



Travel Behaviour and Residential Location of the Millennials:

A Case Study of Post-secondary Students from Four Toronto-Area Universities

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Purpose

Travel behaviour of the millennial generation, defined here as those who were born between 1980 and 2000, has received much attention in the past decade. This report analyzes data collected from four universities located in the Toronto region, to understand travel behaviour of the millennials in a Canadian context. More specifically, the study has three objectives:

To explore patterns in daily and long-term trip-making and travel mode choice behaviour among post secondary students, and identify transportation lifestyles based on these characteristics.

To identify differences in travel behaviour across various neighbourhood types.

To examine the influence of residential/ travel preferences on daily travel outcomes.

While the findings from this report may not be generalizable to all millennials, it is important to recognize that the millennials are pursuing post-secondary education at rates higher than any other generation in history (1). As a result, post-secondary students constitute an important segment of the millennial generation living in urban regions. Existing limited research shows that post-secondary students demonstrate similar travel characteristics to the broader millennial generation and may have different commuting behavior than older population groups (2,3).

In addition, the millennial generation or young adults are under-represented in most legacy transportation surveys such as the Transportation Tomorrow Survey (TTS) in the Greater Toronto and Hamilton Area (GTHA) and the National Household Travel Survey (NHTS) in the US, and as a result, most existing studies focusing on the millennials' travel behaviour have some

selection bias. In the context of a scarcity of representative data, our study of more than 8,000 undergraduate, graduate and continuing education students provides a Canadian comparison to a limited international literature focusing on the millennials' travel behaviour, and begins to provide insights that may inform future studies and policy.

Another key contribution of this paper is an exploration of the neighbourhood types where these young adults live. Perhaps more important, this study provides new insights into how neighbourhood built environment may influence the formation of patterns in daily travel among this sub-population in a large metropolitan region, who would soon become working adults.

A Focus on Millennials' Transportation Lifestyles

Existing literature points to lower rates of drivers' licensing, car ownership and vehicle miles travelled among the millennial generation (3-7). It can be argued that these recent findings are suggestive of the beginning of a trend toward healthier and environmentally sustainable travel preferences, which would have important implications for national, regional and municipal transportation policy and practice.

However, the social or ecological reasons for less driving among the millennial generation are less known. At least hypothetically, spending longer time in educational institutions would lead to a delayed entry to the workforce, and a slower transition through life-cycle stages (e.g., starting a family, having children), which may explain some of the travel-related trends, such as lower car ownership and vehicle km. travelled, which were reported in recent studies (8,9).

Residential location may also have significant influence on an individual's daily travel, and the choice of travel modes (10,11). However, some researchers have emphasized the importance of individual preferences and attitudes as mediating factors that may partly explain the observed built environment-travel behaviour relationship. For example, an individual (or a household) who prefers to walk/cycle to daily destinations might buy/rent their residence in a walkable/cyclable neighbourhood, if and when they can afford to do so (12,13). Previous studies have suggested that travel-related attitudes and residential preferences among the millennials may be somewhat different when compared to the earlier generations (3,14).

Unlike most existing studies, which tend to focus on one aspect of transportation outcome at a time, this research explores patterns in

many aspects of short- and long-term travel behaviour simultaneously, using a latent profile analysis. This approach recognizes that multiple aspects of travel may interact to form 'transportation lifestyles' (15-17), summarizing how an individual allocates time to different activities, and related transportation outcomes. A systematic investigation of transportation lifestyles may have important implications for both Transportation and Urban Planning policy. For example, when students are able to maintain a higher degree (and diversity) of daily activity participation without having to drive much, that would indicate a systematic decline in automobile dependency among this group (5).

Data and Methods

Data for this study came from a large survey of post-secondary students' travel behaviour, named StudentMoveTO, which covered all four universities in Toronto- OCAD University, Ryerson University, University of Toronto and York University (www.studentmoveto.ca). The four participating universities combined represent more than 184,000 students who are affiliated with seven campuses, three of which are located in suburban communities (University of Toronto the Mississauga and Scarborough campuses, and York university Keel campus), while the remaining campuses are located in more urban settings. Most of these can be considered commuter campuses to which students travel from all across the GTHA and beyond.

