

On the Heterogeneity and Substitution Patterns in Mobility Tool Ownership Choices of Post-Secondary Students: The Case of Toronto

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Abstract

The paper presents an investigation of the choices of mobility tool ownership of post-secondary (young adults) students in Toronto. Data came from a 2015 survey of post-secondary students across four universities in Toronto. The choices of owning a basic mobility tool (driver's license, car, transit pass, and bicycle) or combinations of basic tools (composite tools) are investigated through estimation of cross-nested generalized extreme value (GEV) models. Empirical models reveal that heterogeneity and complicated substitution patterns exist in the choices of mobility tool ownership of young adults in Toronto. The paper proposes a parsimonious GEV model that drastically reduces the total number of parameters that are needed to be estimated while accommodating the full range of substitution patterns among the choice alternatives. The model clearly shows the systematic interaction of basic mobility tool ownership utility is more prevalent than the random correlation that a GEV model can capture. Students' personal and household related attributes influence the choice of owning combinations of mobility tools and influence multimodality. It is also found that older and male students are more multimodal than younger and female students. High car ownership levels play a pivotal role in the choice of owning transit passes. These trends provide useful information for policymakers should these patterns continue as the student population enters into the workforce.

Keywords: Mobility tool ownership; travel behaviour of young adults; post-secondary students; GEV model; parsimonious specification; substitution patterns in mobility tool ownership choice.

1. Introduction

There has been a recent surge in interest among transportation researchers on modelling mobility tool ownership as opposed to just modelling car ownership. The concept of a mobility tool breaks the myopic consideration of private car as the only mobility tool. In fact, in large urban areas, various tools/means can provide various levels of mobility to different individuals. For example, owning a driver's license allows someone not only using a driver-owned car but also a car from a car sharing service. Similarly, owning a transit pass allows unrestricted access to transit services. Owning a bicycle allows unrestricted use of bicycles as a travel mode. Of course, many individuals often own multiples of such tools. Ownership of mobility tools can provide profound insight into an individual's reliance on specific modes for daily activities (Kieser et al. 2015). In fact, this indicates the individual's modality (Carel et al. 2011). More specifically speaking, ownership of multiple tools reflects the traits of multimodality. It is important to have an empirical understanding regarding the various factors that influence the choice of owning mobility tools by urban residents. Such understand can facilitate facilitates developing customized policy initiatives to encourage multimodality and reduce private car dependency. In this regard, the choices of mobility tool ownerships by young adults is particularly important as they are the next generation of urban commuters and they will define the services and requirements for future urban transportation systems. It is speculated that travel behaviour originating during individuals' young adulthood will have a profound influence on their future travel behaviour.

Among young adults, students from post-secondary institutions are of particular interest to urban planners as they make up the cohort who will eventually lead the technological and service sectors and can be expected to have a great influence on future urban development (Zhou 2012). Ironically, this cohort of the population is often under-represented in regional household travel surveys that provide data for evidence-based urban planning exercises. For example, in the case of the Greater Toronto Area (GTA), while the post-secondary student population shares more than 23 percent of total population's size, in the regional household travel survey (5 percent household sample) this group constituted less than 2.5 percent of the sample (TTS 2011). Given this under-representation, there has been ample interest in collecting information regarding the travel patterns of post-secondary students. One such initiative is a cross-institutional partnership between the four major universities in Toronto to collect data regarding student travel patterns in Toronto (StudentMoveTO 2016). The survey collected a variety of travel and socio-demographic information, including detailed information on their mobility tool ownership.

This paper makes use of this unique dataset to enhance our understanding of the mobility tool ownership choices of post-secondary students in Toronto. The main objective is to develop insight into the trade-offs involved in making choices of mobility tools and possible multimodal (owning more than one tool) behaviour. The modality style shaped by the choices of mobility tool ownership at this early age could be the mobility style/preferences in the future life of young adults (Buhler and Hamre 2014). Of particular relevance to mobility tool ownership of post-secondary students is the declining attraction of private automobile sales along with delays or forgoing obtaining a driver's license amongst millennials (Delbosc and Currie 2014). Post-secondary students are certainly a part of the millennial cohort and thus examining their mobility tool ownership patterns may provide key insights into understanding the reasoning for these

trends. This paper employs a discrete choice model to unravel the heterogeneity and substitution patterns in the choices of mobility tool ownership of post-secondary students.

The remainder of the paper is organized as follows. First, an analysis of the relevant literature on investigating mobility tool ownership choices is presented. Second, the dataset used for empirical investigation is discussed. Third, the formulations of the econometric model used for empirical investigation is presented. Fourth, the empirical models are discussed. Finally, the paper concludes with a discussion of key findings policy relevance.

2. Literature Review

A large number of studies in the literature focused on modelling the choice of specific mobility tool, e.g., private car, transit pass, bicycle, etc. We are not focussing on an extensive review of those studies; rather we provide a brief overview of a few. De Jong et al. (2004), Potoglou and Kanaroglou (2008), and Anowar et al. (2014) provided comprehensive reviews of modelling private car ownership. Habib (2014), as well as van Ackler and Wilcox (2010), investigated the joint choices of owning a private car and the travel mode choice behaviour. In a recent study Anowar et al. (2016) examined the longitudinal patterns of car ownership choices in Montreal as a function of land use and household structure-related variables.

Compared to car ownership investigations, studies of transit pass ownership is scarce. Among the few studies available Vance and Peistrup (2012) investigated the choice of transit pass ownership for investigating the effects of transit stop proximity, fuel price fluctuation, transit service density, and gender. Badoe and Yendeti (2007) presented models of transit pass ownership and the number of transit trips taken during the day.

A large number of studies are available that focused on bicycle ownership modelling. A large number of these studies focused on commuting by bicycle than just modelling bicycle ownership. Heinen et al. (2010) presented a comprehensive review of such studies. Handy et al. (2010) investigated factors influencing bicycle usage (ownership) in six small American cities. In the most recent paper, Muñoz et al. (2016) presented a comprehensive review of bicycle ownership modeling studies that used a latent variable approach. Also, some studies investigated the correlations between bicycle ownership and other relevant choices. For example, Pinjari et al. (2008) presented a model that jointly considered bicycle ownership and residential location choice. In a recent study Habib et al. (2014) presents a hybrid choice model of bicycle ownership and bicycle usage in Toronto.

As opposed to modelling the choices of one or two specific tools and/or their usage, a number of studies focused on the choices of mobility tools in general and are relevant to our investigation. Beige (2004) is the earliest available study that modelled the choices of mobility tool ownership considering multiple tool options. Driver's license, car and three categories of transit passes are considered as mobility tool options and the choices of owning one of those tools were modelled as a discrete choice (multinomial logit model: MNL) as functions of personal attributes, household attributes, location specific effects, and performances of public transport in the region. The study considered choices of mobility tool ownership of all adult (over 18 years of age) in Switzerland and use multiple Swiss national travel survey data for empirical investigation. This

investigation revealed that in Switzerland, males showed more multimodal behaviour (owning more than one tool) than females. Household income was found to influence owning car and driver's licenses as well as owning public transport tickets. It is also found that a larger population size in a city encouraged a higher level of transit pass ownership.

Scott and Axhausen (2006) investigated the joint ownership of cars and transit passes at the household level using data collected from a stated preference experiment. They used a Bivariate Ordered Probit model for investigating the relationship between the choice of owning cars and season tickets of public transit in the German city of Karlsruhe. The study established that it was prudent to refrain from the practice of modelling only car ownership and to focus instead on the comprehensive modelling of mobility tool ownership. The study warned that modelling the choice of a specific tool might be biased and misleading regarding understanding peoples' travel behaviour and modality.

Beige and Axhausen (2008) investigated the long-term impacts (on travel behaviour) of mobility tool ownership choices and corresponding trends in Zurich. They used data from a retrospective survey and found that the mobility ownership trend remained fairly stable over time, but was affected strongly by turning points (life event e.g., birth, death, marriage, etc.) in an individual's life. The study identified that mobility tool ownership choices were very closely related to location (home, work, school, etc.) changes. It was found that location changes occurred with a greater degree of frequency than mobility tool changes, so there was a higher degree of probability that the two occurred simultaneously or in close succession.

