# The happy commuter: A comparison of commuter satisfaction across modes

**Evelyne St-Louis**
Research Assistant
School of Urban Planning, McGill University
Suite 400, 815 Sherbrooke St. W.
Montréal, Québec, H3A 2K6, Canada
Tel.: 514-398-4058
Fax: 514-398-8376
E-mail: evelyne.st-louis@mail.mcgill.ca

**Kevin Manaugh**
Assistant Professor
Department of Geography & McGill School of Environment
Room 322, 805 Sherbrooke St. W.
Montréal, Québec, H3A 2K6, Canada
Tel.: 514-398-4058
Fax: 514-398-8376
E-mail: kevin.manaugh@mail.mcgill.ca

**Dea van Lierop**
PhD Student
School of Urban Planning, McGill University
Suite 400, 815 Sherbrooke St. W.
Montréal, Québec, H3A 0C2, Canada
Tel.: 514-398-4058
Fax: 514-398-8376
E-mail: dea.vanlierop@mail.mcgill.ca

**Ahmed El-Geneidy**
Associate Professor
School of Urban Planning, McGill University
Suite 400, 815 Sherbrooke St. W.
Montréal, Québec, H3A 2K6, Canada
Tel.: 514-398-4058
Fax: 514-398-8376
E-mail: ahmed.elgeneidy@mcgill.ca

**August 2014**

**Word Count:** 6375, 2 Tables, 2 Figures

**For citation please use:** St-Louis, E., Manaugh, K., van Lierop, D., & El-Geneidy, A. (2014). The happy commuter: A comparison of commuter satisfaction across modes*. Transportation Research Part F: Traffic Psychology and Behaviour,* 26, 160–170.

**ABSTRACT**

Understanding how levels of satisfaction differ across transportation modes can be helpful to encourage the use of active as well as public modes of transportation over the use of the automobile. This study uses a large-scale travel survey to compare commuter satisfaction across six modes of transportation (walking, bicycle, automobile, bus, metro, commuter train) and investigates how the determinants of commuter satisfaction differ across modes. The framework guiding this research assumes that external and internal factors influence satisfaction: personal, social, and attitudinal variables must be considered in addition to objective trip characteristics. Using ordinary least square regression technique, we develop six mode-specific models of trip satisfaction that include the same independent variables (trip and travel characteristics, personal characteristics, and travel and mode preferences). We find that pedestrians, train commuters and cyclists are significantly more satisfied than drivers, metro and bus users. We also establish that determinants of satisfaction vary considerably by mode, with modes that are more affected by external factors generally displaying lower levels of satisfaction. Mode preference (need/desire to use other modes) affects satisfaction, particularly for transit users. Perceptions that the commute has value other than arriving at a destination significantly increases satisfaction for all modes. Findings from this study provide a better understanding of determinants of trip satisfaction to transport professionals who are interested in this topic and working on increasing satisfaction among different mode users.

**Keywords:** Commuter satisfaction, behavior, mode comparison, travel survey, personal preferences, social factors

## INTRODUCTION

In recent years, the study of commuter perceptions and satisfaction has become increasingly prevalent in the field of transportation. As researchers and policy makers seek to encourage the widespread use of active and public transportation, it is essential to understand the multifaceted issue of trip satisfaction, and its implications for travel behaviour.

This research compares commuter satisfaction with six different modes of transportation (walking, bicycle, automobile, bus, metro, commuter train), and investigates how the determinants of satisfaction differ across modes. This objective is based on the premise that trip satisfaction is affected not only by external trip characteristics, but also influenced by less tangible, internal factors such as attitudinal and personal variables related to the commuter him/herself. The research framework adopted in this study is illustrated in Figure 1. It shows that personal characteristics, travel and mode preferences, as well as trip and travel time characteristics can be placed on a continuum from internal to external, and all have influences on trip satisfaction. This framework is inspired by previous work which conceptualizes travel behaviour as being influenced by three factors: the spatial component, the socio-economic component and the personality component (lifestyle and attitude) (van Acker, van Wee, & Witlox, 2010; Willis, Manaugh, & El-Geneidy, 2013).

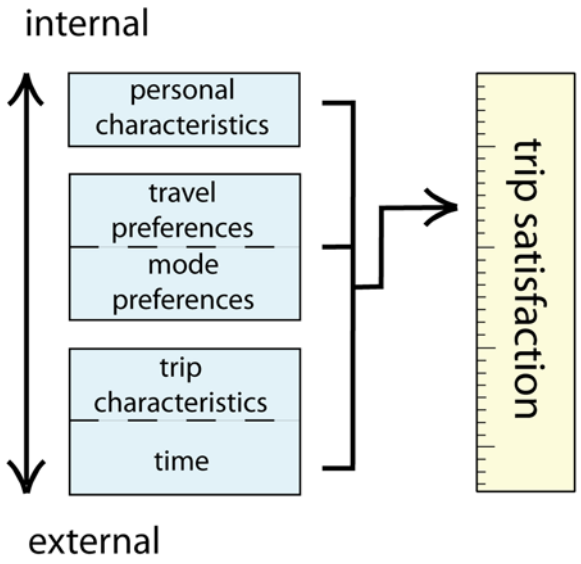


**FIGURE 1 Research framework.**

This study is based on a university-wide commuter survey conducted in Montreal, Canada, in the spring of 2013, and uses a sample of 3,377 single-mode commuters. Pedestrians and cyclists are considered as separate active transportation users, and bus, metro, and train commuters as separate public transit users. Although these modes have previously been grouped together – or even ignored – in travel behaviour studies, their inclusion as distinct modes is expected to yield more nuanced findings about their differences with regard to commute satisfaction. Alternatively, certain factors may be associated to higher levels of satisfaction for various sustainable modes, in which case policy makers can more easily promote the uptake of these forms of transport.

To better understand how commuter satisfaction varies between the six modes, we ask how satisfaction is influenced by various external and internal determinants, and how this varies across modes. The paper starts with a review of the literature on trip satisfaction, focusing on factors affecting satisfaction that have been discussed in previous studies. Then we present the data used, and discuss the statistical methods - ANOVA and OLS regression - applied to analyze the data. Then we present the six mode-specific models of trip satisfaction developed to compare the significance and the effect of different external and internal variables across modes. The paper concludes with a discussion of the results and makes suggestions for future transportation studies and policy-relevant interventions.

