HAPPINESS AND TRAVEL BEHAVIOR MODIFICATION

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ABSTRACT

We develop and test a new approach for measuring travel well-being that accounts for the routine nature of travel. We postulate that when people are in a routine, they don't fully consider their travel happiness. Only when people evaluate their options and reconsider their decisions will they think of their travel happiness. Consequently, a travel happiness measure collected at the time of decision-making might be a more relevant measure of their happiness that correlates better with behavior.

To test this hypothesis, an experiment was conducted at three employment centers in Switzerland requiring habitual car drivers to switch temporarily to public transportation for their commute to work. The idea is that after the public transportation trial, the participants would think of their happiness as they reconsider their mode choice decisions. Participants' travel happiness, perceptions, attitudes, and mode choice were measured before and after the intervention. Two main findings emerged from the analysis: first, the measures of happiness with the commute by car collected before and after the public transportation trial were significantly different, with generally a greater happiness with car reported after the experiment. Using the happiness measures as additional indicators of utility, a greater correlation was found between utility and the "after" measure, which supports the hypothesis that the measure of travel happiness collected when people evaluate their options is a more relevant measure for situations involving decision-making than that collected when people are in a routine. The implications for the measurement of well-being could apply to other domains involving routine behavior. Second, a number of participants continued to commute by public transportation after the required trial, which suggests that a temporary change in behavior might be effective in inducing behavioral modification or at least in affecting people's choice sets. This has policy implications for public transportation agencies or institutions that are trying to encourage car drivers to shift to public transportation.

1. INTRODUCTION

The study of happiness in various domains of life, involving a great number of surveys measuring well-being (see, for example, DIW Berlin, German Institute for Economic Research, 2008; The ESRC United Kingdom Longitudinal Studies Centre, 2008; European Commission, 2008; Kahneman and Krueger, 2006; National Opinion Research Center at the University of Chicago, 2008; World Values Survey, 2006), has become a topic of extensive research over the past few decades. Among the various domains, travel well-being has also emerged as a major area of research due to the importance of planning for sustainable transportation systems and technologies. A number of recent efforts have attempted to measure travel happiness (Duarte et al., 2007), travel liking (Ory and Mokhtarian, 2005), satisfaction with public transportation (surveys conducted for public transportation agencies, see for example, Chicago Transit Authority, 2004; Metropolitan Council, 2007; Sacramento Regional Transit, 2006), and most notably commuting stress (Clothier, 2005; Healey and Picard, 2005; Hennessy and Wiesenthal, 1997; Kluger, 1998; Koslowsky et al., 1995; Lucas and Heady, 2002; Van Rooy, 2006). These measurement efforts have generally taken place in a cross-sectional setting.

In previous research (Abou-Zeid and Ben-Akiva, 2007), we also measured travel well-being in a cross-sectional setting through a commuting satisfaction survey which established evidence for the existence of relationships between travel well-being and behavior, travel attributes, and individual characteristics. However, we also concluded that a travel well-being measure collected cross-sectionally might not be a reliable assessment of people's well-being due to the routine nature of travel. We postulate that people generally don't fully consider or evaluate their travel well-being unless they are considering or reviewing their travel choices. An example would be when changes take place in people's lives or in the transportation system. Thus, the key to elicit people's travel happiness is to measure it as they reconsider their travel decisions following, for example, a travel-related change in their lives. Such a measure would be a more relevant measure of travel happiness for situations involving decision-making.

The main objective of this paper is to develop and test an approach for measuring travel well-being that accounts for the routine nature of travel. We test our hypothesis in a mode choice context through an experiment inducing a temporary change in behavior to unfreeze the travel habit and cause travelers to carefully consider their options following the intervention. In particular, we conducted an experiment at three employment centers in Switzerland, whereby commuters with strong car habits were required to switch temporarily to public transportation. Through this direct experience with an alternative non-habitual mode, people would confirm or update their perceptions about public transportation and would consequently re-evaluate their mode choice for their daily commute. Our objectives were to (1) measure their travel happiness when they make their mode choice decisions in a "free choice" phase after this

intervention, (2) measure the changes in their perceptions and attitudes, (3) measure the longer term effect of the intervention on mode choice, and (4) model the relationship between travel happiness and behavior.

