Transportation Research Part D 127 (2024) 104053

Contents lists available at ScienceDirect

Transportation Research Part D

journal homepage: www.elsevier.com/locate/trd

# Does it matter if you like it? exploring the relationship between travel mode choice, preference, and satisfaction

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ARTICLE INFO

*Keywords:*
Travel Satisfaction
Travel Behaviour
Mode Preference

ABSTRACT

Understanding the level of dissonance between travel mode and preference and its relationship with satisfaction can help develop transport strategies that encourage the use of sustainable modes. We study the difference in satisfaction levels for work and school trips of consonant travellers and dissonant travellers. The research uses a large-scale (N = 1,865) travel survey administered in Montreal, Canada. A binary logistic regression model reveals that both consonant and dissonant commuters have a high probability of satisfaction with their commute, except for dissonant car users. We find that consonant pedestrians have the highest probability of satisfaction when compared to all other groups, and that dissonant car users have the lowest probability of satisfaction. We further investigate the reasons preventing the use of preferred modes for dissonant car and transit users. Findings from this research help inform researchers and practitioners aiming to make sustainable mode choices the preferred one among travellers.

## 1. Introduction

Travel satisfaction has been the focus of many studies aiming to induce the use of sustainable modes of transport (Ettema et al., 2010; Gärling et al., 2018). Many factors affect travel attitude, behaviour, and satisfaction (Abdelfattah et al., 2022; De Vos and Witlox, 2017), ranging from neighborhood selection (Handy et al., 2005) and built environment (Cervero, 2002) to psychological influences (Collins and Chambers, 2005) and environmental responsibility (Hunecke et al., 2001). In turn, travel satisfaction affects loyalty, which impacts mode usage and switching (Carvalho et al., 2022; van Lierop et al., 2018). Emphasizing the shift towards sustainable modes of transportation is essential to achieve sustainable development, as highlighted by the UN High-level Advisory Group on Sustainable Transport (2016). It is imperative to underscore the significance of understanding the satisfaction levels among various groups, particularly dissatisfied individuals. This understanding is pivotal in developing strategies that can attract unsatisfied car users to sustainable modes and/or maintain existing use of these sustainable modes.

The travel mode choice cycle (TMCC), introduced by De Vos et al. (2022), elaborates on the link between travel attitude, desire, intention, behaviour, and satisfaction based on several psychological theories in travel behaviour research. This link is necessary as many studies focus on travel satisfaction in relation to travel behaviour and attitude (De Vos et al., 2016; Friman et al., 2013; Páez and Whalen, 2010; St-Louis et al., 2014), while only a few include the notion of desire to use a specific mode (De Vos, 2018; Hu et al., 2023; Ye and Titheridge, 2019). In their model, De Vos et al. (2022) incorporate the theory of cognitive dissonance (Festinger, 1957) as a

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https://doi.org/10.1016/j.trd.2024.104053
Received 4 August 2023; Received in revised form 13 December 2023; Accepted 2 January 2024
Available online 12 January 2024

pivotal framework. This theory posits that satisfaction is influenced not merely by individual behaviours or attitudes but mainly by the alignment of behaviour with attitudes. Simply put, the inability of a person to travel in their desired/preferred mode, travel mode dissonance (De Vos and Singleton, 2020), may have a significant impact on travel satisfaction, and consequently, overall life satisfaction.

As the impact of the alignment of travel behaviour and desire on satisfaction remains understudied, especially for commuting trips, our study focuses on understanding the difference in satisfaction levels among dissonant commuters (travel mode is different from their preferred mode and consonant commuters (travel mode is their preferred mode) in Montreal, Canada. We first examine the main mode, preferred mode, and satisfaction with work and school trips through a series of cross-tabulations and summary statistics. Following this preliminary overview, we build a weighted binary logistic model and a sensitivity analysis to estimate the effect of mode consonance and dissonance on satisfaction with trips among different mode users. The last section briefly explores the factors contributing to user dissonance as a preliminary step to lay the groundwork for future research in this area. This study broadens our comprehension of how mode preference influences satisfaction, providing useful insights for shaping public policies aimed at improving commuters' subjective well-being.

### *1.1. Literature review*

Studies suggest that travel satisfaction can have a long-term effect on life satisfaction and well-being (Bergstad et al., 2011; Friman et al., 2017; McCarthy and Habib, 2018). De Vos and Witlox (2017) display that there is a bidirectional relationship between short-term trip satisfaction and long-term life satisfaction, with satisfaction with daily travel in between. According to them, the idea of bidirectional relation applies to travel satisfaction and travel mode choice. For example, having active travel as a choice was noticed to have the highest levels of travel satisfaction (Friman et al., 2013; Páez and Whalen, 2010; St-Louis et al., 2014). Travel satisfaction can also affect mode choice, as the choice of a travel mode can be affected by satisfaction with previous trips made with that mode. The relation of bidirectionality has also been studied between travel satisfaction and internal factors such as travel attitudes and personal perceptions. Having a positive attitude towards a mode increases satisfaction with that mode (St-Louis et al., 2014), and people who value exercise are more likely to be satisfied with their walking trips than others (Manaugh and El-Geneidy, 2013).

These intricate relations between travel aspects have been recently incorporated into the TMCC suggested by De Vos et al. (2022). This model links attitude, desire, intention, behaviour, and satisfaction through direct and indirect relationships in which they affect each other. It is constructed based on a number of social-psychological attitude theories; the most relevant of which to this research is the theory of cognitive dissonance (De Vos and Singleton, 2020; Festinger, 1957). This theory suggests that experiencing discomfort from conflicting behaviors and attitudes motivates individuals to alleviate it by adjusting either their behaviors or attitudes.

In the transportation field, one of the factors that could be causing cognitive dissonance and affecting satisfaction and comfort is the degree of freedom or captivity that travelers have in choosing their mode of transportation (Humagain et al., 2021). Research typically categorizes riders into two main groups: choice riders and captive riders (Beimborn et al., 2003; Wilson et al., 1984). Choice riders usually have access to multiple transportation options, including cars, but they deliberately opt for public transit for specific trips (Guerra, 2022). Captivity can refer to either transit or automobile use, where riders have no choice but to use one of these modes (Beimborn et al., 2003). It is usually used to refer to captive transit users (Fang et al., 2021; van Lierop and El-Geneidy, 2017; Zhao et al., 2014). Areas characterized by transit poverty, however, are prone to house captive car users, whether or not they are socially included (Lucas, 2012). A third group was defined as captive by choice riders by van Lierop and El-Geneidy (2017). This group was identified as users who have the financial capabilities and spatial accessibility to use various transportation options, yet they choose to take transit.