Each undergraduate, graduate and continuing



Figure 1: Study area

education student registered in these universities received an email in Fall 2015 with invite to participate in an online survey, which collected retrospective travel data in the form of a travel diary for one full day for a randomly selected day between October and November of 2015, as well as information on some long-term travel behaviours. A total of 15,226 individuals filled out the survey, at a response rate of 8.3%. Unweighted person-level data from this sample was analysed. Study area was defined based on the residential locations of participating students, which covers the GTHA and some surrounding communities (Figure 1).

A series of statistical analyses were conducted on data collected from students who reported making a trip on the day of the survey. After removing records with statistical outliers and missing values, 8,486 students were included in analysis. Student traveller types were identified by utilizing Latent Class Analysis (LCA) on disaggregate transportation data from each student. This analysis produced five traveller types or transportation lifestyles, based on students' short- and long-term travel behaviours.

Next, a two-step approach was utilized to create a neighbourhood typology for our study area, comprising of 11,519 census dissemination areas (DA) (Figure 1). First, a principal component analysis (PCA) was conducted using 16 different built environment characteristics. This PCA procedure produced six principal components or built environment 'factors'. Second, the

resulting factor scores were utilized in a k-means cluster analysis to identify distinct neighbourhood types based on the characteristics of the built environment in each DA. A seven-cluster solution produced well defined neighbourhood types, which was confirmed by a ground-proofing conducted using orthophotography in some neighbourhoods.

Finally, logistic regression models were estimated to explore the correlation between a transportation lifestyle (in comparison to not belonging to that particular lifestyle group) and various social, neighbourhood-level and attitudinal /preference-related characteristics of each individual. A total of five binomial logistic regression models were estimated for this purpose.

Key Results

An analysis of 8,486 post-secondary students produced the following results:

Five Types of Transportation Lifestyles

Post-secondary students' transportation lifestyles were clearly distinguishable by their travel mode use. 'Transit riders' constituted the largest proportion of these young adults, followed by 'drivers' and 'active travellers' (Figure 2). Only 10% were multi-modal travellers. The characteristics of each of these traveller groups are described below:

Transit Riders: Transit riders made little use of other alternative modes for their day-to-day transportation. With regard to long-term behaviour, less than one-fourth (24%) of them reported using cars in the past month; only 8% reported the use of active transportation modes. Most would have travelled >10km in a day, and spent > 60 minutes travelling. This group had the lowest overall number of daily trips.

Active Travellers: Active travellers took almost all their trips, on the day of survey, on foot or using a bicycle. However, 40% reported the use of transit in the past month, demonstrating a greater overall travel mode-related flexibility than transit users. Active travellers also had shorter trip distances and commute times when compared to other groups, with more than half of them (53%) spending less than 60 minutes travelling in a full day and nearly one in seven (16%) travelled <30 minutes. While they may spend less time travelling, the number of trips that they take in a typical day are likely higher than transit users.

Multi-modal Travellers: Multi-modal travellers showed varying degrees of use of all three measured modes of transportation- active transportation, transit and cars. All members likely used active transportation in the last month, 1 in 5 (20%) would have used a car, while half (58%) likely used transit. Multi-modal travellers were most likely to make > 4 trips per day, suggesting that of the different traveller types, this group likely have the greatest variety and flexibility in daily activity participation.

Occasional Drivers: Occasional drivers are unique among the five groups as the only group with an almost zero probability (0.5%) of completing all their daily travel using a single mode, meaning that they are the most likely of all groups to be truly multi-modal. However, their typical travel modes comprise mostly transit and private automobiles (car); 90% or more occasional drivers were likely to have average trip lengths of >10km and would have spent >60 minutes travelling during a day.

