

Modeling the desire for using public transport

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Abstract

The desire to use public transport, or use it more frequently, can be an important indicator of people's intention to travel by public transport. However, the desired and relative desired travel amount (wanting to travel less or more) in the context of public transport use has not yet been analyzed. In this paper, we examine the relationship between actual and desired public transport frequency of 986 students of Laval University, Canada. Results indicate that most respondents have a desired public transport frequency close to their actual frequency. In line with the model of goal-directed behavior we found that – based on ordered logit models – the desire for frequently using public transport is positively affected by attitudes towards – and satisfaction with – public transport, while the desired public transport frequency positively influences actual public transport frequency. Besides positive effects of attitudes and satisfaction, we also found that the desire to travel more frequently by public transport is positively affected by easy car access and living in rural areas. This suggests that rural residents are potential public transport users who are perhaps restricted by their living context and that moving into urban areas may present an opportunity for them to increase public transport use. Finally, we also found that the intention to use public transport in later life (i.e., after university) is positively affected by respondents' desired public transport frequency.

Keywords: Travel behavior; Public transport use; (Relative) desired public transport use; Attitudes; Satisfaction

1. Introduction

The theory of planned behavior (Ajzen, 1991) proposes and gives evidence that attitudes have an important effect on behavioral intention. Based on this theory, a considerable amount of travel behavior studies have found strong effects of travel attitudes on travel mode choice (e.g., Bagley & Mokhtarian, 2002; Handy et al., 2005; Kitamura et al., 1997). However, attitudes are evaluative concepts which do not indicate a clear association between a positive evaluation and a certain behavior (Perugini & Bagozzi, 2004). A person with a positive stance towards public transport (e.g., due to its positive effects for the environment) might not have a motivation or desire for using public transport. In fact, desires – which can be defined as “a state of mind whereby an agent has a personal motivation to perform an action or to achieve a goal” (Perugini & Bagozzi, 2004, p71) – might have stronger effects on behavior than attitudes do. Desires can mediate the effects of attitudes on intentions, and the effect of attitudes on intentions is therefore mainly indirect (through desires). Desires can also be influenced by how satisfied people were with previous choices or with the level of anticipated (positive or negative) emotions when choosing a certain alternative. For instance, positively perceived cycling trips can create a desire to cycle in the future, as positive emotions can be expected during future cycling trips. According to the model of goal-directed behavior, desires are affected by attitudes and satisfaction, and can in turn influence intentions (Figure 1) (Perugini & Bagozzi, 2001). Although desires and intentions are often treated as synonyms, desires are (i) less connected to actions and framed over longer time horizons than intentions and (ii) important predictors of intentions (Perugini & Bagozzi, 2004).

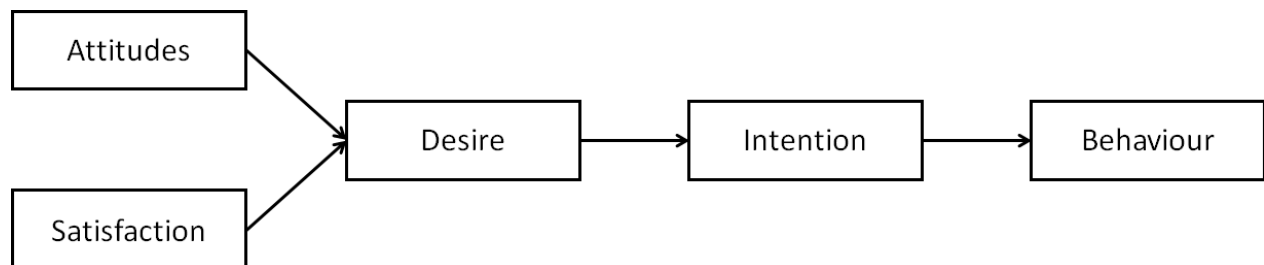


Figure 1. The model of goal-directed behavior (based on: Perugini & Bagozzi, 2001)

Travel behaviour studies have not paid a lot of attention to either the model of goal-directed behavior or to desires. Although mentioned in some review papers (Bohte et al., 2009; Mokhtarian et al., 2015), the model of goal-directed behavior has only been analyzed in the context of travel behaviour to a limited extent. Carrus et al. (2008) is one study that examined this model with respect to travel. They found that the desire to use public transport is positively affected by attitudes towards public transport and positive anticipated emotions (expected positive emotions if using public transport in the two weeks after measurement). This desire in turn has a positive effect on the intention to travel by public transport. In the context of the positive utility of travel, some studies have analyzed people’s ideal or desired travel amount. Redmond and Mokhtarian (2001), for instance, found that people do not necessarily want to minimize their commute time, and that most respondents have a desired commute time between 10 and 20 minutes. Similar results were later found by LaJeunesse and Rodríguez (2012), and Páez and Whalen (2010). Ory and Mokhtarian (2009) found that positive attitudes towards travel (i.e., “travel liking”) have

a positive effect on the desired amount of travel. However, apart from the study by Carrus et al. (2008), we are unaware of studies analyzing the desired level of use of a certain travel mode.

In this study we will analyze the desired frequency and relative desired frequency (i.e., wishing to travel less or more frequently than current frequency) of public transport use, using 986 students and staff members of Laval University, Canada. Additionally, based on the model of goal-directed behavior we examine how the (relative) desired public transport frequency is affected by public transport attitudes and satisfaction with public transport using ordered logit models. The remainder of this paper is organized as follows. Section 2 provides a literature overview of attitudes towards and satisfaction with public transport use. Section 3 describes the data, while the results are provided in Section 4. Discussion and conclusions are provided in Section 5.