Fang et al. (2021) found that some transit service attributes can contribute to the satisfaction of both choice and captive riders. Meanwhile, other attributes are specific to the satisfaction of one group or the other, such as bus comfort and convenience for captive riders. These group-specific satisfaction attributes were also highlighted by van Lierop and El-Geneidy (2016). While it is reasonable to expect that choice riders would generally be more satisfied by transit (Grisé and El-Geneidy, 2018) and that captive riders would report lower satisfaction levels (Zhao et al., 2014), Deng and Nelson (2012) found that captive users have a higher satisfaction than choice users with a BRT service. This could be associated with captive riders developing a positive attitude towards public transit as it is their only choice.

Humagain et al. (2021) investigate travel satisfaction with chosen and alternatives (hypothetical) modes for commuter in Portland, Oregon. They define the travel satisfaction gap as the difference in travel satisfaction between the chosen and alternative modes and use it as a proxy measure of travel captivity. Their results indicate that car users would be less satisfied if they had to take transit, but more satisfied if they had to take an active mode. Meanwhile, transit and active modes' users would be less satisfied if they had to switch to cars; suggesting that car users are most captive, while active travelers are mostly choice users. This study, however, acknowledges that the focus is on alternative modes, not preferred ones. They hypothesize that if the question was rather focused on the preferred mode as the alternative, satisfaction would have been higher with that alternative than the actual mode.

Only a few studies have actually studied the notion of mode preference or desire to travel in a certain mode. De Vos (2018) studied leisure trips' satisfaction for consonant and dissonant travellers in Ghent, Belgium. He found that traveling with one's preferred travel mode has a strong influence on satisfaction with travel. Consonant travellers had above-average travel satisfaction scores while dissonant travellers had below average satisfaction scores. Dissonant pedestrians had an above-average satisfaction even though they were not using their preferred mode. Another study in Ganyu, China that looked into commuting by car or active modes found that travel satisfaction is only slightly impacted by travel mode dissonance and that the main cause for dissonance is travel distance (Hu et al., 2023). Due to the exclusion of transit in this study, considering its limited context, various forms of dissonance—such as transit users favoring cars or vice versa—are not accounted for. This aspect remains unexplored and warrants further investigation.

To our knowledge, the relationship between travel behavior, preference, and satisfaction has not been studied for work and school trips in the North American context. To bridge this gap in the literature, our research aims to study the possible effect of the cognitive dissonance caused by the mismatch between travel behaviour (main mode choice) and preference (preferred mode) on commuting trip satisfaction in Montreal, Canada.

## 2. Data and methods

This research uses data from the third wave of the Montreal Mobility Survey (MMS) conducted in November 2022 in the Montreal metropolitan region. MMS is a bilingual online survey that collects travel behaviour data as well as opinions on major transport projects in the region. Across three waves, the MMS has collected respondents' sociodemographic characteristics, attitudes towards transit, current and past travel behaviour, and physical activity levels. To ensure the representativeness of the sample, we employed various recruitment techniques recommended by Dillman et al. (2014), including the distribution of flyers, and targeted online recruitment through paid advertisements on multiple social media platforms. As an incentive, survey participants entered a draw for the possibility of winning prizes. Since online access to the survey is more convenient, we observed that online recruitment yielded a significantly higher number of responses compared to distributing flyers. We also hired a public opinion survey company to help recruit part of the sample. In this arrangement, each respondent gets a financial compensation for their participation.

### 2.1. Data

A thorough filtering validation process enforced a set of exclusion criteria to eliminate unreliable responses. This process used participants' e-mail and IP addresses, the time they took to fill out the survey, the location pins or addresses they indicated for home, work and/or school, household structure, and age and height data for participants who filled out previous waves of the MMS. Any incomplete responses were dropped. If more than one survey was filled out from the same IP address or with the same email address, they were removed from the valid responses. Participants received different sets of questions based on their answers, which produced different groups of respondents. For each group, surveys in the top 5 % in speed of completion were dropped. The 5 % cut-off was selected based on the distribution of response times. When plotting all response times in ascending order, a sudden shift in the slope was found at around the 5th percentile. This break in the distribution indicates that responses below 5 % correspond to outliers in response time. Observations were eliminated if any of the home, work, or school locations indicated by participants were outside of the Montreal Census Metropolitan Area (CMA) or were in invalid locations (e.g., on water). Any participant who did not provide their home location was excluded. Participants with a household structure that did not add up (e.g., the number of adults in residence bigger than the household size) were eliminated. In the case of people who answered previous waves, an unexpected age or height change caused this observation to be dropped. This wave's recruitment resulted in a total of 4,065 complete and valid answers after this thorough filtering validation process from which 2,215 reported a work or school trip. Only those who commuted to work or school (college level) by active travel (walking or cycling), public transit (metro, bus, BRT, or commuter rail), and car (driving, ride hailing, or carpooling) and provided their overall satisfaction with their last trip were primarily considered for the analysis (N = 2,035). In the case of one participant having both a work and a school trip, only the school trip was included in the analysis. For participants with multiple travel modes for the trip in question, we focused on their self-reported main mode (the mode they travelled the furthest using).

Distances between origin–destination pairs (home to work, and home to school) were calculated using the dodgr package in R, supported by OpenStreetMap (OSM). For walking and cycling trips, these distances were used to calculate travel times (TT) with an estimated speed of 4.5 km/h for walking and 16 km/h for cycling (El-Geneidy et al., 2007; Silva et al., 2014). For public transit and car trips, we used a Google Maps API to calculate the TT based on the departure time and date of each trip. To calculate regional accessibility to jobs by public transport and car we used the r5r package in R (Pereira et al., 2021) and a Google API to obtain the congested travel times. To account for local accessibility, we used Walk Score® data (walkscore.com), which focuses on the number and diversity of activities that can be reached within walking distance. This measure has been tested repeatedly in the transport literature (Hall and Ram, 2018), showing reliability as a walkability indicator (Manaugh and El-Geneidy, 2011).