Pinjari et al. (2008) present a joint investigation into residential location, automobile ownership, bicycle ownership and commute mode choice. This joint modelling exercise attempted to link the relationships among long-, medium- and short-term decisions. This joint modelling framework was supported by the concept of lifestyle decisions, where mobility tool ownership played a key role. The authors also noted the challenges associated with such modelling exercises, stating concerns regarding self-selection bias/endogeneity among decisions, among other issues.

Weis et al. (2010) conducted a set of stated preference experiments regarding mode choice and mobility tool fleet composition in response to increased fuel prices. They also developed a model for mobility tool ownership (transit pass and car ownership) choices, considering the impact of vehicle age on the decision to upgrade/replace the respondent's vehicle. The study found that like mode choice, mobility tool ownership choice was also price inelastic. A considerable amount of inertia was detected in not changing mobility tool ownership choices even in the face of increasing ownership/maintenance costs.

Habib and Sasic (2014) presented an econometric model of joint mobility tool ownership choice and mode choice for non-commuting trips. The paper employed Generalized Extreme Value (GEV) modelling structure to capture preference heterogeneity in mobility tool ownership choice behaviour. Results of this investigation clearly identified that daily modal preferences were strongly conditioned by mobility tool ownership choices. This highlights the fact that mobility tool ownership choices were perhaps based on perceived short- to medium-term lifestyle or a modality choice that has profound influences on daily travel behaviour. Fatmi et al. (2014)

presented an investigation on mobility tool ownership of young adults aged between 17 to 19 years in Toronto. They used household travel survey data and employed a latent class multinomial logit model to investigate the choices of owning driver's licenses, an automobile, and transit passes. Classification of a mobility tool considered the choices of a single tool or combinations of tools. Latent class structure identified two separate classes of people that might have different underlying patterns of preferences. Among covariates, trip types, personal attributes, neighbourhood characteristics and network accessibility measures were found significant in influencing choices of mobility tools by young adults.

In a most recent study, Kieser et al. (2015) used 2000 and 2010 Swiss micro-census data to model mobility tool ownership using discrete choice models for evaluating the predictive capacities of the model for forecasting mobility tool ownership choices. Mobility tools were classified as driver's licenses, private car and season's tickets of transit passes. The study emphasised the importance of developing a predictive model of mobility tool ownership choices as it pre-conditions peoples' daily travel behaviour, especially modal preferences for daily travels. Among many variables, the study found that an individual's age, gender, income, urban location specific effects and transportation system performances played critical roles in defining preferences to different mobility tool ownership choices.

Although the study pool on comprehensive mobility tool ownership choices is increasing, the classifications of mobility tools are not often done comprehensively. For example, none of the studies discussed above included bicycle ownership choice as part of mobility tool options. This is a significant limitation, particular in the context of young adults who are more likely to consider active modes for utilitarian purposes. Also, in all comprehensive mobility tool ownership studies, personal level mobility tools classifications are inter-mingled with household level tool availabilities. This is another critical limitation, especially for young people as many may not live with family/parents. In terms of modelling the choice of mobility tool ownership, some studies focused more on heterogeneity across the population while completely overlooking substitutions between the alternative mobility tools. For example, a latent class multinomial logit model of mobility tool ownership choice (as presented by Fatmi et al 2014) can capture distinct patterns of heterogeneity across the population, but completely overlooks the fact that if the tool alternatives are not completely independent, the multinomial choice with each latent class will lead to biased substitution patterns in mobility tool ownership choices.

This paper takes the advantage of a recently collected comprehensive travel survey data of post-secondary students in Toronto to investigate the preference heterogeneity and substitution patterns in mobility tool ownership choices of post-secondary students in Toronto.

3. Data for Empirical Investigation

The data for this research comes from a survey conducted in the four universities in the city of Toronto: (1) Ontario College of Art and Design (OCAD) University; (2) Ryerson University; (3) York University; and the (4) University of Toronto. These four universities have seven campuses in the city of Toronto. The University of Toronto has three campuses (St. George, Scarborough, and Mississauga) and York University has two campuses (Glendon and Keele) whereas OCAD University and Ryerson University have one campus each. These four universities combined

have more than 184,000 post-secondary students. Unfortunately, the conventional household level travel survey typically under-represents post-secondary students. The survey is named as “StudentMoveTO”, which aims to collect detail data on students’ personal and household attributes, activity scheduling information and various behavioural characteristics that are revealed through attitudinal questions. The survey was conducted in the fall of 2015. A total of 15,226 completed responses were collected through the StudentMoveTO with an 8.3% response rate. Twelve types of mobility tool ownership were collected through this survey:

1. No tools
2. Driver’s license only
3. Car only
4. Transit pass only
5. Bicycle only
6. Driver’s license and transit pass
7. Driver’s license and bicycle
8. Car and transit pass
9. Car and bicycle
10. Bicycle and transit pass
11. Driver’s license, transit pass, and bicycle
12. Car, transit pass, and bicycle

Table 1 shows the summary statistics of a few key variables in the sample dataset. It shows that 12.3% respondents do not have any mobility tools. Around 11.70% of the respondents have a driver’s license only and 13.98% have both a driver’s license and a bicycle. Though 48.21% respondents use local transit as their commuting mode, the proportion of transit pass ownership is surprisingly low (11.53%).

Table 1. Summary statistics of sample data set for empirical investigations

Variables	Mean	Maximum	Minimum
Home to campus distance	12.507	70.50	0.25
Household size	3.37	20	1
Total number of car owned by the households	1.123	9	0
Distance (km) to nearest bus stop	0.273	12.65	0.0000
Distance (km) to nearest rail (GO) station	3.68	36.08	0.0454
Distance (km) to nearest subway station	7.75	68.30	0.0009
Average distance (km) between intersection within a 1 km walking buffer	177.48	3061.76	20.23
Area (sq. km) of 1 km walk buffer	1.41	2.19	0.024
Home zone population density in thousands per sq. km	10.42	273.51	0.005
Home zone employment density in thousands per sq. km	8.21	383.96	0.001
	Percentage of the total sample		
Mobility Tool Ownership			
No tools		12.30	
Driver’s license only		11.70	

Car only	6.06
Transit pass only	11.53
Bicycle only	8.81
Driver's license and transit pass	8.37
Driver's license and bicycle	13.98
Car and transit pass	2.43
Car and bicycle	7.21
Bicycle and transit pass	7.41
Driver's license, transit pass and bicycle	7.92
Car, transit pass and bicycle	2.29
Female	
Current living situation	67.16
Live with family/parents	
Living with a partner	56.20
Living alone	11.98
Living with roommates	10.67
Living with someone of the same generation	21.15

4. Econometric Models

Considering the nature of alternative mobility tools (basic tools and combinations of basic tools as composite tools), it is incorrect to assume that alternatives are independent and the random errors are identical and independently distributed. As a result, a Generalized Extreme Value (GEV) model structure is proposed.