## LITERATURE REVIEW

The increased attention recently given to trip satisfaction as an integral step to the promotion of sustainable modes of transport has been part of a larger shift in the field of transportation towards the study of travel behaviour. Conceptual and empirical studies have progressively combined theories of transport geography and social psychology. For example, van Acker et al. (2010) make clear that travel decisions and perceptions depend on individual opportunities and constraints, which are embedded in social and spatial environments that hold their own set of opportunities and constraints. Additionally, other social psychology theories have been incorporated in transportation research, such as social value orientations (van Vugt, Meertens, & van Lange, 1995), and the theory of planned behavior (Anable, 2005) . Travel behaviour, therefore, is influenced by factors external and internal to the individual. While the attention paid to external factors in travel behaviour studies comes from traditional transport geography theory (activity-based, built environment), the additional inclusion of internal variables i.e. socio-demographics, personality, attitudes, preferences, and habits – results from the incorporation of social psychology theories (van Acker et al., 2010). With this research framework in mind (see Figure 1), we review the literature in three areas: first, we briefly define satisfaction and discuss how it can been measured; second, we examine how satisfaction can vary across modes and how these modes rank in relation to each other; and third, we review variables previously studied and found to influence trip satisfaction.

### What is commuter satisfaction?

Before exploring which commuters are satisfied and why, it is necessary to understand what commuter satisfaction is. This concept originated from customer satisfaction research, which has been a popular field of study in domains such as marketing (Fornell, Johnson, Anderson, Cha, & Bryant, 1996). Given that trip satisfaction can be considered a type of customer satisfaction, it often results from the service offered (in this case, the trip characteristics), but also from the customer's (here, the commuter's) reaction to the service, which varies depending on a person's attitudes, personality, and predispositions (Friman & Fellesson, 2009).

Other conceptualizations of trip satisfaction have also been developed. One insightful approach is the Satisfaction with Travel Scale (STS), which has been discussed and used extensively – see for example Ettema et al. (2011) and Friman et al. (2013). The STS was conceived based on the idea of subjective well-being, which suggests that both cognitive judgment (self-reported rating), as well as affective judgment of satisfaction (duration and intensity of positive and negative affects during a given time span), should be examined when

assessing overall satisfaction. Though the STS is not used in this study, this method of measurement is useful to shed light on the multi-faceted nature of satisfaction.

**Who is the Satisfied Commuter?**

Previous research has sought to evaluate which mode-users are the most satisfied with their commute. Studies by Turcotte (2005, 2011) and Páez & Whalen (2010) in Canada, and by Olsson et al. (2013) and Friman et al. (2013) in Sweden, found that active transportation commuters tend to be the most satisfied. Cyclists display the highest satisfaction scores, and pedestrians usually rank in second. This finding sparked an interest to understand why active transportation users experience higher levels of satisfaction compared to motorized commuters, and led to studies such as Willis et al. (2013) and Manaugh & El-Geneidy (2013) that focused respectively on cyclist and pedestrian satisfaction.

Meanwhile, an analysis of the literature found that public transport users are generally the least satisfied compared to users of other modes (Friman et al., 2013; Gatersleben & Uzzel, 2007; Páez & Whalen, 2010; Turcotte, 2005). Recent work has especially focused on differences between drivers and public transit users, as the uptake of public transit instead of the car is a mode switch that several governments seek to encourage. Eriksson, Friman, & Gärling (2013), Gatersleben & Uzzel (2007), and Turcotte (2005) found that automobile satisfaction was higher than that of public transit. Another study by Turcotte (2011) focused on the difference between drivers and transit users in terms of their satisfaction with commute travel time. Public transit users were less satisfied than drivers for shorter commutes, but with longer commute times, a large portion of public transit users remained satisfied with their travel time. This indicates that transit users may have a higher tolerance for longer commutes than drivers.

Finally, limited literature with contradictory results is available on the differences in satisfaction between various types of public transit. For example, some research has found that bus users were not more likely to be satisfied with their commute than metro and/or train riders (2005), while Ory & Mokhtarian (2005) found that train users were significantly more satisfied than bus users. Finally, Beirão & Sarsfield Cabral (2007) in a qualitative study, found that people perceived light rail more positively than buses. So in general there are some disagreements and agreements in the field when it comes to understanding the satisfaction of commute by different modes, which highlights the need for more studies in this area to help in understanding trip satisfaction among different modes.

**What Influences Commuter Satisfaction?**

As presented in the research framework, trip satisfaction results not only from trip and mode characteristics, but also from an individual commuter's experience, which depends on socio-demographics, personality characteristics, and travel and mode preferences.

*External Factors and Mode-Specific Attributes*

Objective elements of a commute are typically considered key determinants of commuter satisfaction, such as mode, trip cost, duration, distance, and season if applicable. For example, Turcotte (2011) found that commute satisfaction decreases as travel time increases, and that traffic congestion was a major source of dissatisfaction for both drivers and bus users. With regard to seasonality, Willis et al. (2013) found that seasonal variation was significant in explaining cyclist satisfaction. However, Ory & Mokhtarian (2005) altered the traditional approach taken towards satisfaction studies by questioning the assumption that commuters always seek to minimize travel time and other associated costs. They found that trip practicality is

not necessarily the primary factor to explain satisfaction, but that subjective factors specific to an individual commuter may also have an effect on overall trip satisfaction. Similarly, other research has not found the expected relationships between trip satisfaction and such external factors as travel time (Páez & Whalen, 2010) or elevation in the case of pedestrians and cyclists (Manaugh & El-Geneidy, 2013; Willis et al., 2013). In their mode-choice study, Whalen, Páez and Carrasco (2013) even found a positive utility of travel time for drivers and cyclists. This body of research points towards the idea that the enjoyment of a commute is essential to trip satisfaction and traditional disutilities are not the only factors to consider.

The positive and negative sentiments associated to commuting have also been explored as influencing overall trip satisfaction. Though commuter stress is a commonly used indicator (Anable & Gatersleben, 2005), authors such as Gatersleben & Uzzel (2007) have turned to a more varied range of mode-specific affective appraisals (positive and negative emotions), such as arousal and pleasantness, to explain the negative perception of public transit in comparison to other modes. While walking and cycling have a high level of arousal (i.e. exciting vs. stressful vs. boring), it is low for transit, since delays and waiting times may lead to boredom or stress. Likewise, Eriksson et al. (2013) established that higher driver satisfaction in comparison to bus users was due to the mediating effect of attributes such as the mode's "fun" factor, its flexibility or inflexibility, and whether the mode matches the commuter's lifestyle. Finally, authors such as Middleton (2010, 2011) and Adey (2008) have broadened the approach typically taken to study walking as a mode of transportation. Instead of focusing solely on the built environment, they argue that closer attention should be paid to the *experience* of walking. Thus, these various studies emphasize the need to not overlook the "experiential dimensions" (Middleton, 2010, p. 591) (p. 591) of travel and commuting.

*Internal and non-mode specific factors*

Non-mode specific elements related to commuter personality, behaviour and preferences also impact trip satisfaction. Apart from basic socio-demographic features which must be accounted for (van Acker et al., 2010), several other factors have been studied. Overall satisfaction with life in relation to trip satisfaction has been explored (Jakobsson Bergstad et al., 2011), though the direction of causality between the two has been debated. For example, Olsson et al. (2013) and Eriksson et al. (2013) assume that trip satisfaction is one of several activities that contributes to life satisfaction, while authors such as Abou-Zeid & Ben-Akiva (2011) instead conceptualize satisfaction with life as an exogenous variable to commuter satisfaction.