Only trips with a TT within the range of 2 to 90 min were included in the analysis. Any trip missing accessibility measures by car within 30 min TT was dropped, retaining 1,883 observations. This sample included 16 dissonant walkers and two dissonant cyclists who were excluded from the analysis due to their small numbers. The final sample size used for the analysis consists of 1,865 work or school trips after removing the outliers.

### 2.2. Methods

Learning about the satisfaction of different traveller types, by main travel and preferred mode, is the central aim of our research. We primarily used descriptive and summary statistics for our analysis utilizing data about the main travel mode used for the most recent work or school trip, satisfaction with that trip, and mode preference to compare between consonant and dissonant travellers. We then used a weighted binary logistic regression to unveil the different characteristics that differentiate the overall satisfaction with work and school trips. The weighting process is key to ensure that results are not biased by the sampling of the survey. The weightings in the model were calculated for all valid responses using the anesrake R package (Pasek, 2018). The weights were calculated to match each sub-sample to the census-tract information (age, income, and gender) obtained from Statistics Canada 2021 census (Statistics Canada, 2023), which was retrieved through the cancensus R package (von Bergmann et al., 2021).

We also tested a multilevel binary logistic model with census tracts as the higher level of analysis. However, the intra-class correlation (ICC = 0.05) indicated that a multilevel statistical approach is not needed. We attempted to split the collective model into four by main travel modes (walking, cycling, public transit, and car) to understand whether certain variables are more relevant to certain modes. This did not yield any results that the collective model missed.

The dependent variable in the logistic regression presented whether commuters are satisfied or unsatisfied with their trip. Commuters who indicated that they are neutral about their overall satisfaction with the trip were grouped with the unsatisfied ones. This decision was prompted by the limited number of dissatisfied individuals, coupled with the assumption that those expressing neutrality might be more vulnerable to the influence of minor factors that could potentially result in their dissatisfaction. For the independent variables, we initially tested four groups of explanatory variables: travellers' sociodemographic, main and preferred travel modes, perception of travel, and built environment factors. The sociodemographic variables included gender, age, annual per capita income, and household size. The main travel modes were grouped into four categories: walking, N = 130; cycling, N = 148; public transit (metro, bus, BRT, or commuter rail), N = 742; and car (driver or passenger), N = 845. To account for consonance and dissonance, we created interaction terms presenting whether these main modes were the preferred mode for the studied trip. The MMS collected a dataset related to the ease and perception of travel, inquiring about the comfort participants feel using certain modes and their access to them in addition to how they perceive their daily travel in terms of value and duration. The relevant variables were tested and retained when proven to affect the model. Finally, the built environment factors were presented via the local (Walk Score®) and regional accessibility to jobs by public transit and car. From these four groups of variables, only the first three were retained in the model as accessibility measures were insignificant in both the collective and the split models by mode.

After the development of the collective statistical model, we produced a sensitivity analysis showing the probability of consonant and dissonant travellers being satisfied with their trip. This showed that the group with the least probability of being satisfied with their trip were dissonant car users who prefer traveling via sustainable travel modes (walking, cycling, or public transit). For this group, we conducted a brief analysis to understand the reasons for their dissonance.