Consider the following random utility function of any alternative j :

$$U_j = V_j + \varepsilon_j \quad ; \quad j = 1, 2, 3 \dots J \quad (1)$$

$j \in C_i$ and C_i is the choice set of an individual i

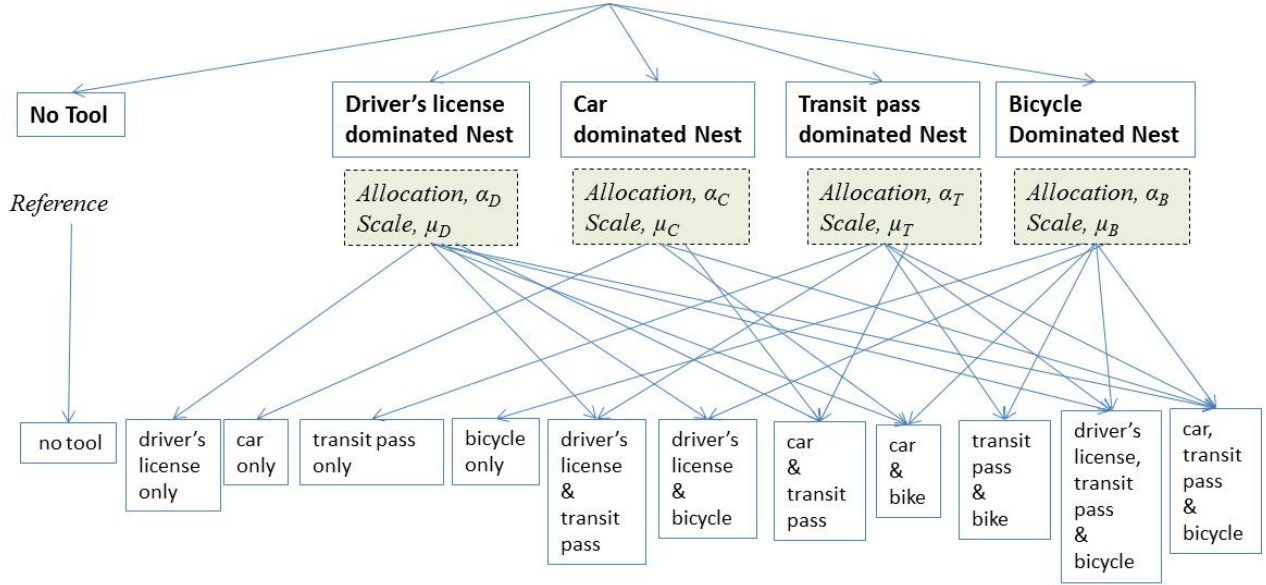
Where, ε_j is the random error term of a utility function and is assumed to have a Generalized Extreme Value (GEV) distribution with zero mean and scale parameter μ .

Figure 1 presents the schematic diagram of a possible nesting structure of alternatives in the choice set.

Considering a mutually exclusive (and collectively exhaustive) set of sub-groups of alternatives from the choice set, but allowing unrestricted sharing of such subgroups/nests by the same alternative, the choice model stands as:

$$\Pr(j) = \sum_g P(j | g)P(g) \quad (2)$$

Where, g indicates the subgroups/nests, of which there can be at most $(2^J - 1)$, where J is the maximum number of alternatives.



- Allocation parameter, α explains the relative weight of a nest and thereby relative importance of alternatives within
- Scale, μ explains the degree of substitution

Figure 1: Choice of mobility tool ownership.

Following Wen and Koppelman (2001), the probability of choice of any alternative mobility tool j becomes:

$$\begin{aligned}
 \Pr(j) &= \sum_g \left[\frac{(\alpha_{gj} \exp(V_j))^{\mu_g}}{\sum_{k \in N_g} (\alpha_{gk} \exp(V_k))^{\mu_g}} \times \frac{\frac{1}{\mu_g} \exp\left(\ln\left(\sum_{k \in N_g} (\alpha_{gk} \exp(V_k))^{\mu_g}\right)\right)}{\sum_{g'} \left(\frac{1}{\mu_{g'}} \exp\left(\ln\left(\sum_{k \in N_{g'}} (\alpha_{g'k} \exp(V_k))^{\mu_{g'}}\right)\right)\right)} \right] \\
 &= \sum_g \left[\frac{(\alpha_{gj} \exp(V_j))^{\mu_g} \left(\sum_{k \in N_g} (\alpha_{gk} \exp(V_k))^{\mu_g}\right)^{\frac{1}{\mu_g}-1}}{\sum_{g'} \left(\sum_{k \in N_{g'}} (\alpha_{g'k} \exp(V_k))^{\mu_{g'}}\right)^{\frac{1}{\mu_{g'}}}} \right] \quad (3)
 \end{aligned}$$

Here,

μ_g is the nest-specific scale parameter of any nest g .

N_g is the total number of alternatives within a nest g .

g' indicates all possible nests and k indicates all alternatives within the nest.

α_{gj} is the allocation parameter of alternative j for the nest g .

The scale parameters, μ_g explains the correlations/substitutions among the alternatives within a nest g with respect to the alternatives outside the nest g . The allocation parameter, α_{jg} explains a relative proportion of an alternative j to the nest g with respect to other nests that also contains

the alternative j . In order to capture heteroscedasticity in a choice of mobility tool ownership, we further parameterized the scale and allocation parameters. For parameterization and the necessary condition to satisfy the Random Utility Maximization (RUM), the scale and allocation parameters are further specified as:

$$\mu_g \geq 1 \quad \text{So, } \mu_g = \exp(\sum \gamma z)_g \quad (4)$$

Here, $\sum \gamma z$ indicates a linear-in-parameter function of variable set z . Furthermore, the allocation parameters for any alternative must sum to one:

$$\sum_g \alpha_{g'j} = 1 \quad \text{So, } \alpha_{gj} = \frac{e^{(\sum \gamma z)_{gj}}}{\sum_{g'} e^{(\sum \gamma z)_{g'j}}} \quad (5)$$

Here, $\sum \gamma z$ indicates a linear-in-parameter function of variable set y .

The marginal effects and elasticities of any variables in the systematic utility function of the proposed GEV model can be written as:

if j is assigned within a single nest, then

$$\text{Marginal Effect of } x = \text{Pr}(j)(1 - \text{Pr}(j))\beta_x$$

if j is assigned in g nests, then

$$\text{Marginal Effects of } x = \sum_g P(g)P(j | g)[(1 - \text{Pr}(j)) + (\mu_g - 1)(1 - P(j | g))]\beta_x \quad (6)$$

Equations for direct elasticities can be written as:

if j is assigned within a single nest, then

$$\text{Direct elasticity of } x \text{ of the choice of } j = (1 - \text{Pr}(j))x\beta_x$$

if j is assigned in g nests, then

$$\begin{aligned} \text{Direct elasticity of } x \text{ of the choice of } j \\ = \frac{\sum_g P(g)P(j | g)[(1 - \text{Pr}(j)) + (\mu_g - 1)(1 - P(j | g))]}{\text{Pr}(j)} \beta_x x \end{aligned} \quad (7)$$

Equations for cross-elasticities can be written as:

If j and j' are not in the same nest, then the cross-elasticity of any variable x (in the utility function of j) of the choice of j' is $-\text{Pr}(j)\beta_x x$. However, j and j' are in one or more nests together, then

Cross - elasticity of x of the choice of j'

$$= - \left[\Pr(j) + \frac{\sum_g (\mu_g - 1) P(g) P(j|g) P(j'|g)}{\Pr(j')} \right] \beta_x x \quad (8)$$

For discussion on the empirical model we use estimated marginal effects and sample enumerated average values are used for evaluations.

5. Empirical Models and Key Findings

Mobility tool ownership choice presents a unique modelling challenge because of the possible combination of basic tools to form composite tools. Here, we define basic tools as driver's license, car, transit pass, and bicycle. Composite tools are combinations of multiple basic tools (e.g., driver's license car and bicycle). To address the challenge of composite tools, we investigated two alternative approaches of formulating the utility functions of mobility tool alternatives. The first approach is the 'parsimonious approach', which considers specifying and estimating only the systematic utility functions of four basic tools and the reference and then defines the systematic utility functions of the composite tools through combinations of the corresponding basic tools functions. The second approach is the 'detailed approach', which considers separate systematic utility functions of all tools (basic and composite) individually and therefore estimates a total of 12 systematic utility functions.

To illustrate the parsimonious approach, consider the following: the coefficient of variables x is β_d in the systematic utility function of basic tool 'driver's license', β_t in the systematic utility function of basic tool 'transit pass', and β_b in the systematic utility function of basic tool 'bicycle'. Now, the variable x in the systematic utility function of the corresponding composite tool, 'driver's license, transit pass and bicycle' will have the imputed coefficient as:

$$\begin{aligned} \text{Mean value: } & \beta_d + \beta_t + \beta_b \\ \text{Variance: } & \sqrt{\text{Var}(\beta_d) + \text{Var}(\beta_t) + \text{Var}(\beta_b) + 2\text{Cov}(\beta_d, \beta_t) + 2\text{Cov}(\beta_b, \beta_t) + 2\text{Cov}(\beta_d, \beta_b)} \end{aligned} \quad (9)$$

The same approach can be extended for any possible combination of basic tools.

