ACTIVE TRANSPORTATION, THAT'S THE WAY TO GO

Examining the impacts of commuting across various modes and attitudes toward investing in transportation infrastructure

Supervised Research Project Report

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ABSTRACT

Commuting is a common experience that can incur consequences besides arriving at the intended destination. While previous studies have examined the impacts of commuting, they typically focus on users of a single mode and rarely consider the impact of mode choice. Therefore, this Supervised Research Project (SRP) aims to complement existing studies by assessing the influence of commuting on individuals across different modes. In particular, this SRP illustrates the benefits of active transportation in comparison to other modes in order to promote its use (Chapters 1 and 2). Since increased adoption of active transportation is necessarily accompanied by the development and expansion of active transportation networks, this SRP also explores the different attitudes individuals have toward investing in transportation infrastructure (Chapter 3). The studies in this work use data from the 2013 McGill Commuter Survey, in which respondents (students, staff and faculty) documented details about their typical commuting experience from their home location within Greater Montreal to McGill University. The first chapter examines the impact of commuting on individuals' energy level and punctuality. The findings indicate that drivers have the lowest odds of feeling energized and the highest odds of arriving late for work, whereas cyclists have the highest odds of feeling energized and being punctual. The second chapter investigates how much additional time commuters of different modes add to their commute due to unreliable travel time. According to the results, pedestrians, cyclists and transit users respectively budget 66%, 55% and 29% less additional time compared to drivers, signifying that active transportation networks have greater travel time reliability than the street network for drivers. Finally, the third chapter segments the university population in search of important allies to endorse and increase public acceptability of active transportation projects. The results reveal five clusters of individuals with varying opinions toward transportation investments and distinct motivations, suggesting that there is no straightforward approach to improving public opinion toward active transportation projects. In short, this SRP illustrates certain benefits of using active transportation and reveals the existing divided opinions toward active transportation projects. These findings are indicative of the great potential there is for improved commuting experiences through a better comprehension of people's reluctance to use active transportation and their resistance in supporting active transportation projects.

RÉSUMÉ

Les déplacements quotidiens s'agissent d'une expérience commune qui encourt des conséquences en plus d'arriver à la destination prévue. Alors que les études précédentes ont examiné les impacts des déplacements, ils se concentrent généralement sur les utilisateurs d'un seul moyen de transport et considèrent rarement l'impact du choix du moyen de transport. Pour cette raison, ce projet vise à compléter les études existantes en évaluant l'influence des déplacements sur les individus utilisant des moyens de transport différents. En particulier, ce projet illustre les avantages du transport actif par rapport aux autres modes afin de promouvoir son utilisation (Chapîtres 1 et 2). Puisque l'adoption accrue du transport actif est nécessairement accompagnée par le développement et l'expansion des réseaux de transport actif, ce projet explore également les différentes attitudes montrées par les individus vers l'investissement dans les infrastructures de transport (Chapître 3). Les études dans ce projet utilisent les données provenant du « 2013 McGill Commuter Survey ». Dans ce sondage, les répondants (les étudiants, le personnel et les enseignants) ont documenté les détails au sujet de leur expérience de déplacements quotidiens typiques de leur lieu de résidence dans le Grand Montréal à l'université McGill. Le premier chapître examine l'impact des déplacements sur le niveau d'énergie et la ponctualité des individus. Les résultats indiquent que les automobilistes sont moins susceptibles de se sentir énergisés et plus susceptibles d'arriver en retard au travail, tandis que les cyclistes sont plus susceptibles de se sentir énergisés et d'être ponctuels. Le deuxième chapître examine le temps supplémentaire que les voyageurs allouent pour tenir compte du temps de transport peu fiable. Selon les résultats, les piétons, les cyclistes et les utilisateurs de transport en commun allouent respectivement 66%, 55% et 29% moins de temps supplémentaire par rapport aux automobilistes. Cela signifie que les réseaux de transport actif ont une plus grande fiabilité des temps de transport que le réseau routier pour les automobilistes. Enfin, le troisième chapître segmente la population universitaire afin de chercher les alliés importants pour endosser et à accroître le niveau d'acceptabilité publique des projets de transport actif. Les résultats révèlent cinq groupes de personnes avec des opinions variables à l'égard des investissements de transport et avec des motivations distinctes, ce qui suggère qu'il n'y a pas d'approche directe à améliorer le niveau d'acceptabilité publique des projets de transport actif. En bref, ce projet illustre des certaines avantages d'utiliser le transport actif et révèle les opinions divisées existantes vers les projets de transport actif. Ces résultats indiquent qu'il existe un grand potentiel pour améliorer l'expérience de déplacements en obtenant une meilleure compréhension de l'hésitation des gens à utiliser le transport actif et de leur résistance vers des projets de transport actif.

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PREFACE

Commuting is a typical part of many people's daily routine. Despite its repetitiveness, the commuting experience is not an uninvolved activity. The commuting patterns that people develop reflect, in part, their values, demands, constraints and decisions (Levinson & Krizek, 2008). For example, the transportation mode that people choose to use may be an indication of what is available and perhaps what is most convenient (Levinson & Wu, 2005). Yet, the implications of choosing between walking, cycling, taking public transit or driving are more than just a matter of convenience. Previous studies have illustrated the benefits and drawbacks of certain modes (Gatersleben & Uzzell, 2007; Hilbrecht, Smale, & Mock, 2014). Most notably, studies have revealed significant advantages of using active transportation (walking or cycling) over driving. For instance, there has been evidence that children who travel to school by foot or bicycle are associated with higher overall levels of physical activity compared to those who are driven to school (Larouche, Faulkner, Fortier, & Tremblay, 2014). Studies have also shown that increased levels of physical activity are related to greater life satisfaction, regardless of age (Maher et al., 2013; Rejeski & Mihalko, 2001). Moreover, walking and cycling trips have been found to be the most relaxing when compared to trips by other modes (Gatersleben & Uzzell, 2007). In contrast, commuting by driving has also been associated to undesirable consequences such as negative moods, poor sleep quality, elevated stress and hypertension (Hansson, Mattisson, Bjork, Ostergren, & Jakobsson, 2011; Wener & Evans, 2011). Hence, cities, schools and employers should encourage the use of active transportation to promote healthier lifestyles and to reduce sedentary behaviour.

In spite of the known benefits of active transportation, there is still a high preference for commuting by car. In Canada, 80% of workers commute by car, 12% by public transit and merely 7% by active transportation (Statistics Canada, 2013a). While there is a higher proportion of workers who use public transit in Montreal (22%), the majority of workers still travel by car (70%) and only 7% by active transportation (Statistics Canada, 2013a).

In an attempt to develop a policy tool to persuade more people to use active transportation, one of the goals of this Supervised Research Project (SRP) is to explore further impacts of commuting in search of other compelling reasons for people to consider switching to active transportation. Hence, the first chapter of this project examines the immediate day-to-day impacts of commuting on individuals. More specifically, it investigates how energized commuters feel when they arrive at their destination. Previous research has shown that commuting can be a tiring experience (Evans, Wener, & Phillips, 2002; Kahneman, Krueger, Schkade, Schwarz, & Stone, 2004a; Koslowsky, Kluger, & Reich, 1995; Stutzer & Frey, 2008), and that it can also affect work performance (Schaeffer, Street, Singer, & Baum, 1988; White & Rotton, 1998). Yet, no previous studies have differentiated how commuting affects the energy of individuals across various modes. Thus, the first chapter studies whether certain modes are more tiring than others. At the same time, it also explores how commuting across different modes impacts people's punctuality. In Canada, it is estimated that the cost of fatigue amounts to 750 million dollars in reduced workplace efficiency per year (Mediabrands and Reprise, 2015). Hence, if commuting by active transportation allows individuals to be more punctual and less fatigued, this may prompt employers to encourage their employees to incorporate active transportation as part of their daily commute.

According to Lyons and Chatterjee (2008), "The commuting journey represents a spatial and temporal frame around which other travel and activities and lifestyles are based." In order words, the commuting experience has a much farther-reaching impact than merely bringing an individual to his or her desired destination. In Montreal, the average commuter spends nearly 30 minutes travelling to work each day (Statistics Canada, 2013b). Yet, the total time budget for commuting can be much greater depending on the reliability and variability of journey time. Typically, variability in travel time can be associated with events within the commute, such as traffic congestion, limited parking availability or delayed transit service (Emre & Elci, 2015; Koslowsky, 2000). In

Montreal, for example, drivers with a 30-minute car commute travelling during peak hours (8:00am – 9:00am and 5:00pm – 6:00pm on weekdays) can expect to experience, on average, 21 minutes of delay due to traffic congestion (TomTom International BV, 2015). To ensure prompt arrival at their destination, individuals may compensate for uncertainty in travel time by adjusting their departure time earlier to offer themselves buffer time (Gaver, 1968; Knight, 1974; Noland & Small, 1995; Small, 1982). However, granted that there are a finite number of hours in a day, additional time budgeted for commuting results in less time available for other activities. While it may seem unconventional to promote active transportation as a method to reduce commuting time given its typical slower speed, there may be circumstances in which a cycling trip with consistent travel duration is more favourable than a driving trip with highly variable travel duration. Yet, most studies on travel time reliability thus far have focused on driving trips (Brownstone, Ghosh, Golob, Kazimi, & Van Amelsfort, 2003; Jackson & Jucker, 1982; Noland, Small, Koskenoja, & Chu, 1998; Tilahun & Levinson, 2010). Consequently, not much is known about travel time reliability of other modes, and how they compare to driving.

To fill this gap in literature, the second chapter of this SRP aims to provide an analysis of the travel time reliability of different modes by assessing how much additional time individuals allocate for their commute. It examines various factors related to commuting, including travel mode and travel duration. Results from this chapter will shed light on the performance of various transportation networks, which will be important for commuters, transit agencies and cities alike. Understanding how much extra time they allocate for commutes due to unreliable travel time will allow individuals to revaluate their time budgets and reconsider their commuting patterns. Similarly, transit agencies and cities will be able to use this information to prioritize transportation improvements and improve people's commuting experience.

In recent years, many cities and active transportation advocates have pushed for the further development of active transportation networks (City of Toronto, 2016; City of Vancouver, 2015; Coalition Vélo de Montréal, 2013). In many cases, this is in recognition of the benefits of active transportation, as well as in response to the unmet needs of active transportation users. For instance, even though Montreal is frequently named as one of world's best cycling cities (Copenhagenize Desing Company, 2015; Walker, 2014), the existing cycling network is fragmented, with many cycling paths ending abruptly, and the overall street network favours drivers (Boisjoly & El-Geneidy, 2016). Hence, in Montreal, there is a need for continual investment in transportation infrastructure. In order to finance and implement such projects, however, it is vital to gather public support.

Therefore, the goal of the third and final chapter of this SRP is to differentiate and identify clusters within the population that exhibit different attitudes toward investing in active transportation infrastructure. Finding groups of individuals who support investing in transportation infrastructure, and in particular active transportation infrastructure, will be valuable in promoting the further use of active transportation. At the same time, it is also important to identify people who oppose funding active transportation projects. Understanding the reasons behind their resistance will be helpful in addressing issues of public acceptability.

Finally, while support for active transportation investment is imperative to the development of active transportation networks, stronger support may not automatically translate to increased mode usage (Manville & Cummins, 2015). Hence, cities need to simultaneously advocate the use of active transportation and the development of necessary infrastructure to support its use. Ultimately, the underlying reason motivating this SRP and the promotion of active transportation is to find ways to improve the quality of people's daily lives.

CHAPTER 1

On time and ready to go: An analysis of commuters' punctuality and energy levels at work or school

ABSTRACT

The strain of the daily commute can negatively impact performance at work. This study differentiates how various modes influence commuters' punctuality and energy levels at work and school. The data for this study come from the 2013 McGill Commuter Survey, a university-wide survey in which students, staff and faculty described their typical commuting experience to McGill University, located in Montreal, Canada. Ten multilevel mixed-effects logistic regressions are used to determine the factors that impact 1) a commuter's feeling of being energized when he or she arrives at work or school and 2) his or her punctuality. Our results show that weather conditions and mode of transportation have significant impacts on an individual's energy at work and punctuality. The models indicate that drivers have the lowest odds of feeling energized and the highest odds of arriving late for work. Cyclists, meanwhile, have the highest odds of feeling energized and being punctual. Overall, this study provides evidence that satisfaction with travel mode is associated with higher odds of feeling energized and being punctual. With these findings in mind, policy makers should consider developing strategies that aim to increase the mode satisfaction of commuters. Encouraging the habit of commuting by bicycle may also lead to improved performance at work or school.

RÉSUMÉ

Les déplacements journaliers peuvent négativement influencer le rendement au travail. Cette étude illustre l'impact de divers moyens de transport sur la ponctualité et le niveau d'énergie des voyageurs au travail ainsi qu'à l'école. Les données de cette étude proviennent du « 2013 McGill Commuter Survey », un sondage à l'échelle de l'université, dans lequel les étudiants, le personnel et les enseignants décrivent leur expérience de déplacement quotidien typique à l'université McGill, situé à Montréal, Canada. Dix modèles de régression logistique multi niveaux d'effets mixtes ont été utilisés afin de déterminer les facteurs qui impactent 1) le niveau d'énergie ressenti par un voyageur lorsque celui-ci arrive au travail ou à l'école, et 2) sa ponctualité. Nos résultats démontrent que les conditions météorologiques ainsi que le moyen de transport ont un impact significatif sur le niveau d'énergie d'un individu, ainsi que sur sa ponctualité. Les modèles indiquent que les automobilistes sont moins susceptibles à se sentir énergisés et plus susceptibles à arriver en retard au travail. Les cyclistes, quant à eux, sont plus susceptibles de se sentir énergisés et d'être ponctuels. En somme, cette étude met à l'évidence que la satisfaction avec un moyen de transport est associée avec une susceptibilité plus élevée de se sentir énergisé et d'être ponctuel. À l'esprit de ces conclusions, les décideurs politiques devraient considérer des stratégies qui visent à augmenter le niveau de satisfaction chez les voyageurs. Encourager l'habitude de se déplacer par bicycle peut amener à une performance améliorée au travail et à l'école.

INTRODUCTION

Commuting is without a doubt a necessary part of many people's daily routine. However, the strain associated with commuting can have a negative impact on academic and work performance. Long travel distances, in particular, contribute to an individual's level of stress and lack of energy (Kluger, 1998; Mokhtarian, Papon, Goulard, & Diana, 2014; Waddell, 2014), which lead to further consequences of lower academic and work performance (Adecco Canada, 2013; Gnoth, Zins, Lengmueller, & Boshoff, 2000; Taris & Schaufeli, 2014). A new Canadian study has shown that 40% of employees have fallen asleep at work, and that 74% of young adults (between the ages of 18-24) have fallen asleep during a class (Mediabrands and Reprise, 2015). The performance of a tired individual has been shown to drop significantly, and is comparable to that of well-rested individuals in the 9th percentile (Durmer & Dinges, 2005). In Canada, it is estimated that the cost of fatigue amounts to 750 million dollars in reduced workplace efficiency per year (Mediabrands and Reprise, 2015). Effectiveness in the workforce is also reduced due to employees arriving late to work. According to surveys conducted in the United States and in the United Kingdom, traffic during commute is the most cited reason for tardiness (Mercer, 2012; Peters-Atkinson, 2012). While the evidence may not draw a direct connection between commuting and work performance, it is reasonable that an individual's commuting experience, based on the cited studies, would partially account for some of these negative impacts. Therefore, it is critical to understand the relationship between commuting and work performance.

The objective of this paper is to investigate how an individual's commute affects his or her 1) feeling of being energized and 2) punctuality at work or school. The study uses cross-sectional data from a university-wide travel behaviour survey conducted during the spring of 2013 in which students, staff and faculty described their typical commuting experiences to McGill University, located in downtown Montreal, Canada. Building on a recent study which has shown that driving is the most stressful transportation mode (Legrain, Eluru, & El-Geneidy, 2015), we hypothesize that individuals who commute by driving are also the ones who feel the least energized when they arrive at their destination. In contrast, we expect those who commute using active transportation to feel the most energized, due to the benefits received from performing physical activity (Biddle, 2003; Fox, 1999). We also anticipate that cyclists and pedestrians will be the most punctual as a result of the greater control they can exert on their commute. On the other hand, due to the dependence on transit operators to provide transit service and thereby lack of control (Legrain et al., 2015), we predict that public transit users will have a relatively strong perception that their commute negatively impacts their punctuality.

The paper begins with a review of the existing literature about the impact of commuting on an individual being energized and punctuality. It then presents the data used for the study, and describes the results of a series of multilevel mixed-effects logistic regression analyses used to determine the factors of a commute that affect a person's energy and punctuality. Finally, the paper concludes with a discussion of the results and proposes suggestions for future transportation studies and policy recommendations.

LITERATURE REVIEW

Commuting can be a tiring experience (Evans et al., 2002; Kahneman et al., 2004a; Koslowsky et al., 1995; Stutzer & Frey, 2008). Kahneman, Krueger, Schkade, Schwarz, and Stone (2004b) identified commuting as one of the least enjoyable activities in a day, and Mokhtarian et al. (2014) found that among other trip purposes, commuting to work was deemed as the most tiring. Transportation researchers have typically associated fatigue to commuting stress, where higher stress levels are correlated with exhaustion (Barden (Barden & Lucas, 2003; Mokhtarian et al., 2014). Legrain et al. (2015) examined the factors that contribute to commuting stress and found that stressors are mode-specific. For instance, a pedestrian's level of stress is affected by his or her sense of comfort and safety from traffic. Legrain et al. (2015)'s study also found that drivers are concerned with travel duration, whereas transit users become anxious when the time they spend waiting is too long.

Some researchers have begun to specifically examine the factors that influence how energized a person feels after a commute. In their analysis of the 2007-2008 French National Travel Survey, Mokhtarian et al. (2014) found that both individual and trip characteristics impact the perception of whether a trip is tiring. Their findings suggest that less healthy individuals find travelling more tiring, as do people who live in suburban areas compared to those who live downtown. These researchers also found that socioeconomic characteristics (age, gender, household composition and social status), as well as attitudinal characteristics are also associated to whether a person feels tired because of a trip. In addition, they found that time of travel, travel duration, travel mode and activities performed during the trip all have an effect on travel-induced fatigue. More specifically, drivers and individuals with longer commutes are more likely to feel tired than others. Interestingly, those whose trips take place in the evening and at night are more prone to feeling tired. Mokhtarian et al. (2014) proposed that this is due to an accumulation of strains during the day, as well as heightened anxieties regarding safety.

The commuting experience impacts mental and physical energy differently. For example, Gatersleben and Uzzell (2007) found that bicycle trips are the most mentally stimulating, while walking trips are the most relaxing for commuters. On the other hand, Mokhtarian et al. (2014) suggested that those who utilize active transportation are more inclined to experience physical tiredness, and those who use public transportation or drive tend to feel tired mentally. Understanding how each mode affects the physical and mental energy of commuters is important in order to analyze the productive capacity of employees and students. For example, an employee working in a labour-intensive job may consider using transportation modes that are less physically draining.

Commuting can also affect work performance. For example, Schaeffer et al. (1988) demonstrated that an exhausting commuting experience can have a negative impact on eventual task performance, and White and Rotton (1998) found that a stressful commuting experience can diminish a person's subsequent frustration tolerance and persistence in problem solving.

Finally, commuting affects punctuality due to its potential unpredictability (Kluger, 1998; N. Nicholson & Goodge, 1984). The variability in travel time can be attributed to various events within the commute such as traffic congestion, limited parking availability or delayed transit service (Emre & Elci, 2015; Koslowsky, 2000). This frequently results in tardiness. Travel distance is also a factor; the greater the commuting distance, the more likely that an individual would be late (Leigh & Lust, 1988). As well, a previous study has shown that weather plays a role in influencing when a person arrives at work (Muesser, 1953). Apart from the environmental factors of the commute, Koslowsky (2000) mentioned individual characteristics, which influence the punctuality of workers as well. These include an individual's attitude, personality, culture and sense of time urgency. A recent study examining the relationship between personality and punctuality of university students showed that those who travelled by bicycle or foot, arrived significantly later than those who travelled by car or train

(Werner, Geisler, & Randler, 2015). However, the study did not take into account the impacts of the commuting experience. To the best of the authors' knowledge, no previous studies have examined how the commuting experience influences an individual's energy level and punctuality across different modes.

METHODOLOGY

Survey

The data used for this study are derived from the 2013 McGill Commuter Survey (Appendix), an online commuter survey conducted during March and April 2013. The target population was comprised of approximately 38,000 McGill University students, staff and faculty, who make regular trips to McGill University's two main campuses. In total, 20,851 survey invitations were sent to randomly selected members of the McGill University community. Respondents had a window of thirty-five days to complete the online survey, and prizes were offered as incentives for participation. The survey had a response rate of 31.7%, which is comparable to a previous study conducted by Whalen, Páez, and Carrasco (2013), whose online survey targeting a Canadian university-based population obtained a 22% response rate.

After cleaning the database by removing incomplete and unreasonable responses, 5,599 records were retained. The survey recorded the respondents' typical commute from their home location to their destination within the two McGill University campuses for a cold and snowy day, and likewise for a warm and dry day. The respondents answered detailed questions regarding each aspect of their daily commute, including duration, satisfaction with service quality, and mode. The survey also collected information about the respondents' socio-demographic information, travel preferences, and personal attitudes toward the commute (Shaw et al., 2013).

Study Sample

This study focuses on individuals who travelled to McGill University's Downtown Campus by walking, cycling, driving or transit (bus, metro and commuter rail). The decision to concentrate only on commuters travelling to McGill University's Downtown Campus is based on the fact that there are stark differences between the experiences of travelling to McGill University's suburban

Macdonald Campus compared to McGill University's Downtown Campus, which is located in the city centre.

Using a 5-point Likert scale, where "1" = strongly disagree and "5" = strongly agree, survey respondents reported their level of accordance with the statements: 1) "I feel energized when I arrive at McGill" and 2) "My commute to McGill negatively impacts my punctuality / attendance / working hours". Self-reported answers are subjected to the response styles of respondents, and Likert-scale data are constrained by interpretation that is relative and lacks in precision (Baumgartner & Steenkamp, 2001; van Herk, Poortinga, & Verhallen, 2004; Weijters, Cabooter, & Schillewaert, 2010). Hence, for each respective statement, ordinal responses were transformed into binary variables by recoding "1", "2" and "3" as "no", and "4" and "5" as "yes". While this practice is common and simplifies the interpretation of the results, we acknowledge that it may induce unknown bias and impact the model estimates (Manor, Matthews, & Power, 2000).

Respondents are classified by their main mode of transportation; for example, those who used public transit for at least one leg of their trip were identified as transit users. The study does not include commuters who carpooled as car passengers or rode the private university shuttle bus, which offers transportation service between the two McGill University campuses due to the small number of observations. Additionally, those who claimed to drive, but did not possess a driver's license were also eliminated from this study.

Travel duration of each trip was calculated using the travel times of each trip leg as reported by each respondent. This includes out-of-vehicle time, such as the time it takes an individual to reach his or her bus stop, as well as in-vehicle time, for instance how long he or she travelled on the bus. Travel distance was not retained due to its strong correlation with travel duration (Pearson's correlation coefficient = 0.70). Furthermore, travel duration was selected over travel distance because it serves as a better representation of the actual commute since it accounts for different travel speeds and delays that occur along the way (Gordon, Kumar, & Richardson, 1988; Legrain et al., 2015; Mokhtarian et al., 2014; St-Louis, Manaugh, van Lierop, & El-Geneidy, 2014). The survey inquired about how much extra time the individual allots for the commute, by asking "On a typical [cold snowy / warm dry] day, how much additional time (in minutes) do you budget to ensure that you get to McGill on time?” Respondents answered the question using a drop-down menu allowing a range of responses from one to 200 minutes. It is important to note that additional budgeted time is separate from, and not integrated with, travel duration.

Residential self-selection variables are included to control for any effect resulting from the choice of home location. In the survey, respondents used a 5-point Likert scale to evaluate the importance of various factors when they were selecting their current residence. For this study, we tested proximity to McGill, proximity to public transit, the cost of commuting and not having to drive. The survey also asked respondents to rate their satisfaction with various aspects of their trip using a 5-point Likert scale. To ensure that the impact of mode-specific attributes can be evaluated accordingly, records of respondents who did not provide an answer or stated that they had no opinion were removed. Our data includes a total of 3068 individuals and 6116 observations consisting of 3065 trips on a warm and dry day, and 3051 trips on a cold snowy day.