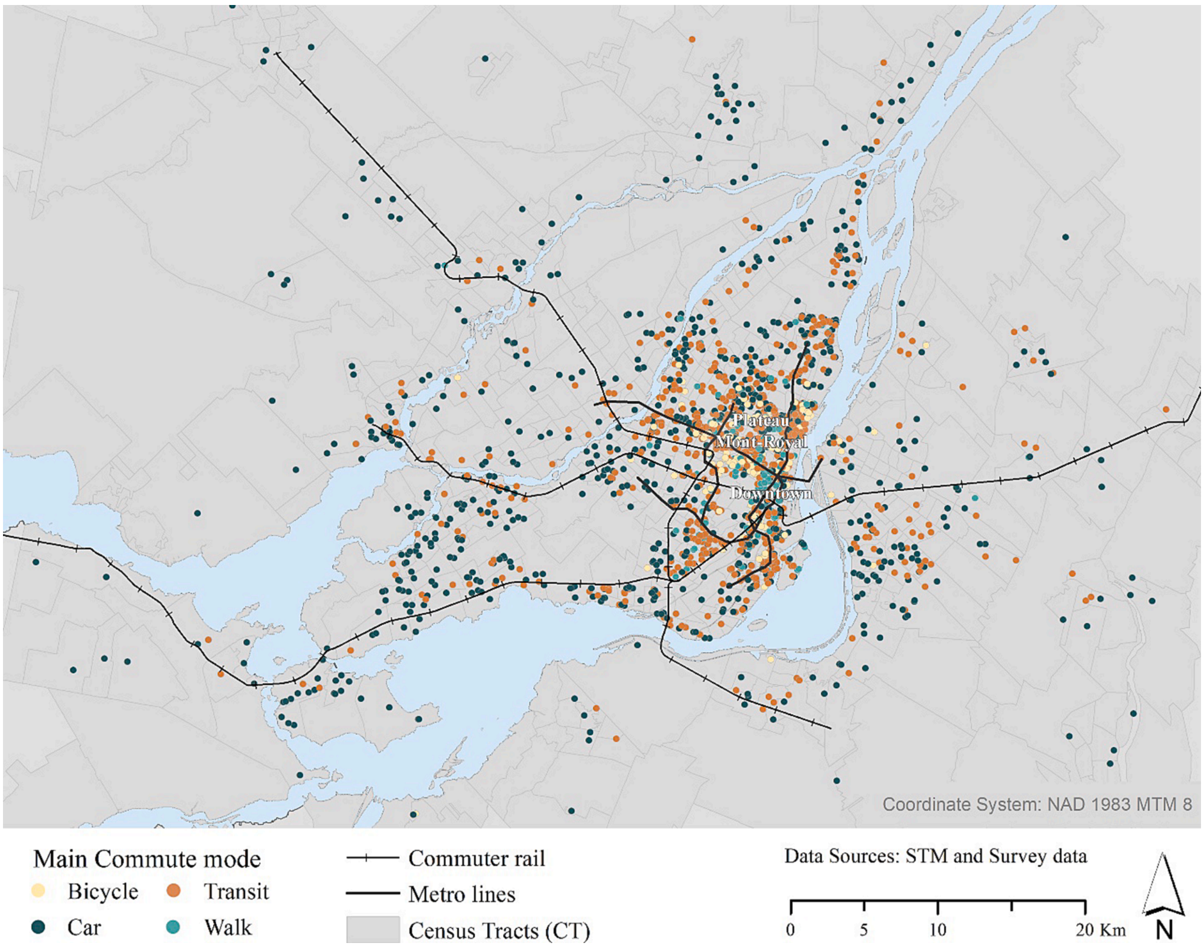


**Fig. 1.** Context map of the study area including the home locations of respondents categorized by main commute mode.

## 3. Results and discussion

### 3.1. Context main travel mode map

The home locations of the study sample (N = 1,865) in the Montreal CMA are presented in Fig. 1. The walking and cycling trips are mainly generated Downtown and in the Plateau Mont-Royal areas. These areas are generally characterized by high densities, mixed-uses, and pedestrian-oriented designs which are known to encourage active travel (Cervero and Kockelman, 1997). The concentration of transit trips is highest along metro lines as 65 % of the transit trips were made by metro, while bus trips account for 29 % of transit trips and have a relative concentration in the eastern side of the Montreal Island. Finally, car trips are generated from all over the CMA, especially from areas where public transit is unavailable or would require a very long travel time.

### 3.2. Descriptive statistics

The descriptive statistics for the sample compared to the Montreal population are presented in Table 1. For our sample, there is an overall positive satisfaction (Mean = 4.09) for work and school trips within all four travel mode groups (walking, cycling, transit, and cars). For the binary satisfaction variable used in the statistical model, the value of 3 (Neutral) was considered as unsatisfied, which

**Table 1**
Descriptive statistics of the sample compared with Montreal CMA 2021 census.

| Variable | Sample | Montreal CMA |
|---|---|---|
| Total N | 1,865 | 4,291,635** |
| Gender | | |
| Female | 50.0 % | 51.0 % |
| Male | 50.0 % | 49.0 % |
| Age | | |
| Under 18 | – | 20.0 % |
| 18–35 | 33.5 % | 21.8 % |
| 36–59 | 56.0 % | 33.8 % |
| 60 and over | 10.5 % | 24.4 % |
| Income [in CAD] | | |
| Below 60 k | 22.7 % | 38.6 % |
| 60 k-120 k | 39.4 % | 36.8 % |
| Over 120 k | 37.9 % | 24.4 % |
| Household size | | |
| 1 person | 22.8 % | 34.4 % |
| 2 persons | 36.0.9 % | 31.9 % |
| 3 or more people | 40.3 % | 33.7 % |
| Main commute mode | | |
| Walk | 7.0 % | 5.7 % |
| Bicycle | 7.9 % | 1.8 % |
| Transit - Metro, BRT, bus, commuter rail | 39.8 % | 15.3 % |
| Car - Individual vehicle, rideshare, taxi | 45.3 % | 75.6 % |
| Preferred travel mode (By category) | | |
| Walk | 10.5 % | – |
| Bicycle | 14.6 % | – |
| Transit - Metro, BRT, bus, commuter rail | 33.0 % | – |
| Car - Individual vehicle, rideshare, taxi | 42.0 % | – |
| Uses preferred mode (By category) | | |
| Yes | 84.0 % | – |
| No | 16.0 % | – |
| Satisfaction with main travel mode (Binary)(Neutral was considered as No) | | |
| Yes | 82.7 % | – |
| No | 17.3 % | – |
| Overall satisfaction with main travel mode (Likert scale) *(1 very unsatisfied – 5 very satisfied)* | 4.09 (0.86)* | – |
| Travel perception (1-Strongly disagree – 5 Strongly agree) | | |
| I value my daily travel | 3.52 (0.93)* | – |
| I have a longer travel duration than desired | 3.16 (1.15)* | – |
| Accessibility by transit within 45 min (x10,000) | 28.52 (24.82)* | – |
| Accessibility by car within 30 min (x10,000) | 61.67 (26.35)* | – |
| Average Walk Score of home location | 66.46 (28.61)* | – |
| Home to destination (work or school) travel time [in minutes] | | |
| All modes (Collective) | 28.95 (16.65)* | – |
| Walking Trips | 22.01 (16.49)* | – |
| Bicycle Trips | 22.23 (13.43)* | – |
| Transit Trips | 37.74 (17.21)* | – |
| Car Trips | 23.49 (12.89)* | – |

** Population of Montreal in 2021.
* Mean (Standard Deviation).

reveals a total of 322 unsatisfied travellers (17.3 % of the sample). Cars are the most common main mode of travel (45.3 %), followed by public transit (39.8 %), and then walking and cycling (14.9 % together). This same descending order applies to the shares of preferred travel modes with 84 % of the participants stating that their main mode is their preferred mode. In some instances, bus users (Transit MM) would have metro as their preferred mode (Transit PM), in this case, they were counted using their preferred mode, as we are taking a broader look at different categories in this paper.

The distribution of main travel mode across the studied income brackets, in Table 2 displays a relatively homogenous spread of trips. The percentage of trips made by pedestrians and transit riders are the most similar across the three income brackets. Meanwhile, the lowest income households make much less trips by bicycle and cars compared to the two other groups.

The distribution of different user groups based on their main and preferred travel mode among different satisfaction levels is shown in Table 3. Very few users appear to have low satisfaction levels. The highest number of users who were dissatisfied with their trips are car and transit riders who are using their preferred mode, meaning that a person who prefers a certain mode could have higher expectations for that mode than others. For example, drivers could be bothered by congestion, yet they believe that cars are their best travel option. An overview shows that on the one hand, the percentage of unsatisfied people who have car, transit, or active travel (waking or cycling) as a preference is less than 8 % of the users in each category and in total. On the other hand, the largest proportion of the sample was in the “satisfied” bin (50 %) followed by the “very satisfied” one (33 %).