Furthermore, travelers' values and lifestyle were found by Ory & Mokhtarian (2005) to be central in explaining satisfaction for both short and long commutes. For instance, having a pro-environmental attitude was a significant explanatory variable for satisfaction with short commutes by rail, bus, and active transportation, while the "status-seeking" variable was significant for the automobile. Ettema et al. (2012) explored whether the secondary activities that can be accomplished while commuting on public transit such as reading, or working may offset the negative aspects of using a mode that is not necessarily time-optimal. Similarly, long bicycle commutes may be perceived positively because they present benefits related to health. Although Ettema et al.(Ettema et al., 2012) found that social interactions during the trip increased satisfaction for the commute back home, surprisingly, working, studying, engaging in ICTs (Information and Communication Technology) or other activities were not always associated to significantly higher satisfaction levels. Finally, in their study examining university students, Páez and Whalen (2010) compared users of public transit, active transport and automobiles and found

that public transit users experienced the lowest commute enjoyment. The authors explained this finding by discussing commuters' attitudinal variables related to the "non-utility" of travel and travel preferences, such as "getting there is half the fun", "I like travelling alone" and "I use my commute time productively". Cyclists, for instance, yielded a higher score for "getting there is half the fun". Although the three components - spatial context, socio-economics, and personality - are all potential influences of travel behavior, recent research indicates that they are not necessarily independent from one another. For example, Whalen et al. (2013) shows that there is a significant degree of spatial organization for attitudinal variables regarding home location preferences ("I like to live in lively neighborhoods), and feelings of safety as a pedestrian ("I feel safe and secure when walking in my neighborhood"). Most likely, processes of self-selection and/or adaptation help explain the observed spatial clustering of these attitudinal variables.

This research continues in this line of inquiry, but uses a larger, and more varied and representative sample. The following section presents the data used to determine who the happy commuter is, and explains the methods used to select the sample and statistically analyse individuals' trip satisfaction.

## METHODOLOGY

### Survey

The data used in this research was obtained from a commuter survey carried out at McGill University in Montreal, Canada. The survey targeted all McGill staff and faculty in addition to a sample of one third of the student population that was randomly selected. Each person on the list received an email invitation to participate in the online survey. Prizes were offered to participants as incentives to take part in the survey. The survey was active for 35 days in March and April 2013, during which 20,851 survey invitations were distributed. A single reminder was sent to every person who did not respond to the original invitation after 2 weeks of receiving the first invitation. The response rate was 31.7%, and after cleaning the data and applying other sampling criteria (described in the following section), 3,377 surveys were kept as usable responses. The survey asked for a description of respondents' commute on a typical cold snowy day and a typical warm dry day. Respondents were asked to describe every part of their commute, specifying the mode used and time spent on the mode. Additionally, respondents were asked to rate their satisfaction levels with every mode used for both seasons. The survey also gathered respondents' travel and mode preferences, and socio-demographic information.

### Sample

The final sample used for this study consists of 3,377 commuters, obtained after removing respondents that used multiple modes of transportation. The breakdown by mode is shown in Table 1. The sample is made up of 54% students, 24% staff, and 22% faculty, and only includes respondents who commute to McGill's Downtown campus. Additionally, using a Likert-scale (1=strongly disagree, 5=strongly agree) respondents rated statements about satisfaction with different trip factors for a typical commute during both weather conditions. Because trip purpose and trip destination are kept consistent, the variation in satisfaction that could be due to differing trip purposes or destinations is limited.

Furthermore, this sample comprises only single-mode commuters, that is, respondents whose commute is composed of only one mode. This includes people who walked, cycled or

drove directly from their home to their destination, as well as transit users (bus, metro, and commuter train) who used a single form of transit and did not make any transfers. Commuters who combined one form of public transit with any mode other than walking were not included in the study. The reason for keeping transit users that also walk in the sample is because users of transit must walk to and from transit. Finally, we randomly selected one of the two seasonal commutes for each respondent, so each respondent is uniquely identified by a single mode for a given season. This sampling criterion consisting of only looking at single-mode commuters is justified from two perspectives. First: conceptually, it allows us to look specifically at satisfaction with an individual mode, without all the other aspects usually associated to it – mainly, transfers and mode changes in the case of public transit. Second: from a practical standpoint, it also eliminates the need to control for additional trip or mode-specific characteristics difficult to control for (e.g. transfer waiting time).

## Methods

### *Measuring satisfaction*

This study measures and analyses satisfaction with the single mode used during the commute. The survey did not ask for respondents' overall trip satisfaction, but alternatively asked individuals to state their levels of satisfaction with each mode used during their commute, for both seasons. To do so, respondents rated their level of agreement on a scale from 1 to 5 with statements related to satisfaction with a mode. We call these the *aspects of satisfaction* with a given mode. For walking, the aspects of satisfaction are: travel time, comfort, safety from traffic, safety from crime, and unwanted attention. For cycling, this additionally includes the quality of bicycle paths; for driving, the measurement of satisfaction also includes cost. For the bus, metro, and train, the aspects of satisfaction are: travel time, consistency of travel time, comfort, safety from crime and unwanted attention, cost, time to reach stop/station, waiting time.

To derive a respondent's overall trip satisfaction score, we calculated the sum of the satisfaction scores with every aspect of the given mode, and expressed this as a percentage. For example, a metro user's satisfaction is the sum of his or her satisfaction with every aspect of taking the metro divided by the highest possible satisfaction score a metro user can rate. By using percentages, we obtain a satisfaction measure that is mode-specific, but comparable across modes. For the sake of consistency, a transit user’s satisfaction score for the walking portion of their trip was excluded from their overall trip satisfaction.

### *Statistical analyses and independent variables*

ANOVA tests were used to compare the mean satisfaction levels by mode, and Ordinary Least Square regression analysis was used to understand the factors explaining variations in trip satisfaction in six mode-specific commuter satisfaction models. Each model includes the same 18 non-mode-specific independent variables. Therefore, given that the dependent variable and the independent variables are the same in every model, it is possible to compare the significance and coefficient strength of these variables across modes. The independent variables can be grouped in five categories, which reflect the research framework presented in Figure 1.

The **trip characteristics variables** are: season (whether it is a commute on a cold snowy day), whether the commute is the same as in the opposite season, and whether the respondent commutes during regular work hours (9 – 5pm). Initially, the pedestrian and cyclist models included elevation change between the origin and destination points, and for the cyclist model, the percentage of time spent on a bicycle path. However, they were removed from the final model as they were not significant.

The **trip time variables** are: total travel time on the mode of transportation, and additional time budgeted for the commute.