Research on travel behavior modification has found that temporary structural changes in the transportation environment, such as a freeway closure (Fujii et al., 2001) or free bus tickets (Fujii and Kitamura, 2003), and travel feedback programs (Taniguchi and Fujii, 2007) might affect the attitudes and habits of car drivers and their frequency of use of public transportation. In these studies, participants are not required to temporarily change their behavior; rather, they are simply observed following the receipt of an incentive or a change in the transportation system.

Our study is different in two main aspects: first, with respect to the treatment employed, as part of the experiment, participants are required to make use of their public transportation passes to commute temporarily by public transportation during the experiment. Second, with respect to measurement, we measure well-being at the time of decision-making. The above mentioned studies on travel behavior modification and others that we are aware of have measured attitudes, perceptions, habits, and choices following the temporary use of public transportation but have not measured well-being.

Our research will potentially advance methods for the measurement of well-being. In addition, it could have significant implications for the design and evaluation of transportation policies that aim to reduce auto use and increase sustainability, such as the provision of free public transportation service occasionally to encourage car commuters to try public transportation.

The remainder of this paper is organized as follows. Section 2 describes the study sample and data collection procedure. Section 3 provides a descriptive analysis, and Section 4 develops and tests a modeling framework for travel happiness and mode switching. Section 5 concludes the paper.

2. DATA COLLECTION

2.1 Sample

Participants were recruited from employees of Geneva airport, Ecole Polytechnique Fédérale de Lausanne (EPFL), and Université de Lausanne (UNIL). All 3 employment centers are well served by public transportation. An email was sent to all employees of Geneva airport and to the employees with parking subscriptions at EPFL and UNIL explaining the participation procedure and eligibility criteria. 30 participants with a strong habit of commuting by car were self-selected. Since the number of participants was small, all of them were assigned to a treatment group and there was no separate control group.

About half of the participants were male. The majority of participants were between 30 and 60 years old, with an average age of 43 years. The average household size was 3.1, and all participants had 2 or more cars in the household. All participants were not accustomed to commuting by public transportation. Out of 30 participants, 7 participants have never commuted by public transportation to their current workplace; 9 participants have used it more than one year before the study; 10 participants have used it 3 months or more before the study; and 4 have used it a few weeks before the study.

2.2 Procedure

Potential participants who expressed interest in the study were interviewed by telephone to confirm their eligibility to participate and to collect their socio-economic and demographic characteristics. Then, before the experiment started, they were asked to fill out a questionnaire about their satisfaction with their commute by car and their perceptions and attitudes towards car and public transportation.

The experiment took place between mid-May and mid-July 2008. Every participant was involved in the experiment for 3 weeks. In the first and third week, participants were free to choose their commute mode. In the second week, participants were required to commute by public transportation for 2 or 3 days. The purpose of the first week of the experiment was to observe the attributes of the commute by the usual mode (car), and the purpose of the third week was to observe the effect of the second week intervention on mode choice. Throughout all three weeks, participants filled out a daily travel diary. In addition, at the beginning of the third week of the experiment (i.e. after trying public transportation), the participants filled out the same questionnaire that they had filled out prior to the experiment, with additional questions related to their public transportation experience.

Participants were given a 2-week or a 1-month free public transportation pass that was valid starting from the second week of the experiment. Those who used a park-and-ride option were paid for the parking fees. Participants did not receive any other form of compensation. After the public transportation pass had expired and just before their parking permits were about to expire, participants filled out one more time the questionnaire about their commute satisfaction, perceptions and attitudes, and indicated whether they commuted by public transportation after the experiment had ended. Moreover, several months after the experiment had ended, participants were contacted one more time and were asked about their commute mode, their satisfaction with it, and their frequency of commuting by public transportation after the study.

3. DESCRIPTIVE STATISTICS

3.1 Satisfaction

Prior to the experiment, participants rated their satisfaction with the commute by car on a 5-point scale anchored by "Very dissatisfied" to "Very satisfied", as a response to the following question:

"Taking all things together, how satisfied are you with your commute by car between your residence and EPFL/UNIL/Geneva airport?"