Aggregating all satisfaction levels together, in Table 4, the overall mean for any combination of main and preferred modes gives us a positive satisfaction level (above 3), which indicates that even the users not using their preferred modes can still be satisfied with their trips. For all modes, consonant travellers enjoy a high satisfaction level (Above 4.00). Aligning with the previous literature (St-Louis et al., 2014), pedestrians are the most satisfied with their trips (Mean = 4.47). Meanwhile, among consonant travellers, transit users are the least satisfied (Mean = 4.03); however, still highly satisfied. This summary shows that both consonant and dissonant travellers can enjoy high levels of satisfaction, which is in line with previous studies (De Vos, 2018; Ye and Titheridge, 2019). The least satisfied group with a considerable N consists of car users who prefer public transit (Mean = 3.16), which required further investigation through a statistical model to validate these results.

### 3.3. Statistical model

The weighted binary logistic regression model in Table 5 presents satisfaction with the main mode for work or travel trips as the dependent variable for the sample of 1,865 observations. Model 1 includes sociodemographic, travel perception, and trip characteristics variables only. Adding the main mode and preferred mode variables to Model 2 allowed for better control of the variables which increased the $R^2$ Tjur (Tjur, 2009) and revealed the significance of income level and travel time in the satisfaction with the commute mode. Some of the variables tested in the models which were found insignificant include the regional and local accessibility measures. This insignificance is probably due to these measures being a representation of the number of opportunities that can be reached within a certain travel time while the model focuses on only one destination for each trip. When looking at Model 2, from the sociodemographic variables, we can conclude that gender has no statistically significant effect on satisfaction. Commuters aged 60 years old and above are 2.45 times more likely than all other age categories to be satisfied with their main mode, when keeping all other variables constant at their mean value. Travellers from income brackets of below 60,000 CAD and 60,001–120,000 CAD have lower odds of being satisfied with their main mode by 35 % and 31 % respectively when compared to the income bracket of above 120,000 CAD ceteris paribus. This can signify either that lower-income households are underserved when it comes to the quality of transit service they are provided, or that switching to a main mode that would provide higher satisfaction for these groups could be more challenging (e.g., affordability issues).

For the travel perception and trip characteristics variables, the results were intuitive and logical. Travellers who expressed that they value their daily travel have 38 % more odds of being satisfied with their trips than those who do not value their travel, complying with previous studies suggesting that travel-liking attitude have a direct effect on travel satisfaction (Ye and Titheridge, 2017). Those who sense that their trips are longer than they desire have almost half the odds of being satisfied with their trips compared to those who do not, all else being equal. Each minute decrease in travel time increases the odds of the traveler being satisfied by 1 %, when keeping all else constant, which matches previous literature about the inversed relationship between travel time and satisfaction (De Vos et al., 2016; Ettema et al., 2011). It is hard to establish a causal relationship between the travel perception variables and satisfaction with travel, especially since the relationship can be bidirectional as is the case for many other aspects of travel satisfaction (De Vos and Witlox, 2017). In other words, travellers can value their daily trips because they are satisfied with them, or because they value them. The same idea goes for the perception of travel duration. This model rather establishes the statistical correlation between the variables.

**Table 2**
Main travel mode distribution by income brackets.

| | Main Mode | | | | Total |
|---|---|---|---|---|---|
| | Walk | Bicycle | Transit | Car | |
| Income [in CAD] | | | | | |
| Below 60 k | 44 (33.8 %) | 30 (20.3 %) | 208 (28 %) | 141 (16.7 %) | 423 |
| 60 k-120 k | 50 (38.5 %) | 52 (35.1 %) | 283 (38.1 %) | 350 (41.4 %) | 735 |
| Over 120 k | 36 (27.7 %) | 66 (44.6 %) | 251 (33.8 %) | 354 (41.9 %) | 707 |
| Total (100 %) | 130 | 148 | 742 | 845 | 1865 |

**Table 3**
Count of travellers in each satisfaction level based on main and preferred modes.

| Preferred Mode | Main Mode | Satisfaction level | | | | | Total% (N) | |
|---|---|---|---|---|---|---|---|---|
| | | [1] v. unsatis. | [2] unsatis. | [3] neutral | [4] satis. | [5] v. satis. | | |
| Walk | Walk | 0.8 % | 0.0 % | 6.2 % | 37.7 % | 55.4 % | 100 % | (130) |
| Bicycle | | – | – | – | – | – | – | – |
| Transit | | – | – | – | – | – | – | – |
| Car | | – | – | – | – | – | – | – |
| Walk as MM total | | 0.8 % | 0.0 % | 6.2 % | 37.7 % | 55.4 % | 100 % | |
| | | (1) | (0) | (8) | (49) | (72) | (130) | |
| Walk | Bicycle | – | – | – | – | – | – | – |
| Bicycle | | 0.7 % | 4.1 % | 5.4 % | 58.8 % | 31.1 % | 100 % | (148) |
| Transit | | – | – | – | – | – | – | – |
| Car | | – | – | – | – | – | – | – |
| Bicycle as MM total | | 0.7 % | 4.1 % | 5.4 % | 58.8 % | 31.1 % | 100 % | |
| | | (1) | (6) | (8) | (87) | (46) | (148) | |
| Walk | Transit | 0.1 % | 0.0 % | 1.1 % | 3.0 % | 1.5 % | 5.7 % | (42) |
| Bicycle | | 0.1 % | 0.7 % | 0.8 % | 7.8 % | 2.6 % | 12.0 % | (89) |
| Transit | | 0.8 % | 2.8 % | 8.2 % | 44.5 % | 18.9 % | 75.2 % | (558) |
| Car | | 0.3 % | 0.8 % | 1.8 % | 3.4 % | 0.9 % | 7.1 % | (53) |
| Transit as MM total | | 1.3 % | 4.3 % | 11.9 % | 58.6 % | 23.9 % | 100 % | |
| | | (10) | (32) | (88) | (435) | (177) | (742) | |
| Walk | Car | 0.0 % | 0.6 % | 0.7 % | 1.1 % | 0.4 % | 2.7 % | (23) |
| Bicycle | | 0.0 % | 0.4 % | 0.8 % | 2.0 % | 0.9 % | 4.1 % | (35) |
| Transit | | 0.4 % | 1.9 % | 1.7 % | 2.0 % | 0.8 % | 6.7 % | (57) |
| Car | | 0.7 % | 3.6 % | 9.2 % | 36.8 % | 36.1 % | 86.4 % | (730) |
| Car as MM total | | 1.1 % | 6.4 % | 12.4 % | 41.9 % | 38.2 % | 100 % | |
| | | (9) | (54) | (105) | (354) | (323) | (845) | |
| Grand Total (N) | | 21 | 92 | 209 | 925 | 618 | 1865 | |