The **mode preference variables** are statements with which respondents indicated their level of agreement on a scale from 1 to 5. These variables convey whether people have a desire or need to use specific modes of transportation. The statements are: "I need a car to do many of the things I like to do", "I would like to walk more", "I would like to cycle more", "I would like to use transit more", and "I would like to drive more". To interpret these variables, consider that an increase in one point of agreement on the variable's scale means trip satisfaction varies by that variable's regression coefficient. These variables are designed to capture the degree to which respondents have “matched” their travel preferences, desires, and needs with actual behaviour, thereby differentiating, for example, those who enjoy taking the bus from those who use public transit but would prefer to drive.

The **travel preferences variables** are also agreement statements. They correspond to how people view their travel time and the effect of one's social environment. The variables are: "my family and I have similar travel habits", "I like travelling alone", "The only good thing about my trip is arriving at my destination", and "I use my travel time productively". The interpretation of these variables is the same as described above. The variable "my friends and I have similar travel habits" was not included because it was not significant in any model.

The **personal characteristics variables** are age, gender, overall satisfaction with life (measured on a scale from 1 to 10), and region of origin (whether the respondent spent most of his/her life in North America). Originally, the study included a variety of regions of origin, but the sample sizes were not large enough by mode. Income, status, and age-squared were also removed from the models because they were not significant.

In the following section, we present the results of the ANOVA test and the six regression models. The results and discussion are organized around the five categories or "determinants of satisfaction" described above.

1 **TABLE 1 Sample summary statistics**
2

| | Walk | Bicycle | Automobile | Bus | Metro | Train |
|---|---|---|---|---|---|---|
| Sample size | 1105 | 439 | 503 | 516 | 628 | 186 |
| Trip characteristics | | | | | | |
| Proportion of "cold snowy" commutes | 0.45 | 0.08 | 0.54 | 0.64 | 0.61 | 0.47 |
| Proportion of commuters with "cold snowy" same as "warm dry" commute | 0.80 | 0.15 | 0.85 | 0.57 | 0.71 | 0.77 |
| Proportion of commuters who work during regular hours | 0.7 | 0.77 | 0.65 | 0.78 | 0.75 | 0.88 |
| Travel time | | | | | | |
| Mean mode time (in min) | 18.466 | 22.31 | 31.85 | 22.17 | 18.49 | 28.27 |
| Mean additional time budgeted (in min) | 5.55 | 5.71 | 17.02 | 14.11 | 10.01 | 9.87 |
| Personal characteristics | | | | | | |
| Mean age | 30.43 | 35.93 | 46.16 | 35.53 | 34.46 | 44.89 |
| Proportion of male commuters | 0.39 | 0.51 | 0.45 | 0.32 | 0.42 | 0.40 |
| Mean overall life satisfaction | 7.42 | 7.73 | 7.73 | 7.32 | 7.32 | 7.27 |
| Proportion of commuters from North America | 0.73 | 0.80 | 0.83 | 0.80 | 0.77 | 0.86 |
| Travel preferences | | | | | | |
| Mean response "My family and I have similar travel habits" | 2.78 | 2.87 | 3.25 | 2.67 | 2.88 | 2.65 |
| Mean response "I like travelling alone" | 3.80 | 3.82 | 3.51 | 3.71 | 3.81 | 3.68 |
| Mean response "The only good thing about my travel is arriving at my destination" | 2.54 | 2.29 | 3.17 | 2.82 | 2.86 | 2.74 |
| Mean response "I use my commute time productively" | 3.23 | 3.51 | 3.12 | 3.26 | 3.39 | 3.83 |
| Mode preferences | | | | | | |
| Mean response "I need a car to do many of the things I like to do" | 2.1 | 2.02 | 4.35 | 2.48 | 2.39 | 3.09 |
| Mean response "I would like to walk more" | 3.04 | 3.04 | 3.74 | 3.28 | 3.37 | 2.93 |
| Mean response "I would like to cycle more" | 3.22 | 3.85 | 3.04 | 3.25 | 3.33 | 3.01 |
| Mean response "I would like to transit more" | 1.97 | 1.84 | 2.64 | 2.12 | 2.11 | 2.12 |
| Mean response "I would like to drive more" | 1.80 | 1.4 | 2.21 | 1.84 | 1.82 | 1.69 |

3
4

# RESULTS

## Who is the Satisfied Commuter?

The mean satisfaction levels by mode show that the most satisfied commuters are, in order: pedestrians (84.98%), train commuters (84.15%), cyclists (81.85%), drivers (77.42%), metro users (75.62%), and bus users (75.47%). Based on an ANOVA analysis, we find that pedestrians, train commuters, and cyclists display a significantly higher satisfaction level than drivers, metro users and bus users ($F = 60.932$; $p < 0.05$).

This is consistent with previous studies that found that active transportation users and rail passengers are, on average, more satisfied with their travel. However, this may be due to the single-mode sampling criterion; for instance, the single-mode train users used in this sample probably live within walking distance from a train station, which means this study does not pick up on all elements usually associated to the train, such as having to drive to the station or transfer modes. Regardless, it is important to recognize that satisfaction with the train itself is high.

## Understanding the Determinants of Satisfaction across Modes

The regression results are summarized in Table 2. Although the explanatory power of the models is not high – especially for walking and cycling – the significance of the variables and the magnitude of their effects across modes are worth examining. Moreover, previous studies examining trip satisfaction and travel behavior that also employ regression analysis display comparable adjusted $R^2$ values (Collantes & Mokhtarian, 2007; Collins & Chambers, 2005; Ettema et al., 2012; Ory & Mokhtarian, 2005).

Characteristics of individuals' trips across modes are examined to explain the external factors influencing overall trip satisfaction. Findings include that commuting during cold and snowy conditions significantly decreases satisfaction for pedestrians, cyclists and bus users, but the coefficient varies by mode. Cyclists are the most negatively impacted (satisfaction decreases by 6.5% in cold snowy conditions), followed by pedestrians (-2.94%), and by bus users (-2.39%). The fact that active transportation users are negatively impacted is not surprising since walking, and especially cycling on icy or snowy surfaces can be hazardous. In addition, bus users are dependent on the road network, may be delayed by snowfalls, and waiting for the bus may be less enjoyable in the winter. The seasonal effect was not significant for drivers.

Also bus and metro users show significantly lower satisfaction levels when their cold snowy commute differs from their commute in warm and dry conditions. For example, bus users who commute by bus all year round are 4.9% more satisfied than those who use a different mode in the opposite season. This exemplifies the importance of reference points when evaluating a commuter's satisfaction with a mode (Abou-Zeid, Witter, Bierlaire, Kaufmann, & Ben-Akiva, 2012). In other words, people have a tendency to compare the different modes or commutes they have experienced, meaning that someone who uses active transportation in the summer, but switches to transit in the winter because the distance is too far to walk/cycle under harsh conditions, may be less satisfied with their transit commute than someone who, either way, commutes by transit all year long.