Figure 1 shows the distribution of responses. Most participants are satisfied or very satisfied with their commute by car.
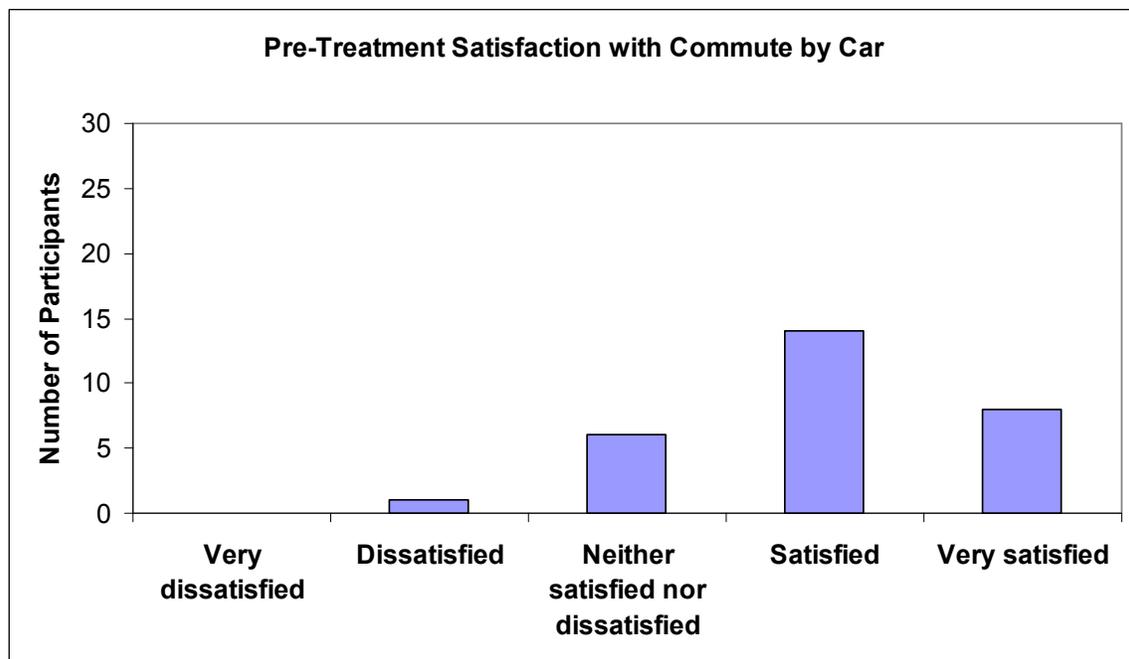
Figure 1. Distribution of participants' pre-treatment satisfaction with their commute by car (N=29).

After trying public transportation, participants answered the same question about satisfaction with the commute by car. In addition, they rated the change in their happiness with using car on a 5-point scale anchored by "Less happy" to "Happier", as a response to the following question:

"After your experience during this study, how do you feel about your decision to use the car for commuting to work?"

Therefore, two measures of the change in happiness ratings were collected. The first one (termed "Computed" in Figure 2) is the difference between the two satisfaction ratings they gave (before and after the public transportation usage),

and the second one (termed "Stated" in Figure 2) is a stated indicator of the change. Both measures indicate that, for many participants, the reported level of happiness with using the car changed after the experiment and mostly in a positive direction, as shown in Figure 2, which might be due to a change in the frame of reference. Moreover, the change in ratings was statistically significant. These statistics confirm the hypothesis that the travel happiness measure collected in a cross-sectional setting is different from that collected after people evaluate their options.
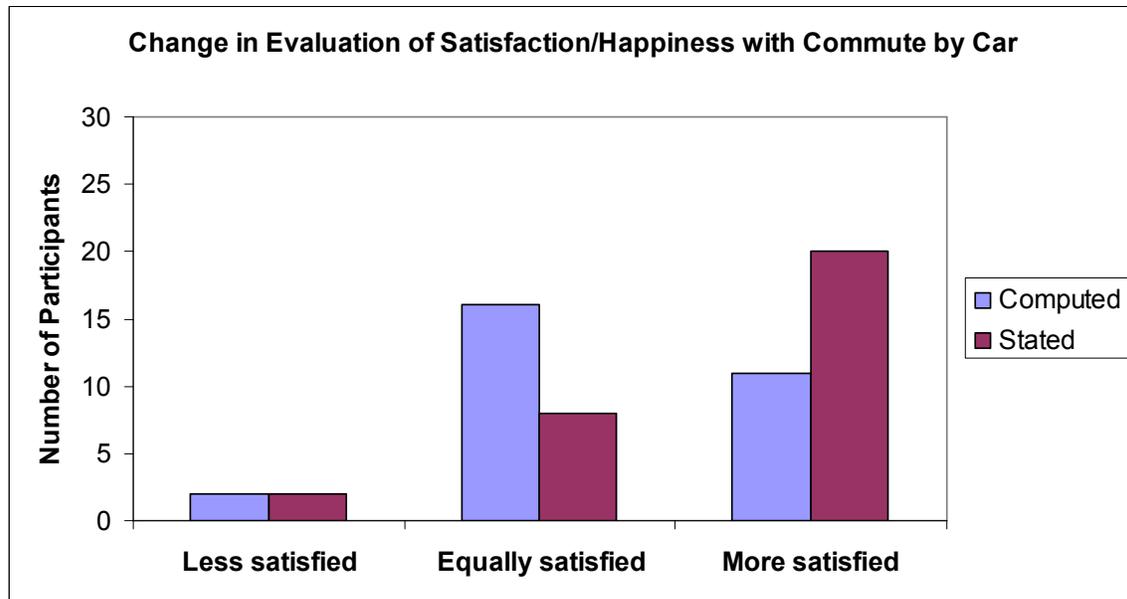
Figure 2. Distribution of the change in participants' satisfaction/happiness with their commute by car. (N=29 for computed measure; N=30 for stated measure).