**Table 4**
Average satisfaction with main mode (Total N = 1,865).

| Main Mode | Preferred Mode | | | | Grand Total |
|---|---|---|---|---|---|
| | Walk | Bicycle | Transit | Car | |
| Walk | 4.47 | – | – | – | 4.47 |
| Bicycle | – | 4.16 | – | – | 4.16 |
| Transit | 4.00 | 4.00 | 4.03 | 3.55 | 3.99 |
| Car | 3.43 | 3.86 | 3.16 | 4.20 | 4.10 |
| Grand Total | 4.25 | 4.07 | 3.95 | 4.16 | 4.09 |

The last section of the model represents the odds ratio for satisfaction with the trip based on the main mode of travel and whether or not it is the preferred mode of travel. For this section, the reference category are dissonant car users. For pedestrians and cyclists, this sample only includes consonant travellers. In turn, we only include their interaction term in the model. For transit users, the value under “Main travel mode” in Table 5 presents dissonant transit users while the product of Transit (MM/not PM) and Transit (MM and PM) (3.50 x 1.78 = 6.24) presents consonant transit users. These results show that consonant pedestrians, cyclists, transit riders, and car users have much higher odds (7.92, 5.54, 6.24, and 5.01 respectively) of being satisfied with their trips than dissonant car users. When comparing dissonant transit riders with dissonant car users, we find that the formers have 1.78 more odds of being satisfied with their trips. To better illustrate these ratios in comparison to each other, we conducted a sensitivity analysis that displays the probability of travellers with different modes and preferences being satisfied with their trip.

The sensitivity analysis in Fig. 2 clearly displays the discrepancies between consonant and dissonant travellers. The group that has the highest probability of satisfaction are consonant pedestrians (probability of satisfaction of 89.5 %), followed by transit users (87.0 %), then cyclists (85.6 %), and finally car users (84.3 %). Dissonant transit users have a lower probability of satisfaction when compared with all consonant travellers; however, it is still high (79 %). Dissonant car users who prefer sustainable modes of travel are the least probable to be satisfied with their trip (probability of 51.8 %).

To better understand the lower trip satisfaction probability, we look deeper into the reasons of dissonance for the two least satisfied groups (dissonant transit and car users). On one hand, dissonant car users should be the focus of policy making as their aspirations align with sustainable development strategies. Understanding the reasons why these travellers are not satisfied with their trips could help develop better strategies to induce switching to sustainable modes for these dissonant car users. It is also important to highlight and. if feasible, address the reasons behind the dissonance experienced by transit users to prevent a decline in their ridership and ensure their use of public transportation as their preferred mode of travel.

**Table 5**
Satisfaction with main mode binary logistic regression model.

| | Model 1 | | Model 2 | |
|---|---|---|---|---|
| | Odds Ratios | CI | Odds Ratios | CI |
| (Intercept) | 17.07 *** | 7.54 – 39.40 | 4.63 ** | 1.85 – 11.73 |
| **Sociodemographic** | | | | |
| Gender [1 = female] | 1.16 | 0.90 – 1.51 | 1.15 | 0.88 – 1.51 |
| Age in 2022 (Ref. category [18–35]) | | | | |
| 36–59 years old | 1.00 | 0.76 – 1.32 | 1.01 | 0.76 – 1.34 |
| 60 years old and above | 2.37 ** | 1.38 – 4.27 | 2.45 ** | 1.40 – 4.53 |
| Income bracket | | | | |
| Below 60 k | 0.79 | 0.56 – 1.12 | 0.65 * | 0.45 – 0.94 |
| 60 k-120 k | 0.77 | 0.55 – 1.08 | 0.69 * | 0.48 – 0.98 |
| **Travel perception** | | | | |
| Value daily travel | 1.42 *** | 1.24 – 1.63 | 1.38 *** | 1.19 – 1.59 |
| Longer travel duration than desired | 0.52 *** | 0.45 – 0.60 | 0.54 *** | 0.46 – 0.62 |
| **Trip characteristics** | | | | |
| Travel time (in minutes) | 0.99 | 0.99 – 1.00 | 0.99 * | 0.98 – 1.00 |
| **Main and Preferred travel mode (Ref. category [Car MM/not PM])** | | | | |
| Main Mode | | | | |
| Transit (MM/not PM) | | | 3.50 *** | 1.98 – 6.25 |
| Main Mode x Preferred Mode interaction | | | | |
| Walk (MM and PM) | | | 7.92 *** | 3.69 – 18.37 |
| Bicycle (MM and PM) | | | 5.54 *** | 2.72 – 11.83 |
| Transit (MM and PM) | | | 1.78 ** | 1.16 – 2.71 |
| Car (MM and PM) | | | 5.01 *** | 3.08 – 8.19 |
| Observations | 1865 | | 1865 | |
| $R^2$ Tjur | 0.122 | | 0.164 | |