Table 1 summarizes the sample statistics by mode of transportation and presents the independent variables that will be tested across all modes for energy and punctuality respectively in the following section of the paper. The sample is composed of 46% students, 33% staff and 21% faculty, while the mode split is 10% cycling, 15% driving, 50% public transit, and 25% walking.

A brief assessment of the study sample reveals that drivers tend to be older (mean age of 46 years), have a higher income and budget the most additional time for their commute (mean of 17 minutes). Transit users have the longest commute (mean of 43 minutes) while pedestrians have the shortest commute (mean of 19 minutes). Pedestrians have the highest proportion of students and hence are younger (mean age of 30 years). Together with the cyclists, they place the highest importance of living in proximity to the university and not having to drive. Lastly, cyclists and drivers have the highest life satisfaction (7.71/10) among the commuters.

TABLE 1: SUMMARY STATISTICS – MEAN OF VARIABLES

	GENERAL	CYCLE	DRIVE	TRANSIT	WALK
Sample size	6116	610	914	3058	1534
DEPENDENT VARIABLES					
I feel energized when I arrive at McGill.	0.36	0.81	0.28	0.27	0.42
My commute to McGill negatively impacts my punctuality / attendance / working hours.	0.26	0.05	0.29	0.32	0.21
WEATHER					
Warm, dry day	0.50	0.92	0.47	0.43	0.50
TIME					
Duration (minutes)	33.63	23.53	32.55	43.53	18.56
Additional budgeted time (minutes)	11.40	5.10	17.03	13.77	5.80
I use my commute time productively (Strongly disagree – 1, Strongly agree – 5)	3.37	3.48	3.19	3.46	3.24
PERSONAL ATTRIBUTES					
Age	37.21	35.66	46.44	38.17	30.42
Male	0.42	0.53	0.46	0.38	0.41
Student	0.46	0.48	0.20	0.40	0.71
Staff	0.33	0.26	0.35	0.43	0.15
Faculty	0.21	0.26	0.45	0.17	0.14
Income (Low – 0, High – 10)	2.12	2.18	4.10	1.94	1.28
Number of children in the household	0.41	0.37	0.82	0.43	0.10
Life satisfaction (Low – 1, High –10)	7.43	7.71	7.71	7.31	7.39
HOME SELECTION					
Importance of the following factors in selecting current home:					
Proximity to McGill (Low – 1, High – 5)	3.46	3.76	3.08	3.05	4.40
Proximity to public transit (Low – 1, High – 5)	4.08	4.24	3.47	4.33	3.87
Cost of commuting (Low – 1, High – 5)	3.26	3.24	3.06	3.30	3.31
Not having to drive (Low – 1, High – 5)	3.72	4.29	2.66	3.64	4.27
MODE USED					
Cycling	0.10	na	na	na	na
Driving	0.15	na	na	na	na
Transit	0.50	na	na	na	na
Walking	0.25	na	na	na	na

na "not applicable"

Figures 1 and 2 respectively show the proportion of respondents who feel energized when they arrive to McGill and those whose commute negatively impacts their punctuality. In general, travel mode and weather conditions are significant for both an individual's energy and punctuality; this observation is confirmed by a series of t-tests and chi-square tests. More precisely, users of active transportation have higher rates of feeling energized and are less likely to be late for work. For instance, on a typical warm and dry day, 82% of cyclists reported that they feel energized when they arrived at McGill, and only 3% experienced problems with punctuality. This is in contrast to transit users, of which only 38% felt energized when they arrived on a typical warm and dry day, and 19% reported that they arrived late.

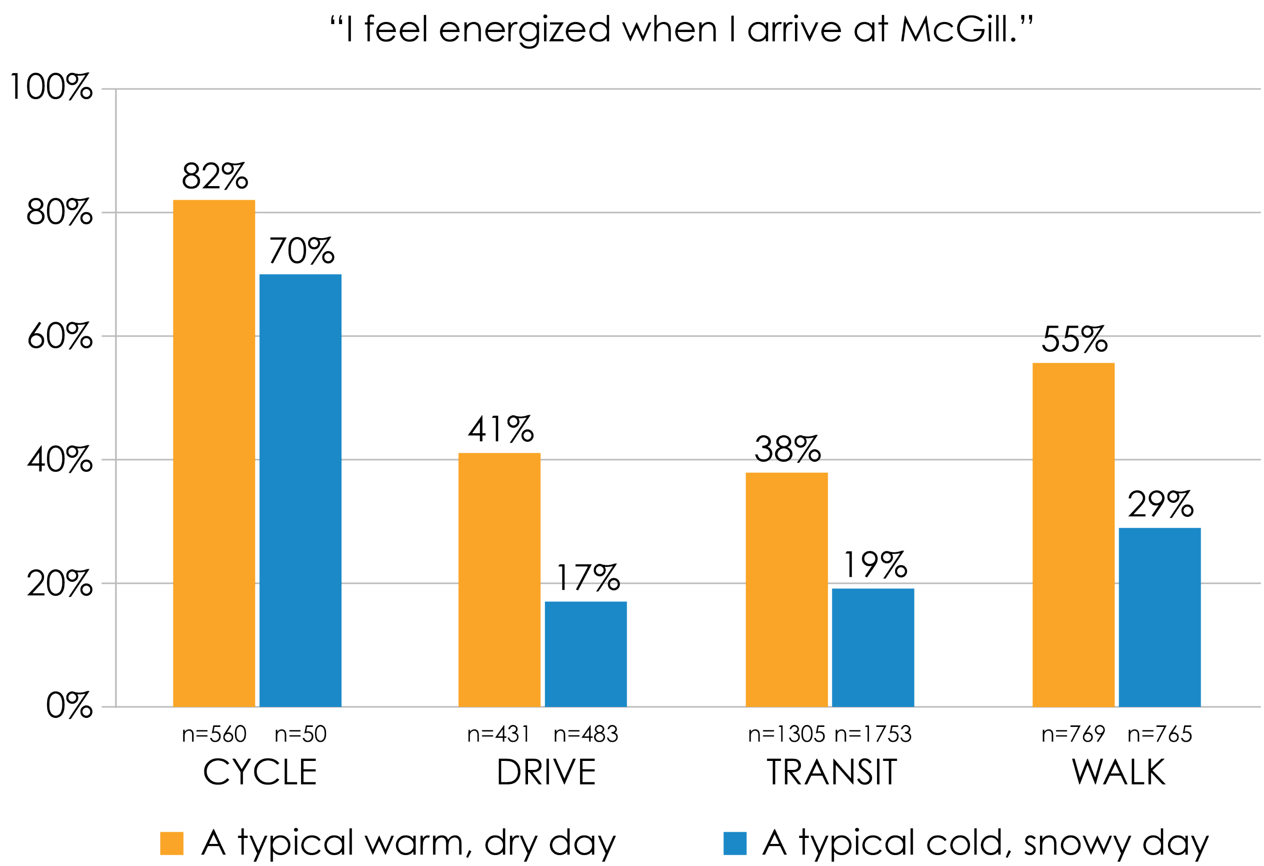

FIGURE 1: Proportion of commuters who feel energized when they arrive at McGill classified by mode and weather.

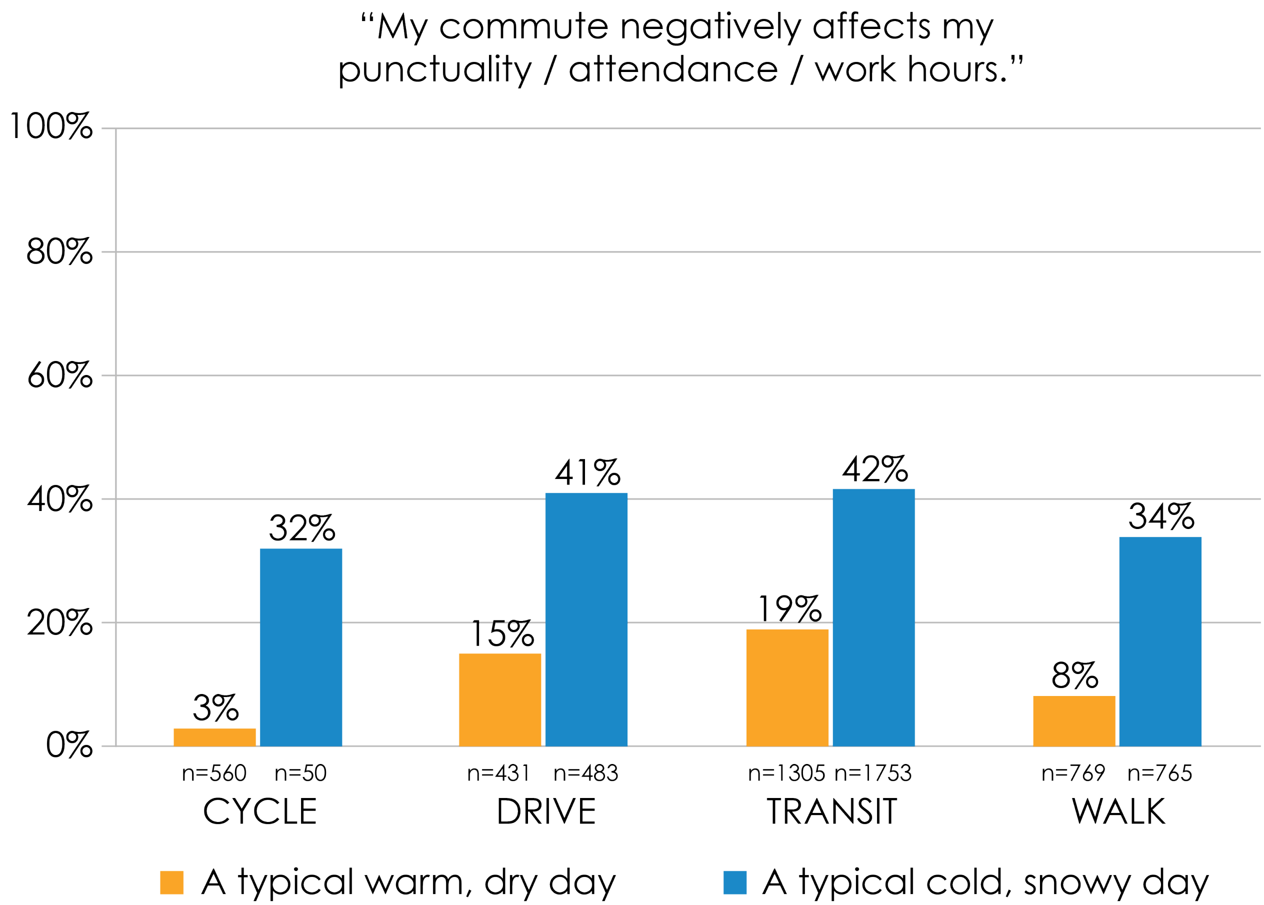

FIGURE 2: Proportion of commuters whose commute negatively impacts their punctuality, attendance or working hours classified by mode and by weather.

Multilevel Mixed-Effects Logistic Regressions

Using multilevel mixed-effects logistic regressions, this study sets out to determine which factors influence a commuter's energy level at work and punctuality. Since the typical commuting trips for both weather conditions of each individual are of interest, multilevel models allow us to appropriately isolate and capture the effects of listed variables, while acknowledging unmeasured individual-level factors (Gelman & Hill, 2007). In other words, multilevel models enable us to distinguish between the variation within individuals and the variation among individuals. The likelihood-ratio rest (LR test) was used to validate the appropriateness of using multilevel regressions.

Based on an evaluation of the independent variables discussed in literature, the models retain variables that proved to be theoretically relevant and consistently statistically significant in the final results. The models also include controlling factors, such as residential self-selection variables, to enable appropriate interpretation of the results. The decision on whether to keep or drop a variable that was not significant in a model was based on its effect on the model's Log-likelihood and the changes that occurred in the other variables.

General models and mode-specific models were developed to improve the understanding of how each mode and specific aspects of different modes influence a commuter's energy level at work and punctuality. The general models consist of universal variables as well as dummy variables to indicate the mode used. The universal variables presented in the general models are also found in the mode-specific models, which contain additional variables specific to a particular mode that is tested. These mode-specific variables are generally related to the satisfaction with the different aspects of the modes used. For example, a respondent who typically rides a bus and takes the metro during his or her commute would answer satisfaction questions for both the bus and the metro. Yet, someone who only takes the bus would only rate his or her satisfaction with the bus. In order to analyze transit users as one group regardless of how many transit modes they use, the average satisfaction for the specific transit modes used was generated. In addition, variables were developed to indicate how many buses, metro and commuter rail lines each commuter took.

For ease of interpretation, ordinal data collected in the form of a 5-point Likert-scale were transformed into dummy variables. We recoded answers of "1" and "2" as "Low", "3" as "Medium", and "4" and "5" as "High". In the case of transit satisfaction variables, we recoded averages of less than 2.5 as "Low", and greater than 3.5 as "High". Averages falling within and including 2.5 and 3.5 were recoded as "Medium".

RESULTS AND DISCUSSION

Tables 2 and 3 present the results of the multilevel mixed-effects logistic regression analyses using odds ratio (OR) and 90% confidence intervals (CI). The Intraclass correlation coefficient (ICC) presented at the bottom of each table is a statistic that measures the consistency of responses by each individual and describes the proportion of variability in energy and punctuality that is due to differences between individuals. In predicting the odds of a commuter feeling energized at work, the ICC is estimated to be 71.2%, 72.0%, 76.4%, 78.9% and 70.0% for the general, cyclist, driver, transit user and pedestrian models, respectively. Likewise, the ICC is estimated to be 75.1%, 68.6%, 77.5%, 79.7% and 72.1% for the general, cyclist, driver, transit user and pedestrian models predicting the odds of a commuter arriving late at work. To put this into context, the ICC of 68.6% associated with the model predicting the odds of a cyclist arriving late at work suggests that 68.6% of the variation is due to differences between the cyclists, or unmeasured factors at the individual level.

TABLE 2: MULTILEVEL REGRESSION RESULTS FOR ENERGY AT WORK

"I feel energized when I arrive at McGill."

	Dummy Level	GENERAL OR [90% CI]	CYCLE OR [90% CI]	DRIVE OR [90% CI]	TRANSIT OR [90% CI]	WALK OR [90% CI]
WEATHER						
A typical warm, dry day		6.069*** [5.041, 7.306]	4.181** [1.383, 12.642]	5.726*** [3.269, 10.031]	4.570*** [3.419, 6.108]	5.965*** [4.116, 8.643]
TIME						
Additional budgeted time (per ten minutes)		0.309*** [0.260, 0.367]	0.813 [0.546, 1.209]	0.292*** [0.194, 0.439]	0.201*** [0.150, 0.269]	0.357*** [0.208, 0.611]
Additional budgeted time (per ten minutes squared)		1.124*** [1.098, 1.150]	–	1.133*** [1.083, 1.185]	1.161*** [1.118, 1.207]	1.246*** [1.105, 1.405]
I use my commute time productively	High	3.294*** [2.579, 4.208]	2.477** [1.164, 5.272]	4.712*** [2.290, 9.696]	3.807*** [2.485, 5.832]	2.726*** [1.742, 4.264]
PERSONAL ATTRIBUTES						
Student		0.699** [0.544, 0.896]	2.267* [1.081, 4.754]	1.339 [0.545, 3.120]	0.965 [0.940. 1.456]	0.235*** [0.142, 0.386]
Life satisfaction (1-10)		1.301*** [1.211, 1.398]	1.146 [0.921, 1.427]	1.251 [0.999, 1.567]	1.274*** [1.131, 1.436]	1.241*** [1.086, 1.420]
HOME SELECTION						
Importance of the following factors in selecting current home:						
Proximity to transit	High	2.162*** [1.597, 2.928]	2.277 [0.851, 6.094]	–	2.002* [1.070, 3.747]	–
Cost of commuting	High	–	–	1.732 [0.856, 3.501]	–	–
Cost of commuting	Low	1.520** [1.156, 1.998]	–	–	1.713* [1.068, 2.750]	–
Not having to drive	High	–	–	–	–	2.025** [1.153, 3.555]

SATISFACTION WITH MODE		GENERAL OR [90% CI]	CYCLE OR [90% CI]	DRIVE OR [90% CI]	TRANSIT OR [90% CI]	WALK OR [90% CI]
Comfort	High	na	6.456** [1.947, 21.410]	–	–	6.151*** [3.459, 10.938]
Safety from traffic	High	na	2.207* [1.016, 4.792]	–	na	–
Safety from traffic	Low	na	–	0.115*** [0.032, 0.420]	na	–
Length of travel time	High	na	–	3.430*** [1.798, 6.543]	–	–
How long it takes to reach the bus stop, metro station or commuter rail station	High	na	na	na	2.103** [1.294, 3.418]	na
Reasonable waiting time for the bus, metro or commuter rail	High	na	na	na	2.392*** [1.565, 3.655]	na
MODE(S) USED						
Compared to: Cycling		v	na	na	na	na
Driving		0.092*** [0.059, 0.142]	na	na	na	na
Bus		0.152*** [0.111, 0.208]	na	na	na	na
Number of bus routes		na	na	na	0.562** [0.382, 0.826]	na
Metro		0.130*** [0.094, 0.179]	na	na	na	na
Number of metro lines		na	na	na	0.527** [0.327, 0.851]	na
Commuter rail		0.100*** [0.063, 0.158]	na	na	na	na
Number of commuter rail lines		na	na	na	0.493* [0.258, 0.944]	na
Walking		0.258*** [0.184, 0.363]	na	na	na	na
Constant		0.090*** [0.043, 0.185]	0.065* [0.006, 0.719]	0.006*** [0.001, 0.053]	0.005* [0.001, 0.020]	0.015*** [0.004, 0.055]
n		6116	610	914	3058	1534
Intraclass correlation coefficient		71.2%	72.0%	76.4%	78.9%	70.0%

*"*** significant at 99%, ** significant at 95%, * significant at 90%, – "found to be insignificant and removed", na "not applicable", v "comparison variable*

TABLE 3: MULTILEVEL REGRESSION RESULTS FOR PUNCTUALITY

"My commute to McGill negatively impacts my punctuality / attendance / working hours."

	Dummy Level	GENERAL OR [90% CI]	CYCLE OR [90% CI]	DRIVE OR [90% CI]	TRANSIT OR [90% CI]	WALK OR [90% CI]
WEATHER						
A typical warm, dry day		0.049*** [0.038, 0.064]	0.011*** [0.001, 0.129]	0.067*** [0.036, 0.124]	0.060*** [0.042, 0.086]	0.041*** [0.023, 0.074]
TIME						
Travel duration (per ten minutes)		1.405*** [1.302, 1.517]	–	1.436*** [1.169, 1.763]	1.330*** [1.184, 1.495]	1.313** [1.073, 1.606]
PERSONAL ATTRIBUTES						
Student		4.625*** [3.420, 6.254]	1.168 [0.383, 3.556]	6.255*** [2.624, 14.913]	3.634*** [2.384, 5.539]	5.717*** [2.907, 11.246]
HOME SELECTION						
Importance of the following facts in selecting current home:						
Proximity to McGill	High	2.224*** [1.635, 3.023]	1.733 [0.455, 6.606]	1.649 [0.789, 3.447]	2.421*** [1.569, 3.736]	4.775*** [1.998, 11.414]
SATISFACTION WITH MODE						
Comfort	Low	na	–	–	–	4.371*** [2.021, 9.454]
Length of travel time	High	na	–	0.392** [0.199, 0.773]	–	–
Length of travel time	Low	na	8.020* [1.042, 61.746]	–	–	2.888** [1.171, 7.121]
Consistent travel time	Low	na	–	6.379*** [2.430, 16.745]	–	–
How long it takes to reach the bus stop, metro station or commuter rail station	High	na	na	na	0.394*** [0.253, 0.613]	na
Reasonable waiting time for the bus, metro or commuter rail	High	na	na	na	0.154*** [0.102, 0.232]	na

MODE(S) USED	**GENERAL** OR [90% CI]	**CYCLE** OR [90% CI]	**DRIVE** OR [90% CI]	**TRANSIT** OR [90% CI]	**WALK** OR [90% CI]
Compared to: Cycling	v	na	na	na	na
Driving	11.259*** [6.723, 18.855]	na	na	na	na
Bus	8.836*** [6.032, 12.950]	na	na	na	na
Number of bus routes	na	na	na	4.864*** [3.254, 7.270]	na
Metro	2.758*** [1.933, 3.936]	na	na	na	na
Number of metro lines	na	na	na	2.283*** [1.426, 3.655]	na
Commuter rail	2.214** [1.277, 3.836]	na	na	na	na
Number of commuter rail lines	na	na	na	1.905 [0.942, 3.851]	na
Walking	2.432*** [1.576, 3.754]	na	na	na	na
Constant	0.006*** [0.003, 0.012]	0.096* [0.013, 0.702]	0.074*** [0.024, 0.232]	0.057*** [0.023, 0.141]	0.007*** [0.002, 0.027]
n	6116	610	914	3058	1534
Intraclass correlation coefficient	75.1%	68.6%	77.5%	79.7%	72.1%

**** significant at 99%, ** significant at 95%, * significant at 90%, – "found to be insignificant and removed", na "not applicable", v "comparison variable"*

General Model

Since the factors affecting both energy at work and punctuality are very similar, this section discusses the results of both models simultaneously while highlighting the relevant differences.

First, dummy variables are included for each mode to determine how mode choice influences energy at work and punctuality. Although individual modes are generally mutually exclusive since respondents are classified according to their main mode of transportation, it is possible for a transit rider to use the bus, metro and commuter rail in one trip. In previous studies, bus, metro and commuter rail users have been grouped under the single category of public transit users (Grimsrud & El-Geneidy, 2014; Mokhtarian et al., 2014). However, the findings from this study suggest that the commuting experience of individuals using different transit modes impact their energy at work and punctuality in different ways. Hence, a distinction between the transit modes is provided in the general models. According to the results, cyclists have the highest odds of feeling energized at work and the lowest odds of being late due to the commute. While it is plausible that those who already have an active lifestyle and tend to be more energized are self-selecting to commute by bicycle, research has also shown that physical activity increases alertness and personal well-being (Biddle, 2003; Fox, 1999). Compared to cyclists, the odds of other commuters feeling energized are 3.88 to 10.87 times lower, while the odds of being tardy are 2.14 to 11.26 times higher. Put simply, drivers have the lowest odds of feeling energized at work and the highest odds of arriving late at work. A careful examination of the confidence intervals, however, reveals that drivers and public transit users (bus, metro or commuter rail passengers) have similar odds of feeling energized, and that bus users have similar odds of punctuality as drivers.

Secondly, weather plays a significant role in affecting an individual's energy at work and punctuality. More precisely, the odds of an individual feeling energized at work are predicted to be 6.07 times higher on a warm and dry day than on a cold and snowy day. Likewise, the odds of being late for work when commuting on a warm and dry day are 20.41 times lower. These effects of the weather can be interpreted as an indirect result of higher stability of the transportation systems and consequently, lower energy exertion required on the part of the individual. The effect of weather conditions, however, may have been exaggerated due to the survey respondents' enthusiasm toward warmer weather after experiencing an unusually long and harsh winter in 2013.

Thirdly, there are temporal factors that influence a commuter's energy level and punctuality. In regards to feeling energized, the model predicts that the amount of additional budgeted time allotted for the trip is a significant factor, albeit a nonlinear relationship. Planning extra time for a commute is usually a response to unpredictability in the length of travel time, and perhaps an indicator of commuting stress. The results indicate that the more extra time allocated up to a certain point, the lower the odds of feeling energized at work. After surpassing a certain point, the reverse holds true. This nonlinear relationship may suggest that some people are not allocating enough additional time for their commute, and thereby negatively affecting their energy at work. Also, the odds of feeling energized is 3.29 times higher for an individual who perceives that he or she is productive during the commute than for someone who does not. However, future research is required to understand this relationship. Travel duration is a significant factor in predicting the odds of whether a commuter will be late for work. More specifically, the model predicts that the odds of an individual being late is 1.41 times greater for every additional ten minutes of travelling.

Next, we consider the model's results with regard to personal attributes. Compared to staff and faculty, the odds of students feeling energized are 1.43 times lower, and being late, 4.63 times higher. This finding is in line with the theory that there are significant differences between the behaviour of students and those of workers (Barr & Hitt, 1986; Carpenter, Burks, & Verhoogen, 2005). These dissimilarities can be attributed to differences in attitudes, lifestyle, responsibilities and stages of life. Other socio-demographic variables were tested in the models, of which age was significant, while gender, income and the number of children living in the same household were not significant. Although age was a significant factor, it was not retained in the final models due to its strong correlation with student status (Pearson's correlation = -0.74). Student status was preferred over age, since being a student often implies other personal characteristics such as younger age, having fewer children, a lower income and less consistent schedule. In contrast, a person's age is not as telling. For instance, the average age of a student is 26 years compared to the average age of a non-student, which is 46 years. Moreover, the median income category for students is from $0 to $19,999, while that of faculty and staff is $60,000 to $79,999. The results reveal a positive relationship between life satisfaction and the odds of feeling energized. While it is possible that the higher life satisfaction has a positive impact on how energized a person feels at work, the reverse is also plausible. Having enough energy to perform well at work may increase overall life satisfaction. Hence, a causal relationship between these two variables cannot be established based on this model.