Participants also rated their satisfaction with public transportation after trying it by answering the following question using a 5-point scale anchored by "Very dissatisfied" to "Very satisfied":

"Taking all things together, how satisfied were you with your commute by public transportation between your residence and EPFL/UNIL/Geneva airport during this study?"

The majority of participants were neither satisfied nor dissatisfied, but there were slightly more dissatisfied than satisfied commuters.

3.2 Perceptions and Attitudes

Participants rated their perceptions and attitudes towards car and public transportation, once before the experiment and once after trying public transportation. They rated on a 5-point scale anchored by "Strongly disagree" to

"Strongly agree" their level of agreement with statements (in the context of their commute) such as:

Perception of reliability: *"I can count on the car (public transportation) to get me to work on time."*
Perception of cost: *"Using the car (public transportation) does not cost much."*
Perception of comfort: "*The car (public transportation) is comfortable."*
Attitude towards transfers: "*I wouldn't mind having to make a transfer when using public transportation."*

Overall, a change in ratings of perceptions and attitudes is observed for both car and public transportation. For car, the change might reflect a change in the frame of reference. For public transportation, the change might be due to prior misperceptions that were corrected once information was gained through direct experience. Table 1 shows the distribution of the change in participants' perception ratings of public transportation. For all aspects of service, there is a fraction of participants that changed their perception ratings. Although most participants provided higher perception ratings of the overall service and certain aspects of it (such as reliability), several others provided lower perception ratings especially of travel time. It must be noted that commuting by public transportation wasn't convenient to many participants, especially for Geneva airport employees, and in all cases involved longer travel time than car. In fact, in the case of Geneva airport, parking permits are granted only to employees who have difficult public transportation connections or have work schedules that fall outside the hours of operation of public transportation.

Table 1. Distribution of the change in participants' perception ratings of public transportation (N =30 for all perceptions other than comfort; N=29 for comfort perception).

Perception	Worse Perception	Same Perception	Better Perception
Overall service	8	9	13
Travel time	9	16	5
Reliability	6	12	12
Flexibility	5	20	5
Comfort	7	14	8
Cost	5	18	7

3.3 Mode Switching

Since this experiment does not involve a control group, every participant's pre-treatment data are used as his/her control. In the first week of the experiment, none of the participants commuted by public transportation[1]. Following the intervention, 10 out of 30 participants commuted by public transportation at least once[2] during the third week of the experiment, and 12 out of 30 participants

indicated that it is likely that they will commute by public transportation in the future.

Moreover, of the 25 participants who were contacted several months after the expiration of the public transportation pass, 5 participants indicated that after the expiration of the pass they commuted by public transportation at a rate higher than that before the intervention. This suggests that the intervention is effective in inducing behavioral modification for a fraction of the participants or at least in having them consider public transportation as part of their choice set for the commute mode.