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

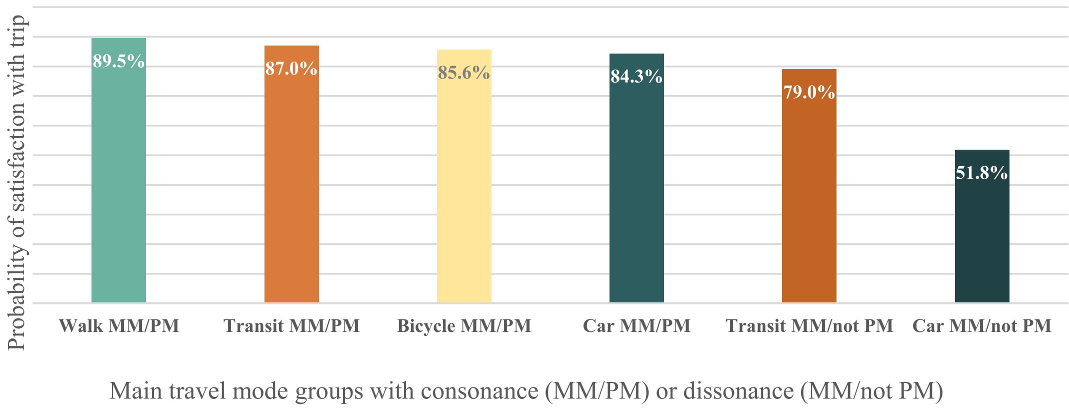


**Fig. 2.** Sensitivity analysis for probability of satisfaction with work or school trip.

### 3.4. Dissonant users analysis

As dissonant car users (N = 115) have the lowest probability of satisfaction with their work or school trips, we investigate the reasons for their dissonance (Fig. 3). The question used to perform this analysis asked why these commuters were not able to take their preferred mode for their trip. This inquiry included a list of choices, with an "other" option available. Some of the frequently stated reasons are considered hard to deal with (e.g., poor weather); however, this is not the case for all the stated reasons. For transit enthusiasts (people who consider transit to be their preferred mode of travel), the two most relevant reasons for not taking their preferred mode were the unavailability of the service and long travel times via transit. It is important to address the unavailability of service as it can be a consequence of service cuts and reducing route frequency, making transit inconvenient for its enthusiasts to use forcing them to use their cars for their commute trips. Decreasing dissonance among car users can be seen as an opportunity for modal switching as these car users are un-happy with their trips and car is not their preferred mode.

As for dissonant transit users (N = 184), while our sensitivity analysis shows that they have a high probability of satisfaction, exploring their reasons for dissonance helps in understanding their travel attitude. The majority of these users in our sample prefer to use other sustainable modes (walking and cycling). The most stated reason by users who would prefer to cycle is poor weather (Fig. 4).