Finally, the general models account for residential self-selection variables. The models predict that those who valued the importance of living in proximity to transit have 2.16 times greater odds of being energized after the commute. Similarly, individuals who did not consider the cost of commuting to be important have 1.52 times greater odds of being energized after the commute. It is possible that those who are living near transit are also living in areas with a lively urban environment; their selection of home location may reflect a more active lifestyle, and hence, these individuals are predicted to have greater odds of feeling energized. On the other hand, the models also predict that those who considered it important to live in proximity to the university have 2.22 times greater odds of being late. Although the previous statement may not seem intuitive, it is possible that those who live closer to the university campuses may be underestimating their commute time. Nonetheless, it is also probable that those who are aware of their tendencies to be late consider it more important to be living near the university.

Mode-Specific Models

When interpreting the results of the mode-specific models, it is critical to understand that even though the same variables may appear across different mode-specific models, there are important distinctions. For instance, a comfortable experience for a driver is different than a comfortable experience for a public transit user. More specifically, a driver may be concerned with the congestion he or she is facing while a public transit user may desire more room and seating. Nevertheless, the results, as discussed below, consistently show that satisfaction with travel mode is associated with higher odds of feeling energized and being punctual.

Cyclists

Similar to the general model, the results for cyclists show that weather conditions have a significant impact on a cyclist's energy and punctuality; cycling on a warm and dry time instead of a cold and snowy day increases the odds of feeling energized at work by 4.18 times and punctuality by 90.91 times. (As mentioned previously, the effect of weather conditions may have been exaggerated.) A cyclist who believes that he or she uses the commute time productively has 2.48 times greater odds of feeling energized. While being a student does not significantly impact the odds of a cyclist being late, it does increase the odds of the cyclist feeling energized at school by 2.27 times. In terms of mode-specific attributes, the models predict that a cyclist who is satisfied with the comfort of the commute and safety from traffic have 6.46 and 2.21 times greater odds of feeling energized. Dissatisfaction with the length of travel time, on the other hand, is associated with 8.02 times lower odds of being punctual. However, it is difficult to confirm the direction of the causal relationship by simply using these models; dissatisfaction with travel time may be an effect rather than a cause of the perception that the commute negatively impacts the individual's punctuality at work. Nevertheless, these results point to the importance of policies directed at improving the travel environment of cyclists.

Drivers

Driving on a warm and dry day, instead of a cold and snowy day improves the odds of the commuter feeling energized at work by 5.73 times and being punctual by 14.93 times. This is expected, as road conditions in Montreal during winter can become quite challenging due to the presence of snow and ice. The models also predict that a productive commute increases the odds of the driver feeling energized at work by 4.71 times. Students are associated with increased odds of feeling energized by 1.34 times, and tardiness by 6.26 times. Drivers who considered the cost of commuting when selecting their current home have 1.73 times higher odds of feeling energized. This, perhaps, may be a result of choosing a home location that is relatively convenient to commute back and forth by car. In regards to mode satisfaction, the models predict that dissatisfaction with safety from traffic lowers the odds of feeling energized at work for a driver by 8.70 times, whereas satisfaction with travel duration is predicted to increase the odds of feeling energized by 3.43 times. It could be that drivers who are satisfied with their travel time are those who do not experience congestion during their commute. Satisfaction with travel time is also associated with 2.55 times increased odds of punctuality, while dissatisfaction with travel time consistency is associated with 6.38 times increased odds of tardiness. Again, the interaction between satisfaction with travel time duration, travel time consistency and the odds of being late are difficult to fully capture using these models; thus theoretically, no causal relationships can be established. However, it is evident that satisfaction with traffic safety and travel duration has an impact on the odds of a driver feeling energized after the commute.

Transit Users

According to the transit models, the more number of transfers required during the commute, the lower the odds of an individual feeling energized at work and the greater the odds of being late. Particularly interesting are the estimates showing that among the transit modes, commuter rail users have the lowest odds of feeling energized, while bus users have the greatest odds of being late. Transit users are sensitive to the time it takes to reach their bus stop, metro station or commuter rail station and how much time they have to wait for their transit service. Satisfaction with the time it takes to reach the transit station or stop is predicted to increase the odds of an individual feeling energized by 2.10 times and of being punctual by 2.54 times. Furthermore, satisfaction with waiting time is estimated to enhance an individual's odds of feeling energized at work by 2.39 times and his or her odds of being on time by 6.49 times. In other words, satisfaction with waiting time and the time it takes an individual to reach his or her desired transit service have important effects on an individual's energy level and is associated with being punctual. Transit agencies, therefore, could make an effort to improve both service accessibility and reliability as such improvements are expected to impact the individuals they are serving.

Pedestrians

For pedestrians, a comfortable commute is predicted to increase the odds of the individual feeling energized by 6.15 times. An uncomfortable commute, meanwhile, is associated to increased odds of tardiness by 4.37 times, and dissatisfaction with travel time is associated with 2.88 increased odds of being late. Students have lower odds of feeling energized; the odds of a student feeling energized is predicted to be 4.26 times lower than that of staff and faculty. This may be due to the shorter distances that students travel as a result of many living in student residences close to campus. Students walk for an average of 15 minutes to the university, while staff and faculty walk for an average of 25 minutes. It is possible that the amount of time students spend walking to school is not enough for them to reap the benefits of walking (Biddle, 2003; Fox, 1999). Another possible explanation is that students may have to carry heavier loads when travelling to school.

CONCLUSION

In conclusion, the findings of this study suggest that similar factors have significant effects on the odds of a commuter feeling energized and being punctual. The results support the hypotheses and demonstrate that the impact of commuting on both energy at work and punctuality is significantly influenced by the transportation mode and weather conditions. Furthermore, this study indicates that drivers have the lowest odds of feeling energized at work, and the highest odds of arriving to work late. Cyclists, on the other hand, have the highest odds of being energized and punctual. While it is possible that individuals who already have an active lifestyle are self-selecting to commute by bicycle, previous research has also found that physical activity increases alertness and personal well-being (Biddle, 2003; Fox, 1999). Thus, it may be valuable for schools and employers to encourage the habit of commuting by bicycle.

Mode satisfaction improves the odds of an individual feeling energized, and is also found to be associated with increased odds of punctuality. However, a theoretically sound causal relationship cannot be established between the variables related to satisfaction with travel time and the odds of arriving on time, and further research is required to rigorously unravel the interactions between these variables.

Nonetheless, this study presents evidence that cyclists who are satisfied with their travel environment, in terms of comfort and safety from traffic, have increased odds of feeling energized. Hence, it would be beneficial to develop policies aimed at improving the safety of cyclists in traffic. The odds of a driver feeling energized, meanwhile, is affected by his or her satisfaction with travel duration and safety from traffic, likely alluding to a drivers dissatisfaction with congestion and the behaviour of other road users. In addition, the odds of a transit user feeling energized are impacted by the time it takes to reach the transit station or stop, as well as the waiting time. Hence, transit agencies should prioritize the improvement of service accessibility and reliability to provide a better commuting experience for their customers. Results from this study indicate that being productive while commuting increases the odds of being energized at work. However, this relationship is not well understood and future studies should focus specifically on understanding the interaction of these variables.

Future studies should also distinguish between physical and mental fatigue, as it will lead to an improved understanding of how each mode affects the physical and mental energy of commuters and ultimately, the productive capacity of employees and students. Other factors such as sleep deprivation, overall exhaustion and enjoyment of activity should be controlled for in order to isolate the effects of commuting on a person's feeling of being energized. Finally, policy makers should consider developing strategies that aim to increase the mode satisfaction of commuters, as the results of this study have shown a positive relationship between mode satisfaction and a commuter's energy and punctuality.

CHAPTER 2

It's a matter of time: An assessment of additional time budgeted for commuting to McGill University across modes

ABSTRACT

Commute travel time is not always reliable, and individuals often budget additional time to ensure that they arrive at their destination punctually. This additional time allotted for the commute needlessly reduces the amount of time that individuals could have spent performing other activities. This study investigates the amount of additional time commuters allocate to account for travel time unreliability and presents the results using a series of log-linear regression models. Data for this study originate from the 2013 McGill Commuter Survey, a university-wide survey in which students, staff and faculty described their typical commuting experience to McGill University, located in Montreal, Canada. Results reveal that drivers allocate the most extra time for their commute, while users of other modes (transit users, cyclists and pedestrians) budget about 29 to 66% less than drivers. The findings of this study also indicate that bus commuters add 14% more buffer time per bus taken, while train users budget 11% less time for every commuter train taken. These findings reveal an existing perception that the street network is unreliable (either when using buses or cars). Hence, the city should consider implementing strategies such as exclusive bus lanes, and variable cost congestion price charging schemes to reduce uncertainty in travel time and improve the reliability of the street

network. Such strategies are expected to decrease the level of uncertainty related to commuting to work/school and accordingly reduce the amount of time lost due to additional time budgeted for uncertainty.

RÉSUMÉ

Le temps pour les déplacements quotidiens n'est pas toujours fiable, les individus doivent souvent prévoir du temps supplémentaire afin de veiller à ce qu'ils arrivent à l'heure à leur destination. Ce temps additionnel alloué aux déplacements réduit inutilement le temps disponible que ces individus auraient pu consacrer ailleurs. Cette étude examine le temps supplémentaire que les voyageurs allouent pour tenir compte du temps de transport peu fiable et présente les résultats en utilisant des séries de modèles de régression log-linéaire. Les données aux fins de cette étude proviennent du « 2013 McGill Commuter Survey », un sondage à l'échelle de l'université, dans lequel les étudiants, le personnel et les enseignants décrivent leur expérience de déplacement quotidien typique à l'université McGill, situé à Montréal, Canada. Les résultats dévoilent que les automobilistes allouent le plus de temps supplémentaire pour leurs déplacements, alors que les voyageurs utilisant d'autres moyens de transports allouent de 29 à 66% moins de temps supplémentaires que les automobilistes. Les résultats de cette étude révèlent aussi que les usagers d'autobus ajoutent 14% de plus de temps de réserve par bus, alors que les usagers de trains allouent 11% de moins de temps pour chaque train. Ces résultats démontrent donc que la perception du réseau routier est que celui-ci n'est pas fiable (en autobus, autant qu'en automobile). La ville devrait donc considérer l'implémentation de stratégies tel que des voies réservées exclusivement aux autobus et une redevance variable de congestion afin de réduire l'incertitude du temps de déplacement et ainsi améliorer la fiabilité du réseau routier. De telles stratégies peuvent réduire le niveau d'incertitude relié au déplacement au travail/à l'école et en conséquence, réduire le temps perdu à cause du temps supplémentaires prévu pour les incertitudes.

INTRODUCTION

Although prior experience helps individuals anticipate events that may arise during their commute, there is always a degree of uncertainty in the travel duration and ultimately arrival time at destinations. In Montreal, Canada, the most recent census statistics show an average commuting time of nearly 30 minutes (Statistics Canada, 2013b). Within the population, however, 24% spend more than 45 minutes commuting. Additionally, based on a 30-minute car commute in Montreal, a driver is expected to experience 21 minutes of delay, which is equivalent to 79 hours per year (TomTom International BV, 2015). If transportation planners and policy makers understand how commuters respond to travel time uncertainty, they can generate appropriate performance indicators to evaluate transportation networks as well as implement policies that effectively improve the travel experience of residents and reduce lost time that people add to their commute due to uncertainty.

When faced with uncertainty in travel time, researchers have found that commuters adjust their departure time by leaving early (Gaver, 1968; Knight, 1974; Noland & Small, 1995; Small, 1982), altering travel routes (Abdel-Aty, Kitamura, & Jovanis, 1997; Jackson & Jucker, 1982; Tilahun & Levinson, 2010) and/or switching their transportation mode (Bhat & Sardesai, 2006; Prashker, 1979). While there are three distinct strategies to mitigate the risk of travel time unreliability, this paper focuses specifically on the first method of adjusting departure time to allocate extra travel time, thereby minimizing the consequences of variability in travel duration. Though many previous studies have relied on stated-preference experiments to determine individuals' behavioural reactions to travel time variability in hypothetical scenarios (Asensio & Matas, 2008; Hollander, 2006; Small, Noland, Chu, & Lewis, 1999), few have studied this topic using data from real-life situations with a comparison across different modes.

This study uses empirical data from a university travel survey to quantify how much extra time commuters allocate to buffer against unexpected circumstances and delays. Based on their typical commuting patterns to McGill University, respondents reported the number of additional minutes they budget to ensure that they arrive at their destination on time. The objective of this study is to investigate the relationship between the variation of travel time contingency and the characteristics of the commute across different modes.

The paper begins with a review of existing literature about travel time reliability, and continues with descriptions of the data and methods used in this study. The results of the log-linear regression models are then presented and discussed. Finally, the paper concludes with recommendations for policy and future research.

LITERATURE REVIEW

What is Travel Time Reliability?

Travel time reliability, a dimension of network reliability, is defined as the consistency of travel duration between an origin and destination or the probability that a trip between two specific locations in a network can occur within a quantified time frame (Emam & Al-Deek, 2006; Lyman & Bertini, 2008; van Lint & van Zuylen, 2005). In other words, transportation networks with high travel time reliability have low travel time variability. Sources of variations in travel time, as proposed by Wong and Sussman (1973), include (a) predictable variations between time of day, different seasons, and days of week, (b) unpredictable variations due to network interruptions such as accidents, and other (c) random minor variations occurring, for example, due to the synchronization of traffic lights. Related to Wong and Sussman (1973)'s sources of predictable variations, A. Nicholson and Du (1997) suggested that variations in travel time can also result from fluctuations in the demand and supply of the system. For instance, in a public transit network, both the frequency of service and the number of passengers boarding and alighting, which typically differ based on time of day and day of the week, have an effect on the travel duration that an individual experiences. As commuters become familiar with their commuting trips, it is expected that they are able to foresee and adjust for predictable variations such as peak-hour congestion (Schönfelder & Axhausen, 2012). Contrastingly, unpredictable variations (network interruptions) such as car accidents and human-caused delays (e.g. metro riders keeping the doors open, personal belongings falling onto the track), are more difficult to account for (Carrion & Levinson, 2012), and are what characterizes travel time reliability of transportation networks (Bates, Polak, Jones, & Cook, 2001). It is important to maintain high travel time reliability of networks, as studies have shown that costs associated to uncertainty in travel time (described in the next section) can trigger changes in travel behaviour (Carrion & Levinson, 2012; Hollander, 2009; Li, Hensher, & Rose, 2010). People account for travel time unreliability by adding more time to their commute to ensure on-time arrival at a destination. This additional time is discussed in more detail in the following section.

What are the Impacts of Unreliable Travel Time? How Do Individuals Respond?

Unreliable travel time results in a mismatch in the desired arrival time and the actual arrival time, and real consequences may affect commuters with temporal restrictions more severely (Mannering, Abu-Eisheh, & Arnadottir, 1990; Noland & Small, 1995; Noland et al., 1998; Small, 1982). Individuals may experience extended waiting times, miss a connection, have difficulty in finding comfortable seating, or face penalties associated to being late for work (Bates et al., 2001). In addition to these consequences, there is an inherent cost related to travel time uncertainty itself; travel time unreliability may cause individuals to experience heightened levels of anxiety or stress as well as dissatisfaction with the transportation system they are using (Bhat & Sardesai, 2006; Cantwell, Caufield, & O'Mahony, 2009). Undoubtedly, individuals traveling on trips with temporal constraints value travel time reliability highly (Concas & Kolpakov, 2009).

Gaver (1968), one of the pioneers in this growing field of research, proposed a theoretical framework in which individuals would start their trip at an earlier time to accommodate travel time variability. Knight (1974) followed with his hypothesis of a "safety margin" which commuters allocate to reduce their probability of arriving late to work. The underlying assumption in these studies is that early arrivals are preferable over late arrivals. In a more recent study, Noland et al. (1998) used data from a stated-preference survey to evaluate how travel time unreliability influences departure time choice for drivers. They found that increased travel time variability resulted in earlier departures, confirming findings from previous studies.

Stated-preference surveys have also been used to investigate the impact of travel time unreliability on route choices. In their analysis, Jackson and Jucker (1982) found that commuters prefer the route with higher travel time consistency, even if total journey time is greater than a shorter route with more variability. Furthermore, Abdel-Aty et al. (1997) found that the availability of traffic information has the potential in influencing drivers to choose an alternative route. Similarly, Brownstone et al. (2003) evaluated revealed-preference data from the San Diego I-15 congestion-pricing project and found that drivers increased their usage of the toll facility when the prices were highest to reduce travel time. Based on their results, they concluded that drivers are anxious about unanticipated travel delays and used the posted prices as indicators of abnormal delays in traffic.

Fewer studies have explored the relationship between travel time unreliability and mode choice. Nevertheless, Prashker (1979) found that car users had less tolerance for waiting time unreliability than transit users, suggesting that satisfaction of reliability is related to the modal choice of individuals. Accordingly, Bhat and Sardesai (2006) also recommended that travel time reliability be included as an important performance measure of transportation services as it significantly impacts the level of usage by commuters.

How to Measure Travel Time Reliability?

An abundance of research has emerged, providing an assortment of mathematical calculations to calculate travel time reliability; however, there is no consensus within the transportation profession as to what the appropriate measures should be (Carrion & Levinson, 2012; Kuhn et al., 2014). Here, we briefly explain an example of a simple measure that is most relevant to our study.

The buffer index is analogous to the concept of a "safety margin" presented by Knight (1974), referring to the extra time people add to their average travel duration to reduce the effects of unexpected delays and to ensure prompt arrival at their destination. The buffer index is calculated as the difference between the 95th percentile of travel time and the average (mean or median) travel time, divided by the average travel time; it is conveyed as a percentage in which travel time reliability decreases with higher values (Kuhn et al., 2014). For example, a buffer index of 30% would indicate that the commuter should allocate 9 additional minutes for a 30-minute trip, whereas a buffer index of 40% would indicate that an allocation of 12 additional minutes for travel is recommended. Typically, these types of measures, which are mode specific, require day-to-day data in order in capture the daily variations in travel time, and can be used to evaluate the effectiveness of policies (Kuhn et al., 2014). For instance, Chen, Skabardonis, and Varaiya (2004) assessed the impacts of using real-time information instead of historical data to alert drivers of traffic conditions at five locations on San Diego freeways and found reductions of buffer time ranging from 7% to 31%.

Due to the data requirements, these measures are inappropriate for this study as each observation in our dataset is a unique trip with a distinct origin and destination. However, since our data is based on our respondents' typical commute, we can assume that their behaviour has been adjusted according to their prior experience. Furthermore, although we cannot compute buffer indexes for each network, we can compare the reported travel duration to the reported additional budgeted time to determine the travel time reliability of the networks. To the authors' knowledge, no studies evaluating travel time reliability have measured additional budgeted time using commuters' revealed behaviour, while comparing across modes.

METHODOLOGY

Survey

This study uses data from the 2013 McGill Commuter Survey (Appendix), a university-wide travel survey. The survey targeted students, staff and faculty and was administered online during March and April 2013. In total, 20,851 members of the McGill University community were randomly selected to partake in the survey and were sent invitation emails. Respondents had a period of thirty-five days to complete the online survey, and prizes were offered as incentives for participation. The response rate of the survey was 32%, which is comparable to earlier surveys conducted at North American universities (Redmond & Mokhtarian, 2001; Whalen et al., 2013). Incomplete and unreasonable responses were eliminated from the database, leaving 5,599 records. In the survey, respondents recorded details about their typical commute from their home location to McGill University for a cold and snowy day, and likewise for a warm and dry day, answering questions regarding each aspect of their daily commute, including duration, satisfaction with service quality, and mode. The respondents also reported their socio-demographic information, travel preferences, and personal attitudes toward the commute (Shaw et al., 2013).

Study Sample

After removing additional records due to illogical responses (such as drivers without driver's licenses), the final number of observations for the study sample is 2,496, comprising of 46% students, 32% staff and 22% faculty, and a mode split of 16% drivers, 54% transit users, 6% cyclists and 24% pedestrians. The final sample consists of respondents whose travel destination is within McGill University's

Downtown Campus, but does not include individuals travelling to McGill University's suburban Macdonald Campus as the traffic patterns and levels of public transit services available are very different.

In this study, drivers, cyclists, and pedestrians are single-mode users, while transit users may have used multiple modes of transit (bus, metro or train), in addition to walking to and from their transit stops. All respondents travelled directly from their home location to McGill University without making any stops at other destinations such as to drop off their children or to purchase a meal. The study sample does not include commuters who carpooled as car passengers or used the private university shuttle bus, which offers transportation service between the two McGill University campuses, due to the small number of observations. Travel duration is calculated using the summation of reported times of all trip legs. This includes, for example, the time that an individual spent waiting for his or her bus, as well as transferring from the bus to the metro. In order to eliminate extreme travel times, the top 1% of reported travel duration for each mode was removed.

The survey asked respondents to rate the importance of various home selection variables with regard to choosing their current residence as well as the satisfaction with the modes they used. A series of statements was presented to the survey respondents, who used a 5-point Likert scale ("1" = strongly disagree and "5" = strongly agree) to indicate their level of accordance. To ensure that the impact of these variables can be evaluated appropriately, records of respondents who did not provide an answer or stated that they had no opinion were removed. In the survey, respondents also described details of their usual commute for two different weather conditions (a cold snowy day and a warm and dry day). For each individual, we randomly selected one of these conditions so that each individual is linked to only a single weather condition.

Table 4 presents summary statistics of the population sample by mode of transportation, showing variables that will be tested across all models in the next section. A brief assessment of the data reveals that 82% of drivers are McGill staff and faculty, resulting in an average age of 47 years and an average of 14 years at McGill. Pedestrians, on the other hand, are mostly students (72%) and thereby have a lower average age of 30 years. Among the different groups of commuters, pedestrians have spent the least number of years at McGill (mean of 5 years). As expected, cyclists and pedestrians place the highest value on living in proximity to the university and not having to drive.

The average commuters travel to McGill University about 18 days a month, equivalent to four to five days per week. In general, these trips are not stressful (mean of 2.75 out of 5), nor do they negatively impact punctuality (mean of 2.71 out of 5). Overall, commuters are satisfied with the mode(s) they use (mean of 3.98 out of 5). Yet, cyclists are the only group that would like to use their mode more (mean of 3.76 of 5), while drivers are the most inclined to feel that the only good thing about travelling is reaching the destination (mean of 3.12 of 5).

TABLE 4: SUMMARY STATISTICS – MEAN OF VARIABLES

	GENERAL	CYCLE	DRIVE	TRANSIT	WALK
Sample size	2496	150	401	1352	593
PERSONAL CHARACTERISTICS					
Age	37.76	34.97	47.32	38.47	30.40
Female	0.58	0.51	0.49	0.61	0.58
Income (0-10)	1.74	1.75	3.35	1.58	1.02
Student	0.46	0.52	0.18	0.42	0.72
Staff	0.32	0.25	0.32	0.40	0.14
Faculty	0.22	0.23	0.50	0.18	0.14
Years at McGill	8.52	6.43	14.25	8.52	5.18
TRIP CHARACTERISTICS					
Warm, dry day	0.37	0.82	0.37	0.32	0.36
Stress (1–5)	2.75	2.05	3.00	2.83	2.59
Trip frequency (days per month)	18.00	18.19	14.89	17.87	20.39
TIME					
Duration (minutes)	33.80	24.01	31.85	42.19	18.44
Additional budgeted time (minutes)	15.29	10.01	19.92	17.40	8.67
My commute negatively impacts my punctuality (1–5)	2.71	1.77	2.66	2.91	2.53
MODE SATISFACTION					
Overall satisfaction (1–5)	3.98	3.96	3.86	3.93	4.18
The only good thing about travelling is arriving at my destination (1–5)	2.87	2.33	3.12	2.97	2.59
HOME SELECTION					
Importance of following factors in selecting current home:					
Proximity to McGill (1–5)	3.44	3.83	3.09	3.07	4.43
Proximity to transit (1–5)	4.09	4.33	3.47	4.36	3.85
Cost of commuting (1–5)	3.28	3.29	3.06	3.33	3.31
Not having to drive (1–5)	3.68	4.33	2.69	3.65	4.24
MODE					
Cycle	0.06	na	na	na	na
Drive	0.16	na	na	na	na
Transit	0.54	na	na	na	na
Walk	0.24	na	na	na	na
Would like to use this mode more (1–5)	2.43	3.76	2.21	2.09	3.03

na "not applicable"

With regard to travel duration, pedestrians experience the shortest commute (mean of 18 minutes), and budget the least additional time (mean of 9 minutes). On the other hand, transit users travel the longest (mean of 42 minutes), and budget an average of 17 additional minutes of travel time for their commute, indicating a total travel time budget of 59 minutes. Drivers travel for an average of 32 minutes, but allocate the most additional time for their trips (mean of 20 minutes). Meanwhile, cyclists on average have a commute of 24 minutes, but budget 15 minutes extra. However, if we try to estimate the buffer index by taking the amount of additional budgeted time as a percentage of average travel duration, cyclists are shown to have the least reliable network (64%). They are followed closely by drivers (63%), then pedestrians (47%), and lastly, transit users (41%). It is important to remember, however, that these percentages do not offer insight into the factors underlying these travel budgets. Accordingly the use of such index might not be the best way to compare network reliability of different modes. Figure 3 compares the average travel duration to the average additional budgeted time across all modes. A series of t-tests and chi-square tests confirm that there are statistically significant differences between additional budgeted times across modes.

