Mind for mass transit: Commuters' assessment of public transport as a "reasonable" option

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ABSTRACT

Retaining and increasing public transport ridership is a centerpiece of many strategies to address both the climate crisis and public health challenges. Understanding how and why commuters choose or reject public transport as a viable option or actual mode is, thus, central to policymakers' efforts. This study makes use of a detailed travel-behavior survey conducted at McGill University in Montreal, Quebec, to answer two key questions: (1) What factors influence travelers' perception of public transport as a reasonable commuting option? and (2) From among those travelers that do consider public transport to be reasonable, what factors influence their final decision to use it. One important finding is that there is sometimes a disconnect between the factors that influence a person's initial assessment of reasonableness and subsequent mode choice. For example, car owners were paradoxically more likely to consider public transport a reasonable option but significantly less likely to use it. More generally, another important finding of this study is that there may be a sizeable contingent of travelers who consider public transport to be a reasonable or viable option but nonetheless decline to use it. It may prove easier to convert these travelers to public transport, making it important for policymakers to understand their motivations. Ultimately, public transport agencies may be able to use this type of information to develop policies better targeted as bolstering ridership.

Keywords: mode choice, mode reasonableness, mode viability, sustainable transportation, public transportation

1. INTRODUCTION

Even as cities around the world seek opportunities to shift travelers from single-occupancy vehicles to more sustainable modes (*1*), public transport ridership has recently declined in most North American regions (*2; 3*). This is especially true for buses. To reverse this trend, and help cities chart a course toward greenhouse gas reductions and more livable urban environments, transport agencies must find new ways to both retain and expand ridership.

Customer satisfaction is undoubtedly central to this effort because it affects both retention and loyalty and recommendations to would-be riders (*1; 4-7*). Although many agencies attribute ridership declines to everything from a slowing economy, to falling gas prices, to the presence of ride-hailing services (*8*), longitudinal studies controlling for these factors have found that annual vehicle revenue kilometers are the central internal factor (*9*). In other words, service cuts, including more limited frequency or canceling routes, can be linked to the overall declines in ridership at the system level. The decline in service frequency leads to increases in waiting time, the most critical element in satisfaction with bus service (*7*).

Many researchers have begun to explore the range of factors that can influence a public transport user's satisfaction (*4*), and much more work remains to be done in this vein. At the same time, however, scholars and policymakers must fix their attention on transport-service, neighborhood, and individual attributes that affect travelers' mode-choice at even earlier stages of the process. That is to say, before travelers can even consider whether they are satisfied with public transport, they must first determine if it is a "reasonable" or viable option at all for them to use.

Much of the research on mode-choice and attracting new public transport riders necessarily relies on census commuting data or origin-destination surveys, which frequently capture detailed sociodemographic information that can be paired with actual mode-choice decisions to infer viability and reasonableness (*10; 11*). It is far rarer that researchers are able to peek under the hood to understand the psychological and other factors that shape individuals' perception of the public transport system as a reasonable or viable option and that shape an individuals' eventual decision to use it. The gap in understanding is especially relevant for policymakers who seek to design public transport systems that can compete with private automobiles for ridership. For these policymakers, it is important to understand distinctions between, for example, a person who considers public transport to be a reasonable travel option and one who doesn't and between a person who considers public transport a reasonable option and actually uses it and one who nevertheless opts for a car instead.

Our aim in this paper is to help facilitate this understanding by explicitly addressing perceived reasonableness or viability while controlling for socio-demographic, self-selection and home-location characteristics. Within that context, our goal is two-fold: first, to understand the factors most strongly correlated with the perception of public transport as a reasonable option for commuting to work or school and, second, to explore the factors that tip the balance from merely finding public transport reasonable to actually using it. To accomplish this, our study applies multilevel statistical modeling to detailed travel and attitudinal data obtained from the 2017/18 McGill University Travel Survey. The McGill Travel Survey is a semi-annual survey that collected travel behavior from 4,859 students, faculty and staff using various modes to commute to school or work. Among other things, the survey explicitly asked respondents to assess whether various modes constituted a "reasonable" option for their commute. The survey also asked all commuters to report the details of their most recent trip, including trip satisfaction, and a range of home selection, socioeconomic, and demographic questions, allowing us to explore the relationship between these variables, perceptions of reasonableness, and actual trip outcomes.