As to the correlation between satisfaction with public transportation and post treatment usage of public transportation (in the third week of the experiment), Table 2 shows the average satisfaction (where 1 denotes "very dissatisfied" and 5 denotes "very satisfied") and the proportion of participants that were dissatisfied with their experience. This is shown separately for participants who used public transportation post treatment and those who didn't, as well as for those who indicated that it is likely that they will commute by public transportation in the future and those who indicated that it is unlikely. As expected, the average satisfaction is higher among participants who used public transportation post treatment or indicated that it is likely that they will use it in the future. Moreover, the proportion of dissatisfied participants is higher among those who didn't use public transportation post treatment or indicated that it is unlikely that they will use it in the future.

Table 2. Distribution of participants' satisfaction with public transportation and post treatment (in week 3) usage of public transportation (PT). (N=30)

	Didn't use PT post treatment	Used PT post treatment	Unlikely to use PT in future	Likely to use PT in future
Average PT satisfaction	2.5	3.4	2.4	3.3
Proportion dissatisfied	0.40	0.10	0.44	0.17

4. MODEL

4.1 Approach

As shown by the descriptive analysis above, the differences between the two measures of happiness with the commute by car support the hypothesis that the travel happiness that people report after they evaluate their options is different from the one they report when they are in a routine. In this section, we extend this analysis to show which of the two measures is "better" in the sense of being a better indicator of utility of post treatment commute mode.

Our approach assumes that happiness (or satisfaction) is the same as utility and uses the happiness indicators as additional indicators of utility. Consequently, 3 measures are used as indicators of utility: post treatment mode switching, the happiness measure collected before the public transportation trial, and the happiness measure collected after the public transportation trial. The happiness measure with the greater utility coefficient (or loading factor) is a better indicator of utility.

4.2 Specification

The structural model is given by the following utility difference equation:

$$\Delta U = V_{\text{Car}} - V_{\text{PT}} + \varepsilon_1 \tag{1}$$

where ε_1 is an error term and V_{Car} and V_{PT} denote the systematic utilities of car and public transportation, respectively, and are specified as follows:

$$V_{\text{Car}} = \beta_0 + \beta_1 * \text{Travel time}_{\text{Car}} + \beta_2 * \text{Distance}_{\text{Car}}/\text{income} \tag{2}$$

$$V_{\text{PT}} = \beta_1 * \text{Travel time}_{\text{PT}} + \beta_3 * \text{Transfer dummy}_{\text{PT}} \tag{3}$$

The measurement model is given by the following 3 equations:

$$y = \begin{cases} 1 & \text{if } \Delta U > 0 \\ 0 & \text{otherwise} \end{cases} \tag{4}$$

$$h_{\text{Car}}^{\text{After}} - h_{\text{PT}} = \lambda_1 \Delta U + \upsilon_1 \tag{5}$$

$$h_{\text{Car}}^{\text{Before}} - h_{\text{PT}} = \lambda_2 \Delta U + \upsilon_2 \tag{6}$$

where y is a choice indicator, $h_{\text{Car}}^{\text{Before}}$ and $h_{\text{Car}}^{\text{After}}$ denote the measures of happiness with car collected before and after the public transportation trial, respectively, h_{PT} denotes the measure of happiness with public transportation collected only post treatment, λ_1 and λ_2 are loading factors to be estimated, and υ_1 and υ_2 are error terms.

4.3 Estimation

We report the results of a preliminary two-stage estimation process. First, the mode switching model was estimated using the Biogeme software (Bierlaire, 2003; Bierlaire, 2008) with post treatment mode choice data. Then, the happiness model was estimated using the Mplus software (Muthén and Muthén, 1998-2006). In both stages, maximum likelihood was used. A multiple imputation method was used to impute the income variable for a few observations where it was missing. The estimation results are shown in Table 3.

Table 3. Estimation results for the model of travel happiness and mode choice.

Parameter	Parameter Estimate	t-statistic
Mode Switching Model		
Intercept (β_0)	0.625	1.04
Travel Time (β_1)	-0.0238	-0.93
Distance/income (β_2)	-0.0333	-0.22
Transfer dummy (β_3)	-0.107	-0.19
Happiness Model		
"After" measure (λ_1)	2.86	0.59
"Before" measure (λ_2)	1.63	0.70

The estimation results of the mode switching model show that the coefficients of travel time, distance, and transfers are negative, as expected. The distance variable is used as a proxy for cost in the car utility equation as no cost other than the cost of fuel is involved (the parking fees had already been paid for through monthly or annual parking subscriptions). Note that a cost coefficient is not included in the utility specification of public transportation as the participants had a free pass in the third week of the experiment. Assuming a gas mileage range of 20-30 miles/gallon (8.5-12.7 km/liter) and a gas price of $6.36/gallon (or 1.9 Swiss Francs/liter), the implied value of time for commuting trips is 48-72 Swiss Francs/hour.