2. Attitudes towards and satisfaction with public transport use

Public transport (PT) can be regarded as a sustainable way of traveling and is frequently encouraged by local governments. It is roughly 20 times more space efficient for vehicles travelling at 50 km/h (Héran & Ravalet, 2008), users can often gain many minutes of physical activity (e.g., Waygood et al., 2015), and it consumes less energy and produces fewer emissions per passenger (e.g., Waygood et al., 2014). However, people's perceptions regarding PT are often rather negative. Studies comparing attitudes towards various travel modes indicate that using PT is least favored, while most people seem to prefer an active way of traveling (Anable & Gatersleben, 2005; De Vos, 2018; Kroesen et al., 2017; van Wee et al. 2002). PT especially does not score well on elements such as flexibility, convenience, predictability, and reliability (Anable & Gatersleben, 2005; De Vos, 2018).

Besides attitudes towards PT, people also seem to experience PT trips rather negatively. Studies analyzing differences in travel satisfaction according to the chosen travel mode, indicate that PT, especially bus users, are the least satisfied with their trips, while typically people walking and cycling are most satisfied (e.g., De Vos, 2019; De Vos et al., 2016; Lancée et al., 2017; Morris & Guerra, 2015; Olsson et al., 2013; St-Louis et al., 2014; Ye & Titheridge, 2017; Zhu & Fan, 2018). PT users tend to experience relatively negative emotions during travel and also evaluate their trips more negatively compared to people using other modes (De Vos et al., 2015; Friman et al., 2013). PT users often experience emotions related to negative deactivation, feelings such as boredom, tiredness, depression, and low levels of excitement (Anable & Gatersleben, 2005; De Vos et al., 2015; Gatersleben & Uzzel, 2007; Singleton, 2019). A considerable number of studies have analyzed the determinants of PT users' satisfaction. These studies indicate that people's satisfaction with PT is affected by elements such as cleanliness, comfort, punctuality, waiting conditions, and personnel's behavior (dell'Olio et al., 2011; de Oña et al., 2013; Susilo & Cats, 2014; van Lierop et al., 2018). Positive attitudes towards PT can positively influence satisfaction levels when using PT, and both attitudes and satisfaction can influence future behavioral intentions. Passengers who are satisfied with PT services tend to be loyal and will most likely use PT for future trips (Abou-Zeid et al. 2012; Lai & Chen 2011; Beirão & Cabral 2007; van Lierop & El-Geneidy, 2018). However, these studies do not take into account the desire to use PT, which might mediate the effect of attitudes and satisfaction on the intention to use PT.

In this study we will analyze the extent and determinants of people's desired (or ideal) PT frequency and their relative desired PT frequency (i.e., the desire to use PT more or less than currently). Based on the model of goal-directed behavior (Figure 1), we will measure how (relative) desired PT frequency is affected by attitudes and satisfaction by performing ordered logit regressions (controlling for elements such as socio-demographics). Analyzing the (relative) desired PT frequency can provide valuable insights into people's intention to use PT, since attitudes towards (and satisfaction with) PT might not be the best predictors of PT frequency.

3. Data

3.1 Context

Data for this study comes from a survey distributed in June and July 2013, to students at Laval University. Laval University is the main university in the city of Québec and the eastern part of the Province of Quebec. The Quebec Metropolitan Area (CMA) covers 3,349.12 square kilometers (km²) and in 2011, the population stood at 765,706 inhabitants, which gave, at that time, a density of 229 inhabitants per km² (Statistics Canada, 2012). The densest part of the CMA is a 633.80 km² territory called the Quebec Agglomeration. Public transportation is offered in the agglomeration by the *Réseau de transport de la Capitale* (RTC). Its bus fleet covered a network of 870 kilometers in 2013, including 60 km of reserved lanes (RTC, 2014). In addition, high-frequency service (<10 minutes head-way) was provided during rush hours on four "Metrobus" (branding name) lines. The buses are (relatively) new, clean, and well maintained. It is not uncommon for the Metrobus (designated lane, bendy-bus) to be so full in rush hour that some users must wait for the next bus. In 2011, in the territory served by the RTC, PT was used for 9.2% of all trips, whereas cars were used for 78.8% of trips and non-motorized modes accounted for 10.9% of trips. In 2010, Laval University students used PT for 38.1% of trips to campus, 26.4% used an automobile and 35.1 % active transportation (Barla et al., 2015). This level of PT use is not uncommon at universities in Canada, and higher levels are observed with universal bus passes (Letarte et al., 2016).

3.2 Data sample description

In June 2013, an email invitation to participate in an online survey on travel behavior – with a focus on PT – was sent to all 20,125 students registered for the 2013 summer semester. In order to reduce possible sampling bias (e.g., PT users being more inclined to participate than non-PT users), the survey invitation was general in nature, indicating that the survey would ask information on the use, attitudes and satisfaction concerning various travel modes; although questions regarding PT were overrepresented in the survey. In the end, 986 respondents completed the survey (response rate = 4.9%), of which small parts were removed for certain analyses due to missing data.¹ The fact that the survey was conducted during the summer semester (a period where students might be less inclined to check their academic email account), and the absence of a reward for survey completion could have contributed to the relatively low response rate. The general characteristics of the respondents are shown in Table 1. The survey sample is composed of more women, more full-time students and more students in the 21-34 year-old category than the general student population (Laval University, 2013). Although we might not have a fully

¹ The number of respondents for all analyses are provided in the tables showing the results of the analyses.

representative sample of the students of Laval University, we do have a relatively large sample size, making it possible to estimate specific relationships with ample confidence.