Drivers: Drivers were differentiated from occasional drivers by the degree of their automobile dependency, and also high usage of regional transit (i.e., GO) for commuting purposes. Only 12% reported the use of active transportation modes in the last month, the lowest of all traveller types. However, three in every four drivers (77%) would have used transit in the last month. This group also had a high probability of travelling > 10km per day, and yet, fewer of them would have spent >60 mins

travelling daily, indicating that compared to transit users or occasional drivers, they were likely more mobile. With regard to typical commute (to/from universities) mode choice, this group demonstrated the highest rates of car (34%) and regional transit (24%) use.

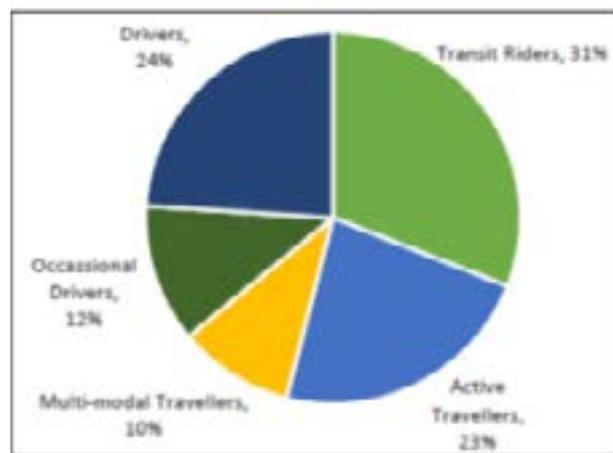


Figure 2: Proportion of post-secondary students by traveller types

Seven Types of Neighbourhoods in the GTHA

Seven distinct types of neighbourhoods can be found within our study area. The most common was the 'residential car-oriented neighbourhoods', which comprised of 34% of all DAs in the study area. A large proportion of the inner-urban landscape is comprised of 'older residential neighbourhoods' (19% of total) or 'bike friendly neighbourhoods' (11% of total). By comparison, 7% of neighbourhoods can be characterized as 'rural'. Figure 3 shows the geographical distribution of these neighbourhoods, focusing specifically on Toronto. The neighbourhood types are described below:

Rural Neighbourhoods: Rural neighbourhoods are characterized by large open areas and farmland. Low land use mix, but a relatively high non-residential intensity is representative of the industrial/farming activities.

Residential Car Oriented neighbourhoods: Residential car oriented neighbourhoods are characterized by the lack of use mix and low employment densities. Poor accessibility to transit/cycling facilities and a disproportionately high street network density suggests that transportation is heavily dependent on private automobiles.

Mixed Use Car Oriented Neighbourhoods: While mixed use car oriented neighbourhoods share many features in common with residential car oriented neighbourhoods, they can be distinguished by their significantly higher jobs/housing balance and a higher overall mix of land uses. However, relatively poor transit/cycle facility access and very low street intersection densities indicates that privately owned automobile is likely the primary means of transportation for employees and residents alike.

Recent (Re)development Neighbourhoods: Recent (Re)development neighbourhoods are characterized by a high proportion of land development or redevelopment over the last 10 years. The majority of these new developments consist of low-to-medium density residential developments, however some neighbourhoods also comprise urban redevelopments and intensifications. This neighbourhood type is also characterised by relatively high jobs/housing balance, high land use mix and better transit/cycle facility access.

Bike Friendly Neighbourhoods: Bike friendly neighbourhoods are characterized by a substantially higher accessibility to cycling facilities as well as very high transit accessibility. High intersection densities suggests the presence of smaller and more traversable residential blocks. These neighbourhoods are more 'mature' than the previously discussed neighbourhood types, meaning that the neighbourhoods are largely located in inner-urban areas and would have proximity to the 'main streets'.

Older Residential Neighbourhoods: Older residential neighbourhoods are characterized by their age, with most of the residential developments being 35+ years old. These neighbourhoods are often representative of low land use mixing and low employment densities. However, these neighbourhoods are located in areas that are in close proximity to non-residential uses and employments. Having the highest street network and intersection densities of all neighbourhood types as well as very high housing and activity densities, these neighbourhoods are likely to consist of very small, populated, and easily traversable residential blocks.

