior of the travelers. Standard random utility theory suggests that the utility of an individual *i* ($i = 1,2,...n$) choosing an alternative *j* ($j = 1,2,...J$) in a given choice set *s* ($s = 1,2,...S$) can be written as Equation 4. Each individual chooses an alternative in a choice set that maximizes his/her utility (U), illustrated below in linear form.

$$U_{i,j,s} = \boldsymbol{\beta}'\mathbf{X}_{ijs} + \epsilon_{i,j,s} \qquad (4)$$

where, $\mathbf{X}_{ijs}$ = vector independent variables which include alternative specific constants, characteristics of the individuals, characteristics of the alternative, and other descriptive variables affecting the choice,

$\boldsymbol{\beta}$ = vector of coefficients weighing the alternative specific attributes, and

$\epsilon_{i,j,s}$ = the error components which may be due to unaccounted measurement error, correlation in the parameters, unobserved individual preferences, and other similar unobserved characteristics of the choice-making.

The first two terms of Equation 4 are called the systematic part of utility function. The last term is called the stochastic part or random (error) part. The standard assumption in the random utility model is that the individual knows the value of the error term while the researcher does not. This implies that there is no risk or uncertainty on the part of the choice maker. Consider the following example of the systematic part of the utility function (see Equation 5).

$$V_{ij} = \beta_0 + \beta_1 * \text{TravelTime}_{ij} + \beta_2 * \text{TravelCost}_{ij} + \beta_3 * \text{Income}_i \quad (5)$$

where, β_k = the estimated coefficient of each independent variable X,

$TravelTime_{ij}$ = the travel time of mode *j* for individual *i*,

$TravelCost_{ij}$ = the cost of travel on mode *j* for individual *i*, and

$Income_i$ = the income of individual *i*.

Because utility is linear in the specification, the VOT can be easily estimated for this example by taking the ratio of the partial derivative of utility function with respect to travel time to the partial derivative of utility function with respect to travel cost, which yields the ratio of coefficients. For this linear utility function, the VOT can be derived as β_1/β_2 .

The structure of the MNL assumes that the error terms are identically and independently distributed as type I extreme value distribution. Under this assumption, the probability that individual *i* chooses alternative *j* in a given choice set is given by Equation 6.

$$\text{Prob (choice } j \text{ |individual i, s, } \boldsymbol{\beta}, \mathbf{X}_{ij}) = \frac{\exp \boldsymbol{\beta}'\mathbf{X}_{ijs}}{\sum_{j=1}^{J} \exp \boldsymbol{\beta}'\mathbf{X}_{ijs}} \quad (6)$$

The independence assumption implies that the ratio of choice probabilities of a pair of alternatives is independent of other alternatives. This property of MNL is called the independence of irrelevant alternatives (IIA). Although this property simplifies the estimation process, it may not be desirable in many cases.

MNL models are thus appropriate when modeling what are truly independent alternatives. However, in the stated preference survey conducted for this research, we had alternatives such as driving alone, carpooling on general purpose lanes, and traveling on the MLs with tolls that vary with the time of day and the mode of travel. In such cases, there may be a possibility that the unobserved information required to make a choice may allow for correlations across alternatives and also across choice situations (Hensher and Greene, 2003). This may cause a violation of the IIA assumption of the MNL model. Also, in the SP survey, multiple observations were obtained from the same individual. To model such responses, mixed logit models are commonly used.

2.4.2 Mixed Logit Model

The mixed logit model, or random parameter logit model, is a relatively new innovation in discrete choice modeling. It is considered by many researchers as the most promising tool for modeling discrete choice data (Hensher and Greene, 2003). A mixed logit model allows the researcher to account for both observed and unobserved heterogeneity of individuals in the models (Greene et al., 2006). With the mixed logit model, it is also possible to model repeated responses from individuals (panel data), scale differences in data sources (although this is also possible with more basic models), modify error structures, and accommodate heteroscedasticity (non-constant variance) from various sources (Ben-Akiva et al., 2001; Bhat and Castelar, 2002; Brownstone and Train, 1998; Greene et al., 2006; Greene and Hensher, 2007; Hensher et al., 2008).

In a mixed logit model, the parameters in the random utility function (Equation 4) are assumed to be random and may vary across individuals to introduce heterogeneity among individuals. The parameters can be specified as in Equation 7.

$$\boldsymbol{\beta_{ik}} = \boldsymbol{\beta_k} + \boldsymbol{\sigma_k}\boldsymbol{\upsilon_{ik}} \tag{7}$$

where, β_k = the population mean for the k^{th} attribute,

υ_{ik} = the individual specific heterogeneity with mean 0 and standard deviation (scaled to) 1, and
σ_k = the standard deviation of the (assumed) distribution of the $\beta_{ik}{}'$s around β_k.

For each or all of the parameters or coefficients, various empirical distributions can be assumed, although in practice, the possibilities are usually limited to a few well-known families (the normal, the log normal, and the triangular). In our case, the travel time and toll parameters can be assumed to be random parameters and have different distributions. However, in this research, we are interested in estimating the value of travel time savings, which is estimated as ratios of two parameters. Hence, assuming random distributions for travel time and toll may add complexity in estimating the VTTS (Hensher et al., 2005). Choosing the right distribution is also critical for drawing meaningful inferences from the estimates. One of the more commonly used distributions in practice is the triangular distribution for the travel time parameter (Hensher et al., 2005).

Preference heterogeneity in the mean and heteroscedasticity relating to the variance can be introduced in the mixed logit by specifying the random parameters, as in Equation 8 (Greene and Hensher, 2007; Patil et al., 2011b).

$$\beta_{ik} = \beta_k + \boldsymbol{\delta}'_k\mathbf{z}_i + \gamma_{i,k}\upsilon_{i,k} \tag{8}$$

where, $\boldsymbol{\delta}'_k\mathbf{z}_i$ = the observed heterogeneity around the mean of the k^{th} random parameter ($\boldsymbol{\delta}_k$ is to be estimated and $\mathbf{z}_i$ is a data vector which may contain individual specific characteristics such as the socio-demographic factors);

$\upsilon_{i,k}$ = the vector that contains individual and choice-specific, unobserved random disturbances with $E[\upsilon_{i,k}]$ = 0 and $\text{Var}[\upsilon_{i,k}] = a_k^2$, a known constant; and

$\gamma_{i,k} = \sigma_k \exp[\boldsymbol{\eta}'_k \mathbf{h}_i]$ with $\exp[\boldsymbol{\eta}'_k \mathbf{h}_i]$ as the observed heterogeneity in the distribution of $\beta_{i,k}$ ($\boldsymbol{\eta}_k$ is to be estimated and $\mathbf{h}_i$ is a data vector which may contain individual specific characteristics).

The results from the model specified using Equation 8 can be used to estimate the values of VTTS for different groups (Hensher et al., 2005). The conditional probability with the above specification of utilities is given by Equation 9 (Greene and Hensher, 2007; Hensher et al., 2008; Patil et al., 2011b).

$$\text{Prob}_{i,s}(\text{j}_\text{s}|\mathbf{X}_\text{is},\boldsymbol{\Omega},\mathbf{z}_\text{i},\mathbf{v}_\text{i}) = \frac{\exp \boldsymbol{\beta}' \mathbf{x}_{ijs}}{\sum_{j=1}^{J} \exp \boldsymbol{\beta}' \mathbf{x}_{ijs}} \qquad (9)$$

where, $\boldsymbol{\Omega}$ = the parameter set that collects all the structural parameters (the underlying parameters in the model/equation).

The conditional probabilities (Equation 9) are functions of the unobserved individual specific random terms; because of this, these cannot be used to form the likelihood function for the estimation of the parameters (Hensher et al., 2008). By integrating the heterogeneity out of the conditional probabilities, the unconditional choice probability can be formed. However, the integral does not exist in a closed form; in other words, it is not integrable in elementary mathematical functions. So, the integral has to be approximated using simulation (Bhat, 2003; Revelt and Train, 1998; Train, 2003). Random draws are taken from each of the random parameters, and the utilities are calculated for each of these draws. The calculated utilities are used to calculate the probabilities and finally are averaged to estimate the unconditional probabilities.

The simulated probabilities are used to form the simulated likelihood function. The estimation procedure is affected by the number of draws taken during the estimation process and the sample size. Halton draws are more efficient and give more precise results than random draws (Bhat, 2001; Hensher, 2001). It is very common to find 100 to 500 Halton draws being used for the model estimation (Greene et al., 2006; Greene and Hensher, 2007; Hensher et al., 2008). In this research, we used 200 Halton draws to estimate the mixed logit models.

2.5 Analysis of Psychological Factors

The individual difference variables that were investigated in the present study were operationalized using self-report measures. Although these measures were developed and established in the extant literature as psychometrically sound instruments for measuring the intended variables, we sought to investigate and refine the measures, as warranted, for the purposes of the present study. Thus, data were collected and subsequently analyzed to confirm that the measures demonstrated acceptable psychometric properties. Specifically, we assessed the reliability of scores from each measure, and the extent to which they displayed the expected pattern of theorized relationships with other measures (i.e., construct-related validity).

Consequently, prior to proceeding with the full scale data collection for the study, offline pilot-test data were first collected from a small independent sample and used to conduct the initial analyses of the measures. This analysis consisted of confirming that the internal consistency reliability estimates were acceptable. The statistic used to assess the internal consistency reliability was Cronbach's alpha, which is an index ranging from 0 to 1 representing the degree to which items consistently (i.e., homogeneously) measure the same construct (i.e., the conceptual psychological variable that is not directly observable). Analyses to examine the construct-related validity entailed an examination of correlations between the psychological constructs. Positive correlations were expected between theoretically similar variables (e.g., risk tolerance and risky driving style), and negative correlations were expected between theoretically dissimilar variables (e.g., risky driving style and careful driving style).

Following necessary revisions to the measures as a result of the offline pilot-test, the complete battery of measures was used to collect offline primary data from a sample of undergraduate students. This was done to provide a set of data in which all participants completed all the measures in the study. A complete dataset is also valuable for providing comparisons with the online dataset, which needed to be blocked in order to advertise the online survey as brief. A description of the blocking structure that was used for the online data collection is provided in the following chapter.

3. DATA COLLECTION

The main goal of this research was to further our understanding of the behavior of travelers using MLs, in particular, the psychological variables that most influence their lane choice. To achieve this goal a stated preference survey was conducted to collect information about travelers' standing on the specified individual difference variables and their preference for MLs.

3.1 Study Area

The survey was conducted in four major cities where ELs have been operational for at least two years. The four locations were:

1) I-25 Express lanes in Denver.
2) I-95 Express lanes in Miami.
3) I-15 Express lanes in San Diego.
4) SR-167 Express lanes in Seattle.

It should be noted here that Express lanes (ELs) are a type of MLs. These four locations preferred to call their MLs as ELs. Also note that due to very poor response to the survey in Seattle (only 2 respondents) no analyses were undertaken for respondents in this city. Consequently, we also do not present a discussion of the Seattle Express lanes.

3.1.1 I-25 Express lanes in Denver

The I-25 HOV/Tolled Express Lanes in Denver opened on June 2, 2006. The facility spans 7-miles running from downtown Denver, Colorado, north to US 36. It is a reversible two-lane, barrier-separated facility. One of the lanes is reserved for HOVs and buses, and the other is open to SOVs for a toll. There are multiple access points at each end but no intermediate entrances or exits (see Figure 3). Prices vary by time of day. The toll is set higher during peak periods to ensure that the HOV/*Express Lanes* are never congested. Toll schedule for SOVs is shown in Table 1. The toll is collected through electronic toll collection facilities. SOVs using the toll lanes should carry an EXpress toll transponder or a sticker tag. SOVs without an EXpress toll transponder or a sticker tag will receive a bill (toll rate plus a surcharge) sent to their license plate registered address. According to recently published 4th quarterly report FY11, the average monthly volume on the HOV/Express lanes for the period April to June 2011 was 295,000 vehicles. Nearly 33 percent of those were toll paying vehicles (26 percent with toll transponders and 7 percent with no transponders) generating a revenue of over $200,000 per month (Colorado Department of Transportation [CDoT], 2012).

According to the policies adopted by intergovernmental agreement, serving buses is the highest priority for the HOT lanes followed by vanpools and 3+ carpools as second, two person carpools as third, inherently low-emitting vehicles as fourth, and the last priority is SOVs (CDoT, 2012).

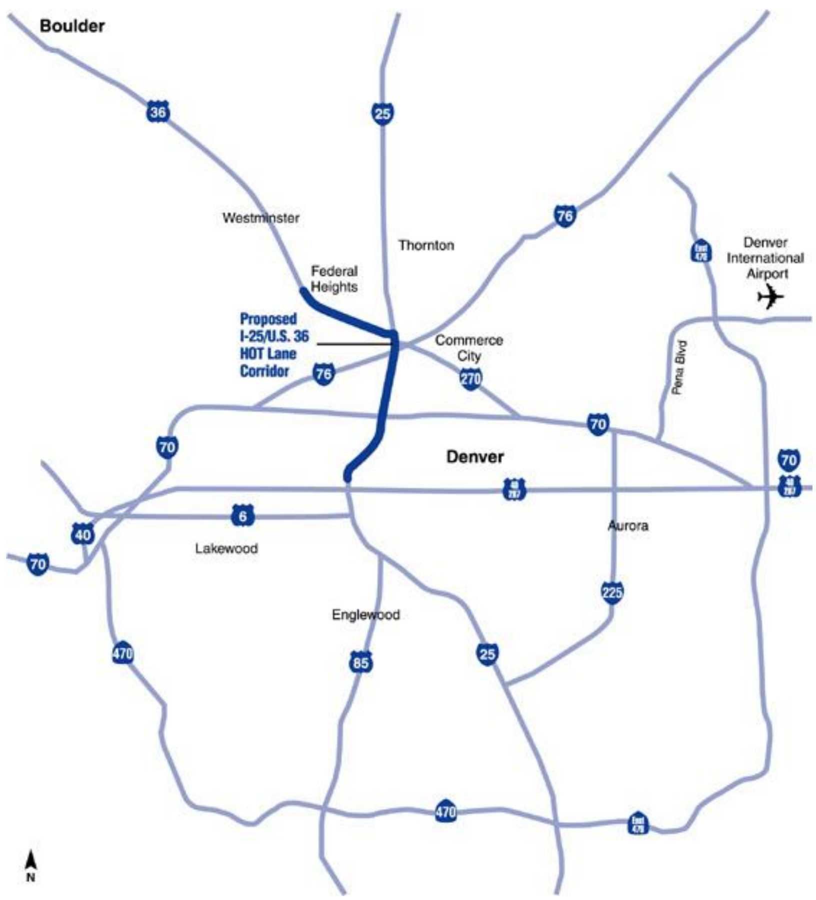

Figure 3: Map Showing Location of I-25 Express Lanes (CDoT, 2012).

Table 1: Toll Schedule on I-25 Express Lanes (CDoT, 2012)

AM		**PM**	
5:00–6:00	$0.50	Noon–3:00	$0.50
6:00–6:45	$1.75	3:00–3:30	$1.50
6:45–7:15	$2.75	3:30–4:30	$2.00
7:15–8:15	***$3.50***	***4:30–6:00***	***$3.50***
8:15–8:45	$2.75	6:00–7:00	$1.50
8:45–10:00	$1.25	7:00–3:00a	$0.50

3.1.2 I-95 Express Lanes in Miami

The I-95 Express lanes project is being conducted in two phases. Phase 1A and 1B was completed in January 2010. Phase 2 started in late 2011 and is expected to be completed in late 2014. Phase 1A project included work on the northbound travel lanes from just south of S.R. 112/I-195 to the Golden Glades area north of 151st Street (see Figure 4). Phase 1B project includes work along southbound I-95 from the Golden Glades area to just north of S.R. 836 (see Figure 4). During phase 1A and 1B, a single northbound High Occupancy Vehicle (HOV) lane (one of two directional HOV lanes) was converted into two northbound variably priced express lanes. The project also enhances and expands Bus Rapid Transit service on I-95 from I-395 in downtown Miami to Broward Boulevard in Fort Lauderdale, reducing congestion on that heavily traveled north-south artery. Phase 2 will extend the express lanes to provide a continuous facility between SR 112 and Broward Boulevard in Broward County and is expected to open in 2014 (see Figure 5).

Tolls vary with level of congestion, the goal being to keep traffic in the express lanes moving at least 45 mph. Registered vanpools, registered carpools of 3+, registered hybrid vehicles, and motorcycles can use the lanes without paying a toll. Buses of several types can also use the lanes toll-free. These are Miami-Dade and Broward County express and regular transit, public school, and over-the-road-vehicles. Tolls for all other EL vehicles are collected electronically, so toll-paying travelers need to own and display a SunPass transponder. Trucks of three or more axles are not allowed to use the express lanes (95Express, 2012). Typical tolls on Express lanes can fluctuate anywhere from $0.25 to $3.50 depending on the traffic conditions. In some extreme cases they could go up to $7.00. According to a recent report on I-95 Express lanes by Florida Department of Transportation (FDoT), during March 2012, average weekday southbound volume on the Express lanes was 34,121 vehicles with an average toll of $1.31 and average weekday northbound volume was 32,959 vehicles with an average toll of $1.24. More than 98 percent of the trips on the Express lanes are tolled trips. The remaining trips are toll free trips and compose of the following vehicle categories, hybrid vehicles (56 percent), registered buses (23 percent), registered HOV3+ (17 percent), and vanpools and motorcycles (4 percent) (FDOT, 2012).

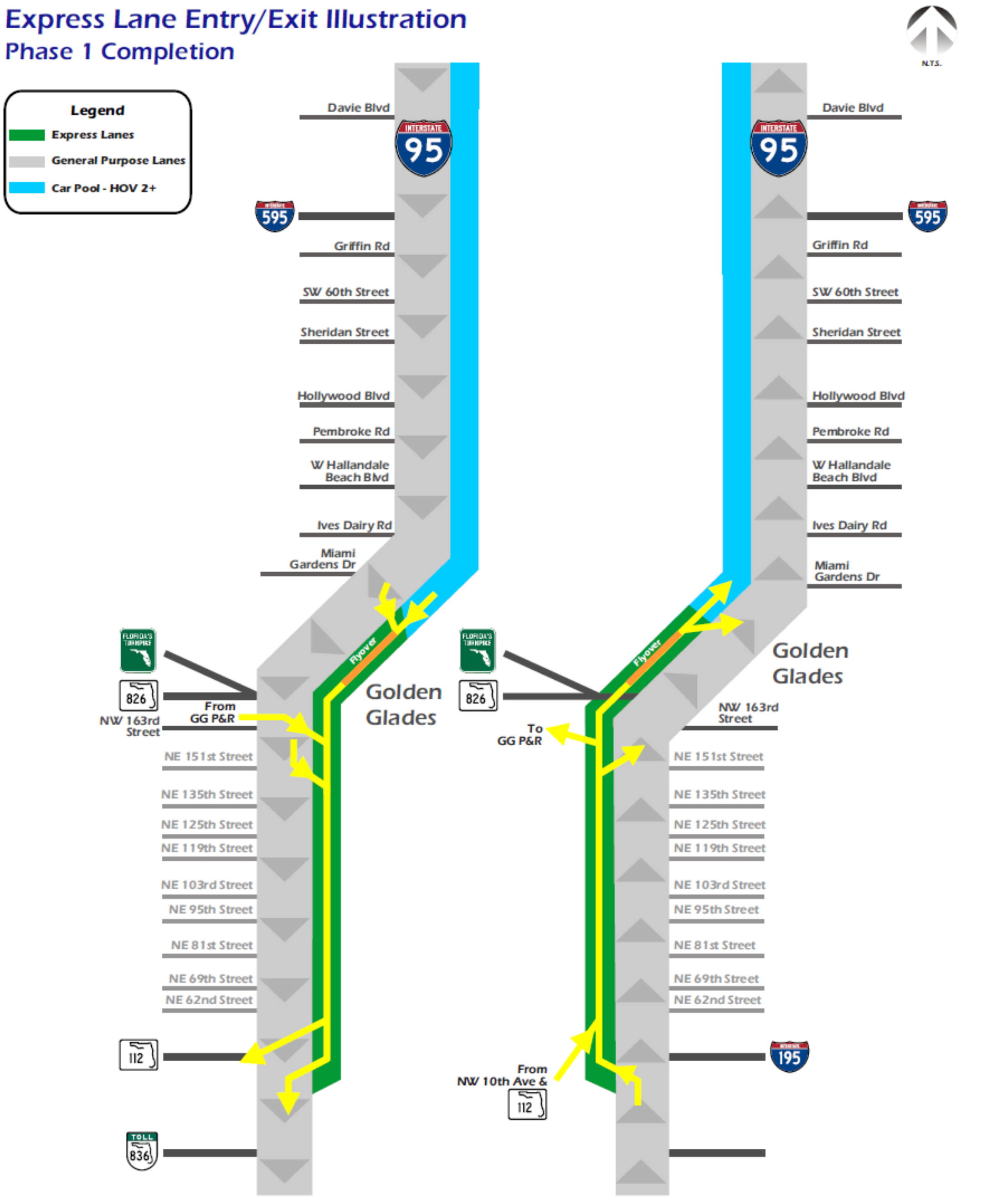

Figure 4: I-95 Express Lanes illustration after Phase 1 (A and B) completion (95express, 2012).