Table 1. Descriptive characteristics of survey respondents (N = 986)

Variable	Percentage
Female	68.3
<i>Age group</i>	
18-20	9.3
21-24	47.5
25-34	33.2
35-44	7.6
45-64	2.3
65+	0.2
Recent immigrant	9.7
<i>Employment status</i>	
Full-time worker	9.7
Part-time worker	18.3
Full-time student	78.8
Part-time student	10.0
Unemployed	1.0
<i>Income</i>	
<20000	42.3
20-30000	13.3
30-45000	9.3
45-60000	9.4
60-80000	7.4
80000+	18.5
<i>Car access level</i>	
No access	17.1
Occasionally	18.7
Often	17.0
Owner	47.2
Bus pass	46.6
<i>Residential built environment</i>	
Rural	6.0
Suburban	39.7
Central	54.3

Note: Since respondents can combine being a student and worker, the total amount of percentages of the employment status is higher than 100%.

In the survey we asked respondents to indicate to what extent they currently travel by PT on a 5-point scale: *Never* (1); *Rarely* (2); *Occasionally* (3); *Regularly* (4); and *Mostly* (5). Using the same scale, we also asked them what their preferred PT use frequency would be. In the remainder of this paper we refer to the former as the *actual PT frequency* and the latter as the *desired PT frequency*. Based on these two measures we created five groups, representing respondents' *relative desired PT frequency*:

- Actual PT frequency >> desired PT frequency (actual frequency – desired frequency ≥ 2);
- Actual PT frequency > desired PT frequency (actual frequency - desired frequency = 1);
- Actual PT frequency ≈ desired PT frequency (actual frequency = desired frequency);

- Actual PT frequency < desired PT frequency (actual frequency - desired frequency = -1);
- Actual PT frequency << desired PT frequency (actual frequency - desired frequency ≤ -2).

The first and last two groups represent respondents who respectively want to travel less or more by PT than they currently do.

Respondents were also asked to indicate to what extent they like to travel by PT, on a scale from 1 (*I absolutely dislike PT*) to 5 (*I really like PT*). The average score on this PT attitude is 3.46, indicating that our respondents have a neutral to positive stance towards PT. Additionally, respondents were asked to indicate how satisfied they are on a four-point scale from 1 (*very dissatisfied*) to 4 (*very satisfied*) with the following PT elements: reliability, flexibility, duration, comfort, costs, supply, and safety. Since the internal consistency (i.e. the average correlation of items) of the seven items on satisfaction are relatively good (Cronbach's alpha is 0.77), we created a variable representing satisfaction with PT by averaging the seven items for analyzing the relationship between PT satisfaction and PT desire (in Section 4.2). Respondents have an average score of 2.80, indicating that most respondents are rather satisfied with their PT trips. Respondents were also asked to indicate whether or not they intend to use PT frequently in three life stages after university. On average, 47.3% of the respondents expect to use PT frequently as an adult without a child, while intended PT frequency is considerably lower when respondents would have children (24.1%) and when they would be retired (32.0%). Note that the data collection did not happen with the model of goal-directed behavior in mind. As a result, we do not have information on respondents' current PT intentions, which could have been used as an explanatory variable for actual PT frequency.

Since studies have indicated that people perform a wide variety of activities during PT trips (e.g., Clayton et al., 2017; Lyons et al., 2007), we asked respondents how frequently (on a 5-point scale from *never* to *always*) they listen to music, talk or text on cellular/mobile phone, read, study or relax during PT trips. Finally, we asked respondents to indicate what their main motivation is for using PT: environment; personal economic savings; save time; simple, less stressful; or other.

4. Results

4.1 Actual versus desired PT frequency

Figure 2 shows that more than half of our respondents (52.6%) frequently (i.e., *regularly* or *mostly*) travel by PT. Somewhat surprisingly, most respondents (77.2%) also indicate that they would like to use PT on a regular basis (*Occasionally* to *Mostly*). Only 14.3% of the respondents never want to travel by PT. This suggests that people attach a certain positive utility to PT or that they at least prefer PT over other travel modes. Tables 2 and 3 provide a more detailed view of respondents' distribution according to their actual and desired PT frequency. The actual PT frequency is equal to the desired PT frequency for a large share of respondents (46.3%). Respondents seem to have a desired PT frequency which is close to their actual PT use, suggesting that most respondents have a considerable freedom to choose a travel mode and are not captive PT users. This suggests that PT captivity might not be as common as mostly assumed in previous studies (Beimborn et al., 2003; Krizek & El-Geneidy, 2007). Table 3 represents the respondents' relative desired PT frequency and shows that 27.0% of the respondents are travelling more by PT than desired, while 27.7% of the respondents want to travel more frequently by PT than they currently do. Not

surprisingly, the actual PT frequency of those preferring to travel less by PT (groups 1 and 2) is higher compared to those preferring to travel more by PT (groups 4 and 5). The opposite is found for desired PT frequency; those preferring to travel less by PT have a lower desired PT frequency compared to those preferring to travel more by PT.