We investigated a number of alternative specifications for both parsimonious and the detailed approach of model formulations considering 95 percent confidence intervals of estimated model parameters. Table 2 presents the summary of final specifications of two formulations along with a summary of a multinomial logit (MNL) version of the detailed formulation.

Both formulations have identified four overlapping nests specific scale and allocation parameters compared to the no nest of the MNL version. However, the scale parameters of the four nests of the detailed formulation are higher than those in the parsimonious formulation. Similarly, the allocation parameters of the four nests are more dissimilar in detailed formulation than those in the parsimonious formulation. To further compare the performances of two formulations, we compared AIC and BIC values along with goodness-of-fit values. The detailed formulation is slightly improved over the MNL version due to the slightly lower AIC and BIC values.

However, the parsimonious model is a substantial improvement over the detailed formulation using AIC and BIC values. This is also consistent with the fact that the parsimonious model has the highest goodness-of-fit (Adjusted Rho-squared value) while having significantly fewer parameters. Considering that the parsimonious formulation is a reduced form of the detailed formulation, we considered a Chi-squared test. As can be seen in table 2, the Chi-squared test supports shrinking the detailed formulation into the parsimonious structure and thereby reducing the total number of parameters. As a result, we adopted the parsimonious formulation of the model and its final specification is presented in Table 3. In addition to estimated (and imputed) parameter values, we also include the marginal effects for each parameter in order to evaluate quantitatively (ME) and qualitative (sign) impact of each variable on the corresponding choice of alternative mobility tools.

The scale parameter values of the parsimonious model reveal a very interesting choice model structure. Almost equal allocation parameters and scale parameters close to unity may support an argument that a multinomial logit could be good enough for modelling mobility tool ownership choices, but elasticity (or marginal effect) calculations would be wrong in that case. It is obvious that the composite alternatives have overlapping properties, but it seems that such overlapping is more in the systematic utility than in the random utility components. It is possible that the parsimonious model can be collapsed into a discrete choice model with multiple and overlapping choice sets (e.g., a model presented by Habib et al. (2013), but with the option of a no choice alternative).

Table 2: Summary statistics of final specifications of two alternative formulations

	Detailed formulation	An MNL version of the detailed formulation	Parsimonious formulation
Total number of observation	13542	13542	13542
Log likelihood at convergence	-28957	-28920	-28652
Log likelihood of null model	-33651	-33651	-33651
Number of estimated parameters	140	132	69
Adjusted Rho-squared value	0.14	0.14	0.15
AIC value	58193	58105	57441
BIC value	59245	59097	57960
Chi-squared test	----		610
Parameter difference:	(Detailed and parsimonious formulation)		71

Nest specific scale parameter	Scale		Scale	
No tool nest: Reference alternative	1.00		1.00	

Additional exponential component	Parameter		t-stat		Parameter		t-stat	
Driver's license common nest	0.26	5.30	2.30	-4.51	-2.41	1.01		
Car common nest	-1.58	-2.64	1.20	-6.08	-1.30	1.00		

Transit pass common nest	-1.01	-3.94	1.36	-2.05	-1.75	1.12
Bicycle common nest	0.31	7.18	2.37	-7.29	-2.15	1.00

Allocation parameter functions (Logit function)

	Parameter	t-stat	
Driver's license and transit pass	-1.34	-1.63	for transit pass dominated nest
Driver's license and bicycle	0.05	1.15	for bicycle dominated nest
Car and transit pass	0.51	0.79	for car dominated nest
Car and bicycle	-0.28	-4.35	for car dominated nest
Transit pass and bicycle	-0.42	-1.51	for bicycle dominated nest

5.1 Systematic utility functions of choice alternatives and unexplained contributors

Comparing the marginal effects of variables explaining the systematic utility functions of choice alternatives, it is clear that for all four basic tool alternatives (driver's license, car, transit pass, and bicycle) alternative specific constants (ASC) are the dominant contributors. This means considerable amounts of systematic utility functions of basic mobility tools are not explainable by available data/variables available in the dataset. However, in the case of composite tools, alternative specific constants are not always the dominant factors explaining the systematic utility of choices. Specially, in case 'driver's license and transit pass' and 'driver's license and bicycle,' the alternative specific constants are not very dominant. Despite these outliers, the majority of basic and composite mobility tool ownership alternatives are not explained by the numerous personal, household-specific and land use variables. We hypothesize that perhaps some key variables that should have been taken into consideration were not collected in the data set. In particular, information regarding income and cost (cost of acquisition and maintenance cost of the tools) should have a substantial impact on mobility tool ownership. The survey that collected the dataset for current investigation attempted to collect income information, but the majority of students did not provide this data. Furthermore, the collection of information on the detailed acquisition and maintenance of mobility tools is often impossible in travel diary surveys as the survey becomes excessively lengthy. These concerns are also prevalent for general household travel surveys and result in similar issues for modelling household mobility tool ownership choices Habib and Sasic (2014).

5.2 Effects of personal and household attributes

We considered the inclusion of personal attributes for a number of alternatives, but only age, gender, household size and household car ownership are found to influence mobility tool ownership choices. Figure 2 presents the comparisons of marginal effects of these variables across different basic and composite mobility tools.

Age has the highest positive influence on the choice of owning a car and the highest negative influence on the choice of owning a transit pass. Interestingly, older students are most likely to only own a car and have driver's license rather than owning just a transit pass or just a bicycle. However, older students are also more likely to own some combinations of transit pass and/or bicycle with a driver's license and/or car. Among the composite mobility tools, it is clear that

older students are most likely to own ‘driver’s license, car and bicycle’ and ‘transit pass and bicycle’. Older students prefer ‘Driver’s license and bicycle’ more than ‘driver’s license and transit pass’ or ‘driver’s license, car and transit pass’. Older students are also more likely to combine a car with transit pass and bicycle. Overall, it is clear that choice of owning composite tools increases with increasing age and it can be inferred that older post-secondary students are more multimodal than younger students in Toronto. One potential reason for this is an increase in savings from summer or part-time work during the year or mature students having previous savings from prior full-time work. These savings could be put towards the purchase of multiple mobility tools.

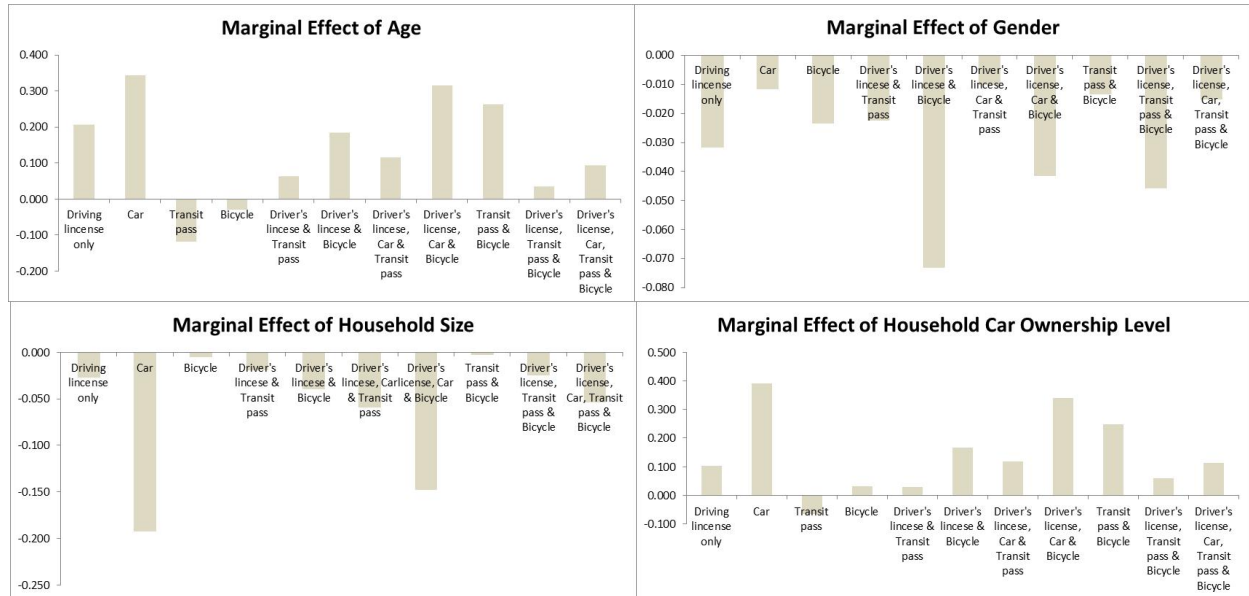


Figure 2: Marginal effects of personal attributes on students’ mobility tool ownership choice.