High Rise Residential Neighbourhoods: High rise residential neighbourhoods are defined by high-rise and high density residential developments. Depending on their location, they can take a variety of forms, ranging from residential tower neighbourhoods with strong separation of land uses to those located in downtowns and growth centers with heavily intermixed commercial/ retail/ residential uses.

Figure 4 shows residential locations of the millennials (more specifically, post-secondary students) by neighbourhood type. Some variations in residential locations can be observed ($p=0.002$). Overall, 37% students lived in either older residential or bike-friendly neighbourhoods, which demonstrate similar built environmental characteristics with proximity to mixed land uses (e.g., the 'main streets') and improved transit/cycling facilities. A high proportion also lived in high-rise residential neighbourhoods. The proportion of students living in the rural areas were low, which is not surprising in the context of this study.

Traveller Types and Neighbourhood Environment

Further exploration using logistic regression models suggested a strong correlation

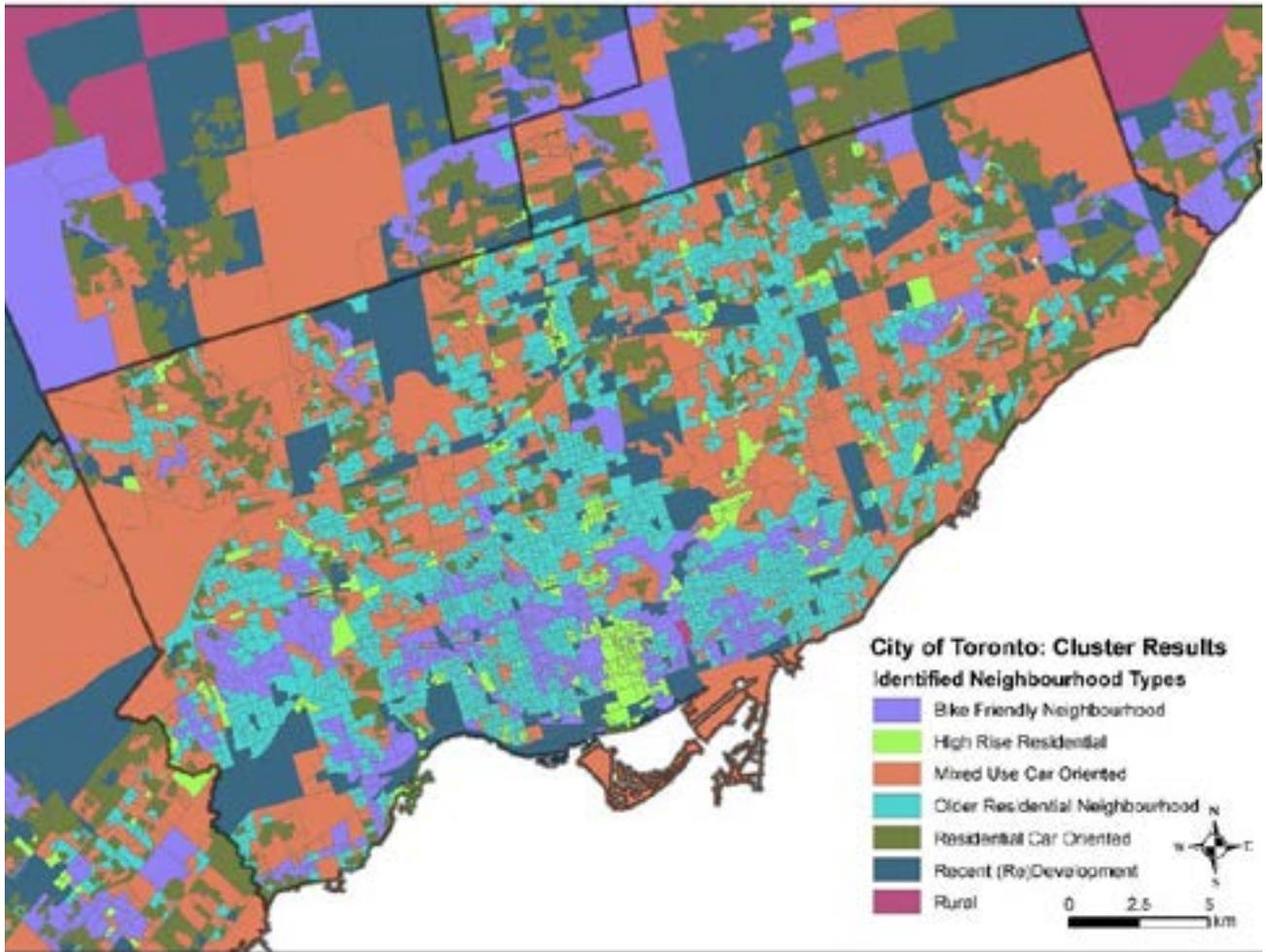