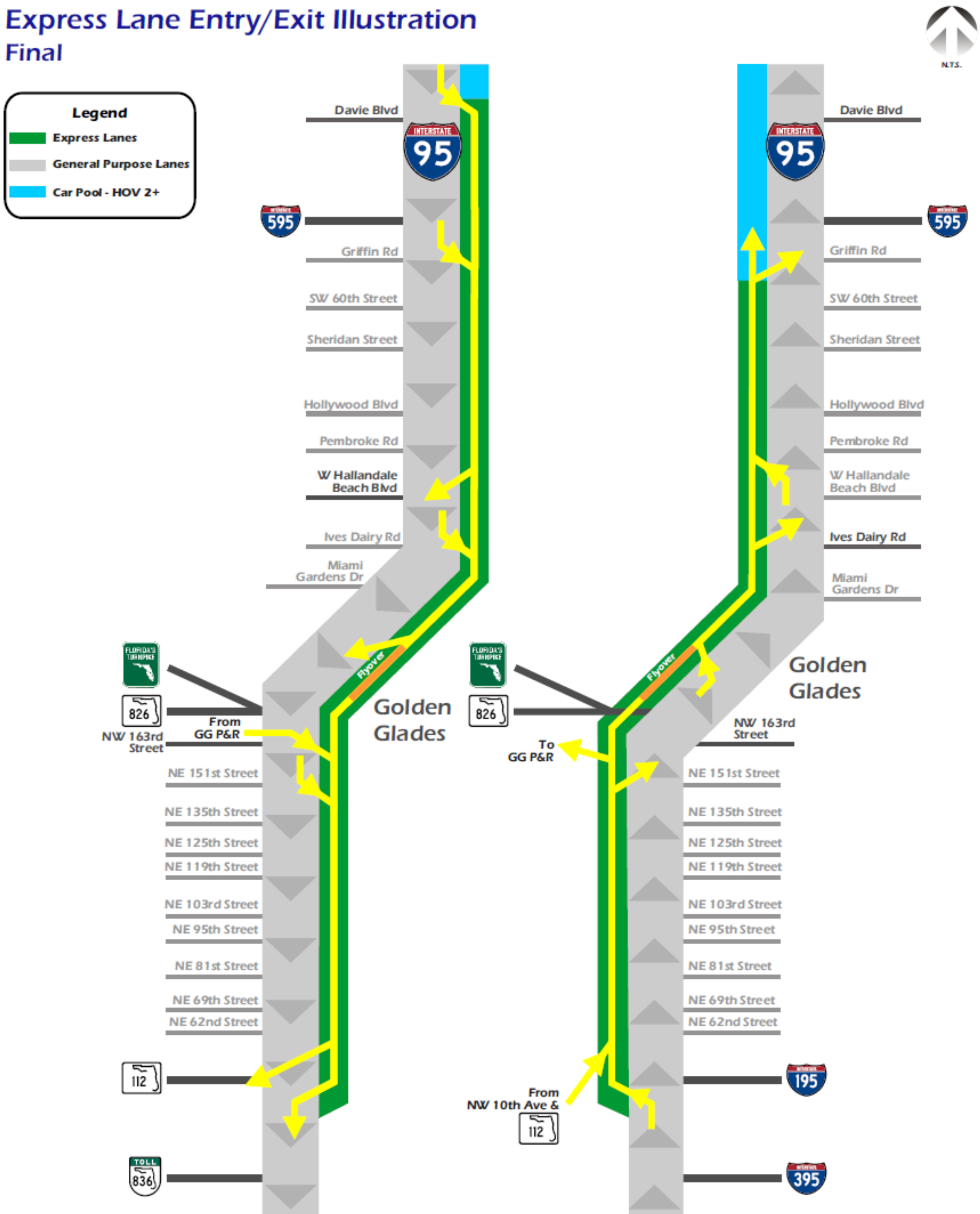

Figure 5: I-95 Express Lanes illustration after Phase 2 completion (95express, 2012).

3.1.3 I-15 Express Lanes in San Diego

The I-15 Express lanes facility in San Diego is a 20-mile, four-lane (two in each direction), facility located in the middle of the I-15 extending from SR 163 in San Diego to

S.R. 78 in Escondido. Access to I-15 express lanes is available at every two to three miles to allow travelers to move on and off the main lanes to the Express lanes (see Figure 6). A Level of Service (LOS) C or better is required by law to be maintained on the express lanes at all times. HOVs with two or more occupants (carpools, vanpools, and buses), motorcycles, and designated hybrid vehicles are permitted to use the I-15 express lanes for free. SOVs may use the lanes by paying a toll. The toll is collected electronically. So, SOVs must carry a FasTrak pass to use facility. The toll is charged on a per mile basis and is calculated based on the level of traffic in the I-15 Express Lanes, ensuring traffic flows freely in them. The toll rate is displayed on signs located before each Express lanes entrance, and the information on the display signs includes minimum and maximum toll that a travelers can expect to pay, which ranges from $0.50 to $8.00. In 2009 and 2010, there were approximately 5200 tolled trips per day on the I-15 Express lanes with a median toll of $1.20 (Burris et al., 2012).

Figure 6: I-15 Corridor Map Showing 20-mile I-15 Express Lanes (from the split at I-15 and SR 163 to SR 78 in Escondido) (Fastrak, 2012)

3.2 Survey Description

The online survey was conducted in the four cities mentioned in the previous section. The survey consisted of five sections. The first section asked the respondents about their most recent trip on one of the major freeway with the Express lanes: I-25 in Denver, I-95 in Miami, I-15 in San Diego, and S.R. 167 in Seattle. Next, about half of the respondents were asked about their most recent actual trip toward downtown and the other half about their trip away from downtown. The direction was chosen at random. Questions included information about the purpose of the trip, day of the week of the trip, when the trip began, when it ended, the length of the trip, the type of vehicle, the number of passengers in the vehicle, and whether the respondent used Express lanes for that trip. (Appendix B includes the actual survey questions.)

In the second section, the Express lanes were briefly described to the respondents in case they were unfamiliar with the lanes. Respondents were then asked if they ever used them. If they had used the lanes, the reasons for using them were asked. If they had not used these lanes, the survey sought their reasons for not doing so. Then they were asked about the number of actual trips they took on the freeway in a week, how many of those were on Express lanes, the average toll the respondent paid, and the travel time he or she saved. The section ended with questions regarding trips where they were unusually pressed for time and had a tight schedule for travel and how often they used Express lanes for those types of trips.

The third section was intended to collect responses on the individual difference variables. Based on a detailed review of the literature, a number of measures to operationalize the variables of interest were identified. To maintain consistency in the presentation of the surveys, the response formats for all the measures were modified to a nine-point Likert-type scale with the exception of the locus of control measure, which used a forced-choice response format (described below). The response anchors, numbers of items, and reliability estimates[1] based on the offline pilot-test and the offline primary data collection are described below for each scale. The scores for all constructs were operationalized as the average of the item ratings.

Conscientiousness. A 10-item measure from Goldberg's (1992) personality markers was used to operationalize conscientiousness. Participants rated the extent to which each statement is descriptive of his or her personality (1 = *very inaccurate*; 9 = *very accurate*). The internal consistency estimates of the test scores from the offline pilot-test and offline primary data were acceptable (α = .86 and .83, respectively).

General External Locus of Control. A subset of the items from the Internal-External Locus of Control Scale (Rotter, 1966) was used to assess participants' external locus of control. Although, this scale is originally comprised of 22 items, results from the offline pilot-test data collection showed that a 10-item subset resulted in acceptable levels of reliability (α = .76). However, preliminary analyses based on 62 participants from the offline primary sample

[1] Reliability is conceptualized as the amount of measurement error in scores obtained from a measurement instrument such as tests, scales, and questionnaires. Although there are several facets of reliability (e.g., test-retest, alternate-form) that speak to various sources of error (e.g., temporal stability), the most common—probably because it requires only a single administration of the measure—is internal consistency reliability. In addition, whereas there are no hard-fast cutoffs or criteria for acceptable levels of reliability, most researchers and practitioners consider .70 to be about the lower end of an acceptable threshold.

indicated that the reliability of the 10-item measure scores from this sample was rather low (α = .46). Thus, in an attempt to further improve this measure, we created an alternate version of the test by separating each response pair and presenting each as a separate item (i.e., as two independent item stems). Consequently, the original 10-item forced-choice external locus of control measure was transformed into a 20-item nine-point Likert-type scale for the remaining participants of the offline primary data collection (*n* = 169) in which participants rated each item on their level of agreement (1 = *strongly disagree*; 9 = *strongly agree*). The new format resulted in a comparatively more reliable set of scores (α = .69). However, the original forced-choice format of the scale was refrained from the online data collection effort because the data collection had commenced and it would have been too disruptive to change the measure midstream.

Personal need for structure. The Personal Need for Structure Scale (Neuberg and Newsom, 1993) consists of 12 items and has two underlying factors—desire for structure and response to lack of structure. Participants rated their level of agreement with each item (1 = *strongly disagree*; 9 = *strongly agree*). Scores on this measure demonstrated high internal consistency in the offline pilot-test and offline primary data (α = .91 and .83, respectively).

Risk tolerance. Weber et al. (2002) original 50-item Risk Taking Scale consists of five subscales of 10 items each. The scales assess risk taking in financial, health/safety, recreational, ethical, and social contexts. However, for the purpose of the present research, only the financial risk taking subscale was used, so the final measure consisted of 10 items. For each item, participants indicated the likelihood that they would engage in each risk-taking activity (1 = *extremely unlikely*; 9 = *extremely likely*). The internal consistency reliability estimates for the risk tolerance scores were .76 and .72 for the offline pilot-test and the offline primary data, respectively.

Driving risk perceptions. A risk perceptions measure, which consisted of a measure of risk-taking cognitions (2 items; Fischer et al., 2007) and risk perceptions (3 items; Rundmo and Iversen, 2004), was created for the purposes of this study. Participants responded based on the extent to which they agreed with each statement (1 = s*trongly disagree;* 9 = s*trongly agree*). The internal consistency reliability estimates for the risk perceptions scores were .77 and .87 for the offline pilot-test and the offline primary data, respectively.

Careful and Risky Driving Styles. For the purpose of this study, we included five of the eight driving styles that comprise the Multi-Dimensional Driving Style Inventory—anxious, risky, high-velocity, patient, and careful driving styles (Taubman-Ben-Ari et al., 2004). Based on the results of the offline pilot-test data, two composite measures of driving styles were created—careful, and risky driving styles. The 11-item careful driving style measure consisted of items from the anxious, patient, and careful driving style subscales. The 9-item risky driving style measure consisted of items from the risky and high-velocity driving style subscales. Participants responded based on the extent to which they agreed with each statement (1 = *strongly disagree;* 9 = *strongly agree*). For the offline pilot-test data, reliability estimates for the careful driving style and the risky driving style scores were .83 and .79, respectively; whereas for the offline primary data, reliability estimates were.78 and .83 for the careful driving style and the risky driving style scores, respectively. *Driving risk perceptions*, *careful driving style*, and *risky* *driving style* measures were combined together and were presented as one scale *driving risk perceptions and driving style*.

Reactions to the measures. Participants from the offline pilot study responded several measures about their perceptions of the survey in terms of readability (4 items; e.g., *It was easy to understand the picture questions*), affective reactions (2 items; e.g., *I enjoyed answering the other questions*), and utility (1 item; *My responses to the picture questions (i.e., with a drawing of a tiny car) reflect how I usually make decisions on these issues*). This measure was only used for the offline pilot-test to confirm that the survey instructions and questions were clear to them. Participants rated their level of agreement with each of the items (1 = s*trongly disagree*, 9 = s*trongly agree*). The reliability estimate for the scores from the combined reaction measures was .71.

Preference for carpooling. A measure was created for the purposes of the present study to assess participant's attitudes toward carpooling. This measure was added after the offline pilot test, so only participants from the offline primary data collection and the online data collection completed this measure. Participants responded to 3 items on their perceptions of how easy it would be to carpool (1 = extremely difficult; 9 = extremely easy), stated preference for carpooling (1 = very strong preference for driving solo; 9 = very strong preference for carpooling), and intentions for carpooling in the future (1 = no intentions to carpool; 9 = very strong intentions to carpool; 10 = I currently carpool). The reliability estimate for the 3-item measure was .75 for the offline primary sample.

Solo and Non-Solo Travel Attributes. Participants from the offline (primary study) and online data collection were asked to rate the importance of nine personal travel attributes related to carpooling (e.g., concerns about the environment). Specifically, participants responded based on the extent to which specified travel attributes were important to them (1 = extremely unimportant; 9 = extremely important). Previous research has shown that solo and non-solo drivers differ in the value they place on these attributes (van Vugt et al., 1996). For instance, solo drivers value relaxation, comfort, and low travel time more than non-solo drivers. Consequently, two scales were developed based on the nine travel attributes, preference for non-solo driving—3 items; reliability estimate for offline primary sample was .31—and preference for solo driving—6 items; reliability estimate for offline primary sample was .67.

3.2.1 A Note on the Online Administration of the Individual Difference Measures

The 5 psychological variable measures plus the preference for carpooling measure (total of 6 measures) consisted of 78 questions (or items), the majority of which were to be answered using a 9 point likert scale. In an effort to increase the number of responses by reducing the total time required to complete the online survey, the 6 measures were broken into 20 blocks or sets of 3 each. This was done so that each survey participant completed 3 of the 6 measures (Scales A, B, C, D, E, and H; see Appendix B). Thus, 20 versions of the survey were created with every three-measure combination without replacement or repetition occurring in one version of the survey. Participants were randomly assigned to complete one of the survey versions.

As a result of this design feature, some analyses that were performed using the offline primary sample could not be replicated using the online sample (see Section 4.3).

3.3 Stated Preference Question Design

A total of three SP questions were presented to each survey respondent. In each question, the respondent was asked to consider a realistic travel scenario on the major freeway in their respective hometown with four different modes of travel available. The modes included SOV on the GPLs, SOV on the Express lanes, HOV on the GPLs, and HOV on the Express lanes; and varied based on travel time, and toll values (see Figure 7 for a sample SP question). The respondent was asked to select the mode that they would most likely choose if faced with the specified choices for their most recent trip.

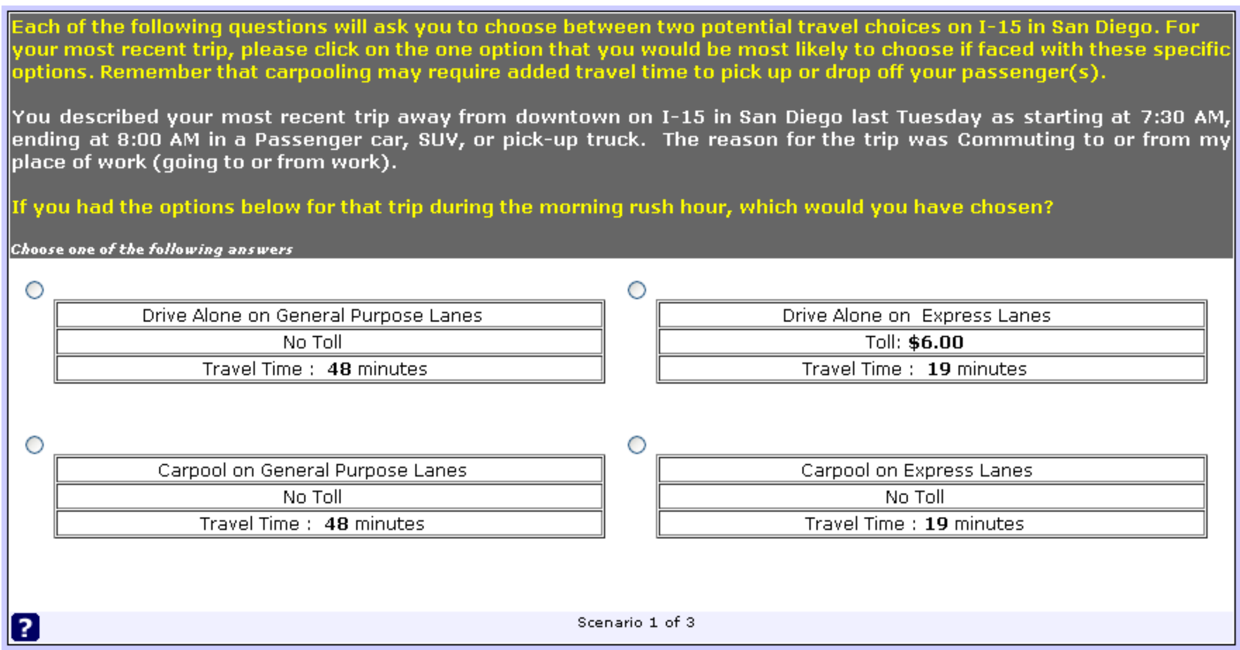

Figure 7: Sample SP Question for a Respondent Travelling on I-15 in San Diego.

Travel scenarios were largely created based on the details of the respondent's most recent trip on the major freeway toward/away from downtown. As noted above, roughly half of the respondents were asked about their recent trip toward downtown and the other half about their trip away from downtown. Trip details included the day of week of the trip, purpose of the trip, when it started, when it ended, the length of the trip, the type of vehicle they used for the trip, and the number of people in the vehicle.

Each of the freeways mentioned in Section 3.1 have both Express and general purpose lanes. On each of those lanes, travelers have the option of either driving alone or forming a carpool with others for travel (other options, such as transit, are also available but were not examined in this research). Travelers will need to pay a toll if they want to travel as a SOV on the express lanes. Carpoolers need not pay any toll to travel on the Express lanes, with the exception of Miami where only pre-registered 3+ person carpoolers are allowed to travel for free on the Express lanes. With these available options, four modes of travel are possible:

1) Drive Alone on the General Purpose Lanes (DA-GPL).
2) Carpool on the General Purpose Lanes (CP-GPL).

3) Drive Alone on the Express Lanes (DA-EL or DA-ML).
4) Carpool on the Express Lanes (CP-EL or CP-ML).

The tolls vary considerably based on the survey design; this is an advantage of SP models over RP models. Often, in an RP setting, there is simply not enough variation in tolls to be able to ascertain the influence of the toll on choices. Travel time on the MLs was adjusted to always be lower than or equal to the travel time on the general purpose lanes.

A note was included that the additional time taken to form in a carpool (i.e., picking up another party at some location) should be added to the travel time shown for the carpool mode. The following sections present a more detailed description of how the values of travel time and toll were selected based on the recent trip information supplied by each respondent.

3.3.1 Time of Day

Tolls on the each of the Express lanes vary according to the time of day. Therefore, time of day is an important variable in determining the tolls for the travel scenarios in the SP questions. Based on the respondent's recent trip start time towards/away from downtown, the time of day for the travel scenarios was categorized as shown in Table 2.

Table 2: Time of Day Based on Trip Start Time

Trip Start Time	Time of Day
12:00 AM to 6:00 AM	Night
6:00 AM to 7:00 AM	Morning Shoulder Period
7:00 AM to 9:00 AM	Morning Peak Period
9:00 AM to 10:00 AM	Morning Shoulder Period
10:00 AM to 4:00 PM	Mid-Day
4:00 PM to 5:00 PM	Evening Shoulder Period
5:00 PM to 7:00 PM	Evening Peak Period
7:00 PM to 8:00 PM	Evening Shoulder Period
8:00 PM to 12:00 AM	Night

If a respondent chose not to answer the start time of his/her recent trip, he/she was assigned a travel scenario that occurred during the peak period. The toll rates during night and mid-day periods were lower than during shoulder hours which, in turn, were lower than the tolls during peak hour. Rates are shown in Section 3.3.3 and 3.3.4 and are based on realistic per mile rates that exist on the specified Express lanes.

3.3.2 Trip Distance

In the first section, the respondents were also asked the length of their most recent trip. Using the trip length the travel time and toll for each mode was calculated. If the total distance was less than 6 miles, then it was increased to 6 miles. Since the Express lanes are available only on a portion of the freeway, it was important to calculate what portion of the trip distance was along the section of the freeway where Express lanes actually existed. For this purpose, each freeway was divided into two sections and the distance traveled on each section was calculated. The section of the freeway where Express lanes existed was defined as section one, and the rest was defined as section two. Only the distance traveled on section one was considered when calculating the toll. If the total distance was less than or equal to 10 miles (20 miles for San Diego), then it was assumed that the whole trip was along section one. If the total distance was greater than 10 miles (20 miles for San Diego), then it was assumed that section one distance was 10 miles and the rest on section two. If a respondent did not answer the question on trip length, then he/she was assigned a trip distance of 10 miles on section one. This distance allocation should not induce any bias in our analysis, as the toll values are calculated based on toll per mile values that are generated using different design strategies.

Since the distances on section one and section two are known, the travel time can be calculated by knowing the speeds on each of those sections. As mentioned earlier, the tolls are calculated only based on section one distances. So by knowing the toll per mile, the toll for each was calculated. The speed and toll level were obtained using two design techniques, (1) D_b-efficient design, and (2) adaptive random designs. Both of these designs are discussed in the next sections.

3.3.3 D_b-Efficient Design

One of the design strategies used in this study was the Bayesian efficient design. As noted above, D-efficient are those designs that are obtained by minimizing the D-error of the asymptotic variance-covariance matrix of the parameter estimates of the discrete choice model. D_b-efficient, or Bayesian efficient, designs are found by minimizing the D_b-error. Normal distributions with non-zero means were assumed for the priors. The mean values of priors for the attributes toll and speed were obtained from the discrete choice models estimated from the previous survey conducted in 2010 on Katy Freeway travelers in Houston (Devarasetty et al., 2012a). The mean and standard deviation of the priors used for obtaining the D_b-efficient design and the exact levels of attributes used for each mode at different times of day are shown in Table 3.

Table 3: Mean, Standard Deviation of Attribute Priors, and Attribute Levels for Different Times of Day

<table>
<tr><th rowspan="3">Attribute</th><th colspan="4">Attribute Levels</th><th rowspan="3">Mean Value of Priors</th><th rowspan="3">Standard Deviation of Priors</th></tr>
<tr><th rowspan="2">Mode</th><th colspan="3">Time of Day</th></tr>
<tr><th>Peak Hours</th><th>Shoulder Hours</th><th>Off-Peak Hours</th></tr>
<tr><td rowspan="4">Toll (cents/mile)</td><td>CP-ML</td><td>0</td><td>0</td><td>0</td><td rowspan="4">-0.19</td><td rowspan="4">0.1</td></tr>
<tr><td>DA-ML</td><td>20,25,30,35,40</td><td>10,12.5,15,17.5,20</td><td>5,6,7.5,9,10</td></tr>
<tr><td>CP-GPL</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>DA-GPL</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td rowspan="4">Speed (mph)</td><td>CP-ML</td><td>55,57.5,60,62.5,65</td><td>55,57.5,60,62.5,65</td><td>60,62.5,65,67.5,70</td><td rowspan="4">-0.5*</td><td rowspan="4">0.3</td></tr>
<tr><td>DA-ML</td><td>55,57.5,60,62.5,65</td><td>55,57.5,60,62.5,65</td><td>60,62.5,65,67.5,70</td></tr>
<tr><td>CP-GPL</td><td>25,30,35,40,45</td><td>30,35,40,45,50</td><td>35,40,45,50,55</td></tr>
<tr><td>DA-GPL</td><td>25,30,35,40,45</td><td>30,35,40,45,50</td><td>35,40,45,50,55</td></tr>
</table>

Note. *Prior is the coefficient of travel time estimated from a previous survey on Katy Freeway (Devarasetty et al., 2012a). Necessary transformation was performed to use it as a coefficient for speed.