2. LITERATURE REVIEW

There is ample evidence that shifting people to more sustainable modes of transport is essential both the environment and individual health and well-being. Transport, for example, constitutes a large and growing portion of the greenhouse gas emissions (GHGs) driving the human-caused climate crisis (*12; 13*). Meanwhile, important social and physical benefits accrue from adopting sustainable modes of transport. Daily commutes impact life satisfaction and social well-being (*14-16*). A clear positive relationship exists between satisfaction with commute and feeling that the commute contributes to greater life satisfaction among all mode users (*16*). This relation is much stronger among walkers, cyclists, and some public transport users compared with drivers. Indeed, research has shown that those who walk, cycle, and use public transport tend to be impacted more positively when it comes to their punctuality and energy at work (*17*) and less likely to be stressed (*18*), and experience higher satisfaction with their commute (*19; 20*) compared to drivers.

Helping shift travelers to more sustainable modes of transport requires a deep understanding of the factors that influence mode choice. As such, public transport mode choice has been heavily studied in the literature (*21; 22*) with clear factors impacting it such as population density (*23*), accessibility (*24; 25*), income (*26*), service characteristics (*27*), and built environment and land use (*28*). This is, of course, in addition to attitudes and behavior (*29; 30*). These studies relied on the revealed preferences of travelers through an analysis of actual travel behavior. Mode choice researchers frequently use census commute-related questions and/or O-D surveys to paint detailed though-after-the-fact portraits of travelers' existing choices. Researchers glean invaluable insights from these studies, but they rarely have the opportunity to directly explore the rationale behind these choices through more detailed questions. That is to say, researchers are often confined to analyses of travelers' existing behavior (*21; 22*). Few studies, if any, have offered the opportunity to analyze people who may be on the cusp of using public transport but do not use it.

At the individual level, mode choice is a two-step process. The first step is to assemble a range of reasonable potential modes for the trip. This reasonable set of modes can be identified based on a self-evaluation of time, cost, and benefits associated with the use of such modes. For example, a person traveling to do a grocery shopping for a family of five will have a different set of reasonable modes compared to a single person selecting a mode to go to work. After defining the set of reasonable modes, a decision is made to select the preferred mode based on the same set of constraints (time, cost, and benefits) and personal preferences. It is largely as this stage, which expected satisfaction plays its greatest role (Figure 1).

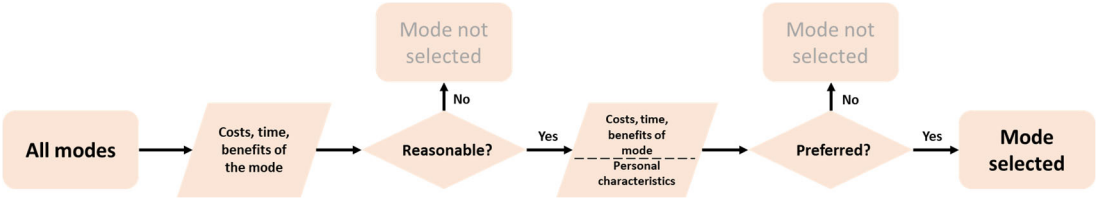

Figure 1: Mode choice process

Our study focuses on the first step in this mode-selection process: the individual and external determinants of a reasonable mode. Our literature review did not readily reveal any studies

that have directly addressed this question from precisely this perspective. Our goal is therefore to incorporate the idea of a reasonable mode in the mode choice process to help public transport agencies target efforts to attract ridership.

3. DATA AND METHODOLOGY

Data

We relied on data obtained from the 2017/18 McGill University Travel Survey. All McGill staff and faculty and a random sample of one third of the student population received e-mail invitations to complete the survey online. Various prizes were offered to encourage participation. Invitees received a single reminder email two weeks after receiving the initial invitation. To obtain a representative sample under various weather conditions, participants were invited in two waves: one in fall 2017 and another in winter 2018. Over the course of both seasons, 16,930 invitations went out. We received 4,859 responses, representing a 33.4% response rate, which is comparable to previous research (*11; 18; 19*).