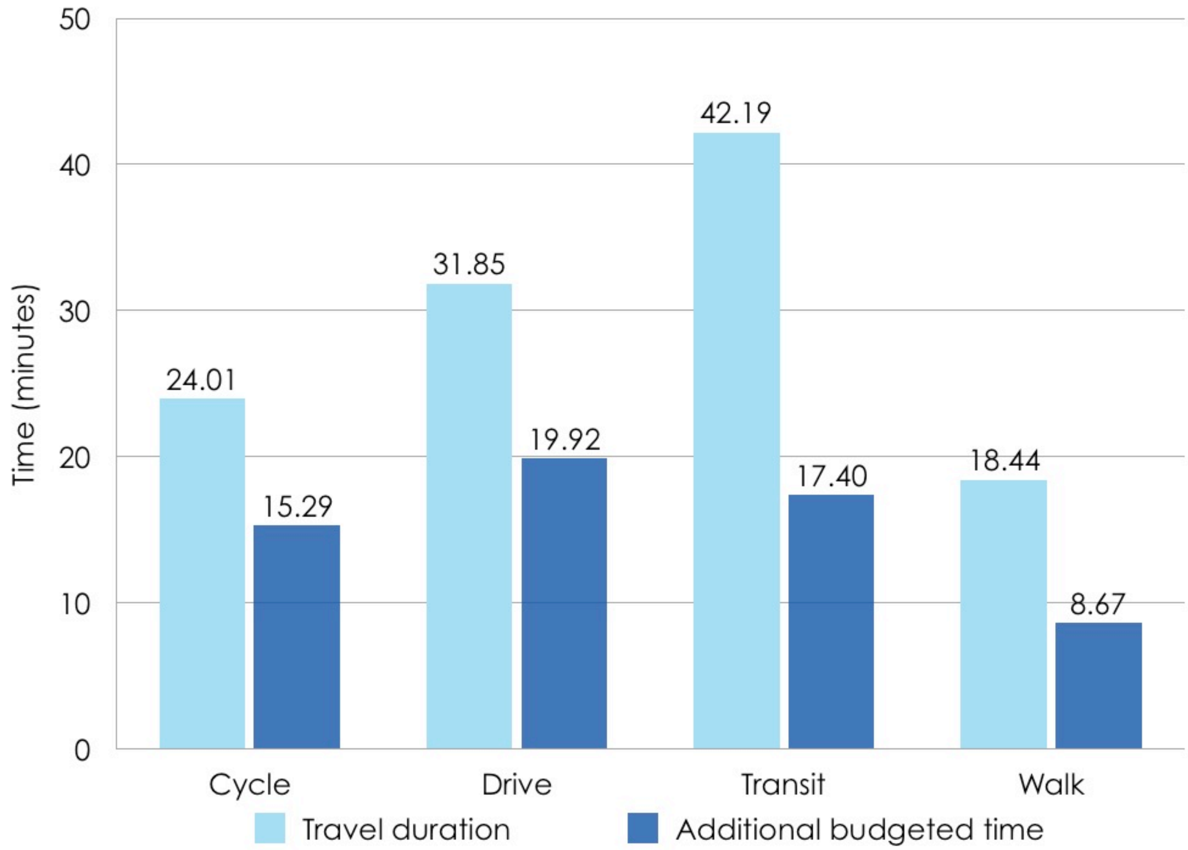

FIGURE 3: Average travel duration and additional budgeted time by travel mode.

Method

This study develops five log-linear regression models (one general model and four mode-specific models) in order to investigate the relationship between how much extra travel time individuals budget for their commute and the different commuting characteristics. Based on the results of the Shapiro-Francia test, we rejected the hypothesis of data normality and used Tukey's ladder of powers to determine that a log-transformation of the dependent variable would most significantly improve normality conditions for modeling. Additionally, respondents within the top and bottom 1% of reported additional budgeted time were discarded to further enhance data normality.

Based on the literature review, commuting stress and non-punctuality are included in the models below as consequences of travel time unreliability. Predictable variations due to seasonality are controlled for by using a dummy variable indicating weather condition, while trip frequency and years at McGill are used as proxies for familiarity with the commute. Travel duration, home selection and personal characteristic variables listed in Table 3 were tested across the five models, but the final models retain only variables that were theoretically relevant and statistically significant.

In the general model, dummy variables denote which mode the commuter used, while the transit model contains additional variables indicating the number of buses, metros and trains the individual took during the trip to account for the impacts of transfer times across modes. Overall mode satisfaction was tested across all models but did not show statistical significance, except in the general model. However, the four mode-specific models also include other variables pertaining to the specific mode.

Since some of the data were collected as ordinal responses, we can neither assume that each survey respondent interpreted the scale in the same manner, nor can we assess whether the differences between each level are the same. Consequently, we have transformed the ordinal variables into binary variables by recoding "1" and "2" as "low", "3" as "medium" and "4 and "5" as "high". In order words, rather than having one ordinal variable (e.g. "Stress"), we now have three dummy variables (e.g. "Stress – Low", "Stress – Medium", and "Stress – High"). Transformation of the ordinal variables will also aid in the interpretation of results.

RESULTS AND DISCUSSION

Table 5 presents the results of the log-linear regression models, which predict how much time contingency an individual provides for his or her commute. Since the factors are generally consistent across all models, this section discusses the results of all of the models simultaneously but emphasizes significances between the modes.

TABLE 5: LOG-LINEAR REGRESSION RESULTS FOR ADDITIONAL BUDGETED TIME

	GENERAL Coefficient (90% CI)	**CYCLE** Coefficient (90% CI)	**DRIVE** Coefficient (90% CI)	**TRANSIT** Coefficient (90% CI)	**WALK** Coefficient (90% CI)
PERSONAL CHARACTERISTICS					
Age (years * 10^{-1})	0.03*** (0.01 – 0.05)	0.08 (-0.03 – 0.20)	0.06* (0.01 – 0.11)	0.01 (-0.02 – 0.04)	0.06* (0.01 – 0.11)
Female	0.10*** (0.06 – 0.15)	0.21** (0.04 – 0.37)	0.14** (0.05 – 0.23)	0.09*** (0.03 – 0.15)	0.10* (0.03 – 0.20)
Income ($0 – $19,999)	0.06 (-0.03 – 0.15)	-0.37 (-0.76 – 0.02)	0.11 (-0.03 – 0.24)	0.14 (-0.01 – 0.28)	–
($20,000 – $79,999)	0.09* (0.01 – 0.18)	-0.34* (-0.68 – -0.01)	0.16** (0.03 – 0.30)	0.16* (0.02 – 0.29)	–
($80,000 – $119,999)	0.07 (-0.02 – 0.17)	-0.25 (-0.64 – 0.14)	0.13 (-0.02 – 0.28)	0.16* (0.01 – 0.32)	–
($120,000 +)	v	v	v	v	–
Years at McGill (years * 10^{-1})	-0.02 (-0.05 – 0.01)	-0.14* (-0.27 – -0.01)	-0.05 (-0.10 – 0.01)	-0.01 (-0.04 – 0.04)	-0.08* (-0.16 – -0.01)
TRIP CHARACTERISTICS					
Warm, dry day	-0.06** (-0.10 – -0.02)	-0.07 (-0.31 – 0.18)	0.03 (-0.07 – 0.12)	-0.11*** (-0.17 – -0.05)	-0.02 (-0.11 – 0.07)
Stress (High)	0.08** (0.03 – 0.14)	–	0.14** (0.04 – 0.24)	0.11*** (0.05 – 0.17)	0.18** (0.08 – 0.27)
(Low)	-0.07* (-0.13 – -0.01)	-0.21* (-0.40 – -0.03)	–	–	–
Trip frequency (% of days per month)	-0.12** (-0.20 – -0.03)	-0.07 (-0.43 – 0.29)	-0.06 (-0.21 – 0.11)	-0.13* (-0.25 – 0.01)	–
TIME					
Duration (minutes * 10^{-1})	0.13*** (0.11 – 0.14)	0.24*** (0.17 – 0.32)	0.15*** (0.12 – 0.18)	0.09*** (0.08 – 0.11)	0.26*** (0.22 – 0.29)
My commute negatively impacts my punctuality (Low)	-0.13*** (-0.18 – -0.08)	-0.22* (-0.44 – -0.08)	-0.02 (-0.12 – 0.08)	-0.16*** (-0.23 – -0.10)	-0.14** (-0.24 – -0.05)
MODE SATISFACTION					
Overall satisfaction (High)	-0.06** (-0.11 – -0.02)	–	–	–	–
Consistent travel time (High)	na	–	-0.12* (-0.22 – -0.01)	–	na
Reasonable waiting time (Low)	na	na	na	0.19*** (0.12 –0.26)	na

HOME SELECTION	**GENERAL** Coefficient (90% CI)	**CYCLE** Coefficient (90% CI)	**DRIVE** Coefficient (90% CI)	**TRANSIT** Coefficient (90% CI)	**WALK** Coefficient (90% CI)
Importance of following factors in selecting current home:					
Proximity to McGill (High)	–	0.20* (0.02 – 0.38)	–	–	-0.04 (-0.17 – 0.08)
Proximity to transit (High)	–	–	-0.12** (-0.22 – -0.03)	-0.10* (-0.19 – -0.01)	–
Cost of commuting (High)	0.05* (0.01 – 0.09)	–	–	0.09** (0.03 – 0.15)	–
Not having to drive (High)	-0.05* (-0.10 – -0.01)	–	–	-0.11*** (-0.17 – -0.04)	–
MODE					
Cycle	-0.55*** (-0.66 – -0.44)	na	na	na	na
Transit	-0.29*** (-0.35 – -0.22)	na	na	na	na
Walk	-0.66*** (-0.73 – -0.58)	na	na	na	na
Compared to: Drive	v	na	na	na	na
Number of buses	na	na	na	0.14*** (0.08 – 0.20)	na
Number of metros	na	na	na	0.04 (-0.04 – 0.11)	na
Number of trains	na	na	na	-0.11* (-0.21 – -0.01)	na
Would like to use this mode more (High)	0.11*** (0.05 – 0.17)	0.18* (0.01 – 0.37)	0.06 (-0.15 – 0.27)	0.04 (-0.06 – 0.15)	0.17*** (0.08 – 0.25)
Constant	2.33*** (2.18 – 2.49)	1.64*** (0.94 – 2.36)	2.06*** (1.77 – 2.35)	2.12*** (1.89 – 2.36)	1.26*** (1.06 – 1.45)
n	2496	150	401	1352	593
R^2	0.35	0.32	0.29	0.21	0.24
Adjusted R^2	0.35	0.25	0.26	0.20	0.23

* *p <0.10, ** p <0.05, *** p <0.01, – "found to be insignificant and removed", na "not applicable", v "comparison variable,*

Travel mode is the greatest determinant of how much additional time an individual allocates for his or her commute. The general model estimates that holding all else equal, pedestrians, cyclists and transit users budget 66%, 55% and 29% less additional time respectively, as compared to drivers. This suggests that active transportation networks have greater travel time reliability than the street network for drivers. Looking more closely at the transit model, it is apparent that there are great differences in reliability between the bus, metro and commuter train networks. For each bus an individual takes, he or she is predicted to budget 14% more additional time and for every metro line, 4%. On the other hand, for every commuter train an individual takes, he or she is predicted to budget 11% less additional time. A possible interpretation of these figures is a perception that the commuter train network in Montreal is reliable, while the bus network is perceived to have frequent problems with consistency due to congestion or bus-bunching. Taken together with the finding that drivers allocate the largest amount of time strongly suggests that Montreal has a reliability issue with its street network as users who commute on the street network allocate the highest amount of extra time compared to other modes. Potential strategies to improve the reliability of the network could include the presence of exclusive bus lanes for buses as well as HOT lanes for cars or schemes of congestion charging with variable costs to attenuate on-street congestion, particularly at peak hours. All these strategies can help in reducing the uncertainty in the network usage and lead to a decline in the buffer time, which drivers and bus users add to their daily commute.

Travel duration has the second strongest influence on the amount of additional budgeted time. Travel distance was tested in the models but due to its high correlation with travel duration (Pearson's correlation coefficient = 0.73), only one of the two variables can be included. Since travel duration proved to be a stronger determinant than travel distance in the models, travel duration is used. The models predict an increase of 26%, 24%, 9% and 15% of extra buffer time for every ten minutes in travel duration for pedestrians, cyclists, transit users and drivers, respectively. The idea that pedestrians and cyclists would add the greatest percentage of additional budgeted time per unit of travel duration, while drivers would add the least can seem counterintuitive. However, this may signify that the design of the street network in Montreal is inefficient for pedestrians and cyclists, more so than for motorized vehicles. For example, depending on the location, the street network may offer more direct routes for drivers compared to cyclists and pedestrians who may be required to make a detour. If so, further investigation is required to understand the source of the network inefficiency for cyclists and pedestrians. Also, due to the nature of these modes, trip duration is much shorter for pedestrians and cyclists compared to that for drivers or transit users (as observed previously in Table 3 and Figure 3). Consequently, an addition of one minute allotted by pedestrians or cyclists appears to be much more than an addition of one minute allotted by drivers or transit users. Hence, further investigation is needed to better understand the additional time added for these modes.

Pedestrians, transit users and drivers who reported high levels of stress have 18%, 11%, and 14% larger buffer times respectively while high levels of stress were not statistically significant in impacting cyclists' buffer times. Yet, cyclists who reported low levels of stress have a 21% smaller buffer time. Likewise, pedestrians, cyclists, transit users, and drivers who do not perceive that their commute has a negative effect on their punctuality allocate 14%, 22% and 16% and 2% less in their additional budgeted time. Interestingly, those who enjoy travelling with a particular mode also assign extra time in their commute. The general model predicts an increase of 11% of additional budgeted time for those who would like to use their mode more, while the models for pedestrians and cyclists predict increases of 17% and 18%. Although not statistically significant, the models also predict an increase of 4% in additional budgeted time for transit users, and 6% for driver. On the other hand, the variable indicating that arriving at the destination is the only good thing about travelling was found non-significant across all models. These results are important to note because they indicate that travel time reliability is not the only consideration individuals have when deciding on departure time, and reflects similar findings from other research. For example, Manaugh and El-Geneidy (2013) found that certain groups of pedestrians, such as those who are eco-conscious and value being physically active, are much more satisfied with their commute despite travelling longer distances than other pedestrians.

Factors that are estimated to reduce time contingency include greater trip frequency, more years spent at McGill, good weather and increased mode satisfaction. The models indicate that greater trip frequency (the number of times a person is on campus per month) would lead to a reduction of additional budgeted time of 7%, 13% and 6% for cyclists, transit users and drivers. Likewise, the models also indicate a reduction of buffer time by 8%, 14%, 1% and 5% for pedestrians, cyclists, transit users and drivers for every 10 years spent at McGill.

This implies that familiarity with the commute allows individuals to decrease their buffer time, likely due to a better understanding of the sources of variations in their trip, such as the magnitude of peak-hour congestion and how long it takes to reach the bus stop. Increased familiarity of the commute may also indirectly decrease the amount of additional budgeted time through the reduction of commuting stress. Ory et al. (2004) and Legrain et al. (2015) proposed similar explanations of commuters being able to cultivate stress-coping strategies as they become more familiar with the commuting environment.

Good weather, in general, is shown to reduce additional budgeted time for a commute. While the models predict a reduction in allocated extra time of 2% for pedestrians and 7% for cyclists, the impact of good weather is most pronounced and only statistically significant for transit users, predicting a decrease in buffer time by 11%. This could imply that among the different transportation networks, the stability of the public transportation network is the most affected by weather conditions. Surprisingly, weather does not have a significant impact on the additional budgeted time for drivers, even though driving conditions during winter in Montreal are notoriously harsh. In fact, the models estimate a 3% increase in additional budgeted time. This could, however, be due to the intensity of road construction and thereby numerous road closures that take place in Montreal during the warmer months of the year.

The models also estimate a decrease in time contingency due to increased mode satisfaction; high overall mode satisfaction is predicted to result in a 6% reduction in additional budgeted time. More specifically, drivers highly satisfied with their travel time consistency are estimated to decrease additional budgeted time by 12%, while public transit users highly satisfied with their waiting time decrease additional budgeted time by 19%. This suggests that drivers are sensitive to unexpected network disruptions, while reasonable waiting time is important to public transit users. These findings agree with those of Brownstone et al. (2003) where they suggested that drivers dislike unexpected congestion, and those of Prashker (1979), who predicted that transit users value out-of-vehicle travel time reliability more than in-vehicle travel time reliability. While extended waiting times for the metro and commuter train network are typically limited to system breakdowns and human-caused delays, prolonged waiting times for buses are usually related to congestion on the street network. This is further evidence pointing to low travel time reliability of the street network in Montreal.

Other mode-specific variables were tested but proved to be non-significant. These variables include satisfaction of travel time, comfort, safety from traffic, and safety from crime for pedestrians. For cyclists, the evaluated variables were satisfaction of travel time, consistency of time, comfort, safety from traffic, safety from crime and quality of cycling infrastructure. For drivers, satisfaction of travel time, comfort, safety from traffic, safety from crime and cost of commuting were tested. Lastly, non-significant variables for transit users that were tested consisted of satisfaction of travel time, consistency of time, comfort, safety from crime, cost of commuting, time it takes to reach the bus stop/metro station/train station, reasonable waiting time as well as the ease of understanding information regarding public transit services. While real-time information can impact travel decisions (Abdel-Aty et al., 1997; Brownstone et al., 2003), a possible reason that the variable regarding understandability of information was not significant in the model is because presently, real-time information is limited to the metro network. Information about the bus network is disseminated through static schedules, which are updated every few months. However, this may soon be changing due to improved technology and access to smartphone applications.

Lastly, the models include control variables for variation between individuals. In terms of personal characteristics, age, gender, income and status at McGill (faculty, staff or student) were tested. However, status at McGill was insignificant across all modes and hence, dropped from the models. For every 10 years of age, the models predict an increased allocation of extra time of 6%, 8%, 1% and 6% for pedestrians, cyclists, transit users and drivers respectively. While income affects the amount of additional budgeted time differently per mode, in general, individuals within the \$0 – \$19,999, \$20,000 – \$79,999, and \$80,000 – \$119,999 income brackets budget 6%, 9% and 7% respectively more time in comparison to individuals earning more than \$120,000. The varied results could be due to the different value of travel time for each group; however, this is beyond the scope of this paper. The models also suggest that females add more extra time than men do. More specifically, female pedestrians, cyclists, transit users, and drivers correspondingly add 10%, 21%, 9%, and 14% more extra time compared to their male counterparts. This finding is expected as females generally have higher risk aversion than males (Eckel & Grossman, 2008). A number of home selection variables were also tested in the different models. According to the general model, those who placed high importance on the cost of commuting budget 5% more buffer time, and those who placed high importance on not needing to drive budget 5% less. Pedestrians who highly valued living near the university campus allocate 4% less additional time, whereas cyclists are predicted to budget 20% more. Drivers who chose their current home based on its proximity to transit budget 12% less additional time. Finally, transit users who placed high value on living in proximity to transit and not having to drive reduce their additional time budgeted by 10% and 11% respectively, while transit users who placed importance on the cost of commuting add 9%. Although there are variations in the magnitude of the impact of home self-selection variables, the general trend observed is that living in proximity to transit and not having to drive reduce additional budgeted time, while individuals concerned about the cost of commuting make a trade-off by increasing their travel buffer time. It is uncertain, however, as to why being close to the university would encourage cyclists to add extra time contingency and reduce that of pedestrians. Perhaps, the perception of cyclists aligns more closely to drivers than to pedestrians; it is possible that the difficulty of navigating around road construction and obstacles faced by cyclists outweighs the advantage of being near the university, which pedestrians enjoy.

Sensitivity Analysis

To better illustrate the findings of the regression models, we performed a sensitivity analysis. First, the general model was used to determine the effect of mode choice on additional budgeted time for a 23-year-old female student with no income who travels 30 minutes to McGill University five days a week. The model predicted that the student would budget 9.5 extra minutes, 16.5 extra minutes, 12.3 extra minutes, and 8.5 extra minutes if she were to cycle, drive, take public transit or walk, respectively. Hence, given the same travel time, there would be a difference of 8 minutes in additional time budgeted if the student were to drive compared to if she were to walk. While maintaining the same travel time across different transportation modes is unrealistic given the same origin-destination pair, it is a necessary proposition to isolate the effects of mode choice. Second, we used the transit model to determine how taking the bus, metro and train affect the predicted buffer time. Keeping the same personal characteristics as above, we estimated the additional budgeted time for a 30-minute commute consisting of a) one bus, b) two buses, c) one metro, d) one bus and one metro, e) one train, and f) one train and one metro. In the same order, the model predicts buffer times of a) 13.2 minutes, b) 15.2 minutes, c) 11.9 minutes, d) 13.7 minutes, e) 10.3 minutes and f) 10.4 minutes. Again, while it is unlikely that the various travel patterns all have the same travel duration, it is essential to keep that assumption in order to segregate the effects of the bus, metro and train. Also, even though we did not test all the possible combinations, the combinations listed above represent 95% of the public transit travel patterns found in our sample. Thus, it can be seen that bus users budget the most additional time among transit users.

Next, we analyzed the effects of travel duration. We used the general model and applied different travel durations (15 minutes, 30 minutes, 45 minutes) across the different modes for the same hypothetical individual. For cycling, the model predicts additional budgeted times of 7.8 minutes, 9.5 minutes, and 11.6 minutes. For driving, the model predicts 13.6 minutes, 16.5 minutes, and 20.1 minutes, which are the highest among all the modes. If the individual were to use public transit, the model predicts that she would budget 10.2 minutes, 12.3 minutes, and 15.0 minutes of additional time. Finally, the model also predicts buffer times of 7.0 minutes, 8.5 minutes, and 10.4 minutes if the individual were to walk. It is apparent that there is a positive association between travel duration and additional budgeted time, and that the effect of travel duration differs across modes.

LIMITATIONS

This study investigates the relationship between the amount of additional budgeted time individuals allocate for their commute and characteristics of the commute, with an underlying assumption that arriving to work or school on time is desirable. Realistically, however, the importance of being punctual differs among individuals and may be influenced by cultural norms. Hence, future studies should take into account the attitudes of individuals toward the importance of being punctual, as this will have a direct impact on how much extra time he or she decides to budget for the commute. Another limitation of this study is the lack of variation in trip patterns. Since no respondents in the study sample made any stops during their commute to McGill University, we were unable to validate the effects of trip chaining on the amount of additional budgeted time, a potential area of research. Furthermore, since this study uses a university-based sample, there may be biases in terms of flexibility of travel time and departure time compared to the general population. For example, most university students do not have the responsibility of taking dependents to daycare or school, and do not necessarily have to adhere to a strict schedule that dictates when they are required to be on campus. Thus, university students may tend to budget more additional time for their travels compared to someone who is constrained by a tight time budget. To overcome these shortcomings, future research should study samples that encompass a broader geographic context and greater demographic variations. In addition, a weakness in this study is its lack of mode-specific commuting attributes, apart from mode satisfaction. For instance, one would expect the availability and price of parking to have an effect on how much extra time a driver allocates for his commute (Arnott, de Palma, & Lindsey, 1991). A survey with a narrower focus on one mode may allow for more detailed questions regarding the commuting experience and thus, capture more attitudes, preferences and concerns.