The N-Gene software package was used to generate the D_b-efficient designs for this survey design strategy (NGene, 2012). To proceed, a random parameter panel logit (rppanel) was specified for the discrete choice model, and the priors were simulated using 400 Halton draws drawn from the prior distributions. The code used from the N-Gene software is included in Appendix C. The design for peak hours obtained from the software is shown in Table 4. The values shown in Table 4 were used as-is with no random variation to calculate the attributes for each mode. The corresponding Bayesian designs for other times of day were obtained by replacing the attribute levels, as shown in Table 3. The design has 15 rows divided into 5 blocks of 3 rows. Each respondent was randomly given all choice sets from one of the blocks. The D_b-error for the design was found to be 0.06. As mentioned earlier, the smaller the D_b-error, the more efficient the design. The D_b-error for this design is very close to zero; hence, the design is an efficient design.

Table 4: D_b-Efficient Design Generated Using N-Gene Software (for Peak Hours)

Mode	**CP-ML**	**DA-ML**		**CP-GPL**	**DA-GPL**	
Choice Situation	**Speed (mph)**	**Speed (mph)**	**Toll (cents/ mile)**	**Speed (mph)**	**Speed (mph)**	**Block**
1	60	60	25	35	35	**1**
2	57.5	57.5	30	30	30	**1**
3	62.5	62.5	35	40	40	**1**
4	62.5	62.5	30	25	25	**2**
5	55	55	20	45	45	**2**
6	65	65	40	35	35	**2**
7	55	55	30	35	35	**3**
8	57.5	57.5	25	25	25	**3**
9	62.5	62.5	40	40	40	**3**
10	65	65	35	30	30	**4**
11	57.5	57.5	20	45	45	**4**
12	60	60	25	40	40	**4**
13	65	65	20	30	30	**5**
14	55	55	35	25	25	**5**
15	60	60	40	45	45	**5**

3.3.4 Adaptive Random Design

The second type of design strategy generated for part of the survey was the adaptive random attribute level generation method. In this method, for the first SP question the attribute levels of each attribute (toll per mile and average speed) were generated randomly from a corresponding range of values for each attribute. The attribute levels used for each attribute at different times of day are shown in Table 5. For the second and third choice set, the attribute levels were generated partially based on the response to the respondent's prior choice sets. The values for speed were generated using the same random method for the second and the third choice set. However, the toll rates were increased by a random percentage anywhere between 15 and 75 if the respondent chose a toll option and decreased between 15 and 50 if the respondent chose a non-toll option for the previous SP question.

Table 5: Attribute Levels Used for Generating the Random Attribute Level Design

Attribute	**Attribute Levels**			
		Time of Day		
	Mode	**Peak Hours**	**Shoulder Hours**	**Off-Peak Hours**
Toll (cents/mile)	CP-ML	0	0	0
	DA-ML	20+(0 to 20)	10+(0 to 10)	5+(0 to 5)
	CP-GPL	0	0	0
	DA-GPL	0	0	0
Speed (mph)	CP-ML	55+(0 to 10)	55+(0 to 10)	60+(0 to 10)
	DA-ML	55+(0 to 10)	55+(0 to 10)	60+(0 to 10)
	CP-GPL	25+(0 to 20)	30+(0 to 20)	35+(0 to 20)
	DA-GPL	25+(0 to 20)	30+(0 to 20)	35+(0 to 20)

3.4 Offline Survey Administration

Two rounds of data were collected prior to the online survey. The purpose of the offline data collection effort was to confirm that the individual difference measures performed as intended—that is, that the internal consistency of the scores were acceptable, and that the correlations between the variables were generally in accord with their hypothesized relationships—and to generate a dataset with complete data for each participant that would permit a replication of the online results to assess their robustness.

The first round of data was collected during October 2011. A pilot-test sample of 24 graduate students completed the initial version of the offline survey consisting of eight measures (conscientiousness, locus of control, need for structure, risk tolerance, driving risk perceptions, driving style, reactions to the measures, and three stated preference items). The participants for this offline pilot-test consisted of a convenient sample of Texas A&M University industrial/organizational psychology (n = 14) and civil engineering (n = 10) graduate students. Color copies of the toll road use preference items were provided to 12 (50%) of the 24 participants.

Based on the results of the offline pilot-test data, a second round of offline primary data collection proceeded with the recruitment of a sample of undergraduate students from four psychology classes at Texas A&M University. From February to April 2012, offline primary data were collected from 231 undergraduate students who participated in the study in exchange for course credit. The study measures consisted of all of the measures included in the offline pilot-test battery except for the reaction measure.

3.5 Online Survey Administration

The survey was posted on a Texas Transportation Institute server and was made available for public access through the *www.TravelChoicesSurvey.org* website. The data collection process started on February 14, 2012, and continued until May 7, 2012. Residents of Denver, Miami, San Diego, and Seattle who use the I-25, I-95, I-15, and S.R. 167 freeways, respectively, were encouraged to participate in the survey. The existence of the survey was advertised to the public through online and news media. To increase the participation in the survey, one VISA gift card worth $250 each was given to one randomly chosen respondent from each city (a total of four gift cards). The contact information for the drawing was stored separately and could not be linked to the survey responses. The list of websites where the survey was advertised is presented in Section 3.5.1.

In addition to the website ads, the agencies in charge of the Miami, Denver, and San Diego Express Lanes added a brief note regarding the existence of the survey to some of their monthly account e-notices. Each city sent notices about survey existence on different dates. Miami toll road authorities sent out notices on February 14, 2012, and only to people who signed up for announcements/surveys. The survey duration for Miami was shorter than other cities; it ran from February 14, 2012, to March 30, 2012. Denver and San Diego toll road authorities sent out notices on March 15, 2012, and April 18, 2012, respectively, as part of their monthly bill emails. For Denver and San Diego, the survey was active till May 7, 2012. The ads for each city were published on the websites only after the agencies announced the survey’s existence.

The survey garnered 1,001 responses. However, only 700 of those 1,001 responses were completed to a point where they were useful for analysis. Among those 700, 34 respondents used a motorcycle or bus for their recent trip; their responses were not considered for further analysis. The final sample consisted of responses from 664 respondents. Total number of responses obtained from each city, Miami, Denver, and San Diego on each day during the survey period are shown in Figures 8, 9, and 10, respectively.

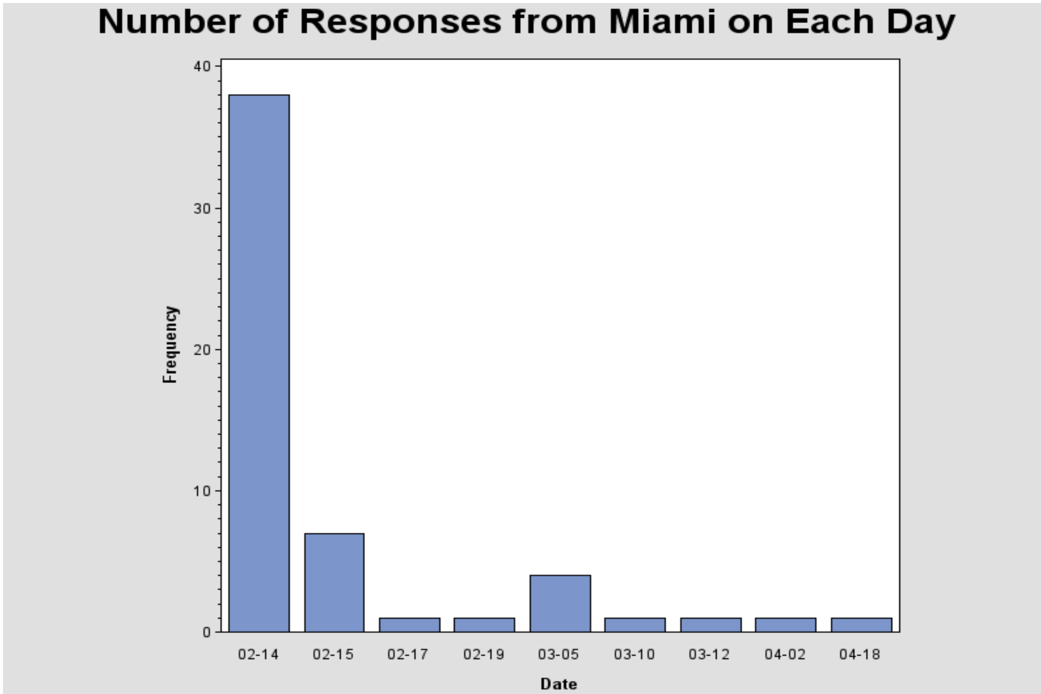

Figure 8: Number of Responses from Miami on Each Day

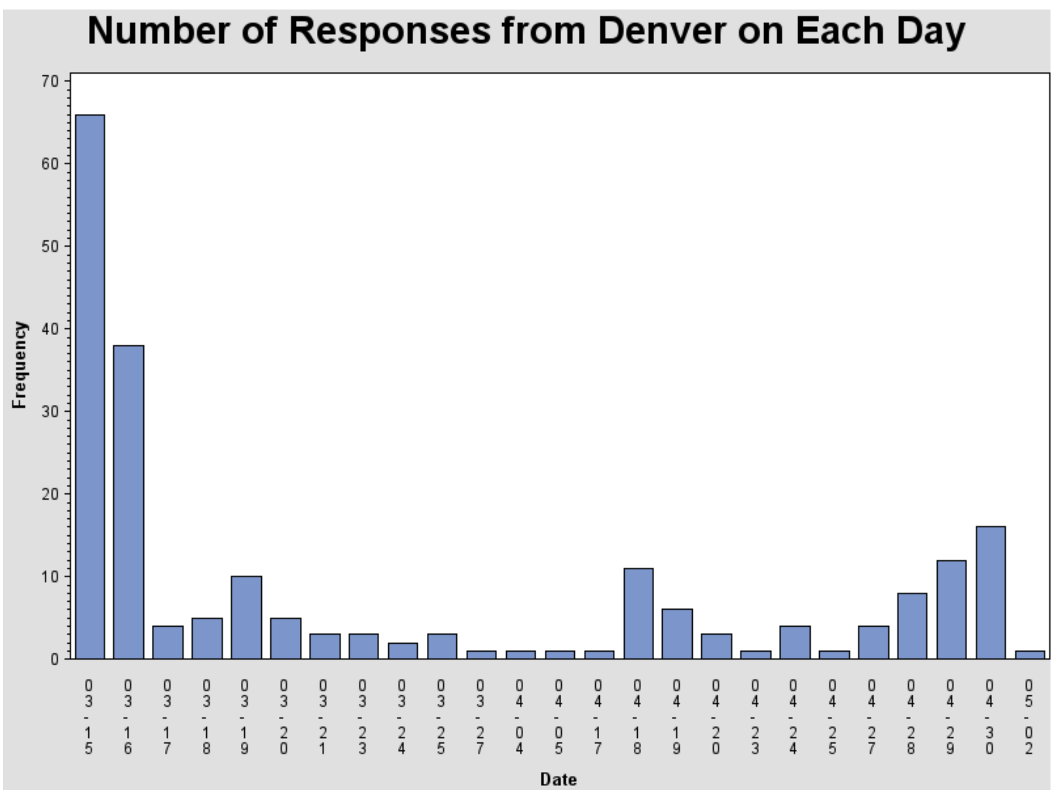

Figure 9: Number of Responses from Denver on Each Day

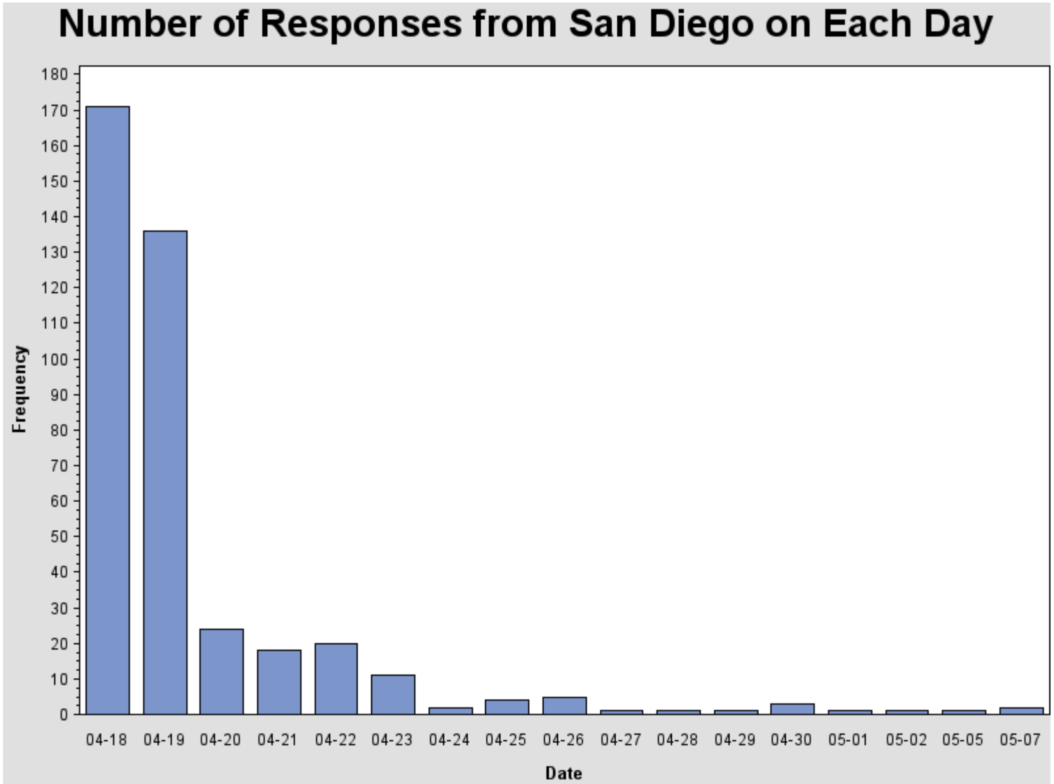

Figure 10: Number of Responses from San Diego on Each Day

3.5.1 Advertising and Social Media Efforts to Increase Survey Response Rate

Texas Transportation Institute (TTI) currently has a presence on Facebook, Twitter, and YouTube. In order to connect with our peers, TTI proactively seeks out Facebook friends and connects to them dynamically through our posts. Based on advertising budget, efforts to publicize the Travel Choices Survey (*http://TravelChoicesSurvey*) included:

- Web banner ad on *http://denverpost.com* on April 27 ($650).
- Web banner ad on *http://seattletimes.com* on April 30 ($795).
- Email blast to more than 20K targeted subscribers of San Diego Union Tribune on April 30 ($795).
- Posts to more than 50 targeted media and DOTs through Twitter.
- Posts to more than 25 targeted media, DOT, and city organization pages on Facebook.

3.5.1.1 Results: San Diego

A total of 401 completed surveys were completed for the San Diego region by automobile travelers. For San Diego an email blast was sent on 5/7/2012 going to 24,950 subscribers that garnered a 10.91% open rate (2,723 opened the ad banner – see Figure 11) with a 2.60% click through rate of 648 people that attempted the survey. However, as shown in Figure 10 only a handful finished the survey.

3.5.1.2 Results: Seattle

A total of two surveys were completed for the Seattle region. For Seattle, a web banner was placed in two sections on the Seattle Times website at *http://seattletimes.com* (see

Figures 12 and 13). Total pages views/impressions on which the survey banners were posted totaled 99,308 and 99,249 for the date of 4/30/2012. The click through success rate was 47 (.05%) and 31 (.03%), respectively. Obviously, this resulted in too few responses for the Seattle region.

3.5.1.3 Results: Denver

A total of 209 surveys were completed for the Denver region by automobile travelers. For Denver, a web banner was placed in the Breaking News, Denver & West and Denver Post Media Center sections on the Denver Post website at *http://denverpost.com* (see Figure 14 and 15). Total pages views/impressions on which the survey banners were posted totaled 12,606; 5,190 and 86,644 for the dates of Friday, May 4, and Monday, May 7 (see Table 6). The click through success rate was 22 (.17%), 12 (.23%) and 1400 (1.61%), respectively. However, this lead to no completed surveys.

Table 6: Section click through rate, Denver Post Website

Section	Impressions	Clicks
Breaking News Page	12,606	22
Denver & the West Section Front Page	5,190	12
Denver Post Media Center Page	86,644	1400

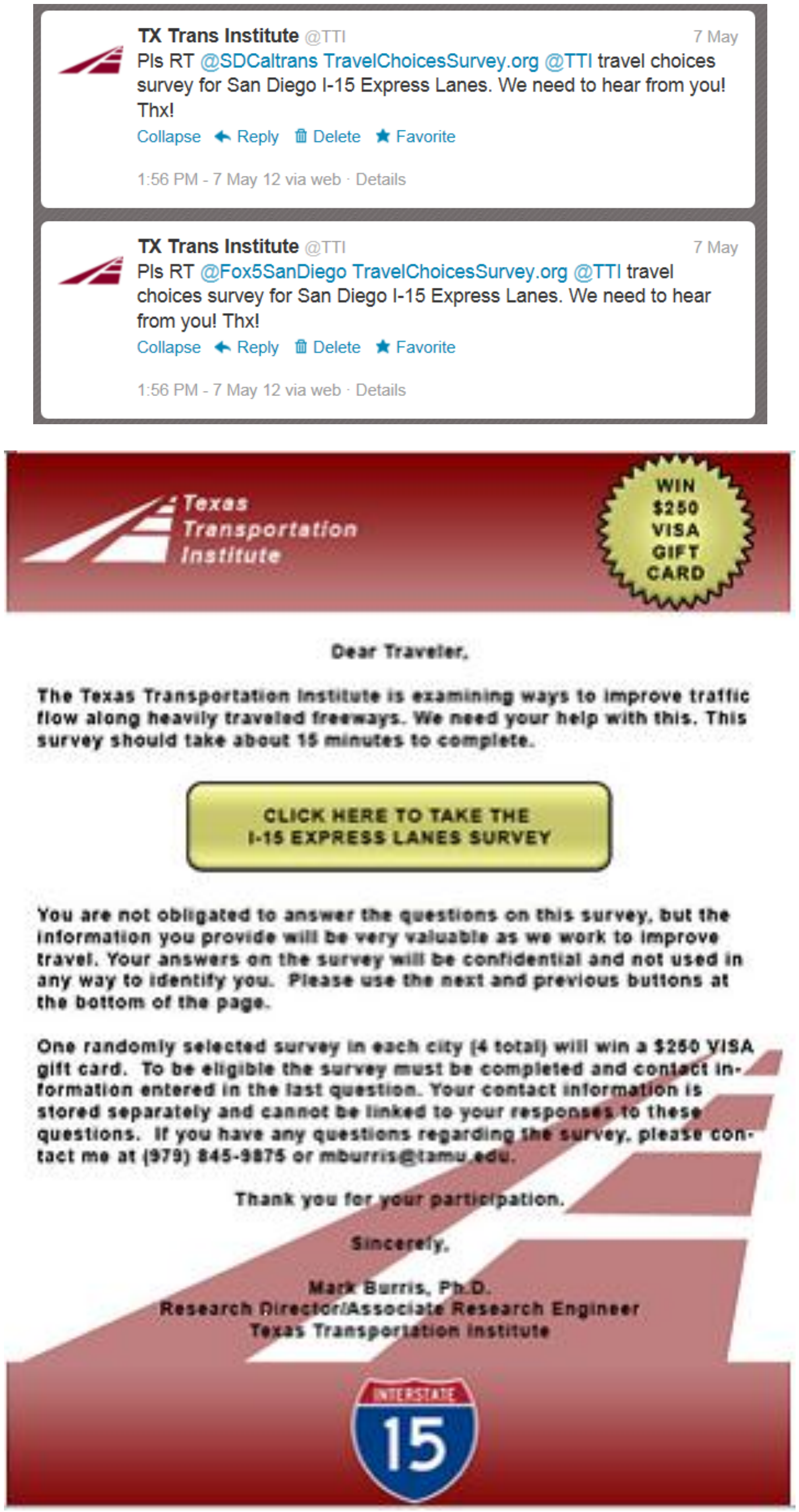

Figure 11: Social Media Screen Grabs and Email Blast for the San Diego Region

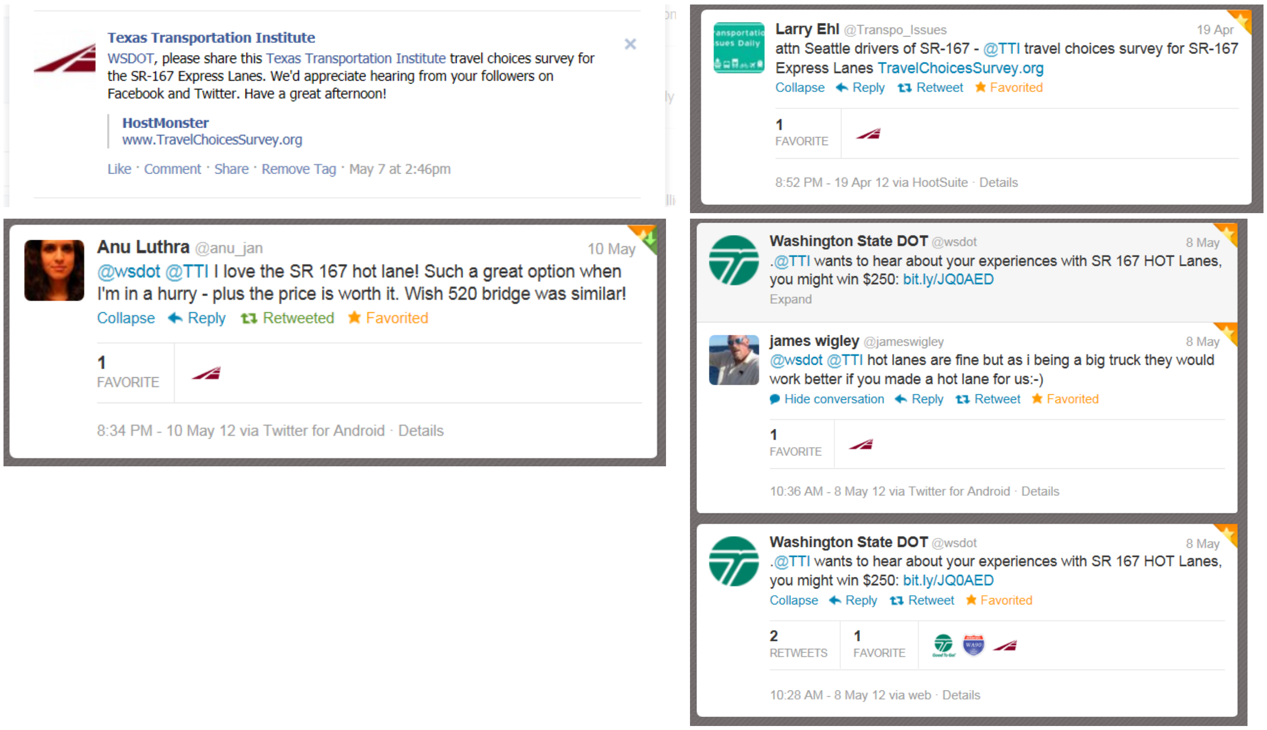

Figure 12: Social Media Screen Grabs for the Seattle Region

Monday, April 30, 2012 | TRAFFIC | 52°F

The Seattle Times
Winner of a 2012 Pulitzer Prize

Business / Technology

Home | News | Business & Tech | Sports | Entertainment | Living | Travel | Opinion | Jobs | Autos | Homes | Classifieds

IN THE NEWS: Superintendent race | Medical-marijuana dispensaries | North Bend bunker | Teenage diabetes

Originally published Monday, April 30, 2012 at 5:31 AM

Dow, S&P 500 slip as Spain enters recession

News that Spain's economy entered another recession renewed worries about the fragility of Europe's finances Monday and nudged stocks lower. The market ended its first losing month this year.