The gender of a student also influences the choices of mobility tool ownerships. We consider being female as the gender specific dummy variable in the model. It is very interesting to note that females are most likely to own only a transit pass than having just a driver’s license or owning only a car. Female post-secondary students in Toronto are less likely to get a driver’s license than their male counterparts. The probability of owning a bicycle, either alone or in combinations with driver’s license, car and transit pass is very low of female students than male students. Also, female students are less likely to own composite mobility tools than the male students. Among the composite tools, ‘driver’s license and bicycle’ seem to be the least popular among the female students in Toronto. Overall, male post-secondary students in Toronto are more likely to own composite tools and are therefore more multimodal than female students.

Household size is shown to have considerable effects on the choices of mobility tool ownership of post-secondary students in Toronto. It seems that post-secondary students from larger households are more likely to own only transit passes than any other basic or composite tool. Larger household size has a highly negative effect on a student owning only a car or ‘car and bicycle’. Students from larger households are more likely to have a ‘transit pass and bicycle’ than having only driver’s license or bicycle or any other composite tools. Overall, large

household size seems to negatively affect the attraction of composite tools, thereby multimodality of the post-secondary students in Toronto. One possible rationale for this is the concept of communal mobility tool ownership. In larger households the direct ownership of the mobility tool may not belong specifically to the student in question, however, the tool may be borrowed by the student if other household members are not using it. This is circumstantial and requires a more detailed discussion of the student's living arrangements (discussed below).

Household car ownership has a profound influence on student's mobility tool ownership choice. Intuitively, a higher number of cars owned by the household influence the probability of a student owning a car by herself/himself. The study found that there is a strong connection between household car ownership and students obtaining a driver's license or bicycle, however, the study also found that high levels of car ownership reduce the attraction of getting only a transit pass. However, students owning a transit pass in combination with a driver's license, a car and a bicycle are more likely than having only a transit pass. Overall, it is clear that high household car ownership increases the attraction of composite mobility tools, in general. The model also explains that high car ownership clearly reduces transit pass ownership.

5.3 Role of living arrangements and geographic location of home

The survey classified the living arrangements of post-secondary students in Toronto in terms of 'living with family' (the base case), 'living alone'; 'living with a roommate(s)'; 'living with someone of the same generation', and 'living with a partner'. Figure 3 presents the comparisons of marginal effects of these variables on choices of mobility tools. The choice of owning only a driver's license is high among all post-secondary students in Toronto who live alone or live with partners or living with someone of the same generation or who live with roommates. This means that living with parents/family discourages owning only driver's license compared to other living arrangements. Living with someone of same generation or living with parents/family discourages owning a car as the only mobility tool. Living with roommates, living alone and living with a partner reduce the choice of owning a transit pass as the only mobility tool. Interestingly, living with a partner seems to have the highest marginal utility of owning a bicycle as an only mobility tool, but living alone or with someone of the same generation or with roommates has, in fact, negative marginal utility of owning a bicycle as an only mobility tool. Living with a partner seems to have the highest influence on owning composite tools suggesting the highest degree of multimodality. Next to this, living with a roommate also increases the higher utility of owning composite mobility tools. However, living with someone of the same generation has the most negative influences on owning composite tools.

The geographic location of the living place also has a significant influence on the choice of mobility tool ownership of post-secondary students in Toronto. It seems that living in downtown, living outside downtown, but within the City of Toronto and living outside the City of Toronto generates differences in mobility tool ownership choice behaviour of post-secondary students. Such influences are mostly the surrogate effects of relative urban forms; transit service coverages; bicycle infrastructure and road network characteristics over and above other transportation and land use measures that are used (explained later) in this investigation. Interestingly, downtown Toronto and outside Toronto influences very similar patterns of mobility tool ownership choice behaviour compared to inner/outer suburbs of Toronto.

We did not find any significant difference in mobility tool ownership choices of post-secondary students who live in inner or outer suburbs of Toronto. Both downtown Toronto and outside Toronto location are most likely to own either only a driver's license or 'a driver's license and bicycle' as a mobility tool. These two places also strongly discourage transit pass ownership. Perhaps complete coverage of transit service in the downtown and chance of not having full utilization of transit passes outside Toronto encourages such behaviour. Counterintuitively, living in downtown Toronto seem to discourage owning a bicycle as the only mobility tool, but encourages owning 'driver's license and bicycle' as a mobility tool even though downtown Toronto has the best bicycle infrastructure. Perhaps better access to bicycle sharing and car sharing services as well as encompassing transit coverage in the downtown enable students not to rely on specific or fixed mobility tools. Overall, it is clear that students who live in inner or outer suburbs of Toronto are more multimodal (more likely to own composite tools) and more transit and bicycle-oriented.