Concerning work hours, bus users who commute at regular work hours are significantly more satisfied than those who did during irregular hours. This may reflect the lack of adequate bus service during irregular hours, or the fact that certain express buses bypass rush-hour traffic (e.g. reserved lane buses). Higher levels of satisfaction may also be a result of commuters knowing when the bus that they take arrives during peak periods, thereby possibly decreasing their overall wait time. This variable was not significant in any other model.

Travel time variables are important to commuter satisfaction for every mode. Increased travel time had a significant negative effect on satisfaction for all six modes. However, comparing coefficients shows that pedestrians, cyclists, and bus users are less negatively impacted by longer travel times than drivers, metro and train users. We keep in mind that an extra minute by foot is not necessarily equivalent to an extra minute by train, and that modes have different mean mode times (see Table 1); however, the varying coefficients of the time variable still demonstrates people's differing enjoyment of a mode itself. This recalls Páez and Whalen's (2010) finding that some cyclists and pedestrians prefer longer commute times.

The large variations in the mean additional time budgeted by mode (see Table 1) is one possible measure of the predictability or consistency of a mode's travel time: while pedestrians and cyclists budget less than 6 minutes, drivers and bus users budget more than 14 minutes. In fact, bus users and drivers show significantly lower satisfaction the more additional time is budgeted for.

The bus is the only mode for which all of the trip and time characteristics variables are significant. This may explain why bus users were found to be the least satisfied commuter: their satisfaction depends on external elements mainly out of their control. In addition, metro users, train commuters and drivers are the most sensitive to longer travel times, and the automobile is the only mode (other than the bus) for which both travel time and additional budgeted time are significant. Indeed, as for the bus, the car depends on the road network and associated congestion.

Turning to personal characteristics and internal factors, gender was significant for metro and pedestrian satisfaction. For metro users, being a male increased satisfaction by almost 3.5%, which may be related to the higher sense of insecurity from crime perceived or experienced by women (Loukaitou-Sideris & Fink, 2009). For pedestrians, the explanation may be related to effort or safety from crime. The region of origin was not significant for any model except for drivers. Respondents from North America are significantly more satisfied (by 4.5%) with their car commute than people from other regions. This seems to confirm the commonly held belief that North Americans consider the car as part of their lifestyle, or at least, are more used to relying on it in their daily lives. Age was significant for pedestrians, cyclists, drivers and metro users. However, for every additional year, satisfaction only increases by 0.1% or less in every model, showing that the effect of age is small. Overall life satisfaction was significant for pedestrians, cyclists, bus and metro users. The effect of increased life satisfaction is uniform across modes: an increase in life satisfaction by one point (on a satisfaction scale of 1 to 10) is associated to an increase in trip satisfaction by 1.0 to 1.3%. This corresponds to previous literature (Abou-Zeid & Ben-Akiva, 2011).

## TABLE 2 Regression results: trip satisfaction

| Variables and determinants of satisfaction | Walk | | Bicycle | | Automobile | | Bus | | Metro | | Train | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B | t | B | t | B | t | B | t | B | t | B | t |
| Trip characteristics | | | | | | | | | | | | |
| Cold snowy season | **-2.938*** ** | -3.366 | **-6.497** ** | -2.127 | -1.629 | -1.274 | **-2.393*** | -1.758 | -1.054 | -0.909 | -2.597 | -1.452 |
| Cold snowy commute same as warm dry commute | 0.471 | 0.412 | 0.218 | 0.089 | 0.660 | 0.375 | **4.952*** ** | 3.732 | **2.070*** | 1.685 | 0.113 | 0.055 |
| Work hours (regular = 1) | 0.121 | 0.133 | 1.271 | 0.922 | -1.631 | -1.284 | **3.469** ** | 2.325 | -0.956 | -0.772 | -0.867 | -0.329 |
| Travel time | | | | | | | | | | | | |
| Time spent on mode (in min) | **-0.140*** ** | -3.426 | **-0.195*** ** | -4.006 | **-0.26*** ** | -6.538 | **-0.130** ** | -1.974 | **-0.388*** ** | -5.670 | **-0.237*** ** | -3.625 |
| Additional time budgeted (in min) | -0.086 | -1.450 | -0.014 | -0.200 | **-0.144*** ** | -3.571 | **-0.159*** ** | -3.174 | -0.070 | -1.335 | -0.055 | -0.831 |
| Personal characteristics | | | | | | | | | | | | |
| Age | **0.107*** ** | 2.995 | **0.092*** | 1.869 | **0.105** ** | 2.366 | 0.038 | 0.856 | **0.082*** | 1.949 | 0.019 | 0.297 |
| Gender (male = 1) | **2.636*** ** | 3.006 | 1.640 | 1.330 | -0.151 | -0.117 | 0.389 | 0.289 | **3.466*** ** | 3.168 | 2.941 | 1.523 |
| Satisfaction with life | **1.059*** ** | 4.022 | **1.203*** ** | 2.962 | 0.515 | 1.303 | **1.225*** ** | 3.631 | **1.296*** ** | 4.294 | 0.665 | 1.378 |
| Region of origin (North American = 1) | 0.974 | 1.012 | 1.216 | 0.831 | **4.495*** ** | 2.770 | 1.331 | 0.867 | 1.481 | 1.147 | -1.447 | -0.581 |
| Travel preferences | | | | | | | | | | | | |
| Family has same travel habits | -0.292 | -0.891 | **0.977** ** | 2.357 | **0.832*** | 1.844 | 0.185 | 0.403 | **0.701*** | 1.760 | 0.577 | 0.932 |
| I like travelling alone | **0.779*** | 1.853 | 0.379 | 0.655 | 0.300 | 0.524 | **1.078*** | 1.758 | **1.007*** | 1.954 | 1.308 | 1.430 |
| Only good thing is destination | **-1.932*** ** | -4.996 | **-0.985*** | -1.663 | **-1.115** ** | -2.119 | **-1.800*** ** | -3.216 | -0.718 | -1.505 | **-2.561*** ** | -3.248 |
| I use commute time productively | **0.702*** | 1.715 | 0.425 | 0.752 | 0.694 | 1.281 | 0.454 | 0.856 | **1.502*** ** | 3.029 | **2.011** ** | 2.161 |
| Mode preferences | | | | | | | | | | | | |
| I need a car to do many things I like to do | 0.056 | 0.153 | **-1.531*** ** | -3.039 | **1.976** ** | 2.526 | **-0.886*** | -1.745 | **-1.281*** ** | -2.771 | -0.163 | -0.241 |
| I would like to walk more | **1.127*** ** | 3.054 | -0.144 | -0.251 | -0.644 | -1.094 | -0.309 | -0.582 | 0.059 | 0.127 | 0.446 | 0.574 |
| I would like to cycle more | 0.118 | 0.356 | -0.475 | -0.828 | -0.326 | -0.693 | 0.437 | 0.960 | 0.559 | 1.315 | 0.158 | 0.231 |
| I would like to transit more | **-1.327*** ** | -3.026 | -0.441 | -0.703 | **-1.704*** ** | -3.490 | 0.365 | 0.582 | 0.464 | 0.820 | -0.171 | -0.183 |
| I would like to drive more | **-1.157*** ** | -2.672 | 0.642 | 0.846 | 0.540 | 0.835 | **-1.478** ** | -2.48 | **-1.496*** ** | -2.824 | **-2.166** ** | -2.521 |
| **Model R-square** | 0.145 | | 0.149 | | 0.266 | | 0.178 | | 0.222 | | 0.324 | |
| **Model adjusted R-square** | 0.130 | | 0.113 | | 0.239 | | 0.148 | | 0.199 | | 0.251 | |