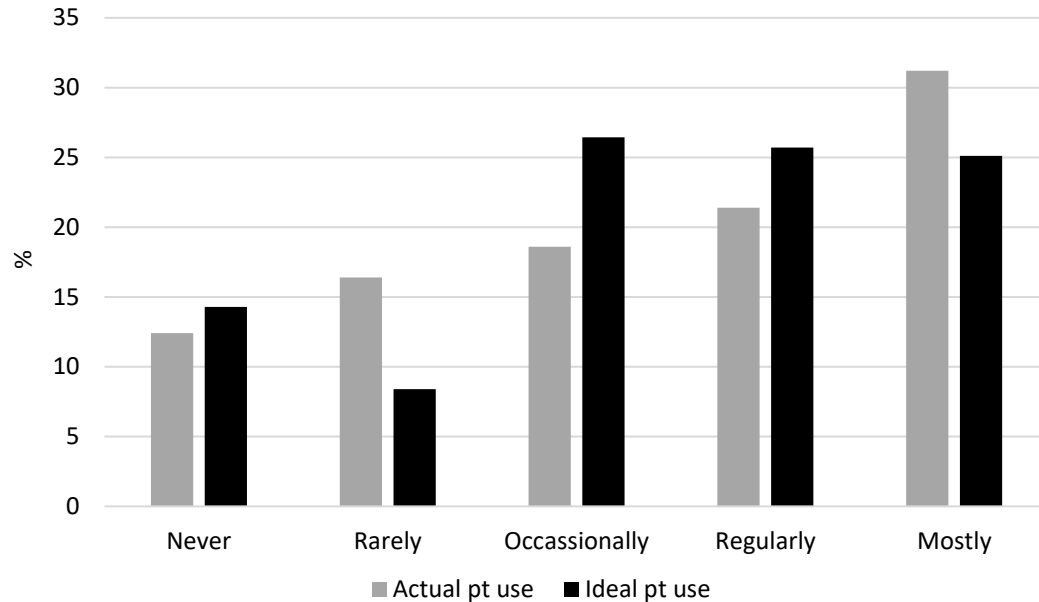


Figure 2. Respondents' actual and desired PT use frequency

Table 2. Distribution of respondents according to actual and desired PT frequency

Actual PT frequency ↓	Desired PT frequency					Total
	Never	Rarely	Occasionally	Regularly	Mostly	
Never	67 (6.9%)	22 (2.3%)	18 (1.9%)	12 (1.2%)	1 (0.1%)	120 (12.4%)
Rarely	39 (4.0%)	25 (2.6%)	56 (5.8%)	25 (2.6%)	14 (1.4%)	159 (16.5%)
Occasionally	9 (0.9%)	8 (0.8%)	89 (9.2%)	48 (5.0%)	24 (2.5%)	178 (18.4%)
Regularly	12 (1.2%)	11 (1.1%)	45 (4.7%)	100 (10.4%)	38 (3.9%)	206 (21.3%)
Mostly	12 (1.2%)	16 (1.7%)	47 (4.9%)	62 (6.4%)	166 (17.2%)	303 (31.4%)
Total	139 (14.4%)	82 (8.5%)	255 (26.4%)	247 (25.6%)	243 (25.2%)	966 (100%)

Note: The Pearson chi-square test indicates that the respondents are not randomly distributed according to their actual and desired PT frequency (Pearson chi-square = 522.435; df = 16, p = 0.000)

Table 3. Average levels of actual and desired PT frequency and distribution of respondents according to relative desired PT frequency²

	N	%	Actual PT frequency (1 - 5; N = 975)	Desired PT frequency (1 - 5; N = 972)
1. Actual PT frequency >> desired PT frequency	107	11.1	4.62 ^{2,3,4,5}	2.13 ^{2,3,4,5}
2. Actual PT frequency > desired PT frequency	154	15.9	3.84 ^{1,3,4,5}	2.84 ^{1,3,4,5}
3. Actual PT frequency ≈ desired PT frequency	447	46.3	3.61 ^{1,2,4,5}	3.61 ^{1,2,5}
4. Actual PT frequency < desired PT frequency	164	17.0	2.62 ^{1,2,3,5}	3.62 ^{1,2,5}
5. Actual PT frequency << desired PT frequency	94	9.7	1.93 ^{1,2,3,4}	4.22 ^{1,2,3,4}
Total	966	100	3.43	3.39

Note: ^{1,2,3,4,5} = significantly different from groups 1, 2, 3, 4, 5 respectively at $p < 0.05$ using one-way ANOVAs with post-hoc multiple comparison analysis using the LSD method.

4.2 PT attitudes and satisfaction according to actual and desired PT frequency

It can be assumed that attitudes towards and satisfaction with PT are related to actual PT use and especially desired PT frequency. Table 4 shows that respondents with high levels of actual and desired PT frequency have more positive attitudes towards PT compared to those not (wanting to) travelling frequently by PT. A more frequent (desired) use of PT is related with more positive attitudes towards PT. As a result, respondents with a high actual and desired PT frequency have the most positive stance towards PT, while those with low actual and desired PT frequency have relative negative attitudes towards PT.

Table 4. Average PT attitudes (1 – 5) according to actual and desired PT frequency (N = 962)

Actual PT frequency ↓	Desired PT frequency					Total
	1. Never	2. Rarely	3. Occasion.	4. Regularly	5. Mostly	
1. Never	1.70	2.27	2.44	2.67	5	2.04 ^{2,3,4,5}
2. Rarely	2.18	2.75	2.96	3.36	3.79	2.87 ^{1,3,4,5}
3. Occasionally	2.56	3.13	3.54	3.67	4.13	3.58 ^{1,2,4,5}
4. Regularly	2.67	3.00	3.38	3.98	4.32	3.78 ^{1,2,3,5}
5. Mostly	2.25	3.00	3.68	4.05	4.37	4.04 ^{1,2,3,4}
Total	2.02 ^{2,3,4,5}	2.74 ^{1,3,4,5}	3.33 ^{1,2,4,5}	3.81 ^{1,2,3,5}	4.30 ^{1,2,3,4}	3.46

Note: ^{1,2,3,4,5} = significantly different from groups 1, 2, 3, 4, 5 respectively at $p < 0.05$ using one-way ANOVAs with post-hoc multiple comparison analysis using the LSD method.

Similar results can be found regarding PT satisfaction. Table 5 shows that respondents traveling more frequently by PT are also more satisfied with it, although no significant differences (at $p < 0.05$) were found between those traveling *occasionally*, *regularly* or *mostly*. Satisfaction with PT is also significantly higher for those having higher levels of desired PT frequency compared to those having lower levels of desired PT frequency. As a result, satisfaction levels are highest for those having high levels of actual and desired PT frequencies and lowest for those having low levels of actual and desired PT frequencies.

