

# The dimensions of loyalty in public transit among older adults: A comparative analysis across three Canadian Regions

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## Abstract

There is an ongoing debate in public transit literature on how loyalty should be defined. While measures of willingness to recommend and to reuse have become the default, some argue for the addition of other dimensions (i.e., satisfaction and importance). We assess whether a unidimensional factor structure representing loyalty exists within these variables using a sample of senior transit users from three Canadian regions. The results are compared to two- and three-variable structures regarding fit and reliability. Including questions on the importance of transit to quality of life as a third dimension to loyalty is recommended while not so for satisfaction.

Keywords: Public transit, loyalty, satisfaction, quality of life, exploratory factor analysis

## Questions

Loyalty in public transit has been studied to curb current trends in loss of public transit ridership. The reasoning is that loyal public transit users are more willing to keep using transit services overtime and more prone to recommend them to others and to attract new riders (Webb, 2010). Even so, there is no consensus on the literature on how loyalty to transit should be conceptualized (Carvalho, Romano, & Gadda, 2021; van Lierop, Badami, & El-Geneidy, 2018). Most scholars examine the construct as a combination of willingness to reuse and to recommend (Minser & Webb, 2010). Loyalty has also been addressed as a one-dimensional construct (Sun & Duan, 2019) and several other variables have also been considered.

For instance, there is an ongoing debate on the role of satisfaction in loyalty. While some argue that satisfaction is only strongly related to loyalty but not part of the construct itself, others believe that satisfaction should be added as a dimension (Zhao, Webb, & Shah, 2014). The rationale is that transit riders would only be willing to reuse and to recommend transit if they are satisfied. Another possible dimension is importance, which refers to the relevance of an object to a person (Zaichkowsky, 1985) and is addressed in this paper as the perceived importance of transit to quality of life. It is believed that loyal users are more emotionally involved with the service, which reflects in higher switching costs (Webb, 2010). By reviewing the literature, van Lierop et al. (2018) argue

that loyalty is defined best when willingness to reuse, willingness to recommend, satisfaction, and importance are included.

We ask the following research questions: (i) is there a single underlying dimension across willingness to reuse, willingness to recommend, satisfaction, and importance to quality of life? (ii) if so, is the 4-variable structure more reliable than the common 2-variable structure (willingness to recommend and willingness to reuse) or a combination of the 2-variable structure and satisfaction and importance to quality of life individually? and (iii) are the factor results consistent across different contexts? We select Montréal, Toronto, and Vancouver as our case studies. All regions have similar rates of transit mode share and older adults' population as shown in Table 1.

**Table 1 - Contextual information on population and transit characteristics in Toronto, Montréal, and Vancouver**

	Greater Toronto	Greater Montréal	Greater Vancouver
<i>General characteristics</i>			
Population	6,202,225	4,291,732	2,642,825
Population density per km <sup>2</sup>	1,050.7	919	918
Median income	CAD 39,600	CAD 40,800	CAD 40,800
Population over 65 (%)	18.3	20.4	19.6
<i>Transit characteristics</i>			
Transit mode share (%)	24.3	22.3	20.4
Number of bus lines	192	213	235
Number of metro lines	4	4	3 <sup>a</sup>
Monthly senior transit pass	CAD 128.15	CAD 28.25 <sup>b</sup>	CAD 58.60 <sup>c</sup>
Reduction from regular fare (%)	18%	70%	68%

<sup>a</sup>SkyTrain; <sup>b</sup>Free fare starting July 1<sup>st</sup>, 2023; <sup>c</sup>Low-income seniors are eligible for a single yearly fee of CAD 45.00

**Data sources:** StatCan (2021); StatCan (2016); TTC (2023); STM (2023); TransLink (2023)

## Methods

Drawing on data from the 2023 Aging in Place Survey, we conducted an exploratory factor analysis (EFA) for complete cases of senior transit users from the Greater Montréal (n = 577), the Greater Toronto (n = 408), and the Greater Vancouver (n = 273). Willingness to reuse was measured by “I plan to keep using public transit in my region within the next year”, willingness to recommend by “I would recommend public transit in my region to a friend or family member”, satisfaction by “overall, I am satisfied with the public transit services in my region” and importance to quality of life by “public transit positively impacts my quality of life”. All variables were measured on a 4-point Likert-scale from strongly agree to strongly disagree (neutral not included). The factorability of the samples was ensured by addressing inter-correlation (Pearson correlation > 0.30), the Bartlett test of sphericity, and the measure of sampling adequacy (MSA).