CONCLUSION

In conclusion, the findings of this study reveal significant differences between additional budgeted times across modes, and this is most likely due to the nature of the different transportation networks and their respective travel time reliabilities. We find that, on average, pedestrians, cyclists, transit users and drivers respectively allocate 9, 15, 17 and 20 additional minutes for their commute to McGill University. These additional minutes are not a part of the actual trip duration; rather, they are unnecessary time lost due to travel time unreliability. From the results of the regression models, we determine that Montreal's street network has reliability issues, and that the city should consider implementing strategies such as exclusive bus lanes, and variable cost congestion price charging schemes to alleviate the uncertainty in travel time and improve the reliability of the network. The regression results also indicate inefficiencies in the pedestrian and cycling networks, despite having relatively high network reliabilities. Further investigation is required to determine the source of inefficiency and how to improve the networks so that less time will be lost to unnecessary travel time. Although the findings from this study are derived from a university survey, we expect similar findings among other groups in the region or even around the world. Transport engineers and planners have been working on reducing travel time for commuters across different modes to avoid time lost due to the commute. Findings from this study can help these engineers and planners in developing better policies and solutions that can reduce the amount of time lost by commuters in the form of buffer time.

CHAPTER 3

The path of least resistance: Identifying supporters of public and active transportation projects

ABSTRACT

Financing and implementing transportation projects are more likely to be successful when local communities are supportive of them. Hence, there is value in understanding current levels of local support and developing strategies that will improve public acceptability to reduce resistance to funding transportation investments. Based on this reasoning, this study uses a factor-cluster analysis to segment a university population in order to discern current levels of support toward transportation investments and to seek out important allies to endorse public and active transportation projects. The results of this study reveal five clusters of individuals with varying opinions toward transportation investments and distinct motivations: *strong advocates*, *highway / transit funders*, *cycling advocates*, *infrequent commuters* and *funding opponents*. In short, *strong advocates* seem to be the greatest allies for promoting public and active transportation investments. Not only do they support financing public and active transportation projects, but they also are well-positioned to endorse the necessity and advantages of such investments. *Highway / transit funders* are motivated by their dissatisfaction with the current transportation system, and hence, are essential to identifying specific areas where investments should be directed. *Cycling advocates* are valuable in publicizing the benefits of expanding the bicycle network as this study has found an overall lower level of support for improving and expanding the bicycle network. While *infrequent* *commuters* do not travel to the university as often as the other groups, they are generally supportive of transportation investments and do not discriminate between modes. Despite the overall positive opinion toward investing in public and active transportation projects, there is a minority of *funding opponents* who are against financing transportation projects. The existence of such clusters demonstrates that there are varying degrees of public acceptability, and thus policy makers should use a multifaceted approach to address the concerns of the different clusters.

RÉSUMÉ

Le financement et la mise en œuvre des projets de transport ont plus tendance à réussir lorsque les communautés locales sont favorables aux projets. Donc, il est important de comprendre les niveaux actuels de soutien local et d'élaborer des stratégies qui permettent d'améliorer le niveau de l'acceptabilité publique pour mener à moins de résistance pour financer les investissements dans le domaine du transport. Selon ce raisonnement, cette étude utilise l'analyse factorielle pour segmenter la population universitaire afin de discerner les niveaux actuels de soutien vers les investissements dans le domaine du transport et de rechercher les alliés important pour endosser les projets de transport publics et actifs. Les résultats de cette étude dévoilent cinq groupes d'individus ayant des opinions variés envers l'investissement dans le système de transport et ayant des motivations distincts : *d'ardents défenseurs*, *bailleurs de fonds pour le transit et l'autoroute*, *défenseurs du cyclisme*, *voyageurs peu fréquents*, et *opposants au financement*. En somme, les *ardents défenseurs* sont les plus grands alliés dans la promotion des investissements en transport public et actif. Les *bailleurs de fonds pour le transit et l'autoroute* sont motivés par leur insatisfaction envers le système de transport actuel, par conséquent, ils sont essentiels à l'identification de domaines spécifiques où les investissements devraient être dirigés. Les *défenseurs du cyclisme* sont importants afin de faire connaitre les avantages de développer le réseau du cyclisme puisque cette étude montre qu'il y a un niveau global moins élevé de support pour améliorer et accroitre le réseau du cyclisme. Bien que les *voyageurs peu fréquents* ne voyagent pas à l'université aussi souvent que les autres groupes, ils sont généralement en faveur des investissements dans le domaine du transport et ne font pas de discrimination entre les moyens. Malgré une opinion globale positive envers l'investissement pour les projets de transport public et actif, il y a tout de même une minorité d'*opposants au financement* qui sont contre le

financement de ces projets de transport. L’existence de ces groupes démontre qu’il y a divers degrés d’acceptation publique, et qu’ainsi, les décideurs politiques devraient utiliser une approche multidimensionnelle afin de répondre aux préoccupations de ces divers groupes.

INTRODUCTION

While the economic benefits of investing in transportation infrastructure are unquestionable, the transportation sector is often underfunded, putting a halt to necessary infrastructure maintenance and upgrades (Bipartisan Policy Center & Eno Center for Transportation, 2012; Dev Bhatta & Drennan, 2003; Goetz, 2011). Although agencies have developed alternative strategies to acquire additional funding, these initiatives frequently lack public acceptance and political will. For example, the results of the recent Metro Vancouver Transit Plebiscite have shown an overwhelming public resistance (62% in opposition) to introducing a 0.5% Metro Vancouver Congestion Improvement Tax, which would have been devoted to supporting the Mayors' Transportation and Transit Plan (Judd, 2015). While this plan mostly focused on improvements to the public transit system, it also included proposals to expand the bicycle network and to replace the 78-year-old Patullo Bridge, benefiting different types of travellers (Mayors' Council on Regional Transportation, 2015).

Public acceptability of funding initiatives and infrastructure improvement programs are not always easy to obtain. Yet, financing and implementing transportation projects typically have higher success rates when local communities are supportive of them (Banister, 2005; Page & Shapiro, 1983). With this in mind, the first objective of this study is, to measure the current level of support toward transportation infrastructure investment. The second objective, then, is to differentiate and identify population groups that would be important allies in promoting funding for public and active transportation infrastructure, as well as other groups who would require more persuasion to gain their support. This study uses empirical data from a university travel survey, in which respondents identified their level of support for using taxes to fund various transportation infrastructure investments. The underlying hypothesis of this study is that within the general population, there are different clusters of people with similar motivations and preferences, who will have similar opinions toward transportation investments. Hence, based on individuals' personal characteristics, commute experience and support for public and active transportation infrastructure investment, a factor-cluster analysis is conducted to identify and differentiate groups.

The paper begins with a review of current literature review on public acceptability of public and active transportation infrastructure investments. It then proceeds with descriptions of the data and methods used in this study. This is followed by a presentation and discussion of the resulting groups from the factor-cluster analysis. Lastly, the paper concludes with policy implications and proposed directions for future research.

LITERATURE REVIEW

The current literature on public opinion toward transportation infrastructure investments is limited. Existing studies focus on public acceptability of funding options and analyzing transportation ballot outcomes (Dixit, Rutstrom, Mard, & Zielske, 2010; Haas & Estrada, 2011; Hannay & Wachs, 2007). For example, Hannay and Wachs (2007) analyzed three local transportation sale tax elections in California and found that the closer the voters lived to proposed transportation projects, the more likely they would support the tax measures. The authors also found that income levels and political views influenced the level of support received. Haas and Estrada (2011), on the other hand, studied how the process leading up to the election ballot influenced the outcome. They concluded that public participation, public consensus of a congestion crisis and the presence of prominent advocates are important factors affecting referendum results.

Other existing research examines public opinion toward the allocation of funds to transportation infrastructure projects. For example, the Reason Foundation (2011) surveyed 1,200 Americans on transportation spending priorities. The results showed that 62% of the sample believed that the government should prioritize funding for road and highway projects, compared to 30% who believed that the government should prioritize funding for mass transit projects instead. However, the survey did not contain any questions regarding pedestrian and cycling infrastructure projects. More recently, Gase, Barragan, Simon, Jackson, and Kuo (2015) surveyed registered voters in Los Angeles County on the presence and importance of pedestrian and cycling infrastructure in their community, as well as their travel behaviour and preferences. Gase et al. (2015) found that the majority of the 1,005 participants viewed pedestrian, cycling and public transportation infrastructure as important and supported reallocating transportation funds to invest in active transportation infrastructure. The greatest support for pedestrian and cycling infrastructure was found among Latinos, African Americans and those with lower education attainment.

In another instance, The Gilmore Research Group (2007) was commissioned to conduct a study for the Washington State Department of Transportation on the attitudes toward pedestrian and cycling infrastructure planning in Washington State. The objective of their study was multi-fold. They were interested in understanding the current active transportation mode share, as well as obstacles deterring people from using active transportation. However, their ultimate goal was to garner an understanding of the public opinion toward financing pedestrian and cycling facility improvements. The Gilmore Research Group (2007) surveyed 400 randomly selected adult residents by telephone. Of the survey sample, 98% had at least one working motor vehicle in their household, but only 62% had a bicycle. The average age was 51 years and most of the respondents were well educated, with 51% having at least one post-secondary degree.

According to their findings, there was a consensus that the government should provide additional pedestrian facilities to improve walking conditions in communities. Yet, only 48% of the survey respondents were willing to support additional spending on pedestrian infrastructure assuming that it would not require an increase in taxes. The level of support dropped to 21% if new taxes were needed. To ameliorate cycling conditions, respondents suggested that the government should provide additional cycling facilities, improve existing facilities and create safer cycling environments. However, support for increased spending on cycling infrastructure significantly depended on whether new taxes were necessary; the majority did not support additional taxes. Respondents who were opposed to additional taxes to fund pedestrian and cycling infrastructure typically believed that they were already paying too many taxes and that there were other more important projects that the government should fund. Overall, survey respondents believed that government spending on transportation projects should be prioritized in the following order: (1) expanding the public transportation network, (2) expanding the road network and widening highways, (3) creating safer walking and cycling environments, and (4) expanding the cycling network and trails.

Only recently have academic researchers developed interest in acquiring a deeper understanding of public opinion toward transportation infrastructure projects. Smart (2014) was interested in understanding determinants of public opinion toward public transportation spending, and found that the volatility of gasoline prices influenced Americans' willingness to support mass transit expenditures. Other significant factors were political views and place of birth. Foreign-born residents were more likely to support public transportation investment than native-born citizens. Interestingly, income was not a significant factor.

Manville and Cummins (2015) also conducted a study to understand why American voters support public transportation. In particular, these authors examined the discrepancy between support for public transportation spending and low public transportation ridership. They found that while transit users generally support increased transit spending, transit supporters might not necessarily be transit users. Thus, Manville and Cummins (2015) cautioned against associating transit supporters to transit users. At least in the United States of America, transit supporters and transit users are of different demographic characteristics; relative to transit users, transit supporters are wealthier, better-educated, less likely to be immigrants and more likely to live in single-family homes (Manville & Cummins, 2015). Furthermore, Manville and Cummins (2015) proposed that transit supporters are motivated by their beliefs that transit can reduce congestion, improve environmental quality, provide access for the poor and socially disadvantaged groups, revitalize cities and create jobs. In other words, transit supporters in the United States of America view public transit as a solution to social problems, rather than a method of transportation (Manville & Cummins, 2015).

In summary, the existing literature, albeit scarce, suggests that personal characteristics such as education, ethnicity and political views may partially account for a person's opinion toward transportation investment. (The cited studies are all situated in American contexts. Factors, such as ethnicity and race, may not play as large of a role in determining public acceptability elsewhere.) A person's proximity to the proposed project and an acknowledgement of a congestion crisis are also important determinants. In order words, it seems that perceived personal benefits may have an effect on an individual's opinion toward transportation projects. On the other hand, if funding a project requires additional taxes from residents, public acceptability is likely to decline. The aforementioned studies also demonstrate the influence of prominent advocates, public participation and gasoline price volatility. Nevertheless, the literature on the topic of public opinion toward transportation infrastructure investments is sparse. Hence, this study will attempt to expand the existing literature by developing an understanding of different opinions toward various transportation infrastructure investments and underlying motivations as found in the context of a Canadian university.

METHODOLOGY

Data

This study uses data from the 2013 McGill Commuter Survey (Appendix), an online university-wide travel survey conducted over a span of thirty-five days during March and April 2013. A total of 20,851 McGill University students, staff and faculty were randomly selected to complete the survey, and prizes were offered as incentives for participation (Shaw et al., 2013). The response rate of the survey was 32%, which is comparable to previous surveys conducted at other North American universities (Redmond & Mokhtarian, 2001; Whalen et al., 2013). The initial data inspection resulted in a dataset containing 5,599 observations (Shaw et al., 2013). However, due to further data requirements described as follows, the final sample used in this research was narrowed down to 2,319 observations. These only include respondents whose travel destination is within McGill University's Downtown Campus and do not include individuals travelling to McGill University's suburban Macdonald Campus as the provision of transportation infrastructure is very different in the two areas.

In the survey, respondents documented details about their typical commuting experience from their home location to McGill University for a cold and snowy day, and similarly for a warm and dry day. For the purpose of this study, one of these weather conditions was randomly selected for each individual so that each individual is linked to only one commuting trip. The survey asked 356 questions to capture information such as commute duration, commute frequency, modes used, and mode satisfaction. The respondents also reported socio-demographic information, mode preference, home selection criteria and personal opinion toward various transportation investments. Individuals who had incomplete responses, selected "Prefer not to answer" or answered "I don't know" for general (not mode-specific) questions were removed in order to ensure a complete set of responses for each observation. The final set of responses is entered into a factor-cluster analysis, as described in the following section, to identify and differentiate between supporters of and opponents against investing in public and active transportation projects.

Methods

This study uses a two-step approach to isolate clusters of individuals within the study sample bearing similar characteristics and opinions. First, a principal component factor analysis with varimax rotation is used to identify sets of highly correlated variables, which are then grouped as factors. Standalone variables that do not group with other variables are eliminated, as were variables that are grouped with others of dissimilar qualities. The resulting set of factors represents overarching themes from the underlying variables and is treated as uncorrelated variables in the subsequent analysis. Second, a cluster analysis is conducted to group respondents into clusters, by maximizing the mean difference between clusters and minimizing the mean difference within clusters. Analysis of variance and the Tukey-Kramer method are used to detect statistically significant differences between the resulting clusters. This two-step approach, known as factor-cluster analysis, has been used by other researchers have used to create cyclist typologies (Damant-Sirois, Grimsrud, & El-Geneidy, 2014; Gatersleben & Haddad, 2010), perform public transit market segmentation (Krizek & El-Geneidy, 2007), and profile different groups of people with distinct travel motivations and preferences (Anable, 2005).

In this study, the principle component factor analysis generated eight factors from 27 variables, which are presented in Table 6. The first factor, *support for public and active transportation investment*, groups variables that inquired about respondents' opinions toward using taxes to improve and expand public transportation, pedestrian areas, sidewalks and the bicycle network. The second factor, *preference for public and active transportation*, indicates whether respondents intend to cycle, walk or use transit more than they currently do. The third factor, *preference for driving*, is a group of variables related to the dependency and enjoyment of driving. The fourth factor, *unpleasant commuting experience*, captures a commute's potential negative effects. The fifth factor, *commuting frequency*, comprises of variables that affect travel demand. The sixth factor, *residential selection criteria*, groups the importance of several considerations when determining home location. The seventh factor, *household characteristics*, includes the number of licensed drivers, individuals and owned automobiles per household. Finally, the eighth factor, *personal characteristics*, includes age, income, occupation, duration of current residence and the number of years commuting to McGill University.

TABLE 6: FACTORS, VARIABLES AND LOADINGS

FACTORS	VARIABLES	LOADING
Support for public and active transportation investment	We need to use taxes to improve and expand public transportation.	0.772
	We need to use taxes to improve and expand pedestrian areas and sidewalks.	0.763
	We need to use taxes to improve and expand the bicycle network.	0.704
Preference for public and active transportation	I would like to cycle more than I currently do.	0.699
	I would like to walk more than I currently do.	0.699
	I would like to transit more than I currently do.	0.606
Preference for driving	We need to use taxes to improve and expand the highway network.	0.761
	I need a car to do many of the things I like to do.	0.691
	I would like to drive more than I currently do.	0.666
Unpleasant commuting experience	I feel stressed during my trips to McGill.	0.847
	My commute to McGill negatively impacts my punctuality / attendance / working hours.	0.837
	I feel energized when I arrive at McGill.	-0.708
Commuting frequency	How often are you on campus?	0.803
	Are you at McGill full-time?	0.798
	I'm on campus during regular work day hours from approximately 9am – 5pm.	0.662
Residential selection criteria	When you moved into your current residence, how important were the following factors in your decisions?	
	Cost of commuting (excluding the cost of parking)	0.773
	Proximity to public transportation	0.761
	Being in a location where I wouldn't have to drive	0.696
	Proximity to McGill	0.635
Household characteristics	How many licensed drivers are in your household, including yourself?	0.893
	How many people are in your household, including yourself?	0.858
	How many automobiles are owned by your household?	0.687
Personal characteristics	What is your age?	0.911
	Are you a faculty or staff at McGill?	0.820
	For how many years have you been regularly commuting to McGill?	0.804
	What is your yearly personal income?	0.742
	For how many years have you been living at your current residence?	0.662

Next, a non-hierarchical (k-means) clustering analysis is conducted using the eight factors developed from the principal component factor analysis. Reiterations of the cluster analysis are performed to produce results ranging from two to ten clusters. The best segmentation of the study sample, however, is obtained through five clusters. The following section describes each cluster in detail.

RESULTS

The five clusters identified from the factor-cluster analysis are: *strong advocates*, *highway / transit funders*, *cycling advocates*, *infrequent commuters* and *funding opponents* (Figure 4). The assigned labels were given after careful examination of the cluster analysis results and summary statistics (Table 7), and signify key characteristics of each cluster.

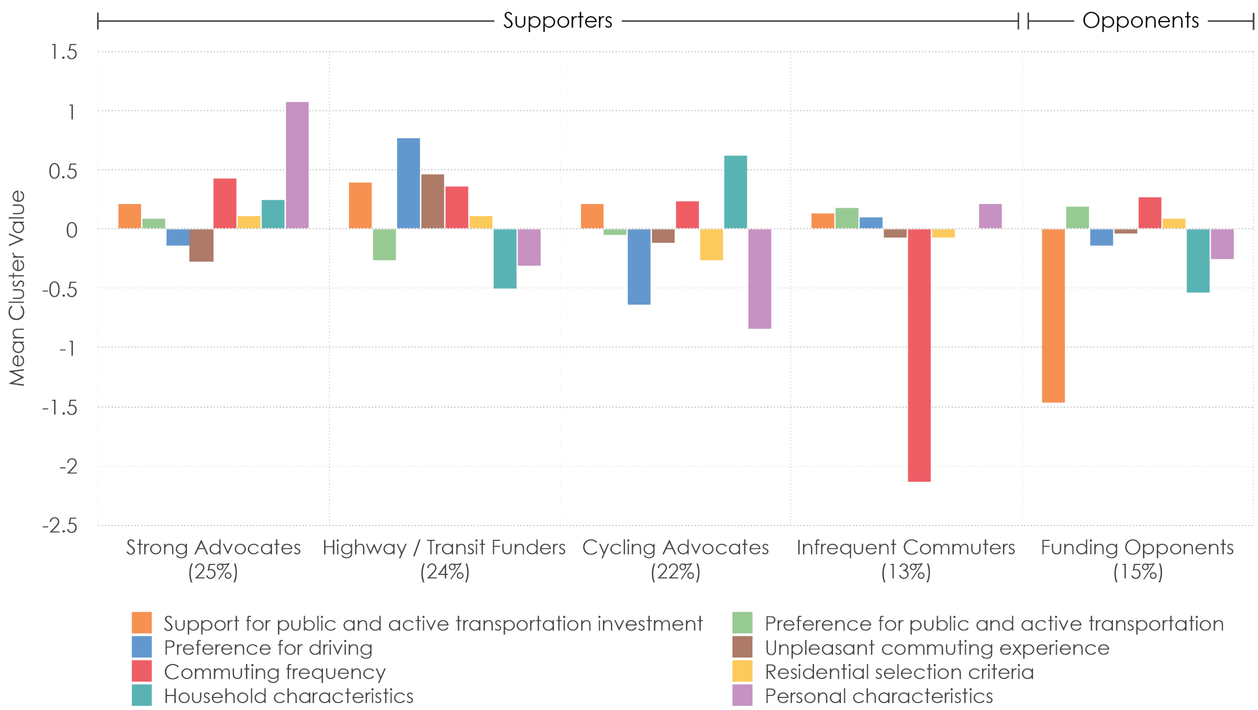

Figure 4: K-means cluster analysis

TABLE 7: SUMMARY STATISTICS – MEAN OF VARIABLES

	All	Strong Advocates	Highway / Transit Funders	Cycling Advocates	Infrequent Commuters	Funding Opponents
Sample size	2319	589	561	521	309	339
SUPPORT FOR PUBLIC AND ACTIVE TRANSPORTATION INVESTMENT						
We need to use taxes to improve and expand:						
Public transportation (1–5)	4.12	4.40*	4.50*	4.20*	4.23*	2.82*
Pedestrian areas and sidewalks (1–5)	3.48	3.76*	3.73*	3.55	3.62*	2.32*
The bicycle network (1–5)	3.60	3.77*	3.56	4.10*	3.66	2.53*
PREFERENCE FOR PUBLIC AND ACTIVE TRANSPORTATION						
I would like to … more than I currently do:						
Cycle (1–5)	3.24	3.21	2.85*	3.69*	3.22	3.23
Walk (1–5)	3.23	3.55*	2.98*	2.93*	3.46*	3.31
Transit (1–5)	2.12	2.14	2.10	1.99*	2.39*	2.06
PREFERENCE FOR DRIVING						
We need to use taxes to improve and expand the highway network. (1–5)	3.04	2.96	3.84*	2.40*	3.22*	2.65*
I need a car to do many of the things I like to do. (1–5)	2.79	3.04*	3.22*	1.93*	3.11*	2.65
I would like to drive more than I currently do. (1–5)	1.92	1.56*	2.50*	1.52*	2.00	2.10*
UNPLEASANT COMMUTING EXPERIENCE						
I feel stressed during my trips to McGill. (1–5)	2.74	2.40*	3.31*	2.56*	2.66	2.72
My commute to McGill negatively impacts my punctuality. (1–5)	2.70	2.22*	3.32*	2.70	2.54*	2.65
I feel energized when I arrive at McGill. (1–5)	2.87	3.14*	2.45*	2.95	2.97	2.85
COMMUTING FREQUENCY						
Frequency on campus (days per month)	18.18	19.39*	19.86*	20.31*	7.20*	20.00*
Full-time status	0.87	0.98*	0.98*	0.98*	0.17*	0.97*
Regular work hours	0.76	0.91*	0.84*	0.76	0.30*	0.77
RESIDENTIAL SELECTION CRITERIA						
Importance of following factors in selecting current home:						
Cost of commuting (1–5)	3.31	3.32	3.61*	2.92*	3.27	3.46*
Proximity to public transportation (1–5)	4.10	4.29*	4.23*	3.82*	4.03	4.02
Being in a location where I wouldn't have to drive (1–5)	3.75	3.80	3.62*	3.89*	3.63	3.78
Proximity to McGill (1–5)	3.47	3.44	3.56	3.45	2.95*	3.87*

HOUSEHOLD CHARACTERISTICS	All	Strong Advocates	Highway / Transit Funders	Cycling Advocates	Infrequent Commuters	Funding Opponents
Number of licensed drivers per household	1.90	2.03*	1.45*	2.31*	1.80*	1.42*
Number of individuals per household	2.70	2.99*	2.21*	3.21*	2.61	2.15*
Number of automobiles per household	1.00	1.35*	0.79*	1.00	1.14*	0.63*
PERSONAL CHARACTERISTICS						
Age	36.90	50.75*	32.93*	25.35*	42.47*	32.09*
Faculty or staff	0.53	0.99*	0.48*	0.12*	0.54	0.40*
Years at McGill	8.07	16.20*	5.32*	2.75*	8.62	6.19*
Income (0–10)	2.03	4.10*	1.35*	0.46*	2.82*	1.26*
Years at current residence	6.94	12.42*	4.36*	4.02*	8.61*	4.67*
CURRENT MODE SHARE						
Cycle	0.07	0.08	0.03*	0.13*	0.06	0.05
Drive	0.13	0.21*	0.09*	0.01*	0.30*	0.10*
Transit	0.55	0.59	0.64*	0.53	0.47*	0.43*
Walk	0.25	0.12*	0.24	0.33*	0.17*	0.42*

Notes:

- 5-point Likert scale: 1 = "Strongly disagree" or "Extremely unimportant", 5 = "Strongly agree" or "Extremely important"
- Income: 0 = "$0 – $19,999", 10 = "Above $200,000"
- *: Significantly different from sample mean at $\alpha = 0.05$

Strong Advocates

Strong advocates (25% of the sample) support investing in public and active transportation. They show statistically higher levels of agreement for using taxes to improve and expand public transportation (mean of 4.40 out of 5), pedestrian areas and sidewalks (mean of 3.76 out of 5) and the bicycle network (mean of 3.77 out of 5) than the average individual from this study. Although all the other clusters except *funding opponents* also demonstrate high levels of support toward improving and expanding public transportation, *strong advocates* are unique in that they display statistically higher levels of agreement toward all three public and active transportation investments. Moreover, *strong advocates* typically wish to increase their use of active transportation, tend to enjoy walking (mean of 3.55 out of 5) more than this study's average individual, and reveal low intentions to increase driving (mean of 1.56 out of 5). Amid the different clusters, they also seem to experience the most pleasant commute. As a group, they undergo the least commuting stress (mean of 2.40 out of 5) and generally do not perceive that their commutes interfere with their punctuality (mean of 2.22 out of 5). They are also statistically above average with regard to feeling energized when arriving at McGill University (mean of 3.14 out of 5). Relative to individuals in other clusters, *strong advocates* tend to be older (mean age of 50 years) and have higher incomes (median income of $60,000 to $79,999). Ninety-nine percent of *strong advocates* are full-time McGill University faculty or staff. Individuals in this group are inclined to strategically select their home location to be near public transit (mean of 4.29 out of 5), and where they would not have to drive (mean of 3.80 out of 5).