By MATTHEW CRAFT
AP Business Writer

NEW YORK —

News that Spain's economy entered another recession renewed worries about the fragility of Europe's finances Monday and nudged stocks lower. The market ended its first losing month this year.

The Standard & Poor's 500 index slipped 5.45 points to close at 1,397.91. For April, it was down 0.8 percent, its first month in the red since November.

The Spanish government said that the country's economy shrank in the first three months of the year, the second straight quarter of contraction.

The worry is that Spain's heft could make it difficult to rescue. Its economy is roughly twice the size of the three other countries that have tapped the European Union for bailout loans added together -- Greece, Portugal and Ireland.

In the U.S., a drop in an index of Midwestern manufacturing and a slowdown in consumer spending last month added to worries that the economy is losing steam.

The Institute for Supply Management said its Chicago business barometer fell in April to the lowest level in more than two years. Coming after two other weak readings for the regions around New York and Philadelphia, the market reaction to the Chicago report could have been much worse, said Clark Yingst, chief market analyst at the brokerage Joseph Gunnar.

"It's very bad news in my opinion," Yingst said. "I'd have thought the market would come under more pressure than it has."

Weaker earnings reports from health insurer Humana and the owner of the New York Stock Exchange, NYSE Euronext, also weighed on stock indexes.

The Dow Jones industrial average slipped 14.68 points to close at 13,213.63, narrowly avoiding its first monthly loss since September. The Nasdaq composite fell 22.84 points to 3,046.36. It posted a monthly loss of 1.5 percent.

Growing concerns about Spain knocked European markets lower on Monday. Spain's main stock index, the IBEX 35, sank 1.9 percent. France's CAC-40 lost 1.6 percent.

The dollar and U.S. Treasury prices edged up as investors parked money in low-risk assets.

Ratings agency Standard & Poor's downgraded Spain's government debt to just three notches above junk Friday. On Monday S&P lowered its rating for 11 Spanish banks, which are loaded with bad debt from a collapsed housing market.

Among stocks making big moves:

- Barnes & Noble jumped 52 percent on news that it will team up with Microsoft to house the digital and college businesses of the bookseller and create a Nook application for Windows 8. The companies said they may separate those businesses entirely. That could mean a stock offering, sale, or some other

RELATED

- Oil falls near $104 on European economic concern
- Spanish lenders in talks over 'bad bank' plan

Market Indexes

	Chg	%Chg	Value
S&P 500	-5	-0.4	1,398
Morningstar	-15	-0.4	3,514
NYSE	-33	-0.4	8,119
Small Cap	-50	-0.9	5,246

MOST POPULAR COMMENTS

"Having lived in Europe for a couple years, I can tell you that these people are so on... (April 30, 2012, by Semians) MORE

"Enters recession??? Their unemployment rate has been awful for a while now... (April 30, 2012, by mexilak) MORE

"WSU, That is a good balance until other people's money runs out... then the tantrums... (April 30, 2012, by JohnPhoenix) MORE

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5. Yacht in fatal race accident was obliterated
6. State's expensive love affair with 4-wheel drive hybrid SUVs
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8. You haven't seen the last of Chris Polk | Jerry Brewer
9. No. 1 pick Irvin leads draft class bent on speed
10. Seahawks' draft class panned by the pundits | Seahawks Blog

MOST VIEWED GALLERIES: Mountain bunker of murder suspect Peter Keller

MOST WATCHED VIDEOS: Schneider, Carroll Round 2-3

Figure 13: Seattle Times Ad Banner Screen Grab

Figure 14: Denver Post Web Banner Ad

Figure 15: Denver Region Social Media Screen Grabs

To summarize, very few completed surveys (approximately 7) were garnered through these announcements, tweets, and advertisements. A much more effective method was to have the local Express Lane operating agency make the survey known to travelers.

4. DATA ANALYSIS

This chapter examines the data collected in both the offline (both pilot-test and primary data collection effort) and the online surveys. To begin, an examination of the data (descriptive statistics) is performed. This provides insight into the potential relationships between traveler characteristics and their choice of GPL or EL. These relationships will then be further explored when modeling the data and attempting to better understand how traveler's psychological makeup influences their choice of lane.

4.1 Offline Survey Results

This section presents the results from the offline survey, which consisted of both the pilot test ($N = 24$) and the primary data collection effort. For the latter, the measures were administered to 231 undergraduate students between February and April 2012. The survey focused on the psychological measures along with a limited number of mode choice questions. Both the offline pilot data and the primary data were collected via means of paper measures.

4.1.1 Descriptive Statistics

Using the offline pilot-test data, analyses of the psychological measures were conducted to confirm internal consistency reliability and to demonstrate that the pattern of relationships between the constructs was consistent with their hypothesized associations. Table 7 presents a summary of the data collected from the offline pilot-test sample. The analyses showed that the scores on each of the measures demonstrated satisfactory internal consistency reliability estimates (from .76 to .86). Also, the direction of the observed correlations between the constructs conformed to the expected pattern of results. For example, individuals with higher careful driving style scores had, on average, lower risky driving scores as demonstrated by the negative correlation between careful, and risky driving style ($r = -.44$).

Table 7: Descriptive Statistics and Intercorrelations among Study Variables for the Offline Pilot-Test Data

Variable	*M*	*SD*	1	2	3	4	5	6	7
1. Conscientiousness	6.61	1.17	(.86)						
2. GELoC (forced-choice)	0.47	0.29	-.39	(.76)					
3. Need for structure	5.96	1.60	-.13	.27	(.89)				
4. Risk tolerance	3.30	1.20	-.05	-.16	**-.59**	(.76)			
5. Driving risk perceptions	4.95	1.40	**-.44**	.30	**.54**	-.09	(.77)		
6. Careful DS	5.04	1.10	-.28	**.42**	**.72**	**-.44**	**.64**	(.74)	
7. Risky DS	4.14	1.32	.36	-.13	-.40	.10	**-.57**	**-.44**	(.79)

Note. $N = 24$. GELoC = general external locus of control; DS = driving style. Correlations in boldface are statistically significant ($p < .05$, two-tailed). Numbers in parenthesis in the diagonal are the internal consistency reliability estimates.

Table 8 presents the results for the reaction measure. As indicated in the table note, items 3, 4, 5, and 7 were reverse coded. Generally, reactions to the measures were favorable (all means above 5 on a scale from 1 to 9, where 9 represents a very favorable view of the measure).

Specifically, respondents thought that the questions were easy to understand and required little effort to do so. In addition, they reported enjoying answering the questions.

Table 8: Reactions Measures for the Offline Pilot-Test Data

Item	*M*	*SD*	min	max
1. My responses to the picture questions (i.e., with a drawing of a tiny car) reflect how I usually make decisions on these issues. (U)	6.63	2.20	1	9
2. It was easy to understand the picture questions. (R)	6.50	1.69	2	9
3. It took a lot of effort to understand the picture questions. [a] (R)	6.13	2.05	3	9
4. Answering the other questions was confusing. [a] (R)	6.88	2.44	1	9
5. It took a lot of effort to understand the other questions. [a] (R)	6.63	2.26	2	9
6. I enjoyed answering the other questions. (A)	5.33	2.50	1	9
7. I was bored answering the other questions. [a] (A)	6.17	2.01	2	9

Note. $N = 24$. R = readability; A = affective reaction; U = utility. [a] Reverse scored.

Descriptive statistics and intercorrelations of study variables for the offline primary data collection are presented in Table 9. As mentioned in Section 3.2, external locus of control was measured using two different response formats—a forced-choice format and a Likert-type format. In order to maximize the number of surveys with complete information, both operationalizations were combined into a single variable. This was done by transforming the 9-point Likert-type measure into a scale from 0 to 1. There were no statistically significant differences between the different operationalizations of external locus of control (t [74.10] = 0.64, $p > .05$), which indicates that the response format did not affect the samples' estimated mean and, thus, justifies using both operationalizations of external locus of control interchangeably.

The observed correlations between the psychological variables were consistent with the conceptual expectations. For instance, individuals high in risk tolerance scored low in perceptions of driving risk ($r = -.18$) and reported a risky driving style ($r = .27$).

Table 9: Descriptive Statistics and Intercorrelations of Study Variables for the Offline Primary Data

	M	*SD*	1	2	3	4	5	6	7	8	9	10	11	12
1. Conscientiousness	6.27	1.17	(.83)											
2. GELoC (forced-choice)	0.41	0.19	**-.35**	(.45)										
3. GELoC (Likert-type)	4.54	0.91	**-.26**	-	(.74)									
4. GELoC (combined) [a]	0.40	0.13	**-.27**	-	-	-								
5. Need for structure	5.65	1.23	**.38**	-.22	.00	-.09	(.83)							
6. Risk tolerance	3.13	1.06	**-.14**	-.02	.10	.05	**-.26**	(.72)						
7. Driving risk perceptions	5.04	1.82	.06	.17	.05	.09	**.21**	**-.18**	(.87)					
8. Careful DS	4.89	1.10	**.14**	-.05	-.03	-.04	**.29**	**-.24**	**.70**	(.78)				
9. Risky DS	4.21	1.43	-.11	.11	.06	.08	-.11	**.27**	**-.46**	**-.63**	(.83)			
10. Preference for Non-solo DTA	6.40	1.19	**.20**	.06	-.14	-.06	-.05	-.03	.10	.04	-.02	(.31)		
11. Preference for Solo DTA	7.17	0.89	.10	.04	-.12	-.05	.06	-.04	.02	-.06	**.17**	**.35**	(.67)	
12. Preference for carpooling	5.41	1.99	.03	**.22**	**-.17**	-.01	**-.15**	.11	.04	.03	.06	**.43**	**.16**	(.75)

Note. *N* = 231 (except for General LoC [forced-choice] where N = 62, and General LoC [Likert-type] where N = 169). Numbers in parenthesis in the diagonal are the internal consistency reliability estimates. GELoC = general external locus of control; DS = driving style; DTA = driving travel attributes. Correlations in boldface are statistically significant ($p < .05$, two-tailed). [a] GELoC (combined) is based on either operationalizations of GELoC (force-choice and Likert-type) and uses a scale ranging from 0 to 1.

4.1.2 Individual Differences as Predictors of Travel Modes: Results from Discriminant Analyses.

A discriminant analysis was performed on the offline primary data to identify a subset of the psychological variables that were most predictive of the travel mode choice. Discriminant analysis is a statistical procedure for evaluating the predictive accuracy of a set of continuous variables (i.e., discriminant predictors) to correctly classify individuals into mutually exclusive categories or groups (Huberty, 1994; Huberty and Barton, 1989; Klecka, 1980). For the present study, four groups of respondents were identified based on their responses to the stated preference questions. Specifically, each individual was classified into one of the following groups based on their responses to the stated preference question—driving alone on a general purpose lane (DA-GPL), carpooling on a general purpose lane (CP-GPL), driving alone on a manage lane (DA-ML), and carpooling on a managed lane (CP-ML). To facilitate the analyses and interpretation of results, all subsequent analyses are based on a sample of individuals who gave consistent responses to the two stated preference questions—that is, individuals who chose either DA-GPL, CP-GPL, DA-ML, or CP-ML in both questions.[2] Collapsing the two stated preference questions into one single variable allowed us to examine the more extreme group of respondents for whom the differences in toll and travel time associated with each travel choice was not as critical—they would chose the same alternative regardless of variations in toll and travel time presented to them in this survey. In addition, by examining a single variable as the criterion, we were able to reduce the complexity in interpreting the findings.

Following the classification, several subsets of discriminant predictors were identified based on their ability to correctly classify individuals into the four groups. The subsets were identified by considering all possible subsets of variables for the purpose of discriminating between the groups using Morris and Meshbane's (1995) method and the accompanying computer program.

Table 10 presents the 10 subsets of discriminant predictors that yielded the highest hit rate (i.e., the proportion of individuals correctly classified according to each discriminant predictor set). The last column of Table 10 shows the weighted average hit rate across the four groups for each predictor subset. Results from Table 10 indicate that a model composed of external locus of control, conscientiousness, need for structure, risky driving style, and preference for carpooling (Model 1) was the best in terms of the number of individuals correctly classified—a hit rate of .60 or correctly classifying individuals into one of the four groups 60% of the time. The remaining models (i.e., 2 to 10) show hit rates that are similar to Model 1, ranging from .59 to .57. Only two participants chose CP-GPL; thus, conclusions regarding this group should be interpreted cautiously.

Preference for carpooling was highly predictive of participants' travel mode choice (see Table 12 and accompanying discussion). In an attempt to partial out the effect of preference for carpooling, we conducted a series of analyses similar to those presented in Table 10 but this time excluding preference for carpooling from the model. The analyses presented in Table 11 demonstrate that need for structure and risky driving style (Model 1) were the best subset of

[2] For the offline data, analyses were on two of the three stated preference questions because the third stated preference question was inconsistent in that three of the four choices presented a carpooling option. This eliminated 81 respondents resulting in a sample of 150 respondents for analysis.

discriminant predictors. As expected, removing preference for carpooling from the analyses resulted in a lower overall hit rate. Specifically, the hit rates for Models 1 to 10 in Table 11 ranged from .43 to .37 (compared to a hit rate of .57 to .60 for the previous analyses). Interestingly, after removing preference for carpooling, preference for solo travel attributes emerged as a predictor of participants' travel mode choices in several models—specifically, Models 3, 4, 5, 7, and 9.

Table 10: Hit Rates from the Top 10 Models of Discriminant Predictors for the Offline Primary Data

Model	Discriminant Predictors	DA-GPL (*n* = 29)	CP-GPL (*n* = 2)	DA-ML (*n* = 28)	CP-ML (*n* = 91)	Total
1	GELoC, CONS, NFS, RDS, and PC	.69	.00	.57	.59	.60
2	CONS, NFS, RDS, and PC	.72	.50	.46	.59	.59
3	CONS, NFS, RT, CDS, and PC	.52	.00	.54	.58	.59
4	CONS, NFS, RT, DRP, CDS, and PC	.69	.00	.50	.58	.58
5	CONS, NFS, DRP, RDS, and PC	.72	.00	.46	.58	.58
6	GELoC, CONS, NFS, DRP, RDS, and PC	.66	.00	.50	.59	.58
7	CONS, NFS, DRP, CDS, RDS, and PC	.62	.00	.50	.60	.58
8	GELoC, CONS, RT, CDS, and PC	.72	.00	.46.	.57	.57
9	CONS, NFS, RT, RDS, and PC	.72	.50	.46	.56	.57
10	CONS, NFS, CDS, RDS, and PC	.72	.00	.46	.57	.57

Note. *N* = 150. Stated preference choice was aggregated within individual only if their responses to the two questions were the same (e.g., always chose DA - GLP). DA = driving alone; CP = carpool; GPL = general purpose lane; ML = managed lane. GELoC = external locus of control; CONS = conscientiousness; NFS = need for structure; RT = risk tolerance; DRP = driving risk perceptions; CDS = careful driving style; RDS = risky driving style; PC = preference for carpooling; SOLO = preference for solo driving travel attributes. Underlined variables showed statistically significant differences when analyzed using ANOVA (see Table 9).

Table 11: Hit Rates from the Top 10 Models of Discriminant Predictors for the Offline Primary Data Excluding Preference for Carpooling.

Model	Discriminant Predictors	DA-GPL (*n* = 29)	CP-GPL (*n* = 2)	DA-ML (*n* = 28)	CP-ML (*n* = 91)	Total
1	NFS and RDS	.59	.00	.39	.40	.43
2	NFS, CDS, and RDS	.72	.00	.39	.35	.43
3	NFS, DRP, and SOLO	.52	.00	.54	.58	.59
4	NFS, RDS, and SOLO	.59	.00	.43	.37	.42
5	GELoC, NFS, CDS, RDS, and SOLO	.59	.00	.46	.36	.42
6	NFS, RT, RDS	.59	.00	.39	.37	.41
7	GELoC, NFS, RDS, and SOLO	.52	.00	.46	.36	.41
8	GELoC, NFS, RT, and RDS	.52	.00	.43	.37	.41
9	GELoC, NFS, DRP, and SOLO	.45	.00	.29	.43	.40
10	CONS, NFS, DRP, and RDS	.55	.00	.36	.37	.40

Note. N = 150. Stated preference choice was aggregated within individual only if their responses to the two questions were the same (e.g., always chose DA - GLP). DA = driving alone; CP = carpool; GPL = general purpose lane; ML = manage lane. GELoC = external locus of control; CONS = conscientiousness; NFS = need for structure; RT = risk tolerance; DRP = driving risk perceptions; CDS = careful driving style; RDS = risky driving style; PC = preference for carpooling; SOLO = preference for solo driving travel attributes. Underlined variables showed statistically significant differences when analyzed using ANOVA (see Table 9).

In addition to the discriminant analysis, mean differences between the discriminant variables were analyzed using a univariate analysis of variance (ANOVA) with the travel mode as the grouping variable and each discriminant predictor as the dependent variable. Consistent with the results of the discriminant analysis, Table 12 indicates that preference for carpooling explained 41% of the variance in travel mode. Post-hoc analysis using Tukey's honestly significant difference (HSD) test indicated that the two carpooling modes (CP-GPL and CP-ML) had significantly higher means in preference for carpooling than the driving-alone modes (DA-GPL and DA-ML). This is not surprising given that both measures assess willingness to carpool over driving alone. In addition, participants who chose the ML modes (DA-ML and CP-ML) reported significantly higher levels of risk tolerance, which is counter to what we had initially posited. However, upon further reflection, these findings may not be that unexpected since the content of the items that comprise the risk tolerance measure pertained to financial risk, which is basically what paying to use a ML entailed. A similar noteworthy finding was that compared to those who chose the GPLs (either the DA-GPL or CP-GPL), individuals who chose the ML modes had higher risky driving style and lower careful driving style scores. Again, while this seemed to run counter to our initial expectations about the direction of this relationship, the item content of these measures leads one to conclude that this pattern of results may not be that unexpected. Finally, whereas participants who value solo travel attributes—that is, relaxation, safety, comfort, low travel time, reliable travel time, and flexibility—chose the ML modes (DA-ML and CP-ML) more often, participants who value non-solo travel attributes—that is, concerns about the environment, low travel costs, and companionship—chose the CP-ML over every other travel mode.

Table 12: Means for Psychological Variables by Stated Preference for the Offline Primary Data

	DA-GPL (*n* = 29)	CP-GPL (*n* = 2)	DA-ML (*n* = 28)	CP-ML (*n* = 91)	η^2
1. Conscientiousness	6.32	5.65	6.27	6.33	.00
2. GELoC	0.41	0.44	0.38	0.39	.01
3. Need for structure	6.00	6.30	5.78	5.43	.04
4. Risk tolerance	$2.49^{\mathbf{A}}$	$2.50^{\mathbf{AB}}$	$3.27^{\mathbf{B}}$	$3.19^{\mathbf{B}}$	$.08^{*}$
5. Driving risk perceptions	5.63	5.58	4.96	4.81	.04
6. Careful DS	$5.53^{\mathbf{A}}$	$4.95^{\mathbf{AB}}$	$4.57^{\mathbf{B}}$	$4.77^{\mathbf{B}}$	$.10^{*}$
7. Risky DS	$3.11^{\mathbf{A}}$	$4.00^{\mathbf{AB}}$	$4.69^{\mathbf{B}}$	$4.36^{\mathbf{B}}$	$.16^{*}$
8. Preference for Non-solo DTA	$5.95^{\mathbf{A}}$	$6.67^{\mathbf{AB}}$	$6.10^{\mathbf{A}}$	$6.80^{\mathbf{B}}$	$.11^{*}$
9. Preference for Solo DTA	$6.69^{\mathbf{A}}$	$7.33^{\mathbf{AB}}$	$7.40^{\mathbf{B}}$	$7.26^{\mathbf{B}}$	$.07^{*}$
10. Preference for carpooling	$3.71^{\mathbf{A}}$	$7.00^{\mathbf{BC}}$	$4.19^{\mathbf{AB}}$	$6.60^{\mathbf{C}}$	$.41^{*}$

Note. N = 150. Stated preference choice was aggregated within individual only if their responses to the two questions were the same (e.g., always chose DA - GLP). DA = driving alone; CP = carpool; GPL = general purpose lane; ML = manage lane; ELoC = external locus of control; DTA = driver travel attributes; η^2 (or eta-squared) is an effect size metric that reflects the amount of variance in a dependent or outcome variable that is explained by the independent variable or predictor. Means that share the same letter superscript (i.e., A, B, or C) are not statistically different. $^{*}p < .05$.