Figure 3: Neighbourhood types within the study area

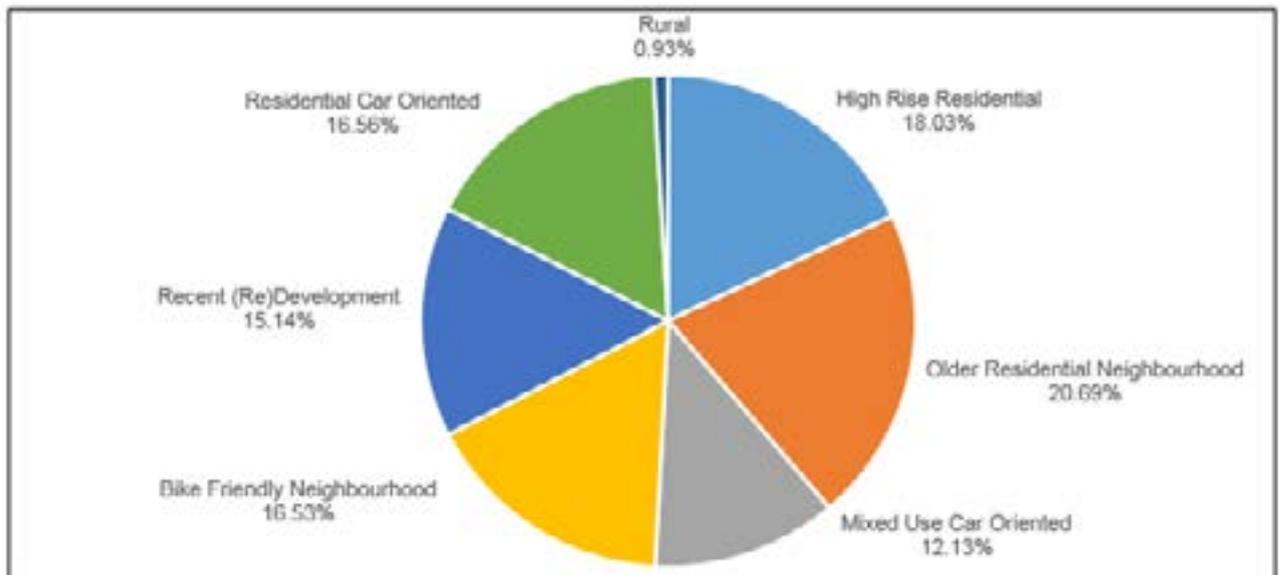


Figure 4: Proportion of post-secondary students by residential neighbourhood type

between a student's transportation lifestyle and the neighbourhood in which they live in. For example, those who lived in bike friendly neighbourhoods, high-rise residential neighbourhoods, older residential neighbourhoods and recent (re)development neighbourhoods were more likely to be 'active travellers' and 'multi-modal travellers', after adjusting for all other differences and variations. Similarly, students living in mixed-use car oriented neighbourhoods, older residential neighbourhoods and residential car oriented neighbourhoods were more likely to be 'Transit riders'. In contrast, all the above-mentioned neighbourhood types were less favourable to 'drivers', who were more commonly to be found in residential car oriented neighbourhoods or rural communities. Among all traveller types, neighbourhood environment apparently had a weaker influence on explaining travel behaviour of 'occasional drivers'. The adjusted probabilities of residential location, by traveller types, are shown in Figure 5.