Highway / Transit Funders

Highway / transit funders (24% of the sample) are highly supportive of investing in public transportation (mean of 4.50 out of 5). Unlike *strong advocates*, however, *highway / transit funders* do not seem to desire an increase in their use of active transportation. Compared to this study's average individual, they reveal significantly lower intentions to cycle more (mean of 2.85 out of 5) and walk more (mean of 2.98 out of 5). Yet, they are in favour of investing in pedestrian areas and sidewalks (mean of 3.73 out of 5). Perhaps, it is the lack of pedestrian-friendly infrastructure that is deterring them from wanting to walk more. Nevertheless, what distinguishes *highway / transit funders* from other clusters is their relatively high preference for driving. They tend to be the greatest proponents of using taxes to improve and expand the highway network (mean of 3.84 out of 5), are inclined to perceive that having a car is a necessity (mean of 3.32 out of 5), and have a comparatively high desire to increase driving (mean of 2.50 out of 5). This may correspond with the relatively low importance they place on not having to drive when selecting their home locations (mean of 3.62 out of 5). *Highway / transit funders* tend to be unhappy with their current commutes and show the highest levels of commuting stress (mean of 3.31 out of 5) and tardiness (mean of 3.32 out of 5), as well as the lowest levels of energy (mean of 2.45 out of 5). The transit share of this cluster is currently at 64%, which is the highest among all the different clusters. However, given the discussed characteristics of *highway / transit funders*, the mode share distributions may change.

Cycling Advocates

Cycling advocates (22% of the sample) are generally younger individuals (mean age of 25 years), who show the greatest support toward using taxes to improve and expand the bicycle network (mean of 4.10 out of 5). Amid the different clusters, they also exhibit the greatest desire to cycle more (mean of 3.69 out of 5) and possess the lowest preference for driving. *Cycling advocates* tend to oppose investing in highway network improvements (mean of 2.40 out of 5), have low dependency on cars (mean of 1.93 out of 5) and do not typically desire to increase their car usage (mean of 1.52 out of 5). In fact, between the different clusters, *cycling advocates* place the highest importance of living at a location where driving is not necessary (mean of 3.89 out of 5). *Cycling advocates* typically find their commutes enjoyable, and endure significantly lower levels of commuting stress (mean of 2.56 out of 5) than the average individual from this study. Eighty-eight percent of *cycling advocates* are McGill University students, who have a median income within the range of $0 to $19,999. Their living arrangements are significantly different from individuals of other clusters. *Cycling advocates* report the highest number of individuals (mean of 3.21 persons) and licensed drivers (mean of 2.31 persons) per household, perhaps suggesting that many live with roommates. While not all *cycling advocates* commute by cycling, they do boast the highest proportion of cycling commuters among the different clusters.

Infrequent Commuters

Infrequent commuters (13% of the sample), by definition, do not travel to McGill University on a regular basis. Compared to the average individual in this study who commutes to McGill University 18 days per month, *infrequent commuters* travel to the university only 7 days per month. Nevertheless, *infrequent* *commuters* are generally supportive of transportation investments and do not discriminate between modes, demonstrating levels of support similar to those of *strong advocates*, *highway / transit funders* and *cycling advocates* for the various transportation infrastructure projects. In other words, individuals identified as *infrequent commuters* may hold opinions toward transportation investments that are similar to individuals belonging in other advocate groups. They are differentiated mainly by their travel frequency. Only 17% of *infrequent commuters* are full-time faculty, staff or students, and less than one-third are on campus during regular work hours (9:00 am to 5:00 pm). Among the various clusters, *infrequent commuters* seem to be the least concerned about situating their residence near McGill University (mean of 2.95 out of 5). Perhaps due to a combination of these characteristics, 30% of *infrequent commuters* commute by driving, which is the highest proportion among the different clusters.

Funding Opponents

Funding opponents (15% of the sample) are a group of individuals who are against using taxes to fund any transportation infrastructure improvements or network expansions. They show significantly lower levels of agreement for using taxes to improve and expand public transportation (mean of 2.82 out of 5), pedestrian areas and sidewalks (mean of 2.32 out of 5) and the bicycle network (mean of 2.53 out of 5) than the average individual from this study. They are also opposed to using taxes to improve and expand the highway network (mean of 2.65 out of 5). In relation to the average individual in this study, *funding opponents* place significantly higher importance on commuting cost (mean of 3.46 out of 5) and being in proximity to McGill University (mean of 3.87 out of 5), when selecting their residential location. The high value they place on commuting cost may be associated to their comparatively low income (median of $20,000 to $39,999). On the other hand, it may be important for individuals in this cluster to live near the university due to their frequent travels to campus (mean of 20 days per month). F*unding opponents* are also characterized by having the fewest number of individuals (mean of 2.15), licensed drivers (mean of 1.42) and automobiles (mean of 0.63) per household. Considering these attributes, it is not surprising that 42% of the individuals in this cluster commute by foot.

DISCUSSION

Before discussing the specifics of the results, it is important to understand the situational context of this study. In general, it was found that most people at McGill University support public transit investment, but only a small percentage would like to use it more. This discrepancy between transit support and desired increase of transit use among all the clusters is portrayed in Figures 5 and 6. Granted that more than half of McGill University's population commute regularly by public transit (Table 6), the lack of desire to increase transit use may be explained by existing frequent use, or factors relating to service quality and convenience. Also important to note is the general tendency of the McGill University community to limit car use and increase participation in active transportation modes (Figure 6). Interestingly, overall support for investing in pedestrian infrastructure (mean of 3.48 out of 5) and expanding the bicycle network (mean of 3.60 out of 5), although present, is not as strong as the support for public transportation spending (mean of 4.12 out of 5). Figure 5 also illustrates the diverse opinions among the different clusters toward investing in the highway network. In contrast, apart from the constant opposition from *funding opponents*, opinions regarding investing in public transportation, pedestrian areas and sidewalks and the bicycle network are relatively consistent. In general, the public opinion toward transportation investments of individuals at McGill University seems to differ greatly from that cited in American literature. Hence, this highlights that public opinion is context- and culture-specific. Findings from other studies should not be casually applied to all settings.

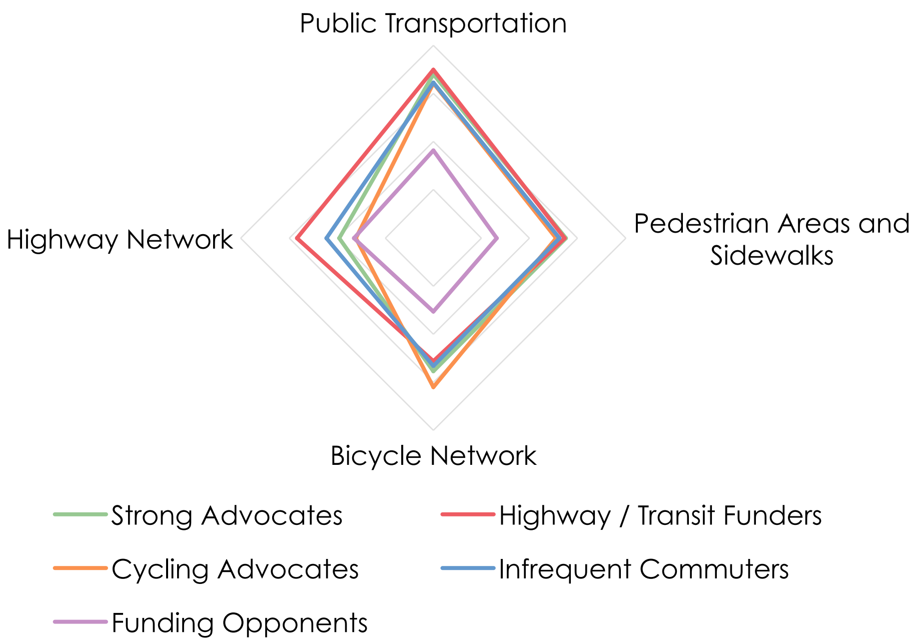

Figure 5: Support for transportation investment

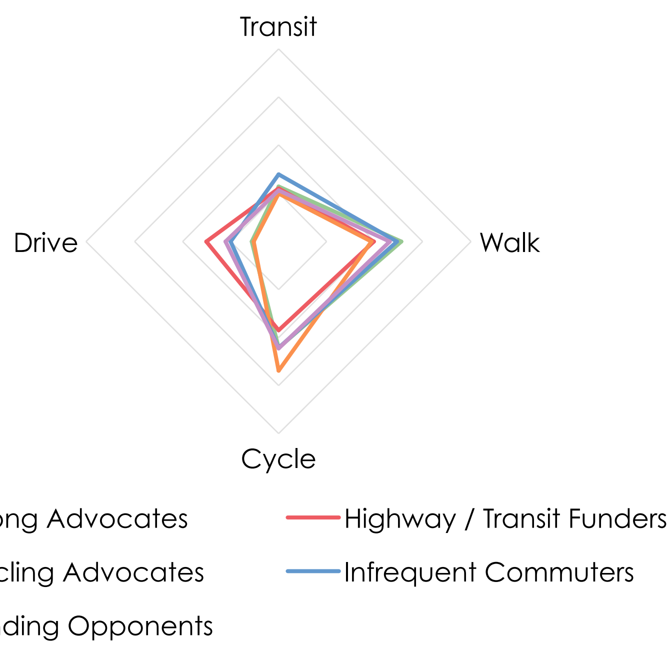

Figure 6: Desire to increase use of mode

Considering the context of this study, it is not surprising that among the five clusters generated from the factor-cluster analysis, only one consists of individuals who oppose using taxes to fund transportation investments (*funding opponents*). However, it is difficult to interpret whether *funding opponents* are simply against spending, opposed to transportation infrastructure investment in general, or specifically against using tax revenue to fund these projects. As suggested by The Gilmore Research Group (2007), opposition to tax-funded transportation projects may be due to the belief that there are too many taxes already. On the other hand, *funding opponents* may perceive that the government should prioritize financing other projects instead. Nevertheless, proper investigation into the reasons behind the *funding opponents*' lack of support is essential to addressing issues of public acceptability.

Strong advocates, highway / transit funders, *cycling advocates* and *infrequent commuters* demonstrate support toward investing in public and active transportation, signalling positive public opinion toward public and active transportation investment. However, this does not indicate that they all have identical motivations and desires. Some i*nfrequent commuters* seem to show a discrepancy between transit support and current transit use. This could be a scenario similar to the phenomenon described by Manville and Cummins (2015), where public and active transportation become ideologies rather than a lifestyle. Although this seems to be a possibility for some, this is not to say that it is the case for all *infrequent commuters*, especially since commuting by car does not necessarily imply that all trips are made by car. Even so, encouraging *infrequent commuters* to travel more by public and active transportation could potentially help improve their opinion toward public and active transportation investment to a level comparable to that of *strong advocates*. A previous study comparing mode satisfaction of regular public transit users and infrequent public transit users revealed that regular public transit users have a higher overall satisfaction with public transit than infrequent users (Pedersen, Friman, & Kristensson, 2011). In the same study, Pedersen et al. (2011) also demonstrated that habitual car users tend to underestimate their satisfaction with public transit. Hence, with increased travelling frequency, it may be possible for *infrequent commuters* to develop more positive opinions toward public and active transportation investment.

Highway / transit funders appear to be driven by a perceived failure of the existing transportation system. As discussed in the previous section, *highway /*

transit funders tend to be unhappy with their current commutes and demonstrate a relatively high preference for driving. Given that most *highway / transit funders* are currently transit users, their inclination toward driving may suggest a potential mode switch in the future (Imaz, Habib, Shalaby, & Idris, 2015). It is of value, hence, to understand their source of dissatisfaction. Understanding the public transit system's weaknesses as experienced by current users would allow effective allocation of funds to finance discernible transportation infrastructure improvements (Beirão & Cabral, 2007; Brog & Kahn, 2003). It may also increase user satisfaction and limit mode switches from using public transit to driving (Imaz et al., 2015).

As mentioned previously, there appears to be less support for investing in the bicycle network than for public transportation spending. Hence, *cycling advocates* are crucial in promoting the importance of expanding the bicycle network. In Montreal, *cycling advocates* currently have the support of influential politicians who are eager to develop Montreal into a better cycling city (Anonymous, 2013). Elsewhere, *cycling advocates* may need to develop partnerships with powerful spokespeople to further their cause. For example, London Cycle Link recently presented their proposals to city council and demonstrated how implementing cycling projects can help the city achieve the council's strategic goals (London Cycle Link, 2016).

Individuals classified as *strong advocates* seem to be the ideal allies in promoting funding for public and active transportation. Since most of them are full-time McGill University faculty or staff, they are in a well-placed position to endorse the necessity and benefits of public and active transportation infrastructure. *Strong advocates* also indicate an intention to increase walking and cycling trips. It will be interesting to observe whether these motives will be realized with the implementation of quality pedestrian and cycling infrastructure since researchers have previously found that appropriate installation of walking and cycling facilities is associated with increased walking and cycling (Dill & Carr, 2003; Gunn, Lee, Geelhoed, Shiell, & Giles-Corti, 2014; Nelson & Allen, 1997). On the other hand, if the implementation of such facilities does not increase the number of walking and/or cycling trips for commuting and non-commuting purposes despite the expressed intentions, then it is possible that some individuals answered the survey based on what they assumed was socially acceptable, in lieu of their true sentiments (Shadish, Cook, & Campbell, 2001).

Of course, there may be other valid explanations; thus, this is a topic for future research.

Finally, *strong advocates, highway / transit funders*, *cycling advocates* and *infrequent commuters* possess statistically distinct personal characteristics, such as age and income, when compared to each other. This may imply that a person's stage of life partially accounts for the attitudes and preferences he or she has (Schwanen & Mokhtarian, 2005). For instance, *cycling advocates*, who earn the lowest income and have the lowest average age, are particularly supportive about investing in cycling facilities. On the other hand, *strong advocates*, who earn the highest income and have the highest average age, support investing in public transit, cycling and walking infrastructure. Hence, for future studies, it will be fascinating to examine whether current *cycling advocates* will remain solely enthusiastic about cycling, or if they will shift toward other existing clusters, supporting a wider range of transportation infrastructure. Findings from this future research may dictate whether the observed phenomenon is a result of life phases or generational trends.

CONCLUSION

In conclusion, *strong advocates* are the greatest allies for promoting public and active transportation investments, while *cycling advocates* are valuable in publicizing the benefits of expanding the bicycle network. Despite the presence of *funding opponents*, there appears to be an overall positive public opinion and low levels of public resistance toward public and active transportation investments at McGill University. However, this level of support may be distinct to the university and not representative of the public opinion in Montreal. Hence, care should be taken when extending the geographic application of this study's findings. Additionally, it is possible that survey respondents answered the questions in a manner, which they thought was socially appropriate and concealed their true opinions (Shadish et al., 2001).

It is important to develop a deeper understanding of the reasons behind opposition against transportation investments. Ballots reveal preferences, but do not disclose underlying motivations (Manville & Cummins, 2015). Hence, based on the existing survey questions, it is difficult to interpret whether *funding opponents* are simply against spending, opposed to transportation infrastructure investment in general, or specifically disagree with using tax revenue to fund these projects. Future research should aim to nurture a better comprehension of issues hindering public acceptance in order to address them effectively. On the other hand, discussions with *highway / transit funders* may uncover current weaknesses in the transportation system, which can guide the allocation of funds to finance discernible transportation infrastructure improvements. Therefore, there is no straightforward approach to addressing the various concerns of the different clusters. Instead, policy makers should carefully weigh the criticisms of each cluster in order to best improve public acceptability.

Lastly, it is important to keep in mind that stronger support for transportation infrastructure investment may not automatically translate to increased mode usage (Manville & Cummins, 2015). Hence, while advocating for public and active transportation investment, there should also be campaigning for increased use of public transit, cycling and walking.

AFTERWORD

In an effort to convince more people to use active transportation, the objectives of this Supervised Research Project (SRP) were 1) to examine the benefits of commuting by active transportation and 2) to identify groups of individuals who would be strong supporters of increasing active transportation usage and infrastructure development. The outcome of this SRP were three studies that discuss the impact of commuting on individuals across different modes (Chapters 1 and 2), as well as the different attitudes individuals have toward investing in transportation infrastructure (Chapter 3).

Chapter one explored the impacts of the daily commute and differentiated how various modes influence individuals' energy and punctuality at work. The findings from this study suggest that transportation mode, weather conditions and mode satisfaction have significant effects on commuters' energy and punctuality. According to the results, drivers have the lowest odds of feeling energized and the highest odds of arriving late for work. Cyclists, on the other hand, have the greatest odds of being energized and punctual. Moreover, cyclists who are satisfied with the safety and comfort of their travel environment have increased odds of feeling energized. Thus, it would be valuable to develop policies and transportation infrastructure that improve the safety of cyclists in traffic.

Chapter two studied the perceived travel time reliability of various transportation modes by analyzing the factors contributing to how much extra time individuals allocate for their commutes. These additional minutes are not a part of the actual trip duration; rather, they are unnecessary time lost due to travel time unreliability. The results show that drivers allocate the greatest amount of additional budgeted time compared to cyclists, transit users and pedestrians, who budget 66%, 55% and 29% less additional time, respectively. This may suggest an existing perception that the active transportation networks have greater travel time reliability than the street network for drivers. Hence, cyclists and pedestrians experience greater travel time reliability and allocate less unnecessary time for their commutes.

The first two chapters revealed benefits of using active transportation and the burdens associated to driving. They have also shown where the existing transportation networks are lacking in performance. However, to improve the travelling experience for individuals, there must be public support for the continual development of transportation infrastructure. Hence, the third chapter segmented the commuting population in search of important allies to endorse active transportation projects.

The results of the third chapter showed that individuals tend to hold similar attitudes toward public transportation as they do toward active transportation. Further analysis revealed five clusters of individuals with varying opinions toward transportation investments and distinct motivations: *strong advocates*, *highway / transit funders*, *cycling advocates*, *infrequent commuters* and *funding opponents*. In brief, there is an overall positive opinion toward investing in public and active transportation projects, and a minority of individuals who oppose transportation investments as a whole. Among the supporters, the group of *strong advocates* seem to be the greatest allies for promoting public and active transportation investments. Not only do they support financing public and active transportation projects, but they also are well-positioned to endorse the necessity and advantages of such investments. Nevertheless, this study demonstrated that there are varying degrees of public acceptability, and therefore, policy makers should use a multidimensional approach to address the concerns of the different groups.

Overall, this SRP has provided evidence that there are benefits to using active transportation, despite the differing attitudes people have toward its usage and investment. Still, there needs to be a better understanding of the issues hindering public acceptance of active transportation usage and infrastructure investment in order to address them effectively. As cities, policy makers and other active transportation activists continue to promote the use of active transportation, it is also important to consider the commuting experience of other mode users and to improve the travel time reliability of transportation networks in general. Since this SRP concentrated on commuters in Greater Montreal travelling to McGill University, future research should encompass broader geographic contexts to verify the validity of the findings of this project.

Moving forward, future studies should go beyond simply repeating what has already been done in other geographic contexts. The world we live in is not static; scientific discoveries and technological advances are progressing rapidly. As a culture that is reliant on technology and obsessive about efficiency, we have, at least in the past, prioritized the automobile when designing our living environments. This has inadvertently led to unfavourable conditions for cycling and walking. Nevertheless, a paradigm shift is occurring, with more cities adopting cycling and pedestrian infrastructure projects as part of their transportation plans. There are, however, more challenges on the horizon. Driving has often been associated with undesirable consequences such as stress, but the dawn of the autonomous vehicle may alter this argument. Not only are autonomous vehicles expected to relieve drivers from traffic-related stress, but they also expected to provide an additional benefit of productive travel time. This will require active transportation promoters to search for more compelling reasons to persuade people to forgo travelling by car. Ultimately, active transportation needs to permeate our daily lives to such an extent that it becomes a part of our culture.

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APPENDIX

2013 McGill Commuter Survey

INVITATION LETTER

The inter-disciplinary research group, Transportation Research at McGill (TRAM) is currently undertaking research aiming to update and enrich information from a 2011 survey assessing travel to and from McGill University. Your participation is greatly appreciated and gives you the chance to win great prizes, including:

- Two nights accommodation at the Marriott Residence Inn on Rue Peel, Montreal (1 prize; odds of winning 1:2000)
- McGill Bookstore gift certificate (TBD prizes; odds of winning 1:500)
- McGill Athletics 3-month or summer membership (1 prize; odds of winning 1:2000)
- McGill Athletics Redbird Sports Shop $25 gift certificate (1 prize; odds of winning 1:2000)
- One course at McGill's center for Personal and Cultural Enrichment (1 prize; odds of winning 1:2000)
- Faculty Club $25 gift certificate (1 prize; odds of winning 1:2000)
- One-year Bixi membership (2 prizes; odds of winning 1:500)
- iTunes $10 gift cards (5 prizes; odds of winning 1:400)
- Second Cup $10 gift certificates (5 prizes; odds of winning 1:400)

With a bit of your time you can help us in making recommendations to improve travel to and from McGill University and to develop recommendations on how to further encourage the use of sustainable transportation for commuting to McGill. This survey is funded by NSERC and is conducted in collaboration with the McGill Office of Sustainability.

The project team includes Dea van Lierop, Colin Stewart, and Kevin Manaugh, graduate students from the McGill School Urban Planning. The research team is working under the supervision of Ahmed El-Geneidy, Associate Professor with the School of Urban Planning.

The above link to the survey has been personalized to your email address and will only work for you. If you want to invite other people to do the survey, please forward them the link at the bottom of this email.

This survey will take approximately 10-15 minutes to complete. Participation is voluntary, and you may exit the survey at any time. Completing the survey indicates consent to participate in this study. All survey responses will remain confidential, stored on password-protected computers, and participants will not be identified in any publications or reports. The data may be kept for future related research purposes.

If you have any questions or concerns regarding this research project, please send an email to tram.urbanplanning@mcgill.ca. If you need urgent assistance, you may call TRAM at 514-398-4058. If you have any questions or concerns regarding your rights or welfare as a participant in this research study please contact the McGill Research Ethics Officer at 514-398-6831 or lynda.mcneil@mcgill.ca.

Thank you for your participation!

PART 1: GENERAL INFORMATION

1. What is your status at McGill?
   *Please choose **only one** of the following:*
   - Student (undergraduate)
   - Student (graduate)
   - Student (continuing education)
   - Post-doctoral fellow
   - Staff (administrative)
   - Staff (security, maintenance, etc.)
   - Faculty
   - Faculty (adjunct)
   - Visitor (visiting scholar, etc.)