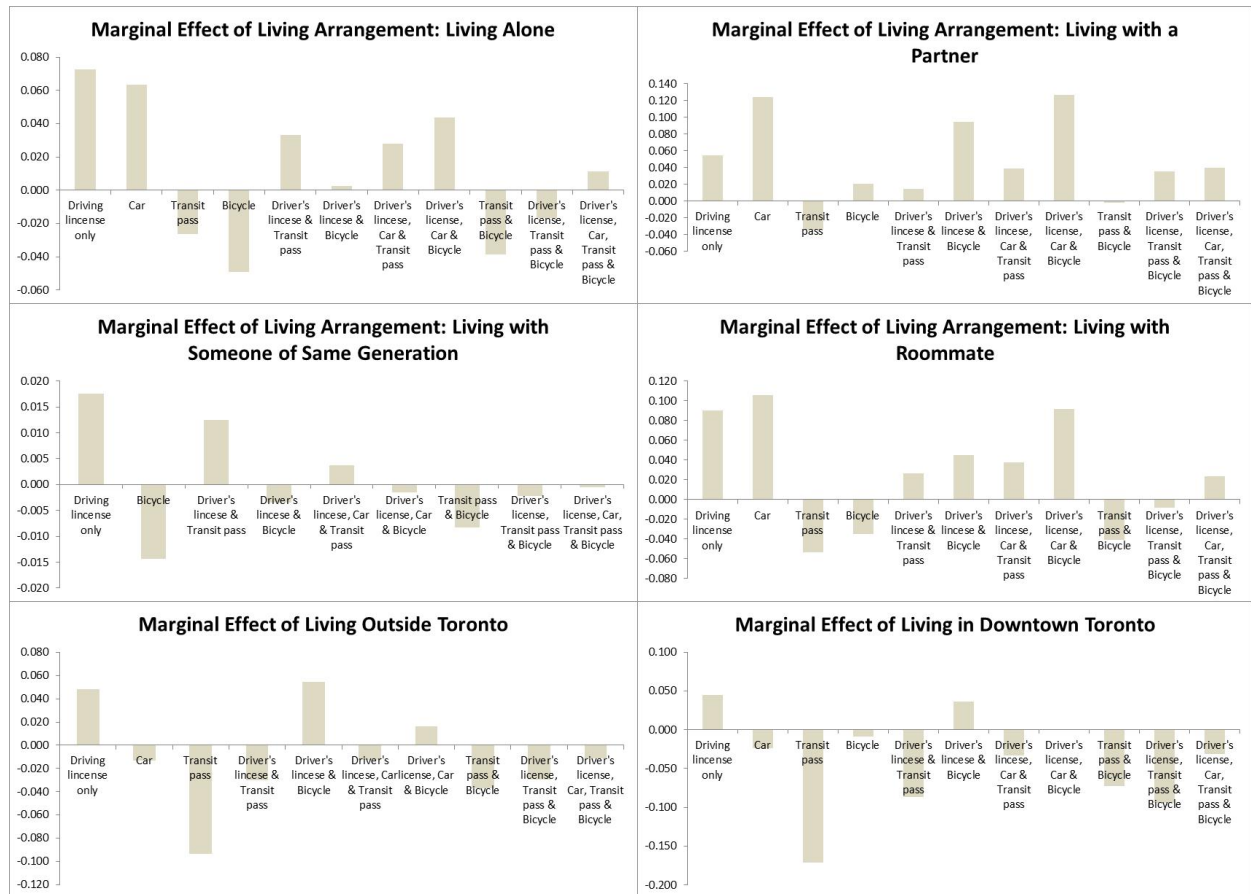
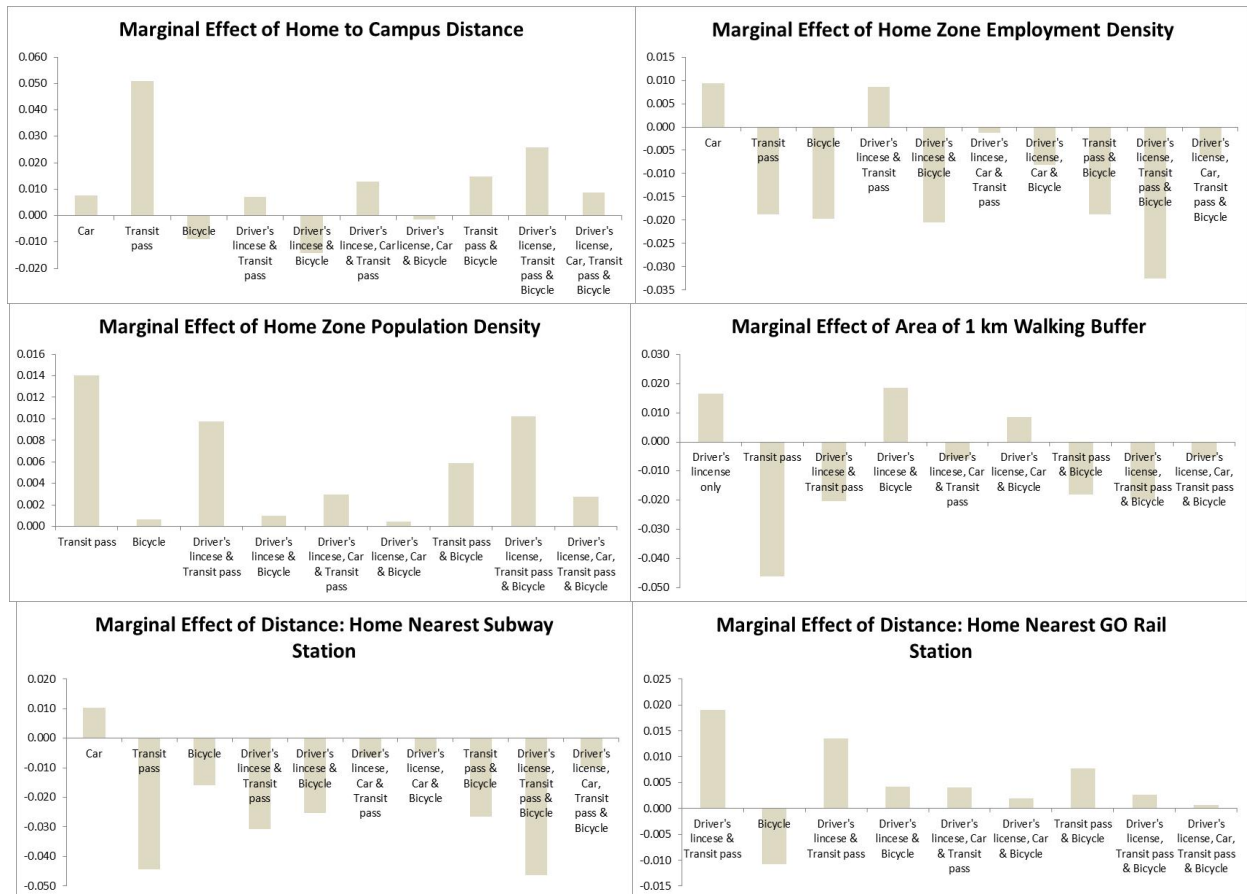


Figure 3: Marginal effects of living arrangements and geographic location of the home on students' mobility tool ownership choice.

5.3 Role of commuting distance, transportation, and land use characteristics of home location

Figure 4 presents the marginal effects of commuting distance (home to campus distance), transportation network characteristics of home location and land use characteristics of home locations of a post-secondary student on his/her mobility tool ownership choice in Toronto.

Commuting distance plays a critical role in mobility tool ownership choices of post-secondary students in Toronto. The long distance between home and campus reduce the choices of the only bicycle, ‘driver’s license and bicycle’ and ‘car and bicycle’ mobility tool options. However, post-secondary students living farther from campus are more likely to own transit pass as the only mobility tool. It is also clear that living farther away from the campus encourages owning more composite mobility tools. In the previous section, we found that students living in inner or outer suburbs of Toronto show similar behaviour. As we considered a logarithmic function of distance and three out of four university campuses are in or very close to downtown Toronto, the marginal effects of distance complements the effect of urban forms and land use characteristics of the City of Toronto on students’ mobility tool ownership choice behaviour.



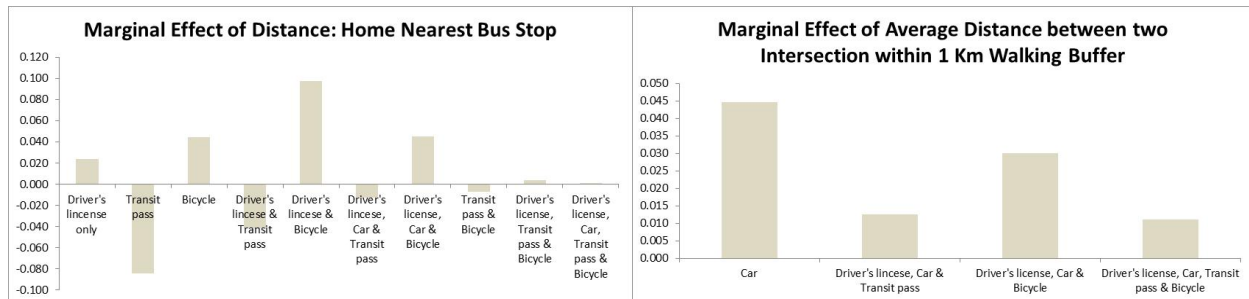


Figure 4: Marginal effects of commuting distance, transportation and land use characteristics.

In terms of land use characteristics, home zone employment density encourages the choice of a car as only mobility tool and discourages owning any other fixed mobility tool altogether. High employment density in the home zone strongly discourages owning only transit passes. However, high population density in the home zone encourages owning all fixed mobility tools against owning a car as the only tool. There seems to be a balancing effect between population and employment density. In downtown Toronto, employment density is relatively higher than the population density and consistently it is seen that students living in downtown Toronto seem to have a lower probability of owning fixed mobility tools. Similarly, factors such as living farther from the downtown, in the inner and outer suburbs, if the population density is higher than the employment density mean that students living within these conditions are more likely to own fixed mobility tools. Home location walkability also plays a crucial role in shaping mobility tool ownership choices of post-secondary students in Toronto. We consider an area of 1 km walking buffer as a variable in the model and it is clear that the larger the area the less likely a student is to own a transit pass as well as most of the composite tools.