4.2 Online Survey Results

As indicated in Chapter 3, the online survey resulted in 664 completed responses from travelers in autos. There were 209 from Denver, 54 from Miami, and 401 from San Diego. Not all respondents answered every question, but many did answer all questions, and those that did not answer every question left only a few questions blank. The analyses shown below include all 664 respondents.

To begin, the respondents were examined to see if there were differences between travelers based on which city they lived (see Table 13).

Table 13: Traveler Data by City (Online Survey)

Characteristic City	Percent of Travelers: Denver	Miami	San Diego	All
Day of Travel of most recent trip on the freeway*				
Weekday	82	85	95	90
Weekend	18	15	5	10
Direction of travel				
Towards downtown	49	50	43	46
Away from downtown	51	50	57	54
Trip Purpose*				
Commuting to or from my place of work	35	59	71	59
Recreational/Social/Shopping/ Entertainment/Personal Errands	40	26	13	23
Work related (other than to or from home to work)	16	9	11	12
To attend class at school or educational institute	1	2	1	1
Other	8	4	3	5
Survey design type				
D-Efficient	45	43	48	47
Adaptive random	55	57	52	53
Used Express Lanes on most recent trip*				
Yes	20	70	79	60
No	80	30	21	40
Ever used Express Lanes*				
Yes	65	71	100	76
No	35	29	0	24
Weighted average of psychological variables				
Conscientiousness	7.45	7.09	7.39	7.38
Locus of control*[C]	0.37	0.25	0.31	0.32
Need for structure	5.23	5.54	5.44	5.38
Risk tolerance	2.55	2.52	2.33	2.42
Driving risk	3.92	5.12	4.20	4.19
Male*	43	43	60	53
Age				
16 to 24	2	2	1	1
25 to 34	12	11	7	9
35 to 44	16	8	18	16
45 to 54	24	26	30	28
55 to 64	34	32	32	32
64 or older	11	21	13	13
Income*				
Less than $14,999	1	2	1	1
$15,000 to $34,999	4	8	3	4
$35,000 to $49,999	8	10	7	8
$50,000 to $74,999	24	28	14	18

$75,000 to $99,999	21	18	21	21
$100,000 to $199,999	33	28	39	36
Greater than $200,000	8	6	15	12
Household Type*				
Single adult	20	31	17	19
Unrelated adults	9	2	4	6
Married without children	28	33	27	28
Married with children	38	29	46	42
Single parent	5	4	6	5
Size of household*				
1 person	19	26	12	
2 people	46	42	41	
3 people	14	17	19	
4 people	12	11	18	
5 or more people	8	4	9	
Number of Vehicles*				
0	0	0	0	0
1	18	28	11	15
2	47	47	44	45
3 or more	35	25	45	40
Education Level*				
Less than high school	1	2	0	1
High school	2	11	5	5
Some college or vocational school	19	30	23	22
College graduate	48	34	42	43
Postgraduate degree	30	22	30	29
Length of Recent Trip (miles)*				
Less than 2 miles	0	2	0	0
3 to 5 miles	1	2	1	1
6 to 10 miles	11	6	4	6
11 to 15 miles	14	4	8	10
16 to 20 miles	19	19	19	19
21 to 25 miles	8	15	19	15
26 to 30 miles	11	13	17	15
More than 30 miles	36	40	32	34
Number of vehicle occupants*				
1	62	72	80	74
2	32	20	15	21
3	5	2	3	3
4 or more	1	6	2	2
Average time to pick up carpool passengers (minutes)	5.4	12.9	5.5	6.1
Average time saved on the EL (as perceived by respondent) (minutes)	15.4	22.9	16.4	16.9
EL trips per week*	1.3	4.9	5.0	4.1
Trips on this freeway per week*	3.9	5.5	7.1	6.0
Percent of freeway trips on EL*	32	89	70	68
Unusual (pressed for time/urgent) trips per week*	1.6	2.4	2.4	2.2

Frequency of EL use for unusual trips				
Never	3	3	0	1
Rarely	8	0	1	2
Around half of all unusual trips	18	7	7	8
Most of the unusual trips	34	16	30	29
Always	37	74	62	60
Stated preference value of travel time savings (dollars per hour) presented to respondent				
Question 1	19.79	20.19	19.42	19.60
Question 2*	20.91	23.75	25.00	23.61
Question 3*	26.14	33.17	30.35	29.26
Reasons for using the ELs (totals greater than 100% as respondents could choose multiple reasons)				
Being able to use the Express Lanes for free as a carpool	47	11	26	30
During the peak hours the Express Lanes will not be congested	58	39	64	60
Travel times on the Express Lanes are consistent and predictable	34	35	49	44
The Express Lanes are safer/less stressful than driving on the general purpose lanes	46	50	62	57
Travel times on Express Lanes are less than those on the general purpose lanes	60	59	73	69
Trucks and larger vehicles are not allowed on the Express Lanes	20	24	19	20
My employer pays for the tolls	4	7	3	3
Other: __________________	2	9[A]	3	3
Reasons for not using the ELs (totals greater than 100% as respondents could choose multiple reasons)				
Participation in a carpool is difficult/ undesirable	12	0	0	11
I do not have a credit card so it is inconvenient to set up a toll account	0	0	0	0
I do not want a toll transponder in my car	8	0	0	7
Access to the Express Lanes is not convenient for my trips	34	50	0	35
The Express Lanes do not offer me enough time savings	18	0	0	17
Express Lane use is complicated or confusing	20	0	0	19
I don't like that the toll changes based on time of day	14	25	0	15
I have the flexibility to travel at less congested times	38	0	0	35
I do not want to pay the toll for this trip	36	25	0	35
I can easily use other routes than the Freeway, so I'll just avoid it if I think there	22	0	0	20

is a lot of traffic				
I do not feel safe traveling on Express Lanes	2	0	0	2
The tolls are too high for me	22	25	0	23
Other:	14[B]	0	0	13

A: Several Miami respondents mentioned having a hybrid vehicle. B: A few Denver respondents mentioned a lack of EL going south of the city. C: Locus of Control is measured from 0 to 1 while the other psychological variables are from 1 to 9.
* = significantly different by city at a 95% level of confidence.

Based on these results it is clear that there were somewhat different groups of travelers on the three freeways with Express Lanes. Due to the small sample size it is not possible to infer anything about the population of travelers on the three freeways. However, the sample was large enough to examine how the survey sample differed by freeway. In general, the travelers on I-15 in San Diego were more likely to be commuting on a weekday alone in their vehicle in the Express Lanes. They had higher average incomes and owned more vehicles as well. Results from the psychological variables were very similar between cities.

Next the results were examined based on the mode choice of the traveler. Each respondent answered four SP questions, and therefore each respondent is represented four times in Table 14. Some of the traveler characteristics that varied by mode were as expected. For example, those respondents who chose a carpool option in the SP questions were more likely to have carpooled on their most recent trip. Other traveler characteristics that varied by mode that deserve mention were that:

- Respondents on Recreational/Social/Shopping/Entertainment/Personal Errands trips were more likely to choose a carpool mode.
- Males were more likely to use the GPLs.
- A higher percentage of EL users indicated that they had more unusual or hurried trips each week.

Many other characteristics were significantly different by mode. However, the respondent characteristics were quite similar, indicating the difference was quite small, despite being significantly different. The psychological variables, the focus of this research, fell into this category as they were significantly different by mode but had very similar values in each mode. The weighted average of the conscientiousness psychological variable is the perfect example. It was significantly different by mode, but the values ranged from 7.33 to 7.49 on a 9 point scale.

Table 14: Traveler Data by Mode Choice (Online Survey)

Characteristic	Percent of Travelers Choosing Mode:				
Mode	DA-GPL	CP-GPL	DA-EL	CP-EL	ALL
Day of Travel of most recent trip on the freeway					
Weekday	91	89	91	88	90
Weekend	9	11	9	12	10
Direction of travel					
Towards downtown	44	58	47	45	46
Away from downtown	56	42	53	55	54
Trip Purpose*					
Commuting to or from my place of work	59	50	66	53	59
Recreational/Social/Shopping/ Entertainment/Personal Errands	23	42	15	28	23
Work related (other than to or from home to work)	12	3	14	12	12
To attend class at school or educational institute	0	0	1	2	1
Other	7	6	3	5	5
Survey design type					
D-Efficient	45	50	50	46	47
Adaptive random	55	50	50	54	53
Used Express Lanes on most recent trip*					
Yes	44	53	77	61	60
No	56	47	23	39	40
Ever used Express Lanes*					
Yes	65	65	90	87	76
No	35	35	10	13	24
Weighted average of psychological variables					
Conscientiousness*	7.35	7.49	7.46	7.33	7.38
Locus of control*[C]	0.33	0.27	0.32	0.32	0.32
Need for structure*	5.80	6.25	5.76	5.71	5.76
Risk tolerance*	2.46	2.73	2.45	2.36	2.43
Driving risk*	4.22	5.11	3.95	4.29	4.18
Male*	52	31	60	49	53
Age*					
16 to 24	1	0	1	2	1
25 to 34	8	0	6	12	9
35 to 44	18	6	18	14	17
45 to 54	29	25	29	25	28
55 to 64	32	31	33	33	32
64 or older	11	39	14	14	13
Income*					
Less than $14,999	1	3	1	1	1
$15,000 to $34,999	5	11	3	3	4
$35,000 to $49,999	11	17	5	6	8

Characteristic Mode	Percent of Travelers Choosing Mode:				
	DA-GPL	CP-GPL	DA-EL	CP-EL	ALL
$50,000 to $74,999	21	14	17	17	18
$75,000 to $99,999	18	25	19	25	21
$100,000 to $199,999	32	31	38	40	36
Greater than $200,000	12	0	17	8	12
Household Type*					
Single adult	24	12	22	13	19
Unrelated adults	5	0	4	8	6
Married without children	26	41	25	32	28
Married with children	40	41	44	42	42
Single parent	5	6	5	5	5
Size of household*					
1 person	20	11	17	11	16
2 people	40	64	41	48	43
3 people	20	6	16	16	17
4 people	13	8	17	16	16
5 or more people	7	11	9	9	8
Number of Vehicles*					
0	0	0	0	0	0
1	18	15	15	11	15
2	44	53	46	46	45
3 or more	38	32	39	43	40
Education Level*					
Less than high school	1	6	0	0	1
High school	4	8	6	3	4
Some college or vocational school	25	17	21	22	24
College graduate	44	42	44	42	43
Postgraduate degree	27	28	28	33	30
Length of Recent Trip (miles)*					
Less than 2 miles	0	0	0	0	0
3 to 5 miles	1	0	1	1	1
6 to 10 miles	7	22	7	5	7
11 to 15 miles	11	6	8	10	10
16 to 20 miles	20	28	17	20	19
21 to 25 miles	16	0	15	14	15
26 to 30 miles	12	8	17	16	15
More than 30 miles	33	36	36	33	34
Number of vehicle occupants*					
1	84	50	89	54	74
2	12	39	9	37	21
3	3	3	1	5	3
4 or more	1	8	1	4	2
Average time to pick up carpool passengers (minutes)*	6.9	14.1	7.5	5.3	6.1
Average time saved on the EL (as perceived by respondent) (minutes)*	16.3	21.6	17.9	16.0	16.9
EL trips per week*	3.4	3.4	4.7	4.1	4.1

Characteristic Mode	Percent of Travelers Choosing Mode:				
	DA-GPL	CP-GPL	DA-EL	CP-EL	ALL
Trips on this freeway per week*	5.7	4.6	6.3	6.0	6.0
Percent of freeway trips on EL	60	74	74	67	68
Unusual (pressed for time/urgent) trips per week*	2.0	1.8	2.3	2.3	2.2
Frequency of EL use for unusual trips*					
Never	2	0	0	0	1
Rarely	5	11	1	0	2
Around half of all unusual trips	8	26	4	12	8
Most of the unusual trips	33	26	29	27	30
Always	52	37	67	61	60
Stated preference value of travel time savings (dollars per hour) presented to respondent					
Question 1	19.81	17.93	19.24	19.77	19.60
Question 2	22.69	32.39	26.68	21.59	23.62
Question 3	28.46	26.37	35.89	24.84	29.27
Reasons for using the ELs (totals greater than 100% as respondents could choose multiple reasons)					
Being able to use the Express Lanes for free as a carpool	13	15	11	39	22
During the peak hours the Express Lanes will not be congested	42	50	47	44	45
Travel times on the Express Lanes are consistent and predictable	26	38	40	30	32
The Express Lanes are safer/less stressful than driving on the general purpose lanes	34	35	48	44	42
Travel times on Express Lanes are less than those on the general purpose lanes	46	50	56	50	51
Trucks and larger vehicles are not allowed on the Express Lanes	12	5	17	15	15
My employer pays for the tolls	1	5	4	2	3
Other: _________________	2	3	2	3	2
Reasons for not using the ELs (totals greater than 100% as respondents could choose multiple reasons)					
Participation in a carpool is difficult/ undesirable	6	13	13	16	9
I do not have a credit card so it is inconvenient to set up a toll account	0	0	0	0	0
I do not want a toll transponder in my car	9	0	0	0	6
Access to the Express Lanes is not convenient for my trips	24	13	31	39	27
The Express Lanes do not offer me enough time savings	17	0	19	0	13
Express Lane use is complicated or	11	0	13	27	14

Characteristic Mode	Percent of Travelers Choosing Mode:				
	DA-GPL	CP-GPL	DA-EL	CP-EL	ALL
confusing					
I don't like that the toll changes based on time of day	15	0	13	2	12
I have the flexibility to travel at less congested times	30	38	25	18	27
I do not want to pay the toll for this trip	30	0	13	30	27
I can easily use other routes than the Freeway, so I'll just avoid it if I think there is a lot of traffic	16	0	19	18	16
I do not feel safe traveling on Express Lanes	2	0	0	0	1
The tolls are too high for me	18	13	6	20	17
Other:	12	0	13	5	10

C: Locus of Control is measured from 0 to 1 while the other psychological variables are from 1 to 9.
* = significantly different by city at a 95% level of confidence.

4.3 Multinomial Logit Models of Mode Choice

In Section 4.2 the characteristics of the online survey respondents were compared by city and by mode chosen in the SP questions. This provides some indication as to how all variables, including the psychological variables, might influence mode choice. However, this is a very one dimensional analysis as it only includes one variable at a time. In this section of the report, several mode choice models of survey respondents will be developed using the mixed Logit modeling technique. The models can incorporate multiple variables to provide a better understanding of the influence of all variables on mode choice. Previous studies have found that the mode choice models for ELs should include the travel time and toll rate. They may also include the gender of the traveler, the income of the traveler and other characteristics as discussed in Chapter 2.

The models developed here began by including many of the variables found to be significantly different by mode (see Table 14). Then variables that were not significant in the model or did not improve the models predictive ability were removed in a stepwise fashion. Since the focus of this research was the impact of the psychological variables on mode choice, a model incorporating each of those variables was developed. This was necessary since none of the psychological variables were significant in the model that incorporated several psychological variables.

The first set of models examined here were the base models with no psychological variables included (see Table 15, model 1). The models yielded reasonable results with a rho squared value of 0.36 and a value of time of $29.25/hour. The next set of models included the psychological variable general external locus of control. Locus of control made little difference in rho squared (0.37) or value of time ($36.39/hour). The locus of control variable was not significant in any of the mode choice models (both the ones shown here in Table 15 plus many others that were estimated).

The next set of models included the three driving variables: (1) driving risk perceptions, (2) careful and (3) risky driving styles. Only one of these variables (risky driving style) was significant in one of the models (negative impact on the utility of carpooling in the GPLs). This indicated drivers who had a more risky driving style disliked carpooling in the GPLs. This seems logical as carpooling and using the GPLs both tend to increase travel time where many components of the risky driving style include the driver trying to find the fastest route possible. This model had a slightly better rho squared value of 0.39.

Psychological variables were only significant in one other model. Conscientious drivers had a decreased utility for carpooling on the GPLs.   This again makes sense as these people prefer order. The GPLs have considerably more travel time variability than the MLs. Plus carpooling brings in a whole set of unknowns (delayed riders, unscheduled stops, etc.) into the trip. Therefore, carpooling on the GPLs has the least structure and order and is less preferred by those travelers who had high conscientiousness scores.

Unfortunately, the psychological variables did little to improve the models' ability to predict mode use. In all but the two cases noted above the psychological variables were not significantly different from 0 at a 95 percent confidence limit. Therefore, based on these limited results, travel time savings, toll rate, gender, and income were far more likely to be indicators of a travelers' use of ELs than any of the psychological characteristics of those travelers.

Table 15: Mode Choice Models (Online Survey)

Mode	Independent Variable	Model 1: No PSYC Variables (n=1811)	Model 2: Locus of Control (n=937)	Model 3: Driving Risk (n=973)	Model 4: Financial Risk Tolerance (n=909)	Model 5: Need for Structure (n=998)	Model 6: Conscien-tiousness (n=919)
All	Travel Time (min.)	-0.59 (0.00)	-0.32 (0.00)	-0.29 (0.00)	-0.25 (0.00)	-0.25 (0.00)	-0.67 (0.00)
	Toll ($)	-1.21 (0.00)	-0.54 (0.00)	-0.49 (0.00)	-0.41 (0.00)	-0.54 (0.00)	-0.21 (0.01)
Drive Alone – GPLs	-	-	-	-	-	-	-
Carpool - GPLs	ASC	-4.25 (0.00)	-3.62 (0.20)	1.66 (0.78)	-9.52 (0.00)	-16.1 (0.07)	-6.45 (0.02)
	Male	0.81 (0.05)	2.20 (0.23)				1.32 (0.03)
	Med. Income		-4.64 (0.01)				
	High Income		5.05 (0.01)				
	Recreational / Shopping / Errand trips						0.53 (0.36)
	Locus of Control		-6.06 (0.16)				
	Driving Risk Perceptions			0.97 (0.10)			
	Careful Driving Style			-1.62 (0.28)			
	Risky Driving Style			-3.79 (0.00)			
	Risk Tolerance (Financial)				0.16 (0.82)		
	Need for Structure					-0.06 (0.93)	
	Conscientiousness						0.32 (0.38)
Drive Alone – MLs	ASC	-1.90 (0.027)	-0.87 (0.08)	0.29 (0.85)	-1.33 (0.03)	-0.93 (0.28)	-1.32 (0.48)
	Male	-1.77 (0.02)	-0.85 (0.03)	-0.79 (0.04)	-1.31 (0.00)	-0.91 (0.01)	-0.53 (0.11)
	Locus of Control		-0.52 (0.55)				
	High Income			0.88 (0.02)	0.77 (0.07)	1.11 (0.00)	
	Recreational / Shopping / Errand trips						-0.92 (0.02)
	Driving Risk Perceptions			-0.21 (0.12)			
	Careful Driving Style			-0.10 (0.72)			
	Risky Driving Style			-0.12 (0.49)			
	Risk Tolerance (Financial)				0.09 (0.62)		
	Need for Structure					-0.01 (0.90)	
	Conscientiousness						-0.15 (0.53)

Mode	Independent Variable	Model 1: No PSYC Variables (n=1811)	Model 2: Locus of Control (n=937)	Model 3: Driving Risk (n=973)	Model 4: Financial Risk Tolerance (n=909)	Model 5: Need for Structure (n=998)	Model 6: Conscien-tiousness (n=919)
Carpool - MLs	ASC	-0.38 (0.00)	-4.27 (0.00)	-1.44 (0.77)	-3.41 (0.00)	-1.81 (0.37)	-0.65 (0.62)
	Weekday	-3.40 (0.00)		-3.43 (0.04)			
	Married w/o Children	1.07 (0.07)					0.53 (0.01)
	Locus of Control		0.43 (0.82)				
	Driving Risk Perceptions			0.15 (0.64)			
	Careful Driving Style			0.01 (0.99)			
	Risky Driving Style			-0.27 (0.53)			
	Risk Tolerance (Financial)				-0.08 (0.83)		
	Need for Structure					-0.43 (0.20)	
	Conscientiousness						-0.38 (0.03)
Standard Deviations	Travel Time	1.18 (0.00)	0.39 (0.00)	0.20 (0.14)	0.20 (0.02)	0.11 (0.34)	2.11 (0.00)
	ASC- CP-GPLs	1.19 (0.00)	4.40 (0.05)	6.52 (0.00)	4.86 (0.00)	8.13 (0.05)	0.07 (0.99)
	ASC- DA-MLs	5.18 (0.00)	1.80 (0.00)	2.06 (0.00)	2.36 (0.00)	1.94 (0.00)	2.32 (0.00)
	ASC- CP-MLs	7.37 (0.00)	5.98 (0.00)	7.10 (0.00)	6.69 (0.00)	7.50 (0.00)	0.25 (0.74)
Model Results	Log Likelihood	-1604.6	-821.2	-818.4	-791.1	-830.7	-948.8
	Log Likelihood (restricted)	-2510.6	-1299.0	-1348.9	-1260.1	-1383.5	-1274.0
	Log Likelihood (constants only)	-2014.8	-1041.6	-1067.3	-1017.1	-1096.0	-1019.1
	Rho Squared	0.36	0.37	0.39	0.37	0.40	0.26
	Rho Squared (constants only)	0.20	0.21	0.23	0.22	0.24	0.07
	Value of Travel Time Savings ($/hr)	29.25	36.39	35.65	36.28	27.70	19.09
	Percent Correct Predictions	34.4	35.0	35.5	34.8	35.7	33.0

4.4 Individual Differences as a Function of Travel Mode Choice

As in Section 4.1.2, in this section we examined the individual difference variables by focusing on a group of respondents for whom the toll and travel time was not as critical—they would chose the same alternative regardless of the variations in toll and travel time presented to them in this survey. However, one important difference between the online and offline primary data collection is that different groups of participants in the online survey completed different sets of psychological measures. Although the final online sample consisted of 664 individuals, the number of participants who responded to each measure varies as does the number of individuals who completed each set of measures. As a consequence, some of the analyses performed with the offline primary data sample could not be replicated with the online sample. For instance, the full set of discriminant predictors could not be used to replicate the results of the offline primary study because this analysis requires complete data for all the variables.