The factor analyses for each combination of variables and region were conducted in R using the psych package. We applied common factor analysis as the extraction method, which is better suited for identifying latent constructs (Hair, Black, Babin, & Anderson, 2014). The number of factors to extract was defined based on latent root (eigenvalue  $\geq 1$ ) and percentage of variance (at least 60%)

criteria and varimax was applied as the rotation method. To reduce the influence of non-normality on the results, the correlation matrix was defined using polychoric correlation as it better deals with variables with less than five categories with asymmetrical distributions (Watkins, 2018). Reliability was measured by the Cronbach's alpha coefficient. Results are compared across regions to assess the consistency of the loyalty construct across regions.

## Findings

Montreal's seniors are more willing to reuse and to recommend transit, more satisfied, and more likely to perceive a positive impact of transit in their quality of life than seniors from other regions, as demonstrated by pairwise Kruskal-Wallis's tests (Table 2). Samples from Toronto and Vancouver are not significantly different across all variables.

**Table 2 - Descriptive statistics by variable and region**

Category/Measure	Willingness to reuse	Willingness to recommend	Importance to quality of life	Satisfaction
<b>Montreal (n = 577)</b>				
Strongly agree	392 (67.9%)	328 (56.8%)	302 (52.3%)	200 (34.7%)
Agree	182 (31.5%)	232 (40.2%)	238 (41.2%)	312 (54.1%)
Disagree	3 (0.5%)	17 (2.9%)	37 (6.4%)	64 (11.1%)
Strongly disagree	-	-	-	1 (0.2%)
<i>Shapiro-Walker test</i>	0.798**	0.752**	0.709**	0.632**
<b>Toronto (n = 409)</b>				
Strongly agree	216 (52.9%)	146 (35.8%)	141 (34.6%)	79 (19.4%)
Agree	180 (44.1%)	228 (55.9%)	210 (51.5%)	220 (53.9%)
Disagree	8 (2%)	31 (7.6%)	51 (12.5%)	96 (23.5%)
Strongly disagree	4 (1%)	3 (0.7%)	6 (1.5%)	13 (3.2%)
<i>Shapiro-Walker test</i>	0.835**	0.801**	0.763**	0.693**
<b>Vancouver (n = 282)</b>				
Strongly agree	162 (59.3%)	115 (42.1%)	97 (35.5%)	57 (20.9%)
Agree	107 (39.2%)	139 (50.9%)	140 (51.3%)	155 (56.8%)
Disagree	4 (1.5%)	19 (7%)	36 (13.2%)	53 (19.4%)
Strongly disagree	-	-	-	8 (2.9%)
<i>Shapiro-Walker test</i>	0.830**	0.805**	0.764**	0.673**
<b>Kruskal-Wallis Test</b>				
Montreal-Toronto	$\chi^2 = 14.66^*$ (d.f. = 1)	$\chi^2 = 34.73^*$ (d.f. = 1)	$\chi^2 = 21.97^*$ (d.f. = 1)	$\chi^2 = 37.98^*$ (d.f. = 1)
Montreal-Vancouver	$\chi^2 = 3.34$ (d.f. = 1)	$\chi^2 = 14.12^*$ (d.f. = 1)	$\chi^2 = 15.60^*$ (d.f. = 1)	$\chi^2 = 24.34^*$ (d.f. = 1)
Toronto-Vancouver	$\chi^2 = 2.18$ (d.f. = 1)	$\chi^2 = 1.70$ (d.f. = 1)	$\chi^2 = 0.00$ (d.f. = 1)	$\chi^2 = 0.26$ (d.f. = 1)

\* p-value < 0.01, distribution is significantly different; \*\* p-value  $\leq$  0.05, data is not normally distributed

In the factor analyses (Table 3), for all variable combinations and regions, a one-factor solution was derived indicating the presence of a single construct. Nonetheless, factors including satisfaction for Toronto and Vancouver displayed limited reliability due to either displaying illogical loadings due to negative variance (Heywood case) or by not sufficiently explaining satisfaction (low communality). Consequently, satisfaction would have to be dropped from the

analyses in both cases to improve fit. Therefore, the analysis offers limited support for satisfaction as a dimension in the loyalty construct.