***Significant at 99% (p-value < 0.01)

**Significant at 95% (p-value < 0.05)

*Significant 90% (p-value < 0.1)

In terms of mode preferences, we found that the "matching" or "mismatching" of the actual used mode to the preferred or desired mode had a significant influence on trip satisfaction. It is especially relevant to compare public transit to the automobile, as the mode switch from driving to transit is one of the most promising (distance is often a barrier to encouraging a switch to walking and cycling). The negative impact on satisfaction of mismatching mode reality to mode preference is shown by the variable "I need a car to do many of the things I like to do": cyclists, bus and metro users who agree more with this statement have a significantly lower level of satisfaction. This suggests that these respondents would find it more convenient to have a car, so are less satisfied with their transit or bicycle commute. Alternatively, drivers who agree more with this same statement show a significantly *higher* level of satisfaction with their commute. Likewise, pedestrians who agree with the statement "I would like to walk more" are significantly more satisfied with their walking commute. These drivers and pedestrians are thus already doing what they wish to do, which contributes to higher satisfaction levels.

To further confirm the mode-preference to mode-reality hypothesis, transit users who want to drive more are significantly less satisfied with their trip (decrease in satisfaction from 1.5% to 2.2% for every increased degree of agreement for public transit modes). This indicates that a portion of transit users are dissatisfied not necessarily because of the service, but because they would prefer driving (it may be faster, more convenient, more direct) though they cannot do so for one reason or another (cost, lack of parking, vehicle availability). These results may point towards the presence of captive transit users in our sample. Indeed, the bus, metro and train commuters who would like to drive more, that need a car to do many of the things they like to do, and that show a significantly lower satisfaction level may correspond to captive transit commuters, that is, people who may not have any choice other than use public transit.

Comparably, drivers who want to use more transit are significantly less satisfied with their trip. Though it is unclear whether these respondents can be referred to as "captive" drivers, it is possible that these drivers would like to use more transit but do not due to inadequate transit service near their home location. This idea of mismatching can also be applied to the bus and metro users who are less satisfied because they change modes from cold snowy to warm dry days. If they are not doing what they would ideally like to be doing in both seasons, then their trip satisfaction may be lower.

In terms of travel preferences, the only variable that was significant in every model except for metro was "the only good thing about my travel is arriving at my destination". In every case, a higher level of agreement with this statement has a negative effect on satisfaction. People's perception of the intrinsic value of a commute influences their satisfaction: if people do not see added value to their travel, they will tend to be less satisfied. This effect is relatively stronger for the train, bus, and walking in comparison to cyclists. This recalls findings by Manaugh & El-Geneidy (2013) that pedestrians who value convenience and proximity tend to be less satisfied, even if their commute time is short. Using travel time productively significantly increases satisfaction for pedestrians, metro and train commuters, though the coefficient for the metro and train is more than double that of pedestrians – which is consistent with previous literature (Páez & Whalen, 2010; Turcotte, 2011). This highlights opportunities to increase transit user satisfaction by enabling users to use their time productively, for example by providing free Wi-Fi.

The variable concerning people's preference to travel alone was somewhat inconclusive. The goal of capturing this element was to measure the impact of matching a user's desire to travel alone. For example, do cyclists, pedestrians and drivers who value privacy show a significantly higher satisfaction level in relation to users of more public modes? However, we found instead that pedestrians, bus and metro users who agree more with the statement also display a

significantly higher level of trip satisfaction. Though pedestrians may travel alone, bus and metro users, ironically, almost always travel in a crowded environment.

Concerning the relation between people's social environment and trip satisfaction, cyclists, drivers, and metro users who agree more with the statement "my family and I have similar travel habits" are significantly more satisfied. This means that how one's family travels can influence an individual's commute experience. A potential explanation relates to the question of reference points and social comparisons mentioned earlier (Abou-Zeid & Ben-Akiva, 2011). A commuter who takes the metro but whose family drives may not be as satisfied as someone whose siblings, parents, or children (depending on the respondent's life stage) also take the metro – since people tend to rate their satisfaction in relation to what other people around them do. Another possible explanation, especially in the case of cyclists and drivers, is the effect of cultural and social upbringing. Given that the statement concerning commuters' friends' habits was not significant and the statement concerning family was, it appears that cycling and driving satisfaction is more likely to be influenced by a commuter's family's habits, education or encouragement.

## DISCUSSION

Figure 2 illustrates the different "shapes" of trip satisfaction by mode. The shapes are derived from the findings in Table 2. The branches of each pentagon represent the five categories, or determinants of satisfaction described previously. The five categories in each of the graphs in Figure 2 account for the variables that were significant for a given mode. The sum of the coefficients of the significant variables (using absolute values) for a given mode for a given category was then expressed as a proportion of the highest sum of coefficients of the six modes for this same category. By standardizing the coefficient sums, it is not only possible to compare the importance of variables across modes, but also the magnitude of the coefficients in relation to each other. This chart conveys how modes are influenced differently by these determinants. For example, though "transit" is usually treated as one type of mode, the shapes of the bus, metro and train satisfaction are quite different. We will discuss each determinant of satisfaction, how its importance varies across modes, and whether it has any direct policy implications.

Starting with the travel time category, pedestrians, train users and cyclists are the least affected by the time variables, while drivers, metro and bus users are the most affected. The modes most affected correspond to the least satisfied modes. Overall, however, this is the satisfaction determinant for which all modes are affected: travel time and time reliability may be one of the most direct external influences of satisfaction. Therefore, decreasing travel time, especially for metro and bus users, is one objectively measured channel of action through which satisfaction can be increased.

Trip characteristics, also on the external end of the continuum, do not affect all modes. Drivers and train users are not affected by this category, while bus users are the most affected. It is an important category to focus on for bus users because all three variables are significant. To remediate this would require more frequent bus service during off-peaks, higher priority given to buses in winter conditions, or the implementation of heated bus shelters. In addition, the accommodation of active transportation all year round is also a relevant policy question; indeed, cyclists and pedestrians came in as second and third most affected. For example, the snow removal of bicycle paths is an important issue in cities such as Montreal.