For our analysis, we focused on the subset of data for those people who reported traveling to McGill University's main campus in downtown Montreal, Quebec (n=4,257). Relatively few respondents traveled to other McGill locations and they were therefore excluded from our analysis. Distance and potential travel time were hypothesized to play an important role in commuters' perceptions of the reasonableness of different modes. We therefore excluded all records for which we were unable to geolocate a home address. From the geolocated data set, we then excluded highly infrequent typical modes of travel, including motorcycle, scooter and taxi trips. Within this retained data set, only 16 people described their sex as "other," a number too small to retain as a separate category for purposes of analysis, leaving us with 2,758 records. Within the regression models described below, we further omitted any observations for which we did not have a complete set of responses for each of the included variables. Our primary question of interest asked participants to assess whether particular modes represented "reasonable" commuting options for them. Participants were asked to agree or disagree with each of the following statements:

WALKING is a reasonable option for me to commute to McGill;
CYCLING is a reasonable option for me to commute to McGill;
PUBLIC TRANSPORT is a reasonable option for me to commute to McGill;
DRIVING is a reasonable option to commute for me to McGill

The responses to this question served as the basis for the dependent variable within our first model: whether commuters perceived public transport as a reasonable option for their commutes. A second question asked survey respondents to identify the main mode for their most recent trip to McGill University. The survey defined "main mode" as the mode that occupied the largest amount of respondents' time during the commute. For purposes of our analysis, these responses represented respondents' "actual" mode choice, serving as the dependent variable for our second regression model. Survey participants were also asked to rate the importance of various factors in their home-selection process using a five-option scale: "very unimportant," to "very important." The factors included, among other things, the importance of public transport and bicycling infrastructure and of social, and traffic safety. For this analysis, we converted these survey responses into binary variables. Responses of "very unimportant," "somewhat unimportant," and "neutral," were reclassified as "unimportant;" the remainder were reclassified

as "important." We relied on Google's Distance Matrix API to compute travel distances and projected times by various modes for each of the survey respondents.

Modeling

For our modeling, we adopted a multi-step process. First, we sought to determine which factors influenced survey respondents' perception of the reasonableness of public transport as a commuting option. To answer this question, we constructed a logistic regression model with the dichotomous outcome variable "transit is a reasonable option for my commute" and various individual, home-selection and neighborhood characteristics as explanatory variables. The variables are identified in Table 1.

Table 1 Variables retained for analysis of transit reasonableness and mode use

Variables	Model		Source
	Reasonableness	Actual Mode Use	
Individual variables			
Age	*	*	McGill Travel Survey 2017/2018
Children 16 years or younger	*	*	McGill Travel Survey 2017/2018
Sex (male =1)	*	*	McGill Travel Survey 2017/2018
Own a car	*	*	McGill Travel Survey 2017/2018
Home-location variables			
Road-network distance (km)	*	*	Google
Road-network distance squared (km)			Google
Home-selection variables (important = 1)			
Being near to McGill	*	*	McGill Travel Survey 2017/2018
Being near to amenities			McGill Travel Survey 2017/2018
Being near to public transportation	*	*	McGill Travel Survey 2017/2018
Being near to bicycle infrastructure		*	McGill Travel Survey 2017/2018
Social safety/low crime		*	McGill Travel Survey 2017/2018
Traffic safety		*	McGill Travel Survey 2017/2018
Being in a place where one doesn't have to drive		*	McGill Travel Survey 2017/2018
Typical mode for commuting	*		

We tested numerous variables, including transit-to-car travel time ratios, the type of neighborhood where respondents were raised (urban, suburban, rural) and university status, among others. They were not statistically significant or were too closely correlated with other variables in the model and had to be removed to avoid multi-collinearity.

In the second step, we sought to identify the factors that influenced whether the subset of commuters who considered public transport to be reasonable actually used it. We did not include typical commuting mode as an explanatory variable for this model because it could introduce unwarranted bias where the vast majority of survey respondents reported using the same modes for their typical commutes and for their last trip to campus.

For both questions, we experimented with multiple modeling algorithms. To reduce spatial estimation bias, we tested two multilevel modeling approaches to nest respondents within neighborhoods, as represented by census tracts from the 2016 Canadian Census. One approach used a penalized quasi-likelihood method from the MASS package of the R statistical programming language; the other used an adaptive Gaussian Hermite quadrature method (QUAD) from R's LME4 package. The approaches yielded similar results in terms of statistical significance and direction. We retained the results of the QUAD function for analysis because some literature suggests it may yield less biased results when dealing with small numbers of observations within clusters or for binary response variables as we have here (*31*). We also examined a traditional generalized linear model with no random effects and attempted to account spatial bias by removing entirely people who walked or rode a bicycle as they were tightly clustered in areas directly adjacent to campus. This model yielded similar results and was excluded from the paper.