The 2-variable and 3-variable combinations with importance to quality-of-life showed adequate fit across all regions. Reliability in terms of Cronbach's alpha scores improved from the 2-variable to 3-variable structure, while retaining similar levels of internal factor consistency (item-to-score and inter-item correlations) across all regions. Moreover, levels of variance explained also improved in Toronto and Vancouver, providing evidence for including importance to quality of life as a third dimension of loyalty across all regions.

In conclusion, the factors do not provide consistent support for satisfaction as part of the loyalty construct. Nonetheless, importance of public transport to quality-of-life is supported as a third dimension to be included in the loyalty construct across all contexts. Montreal was the only location where all four combinations of variables displayed adequate levels of fit, which might be explained by the differences in public transit structure compared to the two other regions. Our findings contribute to the understanding of the dimensions of loyalty and how to operationalize it in surveys. Future studies can further test our findings by assessing a more diverse range of public transit users and by evaluating discriminant validity by adding more constructs.

**Table 3 - Results of the factor analysis by combination of variables and region**

Variable/Metric	(1) Reuse and recommend	(1) + Satisfaction	(1) + Importance to quality of life	All variables
<b>Montreal (n = 577)</b>				
Willingness to reuse	0.925 (0.855)	0.879 (0.773)	0.928 (0.860)	0.897 (0.805)
Willingness to recommend	0.925 (0.855)	0.971 (0.943)	0.921 (0.848)	0.936 (0.875)
Involvement	-	-	0.835 (0.697)	0.850 (0.723)
Satisfaction	-	0.754 (0.568)	-	0.771 (0.595)
Variance Explained	85.50%	76.20%	80.20%	74.90%
Cronbach's Alpha	0.822	0.811	0.844	0.854
MSA*	0.500	0.680	0.720	0.800
Bartlett's Test of Sphericity	$\chi^2 = 796.73$ (d.f. = 1, p-value = 0)	$\chi^2 = 1,270.92$ (d.f. = 3, p-value = 0)	$\chi^2 = 1,116.78$ (d.f. = 3, p-value = 0)	$\chi^2 = 1,926.33$ (d.f. = 6, p-value = 0)
<b>Toronto (n = 409)</b>				
Willingness to reuse	0.876 (0.767)	0.727 (0.529)	0.850 (0.722)	0.796 (0.633)
Willingness to recommend	0.876 (0.767)	1.053 (1.108) **	0.902 (0.813)	0.937 (0.879)
Involvement	-	-	0.819 (0.671)	0.836 (0.699)
Satisfaction	-	0.588 (0.345) ***	-	0.624 (0.390) ***
Variance Explained	66.10%	66.10%	73.50%	65.00%
Cronbach's Alpha	0.500	0.600	0.710	0.760
MSA*	0.755	0.721	0.808	0.797
Bartlett's Test of Sphericity	$\chi^2 = 360.74$ (d.f. = 1, p-value = 0)	$\chi^2 = 562.37$ (d.f. = 3, p-value = 0)	$\chi^2 = 718.27$ (d.f. = 3, p-value = 0)	$\chi^2 = 938.66$ (d.f. = 6, p-value = 0)

Variable/Metric	(1) Reuse and recommend	(1) + Satisfaction	(1) + Importance to quality of life	All variables
<b>Vancouver (n = 282)</b>				
Willingness to reuse	0.867 (0.752)	0.802 (0.643)	0.928 (0.861)	0.850 (0.722)
Willingness to recommend	0.867 (0.752)	0.936 (0.877)	0.809 (0.654)	0.834 (0.696)
Involvement	-	-	0.784 (0.615)	0.834 (0.696)
Satisfaction	-	0.637 (0.405) ***	-	0.688 (0.473) ***
Variance Explained	64.20%	64.20%	71.00%	64.70%
Cronbach's Alpha	0.500	0.640	0.700	0.750
MSA*	0.754	0.734	0.792	0.804
Bartlett's Test of Sphericity	$\chi^2 = 233.06$ (d.f. = 1, p-value = 0)	$\chi^2 = 360.15$ (d.f. = 3, p-value = 0)	$\chi^2 = 454.11$ (d.f. = 3, p-value = 0)	$\chi^2 = 630.43$ (d.f. = 6, p-value = 0)

\*Measure of sampling adequacy, \*\*Heywood case, \*\*\*Inadequate levels of communality

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