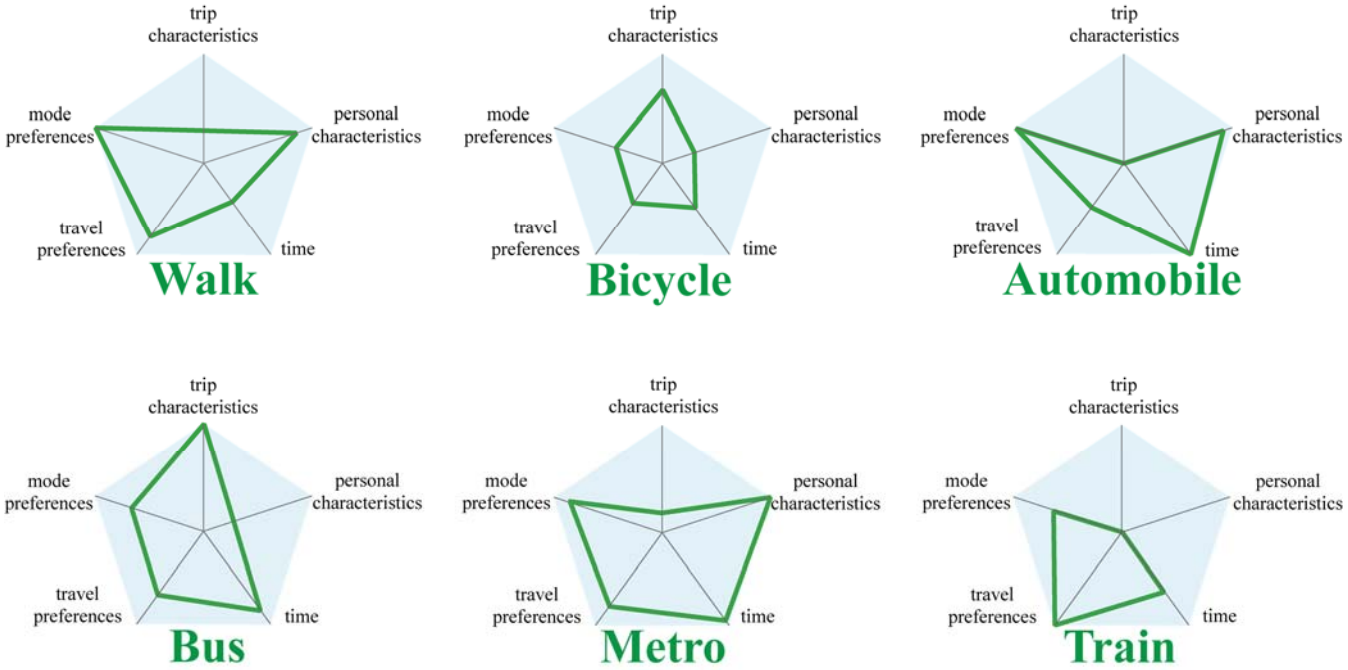


**FIGURE 2 Determinants of trip satisfaction with different modes.**

However, as stated above, trip practicality alone does not define or determine trip satisfaction: the influence of internal factors plays a role in determining different mode users' satisfaction. Figure 2 makes clear that the effect of personal characteristics is difficult to generalize. Train users are not affected by personal socio-demographic factors; bus users and cyclists are minimally affected; while drivers, pedestrians, and metro users are considerably influenced by this category. However, these influences are "isolated effects". In the case of drivers, this is mainly the effect of being North American; in the case of metro users and pedestrians, this is mainly the effect of gender. From a policy perspective, it is more difficult to make clear conclusions. Nevertheless, understanding people's cultural background, or knowing that men and women are affected differently is useful to the promotion of sustainable modes of transport, and to increase the satisfaction of current mode users (e.g. female transit users).

In terms of travel preferences, people who perceive travel only as a means to get to a destination are less satisfied, no matter the mode. Thus for modes of transportation that people are less satisfied with, such as the bus and the metro, framing the commute time as having a value added above simply getting somewhere may increase people's satisfaction, and encourage mode switch. This argument is confirmed by the finding that using time productively increases satisfaction with the metro and train. Yet, the weaker effect of travel preferences on cyclist satisfaction, due to the lower coefficient of this variable, may reflect a higher enjoyment of the commute itself ("getting there is half the fun", as termed by Ory and Mokhtarian (2005)). This may explain the overall higher satisfaction levels of cyclists. In addition, both cyclists and drivers, although only slightly affected by travel preferences in comparison to other modes, are significantly affected by their family's travel habits. Future research should consider this finding to better understand how the social environment, or family upbringing and habits, influence their travel behaviour and satisfaction.

Finally, the mode preference category is more complex to compare across modes, since it concerns the matching of mode preferences to mode used. It seems that the desire, or the need, to use a mode of transportation different than the one currently used negatively influences satisfaction. This may be related to whether the mode is the outcome of a choice or a constraint (possibly captive mode users). The least affected by this category are cyclists, which rank among the highest in terms of satisfaction levels. On the other hand, bus, metro and even train users are more affected, which points towards the profile of captive transit users. As argued by Jacques et al. (2012), it is essential and equitable to consider ways to encourage not only mode switch, but also to increase satisfaction of all commuters, especially captive transit users.

## CONCLUSION

This paper contributes to the literature by looking at external and internal non-mode specific factors to explain commuter satisfaction across different modes. We provide an analysis of six different modes of transportation (walking, bicycle, automobile, bus, metro, train), and compare the importance of satisfaction determinants across modes. Based on a sample of single-mode commuters from a university-wide transportation survey in Montreal, Canada, we find higher levels of satisfaction for pedestrians and cyclists, which is consistent with the literature, but also find that train commuters were significantly more satisfied than drivers, bus and metro users. This study makes clear that understanding and improving commuter satisfaction is not a straightforward task, as satisfaction is determined by both objective and subjective factors. Trip characteristics and travel time, which are considered "objective" factors, are necessary – but not sufficient – to explain variations in satisfaction across modes. Indeed, a range of internal factors also influences satisfaction: individual perceptions result from socio-demographic characteristics, travel and mode preferences, and influences of people's social environment.

Although this study sheds light on the satisfaction of users of individual modes, it must be recognized that trip satisfaction, especially with public transit, can be highly affected by transfer and waiting time, or combinations of several modes. In this study we used a normalized sum of satisfaction from different aspects of the trip to derive the satisfaction for every mode. Our findings were consistent with previous studies that looked at contributors to overall satisfaction with some of the studied modes, which increases our confidence in the used index. An alternative approach would be to assign weights to the different elements of the trip and derive the satisfaction index accordingly, unfortunately there is not enough literature on this aspect for all modes and no agreement is present on such a weighting scheme. On the other hand, satisfaction with different parts of the commute can be a subject for future research. Future research should also look for ways to increase understanding of social factors relating to commuters' attitudes, and the influence of their social environment on their mode choice and satisfaction. The inconclusive results concerning traveling alone and the influence of friends also point towards the importance of accurately capturing such attributes in surveys.