Finally, we examined a subset of survey respondents who indicated they considered both driving and public transport to be reasonable options for their commute. This group of so-called "swing" commuters could conceivably be swayed to adopt one mode or the other more easily given their positive assessment of both. For officials concerned with bolstering sustainable transport, these swing commuters may represent an important point of focus to avoid defections among existing public transport users and to attract current drivers. In keeping with the primary policy aim of this paper—to identify options to convert drivers to more sustainable modes— we considered only driving and public transport, rather than active modes such as cycling or walking. Though it is conceivable that drivers might be converted to walking or biking, we hypothesize that the conversion from driving to public transport might be easier and more likely given the spatial distribution of responses. To analyze the mode choice determinants, we applied a binary logistic regression with actual public transport use as the dependent variable. In this case, too few observations were available to conduct a meaningful multi-level analysis. We therefore fit a generalized linear model without random effects.

RESULTS

Summary statistics

The average age of the retained study group was 37 years old, with respondents' ages ranging from 19 to 79, as show in Table 2. The population skewed female, with only about 40% of respondents identifying as male. Less than half of households reported owning a car or having children 16 or younger at home. On average, commuters live just over 9 kilometers from McGill's Downtown campus. When selecting their homes, well over 70% indicated that being near public transportation and amenities and in neighborhoods safe from crime were important factors. Over half indicated that being near McGill, not having to drive at home and traffic safety were important factors. A little less than 30% of respondents said being near bicycling infrastructure was important.

Table 2 Summary statistics for commuters to McGill's downtown campus and for whom home locations were available.

Statistic	N	Mean	St. Dev.	Min	Max
Individual variables					
Age	2,758	37.5	14.428	19	79
Gender (male =1)	2,758	0.396	0.489	0	1
Children 16 years or younger in household	2,738	0.404	0.798	0	7
Own a car (yes = 1)	2,758	0.475	0.499	0	1
Home-location variables					
Road-network distance (km)	2,758	9.278	9.777	0	70.657
Road-network distance squared (km)	2,758	181.64	373.603	0	4992.412
Home-selection variables (important = 1)					
Being near to McGill	2,758	0.558	0.497	0	1
Being near to amenities	2,741	0.826	0.379	0	1
Being near to public transportation	2,750	0.83	0.376	0	1
Being near to bicycle infrastructure	2,749	0.291	0.454	0	1
Social safety/low crime	2,745	0.724	0.447	0	1
Traffic safety	2,742	0.529	0.499	0	1
Being in a place where one doesn't have to drive	2,754	0.622	0.485	0	1
Transit-related variables					
Transit is a reasonable option for commute to McGill (yes =1)	2,747	0.851	0.356	0	1
Public transit was main mode for last commute to McGill (yes = 1)#	2,758	0.605	0.489	0	1

includes bus, metro and commuter train

Among those commuters who described transit as a reasonable option for their trip to McGill University's downtown campus, about 70% actually took transit during their most recent trip, as shown in Table 3. Another 13% walked and 8% rode bikes. Despite describing transit as a reasonable option, 207 nevertheless drove or carpooled. This subset of individuals—those who consider transit a reasonable option but nevertheless drive—may be of particular interest to policymakers given the seeming potential to convert them to more sustainable modes of commuting.

Table 3 Reasonableness of Public Transit by Main Mode Actually Used

	Transit is a Reasonable Option		Transit is Not a Reasonable Option	
Main Mode Actually Used				
Walk	303	13%	244	60%
Bicycle	180	8%	27	7%
Bus	536	23%	7	2%
Metro	828	35%	4	1%
Commuter train (RTM)	284	12%	5	1%
Carpool (car passenger)	43	2%	9	2%
Drive (car driver)	164	7%	113	28%
McGill intercampus shuttle#	4#	0%	0#	0%
Other#	5#	0%	1#	0%
Motorcycle or scooter#	2#	0%	0#	0%
Taxi#	8#	0%	0#	0%
Total	2357	100%	410	100%

excluded from regression models. Also excludes people for whom the main mode was unknown.