² The average values of actual and desired PT frequency should be treated with caution, since the 5-point scale measuring frequency (from *never* to *mostly*) can – more than the scales measuring PT attitudes and PT satisfaction – be regarded as ordinal rather than nominal.

Table 5. Average PT satisfaction levels (1 – 4) according to actual and desired PT frequency (N = 931)

Actual PT frequency ↓	Desired PT frequency					Total
	1. Never	2. Rarely	3. Occasion.	4. Regularly	5. Mostly	
1. Never	2.25	2.36	2.31	2.35	3.86	2.31 ^{2,3,4,5}
2. Rarely	2.48	2.64	2.75	2.77	2.72	2.67 ^{1,3,4,5}
3. Occasionally	2.46	2.91	2.85	2.91	2.90	2.86 ^{1,2}
4. Regularly	2.42	2.74	2.82	2.97	2.96	2.89 ^{1,2}
5. Mostly	2.36	2.75	2.80	2.93	3.04	2.93 ^{1,2}
Total	2.36 ^{2,3,4,5}	2.63 ^{1,3,4,5}	2.77 ^{1,2,4,5}	2.90 ^{1,2,3,5}	3.00 ^{1,2,3,4}	2.80

Note: ^{1,2,3,4,5} = significantly different from groups 1, 2, 3, 4, 5 respectively at p < 0.05 using one-way ANOVAs with post-hoc multiple comparison analysis using the LSD method.

Table 6 indicates that the levels of attitudes towards and satisfaction with PT are highest for respondents using PT as frequently as desired. This group of respondents have significantly more positive PT attitudes compared to those travelling (much) less or (much) more frequently than desired. Having an actual PT frequency which equals the desired frequency results in significantly higher levels of satisfaction compared to those travelling far more or far less frequent than desired, but not compared to those travelling somewhat less or more frequently than desired. These results could be partly explained by the cognitive dissonance theory (Festinger, 1957). This theory states that an inconsistency between beliefs/preferences and behavior results in psychological discomfort and dissatisfaction. An inconsistency between actual and preferred PT frequency could therefore result in lower levels of satisfaction and more negative attitudes. As can be seen, the result for attitudes with no dissonance is statistically different from all other dissonance levels, but for satisfaction, it is only different for the two extremes.

Table 6. Average levels of PT attitudes and satisfaction according to relative desired PT frequency

Relative desired PT frequency	Attitudes towards PT (1 – 5; N = 962)	Satisfaction with PT (1 – 4; N = 931)
1. Actual >> desired	3.14 ³	2.66 ^{2,3,4}
2. Actual > desired	3.33 ³	2.79 ¹
3. Actual ≈ desired	3.62 ^{1,2,4,5}	2.86 ^{1,5}
4. Actual < desired	3.39 ³	2.80 ¹
5. Actual << desired	3.38 ³	2.68 ³

Note: ^{1,2,3,4,5} = significantly different from groups 1, 2, 3, 4, 5 respectively at p < 0.05 using one-way ANOVAs with post-hoc multiple comparison analysis using the LSD method.

4.3 Modeling PT frequency: actual, desired, relative desired, and intended

In this section, the actual PT frequency, the desired PT frequency, the relative desired PT frequency (i.e., the difference between actual and desired PT frequency), and the intended PT use in later life stages are examined to determine what might explain the different levels. In line with the model of goal-directed behavior, we will first analyze the desired PT frequency, followed by the actual PT frequency and the relative desired PT frequency. Since PT intention was measured for future life stages (and not for current use), the intention to use PT will be analyzed as last. In order to model different types of PT frequency, an explanatory variable attrition method was used where all potential explanatory variables (see below)

were tested with significant variables retained in the final model. The following explanatory variables were included in the models tested:

- Individual characteristics: Gender; Age group; Recent immigrant; Work or education status (full-time, part-time, unemployed); Residential built environment; Household income; Car access
- Satisfaction with PT elements: Reliability; Flexibility; Trip duration; Comfort; Monthly cost; PT offer (i.e. service levels); Personal security
- Attitude towards PT
- Time use on PT: Listen to music; talk or text on cellular/mobile phone; Read; Study; Relax
- Motivation to use PT: Environment; Personal economic savings; Save time; Simple, less stressful; Other

4.3.1 Desired PT frequency

In this section, an ordered logit model is presented where the desired level of PT is examined. All variables listed at the start of section 4.3 were tested for significance. Only those variables that were significant (at $p < 0.05$) were retained for the model presented in Table 7. As using the average satisfaction gave essentially the same pseudo- R^2 , the specific values were retained so as to give more nuance to the results. Satisfaction with the PT offer and PT attitude both positively influence the desired frequency. No significant effects were found from the built environment on PT desire. However, when excluding attitude towards PT, the built environment has a significant role (i.e., those living in more urban areas want a higher PT frequency) suggesting that PT attitudes attenuate the role of the built environment on PT use. Regularly relaxing or studying during PT trips also seems to positively affect the desire to use PT with the first relating to mental health and the second relating to productive use of time. Based on the odds ratios, a positive attitude towards PT is the most influential measure. No individual or contextual measures were found to have an influence on the desired level of PT use.