Table 13 and Table 14 display the results of the online data collection. Table 14 presents the means for the psychological variables for each group—DA-GPL, CP-GPL, DA-ML, CP-ML. As can be seen on Table 16, the direction of the observed correlations between the constructs conformed to the expected pattern of results. For example, individuals high in careful driving style had a relatively low risky driving style, as demonstrated by a negative correlation between careful and risky driving style measures (r = -.42). Also, individuals who perceived driving as risky (i.e., high driving risk perceptions) reported a more careful driving style (r = .58) and, not surprisingly, also reported taking less risks while driving (r = -.28). Interestingly, whereas preference for non-solo and preference for solo travel attributes were positively correlated (r = .27) only preference for non-solo driving travel attributes was predictive of preference for carpooling.

Table 16: Descriptive Statistics and Intercorrelations of Study Variables for the Online Survey Data

	M	*SD*	1	2	3	4	5	6	7	8	9	10	11	12
1. Sex	0.48	0.50	**-**	668	321	328	352	320	350	350	350	328	330	332
2. Age	4.22	1.20	-.02	-	324	330	352	323	352	352	352	330	332	334
3. Conscientiousness	7.38	1.01	-.05	.08	(.79)	123	137	132	135	135	135	121	123	123
4. GELoC (forced-choice)	0.32	0.21	-.11	**-.16**	**-.25**	(.63)	138	118	143	143	143	132	133	134
5. Need for structure	5.78	1.29	.01	-.09	**.31**	.07	(.84)	138	150	150	150	140	140	142
6. Risk tolerance	2.42	1.08	**.15**	.02	**-.28**	.01	**-.28**	(.74)	135	135	135	126	127	127
7. Driving risk perceptions	4.18	1.68	**-.19**	.02	-.13	**.21**	**.38**	-.02	(.84)	352	352	141	141	141
8. Careful DS	4.91	0.86	**-.18**	**.12**	.06	.11	**.32**	-.10	**.58**	(.65)	352	141	141	141
9. Risky DS	3.03	1.18	**.20**	**-.14**	**-.18**	.08	-.06	**.17**	**-.28**	**-.42**	(.80)	141	141	141
10. Preference for Non-solo DTA	5.84	1.53	-.10	.02	.16	-.05	-.08	-.04	.07	**.27**	-.03	(.46)	331	331
11. Preference for Solo DTA	7.51	1.07	**-.13**	.07	**.24**	-.06	**.21**	-.10	.08	**.21**	-.10	**.27**	(.77)	333
12. Preference for carpooling	3.21	2.20	.04	-.08	.03	-.01	.05	-.03	.02	.10	-.12	**.37**	.05	(.79)

Note. Numbers in parenthesis in the diagonal are the internal reliabilities for each scale. Correlations between study variables are below the diagonal and *n*s for each correlation are above the diagonal. Dummy codes for sex are male = 1 ($N = 320$) and female = 0 ($N = 350$); Age was measured using a scale from 1 to 6 where 1 = 16 to 24; 2 = 25 to 34; 3 = 35 to 44; 4 = 45 to 54; 5 = 55 to 64; and 6 = 65 or older. LoC = locus of control; DS = driving style; DTA = driving travel attributes. Correlations in boldface are statistically significant ($p < .05$, two-tailed).

Consistent with the results of the offline primary data sample, results of the ANOVA (presented in Table 17) indicate that preference for carpooling ($\eta^2 = .31$) and preference for non-solo travel attributes ($\eta^2 = .06$) explained significant amounts of variance in travel mode choice, such that individuals who chose the carpooling modes displayed a higher preference for carpooling and valued non-solo travel attributes attributes—that is, relaxation, safety, comfort, low travel time, reliable travel time, and flexibility. None of the other psychological variables explained significant or meaningful amounts of variance in respondents' travel mode choice

Table 17: Means for Psychological Variables by Stated Preference for Online Data

	N	DA-GPL (*n* = 108)	DA-ML (*n* = 61)	CP-ML (*n* = 174)	η^2
1. Conscientiousness	168	7.34	7.26	7.24	.00
2. GELoC (forced-choice)	155	0.32	0.31	0.32	.00
3. Need for structure	180	5.79	5.90	5.71	.00
4. Risk tolerance	177	2.49	2.29	2.34	.01
5. Driving risk perceptions	181	4.30	3.96	4.24	.01
6. Careful DS	181	4.94	4.75	4.98	.01
7. Risky DS	181	3.31	3.29	2.96	.03
8. Preference for Non-solo DTA	170	$5.57^{\mathbf{A}}$	$5.52^{\mathbf{A}}$	$6.35^{\mathbf{B}}$	$.06^{*}$
9. Preference for Solo DTA	169	7.37	7.83	7.41	.02
10. Preference for carpooling	167	$2.38^{\mathbf{A}}$	$2.12^{\mathbf{A}}$	$4.97^{\mathbf{B}}$	$.31^{**}$

Note. Stated preference choice was aggregated within individual only if their responses to each of the three questions were the same (e.g., always chose DA - GLP). DA = driving alone; CP = carpool; GPL = general purpose lane; ML = manage lane; η^2 (or eta-squared) is an effect size metric that reflects the amount of variance in a dependent or outcome variable that is explained by the independent variable or predictor. Means that share the same letter superscript (i.e., A or B) are not statistically different. Numbers in parenthesis are the *n*s per cell. CP-GPL only had one respondent and was not shown in the table.
$^{*}p < .05$, $^{**}p < .01$

5. CONCLUSIONS

This research examined the impact of several personality traits (conscientiousness, general locus of control, personal need for structure, risk tolerance (financial), driving risk perceptions, risky driving style, and careful driving style) on survey respondents' choice of using MLs or GPLs. The results indicate that some psychological variables had significant relationships with the stated preference questions, but this was very limited. Discriminant analyses performed with the offline primary data sample (after removing preference for carpooling) demonstrated that the best model, which had a hit rate of 43 percent, comprised of need for structure, and risky driving style.

Follow-up ANOVAs indicated that drivers who chose the DA-GPL mode and those who choose to use MLs differed in terms of their risk tolerance. Specifically, individuals who consistently chose a ML option had significantly higher risk tolerance scores. As previously noted, these findings are consonant with the fact that the items for the risk tolerance measure pertained specifically to financial risk—and the MLs are a financial risk. If the MLs are slower or the same speed as the GPLs then the toll was spent for no time savings. Careful and risky driving styles were also significant predictors of travel choices. Drivers with higher careful driving style scores were more likely to choose the DA-GPL mode compared to the DA-ML and CP-ML modes. Again, a review of the item content of this measure helps to provide an explanation for these findings as some of their content pertained to the extent to which the respondent planned in advance for a trip. Thus, individuals who did plan (as reflected in their higher careful driving style scores) would not need the MLs since they gave themselves sufficient time to arrive at their destination on time. Additionally, drivers with higher risky driving style scores were more likely to choose the ML modes. This is conceptually congruent since many of the risky driving items pertained to wanting to travel faster—which the managed lanes usually allow.

Finally, the psychological variables had little impact on the mode choice models. The only two that were significant in any of the models were risky driving style and conscientiousness. Like the ANOVA analysis above, the respondents with higher risky driving style scores were less likely to choose the CP-GPLs. Respondents with higher conscientiousness scores were less likely to choose carpooling on the GPLs. This is consonant with the observation that conscientiousness individuals have a preference for structure and both carpooling and the GPLs were the least structured options.

Although not conclusive, the present results could inform future studies that seek to identify the role of drivers' psychology in predicting ML use. It is recommended that an additional, larger survey be undertaken to be sure that our results were not simply due to a relatively small sample size.

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APPENDIX A: PSYCHOLOGICAL VARIABLES USED IN THE SURVEYS

SCALE A
CONSCIENTIOUSNESS

*Conscientiousness***.** People high in conscientiousness describe themselves as careful, reliable, organized, self-disciplined, persevering, and detail-oriented. In contrast, low conscientiousness individuals describe themselves as careless, undependable, lazy, and disorganized. A 10-item representation of the Goldberg's (1992) markers will be used to measure conscientiousness. Participants will rate the extent to which each statement is descriptive of his or her personality on a nine-point Likert-type scale (1 = *very inaccurate*; 9 = *very accurate*).

Goldberg, L. R. (1992). The development of markers for the Big-Five factor structure. *Psvcholoaical Assessment*. *4*. 26-42.

Listed below are phrases describing people's behaviors. Please use the rating scale provided to describe how accurately each statement describes ***you***. Describe yourself as you generally are now, not as you wish to be in the future. Describe yourself as you honestly see yourself, in relation to other people you know of the same sex as you are, and roughly your same age. Please read each statement carefully, and then mark the number that corresponds to the accuracy of each statement on the scale below.

Very inaccurate	**Inaccurate**	**Somewhat inaccurate**	**Slightly inaccurate**	**Neither accurate nor inaccurate**	**Slightly accurate**	**Somewhat accurate**	**Accurate**	**Very accurate**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

1.	Always prepared	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
2.	Leave my belongings around [a]	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
3.	Pay attention to details	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
4.	Make a mess of things [a]	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
5.	Get chores done right away	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
6.	Often forget to put things back in their proper place [a]	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
7.	Like order	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
8.	Shirk my duties [a]	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
9.	Follow a schedule.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
10.	Exacting in my work.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Note. [a] Reverse scored.

SCALE B
GENERAL LOCUS OF CONTROL

Locus of Control. Locus of control represents the extent to which individuals perceive outcomes or control over events as contingent upon their own behavior, skills, decisions, or internal dispositions. Thus, if a person consistently interprets outcomes as resulting from their own actions, decisions, or internal dispositions, then the person is said to have an internal locus of control. Conversely, if similar events are consistently perceived as the result of luck, fate, or some kind of external force, then the person is said to have an external locus of control (Rotter, 1966). This internal-external scale consists of 12 pairs of statements. Participants are instructed to select one statement from each pair that better reflects their personal beliefs.

Rotter, J. B. (1966). Generalized expectancies for internal versus external control reinforcement. *Psychological Monographs: General and Applied, 80*, (1, Whole No. 609).

This is a questionnaire to find out the way in which certain important events in our society affect different people. Each item consists of a pair of alternatives—**A** or **B**. Please select the one statement of each pair (and only one) which you more strongly believe to be the case as far as you are concerned.

Be sure to select the one you actually believe to be more true rather than the one you think you should choose, or the one you would like to be true. This is a measure of personal beliefs. There are no right or wrong answers.

Please answer these items carefully, but do not spend too much time on any one item. Be sure to choose an answer for every pair. Mark the answer of your choice.

In some instances you may discover that you believe both or neither statements. In such cases, be sure to select the one you more strongly believe to be the case. Also, try to respond to each item independently when making your choice; do not be influenced by your previous choices.

1.	. I have often found that what is going to happen will happen.	. Trusting to fate has never turned out as well for me as making a decision to take a definite course of action.
2.	. Becoming a success is a matter of hard work; luck has little or nothing to do with it.	. Getting a good job depends mainly on being in the right place at the right time.
3.	. The average citizen can have an influence in government decisions.	. This world is run by the few people in power, and there is not much the little guy can do about it.
4.	. When I make plans, I am almost certain that I can make them work.	. It is not always wise to plan too far ahead because many things turn out to be a matter of good or bad fortune anyhow.
5.	. Who gets to be the boss often depends on who was lucky enough to be in the right place first.	. Getting people to do the right thing depends on ability; luck has little or nothing to do with it.

6.	. As far as world affairs are concerned, most of us are the victims of forces we can neither understand, nor control.	. By taking an active part in political and social affairs, the people can control world events.
7.	. Most people do not realize the extent to which their lives are controlled by accidental happenings.	. There really is no such thing as “luck.”
8.	. With enough effort we can wipe out political corruption.	. It is difficult for people to have much control over the things politicians do in office.
9.	. Sometimes I can't understand how teachers arrive at the grades they give.	. There is a direct connection between how hard people study and the grades they get.
10.	. Most of the time I can't understand why politicians behave the way they do.	. In the long run the people are responsible for bad government on a national as well as on a local level.

SCALE C
PERSONAL NEED FOR STRUCTURE

Personal need for structure. Need for structure speaks to a preference for structure and simplicity in one's dealings. People high in need for structure prefer consistent routine and structured situations mainly because under these circumstances their need for structure is fulfilled.

Neuberg, S. L., & Newsom, J. T. (1993). Personal need for structure: Individual differences in the desire for simple structure. *Journal of Personality & Social Psychology, 65*, 113-131.

Read each of the following statements and decide how much you agree with each according to your attitudes, beliefs, and experiences. It is important for you to realize that there is no right or wrong answer to these questions. People are different, and we are interested in how you feel. Please respond according to the following 9-point scale:

Strongly disagree	**Disagree**	**Somewhat disagree**	**Slightly disagree**	**Neither agree nor disagree**	**Slightly agree**	**Somewhat agree**	**Agree**	**Strongly agree**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

1.	It upsets me to go into a situation without knowing what I can expect from it.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
2.	I'm not bothered by things that interrupt my daily routine.*	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
3.	I enjoy having a clear and structured mode of life.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
4.	I find that a well-ordered life with regular hours makes my life tedious.*	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
5.	I don't like situations that are uncertain.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
6.	I hate to change my plans at the last minute.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
7.	I hate to be with people who are unpredictable.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
8.	I find that a consistent routine enables me to enjoy life more.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
9.	I enjoy the exhilaration of being in unpredictable situations.*	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
10.	I become uncomfortable when the rules in a situation are not clear.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

*Notes.** Item is reverse scored.

SCALE D
RISK TOLERANCE

Risk tolerance. Risk tolerance represents a person's generic orientation toward taking or avoiding a risk when deciding how to proceed in situations with uncertain outcomes. Weber, Blais, and Betz's (2002) 50-item scale measures risk tolerance in five areas: ethical (E), financial (F), health/safety (H), recreational (R), and social (S). The scale below includes only the financial risk aversion subscale.

Weber, E. U., Blais, A.-R., & Betz, N. E. (2002). A domain-specific risk-attitude scale: Measuring risk perceptions and risk behaviors. *Journal of Behavioral Decision Making, 15*, 263-290.

For each of the following statements, please indicate your **likelihood** of engaging in each activity. Provide a rating from 1 to 9, using the following scale:

Extremely unlikely	**Unlikely**	**Somewhat unlikely**	**Slightly unlikely**	**Neither likely nor unlikely**	**Slightly likely**	**Somewhat likely**	**Likely**	**Extremely likely**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

1.	Betting a day's income at the horse races.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
2.	Co-signing a new car loan for a friend.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
3.	Investing 10% of your annual income in a blue chip stock.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
4.	Investing 10% of your annual income in a very speculative stock.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
5.	Investing 10% of your annual income in government bonds (treasury bills).	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
6.	Investing in a business that has a good chance of failing.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
7.	Lending a friend an amount of money equivalent to one month's income.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
8.	Spending money impulsively without thinking about the consequences.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
9.	Taking a day's income to play the slot-machines at a casino.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
10.	Taking a job where you get paid exclusively on a commission basis.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Note. Items include only financial risk taking behaviors.

SCALE E
DRIVING RISK PERCEPTIONS AND DRIVING STYLE

Risk perceptions. Driving risk perceptions comprise an individual's cognitive and emotional reactions to traffic safety. This scale was based on previous measures of risk-taking cognitions (2 items; Fischer, Kubitzki, Guter, & Frey, 2007) and risk perceptions (3 items; Rundmo & Iversen, 2004).

Multi-dimensional driving style inventory (MDSI). The MDSI assesses the ways drivers choose to drive or the way they habitually drive (Taubman-Ben-Ari, Mikulincer, & Gillath, 2004). For the purpose of this study, we included 5 of the 8 driving styles that comprise the MDSI—anxious, risky, high-velocity, patient, and careful driving styles.

Fischer, P., Kubitzki, J., Guter, S., & Frey, D. (2007). Virtual driving and risk taking: Do racing games increase risk-taking cognitions, affect, and behaviors? *Journal of Experimental Psychology*, *13*, 22-31.

Rundmo, T., & Iversen, H. (2004). Risk perception and driving behaviour among adolescents in two Norwegian counties before and after a traffic safety campaign. *Safety Science*, *42*, 1-21.

Taubman-Ben-Ari, O., Mikulincer, M., & Gillath, O. (2004). The multidimensional driving style inventory-scale construct and validation. *Accident Analysis and Prevention*, *36*, 323-332.

Please rate the extent to which you agree with each statement using the following scale:

Strongly disagree	**Disagree**	**Somewhat disagree**	**Slightly disagree**	**Neither agree nor disagree**	**Slightly agree**	**Somewhat agree**	**Agree**	**Strongly agree**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

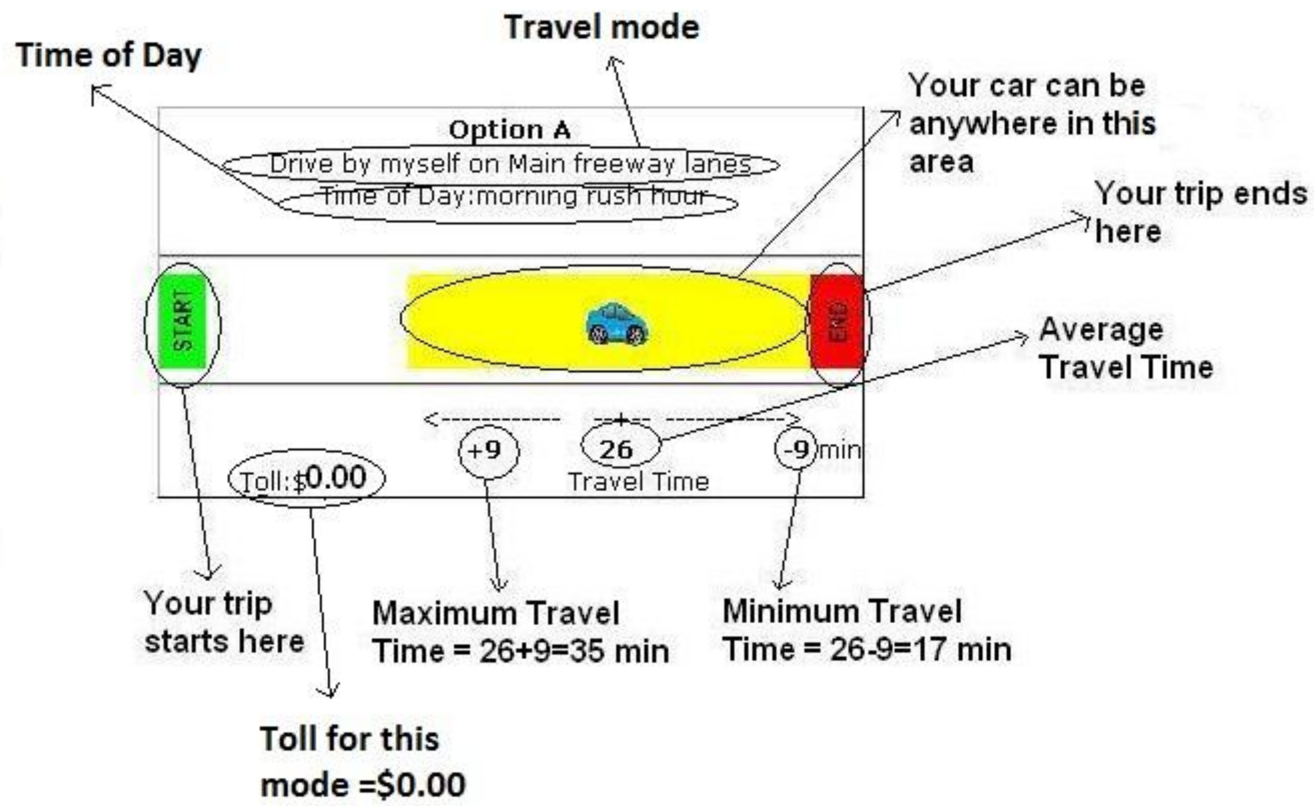
Driving Risk Perceptions Composite		
1.	I mostly respect speed limits.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
2.	I become anxious when driving too fast.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
3.	Sometimes I am afraid that I will have a traffic accident.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
4.	I feel unsafe that I could be injured in a traffic accident.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
5.	I am worried about being injured in a traffic accident.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
6.	I think there is a high likelihood that I will be injured in a traffic accident.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
Careful Driving Style Composite		
7.	I feel nervous while driving.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
8.	I feel distressed while driving.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

9.	It worries me when driving in bad weather.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
10.	On a clear freeway, I usually drive at or a little below the speed limit.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
11.	I feel I have control over driving. [b]	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
12.	I feel comfortable while driving. [b]	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
13.	At an intersection where I have to give right of way to oncoming traffic, I wait patiently for cross-traffic to pass.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
14.	I base my behavior on the motto "better safe than sorry."	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
15.	When a traffic light turns green I just <u>wait patiently</u> for the car in front of me until it moves.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
16.	I plan long journeys in advance.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
17.	I drive cautiously.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
	Risky Driving Style Composite	
18.	I enjoy the excitement of dangerous driving.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
19.	I enjoy the sensation of driving on the edge.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
20.	I like to take risks while driving.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
21.	In a traffic jam, I think about ways to get through the traffic faster.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
22.	In a traffic jam, I move to a faster lane as soon as I see the opportunity.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
23.	When a traffic light turns green I try to urge the driver in front of me to move on.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
24.	I purposely tailgate other drivers.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
25.	I get impatient during rush hours.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
26.	I drive through traffic lights that have just turned red.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Note.. [b] Reverse scored.

SCALE F
TOLL ROAD USE PREFERENCES

The following section asks questions related to your travel choices for a typical trip on a major freeway during morning rush hour. Each question is presented with four potential travel choices. The picture below is an example of a travel choice on main freeway lanes. The average travel time, maximum travel time, minimum travel time, and toll for that travel choice are shown in the picture.



Each of the following questions will ask you to choose between four potential travel choices for your travel on a major freeway during rush hour. Please select one option that you would be most likely to choose if faced with these specific options. Remember that main lane traffic tends to be congested and could be slower than shown here if congestion is worse than usual. The managed/toll lane traffic is fast moving. Also, carpooling may require added travel time to pick up or drop off your passenger(s).

If you had the options below for that trip, which would you have chosen?