A vanishingly small number of commuters reported using public transport as their main mode despite considering it unreasonable. Only about 4% of people who disagreed that transit was a reasonable option, rode the bus, metro or commuter rail. This suggests that a negative assessment of the reasonableness of a mode may, in fact, serve as a good indicator of actual mode choice. Within the group that did not consider public transport reasonable, 60% walked and 7% biked. For these respondents, it seems likely that the commute distance to campus was too short to be considered suitable for transit. The spatial distribution of those individuals who rejected transit as a reasonable option supports this hypothesis for a large number of respondents. As we observe in Figure 2, many people who did not consider transit reasonable cluster in a student-heavy area immediately adjacent to McGill's downtown campus.

The remainder of those respondents who disagreed that transit was a reasonable option, however, are broadly dispersed throughout the greater Montreal area (Figure 2). Indeed, they are largely collocated with those who considered transit a reasonable option, suggesting that the perception of transit as a reasonable option may derive in large measure from idiosyncratic, personal considerations beyond neighborhood-level characteristics, such as access to transit.

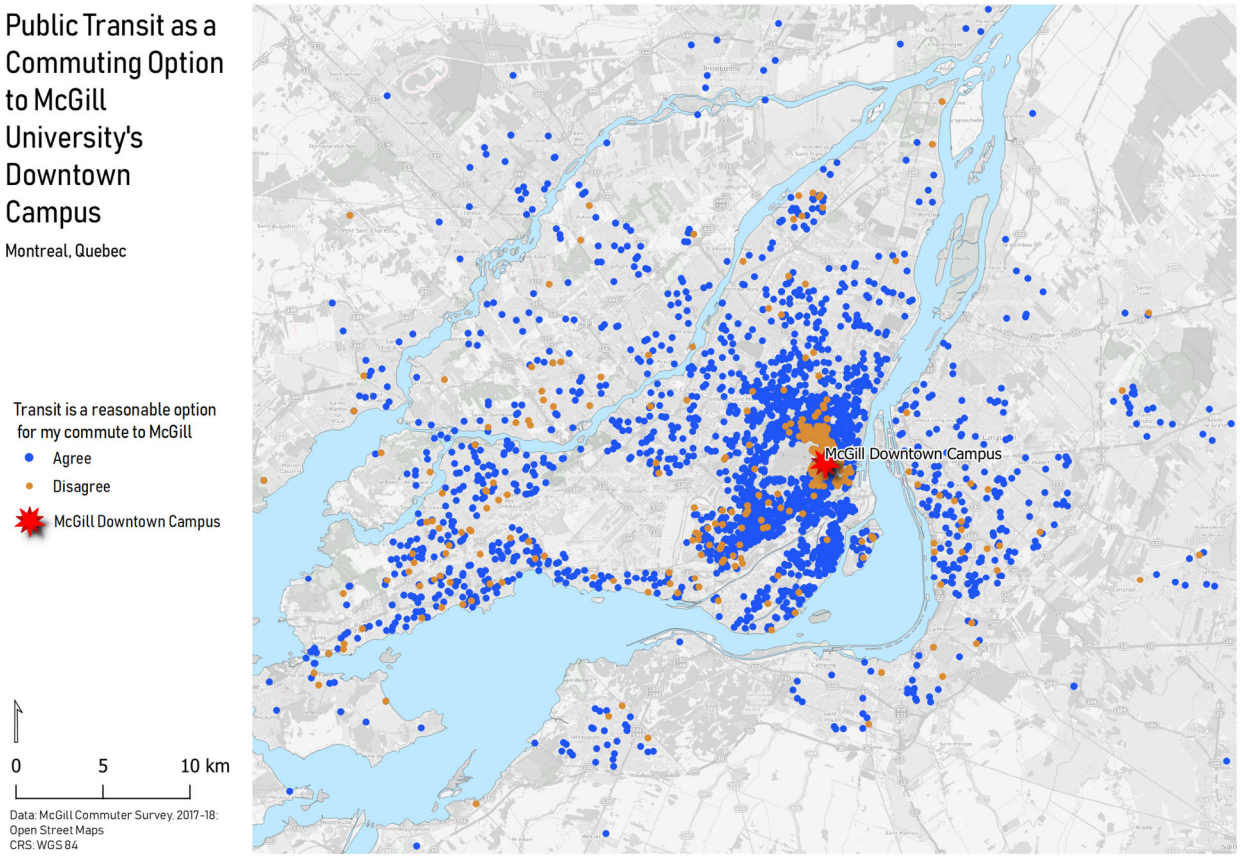

Figure 2 Spatial distribution of responses to survey question regarding reasonableness of public transit as a commuting option