With regard to the effect of residential location preference, students who value cycle/walkability of a neighbourhood in residential location choice decision were more likely to be 'active travellers' and 'multi-modal travellers', whereas 'transit riders', not surprisingly, would value proximity to transit. Those who had no location preference in the selection of their current residence were also more likely to be 'transit riders'. Considerations relating to housing cost and neighbourhood amenities did not explain post-secondary students' transportation lifestyles.

Other Major Findings

Socio-demographic characteristics were the most significant in explaining transportation lifestyles. Older post-secondary students were more likely to be 'drivers' and less likely to be 'active travellers' when compared to younger students. Men were less likely to be 'drivers' or 'occasional drivers' and instead were more

likely to be 'active travellers' or 'transit users' compared to women.

A student's living arrangement also explained part of their travel pattern. Those who lived with family or parents were more likely to be 'drivers', 'occasional drivers; or 'transit users', and less likely to be using active modes for their day-to-day transportation. These findings indicate the importance of the life-cycle stage in understanding the patterns in daily travel (9). It appears that with increased social role and responsibilities within the household, individuals may become more dependent on cars and transit, at the cost of declined use of active transportation modes.

Discussion and Implications

Due to some limitations in data and methodical approach, some caution is necessary before generalizing the results. First, travel diary data was collected for one day only and the respondents self-reported their long-term travel behaviour; it is possible that for some, transportation choices would be somewhat different if data were collected on a different day within the year. Second, and most important, this research focuses on travel behaviour of university-attending students in a large metropolitan area. This sub-population represents a significant share of the millennial generation, but some part-time students are older (5.5%). Post-secondary students are also representative of a specific life-cycle stage and their economic and social constraints may be different than many other millennials who are working full-time.

Within the scope of this study, however, our research provides important insights into travel behaviour of young adults. First, we found that distinct transportation lifestyles exist within post-secondary students, and that these lifestyles contribute to significantly different travel profiles in the short- and long- term. An encouraging observation was that two-thirds