Table 7. Ordered logit regression on desired PT frequency (N = 886)

	Coef.	Odds Ratio	Std. Err.	P>z
<i>Individual and context - no significant influences</i>				
<i>Time use on PT</i>				
Relax				
Never, rarely (ref.)	0.00	1.00		
Occasionally	0.08	1.08	0.20	0.69
Often, Always	0.46	1.58	0.18	0.01
Study				
Never, rarely (ref.)	0.00	1.00		
Occasionally	0.27	1.30	0.15	0.07
Often, Always	0.49	1.64	0.17	0.00
<i>Motivation for using PT</i>				
Environmental (ref.)	0.00	1.00		
Other	-0.06	0.94	0.28	0.82
Personal economic	-0.31	0.73	0.17	0.06
Saves time	-0.45	0.64	0.20	0.02
Simple, less stressful	-0.12	0.88	0.19	0.50
<i>Attitude towards PT</i>				
Negative (ref.)	0.00	1.00		
Neutral	1.81	6.13	0.22	0.00
Positive	3.33	27.83	0.22	0.00
<i>Satisfaction with PT service</i>				
Offer	0.55	1.73	0.14	0.00
/cut1	0.25	0.25	0.24	
/cut2	1.12	1.12	0.24	
/cut3	3.01	3.01	0.26	
/cut4	4.52	4.52	0.28	

Note: LR $\chi^2(11) = 450.3$; Prob. > $\chi^2 < 0.001$; Log likelihood = -1122.8; Pseudo $R^2 = 0.17$

4.3.2 Actual PT frequency

In this section, the frequency of PT use is examined using an ordered logit model. Only significant variables of each were retained in the model shown in Table 8. Since the desired PT frequency is likely to affect actual PT frequency – as suggested by the model of goal-directed behavior (Figure 1) – we also included desired PT frequency as an explanatory variable. Ideally, we would also have included the intention to use PT as explanatory variable. However, since the intention to use PT is measured for future life stages, it cannot be included as an explanatory variable for current PT frequency. Having a positive attitude towards PT has a positive influence along with the desired level of PT use. Based on the odds ratios, desired level of PT use is the most influential measure followed by attitude. Satisfaction with reliability, flexibility, and offer of PT services also positively affect PT frequency. Compared to the economic motivation to use PT, environmental, saving time, and other motivations have smaller influences. The results indicate that having frequent access to a vehicle, and living in rural areas have a significant negative effect on actual PT frequency. No other socio-demographic variables were significant.

Table 8. Ordered logit model on actual PT frequency (N = 864)

	Coef.	Odds Ratio	Std. Err.	P>z
<i>Individual and context</i>				
Access to car				
Never (ref.)	0.00	1.00		
Occasionally	-0.28	0.76	0.23	0.23
Often	-0.82	0.44	0.23	0.00
Owner	-1.92	0.15	0.21	0.00
Built Environment				
Rural (ref.)	0.00	1.00		
Urban, not central	1.31	3.69	0.31	0.00
Central	1.32	3.73	0.32	0.00
<i>Motivation for using PT</i>				
Economic (ref.)	0.00	1.00		
Other	-0.68	0.51	0.28	0.02
Environment	-0.49	0.62	0.18	0.01
Saves time	-0.59	0.55	0.20	0.00
Simple, less stressful	-0.32	0.73	0.19	0.10
<i>Attitude towards PT</i>				
Negative (ref.)	0.00	1.00		
Neutral	0.71	2.04	0.23	0.00
Positive	1.52	4.58	0.24	0.00
<i>Satisfaction with PT service</i>				
Reliability	-0.60	0.55	0.20	0.00
Flexibility	0.34	1.40	0.15	0.02
Offer	0.53	1.70	0.17	0.00
<i>Desired PT frequency</i>				
Never or rarely (ref.)				
Occasionally	0.64	1.89	0.21	0.00
Regularly or more	1.67	5.28	0.23	0.00
/cut1	-1.41	-1.41	0.42	
/cut2	0.50	0.50	0.44	
/cut3	1.89	1.89	0.44	
/cut4	3.27	3.27	0.45	

Note: LR $\chi^2(16) = 556.3$; Prob. > $\chi^2 < 0.001$; Log likelihood = -1054.2; Pseudo $R^2 = 0.21$

4.3.3 Relative desired PT frequency

In this section, the difference between the desired level of PT use and the actual level of PT use – i.e. the relative desired PT use – is examined through an ordered logit model (Table 9). The same process of variable attrition was conducted for this model as is described above. The explanatory power of this model is much lower than the two previous ones, explaining only 6.1% of the variance. Results indicate that especially those living in rural areas and having access to cars want to travel more by PT than they currently do. PT Attitude and satisfaction with reliability and comfort positively affect the relative desired PT use. Relaxing on PT also positively increases the desire to use it more. Compared to the economic

motivation, the environment, saving time, and other motivations had positive influences. Surprisingly, being a car owner was the strongest influence (based on odds ratios) for wanting to increase PT frequency, which may relate to a sense that using a bus is a more “approved of” societal choice.

Table 9. Ordered logit regression on the relative desired PT frequency (N = 850)

	Coef.	Odds Ratio	Std. Err.	P>z
<i>Individual and context</i>				
Access to car				
Never (ref.)	0.00	1.00		
Occasionally	0.12	1.13	0.21	0.56
Often	0.76	2.13	0.22	0.00
Owner	1.47	4.36	0.19	0.00
Built Environment				
Rural (ref.)	0.00	1.00		
Urban, not central	-0.68	0.51	0.29	0.02
Central	-1.00	0.37	0.30	0.00
<i>Time use on PT</i>				
Relax				
Never, rarely (ref.)	0.00	1.00		
Occasionally	0.19	1.21	0.20	0.33
Often, Always	0.44	1.56	0.18	0.02
<i>Motivation for using PT</i>				
Economic (ref.)	0.00	1.00		
Other	0.71	2.03	0.28	0.01
Environment	0.60	1.82	0.17	0.00
Saves time	0.43	1.54	0.20	0.03
Simple, less stressful	0.30	1.35	0.19	0.11
<i>Attitude towards PT</i>				
Negative (ref.)	0.00	1.00		
Neutral	0.57	1.77	0.22	0.01
Positive	0.60	1.82	0.21	0.00
<i>Satisfaction with PT service</i>				
Reliability	0.44	1.55	0.19	0.02
Comfort	0.44	1.55	0.18	0.02
/cut1	-0.46	-0.46	0.41	
/cut2	0.75	0.75	0.41	
/cut3	2.99	2.99	0.43	
/cut4	4.38	4.38	0.44	