(The + and - values show the range of travel times)

Option A
Drive by myself on Main freeway lanes
Time of Day:afternoon rush hour

START END

<------------ --+-- ------------>
+3 17 -3 min
Toll:$None Travel Time

Option B
Carpool with others on Main freeway lanes
Time of Day:afternoon rush hour

START END

<------------ --+-- ------------>
+3 17 -3 min
Toll:$None Travel Time

Option C
Drive by myself on Toll lanes
Time of Day:afternoon rush hour

START END

<---- --+------->
+1 10 -1 min
Toll:$3.50 Travel Time

Option D
Carpool with others on Toll lanes
Time of Day:afternoon rush hour

START END

<---- --+------->
+1 10 -1 min
Toll:$None Travel Time

Scenario 1 of 6
Click Here for Help

The options below have changed.

If you had the options below for that trip, which would you have chosen?

(The + and - values show the range of travel times)

Choose one of the following answers

○ **Option A**
Drive by myself on Main freeway lanes
Time of Day:afternoon rush hour

START | END

<------------ --+-- ------------>
+11 25 -11 min
Toll:$None Travel Time

○ **Option C**
Drive by myself on Toll lanes
Time of Day:afternoon rush hour

START | END

<---- --+------->
+1 9 -1 min
Toll:$2.50 Travel Time

○ **Option B**
Carpool with others on Main freeway lanes
Time of Day:afternoon rush hour

START | END

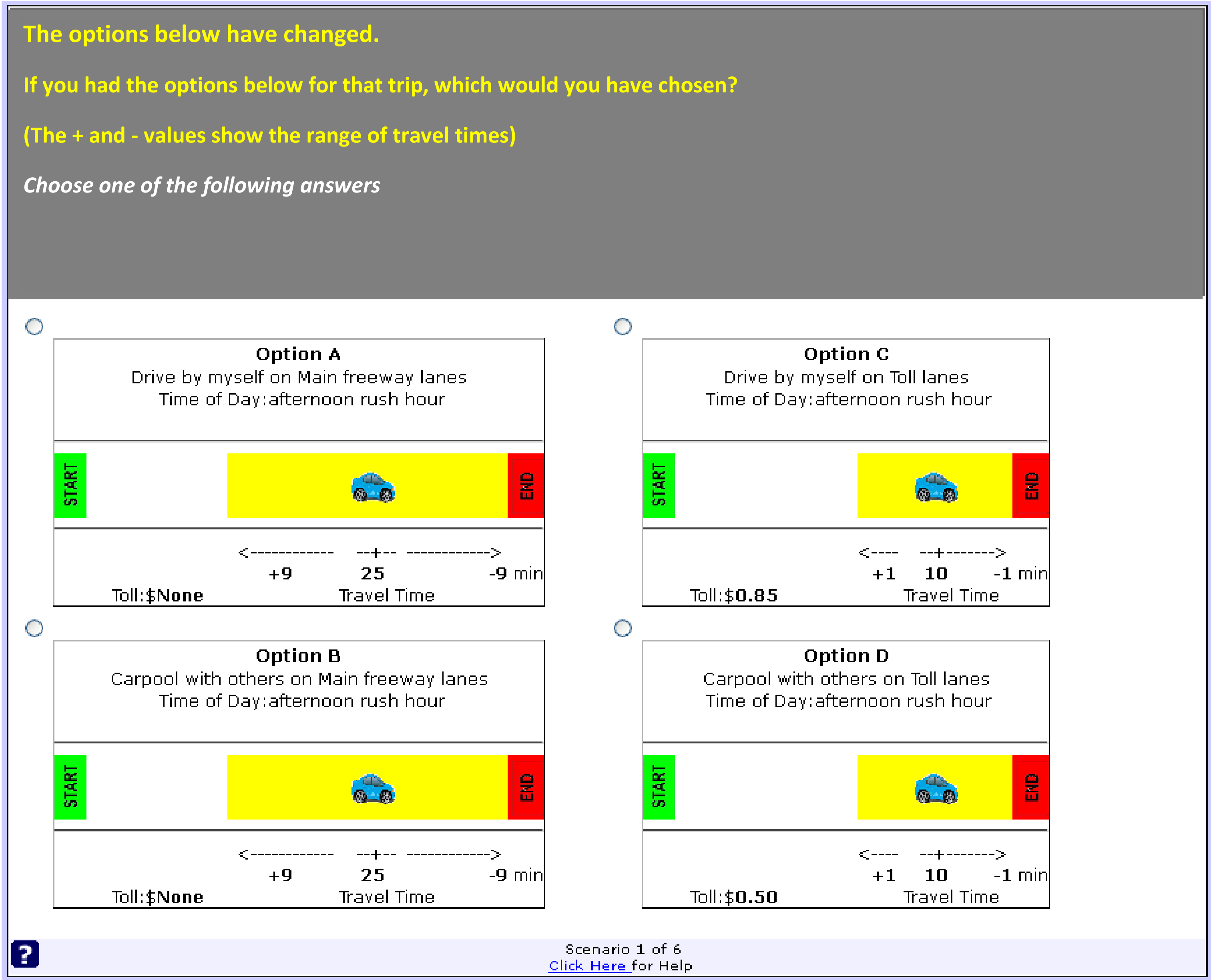
<------------ --+-- ------------>
+11 25 -11 min
Toll:$None Travel Time

○ **Option D**
Carpool with others on Toll lanes
Time of Day:afternoon rush hour

START | END

<---- --+------->
+1 9 -1 min
Toll:$0.50 Travel Time

Scenario 1 of 6
Click Here for Help


The options below have changed.
If you had the options below for that trip, which would you have chosen?
(The + and - values show the range of travel times)
Choose one of the following answers
Option A
Drive by myself on Main freeway lanes
Time of Day:afternoon rush hour
START
END
<------------ --+-- ------------>
+9 25 -9 min
Toll:$None
Travel Time
Option C
Drive by myself on Toll lanes
Time of Day:afternoon rush hour
START
END
<---- --+------->
+1 10 -1 min
Toll:$0.85
Travel Time
Option B
Carpool with others on Main freeway lanes
Time of Day:afternoon rush hour
START
END
<------------ --+-- ------------>
+9 25 -9 min
Toll:$None
Travel Time
Option D
Carpool with others on Toll lanes
Time of Day:afternoon rush hour
START
END
<---- --+------->
+1 10 -1 min
Toll:$0.50
Travel Time
?
Scenario 1 of 6
Click Here for Help

SCALE G
REACTION MEASURES

Reaction Measures. These items will assess reactions to the survey items completed in terms of readability, affective reactions, and utility. (9-point Likert scale, 1 = *Strongly disagree*, 9 = *Strongly agree*). All scales with multiple items are scored by computing averages for the items.

These questions are intended to inquire about your opinions concerning the measures that you just completed. Please rate the extent to which you agree with each statement using the following scale:

Strongly disagree	**Disagree**	**Somewhat disagree**	**Slightly disagree**	**Neither agree nor disagree**	**Slightly agree**	**Somewhat agree**	**Agree**	**Strongly agree**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

1.	My responses to the picture questions (i.e., with a drawing of a tiny car) reflect how I usually make decisions on these issues. (U)	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
2.	It was easy to understand the picture questions. (R)	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
3.	It took a lot of effort to understand the picture questions. [a] (R)	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
4.	Answering the other questions was confusing. [a] (R)	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
5.	It took a lot of effort to understand the other questions. [a] (R)	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
6.	I enjoyed answering the other questions. (A)	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
7.	I was bored answering the other questions. [a] (A)	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Note. R = readability; A = affective reaction; U = utility. [a] Reverse scored.

SCALE H
PREFERENCE FOR CARPOOLING

Preference for carpooling. A measure was created for the purposes of the present study to assess participant's attitudes toward carpooling. This measure was added after the pilot test, so only participants from the offline data collection and the online data collection completed this measure. Participants responded to 3 items on their perceptions of how easy it would be to carpool (1 = *extremely difficult;* 9 = *extremely easy*), stated preference for carpooling (1 = *very strong preference for driving solo;* 9 = *very strong preference for carpooling*), and intentions for carpooling in the future (1 = *no intentions to carpool;* 9 = *very strong intentions to carpool;* 10 = *I currently carpool*).

Van Vugt, M., van Lange, P. A. M., Meertens, R. M., Joireman, J. A. (1996). How a structural solution to a real-world social dilemma failed: A field experiment on the first carpool lane in Europe. *Social Psychology Quarterly*, *59*, 364-374.

Given your present circumstances, if you wanted to commute by carpool, how easy would it be for you to do so? (carpooling constraints)

Extremely difficult								**Extremely easy**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

Do you prefer to drive alone or carpool with others? (preference for carpooling)

Very strong preference for driving solo				**Indifferent**				**Very strong preference for carpooling**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

Do you have any intentions to carpool in the near future? (carpooling intentions)

No intentions to carpool				**Indifferent**				**Very strong intentions to carpooling**	**I currently carpool**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

Using the following scale, please rate the extent to which the following travel attributes are important to you when you commute by car:

Extremely unimporta nt				**Indifferent**				**Extremely important**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

1.	Concerns about the environment. [a]	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
2.	Low travel costs.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
3.	Companionship. [a]	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
4.	Relaxation. [b]	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
5.	Safety. [b]	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
6.	Comfort. [b]	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
7.	Low travel time. [b]	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
8.	Reliable travel time. [b]	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
9.	Flexibility. [b]	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Note. [a] Item reworded. [b] Reverse scored. Solo drivers typically consider travel attributes 4-9 as more important than non-solo drivers who assign a greater importance to attributes 1-3.

APPENDIX B: SURVEY INSTRUMENT

Dear Traveler,

The Texas Transportation Institute is examining ways to improve traffic flow along heavily traveled freeways. We need your help with this. This survey should take about 15 minutes to complete.

You are not obligated to answer the questions on this survey, but the information you provide will be very valuable as we work to improve travel. Your answers on the survey will be confidential and not used in any way to identify you. Please use the next and previous buttons at the bottom of the page.

Four randomly selected surveys will win a $250 VISA gift card. To be eligible the survey must be completed and contact information entered in the last question. Your contact information is stored separately and cannot be linked to your responses to these questions. If you have any questions regarding the survey, please contact me at (979) 845-9875 or mburris@tamu.edu.

Thank you for your participation.

Sincerely,

Mark Burris, Ph.D.
Research Director/Associate Research Engineer
Texas Transportation Institute

This research study has been reviewed by the Human Subjects' Protection Program and/or the Institutional Review Board at Texas A&M University. For research-related problems or questions regarding your rights as a research participant, Click Here for more information or you can contact these offices at (979)458-4067 or irb@tamu.edu.

I. HOMETOWN

1) Please select your hometown

Choose one of the following answers

- Miami
- San Diego
- Seattle
- Denver

II. RECENT TRAVEL (Replace "a Major Freeway" in the questions with the following depending on the hometown

Miami – I-95 in Miami

Seattle – SR-167 in Seattle

San Diego – I-15 in San Diego

Denver – I-15 in Denver)

Please tell us about your most recent trip on a Major Freeway traveling towards downtown during the work week (Monday through Friday). A "trip" is any time you traveled on that Freeway.

2) What was the purpose of your most recent trip?

Choose one of the following answers

- Commuting to or from my place of work (going to or from work)
- Recreational / Social / Shopping / Entertainment / Personal Errands
- Work related (other than to or from home to work)
- To attend class at school or educational institute
- Other ___________________

3) On what day of the week was your most recent trip towards downtown?

Choose one of the following answers

- Sunday
- Monday
- Tuesday
- Wednesday
- Thursday
- Friday
- Saturday

4) What time of day did that trip start? (for example, when did you leave work)
Choose one of the following answers

5) What was the length (in miles) of your trip?

- o Less than 2 miles
- o 3 to 5 miles
- o 6 to 10 miles
- o 11 to 15 miles
- o 16 to 20 miles
- o 21 to 25 miles
- o 26 to 30 miles
- o More than 30 miles

6) What time of day did your trip end (for example, when did you arrive at home)?
Choose one of the following answers

7) What kind of vehicle did you use for your most recent trip?
Choose one of the following answers

- o Motorcycle
- o Passenger car, SUV, or pick-up truck
- o Bus

If your answer to Question 7 is “Passenger car, SUV, or pick-up truck” then

a) How many people including you, were in the Passenger Car/ SUV/Pick-up Truck?
Choose one of the following answers

- o 1
- o 2
- o 3
- o 4
- o 5 or more

If your answer to Question 7-a is not “1” then

b) Were you the driver or a passenger on this recent trip?
Choose one of the following answers

- Driver
- Passenger

c) Who did you travel with on this recent trip?
Check any that apply

- Neighbor
- Child
- Adult family member
- Co-worker / person in the same, or a nearby, office building
- Other:

If your answer to Question 7-b is “Driver” then

d) How much extra time did it take to pick up and drop off the passenger(s)? (minutes)

[ ] Minutes

8) Did you use the Express Lanes for that trip?

- Yes
- No

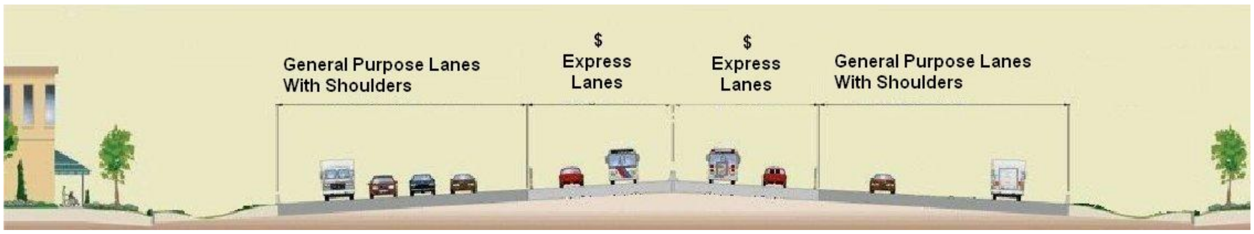
If your answer to Question 8 is “Yes” then

a) How much travel time do you think you saved compared to the general purpose lanes? (minutes)

[ ] Minutes

III. EXPRESS LANES DESCRIPTION

Express lanes are a set of lanes within a freeway which are managed continuously to achieve predefined performance objectives. A typical example of an express lane facility is shown in the figure below. During the rush hour the toll is higher and during other times the toll is lower. Drivers often have multiple entrances and exit locations to get on the express lanes. Qualifying high-occupancy vehicles can often travel for free during the peak hours.



9) Have you ever used the Express Lanes on a Major Freeway?
Choose one of the following answers

- o Yes
- o No

If your answer to Question 9 is "Yes" then

a) What are the main reasons you used the Express Lanes?
Check any that apply

- o Being able to use the Express Lanes for free as a carpool
- o My employer pays for the tolls
- o Travel times on Express Lanes are less than those on the general purpose lanes
- o Trucks and larger vehicles are not allowed on the Express Lanes
- o Travel times on the Express Lanes are consistent and predictable
- o The Express Lanes are safer / less stressful than driving on the general purpose lanes
- o During the peak hours the Express Lanes will not be congested
- o Other: _________________

If your answer to Question 9 is "No" then

b) What are the primary reasons why you have never used the Express Lanes?
Check any that apply

- o I do not want a toll transponder in my car
- o The tolls are too high for me
- o I don't like that the toll changes based on time of day
- o I do not feel safe traveling on Express Lanes
- o Participation in a carpool is difficult / undesirable

- The Express Lanes do not offer me enough time savings
- Access to the Express Lanes is not convenient for my trips
- I do not want to pay the toll for this trip
- I have the flexibility to travel at less congested times
- I can easily use other routes than the Freeway, so I'll just avoid it if I think there is a lot of traffic
- I do not have a credit card so it is inconvenient to set up a toll account
- Express Lane use is complicated or confusing
- Other:

We want you to now think about all of your trips during the last full week on a Major Freeway.

10) How many total trips did you make during the past full work week (Monday to Friday) on a Major Freeway either into, or out of downtown? (Each direction of travel is one trip, include trips on the express lanes or general purpose lanes)

Trips per week: [ ]

If your answer to Question 9 is "Yes" then

11) How many of those Freeway trips were using the Express Lanes?

Trips per week: [ ]

12) How many of those trips would you say you were unusually pressed for time or had a tight schedule?

Urgent Trips per Week: [ ]

If your answer to Question 12 is greater than 0 then

a) Think about those trips that you were pressed for time. What percentage of the time did you use the Express Lanes for those trips?

Choose one of the following answers

- Never use the Express Lanes for those urgent trips
- Rarely use the Express Lanes for those urgent trips
- About half the time I use the Express Lanes for those urgent trips
- Most of my urgent trips are on Express Lanes
- Always use the Express Lanes for those urgent trips

If your answer to Question 11 is greater than 1 then

13) On an average, how much did you pay for the toll for a typical trip on the Express Lanes?
Choose one of the following answers

- Less than $ 1.00
- $1.01 to $2.00
- $2.01 to 4.00
- More than $4.00
- Do not remember

14) Approximately how much time did you save by traveling on the Express Lanes?
Choose one of the following answers

[ ] Minutes

IV. SCALE – A

Listed below are phrases describing people's behaviors. Please use the rating scale provided to describe how accurately each statement describes ***you***. Describe yourself as you generally are now, not as you wish to be in the future. Describe yourself as you honestly see yourself, in relation to other people you know of the same sex as you are, and roughly your same age.

Please read each statement carefully, and then indicate how accurately it describes you.

Very inaccurate	Inaccurate	Somewhat inaccurate	Slightly inaccurate	Neither accurate nor inaccurate	Slightly accurate	Somewhat accurate	Accurate	Very accurate
1	2	3	4	5	6	7	8	9

1.	Always prepared	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
2.	Leave my belongings around	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
3.	Pay attention to details	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
4.	Make a mess of things	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
5.	Get chores done right away	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
6.	Often forget to put things back in their proper place	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
7.	Like order	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
8.	Shirk my duties	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
9.	Follow a schedule	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
10.	Exacting in my work	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

V. SCALE – B

This is a questionnaire to find out the way in which certain important events in our society affect different people. Each item consists of a pair of alternatives—**A** or **B**. Please select the one statement of each pair (and only one) which you more strongly believe to be the case as far as you are concerned.

Be sure to select the one you actually believe to be more true rather than the one you think you should choose, or the one you would like to be true. This is a measure of personal beliefs. There are no right or wrong answers.

Please answer these items carefully, but do not spend too much time on any one item. Be sure to choose an answer for every pair. Mark the answer of your choice.

In some instances you may discover that you believe both or neither statements. In such cases, be sure to select the one you more strongly believe to be the case. Also, try to respond to each item independently when making your choice; do not be influenced by your previous choices.

1.	**A.** I have often found that what is going to happen will happen.	**B.** Trusting to fate has never turned out as well for me as making a decision to take a definite course of action.
2.	**A**. Becoming a success is a matter of hard work; luck has little or nothing to do with it.	**B.** Getting a good job depends mainly on being in the right place at the right time.
3.	**A.** The average citizen can have an influence in government decisions.	**B.** This world is run by the few people in power, and there is not much the little guy can do about it.
4.	**A.** When I make plans, I am almost certain that I can make them work.	**B.** It is not always wise to plan too far ahead because many things turn out to be a matter of good or bad fortune anyhow.
5.	**A.** Who gets to be the boss often depends on who was lucky enough to be in the right place first.	**B.** Getting people to do the right thing depends on ability; luck has little or nothing to do with it.
6.	**A.** As far as world affairs are concerned, most of us are the victims of forces we can neither understand, nor control.	**B.** By taking an active part in political and social affairs, the people can control world events.
7.	**A.** Most people do not realize the extent to which their lives are controlled by accidental happenings.	**B.** There really is no such thing as “luck.”
8.	**A.** With enough effort we can wipe out political corruption.	**B.** It is difficult for people to have much control over the things politicians do in office.
9.	**A.** Sometimes I can't understand how teachers arrive at the grades they give.	**B.** There is a direct connection between how hard people study and the grades they get.
10.	**A.** Most of the time I can't understand why politicians behave the way they do.	**B.** In the long run the people are responsible for bad government on a national as well as on a local level.