In order to capture the direct effects of transportation network accessibility, we considered the average distance between two intersections within 1 km walking buffer around home location, home to nearest rail (GO rail) station distance and home to nearest bus stop distance as explanatory variables in the model. It is clear that widely spaced roadway intersections in the home zone increase the attraction of owning cars as well as car related composite tools. The attraction of owning transit pass as the only mobility tool drops drastically with increasing home to nearest bus stop distance. Similarly, the attraction of transit pass related composite tools decreases with increasing home to nearest bus stop distance. However, the attraction of ‘driver’s license and bicycle’ as the mobility tool increases with the highest rate with increasing home to nearest bus stop distance. Similarly, increasing home to nearest bus stop distance increases attractions of only bicycle and ‘car and bicycle’ are fixed mobility tools.

Accessibility to a rapid transit network in terms of distance between home and the nearest subway station in Toronto plays a decisive role in increasing attraction of private car among the post-secondary students in Toronto. It is clear that with increasing home to nearest subway station distance, the only positive utility of car as the only mobility tool increases, but the disutility of all other single as well as composite mobility tools decreases. The Toronto subway system only covers the City of Toronto; therefore, such behaviour only reflects the choice behaviour of post-secondary students living inside the City of Toronto. Contrary to this the rail network (GO transit) covers mostly of outside Toronto and it seems that distance home to nearest

GO rail station does not necessarily increase the utility of car as the only tool. Rather, it increases the utility of all car-related composite tools.

6. Conclusions and Policy Relevance

The contribution of this paper is twofold. First, it presents an empirical investigation of mobility tool ownership of post-secondary students, which is seldom evident in the literature. Secondly, it presents a parsimonious econometric modelling structure using the generalized nested logit model that can be used for modelling similar other types of choices. Comparison of a detailed and parsimonious formulations of overlapping choice alternatives prove that complex substitution patterns exist in the choice of mobility tool ownership of post-secondary students. Apparent understanding of substitution complexity should not be judged just by looking at the scale and allocation parameters of the generalized nested logit model. This is because these parameters should be judged in perspective of the utility function specification. A parsimonious specification of such complex choice process may give better and simpler representation of alternative substitution patterns than a detailed specification with a huge number of parameters to be estimated.

Owning composite tool is a good indicator of multimodal travel behaviour. The empirical model clearly explains that age, gender, household size and household car ownership have a multitude of influences on multimodality of post-secondary students in Toronto. It is clear that older and male students are more multimodal than younger and female students. Large household size seems to decrease multimodality, but a high number of cars at household increases multimodality among the students. Interestingly, post-secondary students living outside downtown Toronto and mostly in the inner or outer suburbs of Toronto are more likely to own bicycles as their only mobility tool than those living in downtown or outside Toronto. It is also clear that living in inner or outer suburbs of Toronto encourages post-secondary students to own more composite mobility tools than others. A widely spaced road network near the home zone, in terms of widely apart intersections within 1 km of walking buffer around home location increases dependency on private car for post-secondary students. Similarly, lower transit network accessibility in terms of a longer distance between home and the nearest bus stop reduces transit reliability but increases the attraction of biking along with private car among post-secondary students in Toronto.

These conclusions and results provide a solid insight into the travel preferences and multimodality of post-secondary students in Toronto. These outcomes are of particular relevance in the face of declining automobile sales amongst millennials as they shed light on some of the potential reasons for these declining sale figures. More generally, travel preferences are habitual in nature and changes to travel patterns often require significant life shifts to act as a catalyst for changing mobility patterns. By understanding how and why young people travel the way they do now, we will have greater insight into their travel patterns going forward as they transition into the work force.

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Table 2: Empirical model of mobility tool ownership of post-secondary students

Systematic utility functions					Marginal effects
Variable	Parameter	t-stat	Parameter	t-stat	
Alternative specific constant					
No tools	Reference				
Driver's license only	-5.727	-15.41			-0.769
Car	-12.062	-24.56			-1.238
Transit pass	3.745	10.76			0.520
Bicycle	1.763	4.92			0.159
Additional Constant for composite tools					
Driver's license and Transit pass	-0.753	-13.69			-0.186
Driver's license and bicycle	-0.154	-2.95			-0.605
Driver's license, car and transit pass	-2.140	-20.83			-0.402
Driver's license, car and bicycle	-1.257	-13.71			-1.109
Transit pass and bicycle	-0.956	-16.26			-0.961
Driver's license, transit pass and bicycle	-1.025	-13.18			-0.024
Driver's license, car, transit pass and bicycle	-2.401	-18.91			-0.312
Average distance (km) between intersection within a 1 km walking buffer (log transformed)					
Car	0.457	1.11			0.045
Driver's license, car and transit pass			0.457	1.11	0.013
Driver's license, car and bicycle			0.457	1.11	0.030
Driver's license, car, transit pass and bicycle			0.457	1.11	0.011
Area (sq. km) of 1 km walk buffer					
Driver's license only	0.115	1.97			0.016
Transit pass	-0.332	-5.08			-0.046
Driver's license and transit pass			-0.217	-2.51	-0.020
Driver's license and bicycle			0.115	1.97	0.018
Driver's license, car and transit pass			-0.217	-2.51	-0.006

Driver's license, car and bicycle			0.115	1.97		0.009
Transit pass and bicycle			-0.332	-5.08		-0.018
Driver's license, transit pass and bicycle			-0.217	-2.51		-0.020
Driver's license, car, transit pass and Bicycle			-0.217	-2.51		-0.005
Distance (km) to nearest bus stop (log transformed)						
Driver's license only	0.175	1.41				0.024
Transit pass	-0.619	-4.61				-0.084
Bicycle	0.483	4.29				0.044
Driver's license and transit pass			-0.444	-2.53		-0.041
Driver's license and bicycle			0.657	5.01		0.098
Driver's license, car and transit pass			-0.444	-2.53		-0.013
Driver's license, car and bicycle			0.657	5.01		0.045
Transit pass and bicycle			-0.136	-0.76		-0.008
Driver's license, transit pass and bicycle			0.039	0.21		0.004
Driver's license, car, transit pass and bicycle			0.039	0.21		0.001
Distance (km) to nearest rail (GO) station (log transformed)						
Driver's license only	0.142	3.18				0.019
Bicycle	-0.117	-2.69				-0.011
Driver's license and transit pass			0.142	3.18		0.014
Driver's license and bicycle			0.024	0.45		0.004
Driver's license, car and transit pass			0.142	3.18		0.004
Driver's license, car and bicycle			0.024	0.45		0.002
Transit pass and bicycle			-0.117	-2.69		0.008
Driver's license, transit pass and bicycle			0.024	0.45		0.003
Driver's license, car, transit pass and bicycle			0.024	0.45		0.001
Distance (km) to nearest subway station: (log transformed)						
Car	0.103	1.70				0.010
Transit pass	-0.320	-7.47				-0.044
Bicycle	-0.172	-6.24				-0.016
Driver's license and transit pass			-0.320	-7.47		-0.031

Driver's license and bicycle			-0.172	-6.24	-0.025
Driver's license, car and transit pass			-0.217	-2.81	-0.006
Driver's license, car and bicycle			-0.069	-1.04	-0.005
Transit pass and Bicycle			-0.492	-9.35	-0.027
Driver's license, Transit pass and bicycle			-0.492	-9.35	-0.046
Driver's license, car, transit pass and bicycle			-0.389	-4.69	-0.010
Home zone population density in thousands per sq km (log transformed)					
Transit pass	0.103	3.77			0.014
Bicycle	0.005	0.22			0.001
Driver's license and transit pass			0.103	3.77	0.010
Driver's license and bicycle			0.005	0.22	0.001
Driver's license, car and transit pass			0.103	3.77	0.003
Driver's license, car and bicycle			0.005	0.22	0.000
Transit pass and bicycle			0.108	2.87	0.006
Driver's license, transit pass and bicycle			0.108	2.87	0.010
Driver's license, car, transit pass and bicycle			0.108	2.87	0.003
Home zone employment density in thousands per sq km (log transformed)					
Car	0.093	1.90			0.009
Transit pass	-0.137	-4.05			-0.019
Bicycle	-0.213	-7.20			-0.020
Driver's license and transit pass			-0.137	-4.05	0.009
Driver's license and bicycle			-0.213	-7.20	-0.020
Driver's license, car and transit pass			-0.044	-0.71	-0.001
Driver's license, car and bicycle			-0.120	-2.13	-0.008
Transit pass and bicycle			-0.349	-7.54	-0.019
Driver's license, transit pass and bicycle			-0.349	-7.54	-0.033
Driver's license, car, transit pass and bicycle			-0.257	-3.72	-0.006
Home to campus distance					
Car	0.069	1.44			0.008
Transit pass	0.370	9.49			0.051