Regressions

Whether Transit Is Reasonable or not

Among the factors that relate to the perception of public transport as a reasonable option, typical mode choice demonstrated one of the strongest influences, as shown in

Table **4**. As expected, respondents' typical use of public transport was closely correlated with the perception of it as reasonable. Relative to walkers, people who typically commuted by public transport had 18 to 56 higher odds of describing public transport as a reasonable option, when all other variables are held constant at their mean. Interestingly the results underscore the notion that commuters make a clear distinction between satisfaction with a mode and its reasonableness, suggesting their assessment of the two rely on different characteristics. In an earlier study relying on similar data, St. Louis et al. (*19*) found that trip satisfaction was generally highest among commuter train riders and lower for bus and metro riders. Here, however, we find that bus and metro ridership correspond to a higher relative likelihood of perceiving public transport as a "reasonable" commuting option than commuter train use. If riders' satisfaction and their assessment of the overall reasonableness of a mode relied on the same service attributes, one would expect the relative odds to be ordered similarly. Here, the metro's apparent influence suggests that commuters' perception of reasonableness may be more heavily influenced by service-related characteristics, such as frequency, opening hours and cost, than by other attributes, such as comfort.

Those who picked homes with access to public transport in mind were also far more likely to consider public transport a reasonable option. The odds of considering public transport to be reasonable were nearly 380% higher, all else being equal.

Table 4 Multi-Level Logistic Regressions for Public Transport Reasonableness and Subsequent Transit Mode Choice Among Those Who Consider It Reasonable.

	Transit is a Reasonable Option to Commute to McGill		**Transit is a Reasonable Option and Was Main Mode for Last Trip to McGill**	
Predictors	*Odds Ratios*	*CI*	*Odds Ratios*	*CI*
Individual variables				
Age	0.995	0.9834 – 1.0067	0.9926	0.9837 – 1.0015
Children 16 years or younger	1.0824	0.8817 – 1.3288	0.8589 **	0.7476 – 0.9869
Sex (male =1)	1.1579	0.8707 – 1.5398	0.5635 ***	0.4518 – 0.7027
Own a car	1.4250 *	0.9355 – 2.1705	0.5743 ***	0.4378 – 0.7532
Home-location variables				
Road-network distance (km)	0.9776 *	0.9557 – 1.0001	1.2501 ***	1.1964 – 1.3061
Road-network distance squared (km)			0.9964 ***	0.9954 – 0.9973
Home-selection variables (important = 1)				
Being near to McGill	0.802	0.5484 – 1.1728	0.6194 ***	0.4809 – 0.7979
Being near to amenities	0.8625	0.5849 – 1.2720	0.5280 ***	0.3663 – 0.7611
Being near to public transportation	3.7966 ***	2.7639 – 5.2152	5.8295 ***	3.8581 – 8.8084
Being near to bicycle infrastructure			0.5903 ***	0.4658 – 0.7481
Social safety/low crime			0.7767 *	0.5753 – 1.0487
Traffic safety			0.8102	0.6211 – 1.0567
Being in a place where one doesn't have to drive			1.5126 ***	1.1482 – 1.9927
Typical mode for commuting (reference = Walk)				
Bicycle	2.5394 ***	1.5840 – 4.0711		
Bus	23.2064 ***	10.1162 – 53.2349		
Metro	56.7107 ***	19.9642 – 161.0942		
Commuter train (RTM)	18.6099 ***	7.0235 – 49.3100		
Carpool (car passenger)	1.6373	0.6119 – 4.3811		
Drive (car driver)	0.4936 **	0.2807 – 0.8680		
(Intercept)	1.5624	0.8259 – 2.9557	0.985	0.5553 – 1.7473
Random effects				
σ^2	3.29		3.29	
τ_{00}	0.56 $_{CTUID}$		0.53 $_{CTUID}$	
ICC	0.14		0.14	
N	640 $_{CTUID}$		613 $_{CTUID}$	
Observations	2700		2270	
Marginal R2 / Conditional R2	0.505 / 0.576		0.278 / 0.377	
			** p<0.1 ** p<0.05 *** p<0.01*	