2. Are you at McGill…?
   *Please choose **only one** of the following:*
   - Full-time
   - Part-time

3. In which year did you start regularly commuting to McGill?
   *Please choose **only one** of the following:* [drop down menu with years]

4. At which campus do you spend most of your time?
   *Please choose **only one** of the following:*
   - Downtown Campus
   - MacDonald Campus

5. On the following map, please adjust the zoom and drag the pin to where you spend the most time at McGill (Downtown Campus). *Please write your answer here:* ___________________

6. On the following map, please adjust the zoom and drag the pin to where you spend the most time at McGill (MacDonald Campus). *Please write your answer here:* ___________________

7. How often are you on campus?
   *Please choose **only one** of the following:*
   - 7 times per week
   - 6 times per week
   - 5 times per week
   - 4 times per week
   - 3 times per week
   - 2 times per week
   - 1 time per week
   - 3 times per month
   - 2 times per month
   - 1 time per month
   - Less than one time per month

8. Describe your typical work schedule at campus.
   *Please choose **all** that apply:*
   - I’m on campus during regular work day hours from approximately 9am-5pm
   - I’m on campus for nonstandard hours

9. To provide us with your approximate home location, which of the following would you prefer to do?
   - Type my home postal code
   - Put a pin on a map

10. Please enter your current home postal code while at McGill. Please use the format XXX XXX (for example: H3A 0C2). *Please write your answer here:* ___________________

11. On the following map, please adjust the zoom and drag the pin to your current home location. *Please write your answer here:* ___________________

PART 2: COMMUTING HABITS

The following questions ask about the **different parts of your trip to McGill**. For example, you might have a trip with three parts: first, walking to a bus stop; second, riding the bus; and third, walking from the last bus stop to McGill.

You will be asked these questions based on your trips in **two different weather conditions**: cold snowy days and warm dry days. Please answer the following questions accordingly:

Part 2a: Commuting to McGill on Cold Snowy Days (Leg 1)

12. **For the first part of my trip on a typical cold snowy day, I**… :
    *Please choose **only one** of the following:*
    - Walk to transit
    - Walk
    - Ride a bicycle
    - Carpool
    - Drive
    - Ride a motorcycle or scooter
    - Take a taxi
    - Other

13. How many minutes does this part of your trip take? *Please write your answer here:* ____________________ [drop down 1-200 minutes]

14. Do you then reach campus or do you transfer to another mode (walking, cycling, driving, taking a taxi, taking the bus or metro, etc.)
    *Please choose **only one** of the following:*
    - Reach campus
    - Transfer to another mode

Part 2a: Commuting to McGill on Cold Snowy Days (Leg 2)

15. **For the second part of my trip on a typical cold snowy day, I**… :
    *Please choose **only one** of the following:*
    - Walk to transit
    - Walk
    - Ride a bicycle
    - Carpool
    - Drive
    - Take the bus
    - Take the metro
    - Take the commuter train
    - Take the McGill intercampus shuttle
    - Ride a motorcycle or scooter
    - Take a taxi
    - Make a stop
    - Other

16. Which bus route do you take?
    *Please choose **only one** of the following:* [drop down menu with stops]

17. Which metro line(s) do you take?
    *Please choose **all** that apply:*
    - Green Line
    - Orange Line
    - Blue Line
    - Yellow Line

18. Which commuter train line do you take?
    *Please choose **only one** of the following:*
    - Blainville-Saint-Jérôme
    - Deux-Montagnes
    - Candiac
    - Mont-Saint-Hilaire

      Vaudreuil-Hudson

19. What is the purpose of the stop?
*Please choose **all** that apply:*

- Drop children off at school/daycare/etc.
- Shopping
- Buy coffee/meal
- Stop at the gym
- Stop at the bank/post office/etc.
- Other: ___________________

20. How many minutes does this stop take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

21. How many minutes does this part of your trip take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

22. Do you then reach campus or do you transfer to another mode (walking, cycling, driving, taking the bus or metro, etc.)?
*Please choose **only one** of the following:*

- Reach campus
- Transfer to another mode

Part 2a: Commuting to McGill on Cold Snowy Days (Leg 3)

23. **For the third part of my trip on a typical cold snowy day, I**… :
*Please choose **only one** of the following:*

- Walk to transit
- Walk
- Ride a bicycle
- Carpool
- Drive
- Take the bus
- Take the metro
- Take the commuter train
- Take the McGill intercampus shuttle
- Ride a motorcycle or scooter
- Take a taxi
- Make a stop
- Other

24. Which bus route do you take?
*Please choose **only one** of the following:* [drop down menu with stops]

25. Which metro line(s) do you take?
*Please choose **all** that apply:*
- Green Line
- Orange Line
- Blue Line
- Yellow Line

26. Which commuter train line do you take?
*Please choose **only one** of the following:*
- Blainville-Saint-Jérôme
- Deux-Montagnes
- Candiac
- Mont-Saint-Hilaire
- Vaudreuil-Hudson

27. What is the purpose of the stop?
*Please choose **all** that apply:*
- Drop children off at school/daycare/etc.
- Shopping
- Buy coffee/meal
- Stop at the gym
- Stop at the bank/post office/etc.
- Other: ___________________

28. How many minutes does this stop take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

29. How many minutes does this part of your trip take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

30. Do you then reach campus or do you transfer to another mode (walking, cycling, driving, taking the bus or metro, etc.)?
*Please choose **only one** of the following:*
- Reach campus
- Transfer to another mode

Part 2a: Commuting to McGill on Cold Snowy Days (Leg 4)

31. **For the fourth part of my trip on a typical cold snowy day, I…** :
    *Please choose **only one** of the following:*
    - Walk to transit
    - Walk
    - Ride a bicycle
    - Carpool
    - Drive
    - Take the bus
    - Take the metro
    - Take the commuter train
    - Take the McGill intercampus shuttle
    - Ride a motorcycle or scooter
    - Take a taxi
    - Make a stop
    - Other

32. Which bus route do you take?
    *Please choose **only one** of the following:* [drop down menu with stops]

33. Which metro line(s) do you take?
    *Please choose **all** that apply:*
    - Green Line
    - Orange Line
    - Blue Line
    - Yellow Line

34. Which commuter train line do you take?
    *Please choose **only one** of the following:*
    - Blainville-Saint-Jérôme
    - Deux-Montagnes
    - Candiac
    - Mont-Saint-Hilaire
    - Vaudreuil-Hudson

35. What is the purpose of the stop?
*Please choose **all** that apply:*

- Drop children off at school/daycare/etc.
- Shopping
- Buy coffee/meal
- Stop at the gym
- Stop at the bank/post office/etc.
- Other: ___________________

36. How many minutes does this stop take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

37. How many minutes does this part of your trip take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

38. Do you then reach campus or do you transfer to another mode (walking, cycling, driving, taking the bus or metro, etc.)?
*Please choose **only one** of the following:*

- Reach campus
- Transfer to another mode

Part 2a: Commuting to McGill on Cold Snowy Days (Leg 5)

39. **For the fifth part of my trip on a typical cold snowy day, I**… :
*Please choose **only one** of the following:*

- Walk to transit
- Walk
- Ride a bicycle
- Carpool
- Drive
- Take the bus
- Take the metro
- Take the commuter train
- Take the McGill intercampus shuttle
- Ride a motorcycle or scooter
- Take a taxi
- Make a stop
- Other

40. Which bus route do you take?
*Please choose **only one** of the following:* [drop down menu with stops]

41. Which metro line(s) do you take?
*Please choose **all** that apply:*
- Green Line
- Orange Line
- Blue Line
- Yellow Line

42. Which commuter train line do you take?
*Please choose **only one** of the following:*
- Blainville-Saint-Jérôme
- Deux-Montagnes
- Candiac
- Mont-Saint-Hilaire
- Vaudreuil-Hudson

43. What is the purpose of the stop?
*Please choose **all** that apply:*
- Drop children off at school/daycare/etc.
- Shopping
- Buy coffee/meal
- Stop at the gym
- Stop at the bank/post office/etc.
- Other: ___________________

44. How many minutes does this stop take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

45. How many minutes does this part of your trip take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

46. Do you then reach campus or do you transfer to another mode (walking, cycling, driving, taking the bus or metro, etc.)?
*Please choose **only one** of the following:*
- Reach campus
- Transfer to another mode

Part 2a: Commuting to McGill on Cold Snowy Days (Leg 6)

47. **For the sixth part of my trip on a typical cold snowy day, I**… :
    *Please choose **only one** of the following:*
    - Walk to transit
    - Walk
    - Ride a bicycle
    - Carpool
    - Drive
    - Take the bus
    - Take the metro
    - Take the commuter train
    - Take the McGill intercampus shuttle
    - Ride a motorcycle or scooter
    - Take a taxi
    - Make a stop
    - Other

48. Which bus route do you take?
    *Please choose **only one** of the following:* [drop down menu with stops]

49. Which metro line(s) do you take?
    *Please choose **all** that apply:*
    - Green Line
    - Orange Line
    - Blue Line
    - Yellow Line

50. Which commuter train line do you take?
    *Please choose **only one** of the following:*
    - Blainville-Saint-Jérôme
    - Deux-Montagnes
    - Candiac
    - Mont-Saint-Hilaire
    - Vaudreuil-Hudson

51. What is the purpose of the stop?
*Please choose **all** that apply:*

- Drop children off at school/daycare/etc.
- Shopping
- Buy coffee/meal
- Stop at the gym
- Stop at the bank/post office/etc.
- Other: ____________________

52. How many minutes does this stop take? *Please write your answer here:* ____________________ [drop down 1-200 minutes]

53. How many minutes does this part of your trip take? *Please write your answer here:* ____________________ [drop down 1-200 minutes]

54. Do you then reach campus or do you transfer to another mode (walking, cycling, driving, taking the bus or metro, etc.)?
*Please choose **only one** of the following:*

- Reach campus
- Transfer to another mode

Part 2a: Commuting to McGill on Cold Snowy Days (Leg 7)

55. **For the seventh part of my trip on a typical cold snowy day, I**… :
*Please choose **only one** of the following:*

- Walk to transit
- Walk
- Ride a bicycle
- Carpool
- Drive
- Take the bus
- Take the metro
- Take the commuter train
- Take the McGill intercampus shuttle
- Ride a motorcycle or scooter
- Take a taxi
- Make a stop
- Other

56. Which bus route do you take?
*Please choose **only one** of the following:* [drop down menu with stops]

57. Which metro line(s) do you take?
*Please choose **all** that apply:*
- Green Line
- Orange Line
- Blue Line
- Yellow Line

58. Which commuter train line do you take?
*Please choose **only one** of the following:*
- Blainville-Saint-Jérôme
- Deux-Montagnes
- Candiac
- Mont-Saint-Hilaire
- Vaudreuil-Hudson

59. What is the purpose of the stop?
*Please choose **all** that apply:*
- Drop children off at school/daycare/etc.
- Shopping
- Buy coffee/meal
- Stop at the gym
- Stop at the bank/post office/etc.
- Other: ___________________

60. How many minutes does this stop take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

61. How many minutes does this part of your trip take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

62. Do you then reach campus or do you transfer to another mode (walking, cycling, driving, taking the bus or metro, etc.)?
*Please choose **only one** of the following:*
- Reach campus
- Transfer to another mode

Part 2a: Commuting to McGill on Cold Snowy Days (Leg 8)

63. **For the eighth part of my trip on a typical cold snowy day, I**… :
    *Please choose **only one** of the following:*
- Walk to transit
- Walk
- Ride a bicycle
- Carpool
- Drive
- Take the bus
- Take the metro
- Take the commuter train
- Take the McGill intercampus shuttle
- Ride a motorcycle or scooter
- Take a taxi
- Make a stop
- Other

64. Which bus route do you take?
    *Please choose **only one** of the following:* [drop down menu with stops]

65. Which metro line(s) do you take?
    *Please choose **all** that apply:*
- Green Line
- Orange Line
- Blue Line
- Yellow Line

66. Which commuter train line do you take?
    *Please choose **only one** of the following:*
- Blainville-Saint-Jérôme
- Deux-Montagnes
- Candiac
- Mont-Saint-Hilaire
- Vaudreuil-Hudson

67. What is the purpose of the stop?
*Please choose **all** that apply:*

- Drop children off at school/daycare/etc.
- Shopping
- Buy coffee/meal
- Stop at the gym
- Stop at the bank/post office/etc.
- Other: ___________________

68. How many minutes does this stop take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

69. How many minutes does this part of your trip take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

70. Do you then reach campus or do you transfer to another mode (walking, cycling, driving, taking the bus or metro, etc.)?
*Please choose **only one** of the following:*

- Reach campus
- Transfer to another mode

Part 2a: Commuting to McGill on Cold Snowy Days (Leg 9)

71. **For the ninth part of my trip on a typical cold snowy day, I**… :
*Please choose **only one** of the following:*

- Walk to transit
- Walk
- Ride a bicycle
- Carpool
- Drive
- Take the bus
- Take the metro
- Take the commuter train
- Take the McGill intercampus shuttle
- Ride a motorcycle or scooter
- Take a taxi
- Make a stop
- Other

72. Which bus route do you take?
*Please choose **only one** of the following:* [drop down menu with stops]

73. Which metro line(s) do you take?
*Please choose **all** that apply:*
- Green Line
- Orange Line
- Blue Line
- Yellow Line

74. Which commuter train line do you take?
*Please choose **only one** of the following:*
- Blainville-Saint-Jérôme
- Deux-Montagnes
- Candiac
- Mont-Saint-Hilaire
- Vaudreuil-Hudson

75. What is the purpose of the stop?
*Please choose **all** that apply:*
- Drop children off at school/daycare/etc.
- Shopping
- Buy coffee/meal
- Stop at the gym
- Stop at the bank/post office/etc.
- Other: ___________________

76. How many minutes does this stop take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

77. How many minutes does this part of your trip take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

78. Do you then reach campus or do you transfer to another mode (walking, cycling, driving, taking the bus or metro, etc.)?
*Please choose **only one** of the following:*
- Reach campus
- Transfer to another mode

Part 2a: Commuting to McGill on Cold Snowy Days (Leg 10)

79. **For the tenth part of my trip on a typical cold snowy day, I**… :
    *Please choose **only one** of the following:*
    - Walk to transit
    - Walk
    - Ride a bicycle
    - Carpool
    - Drive
    - Take the bus
    - Take the metro
    - Take the commuter train
    - Take the McGill intercampus shuttle
    - Ride a motorcycle or scooter
    - Take a taxi
    - Make a stop
    - Other

80. Which bus route do you take?
    *Please choose **only one** of the following:* [drop down menu with stops]

81. Which metro line(s) do you take?
    *Please choose **all** that apply:*
    - Green Line
    - Orange Line
    - Blue Line
    - Yellow Line

82. Which commuter train line do you take?
    *Please choose **only one** of the following:*
    - Blainville-Saint-Jérôme
    - Deux-Montagnes
    - Candiac
    - Mont-Saint-Hilaire
    - Vaudreuil-Hudson

83. What is the purpose of the stop?
*Please choose **all** that apply:*

- Drop children off at school/daycare/etc.
- Shopping
- Buy coffee/meal
- Stop at the gym
- Stop at the bank/post office/etc.
- Other: ___________________

84. How many minutes does this stop take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

85. How many minutes does this part of your trip take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

86. Do you then reach campus or do you transfer to another mode (walking, cycling, driving, taking the bus or metro, etc.)?
*Please choose **only one** of the following:*

- Reach campus
- Transfer to another mode

Part 2a: Commuting to McGill on Cold Snowy Days (Satisfaction)

87. For the walking portion(s) of your trip on typical cold snowy days, please rate your satisfaction with the following:
Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
I am satisfied with the length of time I spend walking					
I am comfortable when I walk					
I feel safe from traffic when I walk					
I feel safe from crime and unwanted attention when I walk					

88. For the cycling portion(s) of your trip on typical cold snowy days, please rate your satisfaction with the following:

Please choose the appropriate response for each item:

	Strongly disagree	**Somewhat disagree**	**Neutral**	**Somewhat agree**	**Strongly agree**
I am satisfied with the length of time I spend cycling					
The amount of time I spend cycling is usually consistent					
I am comfortable when I cycle					
I feel safe from traffic when I cycle					
I feel safe from crime and unwanted attention when I cycle					
The quality of the bicycle paths I use is good					

89. For the driving portion(s) of your trip on typical cold snowy days, please rate your satisfaction with the following:

Please choose the appropriate response for each item:

	Strongly disagree	**Somewhat disagree**	**Neutral**	**Somewhat agree**	**Strongly agree**
I am satisfied with the length of time I spend driving					
The amount of time I spend driving is usually consistent					
I am comfortable when I drive					
I feel safe from traffic when I drive					
I feel safe from crime and unwanted attention when I drive					
The cost of driving is reasonable					

90. For the bus portion(s) of your trip on typical cold snowy days, please rate your satisfaction with the following:
Please choose the appropriate response for each item:

	Strongly disagree	**Somewhat disagree**	**Neutral**	**Somewhat agree**	**Strongly agree**
I am satisfied with the length of time I spend on the bus					
My bus rides takes a consistent amount of time					
I am comfortable when I am on the bus					
I feel safe from crime and unwanted attention when I am on the bus					
The cost of taking the bus is reasonable					
I am satisfied with how long it takes me to reach my bus stop					
The waiting time for the bus is reasonable					

91. For the metro portion(s) of your trip on typical cold snowy days, please rate your satisfaction with the following:
Please choose the appropriate response for each item:

	Strongly disagree	**Somewhat disagree**	**Neutral**	**Somewhat agree**	**Strongly agree**
I am satisfied with the length of time I spend on the metro					
My ride on the metro takes a consistent amount of time					
I am comfortable when I am on the metro					
I feel safe from crime and unwanted attention when I am on the metro					
The cost of taking the metro is reasonable					
I am satisfied with how long it takes me to get to the metro					
The waiting time for the metro is reasonable					

92. For the commuter train portion(s) of your trip on typical cold snowy days, please rate your satisfaction with the following:
Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
I am satisfied with the length of time I spend on the commuter train					
My ride on the commuter train takes a consistent amount of time					
I am comfortable when I am on the commuter train					
I feel safe from crime and unwanted attention when I am on the commuter train					
The cost of taking the commuter train is reasonable					
I am satisfied with how long it takes me to get to the commuter train					
The waiting time for the commuter train is reasonable					

93. For the McGill intercampus shuttle portion of your trip on typical cold snowy days, please rate your satisfaction with the following:
Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
I am satisfied with the length of time I spend on the intercampus shuttle					
My ride on the intercampus shuttle takes a consistent amount of time					
I am comfortable when I am on the intercampus shuttle					
I feel safe from crime and unwanted attention when I am on the intercampus shuttle					
I am satisfied with how long it takes me to walk to the intercampus shuttle					
The waiting time for the intercampus shuttle is reasonable					

94. On a typical cold snowy day, how much additional time (in minutes) do you budget to ensure that you get to McGill on time? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

95. How much do you agree with the following statements?
Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
On typical cold snowy days, I feel stressed during my trips to McGill					
On typical cold snowy days, my commute to McGill negatively impacts my punctuality / attendance					
On typical cold snowy days, I feel energized when I arrive at McGill					

Part 2b: Commuting to McGill on Warm Dry Days

96. Would your commute to McGill on a typical warm dry day be the same as on a typical cold snowy day?
*Please choose **only one** of the following:*

- Yes
- No

97. Would your opinions about your commute on a typical hot humid day be the same as on a typical cold snowy day?
*Please choose **only one** of the following:*

- Yes
- No

Part 2a: Commuting to McGill on Warm Dry Days (Leg 1)

98. **For the first part of my trip on a typical warm dry day, I**… :
*Please choose **only one** of the following:*

- Walk to transit
- Walk
- Ride a bicycle
- Carpool
- Drive
- Ride a motorcycle or scooter
- Take a taxi
- Other

99. How many minutes does this part of your trip take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

100. Do you then reach campus or do you transfer to another mode (walking, cycling, driving, taking a taxi, taking the bus or metro, etc.)
*Please choose **only one** of the following:*
- Reach campus
- Transfer to another mode

Part 2b: Commuting to McGill on Warm Dry Days (Leg 2)

101. **For the second part of my trip on a typical warm dry day, I**… :
*Please choose **only one** of the following:*
- Walk to transit
- Walk
- Ride a bicycle
- Carpool
- Drive
- Take the bus
- Take the metro
- Take the commuter train
- Take the McGill intercampus shuttle
- Ride a motorcycle or scooter
- Take a taxi
- Make a stop
- Other

102. Which bus route do you take?
*Please choose **only one** of the following:* [drop down menu with stops]

103. Which metro line(s) do you take?
*Please choose **all** that apply:*
- Green Line
- Orange Line
- Blue Line
- Yellow Line

104. Which commuter train line do you take?
*Please choose **only one** of the following:*

- Blainville-Saint-Jérôme
- Deux-Montagnes
- Candiac
- Mont-Saint-Hilaire
- Vaudreuil-Hudson

105. What is the purpose of the stop?
*Please choose **all** that apply:*

- Drop children off at school/daycare/etc.
- Shopping
- Buy coffee/meal
- Stop at the gym
- Stop at the bank/post office/etc.
- Other: ___________________

106. How many minutes does this stop take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

107. How many minutes does this part of your trip take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

108. Do you then reach campus or do you transfer to another mode (walking, cycling, driving, taking the bus or metro, etc.)?
*Please choose **only one** of the following:*

- Reach campus
- Transfer to another mode

Part 2b: Commuting to McGill on Warm Dry Days (Leg 3)

109. **For the third part of my trip on a typical warm dry day, I**… :
*Please choose **only one** of the following:*
- Walk to transit
- Walk
- Ride a bicycle
- Carpool
- Drive
- Take the bus
- Take the metro
- Take the commuter train
- Take the McGill intercampus shuttle
- Ride a motorcycle or scooter
- Take a taxi
- Make a stop
- Other

110. Which bus route do you take?
*Please choose **only one** of the following:* [drop down menu with stops]

111. Which metro line(s) do you take?
*Please choose **all** that apply:*
- Green Line
- Orange Line
- Blue Line
- Yellow Line

112. Which commuter train line do you take?
*Please choose **only one** of the following:*
- Blainville-Saint-Jérôme
- Deux-Montagnes
- Candiac
- Mont-Saint-Hilaire
- Vaudreuil-Hudson

113. What is the purpose of the stop?
*Please choose **all** that apply:*
- Drop children off at school/daycare/etc.
- Shopping
- Buy coffee/meal
- Stop at the gym
- Stop at the bank/post office/etc.
- Other: ___________________

114. How many minutes does this stop take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

115. How many minutes does this part of your trip take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

116. Do you then reach campus or do you transfer to another mode (walking, cycling, driving, taking the bus or metro, etc.)?
*Please choose **only one** of the following:*
- Reach campus
- Transfer to another mode

Part 2b: Commuting to McGill on Warm Dry Days (Leg 4)

117. **For the fourth part of my trip on a typical warm dry day, I**… :
*Please choose **only one** of the following:*
- Walk to transit
- Walk
- Ride a bicycle
- Carpool
- Drive
- Take the bus
- Take the metro
- Take the commuter train
- Take the McGill intercampus shuttle
- Ride a motorcycle or scooter
- Take a taxi
- Make a stop
- Other

118. Which bus route do you take?
*Please choose **only one** of the following:* [drop down menu with stops]

119. Which metro line(s) do you take?
*Please choose **all** that apply:*
- Green Line
- Orange Line
- Blue Line
- Yellow Line

120. Which commuter train line do you take?
*Please choose **only one** of the following:*
- Blainville-Saint-Jérôme
- Deux-Montagnes
- Candiac
- Mont-Saint-Hilaire
- Vaudreuil-Hudson

121. What is the purpose of the stop?
*Please choose **all** that apply:*
- Drop children off at school/daycare/etc.
- Shopping
- Buy coffee/meal
- Stop at the gym
- Stop at the bank/post office/etc.
- Other: ____________________

122. How many minutes does this stop take? *Please write your answer here:* ____________________ [drop down 1-200 minutes]

123. How many minutes does this part of your trip take? *Please write your answer here:* ____________________ [drop down 1-200 minutes]

124. Do you then reach campus or do you transfer to another mode (walking, cycling, driving, taking the bus or metro, etc.)?
*Please choose **only one** of the following:*
- Reach campus
- Transfer to another mode

Part 2b: Commuting to McGill on Warm Dry Days (Leg 5)

125. **For the fifth part of my trip on a typical warm dry day, I…** :
*Please choose **only one** of the following:*
- Walk to transit
- Walk
- Ride a bicycle
- Carpool
- Drive
- Take the bus
- Take the metro
- Take the commuter train
- Take the McGill intercampus shuttle
- Ride a motorcycle or scooter
- Take a taxi
- Make a stop
- Other