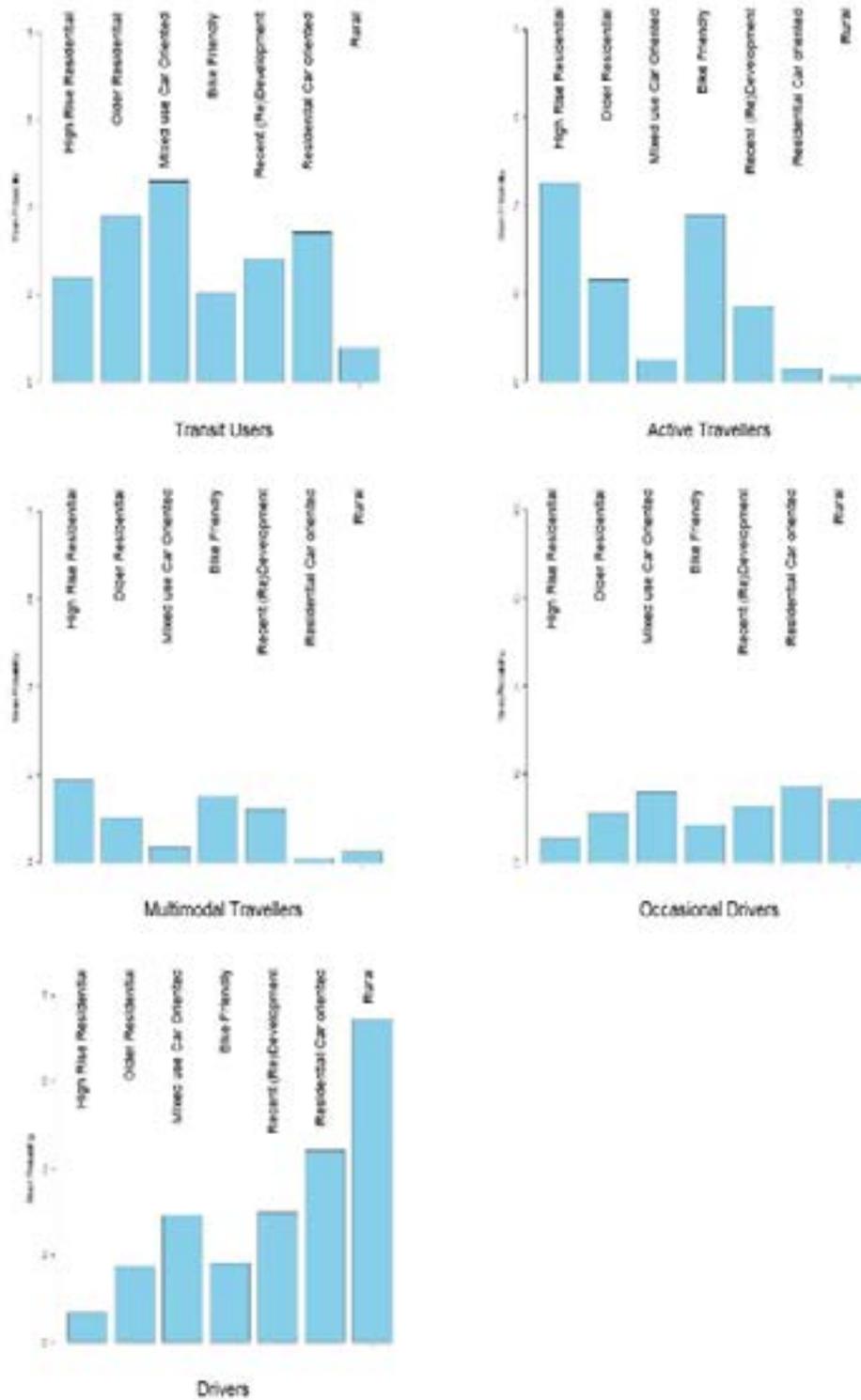


Figure 5: Adjusted probabilities of living in various neighbourhood types, by transportation lifestyle

of all post-secondary students (64.1%) almost exclusively relied on walking, cycling and transit for their transportation needs (i.e., are 'transit riders', 'active travellers' or 'multi-modal travellers').

However, previous research has often linked low auto-dependency with limited mobility options, which may sometimes lead to reduced opportunities for daily participation in social or economic activities (5,18). In our study, we found that 'transit users' were likely to have the lowest levels of activity participation- with the lowest number of average trips per day (2.82 ± 1.35 trips) and very high average trip lengths (12.29 ± 0.84 km). Of the five groups, the 'multi-modals' took the highest number of daily trips, as well as demonstrating a mode choice behaviour that is environmentally sustainable. Unfortunately, this group constituted only 10% of our sample.

Second, the built environment qualities of the neighbourhood of residence were important indicators of a post-secondary student's transportation lifestyle. Our analysis indicates that 'active travellers' and 'multi-modal travellers' were sensitive to similar built environment qualities, and that these traveller groups (33% of all students) would more commonly live in older or redeveloped neighbourhoods with high land use mix and walkable streets. In comparison, 'transit riders' (31%) would more commonly live in GTHA's inner suburban neighbourhoods, which still represent some land use mix, but the street layouts are primarily designed for cars in these neighbourhoods (i.e. high-speed, longer block length, and lack of cycling facilities). In other words, it appears that most of these millennial students live in mixed use neighbourhoods located in inner-urban or inner-suburban communities, while they primarily use active transportation modes or transit for their daily transportation needs.

In the absence of representative data on millennials' travel behaviour, analysis based on large comprehensive datasets, such as the one presented in this study, can be useful in providing partial insights into the travel behaviour of this generation. Our study builds

on a limited literature that has addressed this topic. As this research continues to grow, the findings would contribute to an improved understanding of the potentially changing residential location preferences and choices that has been reported in previous works (19,20), and would inform predictive modelling as well as policy making that focuses on such relationships.

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