Finally, this study illustrates, for each mode, whether there is "room to improve" (depicted in Figure 2) commuter satisfaction, and if so, through which domain of action improvement can occur. Future research should continue in these steps to focus specifically on more direct policy implications. This will support on-going efforts to increase satisfaction of current users of public and active transportation, as well as to encourage more generally the mode switch to more sustainable forms of transportation.

**ACKNOWLEDGMENTS**

This research was funded by the Natural Sciences and Engineering Research Council of Canada (NSERC) discovery program. The authors would like to thank Kathleen Ng and Brian Karasick from the McGill Office of Sustainability for their feedback and guidance at various stages of this project. Thank you to Daniel Schwartz from IT Customer Services, and Colin Stewart for their assistance in developing the online survey and managing the survey distribution. We would like to thank the two anonymous reviewers for their feedback, which was really valuable and helped in improving the final submission. Finally, the authors would like to thank all those in the McGill community who took the time to fill out the survey, and the rest of the TRAM team for their support.

## REFERENCES


Abou-Zeid, M., & Ben-Akiva, M. (2011). The effect of social comparisons on commute well-being. *Transportation Research Part A, 45*, 345-361.

Abou-Zeid, M., Witter, R., Bierlaire, M., Kaufmann, V., & Ben-Akiva, M. (2012). Happiness and travel mode switching: Findings from a Swiss public transportation experiment. *Transport Policy, 19*, 93-104.

Adey, P. (2008). Airports, mobility and the calculative architecture of affective control. *Geoforum, 39*, 438-451.

Anable, J. (2005). 'Complacent car addicts' or 'Aspiring environmentalists'? Identifying travel behavior segments using attitude theory. *Transport Policy, 12*, 65-78.

Anable, J., & Gatersleben, B. (2005). All work and no play? The role of instrumental and affective factors in work and leisure journeys by different travel modes. *Transportation Research Part A, 39*, 163-181.

Beirão, G., & Sarsfield Cabral, J. (2007). Understanding attitudes towards public transport and private car: A qualitative study. *Transport Policy, 14*(478-489).

Collantes, G., & Mokhtarian, P. (2007). Subjective assessments of personal mobility: What makes the difference between a little and a lot? *Transport Policy, 14*, 181-192.

Collins, C., & Chambers, S. (2005). Psychological and Situational Influences on Commuter-Transport-Mode Choice. *Environment and Behavior, 37*(5), 640-661.

Eriksson, L., Friman, M., & Gärling, T. (2013). Perceived attributes of bus and car mediating satisfaction with the work commute. *Transportation Research Part A, 47*, 87-96.

Ettema, D., Friman, M., Gärling, T., Olsson, L., & Fujii, S. (2012). How in-vehicle activities affect work commuters' satisfaction with public transport. *Journal of Transport Geography, 24*, 215-222.

Ettema, D., Gärling, T., Eriksson, L., Friman, M., & Olsson, L. (2011). Satisfaction with travel and subjective well-being: Development and test of a measurement tool. *Transportation Research Part F, 14*, 167-175.

Fornell, C., Johnson, M. D., Anderson, E., Cha, J., & Bryant, B. E. (1996). The American Customer Satisfaction Index: Nature, purpose, and findings. *Journal of Marketing, 60*(4), 7-18.

Friman, M., & Fellesson, M. (2009). Service supply and customer satisfaction in public transportation: The quality paradox. *Journal of Public Transportation, 12*(4), 57-69.

Friman, M., Fujii, S., Ettema, D., Gärling, T., & Olsson, L. (2013). Psychometric analysis of the satisfaction with travel scale. *Transportation Research Part A, 48*, 132-145.

Gatersleben, B., & Uzzel, D. (2007). Affective appraisals of the daily commute: Comparing perceptions of drivers, cyclists, walkers, and users of public transport. *Environment and Behaviour, 39*(3), 416-431.

Jacques, C., Manaugh, K., & El-Geneidy, A. (2012). Rescuing the captive [mode] user? An alternative approach to transport market segmentation. *Transportation, 40*(3), 625-645. doi: 10.1007/s11116-012-9437-2

Jakobsson Bergstad, C., Gamble, A., Gärling, T., Hagman, O., Polk, M., Ettema, D., . . . Olsson, L. (2011). Subjective well-being related to satisfaction with daily travel. *Transportation, 38*, 1-15.

Loukaitou-Sideris, A., & Fink, C. (2009). Addressing women's fear of victimization in transportation settings: A survey of U.S. transit agencies. *Urban Affairs Review, 44*(4), 554-587.

Manaugh, K., & El-Geneidy, A. (2013). Does distance matter? Exploring the links among values, motivations, home location, and satisfaction in walking trips *Transportation Research Part A, 50*, 198-208.

Middleton, J. (2010). Sense and the city: Exploring the embodied geographies of walking. *Social & Cultural Geography, 11*(6), 575-596.

Middleton, J. (2011). Walking in the city: The geographies of everyday pedestrian activities. *Geography Compass, 5*(2), 90-105.

Ory, D., & Mokhtarian, P. (2005). When is getting there half the fun? Modeling the liking for travel. *Transportation Research Part A, 39*, 97-123.

Páez, A., & Whalen, K. (2010). Enjoyment of Commute: A comparison of different transportation modes. *Transportation Research Part A, 44*, 537-549.

Turcotte, M. (2005). Like commuting? Workers' perceptions of their daily commute. *Canadian Social Trends, Statistics Canada Catalogue No. 11-008,*.

Turcotte, M. (2011). Commuting to work: Results of the 2010 General Social Survey. *Canadian Social Trends, Statistics Canada Catalogue no. 11-008-X*.

van Acker, V., van Wee, B., & Witlox, F. (2010). When transport geography meets social psychology: Toward a conceptual model of travel behaviour. *Transport Reviews: A Transnational Transdisciplinary Journal, 30*(2), 219-240.

van Vugt, M., Meertens, R., & van Lange, P. (1995). Car versus public transportation? The role of social value orientations in a real-life social dilemma. *Journal of Applied Social Psychology, 25*(3), 258-278.

Whalen, K., Páez, A., & Carrasco, J. (2013). Mode choice of university students commuting to school and the role of active travel. *Journal of Transport Geography, 31*, 132-142.

Willis, D., Manaugh, K., & El-Geneidy, A. (2013). Uniquely satisfied: Exploring cyclist satisfaction. *Transportation Research Part F, 18*, 136-147.