Note: LR $\chi^2(15) = 148.9$; Prob. > $\chi^2 < 0.001$; Log likelihood = -1137.1; Pseudo $R^2 = 0.06$

4.3.4 Intention to use PT

In order to measure intention to use PT in later life stages, respondents were asked to indicate whether they tend to use PT (yes/no) as an adult without a child, as an adult with a child(ren), and as being retired. We performed three binary logistic regressions to analyze the effects of PT attitudes, PT satisfaction and

the desired PT frequency on respondents' intention to use PT in the future (Table 10). The same process of variable attrition was used to arrive at the models presented. Unlike the other models, gender was found to play a role with female respondents being less likely to have intentions to use PT when they had a child or when they were retired. The results further find that in all cases, being a car owner diminishes the likelihood of future PT use, while the current living environment mainly influences intended PT use the life stage following university when no child is in the home. Time use on PT was relevant for all three models, but not necessarily the same time use. Reading had a positive influence on intended PT use in the two life stages following university, whereas texting or talking on a cellular phone had a negative influence on expected PT use in the final two life stages (i.e., adult with child(ren) and retired). Respondents often relaxing during PT trips intend to frequently use PT when having a child. PT attitudes have a strong positive effect on the intention to use PT in case of having a child and when being retired. A desire to use public transport on (at least) a regular basis results in an intention to use it frequently in all three future life stages. Overall, PT attitudes and the desire to use PT are the strongest explanatory variables. Finally, it should be mentioned that satisfaction with the PT offer was significant for the *adult without child(ren)* life stage until desired PT frequency was added. Such results point back to the model on what relates to the desire to use PT (i.e., Section 4.3.1).

Table 10. Binary logistic regressions on intention to use public transport in three future life stages

	Adult without child	Adult with child(ren)	Retired
	Coef. (odds ratio)	Coef. (odds ratio)	Coef. (odds ratio)
Constant	-1.70** (0.18)	-4.54** (0.01)	-2.16** (0.12)
<i>Individual and context</i>			
Female		-0.45* (0.64)	-0.39* (0.67)
Access to car			
Never (ref.)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
Occasionally	-0.41 (0.67)	-0.27 (0.76)	-0.01 (0.99)
Often	-0.57* (0.56)	-0.30 (0.74)	-0.33 (0.72)
Owner	-1.25** (0.29)	-0.69** (0.50)	-0.74** (0.48)
Built Environment			
Rural	0.00 (1.00)	0.00 (1.00)	
Suburban	0.98* (2.67)	0.89 (2.44)	
Central	1.05** (2.86)	1.21* (3.36)	
<i>Time use on PT</i>			
Read			
Never, rarely (ref.)	0.00 (1.00)	0.00 (1.00)	
Occasionally	0.26 (1.30)	0.48* (1.62)	
Often, always	0.36* (1.43)	0.79** (2.20)	
Relax			
Never, rarely (ref.)		0.00 (1.00)	
Occasionally		0.47 (1.60)	
Often, always		0.60* (1.83)	
Talk/text on phone			
Never, rarely (ref.)		0.00 (1.00)	0.00 (1.00)
Occasionally		-0.33 (0.72)	-0.07 (0.93)
Often, always		-0.62** (0.53)	-0.39* (0.68)
<i>Attitude towards PT</i>			
Negative (ref.)		0.00 (1.00)	0.00 (1.00)
Neutral		1.27* (3.56)	1.14** (3.12)
Positive		1.69** (5.40)	1.52** (4.59)
<i>Desired PT frequency</i>			
Never, rarely (ref.)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
Occasionally	0.69** (2.00)	0.46 (1.58)	0.56 (1.74)
Regularly or more	1.95** (7.05)	1.36** (3.89)	1.42** (4.12)
N	899	890	898
Log ratio chi2	217.9	185.2	177.1
Prob. > chi2	< 0.001	< 0.001	< 0.001
Log likelihood	-513.8	-406.2	-482.1
Pseudo R2	0.17	0.19	0.16

Note: * = p < 0.05; ** = p < 0.01

5. Discussion and conclusion

This study is one of the first travel behavior studies analyzing the desired level of mode frequency, i.e., desired PT frequency, and its relationships with actual PT frequency, intended PT frequency, PT attitudes and PT satisfaction. Although this study can be considered as exploratory, the gathered information regarding the desire to use PT can provide valuable information for increasing PT ridership. In this section we discuss the implications of the main results, and provide avenues for further research.