Car ownership was surprisingly correlated with much higher odds of considering public transport to be reasonable. This seeming contradiction might potentially be explained by the spatial distribution of car ownership and rich transit service. Among the factors that were negatively

associated with perceiving public transport as a reasonable option, driving unsurprisingly stands out. When an automobile represented the typical commuting mode, the odds of a respondent considering public transport a reasonable option were more than 50% lower, all other variables held constant. Multiple explanations are possible: On the one hand, drivers might simply lack awareness of the public transport system, making them less likely to consider it reasonable. On the other, they may choose to drive precisely because they consider public transport unreasonable. Considered in combination with the fact that car ownership correlates with higher odds of finding public transport reasonable, the latter seems more likely. As distance increases, the odds of commuters considering public transport reasonable also decline. Each addition kilometer of distance, as measured on the road network, corresponds to a little more than a 2% decline in the odds of finding public transport reasonable, all else being equal.

Whether Transit is Actually Used

We next sought to identify the factors that influence whether commuters who already consider public transport to be a reasonable option actually use it. The results of this analysis highlight some interesting contradictions. First, a clear disconnect appears to exist between men's assessment of public transport's reasonableness and their actual travel behavior. Men were not significantly more or less likely to consider public transport a reasonable option. Yet among the subset of commuters who affirmatively stated that public transport was a reasonable option for them, being a man was associated with nearly 45% lower odds of actually using it, all other variables held constant. A similar pattern emerges when considering the responses of car ownership. Though car owners were, in fact, significantly more likely to consider public transport a reasonable option for their commutes, car ownership was associated with more than 40% lower odds of actually using public transport.

Having children also appears to represent a significant drag on the odds of taking public transport, even after describing public transport as a reasonable option. Though the influence of having children was not statistically significant in terms of commuters' perceptions of public transport reasonableness, having children at least one child under 17 was associated with nearly 15% lower odds of actually using public transport, all else being equal. Numerous explanations may exist to directly or indirectly explain this result: First, parents may feel compelled to drive because they need to transport children as part of their daily commute. Second, parents may need to transport children outside of their regular commute, making car ownership more likely and, in turn, decreasing the odds of using public transport.

Not all findings revealed contradictions between perception and actual travel behavior among those who considered public transport reasonable. For example, among those who prioritized being near public transport or not having to drive when selecting their homes, the odds of actually using public transport were significantly higher, all other variables held constant. Relatedly, those who prioritized being close to McGill or bicycle infrastructure, had lower odds of using public transport, likely because they walked or rode a bicycle. These findings suggest that people's stated preferences and locational decisions regarding transport modes are good indicators of actual travel behavior.

Preoccupation with social safety and crime were associated with lower odds of public transport ridership on the subset of people who said that public transportation was a reasonable option. When survey respondents ranked these considerations as important factors in selecting their home location, the odds of taking transit dropped more than 22%, all other variables being

equal. This, too, may point the way to rider-retention and -growth policy options aimed at boosting the public's general sense of safety within the public transport system.

Finally, among those who consider public transport a reasonable option, the further someone's home, the more likely they are to use public transport, at least to a point. For many people located in close proximity to campus, public transit may be a reasonable option, but walking or biking may represent an even more reasonable one.

Swing Commuters

A significant portion of commuters consider both transport and driving to be reasonable options. See Table 5. Of the respondents, 621—more than 22%--simultaneously indicated that both public transport and driving were reasonable possibilities for their commute. Among them, 194 currently use cars as either drivers or passengers for their main mode. These represent potential swing commuters who may be at least marginally more susceptible to being shifted to other, more sustainable modes since they already consider public transport a reasonable option. On the other hand, 382 of these swing commuters currently use public transport as their main mode and could potentially be driven to opt for less sustainable modes if conditions were to deteriorate.