126. Which bus route do you take?
*Please choose **only one** of the following:* [drop down menu with stops]

127. Which metro line(s) do you take?
*Please choose **all** that apply:*
- Green Line
- Orange Line
- Blue Line
- Yellow Line

128. Which commuter train line do you take?
*Please choose **only one** of the following:*
- Blainville-Saint-Jérôme
- Deux-Montagnes
- Candiac
- Mont-Saint-Hilaire
- Vaudreuil-Hudson

129. What is the purpose of the stop?
*Please choose **all** that apply:*

- Drop children off at school/daycare/etc.
- Shopping
- Buy coffee/meal
- Stop at the gym
- Stop at the bank/post office/etc.
- Other: ___________________

130. How many minutes does this stop take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

131. How many minutes does this part of your trip take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

132. Do you then reach campus or do you transfer to another mode (walking, cycling, driving, taking the bus or metro, etc.)?
*Please choose **only one** of the following:*

- Reach campus
- Transfer to another mode

Part 2b: Commuting to McGill on Warm Dry Days (Leg 6)

133. **For the sixth part of my trip on a typical warm dry day, I**… :
*Please choose **only one** of the following:*

- Walk to transit
- Walk
- Ride a bicycle
- Carpool
- Drive
- Take the bus
- Take the metro
- Take the commuter train
- Take the McGill intercampus shuttle
- Ride a motorcycle or scooter
- Take a taxi
- Make a stop
- Other

134. Which bus route do you take?
*Please choose **only one** of the following:* [drop down menu with stops]

135. Which metro line(s) do you take?
*Please choose **all** that apply:*
- Green Line
- Orange Line
- Blue Line
- Yellow Line

136. Which commuter train line do you take?
*Please choose **only one** of the following:*
- Blainville-Saint-Jérôme
- Deux-Montagnes
- Candiac
- Mont-Saint-Hilaire
- Vaudreuil-Hudson

137. What is the purpose of the stop?
*Please choose **all** that apply:*
- Drop children off at school/daycare/etc.
- Shopping
- Buy coffee/meal
- Stop at the gym
- Stop at the bank/post office/etc.
- Other: ___________________

138. How many minutes does this stop take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

139. How many minutes does this part of your trip take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

140. Do you then reach campus or do you transfer to another mode (walking, cycling, driving, taking the bus or metro, etc.)?
*Please choose **only one** of the following:*
- Reach campus
- Transfer to another mode

Part 2b: Commuting to McGill on Warm Dry Days (Leg 7)

141. **For the seventh part of my trip on a typical warm dry day, I**… :
*Please choose **only one** of the following:*
- Walk to transit
- Walk
- Ride a bicycle
- Carpool
- Drive
- Take the bus
- Take the metro
- Take the commuter train
- Take the McGill intercampus shuttle
- Ride a motorcycle or scooter
- Take a taxi
- Make a stop
- Other

142. Which bus route do you take?
*Please choose **only one** of the following:* [drop down menu with stops]

143. Which metro line(s) do you take?
*Please choose **all** that apply:*
- Green Line
- Orange Line
- Blue Line
- Yellow Line

144. Which commuter train line do you take?
*Please choose **only one** of the following:*
- Blainville-Saint-Jérôme
- Deux-Montagnes
- Candiac
- Mont-Saint-Hilaire
- Vaudreuil-Hudson

145. What is the purpose of the stop?
*Please choose **all** that apply:*

- Drop children off at school/daycare/etc.
- Shopping
- Buy coffee/meal
- Stop at the gym
- Stop at the bank/post office/etc.
- Other: ___________________

146. How many minutes does this stop take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

147. How many minutes does this part of your trip take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

148. Do you then reach campus or do you transfer to another mode (walking, cycling, driving, taking the bus or metro, etc.)?
*Please choose **only one** of the following:*

- Reach campus
- Transfer to another mode

Part 2b: Commuting to McGill on Warm Dry Days (Leg 8)

149. **For the eighth part of my trip on a typical warm dry day, I**… :
*Please choose **only one** of the following:*

- Walk to transit
- Walk
- Ride a bicycle
- Carpool
- Drive
- Take the bus
- Take the metro
- Take the commuter train
- Take the McGill intercampus shuttle
- Ride a motorcycle or scooter
- Take a taxi
- Make a stop
- Other

150. Which bus route do you take?
Please choose ***only one*** *of the following:* [drop down menu with stops]

151. Which metro line(s) do you take?
Please choose ***all*** *that apply:*
- Green Line
- Orange Line
- Blue Line
- Yellow Line

152. Which commuter train line do you take?
Please choose ***only one*** *of the following:*
- Blainville-Saint-Jérôme
- Deux-Montagnes
- Candiac
- Mont-Saint-Hilaire
- Vaudreuil-Hudson

153. What is the purpose of the stop?
Please choose ***all*** *that apply:*
- Drop children off at school/daycare/etc.
- Shopping
- Buy coffee/meal
- Stop at the gym
- Stop at the bank/post office/etc.
- Other: ___________________

154. How many minutes does this stop take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

155. How many minutes does this part of your trip take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

156. Do you then reach campus or do you transfer to another mode (walking, cycling, driving, taking the bus or metro, etc.)?
Please choose ***only one*** *of the following:*
- Reach campus
- Transfer to another mode

Part 2b: Commuting to McGill on Warm Dry Days (Leg 9)

157. **For the ninth part of my trip on a typical warm dry day, I**… :
*Please choose **only one** of the following:*
- Walk to transit
- Walk
- Ride a bicycle
- Carpool
- Drive
- Take the bus
- Take the metro
- Take the commuter train
- Take the McGill intercampus shuttle
- Ride a motorcycle or scooter
- Take a taxi
- Make a stop
- Other

158. Which bus route do you take?
*Please choose **only one** of the following:* [drop down menu with stops]

159. Which metro line(s) do you take?
*Please choose **all** that apply:*
- Green Line
- Orange Line
- Blue Line
- Yellow Line

160. Which commuter train line do you take?
*Please choose **only one** of the following:*
- Blainville-Saint-Jérôme
- Deux-Montagnes
- Candiac
- Mont-Saint-Hilaire
- Vaudreuil-Hudson

161. What is the purpose of the stop?
*Please choose **all** that apply:*

- Drop children off at school/daycare/etc.
- Shopping
- Buy coffee/meal
- Stop at the gym
- Stop at the bank/post office/etc.
- Other: ___________________

162. How many minutes does this stop take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

163. How many minutes does this part of your trip take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

164. Do you then reach campus or do you transfer to another mode (walking, cycling, driving, taking the bus or metro, etc.)?
*Please choose **only one** of the following:*

- Reach campus
- Transfer to another mode

Part 2b: Commuting to McGill on Warm Dry Days (Leg 10)

165. **For the tenth part of my trip on a typical warm dry day, I**… :
*Please choose **only one** of the following:*

- Walk to transit
- Walk
- Ride a bicycle
- Carpool
- Drive
- Take the bus
- Take the metro
- Take the commuter train
- Take the McGill intercampus shuttle
- Ride a motorcycle or scooter
- Take a taxi
- Make a stop
- Other

166. Which bus route do you take?
*Please choose **only one** of the following:* [drop down menu with stops]

167. Which metro line(s) do you take?
*Please choose **all** that apply:*
- Green Line
- Orange Line
- Blue Line
- Yellow Line

168. Which commuter train line do you take?
*Please choose **only one** of the following:*
- Blainville-Saint-Jérôme
- Deux-Montagnes
- Candiac
- Mont-Saint-Hilaire
- Vaudreuil-Hudson

169. What is the purpose of the stop?
*Please choose **all** that apply:*
- Drop children off at school/daycare/etc.
- Shopping
- Buy coffee/meal
- Stop at the gym
- Stop at the bank/post office/etc.
- Other: ___________________

170. How many minutes does this stop take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

171. How many minutes does this part of your trip take? *Please write your answer here:* ___________________ [drop down 1-200 minutes]

172. Do you then reach campus or do you transfer to another mode (walking, cycling, driving, taking the bus or metro, etc.)?
*Please choose **only one** of the following:*
- Reach campus
- Transfer to another mode

Part 2b: Commuting to McGill on Warm Dry Days (Satisfaction)

173. For the walking portion(s) of your trip on typical warm dry days, please rate your satisfaction with the following:
Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
I am satisfied with the length of time I spend walking					
I am comfortable when I walk					
I feel safe from traffic when I walk					
I feel safe from crime and unwanted attention when I walk					

174. For the cycling portion(s) of your trip on typical warm dry days, please rate your satisfaction with the following:
Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
I am satisfied with the length of time I spend cycling					
The amount of time I spend cycling is usually consistent					
I am comfortable when I cycle					
I feel safe from traffic when I cycle					
I feel safe from crime and unwanted attention when I cycle					
The quality of the bicycle paths I use is good					

175. For the driving portion(s) of your trip on typical warm dry days, please rate your satisfaction with the following:
Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
I am satisfied with the length of time I spend driving					
The amount of time I spend driving is usually consistent					
I am comfortable when I drive					
I feel safe from traffic when I drive					
I feel safe from crime and unwanted attention when I drive					
The cost of driving is reasonable					

176. For the bus portion(s) of your trip on typical warm dry days, please rate your satisfaction with the following:

Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
I am satisfied with the length of time I spend on the bus					
My bus rides takes a consistent amount of time					
I am comfortable when I am on the bus					
I feel safe from crime and unwanted attention when I am on the bus					
The cost of taking the bus is reasonable					
I am satisfied with how long it takes me to reach my bus stop					
The waiting time for the bus is reasonable					

177. For the metro portion(s) of your trip on typical warm dry days, please rate your satisfaction with the following:

Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
I am satisfied with the length of time I spend on the metro					
My ride on the metro takes a consistent amount of time					
I am comfortable when I am on the metro					
I feel safe from crime and unwanted attention when I am on the metro					
The cost of taking the metro is reasonable					
I am satisfied with how long it takes me to get to the metro					
The waiting time for the metro is reasonable					

178. For the commuter train portion(s) of your trip on typical warm dry days, please rate your satisfaction with the following:
Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
I am satisfied with the length of time I spend on the commuter train					
My ride on the commuter train takes a consistent amount of time					
I am comfortable when I am on the commuter train					
I feel safe from crime and unwanted attention when I am on the commuter train					
The cost of taking the commuter train is reasonable					
I am satisfied with how long it takes me to get to the commuter train					
The waiting time for the commuter train is reasonable					

179. For the McGill intercampus shuttle portion of your trip on typical warm dry days, please rate your satisfaction with the following:
Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
I am satisfied with the length of time I spend on the intercampus shuttle					
My ride on the intercampus shuttle takes a consistent amount of time					
I am comfortable when I am on the intercampus shuttle					
I feel safe from crime and unwanted attention when I am on the intercampus shuttle					
I am satisfied with how long it takes me to walk to the intercampus shuttle					
The waiting time for the intercampus shuttle is reasonable					

180. On a typical warm dry day, how much additional time (in minutes) do you budget to ensure that you get to McGill on time? *Please write your answer here:* ____________________ [drop down 1-200 minutes]

181. How much do you agree with the following statements?
Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
On typical warm dry days, I feel stressed during my trips to McGill					
On typical warm dry days, my commute to McGill negatively impacts my punctuality / attendance					
On typical warm dry days, I feel energized when I arrive at McGill					

Part 2c: Commuting to McGill (Wrap-Up, Part 1 of 4)

182. Have you used any of the following modes in the last year to commute to McGill?
*Please choose **all** that apply:*

- Walking
- Bicycling
- Driving
- Taking the bus
- Taking the metro
- Taking the commuter train
- None of the above

Part 2c: Commuting to McGill (Wrap-Up, Part 2 of 4)

183. Of the modes that you don't typically use to commute to McGill, which are you least likely to use?
*Please choose **only one** of the following:*

- Walking
- Bicycling
- Driving
- Taking the bus
- Taking the metro
- Taking the commuter train

184. Please specify why you don't walk more often during your commuter to McGill.

Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
The commute time is too long					
It takes too much effort					
It's uncomfortable					
It's unsafe					

185. Please specify why you don't cycle more often during your commuter to McGill.

Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
The commute time is too long					
It takes too much effort					
It's uncomfortable					
It's unsafe					
There's not enough parking on campus					

186. Please specify why you don't drive more often during your commuter to McGill.

Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
The commute time is too long					
The commute time is inconsistent					
It doesn't allow me to get enough exercise					
It's uncomfortable					
It's too expensive					
It's not good for the environment					
It's unsafe					
Not enough parking on campus					

187. Please specify why you don't take the bus more often during your commuter to McGill.

Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
The commute time is too long					
The commute time is inconsistent					
It doesn't allow me to get enough exercise					
It's uncomfortable					
It's too expensive					
It's not good for the environment					
It's unsafe					

188. Please specify why you don't take the metro more often during your commuter to McGill.

Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
The commute time is too long					
The commute time is inconsistent					
It doesn't allow me to get enough exercise					
It's uncomfortable					
It's too expensive					
It's not good for the environment					
It's unsafe					

189. Please specify why you don't take the commuter train more often during your commuter to McGill.

Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
The commute time is too long					
The commute time is inconsistent					
It doesn't allow me to get enough exercise					
It's uncomfortable					
It's too expensive					
It's not good for the environment					
It's unsafe					

Part 2c: Commuting to McGill (Wrap-Up, Part 3 of 4)

190. How much do you agree with the following statements?
Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
I like travelling alone					
My family members and I have similar travel habits					
My friends and I have similar travel habits					

191. How much do you agree with the following statements?
Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
I would like to walk more than I currently do					
I would like to cycle more than I currently do					
I would like to transit more than I currently do					
I would like to drive more than I currently do					

192. How much do you agree with the following statements?
Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
We need to use taxes to improve and expand pedestrian areas and sidewalks					
We need to use taxes to improve and expand the bicycle network					
We need to use taxes to improve and expand public transportation					
We need to use taxes to improve and expand the highway network					

193. How much do you agree with the following statements?
Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
I prefer to organize my errands so that I make as few trips as possible					
The only good thing about travelling is arriving at my destination					
I use my commute time productively					
I need a car to do many of the things I like to do					
Parking price and availability affect the choices I make about my commute					

Part 2c: Commuting to McGill (Wrap-Up, Part 4 of 4)

194. How much do you agree with the following statements?
Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
Information about the bus (schedules, on-board announcements, website, etc.) is easy to understand					
Information about the metro (schedules, on-board announcements, website, etc.) is easy to understand					
Information about the commuter train (schedules, on-board announcements, website, etc.) is easy to understand					

195. Have you ever felt unsafe with regard to **crime** or unwanted attention while walking from McGill to transit or parking?
*Please choose **only one** of the following:*

- Yes
- No

196. Where did you feel unsafe with regard to crime or unwanted attention?
Please write your answer here: ____________________

197. What caused you to feel unsafe with regard to crime or unwanted attention? *Please write your answer here:* ____________________

198. Have you ever felt unsafe with regard to potential **traffic accidents** while walking from McGill to transit or parking?
*Please choose **only one** of the following:*
- Yes
- No

199. Where did you feel unsafe with regard to traffic accidents? *Please write your answer here:* ___________________

200. What caused you to feel unsafe with regard to traffic accidents? *Please write your answer here:* ___________________

PART 3: PARKING

201. Have you driven or been drive to campus in the past month?
*Please choose **only one** of the following:*
- Yes
- No

202. When you drive to campus, where do you typically park?
*Please choose **only one** of the following:*
- I don't park; I am dropped off at campus
- On-campus parking (Downtown Campus)
- On-campus parking (Macdonald Campus)
- On-street parking
- Public parking lot (Ste. Anne de Bellevue)
- Other non-McGill parking garage/lot
- Other: ___________________

203. How often do you pay for parking at this location?
*Please choose **only one** of the following:*
- I don't pay for parking
- Every day
- Every week
- Every month
- Every year
- Other: ___________________

204. How much do you pay for parking at this location each day/week/month/etc.? For example: $0.50, $2.75, $5, $17, $100, etc. *Please write your answer here:* $__________________ per day/week/month

PART 4: BICYCLE USAGE

205. What type of bicycle(s), if any, do you have access to?
*Please choose **only one** of the following:*
- I do not have access to a bicycle
- Personal bicycle
- Bixi (seasonal access)
- Personal bicycle & Bixi
- Other: __________________

206. During which months do you commute to McGill by bicycle?
*Please choose **all** that apply:*
- January
- February
- March
- April
- May
- June
- July
- August
- September
- October
- November
- December

207. Where do you typically park when cycling to campus? *Please write your answer here:* __________________

208. Do you have difficulty finding bicycle parking on campus?
*Please choose **only one** of the following:*

- Never
- Rarely
- Sometimes
- Often
- Always

209. When was the last time you had a bicycle stolen at McGill?
*Please choose **only one** of the following:*

- I have never had a bicycle stolen at McGill
- 2013
- 2012
- 2011
- 2010
- 2009
- 2008
- 2007
- 2006
- 2005
- 2004
- 2003
- 2002
- 2001
- 2000
- Before 2000

210. The last time your bicycle was stolen, on which campus did it occur?
*Please choose **only one** of the following:*

- Downtown Campus
- MacDonald Campus

211. Where was your last bicycle stolen on the Downtown Campus? *Please write your answer here:* ____________________

212. Where was your last bicycle stolen on the MacDonald Campus? *Please write your answer here:* ____________________

213. How many bicycles, if any, have you had stolen at campus within the past year?

*Please choose **only one** of the following:*

- 0
- 1
- 2
- 3
- 4+

There are several different types of bicycle racks of campus Please rate the following racks in terms of security and ease of use.

214.

Please choose the appropriate response for each item:

	Very low	Somewhat low	Neutral	Somewhat high	Very high	No opinion
Security						
Ease of use						

215.

Please choose the appropriate response for each item:

	Very low	Somewhat low	Neutral	Somewhat high	Very high	No opinion
Security						
Ease of use						

216.

Please choose the appropriate response for each item:

	Very low	Somewhat low	Neutral	Somewhat high	Very high	No opinion
Security						
Ease of use						

217.

Please choose the appropriate response for each item:

	Very low	Somewhat low	Neutral	Somewhat high	Very high	No opinion
Security						
Ease of use						

218. Would you pay for secured indoor bicycle parking on campus?
*Please choose **only one** of the following:*

- Yes
- No

219. How much would you be willing to pay per? For example: $0.50, $2.75, $5, etc. *Please write your answer here:* ____________________

220. Why not? *Please write your answer here:* ____________________

221. Where do you think there is the most bicycle-related crime on campus? (e.g. bicycle theft) *Please write your answer here:* __________________

222. Do you use any bicycle paths on your way to McGill?
*Please choose **only one** of the following:*
- Yes
- No

223. On which bicycle paths do you spend the most time travelling? (*Please choose **only one** of the following:* [drop down selection]

224. Put a pin on the following map where you usually begin using this bicycle path. *Please write your answer here:* __________________

225. Put a pin on the following map where you usually stop using the bicycle path. *Please write your answer here:* __________________

226. Why do you not use a bicycle path?
Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
The average speed of other cyclists is too fast					
The average speed of other cyclists is too slow					
I do not like cycling with beginner cyclists					
There are no bicycle paths on my way					
The pavement quality is not good					
There are too many cyclists (bicycle congestion)					
I don't feel safe on a bicycle path					
I prefer to cycle in traffic					
I would have to divert too far from the most direct path					
I don't like the design of the bicycle path					

227. In terms of safety and comfort, how desirable are the following types of bicycle lanes and streets for cycling?
Please choose the appropriate response for each item:

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
Bi-directional bicycle lane that is physically separated from traffic by a curb					
Bi-directional bicycle lane that is physically separated from traffic by parked cars					
Painted bicycle lane going with the flow of traffic					
Painted bicycle lane going against the flow of traffic					
Calm residential streets					
Non-residential streets with no bicycle lanes					

228. How could McGill make it easier to commute by bicycle to campus? *Please write your answer here:* ___________________

PART 5: TRANSIT PASSES

229. Do you have a monthly transit pass?
*Please choose **only one** of the following:*
- Yes
- No

230. What type of monthly transit pass do you have?
*Please choose **all** that apply:*
- TRAM monthly pass from the AMT
- STM monthly pass (reduced fare)
- STM monthly pass (regular fare)
- Other: ___________________

231. Are you eligible for reduced transit fares?
*Please choose **only one** of the following:*
- Yes
- No
- Don’t know

232. How important is your (in)eligibility for reduced transit fares in your choice of whether to commute by transit or not?
*Please choose **only one** of the following:*

- Extremely unimportant
- Somewhat unimportant
- Neutral
- Somewhat important
- Extremely important

PART 6: PERSONAL PROFILE

233. Select ***all*** the following that apply to you.
*Please choose **all** that apply:*

- I have a driver's license
- I have a Communauto membership
- I have had a Bixi membership/subscription in the past year
- I have used the Allegro carpooling service in the past year
- None of the above

234. How many automobiles are owned by your household?
*Please choose **only one** of the following:*

- None
- 1 automobile
- 2 automobiles
- 3 automobiles
- 4 automobiles
- 5 automobiles
- 6 automobiles
- 7 automobiles
- 8 automobiles
- 9 automobiles
- 10 automobiles
- More than 10 automobiles
- Prefer not to answer

235. How many licensed drivers are in your household, including yourself?
*Please choose **only one** of the following:*

- None
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- More than 10
- Prefer not to answer

236. How many people are in your household, including yourself?
*Please choose **only one** of the following:*

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- More than 10
- Prefer not to answer

237. How many children under the age of 16 are in your household?
*Please choose **only one** of the following:*

- None
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- More than 10
- Prefer not to answer

238. In what year did you start living in your current residence?
*Please choose **only one** of the following:* [drop down menu with years]

239. What language(s) are typically spoken in your household?
*Please choose **all** that apply:*

- English
- French
- Prefer not to answer
- Other: ____________________

240. When you moved into your current residence, how important were the following factors in your decision?
Please choose the appropriate response for each item:

	Extremely unimportant	Somewhat unimportant	Neutral	Somewhat important	Extremely important	No opinion
Proximity to McGill						
Proximity to public transportation						
Cost of commuting (excluding the cost of parking)						
Painted bicycle lane going against the flow of traffic						
Being in a location where I wouldn't have to drive						
The parking situation at McGill						

241. Please list any other factors that were important in your decision to move into your current residence. *Please write your answer here:* ____________________

242. Imagine that you were moving the next 6 months. Please rate the importance of the following factors in deciding where you would move.
Please choose the appropriate response for each item:

	Extremely unimportant	Somewhat unimportant	Neutral	Somewhat important	Extremely important	No opinion
Proximity to McGill						
Proximity to public transportation						
Cost of commuting (excluding the cost of parking)						
Painted bicycle lane going against the flow of traffic						
Being in a location where I wouldn't have to drive						
The parking situation at McGill						

243. Please list any other factors that would be important in deciding where you would move. *Please write your answer here:* ____________________

244. Are you…?

*Please choose **only one** of the following:*

- Male
- Female
- Prefer not to answer

245. What city and country did you grow up in? If you grew up in more than one place, please indicate the city and country in which you spent the most time (e.g. Ottawa, Canada). *Please write your answer here:* ____________________

246. What year were you born in?

*Please choose **only one** of the following:* [drop down menu with years]

247. What is your yearly personal income?

*Please choose **only one** of the following:*

- $0 to $19,999
- $20,000 to $39,999
- $40,000 to $59,999
- $60,000 to $79,999
- $80,000 to $99,999
- $100,000 to $119,999
- $120,000 to $139,999
- $140,000 to $159,999
- $160,000 to $179,999
- $180,000 to $199,999
- Above $200,000
- Prefer not to answer

248. Taking al things into account, how satisfied are you with your life these days (1 = extremely dissatisfied, 10 = extremely satisfied)?
*Please choose **only one** of the following:*

- 1 (extremely dissatisfied)
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10 (extremely satisfied)
- Prefer not to answer

PART 7: FURTHER THOUGHTS

249. Do you have any suggestions to encourage the use of sustainable transportation (cycling, walking, and public transit) to McGill? *Please write your answer here:* ___________________

250. Do you have any other comments or concerns about travelling to McGill? *Please write your answer here:* ___________________

251. In order to be part of our draw for the various prizes please enter your email address. *Please write your answer here:* ___________________

THANK YOU!

Thank you for your participation in the 2013 McGill Commuter Survey! Your name will automatically be included in a drawing for various exciting prizes. Transportation Research at McGill (TRAM), in collaboration with the McGill Office of Sustainability, will use the results of this survey to improve travel to and from McGill University and to develop recommendations on how to further encourage the use of sustainable transportation for commuting to McGill.