For the measurement model, the loading factor λ_1 for the "after" measure of travel happiness is greater than the loading factor λ_2 for the "before" measure; thus, the "after" measure is a better indicator of utility and is a more relevant measure of happiness at the time of decision-making than the one collected while being in a routine, as postulated. Even though the results are not statistically significant, the magnitudes of the loading factors are in the hypothesized direction.

These results are preliminary and would be revised in future work by using a simultaneous estimator. We expect that the more efficient estimator will enhance the statistical significance of the results.

5. CONCLUSION

We presented a new approach to measure travel well-being. We postulated that due to the routine nature of travel, people don't fully consider their travel happiness unless they evaluate their options as they reconsider their travel

decisions. To test this hypothesis, we conducted an experiment in Switzerland involving a temporary change of mode for habitual car drivers, who were asked to commute by public transportation for a few days. Participants' travel happiness, perceptions, attitudes, and mode choice were measured before and after the public transportation trial.

Many participants reported significantly different levels of satisfaction with their commute by car before and after the experiment. In most of the cases where there was a change, it was an increase in the reported level of satisfaction with the commute by car, which might be attributed to a change in the frame of reference. Participants were mostly neither satisfied nor dissatisfied with their public transportation experience, although the number of dissatisfied commuters was slightly larger than that of satisfied commuters. Ratings of perceptions and attitudes towards car and public transportation also changed for several participants, which indicates that people often hold misperceptions of public transportation that may be corrected through direct experience. A number of participants continued to commute by public transportation after the trial (both with and without the incentive), which suggests that a temporary change in behavior might be effective in inducing behavioral modification.

A model incorporating the "before" and "after" measures of travel happiness as additional indicators of utility (besides the choice indicator, using data from the post treatment phase of the experiment) was estimated. It was found that utility correlated better with the "after" measure of travel happiness than with the "before" measure, which supports the hypothesis that the measure of travel happiness collected while people are in a routine is a poor indicator of their happiness in situations involving decision-making.

One caveat of this study is the small sample size that limited the complexity of the model that could be tested. Data from a similar experiment currently being conducted by the authors will be used to augment the data collected in the Swiss experiments. Moreover, a simultaneous estimation procedure will be used to enhance the statistical significance of the results reported in this paper. Another caveat is that the required length of the public transportation trial was limited to 2 or 3 days in a given week. A longer experimentation period might have induced different satisfaction levels or perceptions/attitudes towards public transportation from what was reported in this experiment, due to the availability of more opportunities for learning and adjustment. However, this was not feasible for this study but can be tested when a large sampling frame is available. Other extensions of this research involve testing various behavioral hypotheses that might be driving the change in the reported levels of happiness with car observed in this study.

There are various implications of this research. First, with respect to measurement, the findings suggest that if the objective is to measure travel happiness that is relevant to decision-making, then travel well-being should be

measured at points in time when changes occur in people's lives leading them to evaluate their options. Examples of these changes include residential moves, job changes, etc. More generally, this implication could be extended to certain domains other than transportation involving routine behavior, where satisfaction surveys are typically conducted, and would imply a shift in the context of measurement from routine conditions to points in time when changes or "transactions" occur. Second, with respect to modeling and assuming that happiness or satisfaction is the same as utility, the usual utility specification can be enriched with variables that affect satisfaction, such as disconfirmation and expectations related to a new service or mode (Oliver, 1980). The happiness indicators can also be used as additional indicators of utility, thus increasing the efficiency of the estimation. Finally, with respect to policy implications, it seems that even a few days of experimentation with public transportation could be effective in attracting a fraction of habitual car drivers to public transportation or at least in modifying their choice sets to include public transportation. The implication is that public transportation agencies could provide occasional free service or institutions could give their employees permanent or occasional public transportation subsidies to encourage habitual car drivers to try public transportation.

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NOTES

[1] Except for one participant who misunderstood the requirements of the experiment.
[2] This excludes those who commuted by public transportation for reasons deemed invalid, such as those who misunderstood the requirements of the experiment, etc.