Table 5 Summary of survey respondents by their current main mode and perception of the reasonableness of public transport or driving

	Reasonable Option for Commute to McGill			
Current main mode	Public Transport & Driving	Driving Only	Public Transport Only	Neither
Walk	32	8	271	236
Bicycle	13	3	167	24
Bus	125	2	407	5
Metro	189	0	632	4
Commuter train (RTM)	68	0	215	5
Drive (car driver)	156	109	7	4
Carpool (car passenger)	38	8	5	1
Total	621	130	1704	279

Both subgroups of potential swing commuters should be of interest to policymakers as they seek to retain or boost public transport ridership. Our regression results for this subgroup suggest that many of the same factors play into their mode choice as do among the larger group of survey respondents. Having a car is associated with an even more profound impact, as is having children in the household and preoccupation with crime. Among the subset of swing commuters, having a car was associated with more than 60% lower odds of taking public transport, all else being equal. Having a child in the household cut the odds nearly 25%, all other variables held constant. When concerns regarding social and safety were considered important for home selection, the odds of using public transport were almost 50% lower, all things being equal.

There are, however, a few notable exceptions when considering the swing commuter subgroup alone. For example, age becomes statistically significant, corresponding to decreasing odds of public transport use. Each additional year in age corresponded to an approximately 1.8% decrease in the odds of taking public transport.

Table 6: Transit mode choice results for "swing commuters", those who consider both driving and public transport reasonable options

	Transit is a Reasonable Option and Was Main Mode for Last Trip to McGill	
Predictors	*Odds Ratios*	*CI*
Individual variables		
Age	0.9817 **	0.9670 – 0.9965
Children 16 years or younger	0.7522 ***	0.6097 – 0.9280
Sex (male =1)	0.8324	0.5681 – 1.2196
Own a car	0.3881 ***	0.2319 – 0.6494
Home-location variables		
Road-network distance (km)	1.1367 ***	1.0757 – 1.2012
Road-network distance squared (km)	0.9983 ***	0.9973 – 0.9994
Home-selection variables (important = 1)		
Being near to McGill	0.715	0.4680 – 1.0923
Being near to amenities	0.5842 *	0.3314 – 1.0298
Being near to public transportation	5.6624 ***	3.0720 – 10.4372
Being near to bicycle infrastructure	0.6293 **	0.3990 – 0.9925
Social safety/low crime	0.5028 **	0.2683 – 0.9423
Traffic safety	0.7045	0.4432 – 1.1199
Being in a place where one doesn't have to drive	1.9156 ***	1.2110 – 3.0303
(Intercept)	2.1965 *	0.8669 – 5.5657
Observations	603	Observations
Tjur's R^2	0.21	

** p<0.1 ** p<0.05 *** p<0.01*

CONCLUSIONS

Shifting travelers to more sustainable modes, such as public transport, remains a vitally important, though challenging, environmental and public health objective. This study sought to identify some of the determinants that shape commuters' perceptions regarding the reasonableness or viability of public transport as a mode choice. This initial determination is an essential first step in the mode-choice process. This study further attempted to determine which of those factors might help nudge those commuters who consider public transport to be a viable option to actually use it. Among the most important factors we identified are car ownership, which has a strong negative correlation with actually using public transport. The presence of children in a household is also negatively associated with public transport mode choice, suggesting a range of potential policy responses. Finally, there are clear gender differences in mode choice. No statistically significant difference exists between men and women when it comes to identifying public transport as reasonable. Nevertheless, men in the study had far lower odds of actually using it, suggesting that efforts to boost public transport ridership may need to specifically target men.

Perhaps most importantly, this study highlights the fact that many people may consider public transit to be a reasonable or viable option but nevertheless fail to use it. In theory, a better understanding of their specific concerns and motivations might make them easier targets to convert to public transport. By the same token, the study also reveals that there may be many public

transport users who also consider driving to be a reasonable commuting option. These riders may be at greater risk of defection to less sustainable modes. This foray into the analysis of reasonability or viability represents a limited first step, but points the way to further research. In particular, future research may focus target "swing" commuters more specifically. Future surveys may also directly inquire into the barriers that impede travelers from making the leap to public transport.

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AUTHOR CONTRIBUTIONS

The authors confirm contribution to the paper as follows: study conception and design: DeWeese & El-Geneidy; data collection: DeWeese & El-Geneidy; analysis and interpretation of results: DeWeese & El-Geneidy; draft manuscript preparation DeWeese & El-Geneidy. All authors reviewed the results and approved the final version of the manuscript.

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