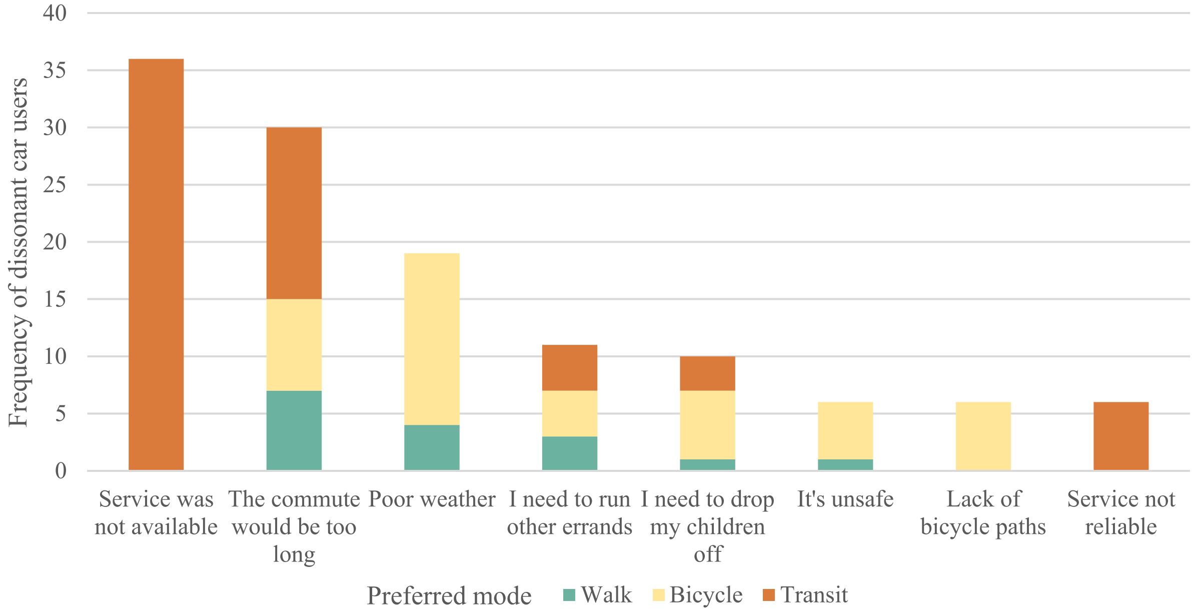


**Fig. 3.** Frequency of reasons why dissonant car users do not take their preferred modes.

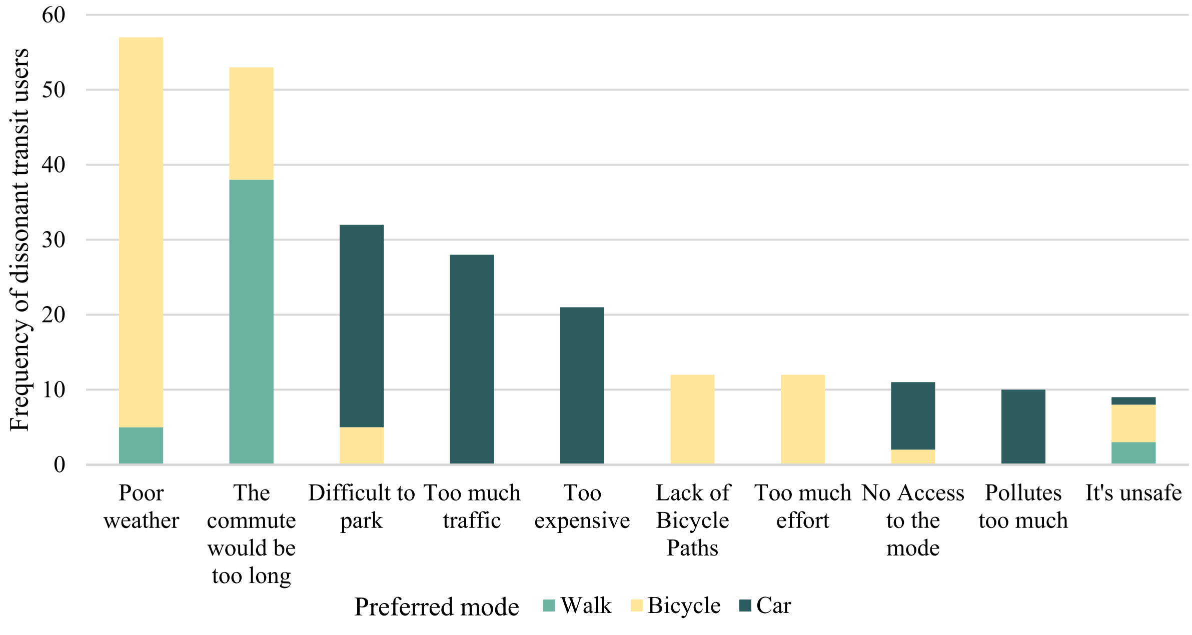


**Fig. 4.** Frequency of reasons why dissonant transit users do not take their preferred modes.

This aligns with previous studies that highlighted the role of weather in the mode switch of certain cyclists (Bachand-Marleau et al., 2012; Damant-Sirois et al., 2014). As the focus destinations of this study are work and school, it is unsurprising that the commute distance would be too long to cover on foot for some transit users who prefer walking (Negm et al., 2023). Regarding dissonant transit users who would prefer to drive, the three most frequently mentioned reasons for dissonance were parking difficulty, congestion, and costliness. This helps explain the high probability of satisfaction for these transit users as avoiding driving saves them time, energy, and financial resources.

## 4. Conclusion

In this study, we investigated the relationship between travel behaviour (mode choice), attitudes (preference), and satisfaction among commuters to work and school in Montreal, Canada with data from a large-scale bilingual online travel survey. Using a weighted binary logistic regression, we analyzed the commute satisfaction of a sample of 1,865 individuals whose main mode of travel is walking, cycling, public transit, or car. In the survey, commuters report their main mode used for the most recent trip, the mode they would have preferred to take if the main mode was not their preferred one, the reason why they were not able to take their preferred mode, and their overall satisfaction with that trip. Although our sample encompassed a significant number of commuters who use transit or cars and favor alternative modes of transport, there was only a minimal presence of pedestrian and cyclist commuters who preferred different modes. Prior research has also identified a consistent trend wherein pedestrians tend to opt for walking or cycling, while cyclists predominantly choose to ride their bicycles (De Vos, 2018).

This research applies Festinger's cognitive dissonance theory (1957) in the context of transportation to investigate the influence of the dissonance between the chosen mode of travel and one's preferred mode of travel on overall travel satisfaction. The study looks at the determinants of this dissonance for public transit and car users. To the best of the authors' knowledge, these factors have not been previously examined in the existing literature. However, they hold significant importance in shaping transport policy. This study contributes fresh perspectives on transport poverty and captivity, aligning with recommendations from De Vos et al. (2022). It underscores the importance for policymakers and urban planners to devise strategies enhancing public satisfaction with transit and active travel. Boosting positive perceptions of these modes can positively impact people's inclination to use them.

Through our model and its corresponding sensitivity analysis, we find that both consonant and dissonant travellers have a high probability of satisfaction with their commute, with the exception of dissonant transit and car users. Our findings align with previous literature that show that pedestrians are the most satisfied with their trips (St-Louis et al., 2014); however, we found that consonant transit users have similarly high satisfaction. Dissonant car users who prefer sustainable modes of travel (walking, cycling, or public transit) were found to have the lowest probability of satisfaction with their commute (probability of 51.8 %) making them more of "captive drivers". Focusing on this group of travellers to achieve switching to sustainable modes could yield successful results as they are more prone to switch modes away from cars to increase their satisfaction with travel.

Other tested variables in the model revealed that lower- and middle-income individuals have lower odds of being satisfied with their commute when compared to high-income individuals. Further studies that investigate travel barriers that these groups face would help in developing more equitable transport systems. As proposed by De Vos (2018), a brief preliminary analysis revealed that improving transit travel options for car users who prefer public transit as their travel mode can alleviate their dissonance and increase their probability of satisfaction. The main policy recommendation based on our findings is enhancing the spatial and temporal availability of public transit (Boisjoly et al., 2018). This entails increasing bus frequency to reduce wait times, and optimizing stops to cut on-vehicle time, thus enhancing bus commuting efficiency. Regarding spatial expansion, a reassessment of Montreal's transit network, especially with the new LRT system, is crucial. Potential improvements may involve introducing new bus routes or consolidating existing routes and stops. These policies aim to alleviate issues related to transit unavailability and unreliability, effectively addressing the problem of lengthy transit commutes. The ultimate goal is to attract dissatisfied car users experiencing dissonance, encouraging them to opt for transit, and simultaneously maintaining ridership among existing transit users by increasing their satisfaction. While regional and local accessibility measures were not statistically significant in our model of satisfaction, they can be very important in developing strategies for sustainable mode switching. Future research can study their effect on the probability of shifting travel preference from the car to more sustainable modes.

**Author Contributions**

The authors confirm contribution to the paper as follows: Study conception and design: Negm, De Vos & El-Geneidy; Data collection: Negm & El-Geneidy; Analysis and interpretation of results: Negm, De Vos & El-Geneidy; Draft manuscript preparation: Negm, De Vos & El-Geneidy. All authors reviewed the results and approved the final version of the manuscript.

## CRediT authorship contribution statement

**Hisham Negm:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Validation, Visualization, Writing – original draft, Writing – review & editing. **Jonas De Vos:** Conceptualization, Formal analysis, Methodology, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Ahmed El-Geneidy:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

The authors do not have permission to share data.

## Acknowledgements

The authors would like to thank James DeWeese, Rania Wasfi, and Rodrigo Victoriano-Habit for their help in designing, building, and cleaning the survey data. This research was funded by The Canadian Institutes of Health Research (CIHR) and The Natural Sciences and Engineering Research Council of Canada (NSERC) Collaborative Health Research Projects (CHRP) Program (CIHR CPG-170602 and CPG-170602 X- 253156, NSERC CHRPJ 549576-20) and NSERC discovery grant (NSERC RGPIN-2023-03852).

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