5.1 Main results

The initial analyses demonstrated that most respondents were using PT at their desired level (46.3%) or close to their desired level (32.9%). The share of individuals who would like to increase versus decrease their PT frequency were roughly equal (i.e., 26.7% versus 27.0% respectively). The average attitudes and average satisfaction levels were then compared with the difference between the desired and actual level of PT frequency. Those analyses found that the highest levels of attitudes and satisfaction were found for those having a PT frequency which is consistent with their desired PT frequency. Following these initial analyses, ordered logit models (OLMs) were conducted to help explain desired PT frequency, actual PT frequency, and the difference between desired and actual PT frequency (i.e., relative desired PT frequency). The desired PT frequency is strongly affected by positive attitudes towards PT and also by satisfaction with the offer of PT services. Actual PT use is positively influenced by PT attitudes, satisfaction with the reliability, flexibility and offer of PT services, but also by the desired level of PT frequency. These results are in line with the model of goal-directed behavior (Perugini & Bagozzi, 2004). Furthermore, living in an urban area and limited access to a car positively affect PT use. The model analyzing relative desired PT frequency indicate that respondents with a positive PT attitude and those satisfied with the reliability and comfort of PT services would like to use PT more frequently than they currently do. Interestingly, the results also indicate that those with easy access to a car or living in a rural neighborhood (i.e. those using PT relatively infrequent) would like to use PT more frequently than they currently do. Finally, we also analyzed the intention to use PT in future life stages by performing ordered logit regressions. Respondents with a positive attitude towards PT and a desire to use PT on a regular basis have the highest intention to use PT after university. This suggests that the desire to use public transport can be regarded as an important predictor of future PT use (intentions).

5.2 Discussion

For both PT frequency and desired PT frequency, a number of expected outcomes were found. Limited car access and greater urban development increase actual use, while PT satisfaction and attitudes positively affect both actual and desired PT frequency. The result that the non-central areas are nearly equal to central neighborhoods for actual use is perhaps related to the express bus services (limited stops, but only at peak hours) from outlining neighborhoods to the university or that the university itself is not centrally located. Another point of note is that for the desired level of PT use, the built environment did not play a significant role once attitudes were included in the model. This is in line with studies suggesting that people try to choose a residential neighborhood based on travel needs and preferences; those who like PT may choose to reside in locations that have better service levels. Due to this this transport-related

self-selection, travel attitudes can mediate the effect of the built environment on travel behavior (see, for instance, Cao et al., 2009). Finally, we found that the activities performed during PT trips – such as relaxing, reading and studying – can positively influence the desired and relative desired PT frequency, and the intention to use PT in the future. In line with studies on the positive utility of travel (e.g., Jain & Lyons, 2008; Ory & Mokhtarian, 2005), this indicates that relaxing/productive activities during PT trips can result in a useful spending of travel time. As a result, policy makers should try to create more possibilities for passengers to use travel time in a relaxing/productive way (e.g., by improving comfort and seating capacity, and providing free Wi-Fi and power sockets on board) in order to increase people’s desire and intention to use PT.

An important consideration is who is interested in increasing their PT use and what might help them to do so. The OLM presented in Table 9 shows that car owners and people living in rural areas would like to use PT more frequently than they currently do (though their current use is more likely to be lower). Post analysis (margins) of those two variables show that people owning cars are over 10% more likely to prefer using PT far more frequent as compared to those who never have access to a car (Table 11). That might suggest that certain PT users who do not have access to a car may feel that they are captive PT users (although results from Section 4.1 indicated that most PT users are not captive users). People owning cars, on the other hand, might also be captive travelers as they can feel forced to drive in order to justify the costs they made related to their car (e.g., purchase, insurance, maintenance). It also suggests that it is not necessarily the case that once a person owns a car that they are no longer interested in using PT. The built environment may also force people to own and use a car. A person preferring to use PT but living in a suburban/rural area might not be able to use PT (due to limited PT services) and be forced to travel by car. Table 10 also indicates that those living in rural areas are over 12% more likely to prefer using PT far more frequent as compared to those in the central neighborhoods of Quebec. This may reflect the situation where PT service is not available, or considerably lower (e.g., a commuting service, but not the regular to high service on multiple lines that are available to those in the center). PT ridership of rural residents might consequently increase when improving PT services in rural areas or stimulating them to move to more urban neighborhoods where they can easily travel by PT. Since PT is often difficult to organize in rural areas, introducing shared ride services – such as microtransit and ridehailing – might be considered in these areas (Shaheen & Cohen, 2019).

Table 11. The likelihood of an individual being at different levels of dissonance by car access and by residential location

	Versus Never access to car			Versus Rural	
	Occasionally	Often	Owner	Suburbs	Central
Actual >> desired	-1.0%	-9.0% **	-14.0% **	5.1% *	8.4% **
Actual > desired	-0.6%	-6.8% **	-13.0% **	6.4% *	9.5% **
Actual ≈ desired	0.8%	5.0% **	2.0%	5.8%	5.6%
Actual < desired	0.5%	6.8% **	14.3% **	-7.4% *	-10.8% **
Actual << desired	0.3%	4.0% **	10.7% **	-9.9%*	-12.6% **

Note: * = p < 0.05; ** = p < 0.01

5.3 Future research

In this study we analyzed (relative) desired PT frequency, and its relations with attitudes towards and satisfaction with PT. Although we included PT attitudes and satisfaction as independent variables of (relative) desired PT frequency, it might also be possible that people's desired and relative desired PT frequency influence attitudes and satisfaction levels. Being forced to travel more frequently by PT than desired might negatively impact attitudes and satisfaction, while an actual PT frequency close to the desired frequency could result in positive attitudes and satisfied PT riders. Future studies should therefore focus on the causality between (relative) desired PT frequency and PT attitudes/satisfaction. Longitudinal studies (with multiple waves) could provide valuable insights into how changes in PT ridership relate to changes in attitudes and satisfaction and what the causality of these relationships are. Qualitative research, such as in-depth interviews or focus groups, could also create understandings of how (relative) desired PT frequency is related with attitudes and satisfaction.

Future studies might also analyze the model of goal-directed behavior, as shown in Figure 1, using a structural equation modeling approach. Doing so would enable the measurement of indirect effects, through travel desire, of travel attitudes and travel satisfaction on travel behavior (intentions). This could be done for PT, but also for other travel modes, or travel durations. However, in order to perform these structural equation models more precise and continuous measures – preferably latent (unobserved) variables – should be used, instead of ordinal and (directly observed) manifest variables present in this study.

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