VI. SCALE – C

Read each of the following statements and decide how much you agree with each according to your attitudes, beliefs, and experiences. It is important for you to realize that there is no right or wrong answer to these questions. People are different, and we are interested in how you feel. Please respond according to the following 9-point scale:

Strongly disagree	Disagree	Somewhat disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Somewhat agree	Agree	Strongly agree
1	2	3	4	5	6	7	8	9

1.	It upsets me to go into a situation without knowing what I can expect from it.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
2.	I'm not bothered by things that interrupt my daily routine.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
3.	I enjoy having a clear and structured mode of life.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
4.	I find that a well-ordered life with regular hours makes my life tedious.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
5.	I don't like situations that are uncertain.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
6.	I hate to change my plans at the last minute.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
7.	I hate to be with people who are unpredictable.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
8.	I find that a consistent routine enables me to enjoy life more.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
9.	I enjoy the exhilaration of being in unpredictable situations.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
10.	I become uncomfortable when the rules in a situation are not clear.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

VII. SCALE – D

For each of the following statements, please indicate your **likelihood** of engaging in each activity. Provide a rating from 1 to 9, using the following scale:

Extremely unlikely	Unlikely	Somewhat unlikely	Slightly unlikely	Neither likely nor unlikely	Slightly likely	Somewhat likely	Likely	Extremely likely
1	2	3	4	5	6	7	8	9

1.	Betting a day's income at the horse races.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
2.	Co-signing a new car loan for a friend.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
3.	Investing 10% of your annual income in a blue chip stock.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
4.	Investing 10% of your annual income in a very speculative stock.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
5.	Investing 10% of your annual income in government bonds (treasury bills).	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
6.	Investing in a business that has a good chance of failing.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
7.	Lending a friend an amount of money equivalent to one month's income.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
8.	Spending money impulsively without thinking about the consequences.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
9.	Taking a day's income to play the slot-machines at a casino.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
10.	Taking a job where you get paid exclusively on a commission basis.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

VIII. SCALE – E

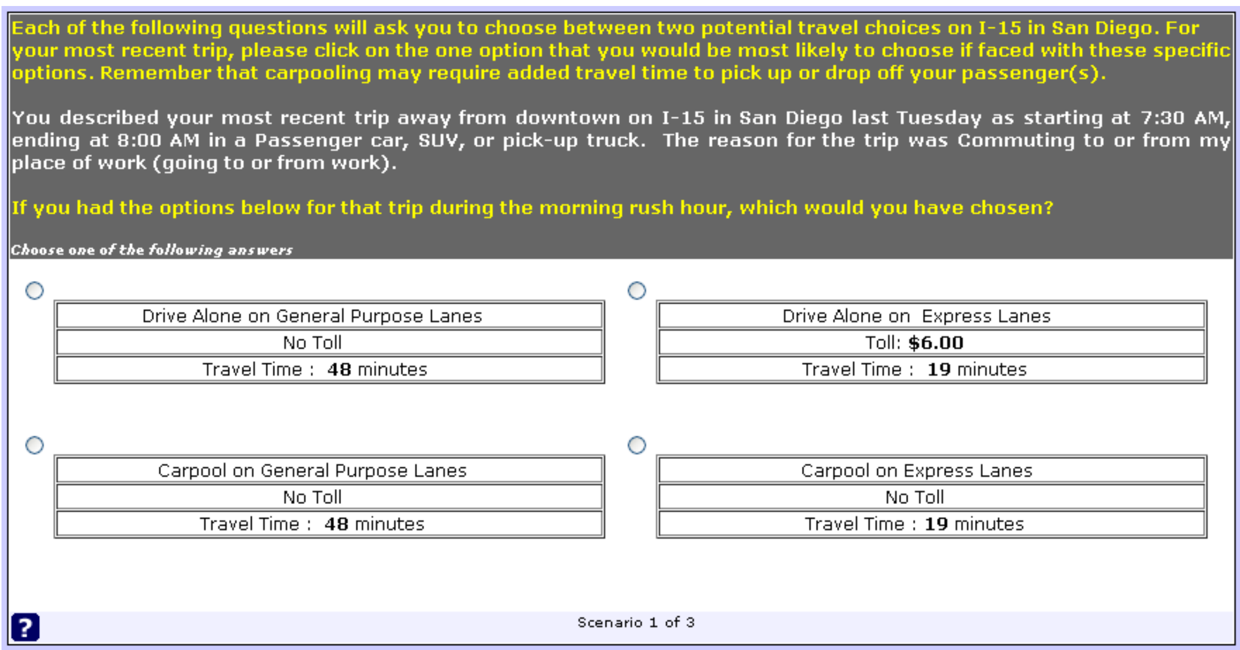
Please rate the extent to which you agree with each statement using the following scale:

Strongly disagree	Disagree	Somewhat disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Somewhat agree	Agree	Strongly agree
1	2	3	4	5	6	7	8	9

1.	I mostly respect speed limits.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
2.	I become anxious when driving too fast.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
3.	Sometimes I am afraid that I will have a traffic accident.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
4.	I feel unsafe that I could be injured in a traffic accident.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
5.	I am worried about being injured in a traffic accident.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
6.	I think there is a high likelihood that I will be injured in a traffic accident.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
7.	I feel nervous while driving.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
8.	I feel distressed while driving.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
9.	It worries me when driving in bad weather.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
10.	On a clear freeway, I usually drive at or a little below the speed limit.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
11.	I feel I have control over driving.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
12.	I feel comfortable while driving.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
13.	At an intersection where I have to give right of way to oncoming traffic, I wait patiently for cross-traffic to pass.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
14.	I base my behavior on the motto "better safe than sorry."	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
15.	When a traffic light turns green I just wait patiently for the car in front of me until it moves.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
16.	I plan long journeys in advance.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
17.	I drive cautiously.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
18.	I enjoy the excitement of dangerous driving.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
19.	I enjoy the sensation of driving on the edge.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
20.	I like to take risks while driving.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
21.	In a traffic jam, I think about ways to get through the traffic faster.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

22.	In a traffic jam, I move to a faster lane as soon as I see the opportunity.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
23.	When a traffic light turns green I try to urge the driver in front of me to move on.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
24.	I purposely tailgate other drivers.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
25.	I get impatient during rush hours.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
26.	I drive through traffic lights that have just turned red.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

IX. TRAVEL CHOICES



Each of the following questions will ask you to choose between two potential travel choices on I-15 in San Diego. For your most recent trip, please click on the one option that you would be most likely to choose if faced with these specific options. Remember that carpooling may require added travel time to pick up or drop off your passenger(s).

You described your most recent trip away from downtown on I-15 in San Diego last Tuesday as starting at 7:30 AM, ending at 8:00 AM in a Passenger car, SUV, or pick-up truck. The reason for the trip was Commuting to or from my place of work (going to or from work).

If you had the options below for that trip during the morning rush hour, which would you have chosen?

Choose one of the following answers

Drive Alone on General Purpose Lanes No Toll Travel Time : **48** minutes	Drive Alone on Express Lanes Toll: **$6.00** Travel Time : **19** minutes
Carpool on General Purpose Lanes No Toll Travel Time : **48** minutes	Carpool on Express Lanes No Toll Travel Time : **19** minutes

Scenario 1 of 3

Scenarios 2 and 3 repeated this with different toll rates and travel times.

X. SCALE H

Given your present circumstances, if you wanted to commute by carpool, how easy would it be for you to do so? (carpooling constraints)

Extremely difficult								Extremely easy
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

Do you prefer to drive alone or carpool with others? (preference for carpooling)

Very strong preference for driving solo				Indifferent				Very strong preference for carpooling
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

Do you have any intentions to carpool in the near future? (carpooling intentions)

No intentions to carpool				Indifferent				Very strong intentions to carpooling	I currently carpool
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

Using the following scale, please rate the extent to which the following travel attributes are important to you when you commute by car:

Extremely unimportant				Indifferent				Extremely important
1	2	3	4	5	6	7	8	9

1.	Concerns about the environment. [a]	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
2.	Low travel costs.	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
3.	Companionship. [a]	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
4.	Relaxation. [b]	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
5.	Safety. [b]	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
6.	Comfort. [b]	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
7.	Low travel time. [b]	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
8.	Reliable travel time. [b]	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
9.	Flexibility. [b]	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Note. [a] Item reworded. [b] Reverse scored. Solo drivers typically consider travel attributes 4-9 as more important than non-solo drivers who assign a greater importance to attributes 1-3.

XI. DEMOGRAPHICS

The following questions will be used for statistical purposes only and answers will remain confidential. All of your answers are very important to us and in no way will they be used to identify you or released to any other person outside the research team.

1) What is your age?
Choose one of the following answers

- 16 to 24
- 25 to 34
- 35 to 45
- 46 to 55

- 56 to 65
- 65 and over

2) What is your gender?
Choose one of the following answers

- Male
- Female

3) Please describe the type of household you live in.
Choose one of the following answers

- Single adult
- Unrelated adults
- Married without children
- Married with child(ren)
- single parent family
- Other

If your answer to question 3 is "Married with child(rend)" then

3a) Is your child(ren) between 5 to 17 years old (school age)?

- Yes
- No

4) Including yourself, how many people live in your household?

____

5) Altogether, how many motor vehicles (including cars, vans, trucks, and motorcycles) are available for use by members of your household?

____

6) What category best describes your occupational or work status?
Choose one of the following answers

- Sales
- Professional / Managerial
- Manufacturing
- Stay-at-home homemaker / parent
- Educator
- Unemployed / seeking work
- Technical
- Administrative / Clerical
- Retired

- Self employed
- Student
- Other _________

7) What was the last year of school that you have completed?

Choose one of the following answers

- Less than high school
- High school graduate
- Some college or vocational school
- College graduate
- Postgraduate degree

8) What was your gross annual household income before taxes in 2010?

Choose one of the following answers

- Less than $10,000
- $10,000 to $14,999
- $15,000 to 24,999
- $25,000 to $34,999
- $35,000 to $49,999
- $50,000 to $74,999
- $75,000 to $99,999
- $100,000 to $199,999
- $200,000 or more
- It is easier to tell my hourly wage rate: _____ $/hr

Thank you for taking the time to fill in this survey. Your responses will be helpful as we work to improve travel in your area. If you have any general comments about travel on the Freeway, please type them below.

Please finish the survey by hitting "Submit" below. You will then have a chance to enter your contact information to be eligible to win one of the $250 VISA gift cards. Your contact information is stored separately and cannot be linked to your responses to these questions.

The survey results will be made available at TravelChoicesSurvey.org/SurveyResults.htm. Thanks!

APPENDIX C: NGENE CODE

```
;Design
;alts=dagl,cpgl,daml,cp2ml
;rows=15
;block=5
;eff=(rppanel,d)
;rep=1000
;rdraws=halton(400)
;cond:
if(cp2ml.spdlvl_m <> daml.spdlvl_m , cp2ml.spdlvl_m = daml.spdlvl_m) ,if(cpgl.spdlvl_g <>
dagl.spdlvl_g,cpgl.spdlvl_g=dagl.spdlvl_g)
;model:
U(cp2ml)=c3[-2.30]+spd[n,0.5,0.3]*spdlvl_m[55,57.5,60,62.5,65]
/
U(daml)=c2[-1.37]+spd*spdlvl_m+toll[n,-0.19,0.1]*tlvl[20,25,30,35,40]
/
U(cpgl)=c1[-2.02]+spd*spdlvl_g[25,30,35,40,45]
/
U(dagl)=spd*spdlvl_g
$
```

APPENDIX D: SAMPLE NLOGIT CODE AND RESULTS FOR THE MODE CHOICE MODELS

```
--> sample;all$
--> create;nalts =4$
--> sample;all$
--> reject;timoday=-999$
--> create;if (timoday =1) peak =1 ; (else) peak =0$
--> create;if (timoday =2) shoulder =1 ; (else) shoulder =0$
--> create;if (timoday =3) offpeak =1 ; (else) offpeak =0$
--> create;if (timoday =1|timoday=2) TODpeak =1 ; (else) TODpeak =0$
--> sample;all$
--> reject;dayofwk=-999$
--> create;if(dayofwk=6|dayofwk=7) weekday = 0;(else) weekday =1$
--> sample;all$
--> reject;occ=-999$
--> create;if(occ=1) ocprof=1;(else) ocprof =0$
--> create;if(occ=2) octech=1;(else) octech =0$
--> create;if(occ=3) ocsales=1;(else) ocsales =0$
--> create;if(occ=4) ocadmin=1;(else) ocadmin =0$
--> create;if(occ=5) ocmanu=1;(else) ocmanu =0$
--> create;if(occ=6) ocparent=1;(else) ocparent =0$
--> create;if(occ=7) ocstud=1;(else) ocstud =0$
--> create;if(occ=8) ocself=1;(else) ocself =0$
--> create;if(occ=9) ocunemp=1;(else) ocunemp =0$
--> create;if(occ=10) ocretire=1;(else) ocretire =0$
--> create;if(occ=11) oceduc=1;(else) oceduc =0$
--> sample;all$
--> reject;hhtype=-999$
--> create;if(hhtype=1) HHSA=1;(else) HHSA =0$
--> create;if(hhtype=2) HHUA=1;(else) HHUA =0$
--> create;if(hhtype=3) HHM=1;(else) HHM =0$
--> create;if(hhtype=4) HHMC=1;(else) HHMC =0$
--> create;if(hhtype=5) HHSP=1;(else) HHSP =0$
--> reject;age=-999$
--> create;if(age=2|age=3|age=4) MIDAGE=1;(else) MIDAGE=0$
--> create;if(age=5|age=6) highAGE=1;(else) highAGE=0$
--> create;if(age=1) lowAGE=1;(else) lowAGE=0$
--> sample;all$
--> reject;trippurp=-999$
--> create;if(trippurp=1) TPCOMM=1;(else) TPCOMM =0$
--> create;if(trippurp=2) TPREC=1;(else) TPREC =0$
--> create;if(trippurp=3) TPWR=1;(else) TPWR =0$
--> create;if(trippurp=4) TPSCH=1;(else) TPSCH =0$
--> create;if(trippurp=5) TPOTH=1;(else) TPOTH =0$
--> sample;all$
--> reject;decision=-999$
--> NLOGIT  ;Lhs=DECISION,NALTS,alt;
            Choices = A,B,C,D;
            Model:U(A)= 0/
                  U(B)= A_B/
                  U(C)= A_C/
                  U(D)= A_D$
```

```
+--------------------------------------------+
| Discrete choice and multinomial logit models|
+--------------------------------------------+
Normal exit from iterations. Exit status=0.
+--------------------------------------------+
| Discrete choice (multinomial logit) model   |
| Maximum Likelihood Estimates                |
| Model estimated: Jul 10, 2012 at 03:57:58PM.|
| Dependent variable              Choice      |
| Weighting variable                None      |
| Number of observations            2015      |
| Iterations completed                 1      |
| Log likelihood function       -2345.966     |
| Number of parameters                 3      |
| Info. Criterion: AIC =          2.33148     |
|   Finite Sample: AIC =          2.33149     |
| Info. Criterion: BIC =          2.33983     |
| Info. Criterion:HQIC =          2.33454     |
| R2=1-LogL/LogL*  Log-L fncn  R-sqrd  RsqAdj |
| Constants only.  Must be computed directly. |
|                  Use NLOGIT ;...; RHS=ONE $ |
| Response data are given as ind. choice.     |
| Number of obs.=  2015, skipped   0 bad obs. |
+--------------------------------------------+

+--------------------------------------------+
| Notes No coefficients=> P(i,j)=1/J(i).      |
|       Constants only => P(i,j) uses ASCs    |
|         only. N(j)/N if fixed choice set.   |
|         N(j) = total sample frequency for j |
|         N    = total sample frequency.      |
|       These 2 models are simple MNL models. |
|       R-sqrd = 1 - LogL(model)/logL(other)  |
|       RsqAdj=1-[nJ/(nJ-nparm)]*(1-R-sqrd)   |
|         nJ   = sum over i, choice set sizes |
+--------------------------------------------+
+--------+--------------+----------------+--------+--------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]|
+--------+--------------+----------------+--------+--------+
 A_B     |   -2.96756140       .17089865   -17.364   .0000
 A_C     |    -.20019462       .05633624    -3.554   .0004
 A_D     |     .00853490       .05333856      .160   .8729

-->   calc;LLc=LogL-kreg;$
--> RPLOGIT ;Lhs=DECISION,NALTS,alt;
            Choices = A,B,C,D;
            Halton;
            Maxit=200; pts=200;pds=pds_n;
            Fcn=c_time(t),A_B[n],A_C[n],A_D[n];

            Model:U(A)=0+c_time*TT+c_toll*TOLL/

                  U(B)=A_B+c_time*TT+c_toll*TOLL+cb_male*MALE
                  +cb_cons*CONS+cb_TPRec*TPREC/
```

```
      U(C)=A_C+c_time*TT+c_toll*TOLL+cc_male*MALE+cc_TPRec*TPREC+cc_cons*CONS
/
                  U(D)=A_D+c_time*TT+c_toll*TOLL+cd_hhm*HHM+cd_cons*CONS;
    crosstab$
+---------------------------------------------+
| Discrete choice and multinomial logit models|
+---------------------------------------------+
Normal exit from iterations. Exit status=0.
+---------------------------------------------+
| Start values obtained using MNL model       |
| Maximum Likelihood Estimates                |
| Model estimated: Jul 10, 2012 at 03:58:00PM.|
| Dependent variable               Choice     |
| Weighting variable                 None     |
| Number of observations              919     |
| Iterations completed                 20     |
| Log likelihood function       -1019.112     |
| Number of parameters                 13     |
| Info. Criterion: AIC =          2.24616     |
|   Finite Sample: AIC =          2.24660     |
| Info. Criterion: BIC =          2.31439     |
| Info. Criterion:HQIC =          2.27220     |
| R2=1-LogL/LogL*  Log-L fncn  R-sqrd  RsqAdj |
| Constants only.  Must be computed directly. |
|                  Use NLOGIT ;...; RHS=ONE $ |
| Chi-squared[10]          =     94.90604     |
| Prob [ chi squared > value ] =   .00000     |
| Response data are given as ind. choice.     |
| Number of obs.=  2015, skipped1096 bad obs. |
+---------------------------------------------+

+---------------------------------------------+
| Notes No coefficients=> P(i,j)=1/J(i).      |
|       Constants only => P(i,j) uses ASCs    |
|         only. N(j)/N if fixed choice set.   |
|         N(j) = total sample frequency for j |
|         N    = total sample frequency.      |
|       These 2 models are simple MNL models. |
|       R-sqrd = 1 - LogL(model)/logL(other)  |
|       RsqAdj=1-[nJ/(nJ-nparm)]*(1-R-sqrd)   |
|         nJ   = sum over i, choice set sizes |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]|
+--------+--------------+----------------+--------+--------+
 C_TIME  |    -.08017202       .01387156    -5.780   .0000
 A_B     |   -6.45231813      2.17807511    -2.962   .0031
 A_C     |   -1.22023763       .66755930    -1.828   .0676
 A_D     |    -.51483337       .59293954     -.868   .3852
 C_TOLL  |     .00378244       .03775931      .100   .9202
 CB_MALE |    1.31822033       .65182949     2.022   .0431
 CB_CONS |     .31402072       .27447519     1.144   .2526
 CB_TPREC|     .47620925       .53878673      .884   .3768
```

```
 CC_MALE |    -.59237734       .15478421    -3.827   .0001
 CC_TPREC|    -.70015080       .21363656    -3.277   .0010
 CC_CONS |     .09241242       .08698217     1.062   .2880
 CD_HHM  |     .30654002       .15082455     2.032   .0421
 CD_CONS |    -.04122193       .07889439     -.522   .6013

Line search does not improve fn. Exit iterations. Status=3
Check derivatives (with ;OUTPUT=3). This may be a solution
if several iterations have been computed, not if only one.
  Error   806: (The log likelihood is flat at the current estimates.)
+----------------------------------------------+
| Random Parameters Logit Model                |
| Maximum Likelihood Estimates                 |
| Model estimated: Jul 10, 2012 at 04:10:58PM.|
| Dependent variable            DECISION      |
| Weighting variable                None      |
| Number of observations             919      |
| Iterations completed                 9      |
| Log likelihood function       -948.8222     |
| Number of parameters                17      |
| Info. Criterion: AIC =         2.10190      |
|   Finite Sample: AIC =         2.10264      |
| Info. Criterion: BIC =         2.19112      |
| Info. Criterion:HQIC =         2.13595      |
| Restricted log likelihood     -1274.005     |
| McFadden Pseudo R-squared      .2552443     |
| Chi squared                   650.3647      |
| Degrees of freedom                  17      |
| Prob[ChiSqd > value] =         .0000000     |
| Constants only.  Must be computed directly. |
|                  Use NLOGIT ;...; RHS=ONE $ |
| At start values  -1019.1117  .06897 ******* |
| Response data are given as ind. choice.     |
+----------------------------------------------+
+----------------------------------------------+
| Notes No coefficients=> P(i,j)=1/J(i).      |
|       Constants only => P(i,j) uses ASCs    |
|         only. N(j)/N if fixed choice set.   |
|         N(j) = total sample frequency for j |
|         N    = total sample frequency.      |
|       These 2 models are simple MNL models. |
|       R-sqrd = 1 - LogL(model)/logL(other)  |
|       RsqAdj=1-[nJ/(nJ-nparm)]*(1-R-sqrd)   |
|         nJ   = sum over i, choice set sizes |
+----------------------------------------------+

+----------------------------------------------+
| Random Parameters Logit Model                |
| Replications for simulated probs. = 200     |
| Halton sequences used for simulations       |
| -------------------------------------------- |
| RPL model with panel has  676 groups.       |
| Variable number of obs./group =PDS_N        |
| Random parameters model was specified       |
```

```
| ----------------------------------------- |
| Hessian was not PD. Using BHHH estimator.   |
| Number of obs.=  2015, skipped1096 bad obs. |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]|
+--------+--------------+----------------+--------+--------+
---------+Random parameters in utility functions
 C_TIME  |    -.66897992       .05158031   -12.970   .0000
 A_B     |   -6.44835047      2.85140059    -2.261   .0237
 A_C     |   -1.31786221      1.88162176     -.700   .4837
 A_D     |    -.65112387      1.32630888     -.491   .6235
---------+Nonrandom parameters in utility functions
 C_TOLL  |    -.21291271       .08526222    -2.497   .0125
 CB_MALE |    1.32392140       .60833513     2.176   .0295
 CB_CONS |     .32097361       .36512067      .879   .3794
 CB_TPREC|     .53017437       .57548956      .921   .3569
 CC_MALE |    -.53047717       .33547524    -1.581   .1138
 CC_TPREC|    -.92380472       .40052777    -2.306   .0211
 CC_CONS |    -.15346340       .24805629     -.619   .5361
 CD_HHM  |     .52618257       .21558240     2.441   .0147
 CD_CONS |    -.37913363       .17318501    -2.189   .0286
---------+Derived standard deviations of parameter distributions
 TsC_TIME|    2.11315447       .11899339    17.759   .0000
 NsA_B   |     .06609800      3.84107166      .017   .9863
 NsA_C   |    2.32427140       .39626206     5.865   .0000
 NsA_D   |     .25309605       .75602795      .335   .7378

+-------------------------------------------------------+
| Cross tabulation of actual vs. predicted choices.    |
| Row indicator is actual, column is predicted.        |
| Predicted total is F(k,j,i)=Sum(i=1,...,N) P(k,j,i). |
| Column totals may be subject to rounding error.      |
+-------------------------------------------------------+

Matrix Crosstab has  5 rows and  5 columns.
         A             B             C             D             Total
        +--------------------------------------------------------------------
--
A       |  131.00000     16.00000     87.00000     87.00000    321.00000
B       |    6.00000      1.00000      4.00000      4.00000     15.00000
C       |   96.00000     14.00000     80.00000     77.00000    266.00000
D       |  120.00000     17.00000     89.00000     91.00000    317.00000
Total   |  352.00000     48.00000    260.00000    259.00000    919.00000
--> calc;list;r2adjC=1-((LOGL-kreg)/LLc);LLmnl=LogL;kmnl=kreg;
    VTTS=(b(1)/b(2))*60 $
+------------------------------------+
| Listed Calculator Results          |
+------------------------------------+
 R2ADJC  =       .588831
 LLMNL   =   -948.822167
 KMNL    =     17.000000

Calculator: Computed   3 scalar results
```

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