Bicycle	-0.097	-3.25			-0.009
Driver's license and transit pass			0.370	9.49	0.007
Driver's license and bicycle			-0.097	-3.25	-0.014
Driver's license, car and transit pass			0.439	6.94	0.013
Driver's license, car and bicycle			-0.028	-0.50	-0.001
Transit pass and bicycle			0.274	5.39	0.015
Driver's license, transit pass and bicycle			0.274	5.39	0.026
Driver's license, car, transit pass and bicycle			0.343	4.87	0.009
Living in downtown Toronto					
Driver's license only	0.355	5.55			0.045
Car	-0.231	-1.77			-0.024
Transit pass	-1.267	-14.61			-0.171
Bicycle	-0.102	-1.31			-0.008
Driver's license and transit pass			-0.912	-8.45	-0.087
Driver's license and bicycle			0.253	2.73	0.037
Driver's license, car and transit pass			-1.498	-9.16	-0.033
Driver's license, car and bicycle			-0.333	-2.18	0.001
Transit pass and bicycle			-1.370	-11.10	-0.072
Driver's license, transit pass and bicycle			-1.015	-7.64	-0.094
Driver's license, car, transit pass and bicycle			-1.601	-8.61	-0.031
Living outside Toronto					
Driver's license only	0.365	7.51			0.048
Car	-0.129	-1.12			-0.013
Transit pass	-0.684	-9.15			-0.093
Driver's license and transit pass			-0.319	-3.62	-0.030
Driver's license and bicycle			0.365	7.51	0.054
Driver's license, car and transit pass			-0.448	-3.02	-0.013
Driver's license, car and bicycle			0.236	1.91	0.016
Transit pass and bicycle			-0.684	-9.15	-0.037
Driver's license, transit pass and bicycle			-0.319	-3.62	-0.030
Driver's license, car, transit pass and bicycle			-0.448	-3.02	-0.011

Living with a partner

Driver's license only	0.421	4.83			0.054
Car	1.212	12.27			0.124
Transit pass	-0.262	-3.44			-0.034
Bicycle	0.222	2.61			0.021
Driver's license and transit pass			0.159	1.47	0.015
Driver's license and bicycle			0.643	6.50	0.094
Driver's license, car and transit pass			0.950	7.19	0.039
Driver's license, car and bicycle			1.434	0.13	0.127
Transit pass and bicycle			-0.040	-0.33	-0.001
Driver's license, transit pass and bicycle			0.381	3.07	0.036
Driver's license, car, transit pass and bicycle			1.172	7.23	0.040

Living alone

Driver's license only	0.554	5.94			0.072
Car	0.619	4.55			0.063
Transit pass	-0.195	-2.33			-0.026
Bicycle	-0.540	-5.62			-0.049
Driver's license and transit pass			0.359	2.96	0.033
Driver's license and bicycle			0.015	0.13	0.002
Driver's license, car and transit pass			0.424	2.55	0.028
Driver's license, car and bicycle			0.080	0.48	0.044
Transit pass and bicycle			-0.735	-5.50	-0.039
Driver's license, transit pass and bicycle			-0.180	-1.24	-0.017
Driver's license, car, transit pass and bicycle			-0.115	-0.59	0.011

Living with roommates

Driver's license only	0.687	10.11			0.090
Car	1.027	10.12			0.105
Transit pass	-0.393	-5.67			-0.054
Bicycle	-0.376	-5.46			-0.035
Driver's license and transit pass			0.293	3.08	0.027

Driver's lances and bicycle			0.310	3.74	0.045
Driver's lances, car and transit pass			0.633	4.89	0.038
Driver's license, car and bicycle			0.650	5.33	0.092
Transit pass and bicycle			-0.770	-7.37	-0.041
Driver's license, transit pass and bicycle			-0.083	-0.74	-0.008
Driver's license, car, transit pass and bicycle			0.257	1.71	0.024
Living with someone of same generation					
Driver's license only	0.131	1.87			0.018
Bicycle	-0.156	-2.21			-0.014
Driver's license and transit pass			0.131	1.87	0.012
Driver's license and bicycle			-0.025	-0.30	-0.003
Driver's license, car and transit pass			0.131	1.87	0.004
Driver's license, car and bicycle			-0.156	-2.21	-0.002
Transit pass and bicycle			-0.156	-2.21	-0.008
Driver's license, transit pass and bicycle			-0.025	-0.30	-0.002
Driver's license, car, transit pass and bicycle			-0.156	-2.21	-0.001
Total number of car owned by the households: Log transformed					
Driver's license only	0.785	12.88			0.103
Car	3.799	41.23			0.391
Transit pass	-0.470	-7.91			-0.064
Bicycle	0.335	5.80			0.032
Driver's license and transit pass			0.315	3.79	0.029
Driver's license and bicycle			1.119	14.94	0.166
Driver's license, car and transit pass			3.329	29.50	0.118
Driver's license, car and bicycle			4.133	37.56	0.339
Transit pass and bicycle			-0.135	-1.56	0.247
Driver's license, transit pass and bicycle			0.649	6.68	0.061
Driver's license, car, transit pass and bicycle			3.664	28.10	0.113
Household size: Log transformed					
Driver's license only	-0.210	-2.67			-0.027

Car	-1.863	-17.11			-0.193
Bicycle	-0.066	-0.83			-0.006
Driver's license and transit pass			-0.210	-2.67	-0.019
Driver's license and bicycle			-0.276	-2.82	-0.040
Driver's license, car and transit pass			-1.863	-17.11	-0.060
Driver's license, car and bicycle			-1.928	-14.26	-0.147
Transit pass and bicycle			-1.863	-17.11	-0.003
Driver's license, Transit pass and Bicycle			-0.276	-2.82	-0.025
Driver's license, car, transit pass and bicycle			-1.928	-14.26	-0.054
Gender: Female					
Driver's license only	-0.243	-6.25			-0.032
Car	-0.116	-1.96			-0.012
Bicycle	-0.256	-6.74			-0.024
Driver's license and Transit pass			-0.243	-6.25	-0.023
Driver's license and bicycle			-0.499	-10.35	-0.073
Driver's license, car and transit pass			-0.116	-1.96	-0.010
Driver's license, car and bicycle			-0.372	-5.24	-0.042
Transit pass and bicycle			-0.256	-6.74	-0.014
Driver's license, transit pass and bicycle			-0.499	-10.35	-0.046
Driver's license, car, transit pass and bicycle			-0.372	-5.24	-0.015
Age: Log transformed					
Driver's license only	1.532	14.91			0.206
Car	3.343	25.61			0.344
Transit pass	-0.858	-8.35			-0.119
Bicycle	-0.318	-3.19			-0.029
Driver's license and transit pass			0.675	6.06	0.064
Driver's license and bicycle			1.215	10.91	0.184
Driver's license, car and transit pass			2.486	19.03	0.115
Driver's license, Car and bicycle			3.026	18.75	0.315
Transit pass and bicycle			-1.175	-7.77	0.264
Driver's license, transit pass and bicycle			0.357	2.40	0.034

Driver's license, car, transit pass and bicycle

2.168 11.57

0.094

Nest Specific Scale Parameter Functions

No tool nest: 1 alternative

Reference

Additional Component: exponential Function

Driver's license common nest

-4.514 -2.41

Car common nest

-6.081 -1.30

Transit pass common nest

-2.053 -1.75

Bicycle common nest

-7.291 -2.15
